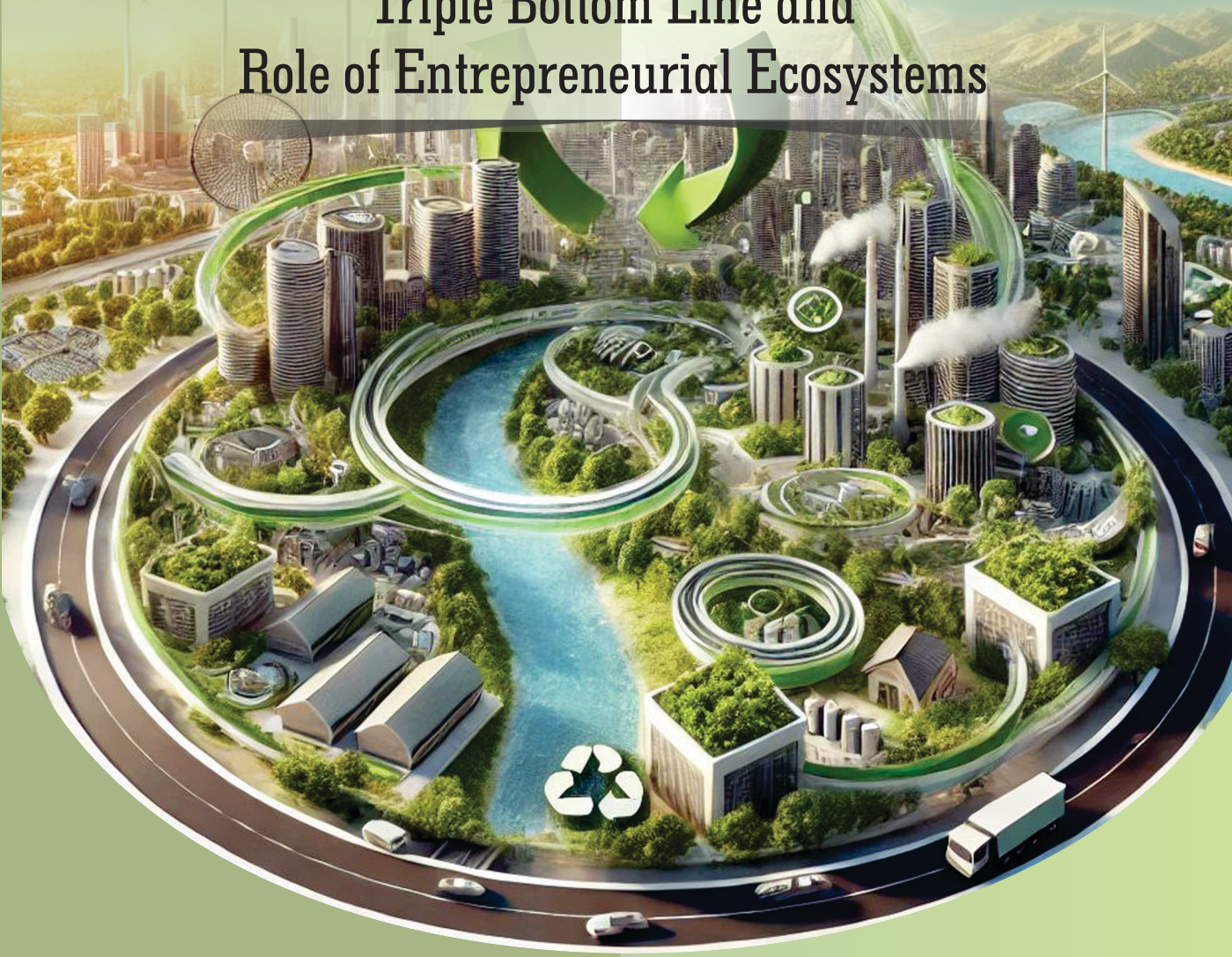
TRANSITIONING TO A CIRCULAR ECONOMY

Triple Bottom Line and Role of Entrepreneurial Ecosystems



Editors

Prof. (Dr.) AMARJEET KAUR MALHOTRA
Prof. (Dr.) NICLAS ERHARDT
Dr. SURABHI GOYAL
Dr. TABASSUM AHMED

PEN TO PRINT PUBLISHING

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Prof. (Dr.) Niclas Erhardt
Dr. Surabhi Goyal
Dr. Tabassum Ahmed

PEN TO PRINT PUBLISHING
New Delhi

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Gurugram University, Gurugram (2024)

First published, 2024
This edition published in 2024

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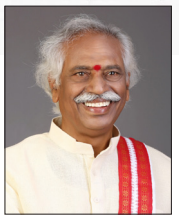
ISBN: 978-93-92877-77-3
2 4 6 8 10 9 7 5 3 1

Pen to Print Publishing LLP
WZ-911/2, Shankarlal Street, Ring Road
Naraina, New Delhi – 110028
E-mail: pen2print.publishing@gmail.com

Typeset by Pen to Print Publishing, Ring Road,
Naraina, New Delhi

Printed and bound in New Delhi, India

Bandaru Dattatraya
Governor, Haryana



सत्यमेव जयते

बंडारू दत्तात्रेय
राज्यपाल, हरियाणा

Message

From the Governor, Government of Haryana

It gives me immense pleasure to extend my warm congratulations to the Department of Management, Gurugram University, Gurugram, for its endeavor of collaborating with Valparaiso University, USA and jointly organizing the 4th International Conference on 'Transitioning to a Circular Economy: Triple Bottom Line and Role of Entrepreneurial Ecosystems' on December 4-5, 2024.

I appreciate the choice of theme, taken up by the Gurugram University to deliberate upon at IC-MGMT-2024. Circular economy gives us the tools to deal with environmental issues, while addressing the social needs. The entrepreneurial ecosystems can play a pivotal role in the transition to a circular economy by fostering innovation, promoting sustainable business models, and creating new opportunities for economic growth.

I strongly feel that the circular economy also offers a transformative approach to building an inclusive socio-economic order, particularly given the country's significant income disparities and resource dependencies. By emphasizing resource efficiency, waste reduction, and recycling, a circular economy creates economic opportunities that can benefit marginalized communities.

For instance, recycling and up-cycling industries offer jobs that require diverse skill levels, providing stable income sources for those in rural and underprivileged areas. Circular economy models encourage sustainable local enterprises, often small or medium in scale, which foster entrepreneurship and community resilience.

This inclusive framework not only reduces environmental degradation but also redistributes economic benefits more equitably, reducing the urban-rural income gap and empowering communities to become stakeholders in a sustainable future. Embracing the circular economy can thus support India's goals for both economic growth and social equity.

Best wishes!

(Bandaru Dattatraya)

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नायब सिंह
NAYAB SINGH



सत्यमेव जयते

मुख्य मन्त्री, हरियाणा,
चण्डीगढ़।
CHIEF MINISTER, HARYANA,
CHANDIGARH

Dated 08-11-2024

Message

From the Chief Minister, Government of Haryana

I am delighted to learn that the Department of Management at Gurugram University is hosting a two-day international conference titled "Transitioning to a Circular Economy: Triple Bottom Line and the Role of Entrepreneurial Ecosystems (IC-MGMT-2024)" on December 4 & 5, 2024, in our vibrant cyber city, Gurugram.

The choice of topic for IC-MGMT-2024 is commendable, especially considering the current pace of global economic development. In today's context, it is crucial to enrich the discourse on sustainable development by emphasizing the necessary shift to a circular economy, which aligns with the principles of the triple bottom line.

I believe this international conference will provide a valuable platform for academicians, researchers, practitioners, government officials, and students to share their diverse perspectives on this important subject. I would like to extend my congratulations to the University for its commitment to fostering a research-driven environment in our country and contributing to our nation's future.

My warmest greetings to all participants travelling from around the globe.

I wish the organizing team great success in making IC-MGMT-2024 a resounding success.

(Nayab Singh)

महीपाल ढांडा
Mahipal Dhanda



विद्यालय एवं उच्चतर शिक्षा, अभिलेखागार तथा संसदीय मामले मंत्री, हरियाणा
School & Higher Education, Archives & Parliamentary Affairs Minister, Haryana

D.O. No. SPL/2024

संदेश

मुझे यह जानकर बेहद खुशी हुई कि प्रबंधन विभाग, गुरूग्राम विश्वविद्यालय, गुरूग्राम, वालपराइसो विश्वविद्यालय, यूएसए के सहयोग से, "सर्कुलर इकोनॉमी में परिवर्तन: ट्रिपल बॉटम लाइन और एंटरप्रेन्योरियल इकोसिस्टम की भूमिका" विषय पर चौथा अंतरराष्ट्रीय सम्मेलन (IC-MGM1- 2024) 4 और 5 दिसंबर, 2024 को आयोजित करने जा रहा है।

जैसे कि हम सभी को विदित है कि भारत सरकार ने देश में नई शिक्षा नीति (एनईपी) 2020 लागू की है, सभी राज्यों को एनईपी 2020 को वर्ष 2030 तक लागू करने का लक्ष्य दिया है, जबकि हरियाणा ने एनईपी 2020 को वर्ष 2025 तक पूरे राज्य में लागू करने का निर्णय लिया है। प्रदेश सरकार के इस लक्ष्य को हासिल करने के लिए राज्य के सभी विश्वविद्यालयों और शिक्षा संस्थानों ने पहले ही एक रोडमैप तैयार कर लिया है।

जैसा कि हम जानते हैं कि एनईपी 2020 में शिक्षा के वैश्विक मानकों के अनुरूप एक नई शिक्षा प्रणाली पर जोर दिया गया है। हरियाणा में केजी से पीजी तक छात्रों को एक ही छत के नीचे वैश्विक स्तर की शिक्षा प्रदान की जाएगी।

गुरुग्राम को देश में एक वैश्विक शहर के रूप में भी जाना जाता है और कई बहुराष्ट्रीय कंपनियों ने गुरुग्राम में काम करने वाले विदेशी बच्चों की शिक्षा को पूरा करने के लिए शहर में अपने उद्यम स्थापित किए हैं।

गुरुग्राम विश्वविद्यालय बौद्धिक उत्कृष्टता, महाविद्यालयीनता, विविधता और अखंडता के निहित मूल मूल्यों के माध्यम से शिक्षा पारिस्थितिकी तंत्र पर ध्यान केंद्रित करता है। वलपरिसो विश्वविद्यालय या वालपो की स्थापना वर्ष 1859 में संयुक्त राज्य अमेरिका के पहले सह-शिक्षा महाविद्यालयों में से एक के रूप में की गई थी।

सम्मेलन का विषय 'एक सर्कुलर इकोनॉमी में परिवर्तन: ट्रिपल बॉटम लाइन और एंटरप्रेन्योरियल इकोसिस्टम की भूमिका (आईसी-एमजीएमटी-2024)' हमारी वर्तमान अर्थव्यवस्था के नवीकरणीय ऊर्जा और सामग्रियों में संक्रमण के महत्व पर जोर देता है। उद्यमशील पारिस्थितिकी तंत्र को इस तरह से विकसित होना चाहिए कि वे लाभ कमाने के अलावा समाज और पर्यावरण पर सकारात्मक प्रभाव डालने के लिए अपने व्यवसाय संचालन के हर पहलू में टिकाऊ प्रथाओं को एकीकृत करें। इस प्रकार, नए युग के उद्यमियों द्वारा परिपत्र अर्थव्यवस्था की लचीली प्रणाली को अपनाने की आवश्यकता है, उनकी दृष्टि विशेष रूप से ट्रिपल बॉटम लाइन (लोग, ग्रह, मुनाफा) पर केंद्रित है।

इस दो दिवसीय सम्मेलन का लक्ष्य सतत विकास लक्ष्यों (एसडीजी) को प्राप्त करना है, विशेषकर नहीं। 2030 तक सतत विकास के लिए 6, 12 और 13, संयुक्त राष्ट्र द्वारा अपनाया गया। इस सम्मेलन में कई अंतरराष्ट्रीय हितधारक भाग ले रहे हैं, उनके अनुभव और विषय पर चर्चा से सार्थक परिणाम आएंगे।

मैं सम्मेलन के आयोजकों, प्रतिभागियों और शैक्षणिक प्रयासों को अपनी शुभकामनाएं देता हूं।

(महीपाल ढांडा)

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Prof. Dinesh Kumar Ph.D. (Cantab)
Vice-Chancellor



Message

From the Patron, Vice Chancellor

It is my pleasure to write this message for the readers of the Proceedings of the Fourth International Conference, IC-MGMT-2024, on "Transitioning to a Circular Economy: Triple Bottom Line and Role of Entrepreneurial Ecosystems", being jointly organized during 4-5 December, 2024, by the Department of Management, Gurugram University, Gurugram, India and College of Business, Valparaiso University, Indiana, USA.

The resilient system of circular economy needs to be adopted by the new age entrepreneurs, with their vision specifically focused on the triple bottom line. Entrepreneurial ecosystems should thrive in such a way that they integrate sustainable practices into every facet of their business operations to positively impact society and the environment, in addition to profit-making.

The conference like this is a great endeavor to update and enrich the thought process of all delegates. It provides a grand platform for demonstrating research and development in the field of sustainable development and enlightens us about the significance of the shift towards circular economy.

I extend my heartfelt thanks to the Valparaiso University for collaborating with us for yet another time; with this international conference marking the third anniversary of our joint venture.

For organizing this momentous event of international repute, I would like to convey my sincere appreciation to Dean, Prof. Amarjeet Kaur, for her relentless efforts towards keeping up the tradition of bringing the intelligentsia from across the globe on a single platform.

My best wishes to the Department of Management and the organizing team for the grand success of this conference.

Prof. Dinesh Kumar
Vice-Chancellor, Gurugram University



Message

From the Chairperson & Dean-FCM

It is a matter of profound privilege and pleasure to welcome you to the fourth International Conference on "Transitioning to a Circular Economy: Triple Bottom Line and Role of Entrepreneurial Ecosystems (IC-MGMT-2024)", organized during 4th to 5th December, 2024, as a collaborative effort by the teams at the Department of Management, Gurugram University, Gurugram, India and Valparaiso University, Indian, USA.

This International Conference represents a larger theme which focuses on various agendas of global interest towards the attainment of sustainable development goals (SDGs), especially no. 6, 12 & 13. These aspects can also be seen as accelerating gears which provide the necessary momentum to any economy to progress towards sustainable development. Entrepreneurial ecosystems should thrive in such a way that they integrate sustainable practices into every facet of their business operations to positively impact society and the environment in addition to profit making. Thereby, the resilient system of circular economy needed to be adopted by the new age entrepreneurs, and the Gurugram University seeks to provide a platform to deliberate on these global agendas through the 4th edition of this international conference.

The organizing universities through this Conference have tried to bring together the stakeholders both from academia and industry to this platform for discussions on circular economy, triple bottom line and entrepreneurial eco-systems. I am sure that after the deliberations amongst various stakeholders there would be some practical, concrete and workable solutions for developing circular economies in the world.

I am very grateful to Prof. (Dr) Dinesh Kumar, Vice Chancellor, Gurugram University for his continuous support and motivation to organize such a prestigious event of international importance. I would also like to extend many thanks to the sponsors of this event for their generous support.

Finally, I would express my heartfelt thanks and appreciation to the conference organizing team for their untiring efforts to ensure success to the conference. However, if there is any disappointment to any of the participant, I shall solely be held responsible and credit of the success goes to the Team-Department of Management.

Once again, a warm welcome to one and all!

Prof. (Dr.) Amarjeet Kaur
Dean, Faculty of Commerce & Management
Conference-Chair (IC-MGMT-2024)



VALPARAISO UNIVERSITY
BUSINESS

Message

From the Conference Chairperson

Greetings from Valparaiso University!

We are thrilled to announce that the College of Business at Valparaiso University is once again partnering with Gurugram University to co-sponsor our third international conference on **"Transitioning to a Circular Economy: Triple Bottom Line and the Role of Entrepreneurial Ecosystems,"** which will take place on December 4-5, 2024, in Gurugram, Haryana, India.

Transitioning to and supporting a global circular entrepreneurial ecosystem—where resources are continuously reused, recycled, and regenerated—is crucial for fostering social, environmental, and financial sustainability in Indiaand beyond. In these rapidly growing economies, young entrepreneurs are key drivers of change, bringing fresh perspectives and a strong commitment to sustainable practices. Their leadership is essential in addressing challenges such as resource scarcity, waste management, and environmental degradation, while also creating local opportunities that promote inclusive growth. By adopting circular models, these regions can enhance financial resilience, reduce waste, and position themselves as global leaders in sustainability. Supporting this shift not only ensures business viability in a changing world but also contributes to a more balanced, regenerative global economy for future generations.

This conference will feature international scholars and practitioners who are experts in sustainability-related fields. We look forward to diving into this multifaceted topic, covering areas such as innovation, workforce development, business ethics, durable skills, social entrepreneurship, and more over the course of two days.

Allow me to introduce Valparaiso University (Valpo). Valpo is a selective private institution founded in 1859 and located less than an hour from Chicago, Illinois. Valpo offers a holistic, hands-on learning experience that develops the whole person for life, leadership, and service. Our College of Business is among the top 5% of schools accredited by AACSB—the international gold standard in business education. We are consistently recognized by Princeton Review and U.S. News for the quality of our programs and the caliber of our faculty. Our MBA has been ranked the 5th best Green MBA for three years running since 2020 and is listed in the top 50 by Princeton Review. Our programs includes STEM majors and internships designed for international students. Valpo enrolls students from over 50 countries, and we are proud of the personalized support we offer, evidenced by our 98% job placement rate for graduates.

Sincerely,

Niclas Erhardt
Dean, College of Business, Valparaiso University

Preface

It's our immense pleasure to bring you the Proceedings of the Fourth International Conference, IC-MGMT-2024, on "Transitioning to a Circular Economy: Triple Bottom Line and Role of Entrepreneurial Ecosystems", being jointly organized during 4–5 December, 2024, by the Department of Management, Gurugram University, Gurugram, India and College of Business, Valparaiso University, Indiana, USA. We take pride in introducing the proceedings of the fourth edition of the annual series; IC-MGMT-2024, to the delegates and authors, who have contributed to the conference. We hope that you find the proceedings book thought provoking and worthwhile.

At this juncture, we would like to introduce the readers to both of the conference organizing universities. Gurugram University is an internationally acclaimed premier institution of higher education in India. The University aims at developing global citizens of tomorrow through research, innovation, life skills, technical skills, and ethical training. The University focuses on the education ecosystem through enshrined core values of intellectual excellence, collegiality, diversity, and integrity. The University has a dynamic academic fraternity drawn from top universities nationally and internationally. This event is the brainchild of the Department of Management. The Department is the epitome of excellence and has created dynamic industry leaders and aspires to develop into a destination of choice for future managers. Valparaiso University or Valpo was founded in 1859 as one of the first co-education colleges in the United States, Valpo consists of five undergraduate colleges. Valpo is consistently recognized for high-quality teaching and ranks among the best universities in the region by the U.S. News. In 2020, Valpo's MBA was ranked 5th best Green MBA program by the Princeton Review. The college has a placement rate of over 98%.

The idea to prioritize the agenda of research at the Department of Management was conceptualized in the year 2021, and resulted in the form of organinsing Annual International Conference every year since then. The department has been relentlessly making efforts to be recognized as a leading global institution which produces not only qualified management professionals, but also compassionate human beings, who gain objectivity and clarity of thoughts through the research conference and other research-oriented deliberations to make our world a better place to live (Please try to divide this sentence). The department attracts a great diversity of students who have the drive, confidence, and a burning desire to advance the progress for business and society. Here, we provide a perfect platform to the students for not only academic excellence, but also for making them socially responsible citizens by helping them seek deep insights into the problems and possible solution. Special emphasis is given to their holistic development through a healthy and collaborative learning environment.

Transitioning to a Circular Economy: Triple Bottom Line and Role of Entrepreneurial Ecosystems (IC-MGMT-2024) represents a plethora of ideas that focus on measuring the success and health of businesses, not just on the basis of the traditional financial bottom line, but also by their social, ethical and environmental performance. Ethical business practices and social responsibility are important functions of corporate governance and management. In this regard, the mention of the Triple Bottom Line becomes even more significant. The resilient system of

circular economy needs to be adopted by the new age entrepreneurs, with their vision specifically focused on the triple bottom line (people, planet, profits). Entrepreneurial ecosystems should thrive in a way such that they integrate sustainable practices into every facet of their business operations to positively impact society and the environment in addition to profit-making. The conference aims to add insights to the field of sustainable development by focussing on the much needed transition towards circular economy, which reflects on seeing the world rationally and understanding the social responsibility of mankind towards the people, planet & profits.

In our endeavor, contributions were made by more than 170 researchers, as authors or co-authors. After passing through a stringent double blind review process, finally 46 papers have been included in this edited book and 5 papers have been included in the 'Gurugram University Business Review' Journal and 10 working papers will be only presented in the five technical sessions.

The edited book has been divided into five sections comprehensively encompassing all the themes of the international conference. These sections are:

- Finance for Circular Economy
- Circular Human Resource Management
- Marketing for Circular Economy
- Supply Chain Management for Regenerative Economy
- ICT, Innovation and Triple Bottom Line

We hope that these five sections, encompassing the theme of this conference, anchoring the research and perspective of the researchers and educators, can help develop entrepreneurial ecosystems that further the goals of sustainable development, in the fields of technology, environment, energy, education and humanities.

This Conference is the outcome of sincere endeavors by the organizing team from the Department of Management, Gurugram University, Gurugram, India and Valaparaiso, University, Indiana, USA. We are grateful to the Hon'ble Vice Chancellor and Conference Patron Prof. (Dr.) Dinesh Kumar, for being the torch bearer for this remarkable event. We extend our gratitude to Prof. (Dr.) Subhash C Kundu, Dean Academic Affairs, Gurugram University, Gurugram for his continuous encouragement. We are indebted to Dr. Rajiv Kumar Singh, Registrar, Gurugram University, Gurugram for his motivation and support. We are also thankful to the members of the International Conference Advisory Committee for their valuable insights. We deeply acknowledge the efforts of all the intellectual authors for their valuable contributions. We extend our humble gratitude to Dr. Surabhi Goyal, Chairperson, Department of Management, for providing us with her continuous support, in all possible ways. We express our heartfelt thanks to the conference secretaries, Dr. Hawa Singh and Dr. Naveen Kumar, for their tireless and appreciable team efforts. Last, but not the least, our sincere thanks and appreciation goes to Mr. Lalit Kumar Jha, Development Editor, Pen to Print Publishing LLP and his team for their cooperation and interest in publishing this volume, in meeting deadlines and continued support in designing and editing the content in time.

Editors

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FINANCE FOR CIRCULAR ECONOMY

A Comprehensive Study on Green Financing: Global Trends and Patterns

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Abstract

This research paper attempts to summarise the vast literature available in the domain of Green Financing. It aims to present a consolidated picture of the past research in this domain in an organised and systematised manner. The methodology involves manual research around the main keywords i.e. green financing, Green bonds and Green Investment within the title, abstract or objectives of the paper. It excludes the thesis and the dissertation articles. The paper follows a thematic approach and covers the various aspects of green financing, namely – concept, significance, the various green financial instruments, strategies for enhancing green investment and role of regulatory agencies. It further lists down the challenges of Green Financing and the recent developments in various nations vis-à-vis this domain. The in-depth study of the area shows that green finance has the potential to make a significant difference in the environment, society and for climate change mitigation, but has to address issues like lack of awareness, inconsistent definitions, missing policy coordination and lack of profitable incentives to investors who are willing to invest in climate change mitigation. Towards the end, this paper also covers recent developments in this field across the world.

Keywords: *Green Financing, Sustainable Development, Strategy, Role of Technology*

INTRODUCTION TO GREEN FINANCING

Green financing is a rapidly growing area within the financial sector that focuses on channelling investments into projects and initiatives aimed at promoting environmental sustainability and addressing climate change. This approach is rooted in the belief that economic growth can be harmonised with environmental protection, enabling the transition to a low-carbon economy while supporting sustainable development (Linderberg,2014). Green financing includes a range of financial instruments, such as green bonds, green loans, and green investment funds, which are specifically designed to fund activities that reduce greenhouse gas emissions, improve energy efficiency, and conserve natural resources.

Green financing plays a fundamental role in addressing the dual challenges of economic growth and environmental sustainability. As the world grapples with the urgent need to mitigate climate change, reduce greenhouse gas emissions, and preserve natural resources, green financing emerges as a key mechanism for mobilising the necessary capital to fund these efforts (Bhatnagar and Sharma, 2022). By channelling investments into environmentally sustainable projects, green financing supports the transition to a low-carbon economy, thereby helping to achieve the targets set by international agreements such as the Paris Agreement.

According to Martin,2023, Green financing is vital as it aligns financial systems with sustainability goals, ensuring that economic development does not come at the expense of the environment. This alignment helps to bridge the gap between environmental needs and financial markets, encouraging investments in renewable energy, energy efficiency, and other green technologies. These investments are crucial for reducing the global carbon footprint and mitigating the adverse effects of climate change.

Moreover, financing in green projects fosters innovation in financial products and services, leading to the development of green bonds, green loans, and other financial instruments specifically designed to support sustainable projects. We will talk about these instruments and products in detail in the paper later. These innovations not only provide new opportunities for investors but also enhance the capacity of financial markets to contribute to environmental protection and sustainable development (Ilic et al, 2018).

Furthermore, green financing is essential for creating resilient economies that can withstand environmental shocks and stresses (Sharma et al., 2020). By promoting investments that are environmentally sustainable, green financing contributes to the long-term stability of financial systems and the broader economy, reducing the risks associated with climate change and environmental degradation.

Although green financing has utmost significance in the current situation, it has not been tapped fully owing to several hurdles namely: lack of awareness, lack of transparency etc. Consequently, Regulatory frameworks and standards, such as the Green Bond Principles and the Climate Bonds Standard, have been established to ensure that green financing instruments are used transparently and effectively (Martin, 2023). These frameworks help define what qualifies as a "green" investment, providing guidelines for issuers and investors alike. This increased transparency and accountability have encouraged broader participation in green financing, making it a key component in global efforts to combat climate change and promote sustainable development.

The in-depth study of the area shows that green finance has the potential to make a significant difference in the environment, society and for climate change mitigation, but has to cope with issues like lack of awareness, inconsistent definitions, missing policy coordination and lack of profitable incentives to investors who are willing to invest in climate change mitigation. This paper towards the end will also cover recent developments in this field across the world and also review key literature around this topic.

In a nutshell, green financing is essential for mobilising capital to support the transition to a sustainable global economy. As the world faces increasing environmental challenges, the role of green finance in shaping a resilient and sustainable future continues to grow.

OBJECTIVE

The present research paper is written with the following objectives in mind:

- To review the existing literature on green financing.
- To organise the vast literature on green financing on the basis of selected themes namely Green Financing Instruments; the strategies to increase green financing; efforts to make such financial investments profitable; promoting green financing using technology and policy and the role of regulators and financial institutions in the green financing agenda.
- To present the global trends in this domain and identify the challenges faced by different nations regarding Green Financing.

RESEARCH METHODOLOGY

This research paper attempts to present the extant literature in the area of 'Green Financing" in a systematic and organised manner. A thematic search was conducted using article abstract search and a search on the body-of-articles. The keywords used were "green finance", "green bonds", "green financing" and "green investments". References have been taken from journal articles, industry expert papers and policy papers. The selection of articles was done manually. Thesis and dissertation articles were excluded from this review. A sincere effort was made to include more and more of recent articles to ensure that the review captures the recent research in the green finance literature.

DEFINITIONS OF GREEN FINANCING

The concept of "green financing" has been defined in various ways across the literature, reflecting the evolving nature of this field as it gains prominence in global financial markets. Here are some of the key definitions:

Table 1: Definitions of Green Financing

Sr No.	*Definition Theme*	*Definition*	*Author*
1	Broad Environmental Focus	According to Lindenberg (2014), green financing involves the financing of public and private investments in environmental goods and services, as well as initiatives that prevent, minimise, or compensate for environmental damage. This definition emphasises the financing of projects related to climate change mitigation and adaptation, such as energy efficiency, renewable energy, and biodiversity conservation.	(Lindenberg, 2014)
2	Integration with Economic Growth	Another definition posits that green financing is a process that integrates environmental protection with economic growth. This approach suggests that green financing is part of a broader effort to align financial industry practices with the principles of sustainability, promoting long-term development by balancing ecological and economic interests. The focus is on the financial mechanisms that support this integration, such as green bonds, green loans, and green investment funds.	(Ilić et al., 2018)
3	Financial Instruments and Market Development	Green financing is also defined in terms of the specific financial instruments and markets that have been developed to support sustainable development. This includes not only the creation of new financial products but also the development of regulatory frameworks and standards that ensure these products contribute meaningfully to environmental goals. The focus here is on the role of green finance in fostering sustainable economic growth through the mobilisation of capital for green projects.	(Martin, 2023)
4	Sustainability Transition	Another perspective defines green financing as a financial mechanism that supports the transition to a sustainable economy. This definition highlights the role of green finance in addressing the global challenges of climate change, energy scarcity, and environmental degradation. It underscores the idea that green finance is not just about funding individual projects but also about facilitating a broader transition to sustainable economic practices.	(Sharma et al., 2023)

Each of these definitions reflects different aspects of green financing, whether it's the environmental objectives, the integration with economic growth, the development of financial instruments, or the broader sustainability transition. Together, they illustrate the multifaceted nature of green finance and its critical role in promoting a sustainable future.

PRODUCTS AND INSTRUMENTS IN GREEN FINANCING

Green financing instruments and products are essential tools in the global effort to achieve sustainable development and combat climate change. By offering a range of financial products tailored to support environmentally sustainable projects, these instruments provide the necessary capital and incentives to drive the transition to a greener economy. As the market for green finance continues to grow, it will play an increasingly vital role in shaping the future of sustainable development worldwide. Various green financing instruments and products have emerged, offering a range of options for investors and institutions to support green projects. Here, we explore some of the key instruments and products in green financing, highlighting their importance, benefits, and challenges.

- **Green Bonds:** Green bonds are perhaps the most well-known and widely used green financing instruments. They are fixed-income securities that raise capital specifically for projects with environmental benefits, such as renewable energy, energy efficiency, sustainable agriculture, and pollution prevention (Kazalauskiene & Draksaite, 2020). Green bonds have gained significant traction due to their ability to attract a broad range of investors who are increasingly prioritising sustainability in their portfolios. These bonds provide an opportunity for investors to contribute to environmental initiatives while earning returns comparable to traditional bonds. The growing market for green bonds reflects a shift in investor priorities towards more sustainable investments.
- **Green Loans:** Green loans are another vital component of the green financing landscape. These are loans provided to finance environmentally friendly projects, such as renewable energy installations, green buildings, and sustainable agriculture (Gulzhan et al., 2023). Green loans often come with favourable terms, such as lower interest rates, to incentivize borrowers to undertake projects that contribute to environmental sustainability. The market for green loans is still relatively new, but it is growing as more financial institutions recognize the importance of supporting sustainable development through innovative lending practices.
- **Green Equities:** Green equities refer to shares in companies that are actively engaged in environmentally sustainable practices or that operate within the green sector, such as renewable energy firms, eco-friendly product manufacturers, and companies with robust sustainability initiatives (Kazalauskiene & Draksaite, 2020). Investing in green equities allows investors to support companies that are leading the charge in the transition to a greener economy. This type of investment not only provides potential financial returns but also aligns investors' portfolios with their environmental values.
- **Green Insurance:** Green insurance products are designed to support and incentivize environmentally friendly practices among businesses and individuals. For example, green insurance policies might offer lower premiums to companies that implement sustainable practices or provide coverage for risks associated with environmental projects. This type of insurance plays a crucial role in managing the risks associated with green projects, thereby making them more viable for investors and companies (Kahraman, 2022).

- **Carbon Finance:** Carbon finance is a specialised area within green finance that involves the trading of carbon credits, which are permits representing the right to emit a certain amount of carbon dioxide or other greenhouse gases. This market-based approach aims to reduce global carbon emissions by setting a cap on emissions and allowing companies to buy and sell permits according to their needs (Kazalauskiene & Draksaite,2020). Carbon finance incentivizes companies to reduce their emissions by creating a financial value for carbon savings, thereby contributing to global efforts to combat climate change.
- **Green Investment Funds:** Green investment funds pool capital from multiple investors to invest in a diversified portfolio of green projects or companies. These funds offer a way for investors to gain exposure to a range of environmentally sustainable investments without having to select individual projects or companies. Green investment funds can focus on various areas, such as renewable energy, energy efficiency, or sustainable agriculture, and they often aim to achieve both financial returns and positive environmental impacts.

STRATEGIES TO INCREASE GREEN FINANCING

Multiple strategies followed by different countries collectively aim to create a more robust and accessible green finance market, supporting the transition to a sustainable economy. Here are key strategies to increase green financing:

- **Government Incentives and Regulations:** Governments can play a crucial role by providing incentives such as tax breaks, subsidies, or grants for green projects. (Wasan et al., 2021) Strong regulatory frameworks that mandate environmental disclosures and set stringent environmental standards can also drive the adoption of green finance by compelling businesses to align with sustainable practices.
- **Public-Private Partnerships:** Collaboration between public and private sectors can enhance the scale and impact of green financing. Public institutions can leverage private capital by providing guarantees, co-financing arrangements, or creating blended finance mechanisms that reduce risks for private investors (Taghizadeh-Hesary & Yoshino, 2020).
- **Development of Green Financial Instruments:** As discussed in the previous section, expanding the availability of green bonds, green loans, and other sustainable financial products can attract a broader range of investors interested in supporting environmental initiatives. According to Sulaksana, 2023. these instruments provide tailored financing solutions for specific green projects, making it easier for organisations to access funds for sustainable initiatives.
- **Enhancing Transparency and Reporting Standards:** Implementing clear standards and improving the transparency of green financing processes can build investor confidence (Desalegn & Tangi, 2022). This includes developing and enforcing guidelines for what qualifies as a green investment and ensuring that there is regular reporting on the environmental impacts of financed projects.
- **Capacity Building and Education:** Increasing awareness, education and understanding of green finance among businesses, investors, and financial institutions can drive more informed decision-making. This includes training programs, workshops, and other educational initiatives to promote the benefits and mechanisms of green financing.

STRATEGIES TO MAKE GREEN FINANCING PROFITABLE

To make green financing profitable, several strategies can be employed. This is important to address as green investments would compete with traditional investments for capital and returns. Hence, strategies have to be employed to make green investments equally attractive if not more attractive than their traditional counterparts. These strategies ensure that investments in environmentally sustainable projects not only deliver positive environmental impacts but also generate competitive financial returns.

- **Government Incentives and Subsidies:** According to Li et al., (2018), Governments can provide direct subsidies, tax incentives, and grants to lower the costs of green projects. This makes green investments more attractive by improving their financial viability and reducing risks. For example, subsidies for renewable energy projects can significantly enhance the profitability of green financing and enable investors to reach favourable IRR in fewer years.
- **Green Bonds and Green Loans:** Issuing green bonds (with fixed and higher interest rates) and providing green loans (with fixed and lower than market interest rates) are effective ways to raise capital specifically for sustainable projects (Martin,2023). These financial instruments are designed to attract investors who are interested in both financial returns and environmental impact. The demand for green bonds has been rising, which can lead to lower interest rates and improved profitability for issuers. The table below illustrates the demand growth in green bonds issuance (globally) over the last 10 years:

Table 2: Trends in Green Bonds Issuance

Year	*Green Bond Issuance (USD Bn)*		*Year*	*Green Bond Issuance (USD Bn)*
2014	36.6		2019	257.7
2015	42.0		2020	269.5
2016	81.6		2021	500.0
2017	155.5		2022	650.0
2018	167.3		2023	700.0 (Estimated)

Source: Pham, 2016, Gabr & ELBannan, 2023,

- **Public-Private Partnerships (PPP):** Public-private partnerships can play a crucial role in enhancing the profitability of green finance. By sharing risks and rewards between public and private entities, PPPs can attract private capital into green projects. Governments can de-risk projects through guarantees, making them more appealing to private investors (Taghizadeh-Hesary & Yoshino, 2020).
- **Green Credit Guarantee Schemes:** Implementing green credit guarantee schemes can reduce the perceived risks of investing in green projects. These schemes can provide guarantees for loans made to green projects, thereby lowering the cost of capital and improving profitability for lenders and borrowers alike (Taghizadeh-Hesary & Yoshino, 2019).
- **Enhancing Market Liquidity:** Increasing the liquidity of green financial instruments, such as green bonds, can make them more attractive to investors and make it easier to enter and exit these investments. This can be achieved through policy measures that promote secondary markets for green assets, improving their tradability and profitability (Desalegn & Tangl, 2022).

ROLE OF TECHNOLOGY IN GREEN FINANCING AND INVESTMENT

The role of technology in green finance and investment has become increasingly significant

as the world faces urgent environmental challenges and the need for sustainable development. Technology not only facilitates the deployment of green finance but also enhances its efficiency, scalability, and impact. We will next explore how various technological innovations contribute to the advancement of green finance and investment.

- **Digital Finance and Green Technology Innovation:** Digital finance plays a crucial role in promoting green technology innovation by alleviating financial constraints and providing new avenues for funding. Digital platforms, blockchain, and big data analytics enable more efficient allocation of resources, reducing transaction costs and increasing transparency in green investments. For instance, digital finance has been shown to facilitate corporate green technology innovation by improving the financial environment and reducing financing costs (Tang et al., 2023).
- **Blockchain and Sustainable Development:** Blockchain technology has emerged as a powerful tool in green finance by enabling decentralised and transparent systems for tracking and trading environmental assets such as carbon credits and renewable energy certificates (Nassiry, 2018). The use of blockchain in green finance can enhance the credibility and efficiency of carbon markets, making it easier for companies to offset their emissions and for investors to participate in climate finance. Blockchain applications in green finance are particularly promising for renewable energy projects, where they can support decentralised energy markets and enhance the traceability of green bonds .
- **Artificial Intelligence (AI) in Green Finance:** AI and machine learning are being increasingly applied in green finance to analyse large datasets, predict environmental risks, and optimise investment strategies. AI can help financial institutions assess the environmental impact of investments, identify greenwashing risks, and improve decision-making processes. For example, AI-driven models and algorithms can evaluate the potential of green technologies and assist in the allocation of capital towards the most promising projects.
- **Financial Technology (Fintech) and Green Investment:** Fintech innovations, including digital wallets, mobile banking, and crowdfunding platforms, have democratised access to green investments by lowering barriers for individual and institutional investors. These technologies enable more inclusive participation in green finance by offering new investment products tailored to environmental sustainability. Fintech also supports the development of new financial instruments, such as green bonds, by improving the efficiency of issuance and trading processes (Azamjon o‘g‘li & Nazarali o‘g‘li, 2023).

ROLE OF REGULATORY INSTITUTIONS IN GREEN FINANCING

Green financing regulations vary significantly across different countries, reflecting each nation’s approach to promoting environmental sustainability through financial mechanisms. These regulations are critical in shaping the green finance landscape, influencing the availability of capital for environmentally friendly projects, and determining the success of green financial products such as green bonds, loans, and insurance. Below is an overview of the green financing regulations in several key regions and countries.

- **European Union (EU):** The EU has been at the forefront of establishing a comprehensive regulatory framework for green finance. One of the most significant initiatives is the European Green Deal, introduced in 2019, which aims to make Europe the first climate-

neutral continent by 2050. The EU has also developed a taxonomy for sustainable activities, which provides a classification system for environmentally sustainable economic activities (Ermakova, 2020). This taxonomy is crucial for determining which activities can be labelled as green and is a cornerstone for green finance regulations in the EU. Additionally, the EU has introduced stringent disclosure requirements under the Sustainable Finance Disclosure Regulation (SFDR) for financial market participants .

- **China:** China is a global leader in green finance, driven by its government's strong regulatory framework. The country has implemented the Green Credit Guidelines, which mandate financial institutions to incorporate environmental factors into their lending decisions (Yu et al.2021). China also established a national green finance taxonomy, which is aligned with international standards and aims to promote green bonds and other sustainable financial instruments. In recent years, China has seen substantial growth in its green bond market, supported by these regulations. The government's focus on green finance is part of its broader strategy to address environmental degradation and promote sustainable development.
- **United States:** The United States does not have a unified national green finance framework like the EU or China. However, various federal and state-level regulations encourage green finance initiatives. The Securities and Exchange Commission (SEC) has been increasingly focused on climate-related financial disclosures, pushing for greater transparency from companies and financial institutions regarding their environmental impacts. Additionally, states like California have implemented robust green finance programs, such as cap-and-trade systems and green bonds, to fund sustainable infrastructure projects.
- **BRICS Countries:** The BRICS nations (Brazil, Russia, India, China, and South Africa) have each developed unique regulatory approaches to green finance, with varying degrees of success (Khudyakova & Urumov, 2021). For instance, India has issued guidelines for green bonds, which have become an essential tool for financing renewable energy projects. Brazil has focused on using green finance to combat deforestation and promote sustainable agriculture. Russia has started to develop its green finance framework, although it lags behind other BRICS nations in terms of implementation.

CHALLENGES IN GREEN FINANCING

Green financing, despite its critical role in promoting sustainable development and combating climate change, faces several significant challenges that hinder its widespread adoption and effectiveness. These challenges span regulatory, market, and operational aspects, creating barriers to the mobilisation of capital for environmentally sustainable projects. Here's are the key challenges in growth of green financing:

Table 3: Challenges in Green Financing

Challenge	*Issue*	*Impact*	*Reference*
Lack of Standardised Definitions and Frameworks	There is no universally accepted definition of what constitutes a "green" investment.	This leads to inconsistencies in the market and the risk of "greenwashing," where projects are labelled as environmentally friendly without meeting rigorous standards, reducing investor confidence	(Lindenberg, 2014)

Challenge	*Issue*	*Impact*	*Reference*
Insufficient Regulatory and Policy Support	Green finance regulations, such as the Green Bond Principles, are not uniformly adopted or enforced globally.	This regulatory fragmentation creates uncertainty for investors, especially in emerging markets where institutional frameworks are underdeveloped, making it more difficult to invest in green projects.	(Martin, 2023)
Limited Market Size and Perceived Risks	The green finance market is relatively small compared to traditional financial markets.	Green projects often struggle to attract investment due to perceptions of higher risks and lower returns, as well as the significant upfront capital and long payback periods required.	(Ilić et al., 2018)
Access Challenges for SMEs and Developing Countries	Small and medium-sized enterprises (SMEs) and projects in developing countries often find it difficult to access green financing.	These entities may not meet the stringent criteria for green financing, and lack of financial literacy or awareness further limits their ability to secure funding	(Sharma et al., 2023)
Scalability and Replicability Issues	Scaling successful green finance initiatives to a global level is challenging	Achieving global scalability requires substantial coordination, resources, and a supportive policy environment, which are currently lacking in many regions.	(Semieniuk & Mazzucato, 2019)

RECENT DEVELOPMENTS IN GREEN FINANCING IN WORLD ECONOMIES

Green financing has seen significant developments across the major countries in the world including India. We will study in detail, major developments across 6 different countries.

United States

Green financing in the United States has seen significant developments, particularly in the areas of policy initiatives, investment in renewable energy, and innovation in financial products. Here are some of the major developments:

- **Public Financing and Policy Initiatives:** The U.S. government has played a crucial role in financing green growth, particularly through public investments in energy transitions (Semieniuk & Mazzucato, 2019). Historical examples include the shift to shale gas and the ongoing transition to low-carbon energy sources. Public financing remains essential to achieving climate targets .
- **Green Venture Capital:** Green venture capital has emerged as an important financing mechanism for eco-oriented startups. This sector is growing, although many environmentally focused startups remain underfunded. Green VC is seen as a critical driver of innovation in sustainable technologies (Orsato et al., 2003).
- **Renewable Energy and Energy Efficiency:** The U.S. has seen a push towards renewable energy and energy efficiency, driven by both public and private investments (Liu et al., 2021).

To sustain growth and meet energy sustainability goals, it is estimated that around $26 trillion will be required in green financing by 2030.

- **Green Loans:** Green loans have become a key tool in the U.S. for financing environmental projects related to agriculture, renewable energy, and eco-friendly industries. These loans help reduce the risk of default and support the financial viability of green projects'
- **Post-COVID Green Financing:** The COVID-19 pandemic has prompted renewed interest in green financing as part of the recovery strategy (Liu et al., 2021). Policies aimed at boosting renewable energy generation and efficiency are being discussed as part of the broader economic recovery plans.

These developments indicate a growing recognition of the importance of green financing in achieving sustainable economic growth in the U.S.

BRICS Countries

Green financing has emerged as a crucial component of sustainable development strategies in BRICS countries (Brazil, Russia, India, China, South Africa). Each country has integrated green finance into its national framework, with varying degrees of success and focus.

- **China** is the leader in green financing among the BRICS nations. The country has implemented stringent regulations and introduced a national green taxonomy, which has guided the issuance of green bonds and loans. China's green bond market is one of the largest globally, driven by strong government support and a clear regulatory framework. The country's focus has been on renewable energy, pollution control, and sustainable infrastructure .
- **India** has also made significant strides in green finance, with a particular focus on renewable energy projects. India has issued green bonds to fund solar and wind energy projects, and there is growing interest in sustainable agriculture and water management. As per Chaudhary & Mittal (2023), the country is working on improving its green finance regulations and expanding its market to meet its ambitious renewable energy targets.
- **Brazil** has utilised green finance primarily to combat deforestation and promote sustainable agriculture (Khudyakova & Urumov, 2021). The issuance of green bonds in Brazil has been directed towards protecting the Amazon rainforest and supporting renewable energy initiatives. However, challenges remain in scaling these efforts across the broader economy.
- **Russia** has established a legislative framework for green finance but lags in implementation. The country's green finance activities have primarily focused on energy efficiency and reducing carbon emissions (Khudyakova & Urumov, 2021). However, the progress has been slower compared to other BRICS nations due to regulatory and market barriers.
- **South Africa** has focused on green finance to support its transition to a low-carbon economy. The country has issued green bonds and promoted investments in renewable energy, particularly in solar and wind projects. However, economic challenges have slowed the expansion of green finance in South Africa.

United Kingdom

Green financing in the United Kingdom has seen significant developments over the past decade, driven by the country's commitment to achieving net-zero carbon emissions by 2050. These developments are characterised by the growth of green bonds, government policies, and private sector initiatives.

One of the major developments is the UK's leadership in issuing green bonds, which are used to fund projects that have positive environmental outcomes. The UK government issued its first sovereign green bond in 2021, raising £10 billion, making it one of the largest green bonds issued globally at that time (Park & Jeong, 2013). This bond is part of the UK's Green Financing Framework, which is designed to finance projects that align with the country's environmental goals, such as renewable energy and clean transportation.

In addition to government-led initiatives, the private sector has also played a crucial role (Fedotova et al., 2022). The emergence of green venture capital in the UK has provided necessary funding to eco-oriented startups. This has been vital in advancing innovative technologies and sustainable practices in various industries, including energy and waste management. Green venture capital is becoming an increasingly important part of the UK's financial landscape, supporting the development and commercialization of green technologies.

Moreover, the UK has seen the growth of sustainability-linked loans and green mortgages, which provide financial incentives for companies and individuals to improve their environmental performance. These financial products are designed to encourage borrowers to meet specific sustainability targets, further embedding green finance within the broader financial ecosystem.

France

France has been at the forefront of green financing, particularly in its commitment to combating climate change and transitioning to a low-carbon economy. Here are some of the major developments in green financing in France:

- **Government Initiatives:** France has established itself as a leader in green finance through significant government initiatives. The country launched its first sovereign green bond in 2017, raising €7 billion to finance various environmentally friendly projects, including renewable energy, energy efficiency, and sustainable transportation. This initiative set a precedent for other countries and positioned France as a key player in the green bond market.
- **Corporate Involvement:** French corporations have also been heavily involved in green financing. Companies like EDF and Engie have issued green bonds to finance their renewable energy projects. The French financial market has seen a rise in green bond issuance, making it one of the leading markets in Europe for green finance. These corporate bonds are instrumental in funding France's transition to a sustainable economy.
- **Innovative Financial Products:** France has also introduced innovative financial products aimed at supporting green initiatives. The French government and private sector have collaborated to create green loans and sustainability-linked bonds, which provide financial incentives for companies to meet environmental targets (Fedotova et al., 2022). These products have become essential tools for driving corporate responsibility and environmental sustainability in the country.
- **Policy and Regulatory Framework:** France has implemented a robust regulatory framework to support green finance. The country has established guidelines for green bond issuance, ensuring transparency and accountability in how funds are used. These regulations have contributed to the growth of a trustworthy and credible green finance market in France, attracting both domestic and international investors (Castro, 2012).

Australia

Green financing in Australia has seen several important developments, particularly in the areas of government initiatives, green bonds, and the integration of sustainability into housing and infrastructure projects. These efforts are part of Australia's broader commitment to reducing carbon emissions and promoting sustainable development.

- **Government Initiatives and Policies:** The Australian government has implemented various programs aimed at promoting green financing, with a focus on energy efficiency and renewable energy (Kortt & Dollery, 2012). However, some initiatives, such as the Green Loans Program, which started in 2009, faced criticism for their implementation and management. Despite this, the government continues to support green projects, emphasizing the importance of financial incentives for sustainability.
- **Green Bonds:** Australia has seen a rise in the issuance of green bonds, which are used to finance projects that have environmental benefits. These bonds have become an essential tool for funding sustainable infrastructure, renewable energy projects, and green buildings (Martin, 2023). The introduction of bond-based funding mechanisms, such as the Australian Affordable Housing Bond Aggregator (AHBA), has provided opportunities to integrate green building practices into affordable housing, contributing to long-term environmental and economic benefits.
- **Private Sector and Green Loans:** The private sector in Australia has also embraced green financing, with banks and financial institutions offering green loans to support projects in renewable energy, sustainable agriculture, and environmentally friendly industries (Fedotova et al., 2022). These green loans are crucial for driving private investments in sustainability, helping to reduce the environmental impact of various sectors .
- **Green Affordable Housing:** The integration of green building standards into affordable housing policies has shown promise in delivering both environmental and social benefits. Although these projects may have higher initial costs, they offer long-term savings in energy and water, contributing to Australia's carbon reduction targets and providing financial relief to low-income tenants through reduced utility bills.

Japan

Japan has made notable advancements in green financing as it strives to meet its ambitious carbon neutrality target by 2050. A central development is the introduction of Climate Transition Bonds in 2024, designed to fund the country's Green Transformation (GX) initiative. The government plans to mobilize ¥150 trillion ($997 billion) through these bonds, which align with the International Capital Market Association's Green Bond Principles. These bonds are intended to support decarbonization across various sectors, particularly those that are difficult to abate, such as heavy industry and transportation.

One of the most significant aspects of these bonds is the inclusion of stringent eligibility criteria, ensuring that the proceeds are used for projects that contribute meaningfully to reducing emissions. For example, a significant portion of the funds is allocated to "deep green" activities, such as renewable energy projects and energy-efficient technologies. This ensures that the investments support real environmental improvements rather than superficial changes, addressing concerns about potential greenwashing.

Additionally, Japan's government has established the GX Implementation Council to oversee the integration of green policies across various sectors, including transportation and building. This council is tasked with ensuring that the financed projects align with the country's broader industrial and economic goals while also contributing to emission reductions. This holistic approach to green financing has positioned Japan as a leader in the Asia-Pacific region, with its strategies potentially serving as a model for other countries.

In conclusion, Japan's green financing developments, particularly the Climate Transition Bonds and the overarching GX framework, represent significant steps toward its carbon neutrality goals, balancing economic growth with environmental responsibility.

CONCLUSION

The detailed analysis of the green financing landscape suggests that it has the capacity to significantly impact both the environment and society, though numerous challenges remain, such as a lack of awareness, inconsistent definitions, poor policy coordination, and insufficient incentives for investors and financial institutions. Further research would be needed in the following areas to arrive at strategies to take green finance mainstream viz.: investigating the trade-offs between green innovation and risk-return, exploring the relationship between green investment and environmental changes, defining the roles of the private and public sectors in green financing, examining the synergy between green finance, social finance, and digital finance, assessing the impact of regulations on green businesses, and exploring green finance opportunities in developing countries. Additionally, more research is needed to determine the effectiveness of traditional financial analysis tools in evaluating the viability of green projects and investments. Current research does have a limitation in potentially overlooking some relevant research, despite efforts to include all pertinent studies. The application of mainstream finance tools and principles could significantly contribute to addressing the challenges in green finance, thereby enriching the literature in a meaningful way.

In summary, green financing is a critical tool for advancing sustainable development, combating climate change, and ensuring that economic growth is achieved in harmony with environmental preservation.

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Ensuring Sustainable Corporate Governance through Forensic Accounting

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Abstract

Purpose: *The objective of this study is to investigate how forensic accounting affect sustainable corporate governance, fraud detection and prevention. This article provides a way ahead to tackle the numerous risks that can distress the organization and human. Forensic accounting aligned with ICAI Standards and sustainable corporate governance can accomplish, anticipate, and stop the fraud before organization reaches the point of no return.*

Design/Methodology: *For this study, forensic accounting is an independent variable and sustainable corporate governance & fraud prevention is the dependent variable. This study used systematic literature review by analysing the existing literature on forensic accounting and sustainable corporate governance and by that recognizing the existing gap in the respective fields.*

Findings: *Results reveal that there is positive relationship between forensic accounting and sustainable corporate governance. And it helps to resolve the unresolved issues, thus strengthening corporate governance.*

Practical Implications: *This study can assist law enforcement agencies, insurance companies, financial institutions, and professional bodies in modifying their codes of corporate governance and organization policies by adding sustainable corporate governance clauses and making forensic accounting a compulsory component of governance system.*

Originality: *This certifies that the study article was produced independently and entirely by the researchers, as far as I am aware there is no prior studies conducted which verifies the forensic accounting aligned with ICAI how it affects sustainable corporate governance.*

Keywords: *Sustainable Corporate Governance, Forensic Accounting, Fraud Prevention, Fraud Detection, Financial Crime, Litigation Support, Digital Forensic, ICAI Standards*

INTRODUCTION

Frauds are increasing at alarming rate; it is very important to stop it for sustainable development. Whether it is developed or developing country no country remains unaffected by the virus of fraud. There is negative relationship between fraud and development, and fraud can place a country on an unsustainable direction in which its assets and capital is ruined. The two primary pillars required for organizational successful business growth and business sustainability are sustainable corporate governance and fraud control (Ali Rehman and Hasim, 2020). In view of the fact of the organizational financial crimes, the contemporary history observed and magnify concern for sustainability in corporate governance and to prevent fraud and financial crime activity on such a large scale, one must have an expertise in fraud detection and that expertise can be achieve only with the complete knowledge of forensic accounting. Corporate sustainability goal is to

build a long-term value for stakeholders by putting an ethical, social, cultural, environmental, and economic perspective on business strategy and operations. The tactics developed aimed to promote longevity, openness, and appropriate staff development in commercial organization.

The four main pillars of corporate governance are:

- **Accountability:** It's an assurance that an individual or organization is judge on its performance or behaviour related to something for which it is responsible.
- **Transparency:** Disclosing relevant information to stakeholders.
- **Fairness:** The BOD must treat employees, shareholders, stakeholders, and other relevant parties equally without any discrimination.

The board must be aware of and support the successful, impartial ongoing performance of the company and risk management and it all affects the trust of stakeholders and board members decisions.

To maintain sustainable corporate governance in companies forensic accounting must be implemented. Forensic accounting is a special branch of accounting which helps in detection and prevention of frauds by examining the evidences and nature of financial crimes. Forensic accountant combines the skills and knowledge of accounting, auditing, and investigation techniques to detect, analyse, study the nature & cause of frauds and financial crimes to present them as legal evidence in court to resolve cases. In now a days forensic accounting has gained a lot of importance because of rapid increase in financial crimes and white-collar frauds. Auditors job is to ensure whether financial statements of the company comply with general accepted accounting principles, auditing standards or not whereas forensic accountant detects the frauds in financial statements. Because of this new branch of accounting has emerged to detect and prevent fraud. With the use of forensic accounting techniques like trend analysis, ratio analysis, CAATs (computer assisted auditing techniques), generalised audit software, data mining techniques, and forensic analysis of material and electronic evidence, forensic accounting is a dynamic and a strategic tool that aids in the fight against corruption, financial crimes, and frauds (Jonika Lamba & Esha Jain, 2020). In India frauds are increasing rapidly because of inadequacy of proper rules and regulations for punishing fraudsters and poor monitoring and auditing of financial statements. Companies should follow the rules and regulations so that they are not open to penalties and litigation against them and it will help companies to retain their goodwill in market and to grow sustainably. White collar fraud can be controlled with the help of accountant who has expertise in forensic accounting and auditing. Three important functions of forensic accounting are litigation support, investigation, and dispute resolution. litigation support is the invaluable function of forensic accounting. As forensic accountant helps in extracting information which is not noticeable or suspicious to others. ICAI has bought FAIS (forensic accounting and investigation standards) effective from 1st July 2023 to unify the financial reporting and to safeguard the trust of interested parties. India is the first country to issue FSAI standards. Till now around 20 FAIS are issued by digital accounting and assurance board (DAAB) of ICAI. FAIS standards explains what to include in financial report, accounting and auditing policies like forensic accounting and investigation standard no. 230 which deals with the responsibility of the professional concerning the use of an expert to assist in collecting relevant and reliable information, FAIS no.240 which deals with engaging with agencies etc. These standards are designed to be beneficial for law enforcement agencies such as CBI, RBI, SFIO, banks, corporate entities, regulators, and other

end users of these financial reports on standardising the exercise and to illuminate the basic principles to be followed by members while auditing and acts as performance benchmark. These standards state the principal subjective action's for conducting inspection. As per Reserve bank of India it is mandatory to have forensic accounting audits for credit disclosure above rupees 200 crore taking into consideration that it was demanding for the reports to be permissible in courts of justice as there was no standard or similar process in such cases.

Forensic accounting can be used in many categories to detect fraud and white-collar crimes example:

- Tax fraud,
- cash embezzlement,
- money laundering,
- cyber-crime frauds,

Table 1: Summary of Various Fraud Survey Reports

Reports	*Important Findings*
Authority ACFE Occupational fraud 2022: A Report to the Nations	It's a greater anti-fraud community, in their 12th edition of report they covered 2110 cases from 133 countries which caused total loss more than $3.6 billion. As per this report the typical organization Losse 5% of revenue to fraud each year, median loss per case $117000 and average loss costed $1783000. Asset misappropriation are 86% frauds are the most common but least costly$100000 and financial statement frauds are 9% least common but most costly$593000.
PwC's Fraud Survey 2022	For this survey 112 companies from diverse industries were taken. As per this report 52% of Indian organization suffered fraud or financial crime within last 24 months. 40% of these companies lost between USD 50000-100000, 17% companies lost between USD 1million-50 million, 5% suffered a loss of USD 50 million and above. As per this survey top 5 frauds that affect organization are: customer fraud, cybercrime, KYC failure, tax fraud, procurement fraud.
2023 AFP payments fraud and control survey report	The report from 2023 AFP payments fraud and control survey in 2022, attacks or attempts at payment fraud affected 65% of the organisations that experienced payments fraud, either through actual or attempted, were victims of business email compromise(BCE).the survey was completed by over 450 treasury practitioners.63% respondent agreed that cheques remains the payment method that is most susceptible to fraud.27% of the victim of fraud organization able to recover at least 75% of lost fund but almost half 44% failed to recover any money.
CII-Kroll India fraud survey second edition 2021	COVID 19 Pandemic has worsen economy. As per this survey 65% companies reported that they have become victim of fraud in this pandemic. As in comparison to fraud survey report in 2019 and in 2021 fraud triggered by conflict of interest increased from 10% to 26% and supply chain frauds went to 14% from 5%. Two out of three companies experienced at least one fraud event as compared to 57% earlier. survey reports that 57% of companies think that biggest impact of fraud on their business is reputation damage to counter fraud 65% companies has strengthened IT security.
STATISTA 2023 public opinion on experiencing financial fraud in the last three years in India from May 2023	In this survey total 11873 respondents participated out of which 30% of the respondent reported that themselves or one of their family members being victim of financial fraud in the last three years 9% reported that they become victim of fraud multiple times in past three years. As per RBIs banking report total of 5046 fraud cases were reported in the first half of fin. Year 2023.

Source: Compiled by author from various published resource

- securities fraud,
- bankruptcy,
- financial statement fraud, etc.
- economic damages calculation,
- insurance fraud,

No matter what the method is followed for committing fraud the result is always the loss of money or profit. Some of the major frauds in India are 2G spectrum case, Vijay Malaya case, Harshad Mehta scam, Satyam scandal, Punjab national bank scam, ABG shipyard scam and many more. As per times of India news India loses rupees 100 crore to banking fraud every day for in the duration of past seven years.

From the Table 1, we can understand that fraud is accelerating rapidly especially because of pandemic. As in pandemic companies, institutions, people, economy all were in pressure which motivated the fraudsters to act. As the fraud environment increasing and to control and minimise white collar crime companies should ensure sustainable corporate governance by ensuring effective board of directors, regular evaluation of financial statement & performance of directors, proper transparency by sharing clear and as it is information to stakeholders including shareholders and outsiders, by ensuring board of directors & auditors independence and are not afraid to think out of box.

Corporate governance states how company is directed and controlled there are various theories which states the importance of corporate governance and how it works some of them are:

1. Agency theory
2. Stewardship theory
3. Stakeholders' theory
4. Resource dependency theory
5. Transaction cost theory and
6. Political theory.

Biggest Financial Scams

Biggest Financial Scams in India are:



Figure 1: Biggest Financial Scams in India

1. **Coalgate Scam INR 1.86 lakh crore:** It's a significant political controversy involving the distribution of the country's coal reserves to private and public sector enterprises (PSEs) by the Indian government. The CAG office accused the Indian government of assigning coal blocks in inefficacious way between 2004-2009 in a preliminary report released in March 2012. The draft reports most important sections are found in chapter 5 where the CAG alleges that:

- Instead of using the screening committee to distribute coal blocks, the government was legally able to do so in 2005 but it chooses not to.
- Public and Private corporations received "windfall gains of INR 10673 billion because of its inability to auction the coal blocks; private companies received INR 4795 and government companies received INR 5078 billion (55%).

2. **2G Spectrum Scam INR 1.76 lakh crore:** A Raja telecom minister in the year 2007 was charged with selling 2G Spectrum licences for extremely low prices causing the government to lose out on INR 1760 billion. According to the CAG report all the demand drafts were backdated, which suggests that the telecom operator was already aware of the licences that were going to be granted.
3. **Nirav Modi PNB – Bank Fraud INR 14000 crore approx:** Second largest bank in public sector PNB bank disclosed that two of its employees were involved in a fraudulent scheme that resulted in a loss of around INR 11400 crore. The fake letter of undertaking valued at INR 12000 crore, that PNB issued at its brady house branch in fort Mumbai, is the subject the subject of the PNB fraud case.
4. **Satyam Scam INR 14162:** Up to until 2010, the Satyam computer services scam was the biggest corporate fraud in India. The executors, directors, and founder of the outsourcing business Satyam computer services, situated in India, inflated the share price, fabricated the accounting, and embezzled substantial sums money from the business. Most of this was used to buy real estate.
5. **Harshad Mehta Stock Market Scam:** Mehta was found guilty of only 4 of the 27 criminal counts that were bought against him before he passed away suddenly from a heart attack in 2001 at age 47. Mehta was accused of a large-scale manipulation operation that was funded by worthless bank receipts that his company arranged for banks to attract in ready forward transaction.
6. **Vijay Mallaya Scam:** united spirits are the owner of kingfisher. The chairman of united spirits is Vijay Mallya. Mallya is accused of money laundering and fraud in India, where he indebted to 17 Indian banks INR 9000 crore (LAPASS Blog).
7. **CWG Scam:** India media and investigative organisations have bought attention to several 2010 commonwealth games related issues, including grave corruption by games official. It costed total loss 70000 crore approx.

LITERATURE REVIEW

Table 2: Existing Literature on Forensic Accounting

Author	*Area*	*Focus*	*Methodology*	*Findings*
1. Bhavik Umakanth swadia, baxi minouti kaivalya (2010)	India	This study highlighted the functions of forensic accounting in relation to financial fraud and other economic offences.	Descriptive, based on secondary data	A forensic accountant needs variety of skills like technical accounting, critical thinking, time management, deductive analysis, diagnostic composure, diagnostic unstructured problem solving, and fraud risk assessment.

Author	*Area*	*Focus*	*Methodology*	*Findings*
2. Zabihillah rezaae, larry, Robert (2004)	US	Academicians and practitioners view on the significance, applicability, and delivery of FA education are collected in this study.	both secondary and primary (questionnaire) data used.	To a further extent universities are planning to offer forensic accounting education and demand for FA is anticipated to rise and both the respondents have opinion that FA education was pertinent and advantageous to accounting students, accounting profession and business community.
3. Maryjo, Timothy, Bonnie, Richard (2008)	US	This paper has focussed on creating model of curriculum and courses for forensic accounting.	Experimental study	Model for curriculum was developed in three main phases. This project was supported by National institute of justice (NIJ) the research, development, and evaluation agency of US department of justice.
4. Lester E Heitger, Dan L. Heitger (2008)	US	To verify various features of forensic accounting and to direct the special educational experiences that appear from forensic accounting courses.	Based on secondary sources.	In this study author suggested how faculty can provide effective learning environment by carefully constructing the forensic accounting courses in interesting way that come up with essential beginning for practicing forensic accounting services.
5. Prof. Shimoli Dhami (2008)	India	To identify the skills and tools required to become forensic accountant.	Based on secondary sources	Only those possessing these abilities, bravery, and a knowledge of concealment may succeed in the forensic accounting investigative procedure.
6. Nisha Chaturvedi (2015)	India	Need, concept and role in measuring white collar frauds of forensic accounting.	Secondary source and convenience sampling was used.	They examined the meaning, component, and use of forensic accounting. Various big scams happened in India was discussed.
7. R. Parth Bhatt and Prof. Dr. k. Bhatt (2007)	India	Purpose is to provides light on forensic accounting, its history, functions, methods, and the current state of FA in India.	Based on secondary sources and previous studies conducted.	Three-fold approach of forensic accounting and techniques of forensic accounting was discussed.

Author	*Area*	*Focus*	*Methodology*	*Findings*
8. Murat Cihan Sorkun and Taner (2017)	Turkey	This study focussed on data mining methods to find fraud on e-ledgers through financial statements.	Both secondary and survey method was used.	Decision stump has been most fruitful algorithm. Other algorithm that's successful was J48, random forest and decision table.
9. Hrashini and Prabath Perera (2020)	Sri Lanka	Systematically analysed the existing literature on FA and identified the existing gaps	Systematic literature review (SLR) method and PRISMA method is used to analyse the data.	The demand for forensic accounting outpaces the supply. A forensic accountant ought to be knowledgeable in several fields. Big data modules must be added to the forensic accounting curriculum.
10. Jonika Lamba and Dr. Esha Jain (2020)	India	Presents the application of information technology and cyber crime forensics to curb frauds.	Existing literature study	Various techniques such as benchmarking, ratio analysis, specialist software, system analysis, etc., discussed. the roles of forensic auditor are also explained.
11. Bonita, Michael and Georgiy (2017)	US	Focussed on views of accountant, educators, and practitioners regarding forensic accounting.	Survey, univariate analysis was conducted.	Scholars and professions strongly agree that the forensic accounting need to be apart of curriculum because its growing topic in which students' interest is high. To enable teaching additional of non-traditional accounting topics in course of forensic accounting like computer science, law, justice, information technology, etc.
12. Abdulrahman.S (2019)	Nigeria	This paper focussed on whether forensic accounting deters fraud in Nigerian public sector, as well as how it does so.	Conceptual paper, Secondary sources or content analysis	As per this paper additional measures should be implemented to guarantee fraud prevention using forensic accounting. A comprehensive and efficient legal structure should be created for efficient enforcement.
13. Dr. Madan Bhasin (2013)	Kazakhstan	Aim is to know is there a difference in accounting practitioners,	Both primary (questionnaire) and secondary data was used.	study's findings define the necessary abilities to go along with a forensic accounting curriculum,

Author	*Area*	*Focus*	*Methodology*	*Findings*
		academics and consumers of forensic accounting about the pertinent abilities of forensic accountants.		they may be able to help educators build curricula.
14. Augustin and Mrs Rose Mary (2014)	Nigeria	This study presents the opinions of Nigerian accounting and academics professionals regarding the growth and use of forensic accounting in Nigeria today.	Exploratory study	This study makes several recommendations, including that nigerian professional associations and the government provide forensic accounting a specific place in the law and unique professional status.
15. Nornajihah and Shazali (2022)	Malaysia	Examined the global research trend in forensic accounting.	Secondary data, bibliometric analysis, and VOS viewer.	This study suggested that during past 6 years publications pertaining to forensic accounting has increased, most of the contributions from united states and Canada and the type of forensic accounting such as litigation support, expert witness and fraud investigation is also determined in this study.
16. Ms. Nirali Dev (2023)	India	Focussed on certificate course forensic accounting and fraud detection (FAFD) incorporated by ICAI for practicing CAs.	Descriptive study, secondary data.	ICAIs forensic accounting and fraud detection certification course aims to equip accountants with the knowledge and abilities needed to recognise, prevent, and prosecute economic crimes.
17. Hashem Alshurafat, Mohannad Obeid, Ibrahim Mansour (2021)	Jordan	Highlights the strength and weakness of forensic accounting education and profession.	Existing literature review	Advantages are growing demand and need for it, the new career path it offers and the decrease in fraud are its strong points. Lack of specialised research journal, lack of control over entry into the profession, absence of regulation, lack of highly qualified practitioners and educators, etc., are weak points of forensic accounting.

Author	*Area*	*Focus*	*Methodology*	*Findings*
18. Ika sahari and Hashana haron (2020)	Malaysia	This paper presents the value of adopting good governance to achieve accountability, transparency and enhance the effectiveness of performance.	Convenience sampling, least square structural equation modelling statistical software, existing literature review.	This study suggests that institution should adopt stakeholder theory. SSB needs to ensure a diversity in the director and management board of zakat for better governance and should adopt regular auditing.
19. Saloman Ricardo, Joshua Onome, Luciane (2023)	Brazil	This paper focussed on role of connectors in a fraud and corruption prone environment of circular economy.	Surveys, interview, and literature review	This research demonstrated the significant role that connectors have in relation to dishonest and corruption behaviour. Author also demonstrates the the connectors capacity to motivate a team and manipulate others likely by invoking Machiavellianism-while serving as the focal point of group discussion.
20. Pawan Kumar Gupta (2022)	India	This paper examines the theoretical underpinnings of forensic accounting, its application and advancement, the relevant authorities, and recommendations for improved forensic accounting implementation from an Indian standpoint.	Existing literature review	Various fraud survey reports results were discussed. Potential dangers and risk to organisations were identified in FICCI and Pinkertons IRS 2021 report which also released the India risk survey 2021 report. The 12 risk variables from the basis of India risk survey 2021. The corruption, bribery and corporate fraud elements which ranks 10th in the report is noted to be significant in 2021.
21. Ali Rehman and Fathiyah Hashem (2020)	Malaysia	The aim of this paper is the calculation of forensic accounting impact on sustainable corporate governance inside Omani public listed companies.	Descriptive cross sectional survey design, analysed using partial least square structural	The findings indicate that FA significantly influences SCG directly additionally FA can be incorporated into governance management to help attain SCG and eradicate fraud. This

Author	*Area*	*Focus*	*Methodology*	*Findings*
			equational model, PLS SEM.	study has identified three elements required for SCG whereas prior related studies only verified one component.
22. Harish Kumar and Pinki (2022)	India	The study's goal is to give a thorough evaluation of the existing literature by examining the body of knowledge on forensic accounting and corporate governance and identifying any gaps in those domains.	Systematic literature review, Scopus database during 2002-2021.	Except for a very small number of papers, there is little research on the development, application or utility of forensic accounting or any other fraud detection methods beside whistleblowing. Instead they found that in the limited literature, various aspects of corporate governance, rules and regulations are directly or indirectly related to corporate frauds, misgovernance and misstatement in the monetary reporting of the corporations.
23. Dr. Madan Lal Bhasin (2017)	Malaysia	Its to find out how can we combine the proficiency of forensic accounting to enhance overall corporate governance scenario common in India.	Explanatory, Questionnaire based survey,	The most crucial abilities to become CFAs are critical thinking, writing and spoken communication, legal knowledge, auditing abilities, deductive analysis and unstructured problem solving.
24. Neetu Singh and Anjali (2022)	India	This study examined the function of forensic accounting in maintaining sound corporate governance and investigated the potential benefits of forensic accounting and corporate governance integration for financial crime investigation and prevention.	Theoretical research	This study concluded that the organisation will be better able to create a transparent internal control system, maintain transparency by releasing all relevant information, and create a clear and ideal CG policy with the assistance of forensic accounting.

Author	*Area*	*Focus*	*Methodology*	*Findings*
25. Clement Olatunji and Temidayo (2018)	Nigeria	This study looked at how corporate governance in Ekiti state was affected by forensic accounting and inquiry.	Structured questionnaire	Forensic accounting and investigation improved the corporate governance group by 76.2 percent were appropriately classified; altogether the percentage was 80.4 percent. This represented a significant improvement above the 54.5 percent right categorization that resulted from the model's omission of important independent factors including fraud detection, internal control and financial report quality.
26. Vedrana Vukovic and Jelena Cevlic and Blaz Cevlic (2018)	Slovenia	Focussed on the use of FA in the account statements of the company to improve the accuracy and legitimacy of the accounting data provided and allow for more effective corporate management for users, managers, entrepreneurs, and possible investors.	Literature review and survey	The probability of fraud is higher vulnerable with bad corporate governance and low corporate culture. The result of experimental research is emulated in the scientifically justified way of finding the connection between forensic accounting and financial reporting to attain more effective and efficient corporate governance.
27. Obiara, Onuara and Okpala (2022)	Nigeria	This study investigated the utilisation of forensic accounting and CSR in Nigerian listed enterprises.	Descriptive research design.	It has been observed that socially conscious businesses generate more profits as, at their core, all businesses want to maximise profits to fulfil the demands of their shareholders. This paper also suggested for rotation of employees so second employee reviews the work done in forma. Furthermore, it was recommended that the companies should reveal more of this information in their annual reports.

Author	*Area*	*Focus*	*Methodology*	*Findings*
28. Meenu Gupta, Prof. Pradeep Kumar Aggarwal and Rekha Gupta (2023)	India	The goal of this paper is to evaluate the most recent fraud case involving ABG shipyard limited. Which was more significant and widespread than any other fraud case in India's history.	Both quantitative and qualitative methods used.	The report concludes that the primary sources of fraud include self-dealing promoters, tunnelling, negligent auditors, and poor management. It is recommended to utilise forensic accounting and auditing in concert to discover and prevent frauds, as conventional audits have consistently shown to be useless in this regard.
29. Aggelia Xanthupoulou, Patros kalantonis and Christos Kallandrani S (2023)	West Attica	The current study aims to demonstrate the framework of forensic accounting execution to counter fraud risk and crimes and enhance the efficacy of corporate governance in fraud detection.	Descriptive study	This study inspected the methods, expertise and ways that corporate governance and forensic accounting interact to stop fraudulent activities.

THEORETICAL FRAMEWORK

Three main areas of forensic accounting are litigation support, investigation, and dispute resolution (as per CG team).

- **Litigation support:** It offers accounting support in a case involving ongoing or upcoming legal action. It mainly addresses problems pertaining to the estimation of economic damages. To calculate economic damages, forensic accountant is also required to examine and evaluate evidence from contracts, financial accounts, tax returns, emails, and other documents. The aim is to find out how much a person, business or other organization has lost financially because of another's activities particularly considering potential legal ramifications.
- **Investigation of fraud:** The globalisation of the industry, technological advancement, accounting knowledge manipulation, and massive everyday company transactions that could result in complicated situations are some of the factors that have contributed to commercial fraud. Because of these circumstances there is ample need of investigation (AG Kaifah et al., 2022). Forensic accountant tries to expose evidence of financial misconduct or fraud by doing in depth investigation of financial statement.
- **Dispute Resolution:** Forensic accounting plays a crucial role in dispute resolution by examining financial records, identifying discrepancies, and providing expert analysis. it helps in exposing and uncover financial misconduct or irregularities, providing a solid foundation for legal proceedings.

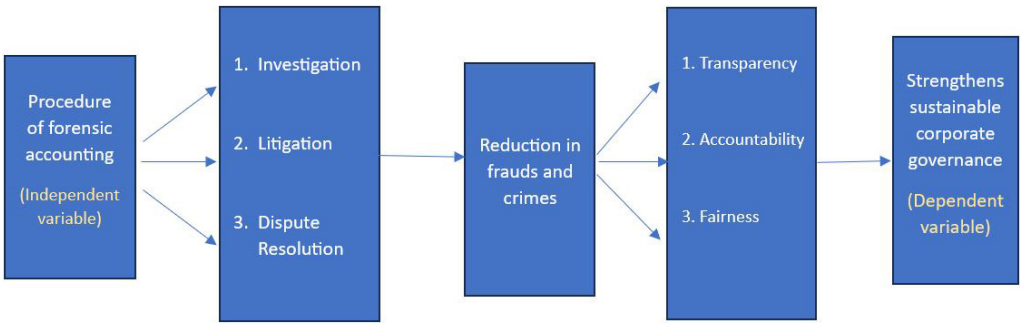


Figure 2: Theoretical Framework Representing the Impact Forensic Accounting for Ensuring Sustainable Corporate Governance

Forensic accounting by providing litigation, investigation and dispute resolution services helps in detection of irregularities, risk mitigation, compliance assurance, preventing fraud and dispute resolution which contributes to sustainable corporate governance.

According to Allias et al. (2017) sustainable corporate governance gives businesses ambitious edge in terms of growing their market share and helps them minimise risk, which incorporate fraud risk. As per Robert et al. (2103) SCG also helps firms avoid misconduct and unfavourable externalities. However, as they are eventually in charge of maintaining fraud free environment and satisfying shareholders, organisations need the involvement of board of directors (Jones and Thompson, 2012) and other governance administration activities to prevent dishonesty, negative face, and fraud risk.

Governance management needs the expertise of forensic accounting to prevent fraud and create anti-fraud measures, which can ultimately help achieve sound and long-lasting corporate governance (Smith, 2016; Rehman and Hashim, 2019). SCG is essential to satisfying shareholders, who also want that their organisational procedures and financial statements be free from fraud and associated practices. Forensic accounting can supply this gratification which will improve organisational opportunities to reach SCG (Rehman and Hashim, 2020).

METHODOLOGY

This study is descriptive study. It's based on existing literature on the topic forensic accounting and how it ensures sustainable corporate governance. A systematic method for reviewing previous

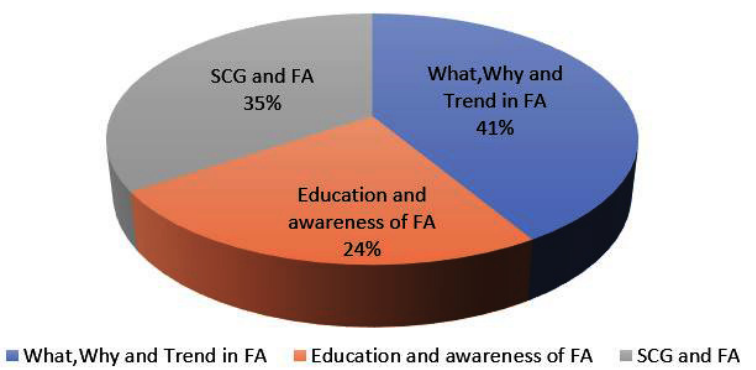


Figure 3: Categorization of Research Articles

research papers created by prior scholars is called a systematic literature review (Haneem, Ali et al., 2017). Data was collected from secondary sources like e journals, websites, reports, books. The articles were selected using keywords like forensic accounting, fraud, sustainable corporate governance, fraud prevention and fraud detection. The following diagram presents sub field of selected literature as forty one percent (12 Articles) describing what, why and trends in forensic accounting, thirty five percent (10 Articles) describing impact of forensic accounting in ensuring sustainable corporate governance and twenty four percent (7 Articles) the awareness and education level of forensic accounting.

LIMITATIONS OF STUDY

This study is completely based on existing literature review, no empirical or practical research was conducted which can limit the conclusion, variability in the quality of studies included in the literature review has also impacted the overall reliability of the findings and major limitation is availability of the data as limited access to certain datasets or information has also constrain the depth of analysis.

CONCLUSION

Forensic accounting plays a pivotal role in ensuring sustainable corporate governance by providing a robust framework for detecting and preventing financial fraud. Through meticulous examination and analysis, forensic accountants contribute to transparency, accountability, and ethical conduct within organizations. By identifying irregularities and implementing preventative measures, they safeguard the integrity of financial systems, fostering long-term corporate sustainability and trust among stakeholders. In essence, the integration of forensic accounting practices is instrumental in upholding the principles of good governance, ultimately fortifying the foundation for a resilient and responsible corporate environment. The literature incorporated herein consists of around thirty articles from renowned databases and various fraud survey reports. There is incredibly less research on examining the relationship between SCG and FA, the results recovered were only 18 articles when we narrowed down our search on the databases to only "corporate governance" and "forensic accounting". Ninety percent of research has been conducted in established or emerging countries, indicating that there is significant geographic disparity in this sector; therefore, undeveloped or developing economies have a plethora of opportunities to pursue research in this domain.

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Trends and Patterns in Financial Markets and Development: A Bibliometric Analysis from 2014 to 2024

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Abstract

To show the developments and patterns in this field of study, this study does a bibliometric analysis of the literature on financial markets and financial development from 2014 to 2024. Data from the Scopus database was gathered and examined methodically, with an emphasis on indicators like co-authorship trends, citation counts, and publication counts. The results highlight the growing scholarly interest in this topic by showing a notable increase in publications, with a peak in 2023. China and the United States of America emerged as the top contributors, demonstrating their significant research output and worldwide influence. The topic's interdisciplinary aspect was demonstrated by the identification of important publications and significant authors. The report also emphasizes how many countries collaborate on a high level and how different ideas related to financial markets and development are interconnected. A decrease in average citations over time, however, indicates that further research and innovation are required. Some of the limitations are the use of Scopus data and the emphasis on bibliometric analysis as opposed to qualitative research. To further our understanding of this developing topic, future study should think about adding more data sources and using qualitative techniques.

Keywords: *Financial Market, Capital Market, Financial Development, Stock Market Development*

INTRODUCTION

The developments in financial markets are very important for the expansion of the economic since it creates new opportunities for the market (J. Greenwood and B.D. Smith, 1997). Furthermore, markets developed to the level of point that resource allocation becomes a concern (S. Naceur et al., 2007). In recent years, there has been a strong interest in empirical study into the relationship between financial sector development and economic growth. The key determinants of stock market development are financial intermediaries (particularly loans to the private sector), stock market liquidity (specifically the ratio of value traded to GDP), and the stabilizing variable (inflation change). Financial intermediaries and stock markets act as complements rather than substitutes in the growth process. To support stock market development in the region, it is vital to stimulate savings through appropriate incentives, and to increase stock market liquidity

N. Masoud and G. Hardaker (2012) found that the financial markets direct the progress, that their innovations facilitate the most efficient use of resources, and also foster creative capital allocation. Furthermore, the stock market in developing nations is becoming more speculative

due to factors like low financial literacy, a lack of regulatory oversight, a dearth of investors, increased costs, and insufficient competition. Majority of stock market developments reflect the expansion of the economy. Further, according to B. Guru et al. (2019) the financial sector called develop when in order it's to be stable, to channelizes economic savings, to have significant opportunities for the growth, and to open doors for institutions, markets, and massive investment opportunities. S. Thangavelu et al. (2004), the financial market was created as a result of the desire for more financial sectors and services. A developed stock market attracts investors because it offers options for risk diversification, fair information and good investment opportunities.

The financial market's role is to provide funds for listing companies, increase savings, and move toward good investment opportunities. D. Zabavnik and M. Verbic (2021), better financial systems encourage innovation. The financial sector and market are important to the economy and to the development of the country. R. Ayadi et al. (2015), a clearly defined financial sector tends to breathe life into idle funds, welcomes foreign investment, and significantly boosts the economic growth. According to S. Ho et al. (2016), the stock market provides market liquidity, allowing investors to exchange financial assets at a lower risk while also providing enterprises with quick access to funds. Stock market development can be divided into two categories: macroeconomic and institutional variables. Macroeconomic factors include but are not limited to economic development, banking sector development, inflation rate, interest rate, exchange rate, and private capital movements. Institutional aspects include legal origin, legal protection, corporate governance, and financial market liberalisation. After capital controls are eliminated, stock markets tend to grow in size, liquidity, volatility, and international integration. H. Shoaib et al. (2020), the stock market is a yardstick of the financial development, and its expansion is beneficial for increased investments. J. Puatwoe and S. Piabuo (2017), they noted that the importance of the financial system capture hype in education and policymakers, financial development market boosts productivity, which enhances growth, and discovered that the growth of financial development greatly influences the development of economic. A. Haseeb et al. (2019), all economies strive to enhance their investment by granting the financial market to welcome international investments, maintaining the financial system, and building a solid stock market, which leads to a rise in investment. According to M. Sehrawat and A.K. Giri (2018), financial markets allow possibilities to take advantage of funds by making investments. H. Zarrouk et al. (2017), the more developed the financial sector, the more resources will be allocated, which will lead to growth. Financial markets provide risk diversification, policymakers.

Peterson K. Ozili (2019), development of the financial sector is particularly essential since it can help the economy deal with the crisis. According to S. Sivaramakrishnan et al. (2017), financial market offer various investment opportunities. T. Osinubi et al. (2003) After taking into account risk, an efficient stock market mobilizes savings and assigns a larger share to companies with the highest potential rates of return. Developing potentially useful stock exchanges takes time. A. Misra et al. (2009), India has been in the process of reforming its financial industry since 1991. The deregulation of interest rates and market-based resource allocation has increased competitiveness in financial markets .

F. Akhtar and N. Das (2019), a financial market is a money – spinning activity, and as of late, involvement in the financial market has grown by the day. In order to make a good decision in stock market, one must have sufficient knowledge. Pan. L (2017), the Financial market assist in investing savings in a gainful capital, financial market. H.M. Nguyen et al. (2022), Financial

market contribute to economic growth and have a favourable impact potential market. O Bustos a, A. Quimbaya (2020), the stock market projection has been a difficult topic to address. They also added that W. Jiang (2021), stock market prediction has long been a classic but difficult topic, attracting the interest of economists and computer scientists. Ng, A. et al. (2016), recent years have seen blossoming research on the potential factors of stock market development, given the growing role of financial markets in numerous economies.

OBJECTIVES

1. To examine trends in the financial market and financial development publications over time
2. To evaluate notable authors', nations', and prestigious journals' contributions to the field of financial market and financial development research
3. To look at the networks of cooperation between academics and organizations involved in financial market and financial development research.
4. To use keyword co-occurrence analysis to look at how research themes and issues on financial markets and financial development have developed in the literature.

RESEARCH METHODOLOGY

This bibliometric analysis will follow a systematic approach that consists of multiple steps. Bibliometric analysis has become more well-known recently due to its use in the analysis of business and management literature (Öztürk et al., 2024). Initially, an extensive exploration of scholarly databases will be carried out in order to generate a dataset containing pertinent papers.

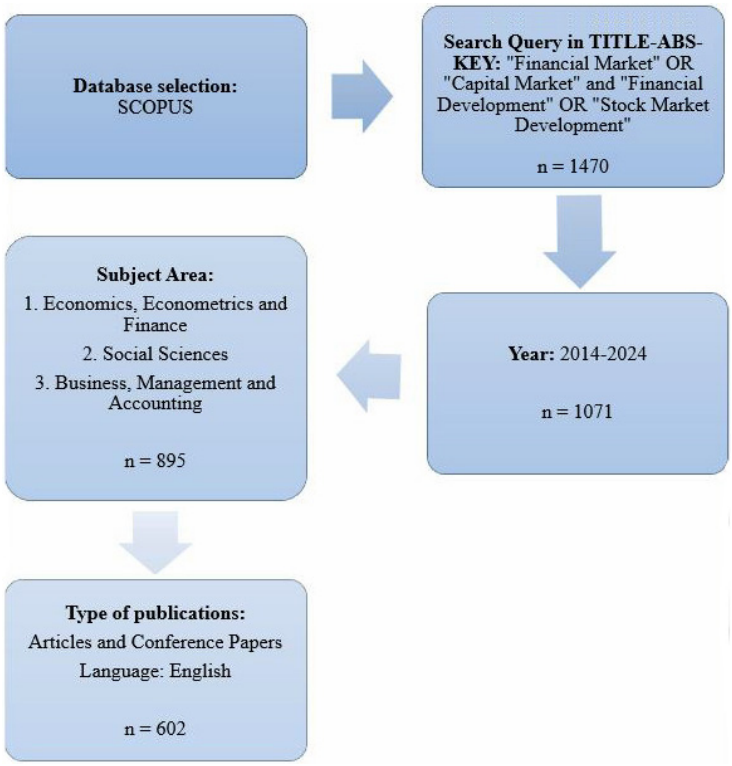


Figure 1: Study Flow Chart

The dataset will next be analysed using bibliometric methods and software, with an emphasis on metrics like co-authorship patterns, citation counts, and publication counts.

This study utilized the technique of bibliometric analysis proposed by Aria and Cuccurullo (2017) to review publications on influencer marketing. The relationships between important publications and authors will be visualized through the use of network analysis tools. Finding significant research clusters and the overarching topics that have influenced the area will be made easier with this. To find titles, keywords, and abstracts in the Scopus database, utilize the search string provided below. To reduce the quantity of data that was discovered, more filters were used:

(TITLE-ABS-KEY (“Financial Market” OR “Capital Market”) AND TITLE-ABS-KEY (“Financial Development” OR “Stock Market Development”)) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , “ECON”) OR LIMIT-TO (SUBJAREA , “SOCI”) OR LIMIT-TO (SUBJAREA , “BUSI”)) AND (LIMIT-TO (DOCTYPE , “ar”) OR LIMIT-TO (DOCTYPE , “cp”)) AND (LIMIT-TO (LANGUAGE , “English”)) AND (LIMIT-TO (EXACTKEYWORD , “Financial Development”) OR LIMIT-TO (EXACTKEYWORD , “Financial Market”) OR LIMIT-TO (EXACTKEYWORD , “Capital Market”) OR LIMIT-TO (EXACTKEYWORD , “Stock Market Development”))

Primary Data Regarding the Information Gathered

Table 1: Main Information of Data

Description	*Results*	*Description*	*Results*
Sources (Journals, Books, etc.)	239	Documents	602
Timespan	2014:2024	Document Average Age	3.48
Average citations per doc	22.43	Annual Growth Rate %	7.37
DOCUMENT CONTENTS		References	31390
Author’s Keywords (DE)	1308	AUTHORS COLLABORATION	
Keywords Plus (ID)	1090	Co-Authors per Doc	2.74
DOCUMENT TYPES		Single-authored docs	99
article	588	International co-authorships %	34.55
conference paper	14	AUTHORS	
		Authors of single-authored docs	96
		Authors	1381

This table provides a thorough summary of the bibliometric information related to studies on financial market and financial development from 2014 to 2024. Over this period, 602 documents total across journals, books, and other media have been generated, with a yearly increase of 7.37%. The documents’ 3.48-year average age indicates that the subject is still very new and evolving swiftly. The average number of citations for each document is 22.43, indicating a considerable influence and level of interest in the topic. The research has acquired 31,390 references, which is a significant number.

The literature uses 1,308 Author’s Keywords (DE) and 1090 Keywords Plus (ID), according to the analysis of document contents, showing a wide range of research topics within the discipline. The author data shows that 1,381 authors have contributed to this body of work, with 96 authors producing single-authored documents. There is a clear trend towards collaborative research as seen by the 99 single-authored publications and the 2.74 average number of co-authors each

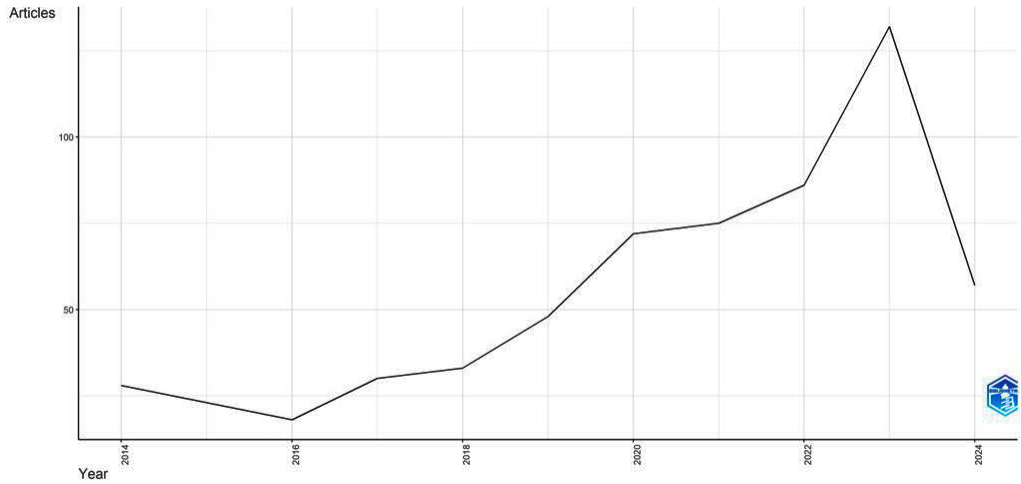


Figure 2: Annual Scientific Production

document. Furthermore, foreign co-authorship is present in 34.55% of the papers, indicating a high degree of international cooperation in financial market and financial development research. Articles (588) represent the majority of document types and conference papers (14). Overall, the data shows how financial market and financial development research is expanding quickly, collaborative, and is conducted globally.

Figure 2 shows the yearly production of related scientific publications from 2014 to 2024. The number of published articles throughout this time period has clearly increased, as seen by the graph, indicating the growing interest of academics in this topic. There was very little annual growth in the number of articles produced between 2014 and 2018. But there was a considerable increase in publications beginning in 2018, which signalled the start of a major increasing trend. With 132 publications published in 2023, there was a peak in scientific output, reflecting a peak in interest and effort in research. However, the graph also reveals a drop in the total number of articles in 2024, which may indicate a slowdown in the number of new publications of research because the data was gathered in the second quarter of that year. Overall, the graphic emphasizes how dynamic financial market and financial development research is, showing a notable increase in academic production over the previous 7 years, a peak in recent years, and a minor decline in the most recent year of data.

Table 2: Country Scientific Production

Country	*Freq*		*Country*	*Freq*
CHINA	374		MALAYSIA	72
USA	110		UK	61
TURKEY	87		GHANA	56
INDIA	80		NIGERIA	46
PAKISTAN	78		AUSTRALIA	39

The table shows "Country Scientific Production," showing the various nations' scientific contributions. The amount of scientific output is represented in this table. The top two contributors i.e. China and USA, with 374 and 110 publications respectively, account for a sizable share of all

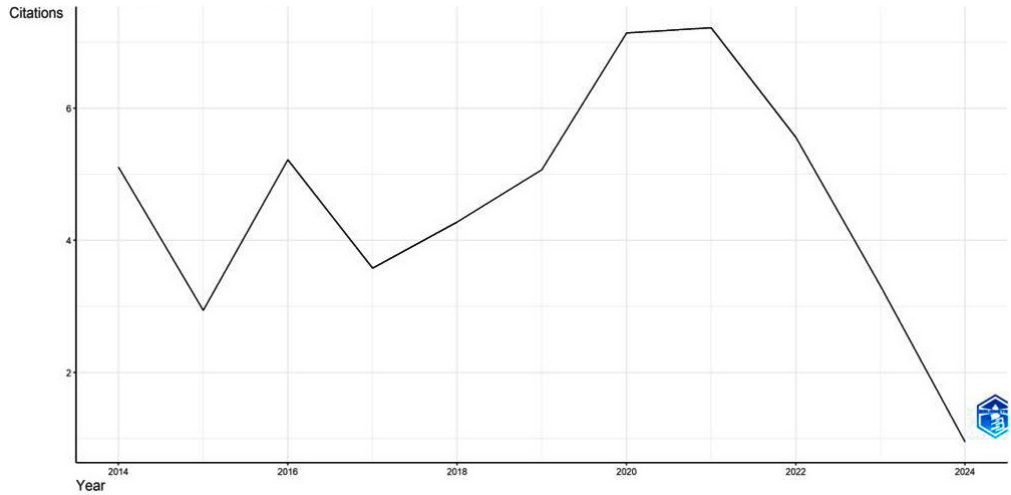


Figure 3: Average Citations Per Year

scientific articles. Turkey (87) contributes a significant percentage of publications, followed by India (89), Pakistan (78), Malaysia (72), and UK (61). These contributions are remarkable and demonstrate the involvement of these countries in international scientific research.

The Figure 3 shows the yearly average of citations received by financial market and financial development related papers between 2014 and 2024. The graph shows the frequency of citations for these papers over time, which can be interpreted as a measure of their influence and importance in the scholarly community. The average citation count in 2014 was quite high, surpassing 56.21 citations per piece. This initial rise might be the result of a few early, highly influential articles that attracted a lot of attention in the subject. But by 2022, the average number of citations per year had sharply decreased, with fewer than 20 citations each article. The chart indicates that the average number of citations annually decreased after 2021. By 2023, the average number of citations per piece has dropped to less than ten. All things considered, this graph indicates that although the early works in the field of financial market and financial development had a significant influence,

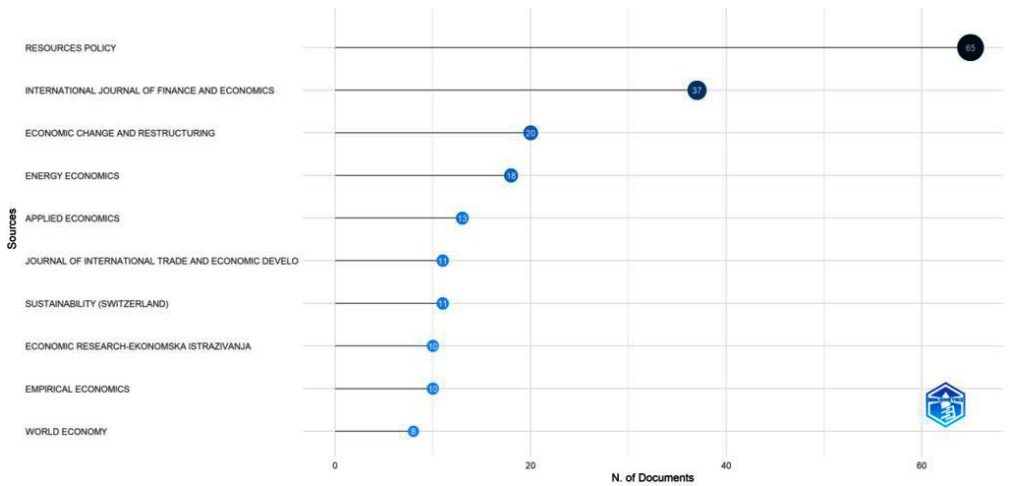


Figure 4: Most Relevant Sources

the average number of citations has generally decreased with time. Numerous causes, such as the field's development, changes in research interests and focus, could be to responsible for this.

The Resource Policy journal has published the most papers, reaching 65, as seen in Figure 4. In contrast, some journals have released between 40 and 10 times as many articles as these. 37 articles have been published on this topic in the International Journal of Finance and Economics, followed by 20 articles on Economic Change and Restructuring, 18 articles on Energy Economics, 13 articles in Applied Economics, 11 articles in the Journal of International Trade and Economic Development, 11 articles on Sustainability (Switzerland), 10 articles in each of Economic Research-Ekonomska Istrazivanja and Empirical Economics. These publications provide a range of study findings for professionals and academics interested in this topic.

Table 3 presents data of most cited countries on the basis of average citations number per article and the total citations number (TC). The China has maximum number total citations (TC) of any country with 3724 citations and 29.60 citations on average per article. USA ranks second with a total of 1555 citations, averaging 47.10 per article citations. Turkey with 1003 citations total is ranked third, averaging 45.60 citations per article. The next two countries are Australia and Pakistan, with total citation (TC) counts of 769 and 400, respectively. For the remaining nations such as India, Canada, United Kingdom, Korea and Malaysia, the total number of citations is decreasing.

Table 3: Countries Most Cited

Country	*Total Citations*	*Average Article Citations*
CHINA	3724	29.60
USA	1555	47.10
TURKEY	1003	45.60
AUSTRALIA	769	54.90
PAKISTAN	400	20.00
INDIA	374	13.40
CANADA	371	61.80
UNITED KINGDOM	351	16.70
KOREA	339	56.50
MALAYSIA	333	15.90

Figure 5 provides information about the regional impacts of various sources on the financial market and financial development. The parameters that are considered are "PY_start" (year of first publication), "TC" (total citations), and "NP" (number of publications). The h-index, which is utilized to evaluate an investigator's productivity and influence, is based on the quantity of articles and citations they receive. While the g-index assesses a scholar's total body of work, the m-index combines elements of the g- and h-indices to quantify a scholar's impact. The variables "PY_start," "TC," and "NP" show the year the source started publishing, the total amount of citations a paper has received, and the number of articles the source has created. The sources in the table, such as "Resources Policy," "Energy Economics," and "International Journal of Finance and Economics," have high g-index, h-index, and m-index values, indicating their significant local influence.

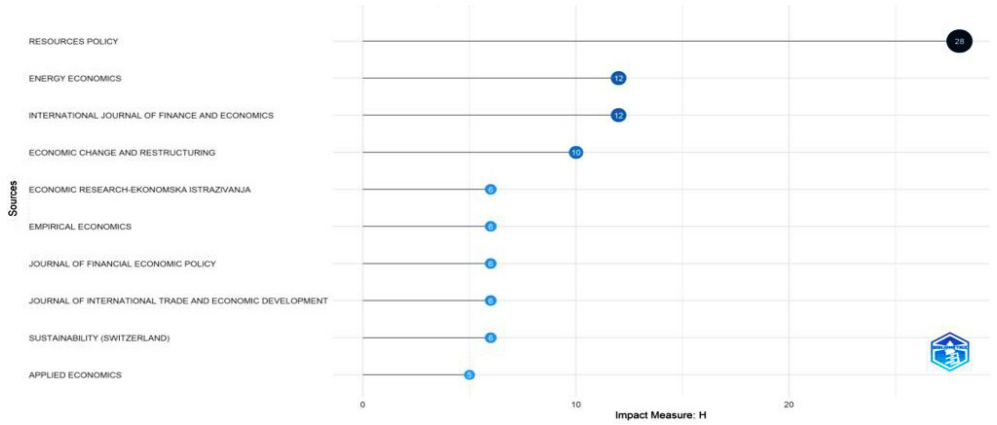


Figure 5: Sources' Local Impact

Table 4: Most Relevant Authors

Authors	*Articles*	*Articles Fractionalized*
SHAHBAZ M	9	2.32
KHAN MA	6	1.20
ODHIAMBO NM	6	4.00
SINHA A	6	1.43
IBRAHIM M	5	2.08
LEE C-C	5	2.00
MAHALIK MK	5	1.23
NGUYEN CP	5	2.20
TIWARI AK	5	1.12
UMAR M	5	1.20

Table 4 presents the most relevant authors based on the number of papers they have published and the fractionalized articles percentage within those publications. Shahbaz M tops the list with nine publications, 2.32 of which have been fractionalized. With 6 articles, Khan Ma, Odhiambo Nm, and Sinha A are not far behind. Furthermore, five publications were published by Ibrahim M, Lee C-C, Mahalik Mk, Nguyen Cp, Tiwari Ak, and Umar M. The fractionalized articles of each author range from 1.12% to 2.08%, indicating the frequency with which their work has been cited and perhaps impacted future investigations.



Figure 6: Word Cloud

Figure 6 is a word cloud, which visually represents the frequency or importance of various terms related to economics and finance. The size of each term in the word cloud indicates its frequency or importance. Larger terms are more significant or frequently mentioned compared to smaller ones. Financial market is the largest term in the word cloud, indicating it is the most important or frequently mentioned concept. Economic Development is also prominent, suggesting significant importance or frequent mention. Another key term is Economic Growth which is closely related to economic development. Financial Development and Financial System are also prominent, indicating their importance in the context. Other notable terms are Sustainable Development, Natural Resource, China, Banking, Finance, Capital Flow, Stock Market, Credit Provision, and Foreign Direct Investment. These terms, while smaller than the central concepts, are still significant in the overall context. Overall, this word cloud highlights the central importance of financial markets, economic growth and economic development within the context of economics and finance, with other related terms providing additional context and connections.

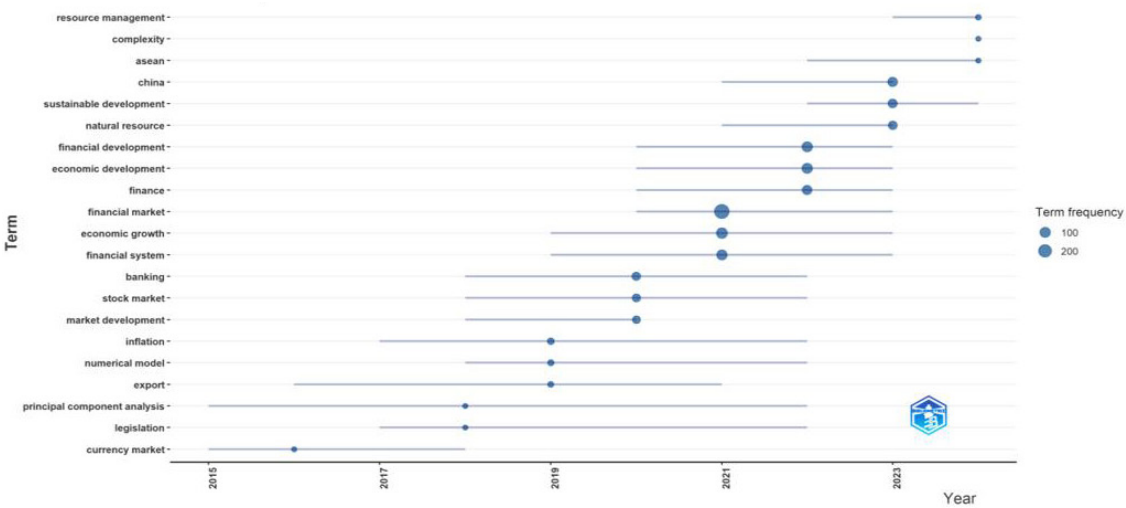


Figure 7: Trend Topics

Figure 7 is a trend chart showing the frequency of various economic and financial terms over time from 2015 to 2023. Y-Axis lists the terms being tracked over time, such as "resource management," "complexity," "China," "economic growth," "financial market," and more. X-Axis (Year) represents the timeline from 2015 to 2023. Each dot represents the frequency of the term in a specific year. The size of the dot indicates the frequency, with larger dots representing higher frequencies. The lines connecting the dots show the trend over time for each term. There are two reference sizes shown: one for a frequency of 100 and one for 200, with larger dots representing higher frequencies. Export and Principal Component Analysis show earlier peaks with some decrease in recent years. Stock Market shows fluctuations but generally increasing over time. Finance and Financial Market both show an increasing trend over the years. Financial Development shows an increasing trend with peaks in recent years. Economic Development consistent trend, peaking in recent years. Resource management gained significance in recent years, particularly peaking around 2023 and complexity shows a consistent trend over the years, increasing slightly towards 2023. Sustainable Development shows an increasing trend, particularly significant from

2020 onwards. Natural Resource gained frequency, particularly peaking in 2023. Overall, the chart highlights the evolving importance and frequency of various economic and financial terms over time, with many terms showing increased significance in recent years, especially around 2020 to 2023.

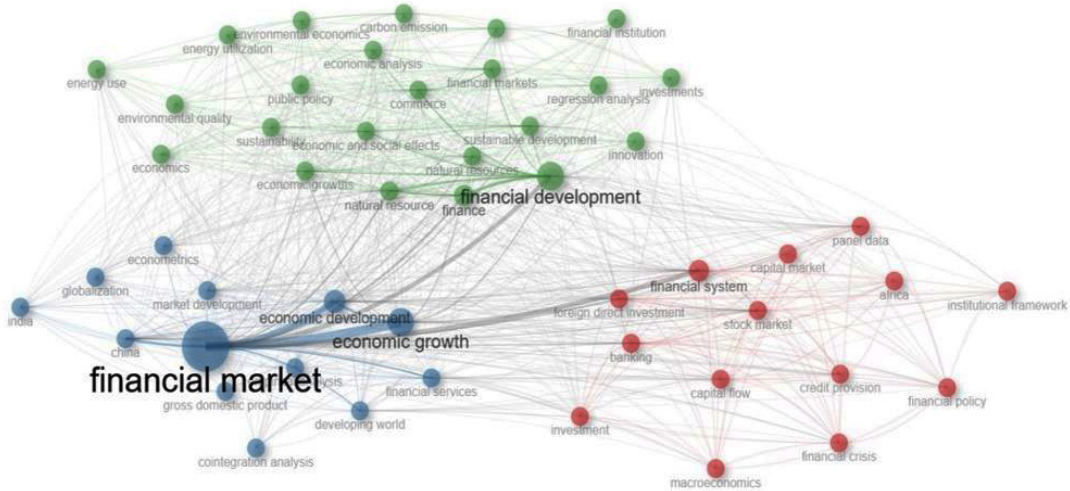


Figure 8: Author's Keywords Co-occurrence Network

Figure 8 shows a network graph representing the relationships between various economic and financial terms. Blue Nodes are likely associated with the "financial market" concept. Green Nodes with the "financial development" concept. Red Nodes with the "financial system" concept. The size of each node represents the importance or frequency of the term. Larger nodes indicate more significant or frequently mentioned terms. The lines between nodes (edges) indicate relationships or co-occurrences between terms. Thicker lines suggest stronger or more frequent relationships. Some key terms are: Financial Market in blue cluster, with strong connections to terms like "economic growth," "economic development," and "market development" focused on broader economic terms and developing economies.

Financial Development in green cluster, with connections to terms like "public policy," "sustainable economic and social effects," "financial institutions," and "innovation" focused on sustainability, innovation, and environmental impacts within the financial context. Financial System in red cluster, connected to terms like "financial policy," "financial crisis," "capital flow," and "stock market" focused on more specific financial system components like "banking," "credit provision," and "institutional framework." Overall, this graph visually represents how different terms within the realms of financial markets, financial development, and financial systems are interconnected, highlighting the central concepts and their relationships.

Table 5 contains the documents that have been mentioned the most globally. The information includes the work's title, the total number of citations received, the yearly average of citations, and the normalized total citations. (TC), and the DOI (digital object identity). The work "HSU P-H, 2014, J FINANC ECON" has the highest normalized total citations (TC) per year, with 943 overall citations and 16.78 normalized TC annually; this is indicated in the table. The total number of citations and the normalized TC per year are the two metrics used in the table to rank the other papers.

Table 5: Documents Most Global Cited

Paper	*DOI*	*Total Citations*	*TC per Year*	*Normalized TC*
HSU P-H, 2014, J FINANC ECON	10.1016/j.jfineco.2013.12.002	943	85.73	16.78
ACHEAMPONG AO, 2019, ENERGY ECON	10.1016/j.eneco.2019.06.025	360	60.00	11.83
KIRIKKALELI D, 2021, SUSTAINABLE DEV	10.1002/sd.2159	312	78.00	10.80
UMAR M, 2020, SUSTAINABLE DEV	10.1002/sd.2116	280	56.00	7.84
CHIEN F, 2021, TECHNOL SOC	10.1016/j.techsoc.2021.101587	265	66.25	9.17
SHAHBAZ M, 2016, ENERGY ECON	10.1016/j.eneco.2016.01.013	259	28.78	5.51
ACHEAMPONG AO, 2020, ENERGY ECON	10.1016/j.eneco.2020.104768	251	50.20	7.03
GROHMANN A, 2018, WORLD DEV	10.1016/j.worlddev.2018.06.020	251	35.86	8.38
KIM J, 2016, ENERGY ECON	10.1016/j.eneco.2016.08.012	241	26.78	5.13
DURUSU-CIFTCI D, 2017, J POLICY MODEL	10.1016/j.jpolmod.2016.08.001	212	26.50	7.40

DISCUSSION

The bibliometric analysis's conclusions draw attention to a number of important aspects of the connection between financial markets and financial development. This discussion will synthesize the key insights, trends, and implications derived from the data, as well as suggest potential directions for future research. The steady increase in the number of publications from 2014 to 2023, with a notable peak in 2023, underscores the growing academic interest in financial markets and their role in financial development. This trend suggests that the topic has gained substantial attention and relevance in recent years, likely driven by global economic dynamics and financial innovations. China and the USA are the leading contributors to this field, with China producing the highest number of publications. This dominance can be attributed to the rapid economic growth and financial market expansion in China, alongside the established financial research infrastructure in the USA. Other countries like Turkey, India, Pakistan, and Malaysia also show significant contributions, indicating a broad international interest and collaborative efforts in this domain.

The analysis of citations reveals that earlier works in the field have had a significant impact, with high average citation counts initially. However, there is a noticeable decline in average citations per year over time. Journals such as *Resource Policy, International Journal of Finance and Economics,* and *Energy Economics* are identified as key sources of influential research. The presence of these journals highlights the interdisciplinary nature of the topic, encompassing aspects of finance, economics, and resource management. Prominent authors like Shahbaz M, Khan MA, and Odhiambo NM have made significant contributions, demonstrating their pioneering contributions to the growth of knowledge about financial markets and financial development.

The data indicates a high level of international collaboration, with 34.55% of papers involving international co-authorship. The co-occurrence network analysis further elucidates the interconnectedness of various concepts, emphasizing the complexity and multifaceted nature of financial markets. The study has a number of limitations that may affect how widely relevant the findings are: Initially, the examination of bibliometric information from

various types of articles is restricted to a single sector of use, which could restrict the relevance of the results to particular domains. Future studies could concentrate on specific subjects like complexity, sustainable development, or research management to give a more narrowly focused overview. Second, the whole scope and depth of the analysis may be constrained by the fact that this study exclusively uses data from Scopus as its major source. In order to provide a more comprehensive view of the subject topic, research teams may consider merging data from databases other than Scopus, such as Google Scholar, Web of Science, etc. in the future. Thirdly, this study just looks at bibliometric data; it does not investigate the caliber or content of the publications under examination. Qualitative methods may be employed in later studies to gain a deeper comprehension of the limitations and contributions of these works. Further research and analysis in this area are recommended in order to build on the findings of this study.

CONCLUSION

This paper provides a comprehensive overview of trends of research in financial markets and financial development during a decade. Key findings shows that there has been a steady increase in the number of publications, peaking in 2023. This indicates growing academic interest and relevance in the topic, driven by global economic dynamics and financial innovations. China and the USA are the leading contributors, reflecting their significant roles in global economic and financial systems. Declining average citations per year over time suggests a potential shift in research focus or saturation in certain areas. This study relies solely on Scopus data. Including other databases such as Google Scholar and Web of Science in future analyses could provide a more comprehensive view. Additional research is recommended to build on these findings, exploring emerging trends, regional differences, and the impact of new financial technologies and policies. In conclusion, the field of financial markets and financial development is rapidly evolving, with significant international collaboration and a diverse range of research topics. Continued exploration and analysis are essential to understand the dynamic nature of this domain and its implications for global economic development.

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Sustainable Finance and Non-Performing Assets (NPAs): A Pathway to Financial Stability

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Abstract

Sustainable finance is known for its focus on Environmental, Social and Governance (ESG) factors into the financial decision-making. It has emerged as a proactive approach of the banking institutions, in order to address the persistent challenges of Non-performing assets (NPAs). This research paper explores the relationship between sustainable finance and NPAs, expanding how responsible practice in finance eradicate the risks of NPAs and encourage finance resilience. It restructures the global financial landscape by strengthening long-term economic stability and accountability. However, the on-going challenges of non-performing assets (NPAs) showcase significant impact on financial institutions and impact the financial progress of banks. The empirical data from leading financial institutions, statistical analysis, and industry best practice supported the papers argument that sustainable finance clear the pathway and reduces NPAs and balance financial stability. The paper collected data from six banks namely, State bank of India, Indian Bank, Punjab National bank, Canara bank, axis bank and HDFC bank for the year 2021 and 2022. The results of this paper show, sustainable finance is a viable decision to control the NPAs level in the banking sector. By including ESG practice bank not only reduces risk associated with the credit but also promote responsible lending. This paper argued that full potential of sustainable finance can be achieved by strengthening regulatory framework and a commitment cultural shift within banking institutions.

Keywords: *Sustainable Finance, Non-performing Assets, ESG, Financial Stability, Credit Risk*

INTRODUCTION

Background

Sustainable finance has emanated as one of the important factors in reshaping the financial systems globally by incorporating Environmental, Social and Governance (ESG) elements into granting and investment practices (United Nations Environment Programme [UNEP], 2021). This change highlights a growing awareness among the policymakers and the financial institutions about the potential credit risk associated with the non-sustainable investment, including climate change, social inequality and governance failures (Clark, Feiner, & Viehs, 2015).

Despite these initiatives, the stability of the banking institutions has been threatened by the NPAs in the present scenario (Acharya & Subramanian, 2016). Loans and advances that are in default are result of lack in credit risk management, poor financial governance, volatile market conditions and sectoral downturn (Banerjee, 2020).

Banking sector serves as a cornerstone of every financial system. Non-performing assets represent the loans and advances that are in default, when interest or principal amount remain overdue for a period of time. Recent research has labelled NPAs as an important "financial threat" (Mishra et al., 2019). According to Reserve Bank of India (RBI), an asset is classified as NPA if, interest and/or instalment of principal remain overdue for a period of more than 90 days (RBI Annual Report, 2021). Non-performing assets arise when a borrower default in making the payment on time. Any asset which stops giving returns to its investors for a specified period of time is known as Non-Performing Asset (NPA) (Kapoor, B & Kumar, R. 2020). Rise in NPAs affects the profitability and efficiency of the banking sector leading to the deterioration in assets quality (Ali et al., 2020).

The Narasimhan Committee Report (1991) proposed that any advances in savings, cash credits, or overdrafts where the interest remains unpaid for a period of four consecutive quarters (equivalent to 80 days) should be classified as Non-performing Assets (NPAs). Additionally, if the interest payments or instalments of the principal remain overdue for more than 180 days, any previously credit amount should also be classified as an NPA. However, the report acknowledges that a lenient requirement of '90 days' has been adopted in line with international standards, ensuring greater transparency and adherence to global norms. This research paper how sustainable financial practice can be used to mitigate the risk associated with NPAs.

Research Objective

1. To study the impact of sustainable finance on reducing NPA level in the banking institutions.
2. Analysing the role of ESG factors in mitigating credit risk.
3. Recommendation of best practices for banks to adopt ESG and restructuring NPAs approach.

LITERATURE REVIEW

Introduction to Sustainable Finance

Sustainable finance is an integration of Environmental, Social and Governance (ESG) factors into decision-making process relating to finance with an aim of promoting responsible economic growth and long-term financial stability (United Nations Environment Programme [UNEP], 2021). This concept is synchronized with the global imitative such as United Nation Sustainable Developmental Goals (SDGs) and Paris Agreement. These initiatives work towards the investment that emphasises on environmentally and socially important to curb the global challenges (European Commission, 2020). According to Baker (2019), "sustainable finance is essential for addressing pressing global challenges such as climate change and social inequality". Over the last decade, sustainable finance has gained attention, especially in developed countries where banks are Entrenching ESG in their lending and investment decisions (Clark, Feiner, & Viehs, 2015).

Sustainable finance is a unfolding framework that encourage investment in the areas such as clean energy, solar energy, infrastructure and ethical governance that not only promotes profitability in the investment but also the positive social and environmental outcome (OECD, 2020). The concept also covers instruments such as green bonds, ESG linked loans, and socially responsible investment, each designed and constructed in such a way that align financial activities and sustainability (International Finance Corporation [IFC], 2020).

Global Growth of Sustainable Finance

Sustainable finance arises because of the increasing awareness about climate risks and the increasing pressure on the stakeholders of the company in order to practice more ethical business activities (European Central Bank [ECB], 2020). In 2020, global issuance of green bonds that are dedicated to financing environmentally beneficial projects, encouraging a bend towards more environmentally friendly projects (OECD, 2020). Moreover, ESG-linked loans are those where interest rates are linked with the borrower's ESG performance and this emerged as a popular instrument for sustainable business (Clark et al., 2015). The research found that the companies with higher ESG scores, have lower capital costs that suggest that market provide rewards to those firms that follow or adopt sustainable practices in their firm. The similar pattern is observable in the banking institutions where institutions that prioritize sustainability in their loan's portfolios have seen a reduction in credit risk and improved financial performance (Friede, Busch, & Bassen, 2015).

Non-performing Assets (NPAs)

Chakraborty (2017) in his research paper Doubtful assets eroding SBIs profitability and liquidity defined NPAs as "a loan assets, which has ceased to generate any income for a bank whether in the form of interest or principal repayment". "Non-Performing Assets (NPAs) are loans or advances that are in default or have not been serviced by the borrower for a specific period, typically 90 days" (Reserve Bank of India [RBI], 2019). Increasing NPAs in the banking sector are persistent challenges for the financial institutions as it erodes profitability, capital adequacy and also hampers the bank's ability to lend money (Ghosh, 2017). When unsustainable financing happens in the financial system in our economy it creates a global financial crisis such as the financial tragedy of 2008. The risk associated with unsustainable practice led to increase in NPAs (Claessens & Kose, 2013; Mohan, 2016).

Factors Contributing to NPAs

There are number of factors that are contributing to the increasing NPAs in the banking sector, including poor credit appraisal system, lack of follow up by banks, economic downturn. Mohan (2016) found that inadequate risk assessment in the credit risk assessment process is a key driver of NPAs as banks often lack in evaluating borrowers' creditworthiness. Additionally, Banerjee (2020) argues that macroeconomic shocks, such as recessions or currency fluctuations, can lead to widespread defaults, particularly in highly leveraged industries like real estate and construction.

Another major reason of increase in NPAs is the weak legal framework. Acharya and Subramanian (2016) suggested that delay in implementation of insolvency and bankruptcy reform gave exaggerated the issue in India. On the other hand, countries with strong legal framework are able to manage NPAs in the banks smoothly and effectively (ECB, 2020).

Linking Sustainable Finance and NPAs

Sustainable finance and its potential to reduce NPAs has gained attention from various academics and practitioners. By adding ESG criterion in lending decisions, banks will be able to manage credit risk, reduce default rate, reduce wilful defaulters, increase in recovery of loans (Friede et al., 2015; Boffo & Patalano, 2020). According to Friede, Busch, and Bassen (2015), banks with ESG practices have low level to NPA default due to better risk management. ESG based lending

somehow encourage borrowers to adopt more sustainable business practice, which in turn lead to improved credit quality and lower NPA ratio (IFC, 2020).

ESG Factors as a Risk Mitigation Tool

The literature suggests that ESG is an important parameter that eradicate financial risk, especially credit risk (Clark et al., 2015). Firms that are encouraging ESG in the performance are more likely to manage operational sustainability by reducing the stress of loan default (Friede et al., 2015). Firms having strong environmental policies have to face less exposure to environmental liabilities, such as fines for non-compliance with environmental regulations (IFC, 2020). Fair labour practices is a social factor that contribute to a firm's long-term stability. Firms that are treating their employees fairly and have engagement with the local communities do not face any dispute in their operations (Clark et al., 2015). When a firm adopt governance factor such as transparency in management practices and strong corporate governance structure, enhance a firm's ability to manage risk and ensure long-term stability (Banerjee, 2020).

Several studies have showcase positive relationship between ESG score and credit risk. Friede et al. (2015) conducted a meta-analysis of over 2000 studies on ESG and financial performance and findings suggest that about 90% of the studies reported a positive or neutral impact of ESG on financial performance. The researcher argues that higher ESG is helpful in managing the credit risk in the banks, that reduces NPAs too.

Sustainable Finance Instruments and NPA Reduction

Sustainable finance instrument such as green bonds, ESG linked fund have shown that when these instruments are used the level of NPA reduces and these instruments promote responsible lending practices (OECD, 2020). Green bonds are used to finance those projects that generate environmental outcomes such as renewable energy and sustainable infrastructure (IFC, 2020). These projects require rigorous risk assessment which help and ensure financial stability and also reduces default risk (European Commission, 2020).

Loans linked to ESG in which interest rates are tied to the borrower's ESG performance is another tool that can be used by the banks to practice sustainable business (Clark et al., 2015). Borrowers who improve their ESG performance are rewarded with low interest rate and vice versa (OECD, 2020). This mechanism encourages borrowers to adopt more responsible business practice, that can help in reducing the default rate (IFC, 2020).

Challenges in Implementing Sustainable Finance for NPA Mitigation

The potential of the sustainable finance to reduce the default rate is clear but there are various challenges to its adoption. One of the major challenges is the lack of standardised ESG metrics, that make it difficult to assess the ESG performance of the borrower for the banks and integrate this phenomenon into the lending decisions (OECD, 2020). Clark et al. (2015) highlights that absence of a framework to measure ESG performance hinder the ability of the bank to fully include sustainable finance. Another challenge faced by the firm to imbibe sustainable finance is the cost of action that incurred when sustainable finance practices came into action. ESG assessment and risk assessment can take lot of resources and cost especially for smaller banks that lack in skills and infrastructure (Friede et al., 2015). Banerjee (2020) point out that banks are unwilling to adopt sustainable finance because for them initial cost appears to be high even after investigating long-term advantages, like low NPA ratio and financial stability.

Regulatory framework and legal policies for sustainable finance are still developing that create uncertainty for the banks. There is no clear vision and guidelines for the bank on how they can incorporate ESG factors into their banking practices (European Commission, 2020). Acharya and Subramanian (2016) argue that government must develop more policies and provide a clear pathway to the bank for the implementation in the banks.

HYPOTHESIS

- **H1:** Banks that incorporate ESG in lending decisions will show low level of NPAs.
- **H2:** Sustainable finance can act as a tool for restructuring NPAs for responsible debt and recovery.
- **H3:** ESG focused banks provide financial stability by minimize default risk.

RESEARCH METHODOLOGY

Research Design

This research study incorporates quantitative analysis to assess the relationship between sustainable finance and NPAs. The research uses secondary data from banks' financial reports.

Data Collection

Quantitative Data: The data set comprises financial reports from 50 global banks over the past five years, focusing on NPA ratios, loan portfolios, and ESG disclosures (RBI, 2019). ESG scores will be obtained from sustainability rating agencies such as MSCI and Sustainalytics.

FINDINGS

Hypothesis Statement: H1 – Banks that incorporate ESG criteria in lending decisions will exhibit lower levels of NPAs.

Table 1: Comparison of NPA Ratios Between Banks with and without ESG Integration

Bank Name	*ESG Integration*	*NPA Ratio (2022)*	*NPA Ratio (2021)*	*Change in %*
PNB	Yes	2.5%	3%	-16.67%
Indian Bank	No	4.5%	5%	-10.00%
SBI	Yes	1.8%	2.0%	-10.00%
Canara Bank	No	5.2%	5.5%	-5.45%
Axis Bank	No	6.0%	6.3%	-4.76%
HDFC Bank	Yes	1.2%	1.5%	-20.00%

Summary of the Result

- **Banks with ESG factors –** The average NPA ratio for banks that incorporate ESG criteria in the lending decisions in 1.8%. The result indicate that NPA level reduced as compared to the previous year.
- **Bank without ESG –** The average NPA ratio for banks that do not adopt ESG is 4.5% that indicate that default rate is high and will accumulate to NPAs.

Statistical Analysis

A correlation analysis conducted on the collected data is negative (r = -0.68) between ESG and NPA ratio. The regression analysis indicated that for every 1-point increase in ESG, the NPA ratio decreases by 0.75%.

Interpretation

The result indicates that the banks that follow and adopt ESG factors into their lending and granting decision will be benefitted by lower level of NPA ratio whereas, the financial institutions that do not follow ESG factors, the NPA ratio is high and the changes of default increases. This indicate thar sustainable finance play a crucial role in enhancing credit quality and reducing credit risk.

Hypothesis Statement: H2 – Sustainable finance can act as a tool for restructuring NPAs by promoting responsible debt management and recovery.

Table 2: Impact of Sustainable Finance on NPA Restructuring

Bank Name	*NPA Restructuring Initiative*	*NPA Ratio Before Restructuring (2021)*	*NPA Ratio After Restructuring (2022)*	*Change (%)*
PNB	Yes (ESG-linked loans)	3.5%	2.5%	–28.57%
Indian Bank	No	5%	5.2%	+4.00%
SBI	Yes (Green bonds)	4.00%	2.8%	–30.00%
Canara Bank	No	6.5%	6.2%	–4.62%
Axis Bank	No	5.8%	6.0%	+3.45%
HDFC Bank	Yes	5.0%	3.5%	–30.00%

Summary of Results

- **Banks with ESG Integration (Sustainable Finance):**
  - Banks PNB, SBI and HDFC showed significant reductions in their NPA ratio after restructuring efforts.
  - Bank PNB improved from 3.5% to 2.5% (−28.57%), SBI improved from 4.00% to 2.8% (-30.00%) and HDFC bank improved from 5.0% to 3.5% (-30.00%).
- **Banks without ESG Integration:**
  - Indian bank, Canara bank and Axis bank had less changes in their NPA ratio, indicating less effective restructuring.
  - Canara bank ratio decreased from 6.5% to 6.2% (-4.62%), Axis bank decreased from 5.8% to 6.0% (+3.45%) and Indian bank increased from 55 to 5.2% (+4.00&).

Interpretation

The data highlight that the bank with sustainable finance can act as an effective tool for restructuring NPAs. Banks that embraced ESG practices experienced more substantial reductions in their NPA ratios compared to those that did not, highlighting the importance of integrating sustainability into financial management strategies.

Hypothesis Statement: H3 – ESG-focused banks contribute to greater financial stability by minimizing systemic risks associated with high levels of NPAs.

Table 3: Comparison of Financial Stability Indicators for ESG-Focused Banks vs. Non-ESG Banks

Bank Name	*ESG Focus*	*NPA Ratio (2022)*	*Capital Adequacy Ratio (CAR)*	*Return on Assets (ROA)*	*Systemic Risk Indicator (SRI)*
PNB	Yes	2.5%	15.0%	1.2%	LOW
Indian Bank	No	6.2%	10.5%	0.5%	HIGH

Bank Name	*ESG Focus*	*NPA Ratio (2022)*	*Capital Adequacy Ratio (CAR)*	*Return on Assets (ROA)*	*Systemic Risk Indicator (SRI)*
SBI	Yes	2.8%	14.5%	1.1%	LOW
Canara Bank	No	6.0%	11.0%	0.4%	HIGH
Axis Bank	No	7.3%	9.0%	0.3%	Very High
HDFC Bank	Yes	3.5%	13.0%	1.0%	Moderate

Summary of Results

- **ESG-Focused Banks:**
  - PNB, SBI AND HDFC bank shoes lower NPA ratios, with PNB AT 2.5%, SBI at 2.8% and HDFC bank at 3.5%.

  These bank shows higher CAR compared to other banks, indicating strong buffer against potential losses.
  - Return on Assets (ROA) for ESG banks are relatively high, indicating that these banks are efficient in generating profit.
- **Non-ESG Banks:**
  - Indian bank, Canara bank and Axis bank have higher ratios (6.2%, 6.0%, and 7.3% respectively), indicating high credit risk.
  - Their CAR are lower in the bank indicating weaker financial health and economic shocks.

Statistical Analysis

A correlation analysis shows a negative correlation between ESG and NPA ratio (r= -0.75) suggesting that banks with strong ESG practices tend to have low level of NPAs and better financial stability. A regression analysis showed that for every 1% decrease in the NPA ratio, the CAR increased by approximately 0.5%, indicate that low level of NPAs indicate financial stability.

Interpretation

Banks with ESG practice in their investment decision have greater financial stability by minimizing systematic risk that is associated with NPAs. Bank with ESG factors manage credit risk effectively.

Challenges

While this phenomenon has various benefits but there are certain challenges while adopting sustainable finance practice.

1. **Regulatory Framework –** one of the initial challenges in adopting sustainable finance is the lack of legal framework governing ESG reporting. Currently, many countries do not have guidelines about how financial institution and banks will report the results of ESG activities. Without complete framework, banks will report half of the information and try to pretend to be more environmentally friendly than they actually are. This practice is known as greenwashing (Lyon & Montgomery, 2015). Such steps not only damage the credibility but also reduces trust among the decision makers.
2. **Lack of Standardized Metrics –** there is also lack in standardised metrics. To evaluate the ESG impact on the bank performance it is important to have some parameters on the basis of which the performance will be measured. Different rating agencies have different methods

to assess the ESG performance, that make it difficult to compare rating (Boffo & Patalano, 2020). This becomes a challenge for the investor who wants to keep an eye on his investment. Without standard measurement metric it would be difficult for the bank to show the results after adopting ESG factors in their practices.

3. **Limited Understanding and Expertise –** one more important challenge for adopting sustainable finance is that many employees in the banking sector do not have required knowledge about ESG practices. It will become more complex for the employees to understand and implement it own their own. Their lack of knowledge for the sustainable finance will result in poor decision making and it will be difficult to integrate sustainable finance into their regular banking activities. To overcome this difference, it is important to provide training and development programme to help the staff learn and how to handle the ESG assessment (Baker, 2019).
4. **Short-Term Focus –** sustainable finance is known for its long-term benefits. Many financial institutions majorly focus on short-term results rather than long-term benefits. For the short-term results banks, it will be very difficult to implement sustainable finance. Bank prefer quick financial gains rather than long-term gain (Harrison & Wicks, 2013). The focus on the bank to achieve quick profit will not let them invest in sustainable finance that could bring benefits for the long run. Because of this, banks may be reluctant to commit resources to sustainable finance initiatives, which limits their ability to effectively tackle issues like Non-Performing Assets (NPAs).
5. Economic and Market Volatility – factors such as economic downturn, change in commodity prices, and shift in regulations can affect borrower's health. In these situations, many banks prefer to manage immediate risk rather than sustainable goals.

CONCLUSION

The ongoing issue of Non-performing assets (NPAs) have gained immense attention of the scholars, academicians, regulators and investors. As banks struggles with the challenges that arise due to NPAs on profitability and the financial health of the bank. This paper investigated how NPAs can be reduces by implementing sustainable finance into the practice. The results says that sustainable finance helps the bank in reducing credit risks, encourage responsible lending and support financial stability. Sustainable finance shift the focus of tha bank from short-term profits to long-term investment. By introducing ESG into the practices, banks can improve the risk assessment within the banks, can reduce the level of NPAs in the bank and maintain the stability in the economy. Therefore, by introducing ESG into the practice banks can take more informed decisions. This approach not only protect the banks from the risk but also promotes healthier economic environment. Introducing sustainable finance into the banking practices encourage responsible lending also. Banks should focus on the consumer who are committed to sustainability, even bank can create a culture of value over money. This can help to understand that for the sake of high profit it is not beneficial to invest in the risker investment that can jump into NPAs but invest in sustainable assets for long run will provide more benefits to the investor. When too much investment is done in the unstable industries, bank fails to examine the risk associated with the investment, when borrowers become wilful defaulters because they are aware of waive of scheme by the government. Higher level of NPA become a problem here. With the help of sustainable finance, bank can diversify their portfolio and reduce the dependency on the traditional sectors.

The diversification not only reduces the risk associated with the NPAs but also supports overall financial stability. Even though sustainable finance showcases various benefits in tackling non-performing assets (NPAs), there are some challenges that are need to be addressed to make most of its benefits. One of the major challenges is the framework for sustainable finance. There are no legal policies that are developed for the banks to make decisions. Even financial institution cannot implement the ESG due to no guidelines of its implementation. To solve this issue, regulatory body should work together with the banks and shareholders to create clear guidelines and standard ESG reporting. A unified regulatory framework would help banks incorporate ESG factors into their lending practices and reporting processes more effectively, increasing accountability and transparency. Additionally, regulators should promote the development of standardized metrics to evaluate ESG performance, allowing banks to make better-informed lending decisions. To maximize the sustainable finance to its full potential, bank need to commit themselves to long-term goals related to sustainability. The staff members of many banks are not knowledgeable enough to implement sustainable finance into their regular practices. Hence, it is important to let the employee learn the skill of how to include ESG into the regular banking tasks to achieve its utmost benefits. If there is lack of knowledge among the staff members, decision making will become difficult. Additionally, the basic knowledge of sustainable finance should be provided to the investor, customers, and communities.

In conclusion, for the current issue of NPAs, sustainable finance is the viable solution in the banking sector. By integrating ESG factors into lending and investment decisions, banks can reduce credit risk, promote responsible lending practices, and contribute to financial stability. However, to unlock the full potential of sustainable finance, regulatory frameworks must be strengthened, and banks must commit to long-term sustainability goals.

RECOMMENDATION

1. Regulators and legal policymakers should work with banks to create standardized framework for ESG reporting and credit risk assessment to ensure transparency.
2. There is a need to develop a dedicated metric on the basis of which results can be measured.
3. Banks should invest in training staff members with the necessary knowledge and skill required to integrate ESG into the banking practices.
4. Banks should actively engage with stakeholders to create a shared vision for sustainable finance, emphasizing the mutual benefits of responsible lending practices.
5. Financial institutions must embed sustainability into their core strategies and operations, ensuring that long-term objectives align with short-term financial goals.

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Crop Insurance a Unique Financial Instrument to Achieve Sustainability and Growth

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Abstract

Objective: *The objective of this paper is to study the adaptation of primary and secondary activities of value chain model of insurance company with rise in catastrophic risk, role of insurance in reducing hazards effect of natural disaster and impact of sustainable insurance in maintaining the social equilibrium.*

Design/Methodology: *The study is based on corpus of articles collected from different renowned data base.*

Findings: *Seeing the uncertain weather-related catastrophes losses insurance industry is slowly trying to strengthen its structural dynamics, its risk assessment process and investment policy. After the digitalization phase of insurance industry, the key barrier identified are access of data base and lack of insurance literacy.*

Practical Implications: *Climate change is becoming an alarming signal for society. India is capturing world interest in the context of climate change and economic development. Adverse climatic conditions are becoming the biggest challenge for growth and stability of the economy. Climate change not only affects the nature of insurance risk but also its operational dynamics. Insurance acts as a financial tool contributing to the relationship between climate change and sustainable growth. The paper concluded that insurance plays a pivotal role in preserving sustainability through precycling insurance, recycling insurance, green insurance.*

Originality: *To the best of my knowledge the written work is original in its nature.*

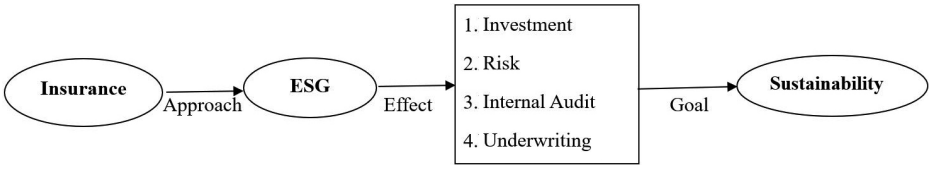
Keywords: *Insurance, Sustainability, Value Chain, Sustainable Insurance, Catastrophic Risk*

INTRODUCTION

The Indian insurance industry is 10th largest in world. Total insurance premium in India increased by 13.5 % in 2021 and the global average was 9%. (Invest India report). Given the immensity of its investment in total GDP of economy it is perceived as a stabilizer during crisis. According to IRDAI India share in global insurance market is 2.73%. In 2022 the insurance industry's value addition to GDP is 2.6%. (Insurance Information Institute). According to EM-DAT international disaster database, following data are found regarding damage cost due to natural disaster in India were US$ 2.92 billion during the 1970s. The extent of damage costs increased in the subsequent decades from US$ 5.92 billion during the 1980s to US$ 18.41 billion and US$ 23.74 billion during 1990s and 2000s, respectively. Further, Padmanabhan (2012) reports that the total economic damages due to extreme events were US$ 48.06 billion during the period 1980-2010 – this corresponds to an average of US$ 1.55 billion per annum during the same period with the direct losses touching about 2% of India's GDP. The data mentioned above show the growing position of Indian insurance industry and its major contribution in economic growth. The data

also talks about the economic loss caused due to natural disasters. The damage caused due to disaster can be covered by the appropriate and timely action of insurers. the paper tries to identify the role of insurance in maintaining sustainability by taking environment, social and governance factors (ESG) approach in its value chain. ESG has 17 valuable goals established by united nation in 2015 which is seen through the lens of sustainability like No poverty, Zero Hunger, Good Health, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industry Innovation and Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace Justice and Strong Institution, Partnership for Goal. Insurance industry is working towards the above following goals i.e No Poverty, Good Health, Affordable and Clean Energy, Responsible Consumption and Production and Life on Land to be achieved. Altogether it will help in mitigating climatic risk, increasing profitability, more stability, achieving resilience and maintain stakeholder expectation.

Due to turbulent movement of economy and drastic change in climatic condition insurance industry is more exposed to catastrophic risk. Investment, Risk management, Internal Audit and Underwriting activities are directly affected. Industry is identifying and redesigning the specific segment of value chain considering ESG as factor for sustainable development.



CONCEPT OF SUSTAINABILITY

Existence of sustainability is almost as old and everlasting as the dismal science. In 1798 Malthus was concerned about how Britain will manage rise in population from finite amount of land. International Union for Conservation of Nature and Natural Resources had internationally established the concept of sustainability and sustainable development in the World Conservation Strategy (IUCN)1980. This concept was more widely recognized through the Brundtland Commission 1987 report. Commission defined Sustainability as "meeting the needs of the present without compromising the ability of future generation to meet their own needs ".

Concern about Sustainability launched a new agenda for development and environment economies (Pezzey Toman 2002). Idea of CSR revamp by the concept that firm productivity is a product of productive intangibles. Mediating role of productivity is discovered between corporate social performance and financial performance (Hasan, Kobeissi, Haizhiwang, 2018). Financial conglomerates are better performer than individual insurer. Social and Ethical aspect of CSR are better integrated in business activities of insurer than environment aspect (Scholtens B., 2011). Creation of the United Nation Environment Programme Financial Institution (UNEPFI)Initiative in 1992 gave a platform for discussion on Sustainable Development Goals (SDG) in financial services.

The year 2010 marks the year of green economy with capital market and finance playing a major role in "Green New Deal". The UNEPFI Insurance Working Group (IWG) an academic group started its survey on understanding and integration of ESG factors in insurance underwriting and product development [3]. UNEPFI Principal for Sustainable Insurance (PSI) launched at

the UN Conference 2012. This initiative is a collaboration between UN and Insurance industry. Sustainable insurance is a strategic approach in which primary and secondary activities of value chain are designed and performed by identifying, assessing, and monitoring risk associated with ESG factors. There are many articles on application of this standard in regular operational practice of insurance industry. Scordis et al. (2014) are one of the first to put the PSI in relation to the (general) literature on sustainability and value maximization.

As the financial world is changing rapidly and experiencing the roller coaster movement: strategic alliances, on demand products, demand-based delivery channel, rise of catastrophic risk, AI influence, big data base, technology intervention etc. These situation leads to focus on value chain model of the insurer. The factors which will give direction to working model of insurance company in today's economy will be customer, technology, and environment. "A sound national insurance and reinsurance market is an essential characteristic of economic growth" (UNCTAD, 1964). Due to deregulation of financial market Insurance is having a major role as a shock absorbent, risk manager and long-term investor for maintaining sustainable and inclusive economy.

Impact of Climate Change on Insurance Sector

- Insured property loss will increase after extreme weather occurrence.
- Climate change will affect the investment decision specifically the long-term asset management.
- Day to day operation of insurance sector will become more costly. After clearing the claim, the reserve will be affected.
- Underwriting will be affected.
- As sustainability is affecting the political environment

Challenges for Sustainable Insurance

Climatic change, continuous decrease of renewable resources, a big gap between above and below poverty line, technological risks are some of the biggest sustainability challenges faced by insurance industry.

INSURANCE AND ITS VALUE CHAIN MODEL

External demand and internal potential are giving birth to new insurance structure which works on preventing measures using back casting in which planning is attached with goal not with current situation.

Value chain is a systematic and fundamental approach to link and analyze the activities which create value addition and competitive advantage in this turbulent economy. Capon (2008) A value chain is "string of units working together to satisfy market demands." Aim of value chain is to add more to bottom line of company and reduce cost and attend the managerial goal of company. Value chain is flexible enough to adjust changes in service industry. Value chain model when ESG factors are proxied for value addition and attending sustainability.

Redesign of Value Chain Model from Product Supplier to Service Provider

Primary Activities	*Old*	*Action Performed*	*New Reality*
Product and Service Development	Restricted product, inadequate service to consumer.	Privatization Globalization Digitalization	Diversity of product: Usage based insurance, i.e. travel.

Primary Activities	*Old*	*Action Performed*	*New Reality*
Marketing	Products were designed and marketed according to set rules of state and advisory body	Focus on customer retention and building trust by brand management, increasing size through strategic collaboration. Focus on financial literacy	Product positioning and pricing according to demographic, psychographic and geographical segment. Engaged the customer by using their sentiments.
Distribution and Sales	Rural areas were neglected, focused only on urban and semi urban areas. Agents were considered the most trusted person for selling insurance product.	A balance between direct selling, digital selling, agent selling and through banks are figuring out to be balanced	Digital platform for selling and information increased in number in urban and semi urban compared to rural areas. Agents are more demanded in rural areas for sake of trust
Underwriting	As policy were regulation-based model product of least competitive and stable environment. Their risk assessment was easy. Accordingly premium pricing was low	Data driven underwriting with the help of technologies Internet of Things. Insurance activities are interconnected with financial system so sematic risk plays an important role in risk assessment. Climate is very vulnerable sustainability Risk and, catastrophic risk is also considered.	Premium prices increased. Risk assessment is becoming a challenging task. More option to switch. Performance of the companies are judged based on ESG factors.
Claim Management	Large number of pending cases for claim settlement, increased operational cost of insurance companies, Dissatisfied customers	Automation of claim management process. Sustainable claim	Easy payment of clean claim, Rapid judicial working on disputed claim. Negative impact of claim on climate is reduced. Claim reporting process improve Sustainable claim is both economical for insurer and customer regarding property.
Investment Management	Investment is managed according to direction given by IRDA. Aim was to protect the capital. Maximum investment in govt securities or in companies having trend of dividend pay from long term	Macroeconomic factor influence: increased inflation rate, higher interest rate, Damage loss due to sudden climate change, implementation of Sustainable investment	Aim is to generate profit along with the protection of capital amount. Through SDG approach investment are done in green bond, green infrastructure, and green asset for sustainable growth of company and shareholder

Value Chain: Supporting Activity

Risk management	*Old*	*Action Performed*	*New Reality*
	Assessment of risk was easy and manageable. pricing of the premium was easy to calculate. More cushion capital was not much required	Risk occurring due to sudden climatic change give rise to catastrophic risk. ESG factor for risk management	To cover catastrophic risk company, alter its coverage condition, pricing, underwriting strategies, or method of capital management. Insurance company can increase their reserve or do more reinsurance. Funds available after disaster helps in resilience of the society

Social inequality is having direct impact on stability and resilience of economy. Social insurance such Employee Provident Fund, Gratuity as Inequality gives protection against various risk like loss of income due to disability sickness. If income gets minimize it directly affects the potential growth of economy. Micro insurance is designed to give protection to rural section of society. Lee et al (2017) the researcher finds that life insurance plays a role in mitigating social inequality, and non-life insurance play a prominent role in promoting economic growth.

Problem Statement

The contribution of insurance is significant in total wealth of the country. The supportive and risk management activity for transition of society towards sustainability attract the attention of various people and government. As incremental improvement is witnessed by insurance industry till 2000 under which problems were managed according to their impact. Problems were common in nature, identifiable and concentrated to specific geographical area. There was no seismic effect. After globalization, digitalization, and drastic change in environment the problems are at varied level and interconnected. Multiplier effect can be seen in different sector of economy due to claim payment (Bouakez et al., 2022). This study will help to get valuable information about the role of specific variable factors which directly influence the value chain of insurance industry. These factors should be considered and controlled on priority basis for achieving sustainability.

Aim of the Paper

The paper aims to study adaptation of value chain model of insurance company with rise of catastrophic risk due to climate change. How insurance companies are helpful in reducing after effect of natural disaster. Role of insurance company in maintaining social resilience and growing to achieve sustainability. For this purpose, articles had been collected from various data base. EBSCO, Google Scholar, Emerald.

Research Contribution

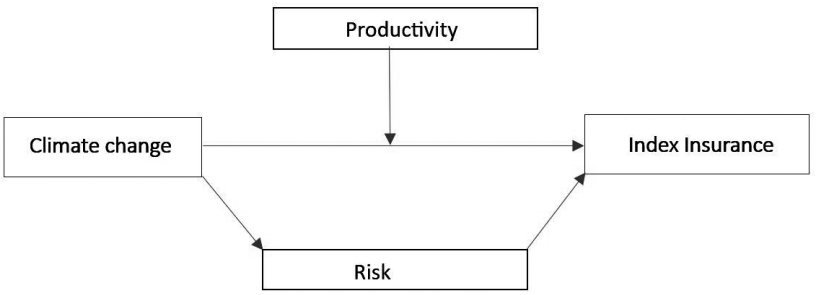
The paper highlights the various areas that need specific attention of insurer, insured, investor and stakeholder. It talks about customer centric value chain model which will help in more insurance penetration. Technology absorption which helped in giving symmetric information. The pace with which insurance industry is coping with climatic challenges and helping in maintaining the growth of economy.

Paper Structure

The paper is divided in three sections:

- Introduction which gives a background for research
- Literature Review and Research methodology
- Conclusion of the research

CONCEPTUAL FRAMEWORK



Climate change is an independent variable having a direct impact on demand of Index insurance. (Index insurance is acknowledged as adaptive strategic instrument to safeguard against the risk of reduced production due to climatic change.) Demand for index insurance decreases when there is an extreme effect of climate change compared to scene of no climate change. When farmers face uncertain distribution of loss, they are not able to understand the benefit of insurance and learning remains stuck to prior belief (Partridge, Wagner, 2016; Daron Stainforth, 2016). Productivity act as a moderating effect on the link between environmental performance and climatic performance (Ramanathan, Ramakrishnan 2016) productivity is significantly affected by climate change and it shows lots of variations depending on operational efficiency of insurers. There are different types of risk which are growing and emerging due to climate change which significantly affect the pricing of premium and product design of index insurance (Pankaj Singh 2022). Catastrophic risk increases the cost of premium. Benefits of Index insurance is highly influenced by climate change phenomenon and environment disaster like drought and flood, etc.

LITERATURE REVIEW

Literature Review consists of structured and standardized identification process. Keywords used are "insurance" and "economy", "sustainable insurance "and "value chain", "insurance" and "sustainability", "insurance" and "risk", "ESG" and "insurance", "sustainability" and "growth" factors 30 papers are selected from 50 identified papers. Data base searched are EBSCO host, Google scholar.

Papers identified talked about the role of insurance in growing economy and maintaining its sustainability. Challenges and opportunities faced by insurance industry due to climate change how it overcome. Optimizing the value chain for implementing ESG factors in its management and operational activities.

- **James Greyson (2006):** The author talked about 'precycling insurance 'an economic instrument based on decision making led by market rather than by regulation. The approach is relevant as China developed a national 'law on the promotion of the Development of Circular Economy'.

- **A.F. Dlugolecki (2000):** The author examined the reason for slow response of insurance industry towards climate change and will this attitude change. Paper explores problems and opportunities that can arise for sector due to climate change within its own internal operational dynamics.
- **Anton van Rossum (2002):** Author tried to clarify the strategic vision of insurer of being specialist or conglomerate in the changing economy. After identifying factors which are fueling the growth how insurer should optimize value chain and identify most value creating segment.
- **G. Parvathi (2013):** The paper talked about the factors responsible for affecting the relationship between economic growth and insurance sector in Indian context after economic reform in1991 and renewal in the 2000.
- **Rahul Kanojia (2014):** Author concluded the study based on secondary data source explain the role and contribution of insurance industry in sustainable development. He tried to find out issues and challenges faced by sector in following the strategic approach for achieving sustainability.
- **Laura Chiaramonte, Alberto Dreassi (2020):** The paper is focused on Americans listed insurers discussed that when sustainability is proxied by ESG factors stability of insurer increases. He concluded that environment and social factor play an eminent role. Contribution of government factor is not so significant. These factors are strongly associated with Life Insurer.
- **Lukas Stricker (2022):** The author analyzed the role of insurer in attending the climate risk challenges in property and casualty areas through an environmentally friendly insurance green insurance which is modeled on the sustainable insurance principal. Road map is drawn around value chain of insurance company concentrating more on property and casualty segment. Proposed business model of green insurance will be a torch bearer for early movers.
- **Debabrata Jana (2020):** The study focused on analyzing the relationship between insurance sector development and economic growth in India. The four variables considered for this study are Economic Growth, Real Premium Growth Rate, Total investment in insurance sector, Insurance Claim. Paying more attention on insurance sector can lead to inclusive growth.
- **Martin Eling, Davide Nuessle (2022):** The paper studied impact of Artificial Intelligence on insurance sector using Porter (1985) value chain and Berliner's (1982) insurability criteria. Shift in business model from loss compensation to loss prevention and prediction cost efficiency and, new income area can be realized. More accurate prediction of loss probability can solve the problem of asymmetric information which will help in reducing and transferring the risk through innovative product design.
- **Nadine Gatzert, Philipp Reichel (2020):** The author outlined appropriate sustainable risk and opportunities of insurance industry in context of its balance sheet and companies set objective. Opportunities comes in term of broader approach for investment and underwriting. Barriers identified are lack of data security and knowledge which hinders transparency between firm and their objectives.
- **Flavio G Nogueira, Andre F.P Lucena (2017):** The author proposed an integrative model set a relationship between progress in ESG risk underwriting and management of ESG issues.

Positive relationship is identified in case of size of company and ESG underwriting and ESG issues in management. Environment and governance are measurement discriminant.

- **John C.V. Pezzey, Michael A. Toman (2002):** The author talked about various areas must be addressed keeping sustainability at center like more avenue for resource substitution, technical changes for resource enhancing. Understanding difference between economic efficiency and equity.
- **Seema Rawat, Aakankshu Rawat (2021):** The aim of the paper is to identify decision factor for claim filing and acceptance through exploratory data analysis (EDA) and feature selection technique.
- **Martin Eling, David Pankoke (2014):** The author reviewed systemic risk in the insurance sector and find new areas of concern. Nontraditional activities are more vulnerable due to higher leverage e.g. (CDS underwriting) they are having impairment with financial system.
- **Patrick M. Liedtke (2007):** According to this paper insurance is a key component of economic development. It talks about the contribution that it makes to the modern society Many activities would not take place unless they are insured.
- **Gulzira Serikova, Yerkenazym Orynbassarova (2019):** The author studied about increasing role of insurance in all spheres of economic activities like income, saving, investment. As integration of activities are taking place competitiveness of every sphere is required for further expansion of industry.
- **Dr. M. Subba Rao, R. Srinivasulu (2013):** The paper identified that insurance contribute a lot for economic growth by improvement in investment climate. General insurance also contributes a lot in economic development.
- **Martin Eling, Martin Lehmann (2018):** The author attempted to study the impact of digital transformation on insurance sector using value chain model as tool. Four major areas get effected customer experience, business process, new product development and competition with other sectors. Identified Key areas where changes are required risk pooling and asymmetric information, Increased dependency due to connectivity, use of technology on severity.
- **Inna Khovrak (2020):** The paper tried to access the effectiveness of ESG approach by insurance companies to manage sustainable development of insurance companies. The paper also highlights the need for improvement in reporting and disclosure practice related to ESG driven approach.
- **Mangulu Charan Dash (2018):** Saving and investment are two most important variable. Factors due to which investment decision are very important larger life expectancy, high rate of inflation, high interest rate, larger income, a greater number of investment outlet. As all business activities are marked by social, economic, and political consideration. Three basic factors which bring opportunity for investment are legal safeguard, positive economic environment, risk bearing capacity of investor.
- **Sussan Holliday, Inna Remizova (2021):** Insurance plays an important role in achieving UN SDG in relation with economic growth, social inclusion, and environment protection. This can be achieved through risk transfer of household, businesses, and public sector.
- **Silvia Bressan (2023):** The author analyzed ESG scores of worldwide property and casualty insurer during 2012-2022 and finds that sustainable insurer has high operating leverage, and

their z score shows that these companies are more stable and deliver excess return which in return create value for company and stake holder.

- **Ruslana Pikus, Natliia Prykaziuk (2018):** As Ukrainian economy is going through economic crisis under frequent change in legislation. It is becoming difficult to maintain the sustainability by insurance company. Companies are losing their solvency and becoming unstable. Researcher tried to identify key group of risk that effect sustainability of insurance company as follows Insurance, Strategic, market risk, risk of inefficient capital structure, liquidity risk, investment risk, operational risk, information risk. To mitigate this risk the author proposes four stage strategies to manage sustainability – 1. Identify the most appropriate risk which is limiting sustainability; 2. Qualitative and quantitative assessment of risk; 3. Development; and 4. Implementation of appropriate measure to minimize consequences.
- **Karolina Pulawska, Wojciech Strzelczyk (2023):** The paper identified that to get better result from investment insurance companies should pay more attention on diversity in company, focusing more on customer satisfaction and considering environmental factors while designing the insurance product and during underwriting process.
- **Marina Brogi, Antonella Cappiello (2022):** This paper aimed to explore the interaction between financial ratio and ESG scores for 107 US listed insurance companies for a period of 2010-2018 to identify the determinants of ESG awareness. Companies bigger in size with high level of solvency and ability to generate profit show highest level of ESG awareness.
- **Laura lveth Aburto Barrera, Joel Wagner (2022):** The paper is systematic literature review about current state of action and research on ESG factor in insurance sector relying on PRISMA protocol. Classification frame is along value chain. Finding says risk, underwriting, and investment management are most researched areas. Claim management and sales are neglected area. Regarding ESG factor climate change as a part of environment factor received most attention by researchers.
- **Asier Garayeta, J.Inaki De la Pena (2022):** The author studied about the change in regulation governing the solvency of world insurance market . A tested qualitative model to analyze the solvency model is applied to European Union, United States of America, China, Australia, Brazil, and South Africa to determine their level of concurrent. It also determines the degree of sustainability of solvency system of insurers.
- **Chao-Chung Ho, Chih Huang (2018):** The study aimed to explore the dimension of Corporate Social Responsibility for sustainable business development of insurance in Taiwan. Study reveals managerial practice dimension as most important part followed by social and then environment factor. Following are factors that must be considered for maintaining sustainability: information disclosure, corporate strategies and commitment, climate change, legal compliance, and environment management.
- **Bert Scholtens (2011):** Author investigated the assessment of Corporate Social Responsibility (CSR) in various insurance companies like (financial conglomerates, life insurance companies, mixed insurers, general insurers). Result reveals that social and ethical aspects of CSR are well integrated in business compared to environmental aspects. Financial conglomerate performs better than other type of insurer.
- **Nadine Gatzert (2020):** The author provided an overview of relevant sustainability risk and opportunities in insurance industry. More discussion is carried on approaches of insurer to

deal with sustainability risk and opportunities mostly for European market. Climate change is seen as a bigger opportunity and wider approach should be taken. Key barriers identified are lack of data and knowledge which hinders transparency between firm with reference to their sustainable approach management.

CONCLUSION

Climate change such as increase in sea level, shift in weather pattern is forecasted to increase the occurrence and intensity of extreme weather after affects in India. It will create a big threat and challenge for economy. Those who can identify the key trend of climate change can vision the definite opportunities. Based on the level of the need of the country and risk to be insured against are agriculture, flood, earthquake, property, crop, and natural disaster. Insurer investment management focus will go for renewable source of energy, green market, green infrastructure etc. These areas will create new opportunity for underwriting. Natural hazards increase the loss potential of the insurer. They are trying to act proactively and taking prior initiatives. Insurance industry is trying to move from taking incremental steps towards the preventive steps. Zero waste, Sustainability and stable economic growth can only be achieved by preventive approach. Insurance plays a very eminent role in the economic development of the country by creating direct and indirect employment opportunities.

Due to increased literacy about sustainability awareness level of consumer, insurer, investor, and stakeholder are growing. They are understanding the positive impact of insurance on adverse effect of climate change. Insurance companies are striving to achieve the goal of sustainability by implying ESG factors for every activity of their value chain. ESG are three pillars on which insurance industry is trying to implement its brand value and trust in eyes of customer, investor, and stake holder although it is an ambitious approach in today's scene, but it will be a prime necessity for survival of future generation. Growth and stability of insurance company is having positive relationship with sustainability. In the conceptual framework productivity is identified as moderating variable and risk is identified as mediating variable between climate change an independent variable and demand for index insurance dependent variable. Although progressively people are becoming aware regarding role of insurance in mitigating risk there is a gap between associated risk and product offered. Few key barriers had been identified in these aspects like illiteracy, asymmetric communication, hinderance of data, standardization of data etc. Following the sustainability path is a real challenge in present for insurance sector. Limitation of our study is research related to data base used considering the topic.

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The Role of Green Finance in Sustainability: Government-Led Initiatives and the Challenges Ahead

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Abstract

Nowadays, climate change and its environmental implications have become serious concerns for both developed and developing countries. As a result, numerous initiatives have been undertaken to address these concerns, including preventing environmental degradation and adopting sustainable development in accordance with global norms. The purpose is to reduce environmental degradation and promote sustainable development through green investment. One of the ways to combat environment degradation is to promote green project and for these green projects green investment is required. Green finance refers to financial products and services promoting environmental sustainability and shifting to a low-carbon economy. Green finance is the most effective way to fund eco-friendly projects and agencies that safeguard the environment. This research paper aims to assess the pattern of the green finance investment. As a result, the study covers recent trends, as well as government initiatives and challenges towards green finance in India and also offers some suggestions to overcome the challenges.

Keywords: *Green Finance, Initiatives, Investment, Sustainable Development, Environment*

INTRODUCTION

In recent years, most countries, particularly in the developing world, have prioritized economic expansion over environmental improvement. As a result, various environmental issues have evolved, including air pollution, climate change, deforestation, and environmental harm (Akter et al., 2018; Zheng et al., 2021). Recently, the worldwide agreement on environmental preservation and the United Nations' proposal for SDGs by 2030 (Akomea-Frimpong et al., 2021) have boosted interest in green financing (Dorry & Schulz, 2018; Amidjaya & Widagdo, 2020). The implementation of an effective green economy through green finance is an important step for economic growth (Lewis, 2012; Liu et al., 2020). Green financing is crucial for sustainable development across the economy. Green financial services are increasingly being used to support sustainable economic development in the global financial industry (Zeng et al., 2014). Green finance (GF) is an emerging topic with no clear and universal definition (Rawat, 2020). Green finance is a new financial pattern that combines environmental preservation with economic rewards, emphasizing "green" and "finance," both of which are controversial subjects (Choi & Sirakaya, 2006; Li & Wang, 2018; Wang et al., 2021). Lindenberg (2014) identified three major categories for green finance: (i) financing of public and private green investments (infrastructure), (ii) funding of green public policies, and (iii) financial instruments. This division recognizes the broadest facets of green financing. Green finance, a new and innovative financial service,

effectively balances environmental conservation and economic development (Labatt & White, 2002). Green finance helps to achieve long-term sustainability goals and mitigate climate change impacts by aligning financial activities with environmental and social objectives.

Many researchers have worked on reducing the rate of environmental degradation (Akomea-Frimpong et al., 2021). In addition, the Indian government has been focusing on setting long-term goals for the country by implementing policies that promote high-quality economic growth and environmentally beneficial practices (Nenavath & Mishra, 2023). Green financing, also known as climate-smart financing, aims to reduce carbon emissions and boost ecologically friendly benefits over the long run (Jha & Bakhshi, 2019). Nenavath & Mishra (2019) analyzed the role of financial technology and green finance in achieving the goals of sustainable economic growth. This study showed that green finance positively impacts economic growth by improving finance structure, financial efficacy, and environmental quality protection. Fintech improves the impact of green finance on financial structures and environmental quality but has little impact on its economic effectiveness. Wang & Zhi (2016) suggest that green finance is the most effective funding choice for environmentally friendly projects and organizations. Sachs et al. (2019) identified that green finance is the driving force behind the development of infrastructure projects. But financial institutions are generally more interested in fossil fuel initiatives than green projects, because these new technologies still carry several risks and provide a reduced rate of return. To achieve sustainable development goals, it is necessary to create a new file for green projects and increase the financing of investments that provide environmental benefits through new financial instruments and policies, such as green bonds, green banks, financial technologies, community-based green funds, and so on, collectively known as "green finance".

LITERATURE REVIEW

Climate change and its environmental consequences have become a major issue for both industrialized and developing countries (Ngwenya & Simatele, 2020). As a result, several strategies, such as preventing environmental degradation and implementing sustainable development following global standards, have been implemented (Zheng et al., 2021) to mitigate these issues. In this regard, banking institutions can play an important role by investing in a variety of environmentally friendly projects, including renewable energy, green industry development, and waste management, among others (Akter et al., 2018; Zhixia et al., 2018), which directly contribute to the country's long-term economic and sustainable development (Zheng et al., 2021). Hoshen et al. (2017) conducted a study in Bangladesh and proposed that banks support various environmentally friendly projects to promote sustainable growth. Banks should play a key role in developing new environmentally friendly products. Green financing is a CSR activity for financial institutions such as banks, mutual funds, and stock corporations (Koo, 2010). Zheng et al. (2021) investigated the elements of green finance and their impact on the sustainability performance of financial institutions in developing countries such as Bangladesh. Among banks and non-bank financial institutions, private commercial banks contributed the most to green financing in Bangladesh, accounting for 78.12% of the total. In addition, the empirical data revealed that the three components of green finance—social, economic, and environmental—have a significant positive impact on bank sustainability performance. The study also discovered that nearly 95% of bankers believe green finance is an important component in the short- and long-term growth of banking strategy in Bangladesh.

Environmental challenges, including ecological imbalances, biodiversity loss, soil deterioration, and devastation, are a growing concern in global economies due to their impact on human survival (Liu et al., 2020). Green finance can promote economic progress and ensure sustainability in impoverished countries (Zheng et al., 2021). Although green finance is an evolving concept in developing nations (Liu et al., 2020). But it has gained popularity, with the financial sector issuing green bonds, stocks, and debentures. Furthermore, green municipal bonds are priced higher than comparable regular bonds (Managi et al., 2021). Wang et al. (2021) examined 815 publications from spanning 2008 to 2020.The authors highlighted government subsidy policy, carbon tax policy, and green bond policy as the most important policy recommendations in the papers. The authors also mentioned that green bonds have been a popular topic in the sector. De Souza Cunha et al. (2021) examined the financial performance of a portfolio of shares in Brazilian carbon-efficient enterprises. The results showed that investing in carbon-efficient companies in Brazil has positively impacted portfolio performance while also providing investors with an option to mitigate climate risk exposure in stock markets. A UNEP inquiry (2017) showed that domestic green bonds will help in the provision of additional financing, hence helping to meet the need for green infrastructure investment. Cheng et al. (2022) identified six themes in this field. These include climate change, green finance, green financing and banking, public policy, green bond valuation, and green bonds and financial markets. The examination of subject trends shows that the authors' recent attention has been on green bonds. The government is also actively participating in the issuance of green bonds by issuing sovereign and sub-sovereign bonds (UNEP Inquiry, 2017). Green finance focuses on two broad areas: finance and the environment; its product has achieved recognition and contributed to high-quality development in a variety of fields around the world. As part of its transformation to a low-carbon economy, India issued $6.11 billion in green bonds in 2021 and another $3.3 billion in 2022 (Nenavath & Mishra, 2023). (Goel, 2016) demonstrated that demand for green bonds and green funds will expand because of the rise in concern about the environment's sustainability. Investment in green initiatives is expanding, which is driving up demand for green financing. Recognizing the importance of green finance, UN Environment has been striving to align countries' financial systems to redirect money flows toward achieving the 2030 Sustainable Development Goals. India requires a national green finance plan to achieve sustainable economic development. By 2040, it will cost around $4.5 trillion to fund green infrastructure. Several private and public banks, as well as non-banking financial institutions, have pledged approximately $2570 million to finance green initiatives (Jha & Bakhshi, 2019).

Liu et al. (2020) investigated the interaction between green finance and the green economy in China to achieve sustainable development. The study stated that green finance is driving sustainable economic growth by prioritizing social responsibility and environmental conservation. (Nawaz et al., 2020) looked examined the relationship between green finance and climate change mitigation. The analysis found no significant difference between the N-11 economies and the BRICS countries in terms of green funding and climate challenges. It was also emphasized that the issue of sustainability is especially important for growing and developing economies. As a result, it has been urged that the N-11 nations and BRICS develop policies to crystallize the green money required to address the risks posed by environmental challenges. Cheng et al. (2022) outlined the literature on climate finance. The corpus analysis suggested that important contributions in the

domain have occurred relatively recently, with the Paris Climate Agreement serving as a major impetus for research. China, the UK and the USA appeared to be the biggest contributors.

The ecological imbalance is caused by excessive carbon dioxide emissions into the atmosphere, which leads to the global warming phenomenon (Chopra et al., 2005). Climate change is the world's most serious environmental threat, but it is far from the only one. The government had previously vowed to reduce global warming but has yet to take significant steps toward establishing a low-carbon energy system (Sachs & Du Toit, 2015). This has prompted governments all over the world to seriously consider these issues for the sake of future generations and has begun the process of overcoming this catastrophe by implementing the Kyoto Protocol and many other United Nations projects. In between these lines, there is an idea of green money, green investment, green technologies, and many other green activities that can all be combined into one word: green finance (Chopra et al., 2005).

Green finance plays a significant role in promoting ecological civilization. Environmental protection enterprises can benefit from financial backing, whereas traditional high-pollution and energy-consuming enterprises may face limitations and exit the market. This resource allocation approach can promote sustainable economic development. "Green" means conserving resources, reducing pollution, safeguarding the environment, and promoting sustainable development. "Green" is synonymous with "environmentally friendly." Green Finance provides financial services for environmental preservation (Xie et al., 2020). Zhang et al. (2019) emphasized the importance of green financing in promoting sustainable economic growth. Green financing is crucial for addressing climate change and achieving sustainable development goals (SDGs) across countries. Green financing is the foundation for green growth (Doh, 2009).

OBJECTIVES OF THE STUDY

The main objectives of the study are:

- To analyze the pattern and trend of Green Fnance investments in India.
- To assess the government initiatives in promoting Green Finance in India.
- To analyze the key the challenges towards Green Fnance in India.

RESEARCH METHODOLOGY

The study is descriptive and analytical in nature. Secondary data has been used in this study. Secondary information has been gathered from published reports, websites and literature review. The literature review section included a variety of work papers, journals, and articles.

DATA ANALYSIS

This section covers what is India targets and from which sources India is raising green finance and what is current investment trend in green projects.

India has updated its Nationally Determined Contributions (NDCs), which are:

- Reducing the country's carbon intensity by more than 45% by 2030 from its 2000–2005 level
- To achieve about 50% of the cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.

To achieve these targets, India is focusing on green finance.

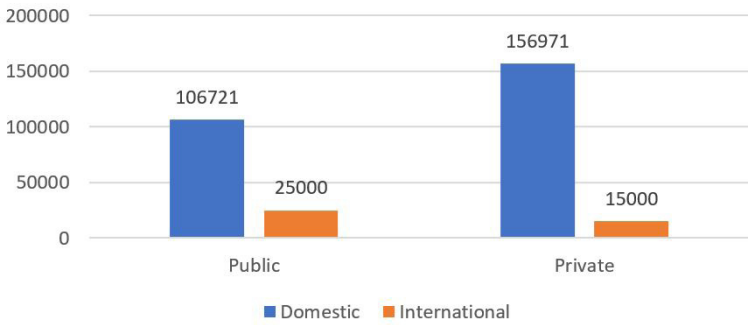


Figure 1: Sources of Green Finance (INR thousand crores)

Figure 1 depicts the sources of green finance in terms of Domestic/International and Private/Public. In FY2019 and FY2020, the total amount of finance raised was INR 309 thousand crore, or USD 44 billion. 85% of this amount, which is INR 263 thousand crore, was raised domestically, which shows the strong interest of domestic investors. Almost 60% of finance is raised from private sources. It indicates that private finance dominates over public sources of finance.

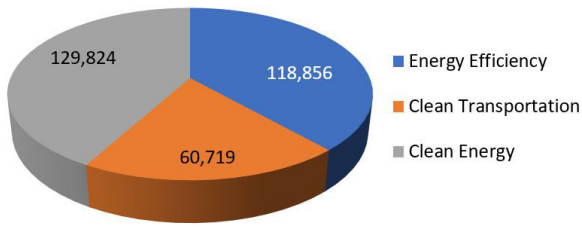


Figure 2: Green Finance Used For (INR thousand crores)

The total green finance raised is used primarily for three sectors: energy efficiency, clean transportation, and clean energy (as seen in Figure 2). In the energy efficiency sector, private sources of finance played a major role, whereas in clean transportation, public finance dominated.

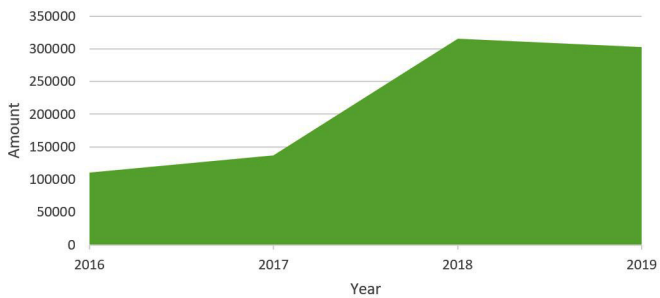


Figure 3: Tracking Green Finance Investments

India's present demand for green financing is falling short as compared to current needs. India required INR 1,100,000 crore to meet its current NDCs. In FY 2019/2020, traced finance was INR 309 thousand crore, which is ¼ of the current need to meet the goals.

GOVERNMENT INITIATIVES TOWARDS GREEN FINANCE

India has been making significant strides toward promoting green finance to support its sustainable development goals. Here are some key initiatives:

(a) **Foreign Direct Investment (FDI) in Renewable Energy:** India requires substantial investment in renewable energy, estimated between INR 15,000 crores to INR 20,000 crores annually. To attract this investment, the Government of India has permitted 100% FDI in renewable energy generation. This policy is designed to draw foreign investors and boost the development of renewable energy projects, such as solar, wind, and hydroelectric power.

(b) **National Action Plan on Climate Change (NAPCC):** The NAPCC, launched by the Indian government, encompasses eight missions focused on promoting sustainability across various sectors. These missions include:
- **Green India Mission:** Aims to protect, restore, and enhance India's diminishing forest cover and respond to climate change by a combination of adaptation and mitigation measures.
- **National Solar Mission:** Seeks to establish India as a global leader in solar energy by creating an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.
- **National Mission for Enhanced Energy Efficiency:** Focuses on creating market-based mechanisms to enhance energy efficiency in various sectors.
- **Others:** Addressing climate change impacts in sectors like agriculture, water resources, and coastal regions.

(c) **National Clean Energy Fund (NCEF):** Established in 2010, the NCEF was created to support funding for innovative clean energy projects. This comprises a variety of activities, such as wind, solar, and biomass energy projects. The fund is financed through a cess on coal produced or imported into India, demonstrating the government's commitment to transitioning to cleaner energy sources.

(d) **Indian Renewable Energy Development Agency (IREDA):** Founded in 1987, IREDA is a public limited government company dedicated to financing and promoting renewable energy projects. IREDA's role includes providing financial support for projects involving solar, wind, small hydro, and biomass energy, thereby encouraging the adoption and expansion of renewable energy sources across the country.

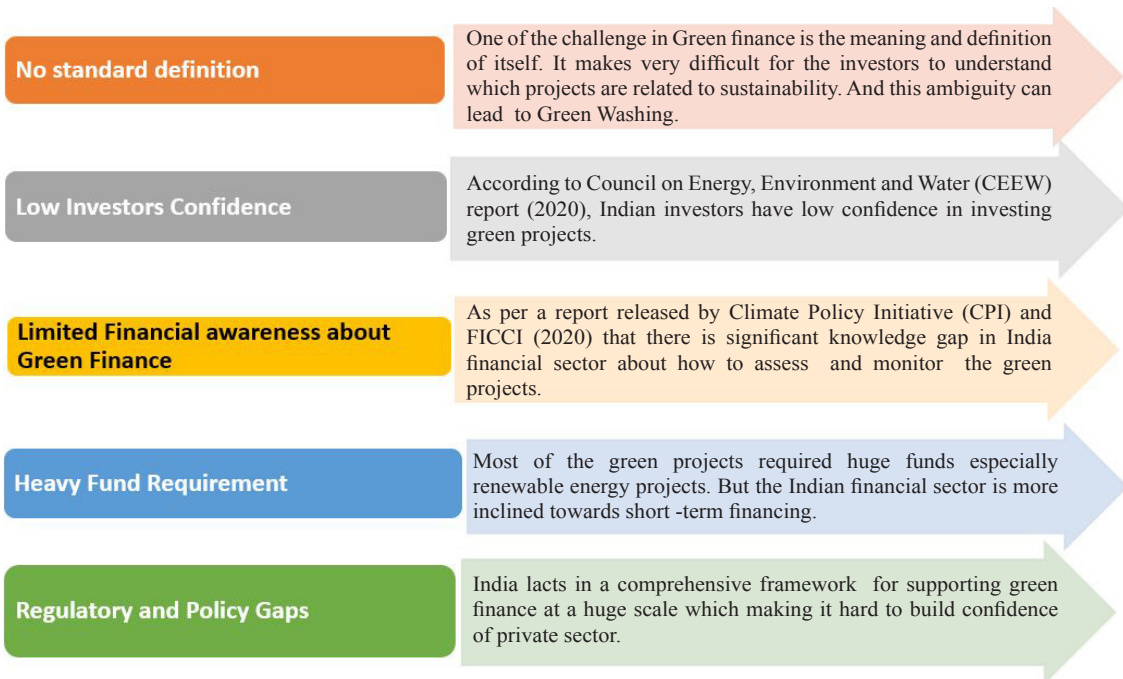
(e) **Sovereign Green Bonds:** On January 25, 2023, the Government of India issued its first tranche of sovereign green bonds, worth INR 80 billion. These bonds are aimed at funding projects that help in reducing carbon emissions and promote sustainability. The issuance of these bonds marks a significant step in India's commitment to financing green infrastructure and sustainable projects, demonstrating the country's dedication to environmental sustainability on the global stage.

Through these initiatives, the Indian government aims to foster a robust green finance ecosystem that supports the development of renewable energy, promotes sustainability, and addresses climate change.

CHALLENGES TOWARDS GREEN FINANCE

Sustainable development, in tandem with economic growth, is becoming a major concern worldwide. With increased knowledge of environmental challenges, the finance industry must become more concerned about its role in dealing with them (Jha & Bakhshi, 2019). There are some challenges to green finance, particularly in developing nations. They often lack professional knowledge and are pricey in their early phases (Zaidi et al., 2019; Tolliver et al., 2019). Therefore,

in developing nations, sustainable green finance development is hindered by a lack of skill, low returns, complex procedures, and high implementation costs (Zheng et al., 2021). Constraints also include a lack of information about green firms (Xie et al., 2020). One of the challenge in Green finance is the meaning and definition of itself. It makes very difficult for the investors to understand which projects are related to sustainability. And this ambiguity can lead to Green Washing. Another issue is the Limited Financial awareness about Green Finance. As per a report released by (Climate Policy Initiative)CPI and FICCI (2020) that there is significant knowledge gap in India financial sector about how to assess and monitor the green projects. According to Council on Energy, Environment and Water(CEEW) report (2020), Indian investors have low confidence in investing green projects. Most of the green projects required huge funds especially renewable energy projects. But the Indian financial sector is more inclined towards short-term financing.



SUGGESTIONS TO OVERCOME THE CHALLENGES

The green financing program and evaluation mechanism are still in their early stages, and thorough execution criteria remain inadequate (Nenavath & Mishra, 2023). To increase the effectiveness of green financing, investing in green technologies, promoting green development, and promoting green finance are all important steps. Accelerating the adoption of green technology in production and increasing green industries, including energy-saving, environmental protection, clean production, and clean energy, is a must (Xie et al., 2020).

The government should provide financial incentives for green businesses. The government should award green enterprises for their innovative use of green technology through cash incentives. The government must implement tax reduction measures based on green enterprises' emission reductions or output of green products. The government should also offer price subsidies

to promote green technologies among firms (Xie et al., 2020). Governments should levy steadily increasing carbon fees and utilize the proceeds to fund low-carbon energy projects (Sachs et al., 2019). Sustainable development cannot remain an aspiration or a phrase; it is the only feasible path to green global growth. Now it is highly required to pay attention and investment it deserves.

CONCLUSION

Climate change and environment has become a measure concern nowadays. It is highly essential to combat the environment degradation for a sustainable future and on this path green finance can play a measure role. From the above paper it has been find out that India is facing a shortage of funds to meet its NDCs targets. Indian government has taken various initiative to promote green finance but still there are some challenges which are required to solve for a greener future. These challenges can tackle with the co-operation among all the stakeholders who are directly and indirectly related with sustainability.

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FDI and International Trade Impact on Economic Growth in India: A Theoretical and Empirical Investigation

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Abstract

The relationship between Foreign Direct Investment (FDI), international trade, and economic growth has been extensively studied in the context of developing economies. In India, these factors have been particularly significant since the economic liberalization in 1991. This paper explores how FDI and international trade have contributed to India's economic growth by examining empirical data, policy changes, and various economic indicators. The analysis focuses on the trends in FDI inflows, the role of trade liberalization, and the interplay between these factors and their impact on key economic outcomes. The paper concludes with policy recommendations to maximize the benefits of FDI and international trade for sustained economic growth.

INTRODUCTION

Background

India's journey from a relatively closed economy to one of the world's fastest-growing markets has been marked by significant changes in its economic policies, particularly since the 1991 economic reforms. The liberalization, privatization, and globalization (LPG) policies ushered in an era where FDI and international trade became central to the country's economic strategy. FDI is crucial for bringing in capital, technology, and managerial expertise, while international trade opens up markets, promotes competitiveness, and facilitates the transfer of goods and services across borders.

Research Problem

Understanding the impact of FDI and international trade on economic growth is essential for framing effective economic policies. While both factors have been integral to India's economic development, their roles and relative importance have evolved over time. This paper aims to analyse the extent to which FDI and international trade have influenced India's economic growth, considering the benefits, challenges, and future prospects.

Objectives

The primary objectives of this research are:

- To analyze the trends in FDI inflows into India and their impact on economic growth.
- To examine the role of international trade in promoting India's economic development.
- To evaluate the interaction between FDI and international trade and their combined effect on economic growth.

- To provide policy recommendations for enhancing the positive impact of FDI and international trade on the economy.

LITERATURE REVIEW

- **FDI and Economic Growth:** The relationship between FDI and economic growth has been the subject of extensive research. According to Dunning's OLI paradigm, FDI contributes to economic growth through the transfer of capital, technology, and skills (Dunning, 1993). Studies by Borensztein, De Gregorio, and Lee (1998) suggest that FDI can have a positive effect on economic growth, particularly when the host country has a certain threshold level of human capital. In the context of India, Agrawal (2015) found that FDI inflows have significantly contributed to GDP growth, particularly in sectors such as telecommunications, infrastructure, and services.
- **International Trade and Economic Growth:** International trade is another key driver of economic growth, as it enables countries to specialize according to their comparative advantage, leading to more efficient resource allocation. Krugman (1979) emphasized that trade openness can lead to economies of scale and increased competition, which in turn boosts productivity and growth. In India, the liberalization of trade policies since the 1990s has been associated with an increase in export-oriented industries, contributing to overall economic growth (Kumar, 2018).
- **Interaction between FDI and International Trade:** FDI and international trade are often seen as complementary components of economic growth. The presence of FDI can enhance a country's export capacity by improving the quality and competitiveness of domestic products. On the other hand, international trade can attract FDI by providing foreign investors with access to larger markets. Studies like that of Alfaro et al. (2004) have highlighted the synergistic effects of FDI and trade on economic growth, particularly in developing economies like India.

METHODOLOGY

- **Data Sources:** This research utilizes secondary data from various reputable sources, including the Reserve Bank of India (RBI), World Bank, United Nations Conference on Trade and Development (UNCTAD), and the Ministry of Commerce and Industry, Government of India. The study period primarily covers data from 1991 to 2023, with a focus on post-liberalization trends.
- **Analytical Framework:** The study employs a mixed-methods approach, combining quantitative analysis with qualitative insights. Additionally, case studies of specific sectors that have received substantial FDI or have been major contributors to trade are analysed to provide deeper insights.

RESULT AND DISCUSSION

FDI in India: Trends and Impact

In 1991–2000, economic liberalization began in India, FDI inflows began to increase. During this period, average annual FDI inflows were around $2 billion. After that, 2000-2010 Significant growth was observed, with FDI inflows reaching approximately $25 billion annually by 2010, driven by sectors like telecommunications, IT, and pharmaceuticals. In 2010-2020 FDI, inflows continued to rise, with a peak in 2020 at around $81.72 billion, even during the COVID-19

pandemic, indicating India's growing attractiveness to foreign investors. In 2021-2023 Post-pandemic, recovery saw further growth, with FDI inflows maintaining levels around $83-85 billion annually. Through analysis, we observed Services Sector Continues to dominate, attracting around 25-30% of total FDI inflows. This includes IT, financial services, and telecommunications. Manufacturing sector Accounts for approximately 20% of FDI, with significant investments in automobiles, electronics, and consumer goods. Pharmaceuticals & Biotechnology Experienced growth, especially during and after the pandemic, making up about 10-15% of FDI inflows. Construction & Infrastructure represents around 10% of FDI, driven by initiatives like Smart Cities and real estate reforms. The top most 4 cities have higher FDI infow is Maharashtra attracting about 28% of total FDI inflows, primarily in Mumbai and Pune. Delhi-NCR Attracts around 20% of FDI, benefiting from its status as the capital and a major economic hub. Karnataka Particularly Bangalore, accounts for about 12% of FDI, largely in IT and biotech sectors. Tamil Nadu and Gujarat attracts around 8-10%, focusing on manufacturing, automobiles, and textiles. FDI inflows to India have shown a consistent upward trend since the 1990s, with occasional fluctuations due to global economic conditions. For instance, FDI inflows peaked in 2008-09 but declined during the global financial crisis. However, since 2014, India has consistently ranked among the top recipients of FDI globally, with inflows reaching a record high in recent years (UNCTAD, 2022).

Economic Impact of FDI

International trade has been a cornerstone of India's economic development, particularly since the country's shift from protectionist policies to a more liberalized trade regime post-1991. Before this period, India's economy was characterized by high tariffs, import substitution strategies, and significant government control, which limited the country's integration with the global market. However, the economic reforms of 1991 marked a turning point, opening up the economy to international trade and investment. This liberalization led to a significant increase in both exports and imports, with exports growing rapidly in sectors such as IT services, pharmaceuticals, textiles, and engineering goods. The IT and software services sector, in particular, emerged as a global leader, contributing to a substantial portion of India's export revenues and transforming cities like Bangalore and Hyderabad into major IT hubs. Imports also grew significantly, driven by the need for capital goods, crude oil, and electronic components, which were essential for supporting India's industrial growth and meeting domestic demand. While this growth in imports has contributed to persistent trade deficits, these have been managed through a combination of strong services exports, particularly in IT, and careful management of foreign exchange reserves. India's participation in global trade agreements, such as those under the World Trade Organization (WTO), as well as bilateral and regional trade agreements, has further strengthened its trade position by improving market access, attracting foreign direct investment, and facilitating technology transfer .Despite these successes, challenges remain, including the need to manage trade deficits, navigate non-tariff barriers in key export markets, and cope with global economic uncertainties. However, there are also significant opportunities, such as diversifying export markets, enhancing value addition in sectors like electronics and pharmaceuticals, and leveraging India's strengths in digital trade and e-commerce. To sustain and enhance the benefits of international trade, it is crucial for India to continue investing in infrastructure, simplifying regulations, and pursuing strategic trade agreements that open up new markets and opportunities. Through these efforts, international trade will continue to play a vital role in driving India's economic growth and development.

Interaction between FDI and International Trade

India's trade policy underwent significant changes post-1991, with a shift towards greater openness and integration with the global economy. The reduction in tariffs, removal of quantitative restrictions, and signing of free trade agreements (FTAs) with various countries and regional blocs have been key components of this strategy (Kumar, 2018).Since the 1990s, India's trade volume has expanded significantly. The country has diversified its export basket, moving from traditional products like textiles and agricultural goods to high-value products like engineering goods, pharmaceuticals, and information technology services. Imports have also increased, particularly in capital goods, oil, and electronics, reflecting India's growing domestic demand and production capacity (World Bank, 2021). International trade has contributed to India's GDP growth by enhancing the country's production capabilities, fostering innovation, and improving resource allocation. Studies show that trade openness has been positively correlated with GDP growth in India, with export-oriented industries being the main beneficiaries (Rodrik & Subramanian, 2003).The interaction between Foreign Direct Investment (FDI) and international trade is pivotal in driving economic growth, as these factors are deeply interconnected and mutually reinforcing. FDI enhances a country's export capabilities by introducing advanced technologies, improving production processes, and integrating the host country into global value chains. When multinational companies invest in a country, they often establish operations designed to export products to international markets, thereby boosting export volumes. Simultaneously, these foreign enterprises may import raw materials, components, or machinery necessary for their production, increasing import volumes as well. This dynamic interaction facilitates a flow of goods and services that enriches the host country's economy. Additionally, FDI brings with it a transfer of technology and management practices that can significantly improve the efficiency and competitiveness of local firms, further enhancing the quality and diversity of exports. Trade policies that support open markets and reduce barriers to trade can make a country more attractive to foreign investors, creating a symbiotic relationship where both trade and investment reinforce each other. Economic reforms that streamline customs procedures and reduce tariffs not only attract FDI but also enhance trade efficiency. The combined effect of FDI and international trade on economic growth is profound, as both contribute directly to infrastructure development, job creation, and skill enhancement, which in turn lead to higher productivity and wages. Indirectly, they foster increased competitiveness among domestic firms and promote economic diversification, reducing dependency on a few sectors and stabilizing the economy against sector-specific shocks. Empirical evidence from various countries demonstrates that integrating FDI and trade policies effectively can lead to robust economic growth, as seen in nations like China and Vietnam. However, managing trade imbalances and ensuring a conducive regulatory environment are crucial to harnessing the full benefits of this interaction. Overall, FDI and international trade together form a powerful engine of economic development, driving growth through enhanced productivity, market expansion, and technological advancement.

Policy Recommendations for Enhancing the Positive Impact of FDI and International Trade on the Economy

To enhance the positive impact of Foreign Direct Investment (FDI) and international trade on economic growth, policymakers should adopt a multifaceted approach. First, simplifying and streamlining regulatory processes is crucial to creating an attractive investment climate. This

involves reducing bureaucratic hurdles, enhancing transparency, and protecting intellectual property rights to build investor confidence. Additionally, promoting trade facilitation by reducing tariffs, eliminating non-tariff barriers, and investing in infrastructure such as ports and logistics can significantly boost trade efficiency and make the country more appealing to investors. Policymakers should also pursue comprehensive trade agreements to expand market access and create new opportunities for local businesses. Fostering innovation and technology transfer is another key area. Supporting research and development through tax incentives and grants can drive technological advancements and improve the competitiveness of local industries. Facilitating partnerships between foreign investors and local firms can enhance knowledge sharing and skills development. Investing in human capital is equally important; developing educational and vocational training programs will ensure that the workforce is equipped with the skills needed for high-tech industries, while policies to attract and retain skilled professionals will support growth and innovation. Inclusive growth should be a priority, with policies designed to promote balanced regional development and support for small and medium enterprises (SMEs). By investing in less developed regions and assisting to SMEs, the benefits of FDI and trade can be more widely distributed. Furthermore, ongoing monitoring and evaluation of FDI and trade impacts are essential. Collecting and analyzing data will help refine policies and address emerging challenges, while maintaining policy flexibility will allow for adaptation to changing global conditions. Strengthening the institutional framework is also vital. Improving governance and institutional quality ensures effective policy implementation, and establishing or enhancing investment promotion agencies can provide vital support services to investors and facilitate trade negotiations. By implementing these comprehensive measures, policymakers can create a robust environment that maximizes the benefits of FDI and international trade, leading to sustained economic growth and widespread prosperity.

CONCLUSION

The study underscores the profound impact of Foreign Direct Investment (FDI) and international trade on India's economic growth, highlighting their synergistic effects in transforming the country's economic landscape. Since the liberalization reforms of 1991, FDI has significantly contributed to India's economic development by infusing capital, advanced technologies, and management expertise. This influx of foreign investment has modernized industries, enhanced productivity, and stimulated job creation, while also supporting infrastructure development and fostering innovation. Concurrently, international trade has played a crucial role in driving economic growth through increased exports, market diversification, and improved domestic industries. The interaction between FDI and trade has magnified their individual benefits, with foreign investments often leading to greater export activities and trade openness attracting more investment. This synergy has resulted in higher economic growth rates, improved competitiveness, and expanded market opportunities. However, challenges such as trade imbalances, regulatory complexities, and global economic uncertainties remain. To build on these successes and address existing challenges, India must continue to pursue strategic policies that enhance the investment climate, streamline trade processes, and promote innovation and technology transfer. Investing in infrastructure, simplifying regulations, and supporting small and medium enterprises (SMEs) will further amplify the positive impacts of FDI and trade. By adopting these measures, India can sustain its growth trajectory, ensure broader economic benefits, and strengthen its position in the

global economy. FDI and international trade have been instrumental in driving India's economic growth since the liberalization of its economy in 1991. These factors have contributed to capital formation, technology transfer, employment generation, and overall economic efficiency. However, to sustain this growth, India must address the challenges associated with FDI and trade while capitalizing on the opportunities they present. By implementing effective policies and investing in critical areas such as infrastructure, innovation, and human capital, India can ensure that FDI and international trade continue to drive its economic development in the future.

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An Investigation of New Developments in Green Finance Research

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Abstract

This paper presents a gauge of recent academic literature analysing the trends in the field of green finance and seeks to determine its scope in the world's largest growing economy. A survey of academic works published between 2014 and 2023 (September) is conducted using the Scopus database. This study shows that in recent years, green finance has drawn a lot of attention in the business, management, and finance literature. The findings show that, since 2021, the number of literature publications in this field has increased significantly, where China has topped the list of maximum number of published documents with the count of 839 articles. The two leading journals that publish material in this field in terms of citations are "Journal of Cleaner Production" and "Energy policy". It is found that there is currently a dearth of research that thoroughly examines the fundamental connections between green finance and the energy sector. Therefore, there is a scope for future studies to explore more trends in this field from different parameters and by using other Statistical techniques to study the relationship between the variables.

Keywords: *Energy, Finance, Green finance, Sustainable Development, Management*

INTRODUCTION

The present study examines the potential growth of green finance globally and what kind of investments were taking place in renewable energy sector. Energy efficiency and green investment go hand in hand. Furthermore, through stimulating technological innovation and increased research and development (R&D) intensity, green investments indirectly advance energy efficiency (Dong et al., 2024).

Investment growth in the renewable energy sector can have a positive impact on national capital accumulation, green growth, and employment creation. The main thing that deters investment in green energy projects is risk and uncertainty. These hazards are brought on by a lack of clarity in policy regulations, an unstable economy, an unstructured capital market, a dearth of diversified financial instruments, and a sluggish pace of technological advancement (Bhatnagar & Sharma, 2022b).

Consequently, a rise in green investment boosts an organization's production effectiveness and encourages the use of renewable energy sources, which lessens the adverse effects of production activities on the environment and fosters green growth. Furthermore, green investment improves the quality of the environment by strengthening the capacity for technological innovation, energy conservation, and industrial structure improvement, all of which support green growth. (Mo et al., 2023)

India is one of the top nations in the world for producing solar energy. India has enormous potential for creating renewable energy initiatives. It does, however, necessitate a hefty investment. Public and private institutions must work together to finance these green energy projects in order to lower the risks and uncertainties associated with green initiatives (Bhatnagar & Sharma, 2022b).

Chinese listed companies see positive returns from their green investments. Furthermore, the enforcement of China's Environmental Protection Law 2015 has strengthened this relationship, and businesses from developed Chinese provinces with less polluted industrial sectors do make money from going greener.(Khalid et al., 2023). Generally, firms that are profitable (high ROA), older (AGE) and affiliated with business groups (GRP) are actively involved in CSR-related activities (Ganguly & Mishra, 2023).

A company can perform better in terms of green innovation if senior executives are encouraged to adopt green practices. Companies that maximize resource utilization and boost operational efficiency and profitability can persuade executives to embrace environmentally friendly practices.(Hou et al., 2023). There is no discernible difference between locally certified and non-certified CPO producers' profitability. In the meantime, RSPO-certified CPO producers with worldwide certification reported 5% lower profitability than locally certified producers (Shahimi et al., 2023).

The costs associated with various carbon emission policies in China are declining as a result of green investment.(Fan et al., 2023). Greater fossil fuel consumption in areas where there are higher carbon emissions during the production and delivery of goods and services. That being said, China's non-sustainable growth can also be attributed to the low uptake of certain renewable energy sources (Sun et al., 2022).

Also it has been observed that increasing green investment contributes to better financial outcomes. Green investments have a positive impact on environmental performance and the reduction of environmental violations; additionally, environmental performance can amplify the influence of green investments on the long-term performance of businesses (Chen & Ma, 2021). Additional comparative analysis reveals that while HPEs primarily show improvements in innovation quantity, green enterprises can simultaneously improve both the quality and quantity of green innovation (Chang et al., 2024).

The research work is divided into 6 parts, which are as follows:

- The second section provides the background insights which emphasizes some key ideas in green finance and concentrates on the goals of the research.
- The third section includes the data specification and research methodology, which describe the journal selection criteria and the primary procedures used to assess the contents of the articles.
- The fourth section comprise the results and findings of the study.
- Future research directions are suggested in the fifth section
- The sixth section provides concluding remarks in addition to outlining the study's limitations.

LITERATURE REVIEW

In order to achieve sustainable development in the modern era, green investment has grown in importance for economic society. There is uncertainty regarding the effect of green investment on

environmental and financial performance due to the positive externalities associated with it and the public goods characteristics of environmental governance (Chen & Ma, 2021).

The Green Finance Measures Database is a global compilation of green finance laws and policies from over 100 developed and developing nations, created to aid in the growth of green finance. It was released by the Green Finance Platform in conjunction with the United Nations Environment Programme's (UNEP) Inquiry into the Design of a Sustainable Financial System (also known as "the Inquiry").

According to G20 Green Finance Study Group, 2016 , GF is termed as: "*financing of investment that provide environmental benefits in the broader context of environmentally sustainable development. These environmental benefits include, for example, reduction in air, water and land pollution, reduction in greenhouse gas (GHG) emissions, improved energy efficiency while utilizing existing natural resources, as well as mitigation of and adaption to climate change and their co-benefit*."

Thus, green finance is the intersection of the financial industry, environment protection and economic growth. The advantages of CSR contracting for a company's green innovation performance are largely attributed to green practices that concentrate on pollution prevention and emissions reduction. (Hou et al., 2023)

During recent times, several happenings such as Israel – Palestine war, Russia – Ukraine war and pandemic, led to crucial market changes, which has affected the Crude oil prices and demand for the green finance globally. Within this scenario, it was found that the relationship between oil and green finance has not been well-established in earlier research. Therefore, this study looks into whether or not Crude oil prices will stimulate the green finance or green investment market, which is important for issuers and investors of green bonds.

Due to all such reasons, the government and businesses of many countries are under pressure to improve social responsibility and cut emissions by modernizing technology and streamlining processes. This in turn raises the need for green financing.

Table 1: Comparison between Previous Green Finance Review Studies

Previous Literature on the emergence of green finance and oil prices volatility

No.	*Source*	*Study*	*Methodology*	*Outcome of the Study*
1	(Azhgaliyeva et al., 2022)	Oil price shocks and green bonds: An empirical evidence	SVAR (structural VAR) model, Regression method	The likelihood of issuing corporate green bonds is positively and significantly impacted by the flow supply shocks, flow demand shocks, and the issuance of sovereign green bonds.
2	(Mohsin & Jamaani, 2023)	Green finance and the socio-politico-economic factors' impact on the future oil prices: Evidence from machine learning	LASSO model	The results show that significant demand drivers include the amount of steel produced globally, the dollar's value, the Kilian, Institute for Supply Management, and green finance indices, as well as the frequency of terrorist attacks in Central and Northern Africa.

No.	*Source*	*Study*	*Methodology*	*Outcome of the Study*
3	(Sharma et al., 2023)	Investigating the nexus between green economy, sustainability, bitcoin and oil prices: Contextual evidence from the United States	Quantile Granger causality and quantile-on-quantile regression (QQR) techniques	There is a negative correlation between sustainability and stock market performance, indicating that changes in sustainability also have an impact on these markets.
4	(Qin et al., 2024)	Empirical evidence of fintech and green environment: Using the green finance as a mediating variable	Advanced green environmental index	Green environmental index will be impacted by green investment.
5	(S. Yang et al., 2022)	The effect of venture capital on green innovation: Is environmental regulation an institutional guarantee?	Quantile regression	Emphasizing the role that venture capital (VC) plays in green innovation (GI)
6	Beltramello et al. (2013)	Why New Business Models Matter for Green Growth	Review	Businesses use technological innovations to lower pollution levels.
7	(Akomea-Frimpong et al., 2022)	Green finance for green buildings: A systematic review and conceptual foundation	Review	Its acceptability in the built environment is driven by increased financial returns, lucid regulations, and raising awareness.
8	(Zhang et al., 2019)	A bibliometric analysis on green finance: Current status, development, and future directions	Bibliometric	The majority of publications in this field are published in policy journals or journals that concentrate on environmental/ climate changes; mainstream economics or finance journals hardly ever publish papers in this field.
9	Dhayal et al.,2023	Mapping the significance of green venture capital for sustainable development: A systematic review and future research agenda	Review	The study offers a comprehensive summary of the body of research that demonstrates the importance of GVCs in achieving sustainable development.
10	(Bhatnagar & Sharma, 2022)	Evolution of green finance and its enablers: A bibliometric analysis	Bibliometric	Examine articles published between 2018 and 2021 (February) to determine which sources support GF.

Table 1 shows that the green economy or green financing from institutions is very sensitive to economic shocks, oil price changes and overall sustainability changes(Sharma et al., 2023). Financial stress and geopolitical risk negatively impact green investment. In contrast, oil price

volatility and clean energy investments positively influence green investment.(Wang et al., 2023). The adoption of CSR-contingent compensation has the potential to facilitate the attainment of corporate sustainability objectives and promote alignment with the United Nations (UN) 2030 sustainable development agenda (Hou et al., 2023).

Research Objectives

- RO1: To scholarly works about green finance have gained the most attention recently.
- RO2: To know the journals and articles which influence green finance research the most.
- RO3: To know the countries, institutions, and writers who had made the most frequent contributions to the field of green finance?

DATA SPECIFICATION AND RESEARCH METHODOLOGY

Since the early 20th century, when it first emerged as a distinct field, bibliometric has been metaphorically applied to literary analysis (Pritchard, 1969). Researching the advancement of disciplines in a range of academic domains has benefited from the increased use of bibliometric, which uses statistical and mathematical techniques to analyse the state and evolution of a discipline over time (Yang & Qiu, 2018).

Because bibliometrics is comprehensive, unbiased, and quantitative, it can offer a quantitative analysis of recent findings and advancements in an area. Through a methodical survey of previous research, it can also predict future trends and objectively reflect the general structure and hotspots of a field over time, revealing features like themes, authors, publications, categories, and keywords.

We have created a collaboration plot, co-citation plot, thematic map, and TreeMap using VOSviewer. Furthermore, we use VOSviewer to produce overlay visualizations of bibliometric coupling and keyword analysis, as suggested by van Eck and Waltman (2009).

- **Data selection:** Using studies from indexed journals located in one of the most extensive bibliometric databases, i.e. Scopus, we perform the bibliometric and systematic literature review. Every article in the database, which cover from year 2014 to 2023 (September), was taken into consideration for selection.“Green” OR “Green finance” OR “sustainable development are the three keyword combinations used to search the papers. And since the subject is still relatively new and emerging, all English-language contributions to articles, conference papers, review and book chapters were included.
- **Sample evaluation:** It entails applying clean filters and eliminating papers that are off-topic and duplicates. After merging the papers derived from combining the three different keywords with a single sample dataset, 28 duplicates were eliminated.

The study is based on the secondary data available ad collected from various reports, articles, and other references and academic databases available on Google and internet explorer.

FINDINGS AND RESULTS

To shed more light on the development of the idea of GF, bibliometric analysis has been done on the pertinent sources in this study. Regarding the current field of study, the chosen database contributes to a deeper comprehension of the historical development of GF and aids in locating significant resea2rch projects carried out over time.

RO1: To analyse the current trends of development of academic research on the subject of green finance.

A variety of tools are used to analyze RO1, including word clouds, top influential articles, top prolific and impactful journals, top authors and countries, top frequency keywords, and publication trends (see Tables 2–3 and Figs. 2, 3 and 4).

Trend Analysis

Table 2: Key Components of the Selected Dataset

Database Used	*Scopus*
Keywords used	"Green" OR "Green finance" OR "sustainable development "OR "Oil prices" OR "Crude oil" OR "Crude oil prices" OR "Oil Supply"
Time span	Time span 2014–2023

The database and keywords used for data collection are detailed in Table 2. The study's focus is on financing the green transition through defined instruments, so terms like clean finance and investment were left out.

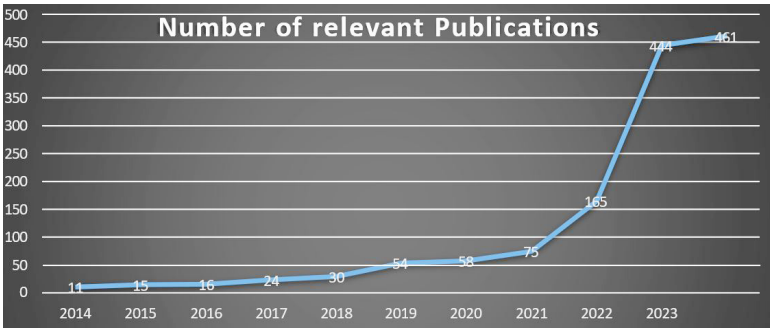


Figure 2: Publication Trend
Source: Author's compilation

With the help of Scopus database the above graph has been created considering publications from the year 2014-2023, which states the increase in the number of publications in the field of Green Finance. Since 2016, the trend of publications has grown exponentially. The reason is that the UN SDGs were announced, with 2030 as the deadline, and the Paris Climate Agreement went into effect at the end of 2016. Some of the important studies conducted at that time, which made a major contribution to the development of this field of study (Bocken, 2015; Criscuolo and Menon, 2015; Wei et al., 2015)

Prominent Authors

Table 3 shows the top proliferative authors working in the area of Green finance.

Table 3: Top Green Finance Journals and Authors in Terms of Citations

Author	*Journal*	*Year of Publication*	*Cited Count*	*Title*
Jiakui C.; Abbas J.; Najam H.; Liu J.; Abbas J.	Journal of Cleaner Production	2023	66	China provides empirical insights into the relationship between green total factor productivity and green technological innovation, green finance, and financial development.

Author	*Journal*	*Year of Publication*	*Cited Count*	*Title*
Zhang M.; Liu Y.	Science of the Total Environment	2022	62	Impact of green technology innovation and digital finance on China's carbon emission efficiency: An empirical investigation using spatial metrology
Ali J.; Rasheed T.; Afreen M.; Anwar M.T.; Nawaz Z.; Anwar H.; Rizwan K.	Science of the Total Environment	2020	34	Opportunities and challenges for waste-to-energy conversion methods
Pacca L.; Antonarakis A.; Schröder P.; Antoniades A.	Science of the Total Environment	2020	23	An analysis of the short- and medium-term impacts of financial crises on air pollution emissions
Lv C.; Fan J.; Lee C.-C.	Journal of Cleaner Production	2023	22	Can corporate green production efficiency be enhanced by green credit policies
Tong L.; Chiappetta Jabbour C.J.; belgacem S.B.; Najam H.; Abbas J.	Journal of Cleaner Production	2022	21	Empirical evidence from the Asian region regarding the contribution of green finance, investment in green technologies, and environmental regulations to green total factor productivity
Banerjee O.; Bagstad K.J.; Cicowiez M.; Dudek S.; Horridge M.; Alavalapati J.R.R.; Masozera M.	Science of the Total Environment	2020	18	Impacts of Rwanda's Green Growth Strategy on the economy, land use, and ecosystem services: Using the IEEM + ESM platform
Teti E.; Baraglia I.; Dallocchio M.; Mariani G.	Journal of Cleaner Production	2022	13	The green bonds: Practical proof and sustainability implications
Feng S.; Chong Y.; Yu H.; Ye X.; Li G.	Journal of Cleaner Production	2022	11	Ecological footprint and digital financial development: Evidence from environmentally conscious technology innovation and environmental inclusion

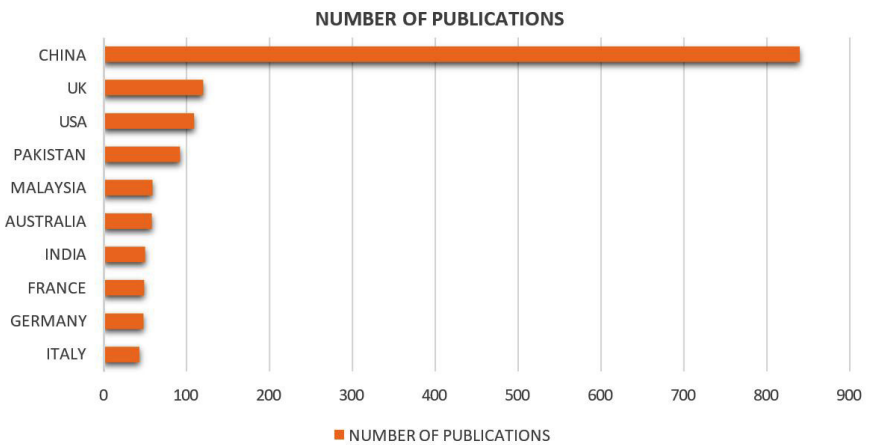


Figure 3: Top 10 Countries of Publication

Country-wise Publication

Publication in Terms of Countries and Affiliations: As Figs. 3 and 4 illustrate, the majority of published articles came from seven countries: China, the UK, the USA, Pakistan, Malaysia, Australia, and India. These countries make a substantial contribution to scientific production. This nations' vigorous academic involvement can likely draw attention to the existence of sophisticated and creative financial systems as well as their enhanced receptivity to environmental preservation and the mitigation and adaptation of climate change. China (839 articles), the UK (120 articles), and the USA (109 articles) are the top three nations in the world for scientific production. India is ranked seventh with fifty articles.

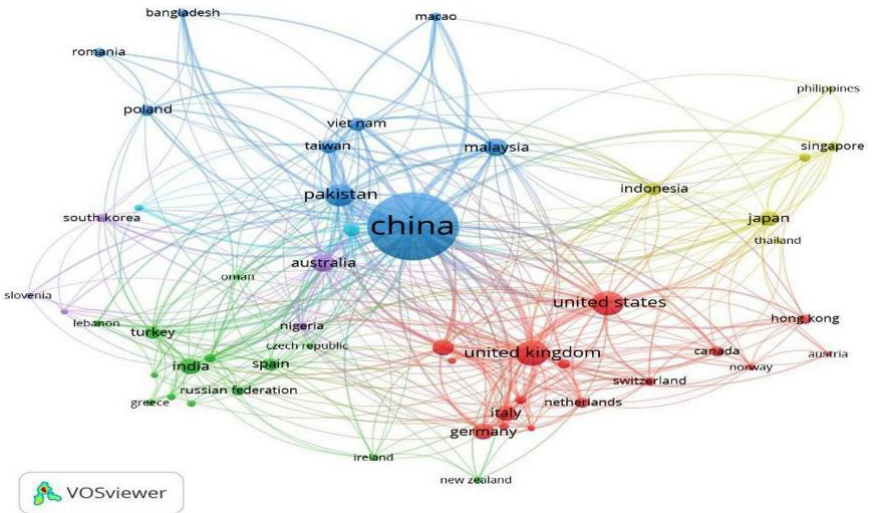


Figure 4: Contribution of Countries in Area of Green Finance

Science Mapping through Word Cloud

The total corpus of the articles has been studied over a time span from 2014 to 2023 (till Sep. 2023). Figure 5 reflects the Green finance research articles with the help of word clouds of the author's keywords, which gives us a clear picture as to how the research literature has progressed over the following periods. Also the Key word such as "Oil Supply", "Oil industry" and "Crude oil " have shown total link strength of 25,22,14 respectively, with green finance, green economy, green bonds and green innovation. Whereas the occurrences were recorded less than 5. So, it is seen that studies have been conducted to know the link between green finance and crude oil prices, but there is scope for more research in this regard.

Science Mapping through Thematic Clusters

Science mapping refers to examining the inter relationship between the research constituents which may be intellectual or structural in nature (Donthu et al., 2021).

RO2: To know whether the crude oil prices will energize the market for green finance.

For the second research objective (RO2), Science mapping was utilized. With the aid of bibliographic coupling of data, we were able to analyze the 34 articles that made up the research corpus into cluster themes. VoSviewer version 1.6.18 helped with this science mapping. In this domain, three main clusters have emerged: Transition towards Green finance, Green finance and

crude oil prices and Green finance and sustainibility. The thorough examination of these cluster analyses also assists us in identifying pertinent areas for future research proposals.

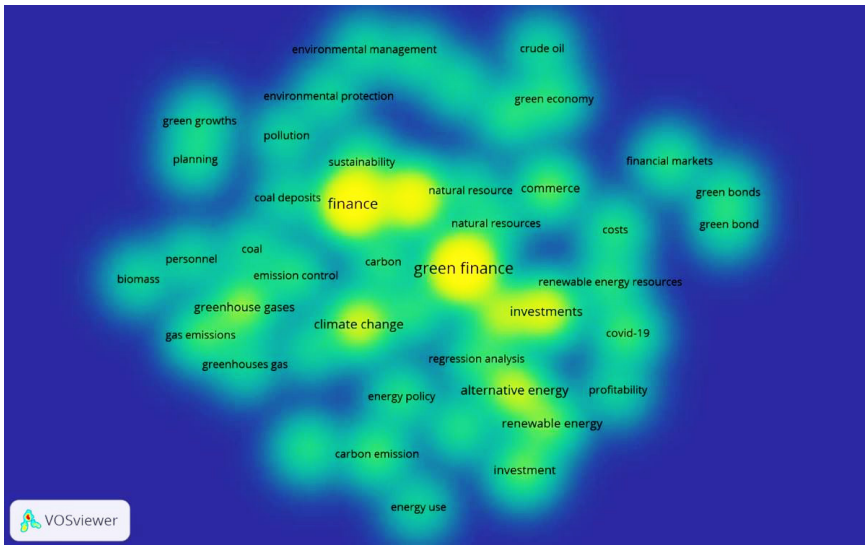


Figure 5: Top Keywords Over the Time Frame of 2014–2023

Cluster 1: Transition towards Green Finance

In this cluster, total 16 articles were studied where, (Zhang et al., 2019) provides a brief review of the recent advances in green finance research which has contributed towards highlighting the growing importance of green finance, whereas (Bhatnagar & Sharma, 2022) identified ten general categories: macroeconomic facilitators; regulatory structure development; favourable investment environment creation; capacity building; rise in institutional engagement levels and forms; technology and technological innovations; financial instruments; financial policies and regulations; a well-developed capital market; and a supportive political climate, which attempts to investigate the development and evolution of GF.

Cluster 2: Green Finance and Crude Oil Prices

In this cluster, 10 Articles were studied and it has been seen that majority of studies are held in the year 2023 and Resouse Policy has emerged as top journal as shown in table 5. It was also found that COVID-19 had an unprecedented effect on the oil market. The price of oil experienced four circuit breakers in ten days in March 2020, making it one of the most volatile months in U.S. stock market history for investors worldwide. According to theory, the COVID-19 pandemic's spread decreased demand for crude oil, which in turn caused prices and returns to drop (Liu, Wang, & Lee, 2020). As a result, a lot of investors are focusing on the green finance sector. The average annual trading volume of green bonds, clean energy, wind, solar, and sustainability index stocks appears to be unaffected by the COVID-19 pandemic outbreak in 2020 and the Russia-Ukraine war in 2022. Furthermore, these green finance indices' average annual trading volume has been steadily rising annually.

So, it could be said that the relationship between crude oil prices and green finance has more scope for research and can be explored in other different dimensions by researchers.

Cluster 3: Green Finance and Sustainability

In this cluster 8 Articles were studied and found that Green finance is becoming increasingly recognised as playing a critical role in India's shift to a net zero economy, as sustainability becomes an agenda item for national, cross-policy, and sector-wide initiatives. However, green finance as an idea is still developing. Thus far, it has manifested itself in various forms such as bonds, equity investments, and loans.

FUTURE RESEARCH AGENDA AND CONCLUSION

This study has brought to light the various dynamics of the Green finance by applying the bibliometric analysis, by study of 167 publications. Based on our analysis, it can be inferred that Green finance is foraying into various facets of sustainability, including clean technology, sustainable development, sustainable entrepreneurship, green innovation, and renewable energy. The findings show that, since 2021, the number of literature publications in this field has increased significantly, with China accounting for 839 of the total number of articles published. In terms of citation "Journal of Cleaner Production" and "Energy policy" are the main journal carriers of the literature in this field.

The financial system and its innovations will undergo transformation due to the growth of the GF market. This will present chances for the data on the green financial system and its instruments to be empirically analyzed. By employing a quantitative approach, more research can be done to determine the factors that support and hinder the GF. It is possible to investigate the relationship between the variables by using different statistical techniques. The field of impact of Green finance due to oil price changes, research is still in its infancy, so there is a great deal of room for future contributions to the body of existing literature. Furthermore, Green finance investments may be very important for sustainability.

LIMITATIONS

It's important to note that this study has certain limitations. Since they are not subjected to the same stringent peer review procedures and also many conference proceeding papers, editorials, book chapters, and notes have been excluded due to the exclusion criteria. Additionally, the articles written in English were the only ones taken into account. This sample bias could therefore affect the study's conclusions and outcomes. Furthermore, only domain area related to green finance and oil price volatility can be generalized from the results, not all other related fields.

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Unveiling 35 Years of Evolution: A Bibliometric Exploration of Green Finance and Sustainable Development (1989–2024)

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Abstract

Purpose: *This study explores the long-term trends in green finance and its contribution to the Sustainable Development Goals (SDGs) over a 35-year period from 1989 to 2024. It seeks to provide a deep understanding of how green finance has evolved to drive sustainability efforts and align with both environmental and financial market goals, emphasizing key phases of development and regional contributions.*

Methodology/Design/Approach: *A bibliometric analysis was conducted on 5,062 documents, primarily research articles, using the Biblioshiny tool from the Bibliometrix R package. The study analysed publication patterns, citations, and collaborations in green finance, focusing on key topics such as green credit, green bonds, fintech, and green supply chain finance. The dataset was extracted from the Scopus database, covering areas like environmental science, business, and economics.*

Findings: *The analysis shows a notable increase in research output from 2016, peaking in 2022. China, India, and the USA lead in research volume, while countries like Australia and Sweden demonstrate higher average citations per publication, indicating greater impact. Key themes identified include green technology, sustainable infrastructure, and economic policy, with emerging topics such as fintech and green investments gaining prominence.*

Research Limitations/Implications: *The study is limited to publications from SCOPUS, potentially overlooking relevant research from other sources. Further investigation is needed into regional policy differences and their long-term effects on sustainability outcomes. Practical Implications: This study highlights how green finance is becoming increasingly integrated into economic policies and infrastructure, providing a pathway for governments and institutions to address environmental challenges through innovative financial solutions.*

Social Implications: *Green finance supports both environmental and social sustainability by fostering practices that contribute to sustainable economic growth, which is critical for achieving the SDGs.*

Originality/Value: *This extensive 35-year bibliometric study offers a unique perspective on the evolution of green finance, underscoring its growing importance in global sustainability efforts and its critical role in shaping financial markets.*

Keywords: *Green Finance, Sustainable Development Goals (SDGs), Sustainable Development, Fintech, Environmental Protection*

Paper Type: *Bibliometric Review Paper*

INTRODUCTION

In today's world, where the effects of climate change are becoming increasingly evident, green finance has emerged as a beacon of hope. It represents a critical strategy in our collective effort to achieve Sustainable Development Goals (SDGs) by directing financial resources toward projects that benefit both our planet and our economies. According to the United Nations Environment Programme (UNEP), green finance encompasses various financial activities, including banking, micro-credit, insurance, and investments aimed at managing environmental and social risks while seizing opportunities that yield both financial returns and environmental benefits (Zhang & Wang, 2021). As we confront the pressing challenges of climate change and environmental degradation, green finance is becoming essential in fostering economic growth while ensuring we remain accountable to our planet.

Historically, economic progress has often come at a steep cost to our environment. Since the Industrial Revolution, our reliance on carbon-based energy sources has wreaked havoc on ecosystems, leading to pollution and resource depletion (Sachs et al., 2019). The ground breaking 1987 Brundtland Report reminded us of the need to balance our current needs with the ability of future generations to meet theirs. It's a call for a new perspective on development—one that acknowledges the delicate relationship between humanity and nature. This shift is crucial as we seek to revitalize discussions about sustainable development in the 21st century (Obina, 2013). Green finance acts as a vital link between the world of finance and environmental conservation, addressing issues like pollution and the urgent need for renewable energy sources (Jha & Bakhshi, 2019).

Moreover, green innovation plays a key role in encouraging companies to develop environmentally friendly products that align with the SDGs. As highlighted by Abbas and Sağsan (2019), governments should actively support businesses in their innovative efforts, enabling them to create high-quality products while using fewer resources. This cooperation underscores the necessity of integrating environmental considerations into everyday business practices.

Despite the strides we've made, the relationship between economic activities and environmental sustainability is influenced by the effectiveness of our financial systems (Goldstein, 2001; Springett, 2003). Companies that communicate their environmental performance well are more likely to enhance their efforts. However, many still grapple with significant information gaps (Delgado-Ceballos & Rueda-Manzanares, 2010). The rise of green finance within the banking sector shows how financial institutions can make a difference by incorporating environmental considerations into lending and investing in low-carbon technologies (Agirman & Osman, 2019). At a broader level, green finance promotes sustainable economic models, fostering global green growth and creating substantial job opportunities (Sachs et al., 2019).

The growing influence of financial institutions and the corporate sector on social responsibility and sustainable development was notably emphasized during the 2002 World Summit on Sustainable Development (Peeters, 2005). This evolution highlights the importance of green finance in addressing global challenges such as pollution and resource depletion, making it essential to examine its impact on sustainable development.

This study employs a bibliometric analysis to explore the evolution of green finance over the past 35 years, highlighting its contributions to sustainable development. By analyzing 5,062 documents through the Biblioshiny tool, we aim to uncover key trends, citation patterns, and collaborative networks in the field of green finance. Focusing on areas such as green bonds, green credit, and green supply chain finance, we hope to reveal how green finance is shaping sustainability efforts and aligning financial markets with our environmental goals.

Ultimately, this study is not just about identifying trends; it seeks to deepen our understanding of the crucial link between green finance and SDGs. As human activities—from industrial processes to agriculture and transportation—continue to contribute to pollution and resource depletion, the role of green finance in mitigating these impacts becomes even more vital (Liu & Xia, 2023). Effective governance in green finance and renewable energy sectors can significantly curb environmental degradation (Zhang et al., 2021).

However, the journey of green finance in promoting sustainable development is not without its challenges. In developing countries, local organizations and bridging entities play a crucial role in linking different sectors and fostering innovative, multisectoral approaches to sustainable development (Brown, 1991). Moreover, we must remain vigilant; sustainable development initiatives can sometimes gloss over pressing issues, reducing them to mere superficial measures (Eden, 1994). Future research needs to broaden its scope, exploring the long-term implications of green finance policies and considering both institutional and resource-based views on corporate sustainable development (Bansal, 2005).

Through this bibliometric exploration, we aim to provide a comprehensive understanding of how green finance has evolved and its contributions to global sustainability efforts from 1989 to 2024. By uncovering these insights, we hope to inspire a deeper alignment between financial systems and environmental goals, ultimately paving the way for a more sustainable future.

RESEARCH OBJECTIVES

1. To explore the long-term trends in green finance and Sustainable Development Goals (SDGs) research from 1989 to 2024.
2. To analyse citation patterns among publications, authors, and institutions over time, highlighting regional differences.
3. To identify key themes in the green finance literature over the past 35 years, emphasizing the impact of emerging technologies on sustainability initiatives.
4. To examine the influence of green finance policies on research, emphasizing the role of interdisciplinary collaboration in sustainability initiatives.

RESEARCH METHODOLOGY

The bibliometric analysis follows a systematic approach, which has gained prominence in recent years, particularly for examining business and management literature (Öztürk et al., 2024). The process begins with an extensive exploration of scholarly databases to generate a comprehensive dataset of relevant papers. This dataset will then be analysed using bibliometric methods and software, focusing on key metrics such as co-authorship patterns, citation counts, and publication volumes.

Our paper employs a bibliometric analysis approach, a method introduced by Pritchard (1969) and extensively used for quantitative literature assessment. To map research patterns in

green finance, We use Biblioshiny, a visualization tool for bibliometric analysis developed by Massimo Aria and Corrado Cuccurullo (2017) as part of the Bibliometrix R package. Our analysis encompasses key aspects such as the main data characteristics, annual scientific output, country-specific production, average citations per year, prominent sources, most cited countries, local impact of sources, leading authors, emerging trends, and globally cited documents. This approach leverages bibliometric indicators, including total citations, total publications, CiteScore, and h-index.

We focus on green finance applications, highlighting key terms such as green credit, green supply chain, green supply chain finance, and green trade-credit, while specifically targeting sustainability-related articles with the term "sustainable" (Fahim & Mahadi, 2022). Our analysis also addresses the ambiguity in green finance definitions by centring on three primary keywords: green finance, climate finance, and carbon finance, and includes variations like green financing, climate financing, carbon financing, green investment, and green bonds (Zhang, Zhang, & Managi, 2019). This approach aids in understanding how green finance supports Sustainable Development Goals (SDGs) and promotes sustainable development across fields such as environmental science, energy, economics, earth sciences, sociology, engineering, and business.

In examining green finance, which is closely related to sustainable development, this analysis seeks to explore its potential for driving positive change in the context of building a better future. Addressing the complex challenges and uncertainties in this field requires rigorous academic review and analysis. Bibliometric analysis, as highlighted by Krastev and Krasteva-Hristova (2024), provides valuable insights from specialized scientific literature, supporting a deeper understanding of green finance's role in achieving SDGs and fostering sustainable development.

The relationships among key publications and authors will be visualized through network analysis tools, providing insights into production and citation trends, geographical contributions, and thematic analysis within the field. This approach will facilitate the identification of significant research clusters and major topics that have influenced the area. We will analyse annual scientific production and average article citation per year to understand the overall impact of research output. Additionally, examining country production and the most cited countries will help assess the geographical distribution of contributions and their influence. Key contributors will be identified by evaluating the most relevant authors, the most globally cited documents, and the most influential sources, measured by their h-index. The thematic analysis will utilize the author's keywords co-occurrence network to uncover trend topics, supported by a word cloud to visualize prevalent themes in the literature. To extract titles, keywords, and abstracts from the Scopus database, the provided search string will be employed, along with additional filters to refine the results:

TITLE-ABS-KEY (sustainable AND finance OR green AND investment OR green AND finance OR sustainable AND development OR sustainable AND development AND goals)
AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON"))
AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "cp"))

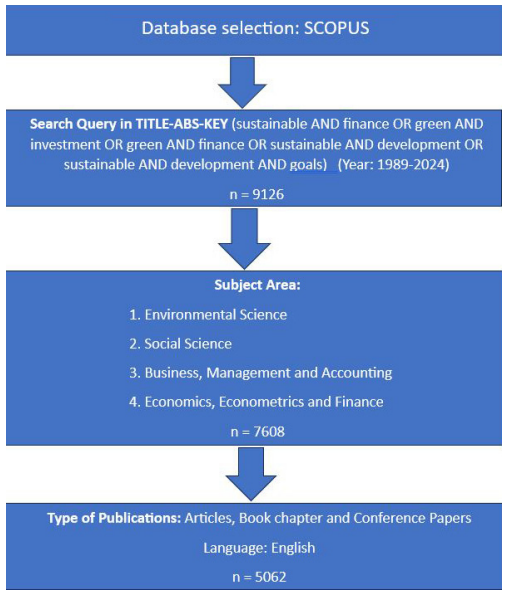


Figure 1: Study Flow Chart

Primary Data Regarding the Information Gathered

Table 1: Main Information of Data

Description	*Results*
Timespan	1989:2024
Sources (Journals, Books, etc.)	1659
Single-authored docs	740
References	258561
MAIN INFORMATION ABOUT DATA	
Keywords Plus (ID)	13916
International co-authorships %	28.49
Documents	5062
DOCUMENT TYPES	
DOCUMENT CONTENTS	
Document Average Age	3.3
conference paper	618
Co-Authors per Doc	3.51
Book chapter	667
Average citations per doc	17.69
Authors of single-authored docs	680
AUTHORS COLLABORATION	
AUTHORS	
Authors	13460
Author's Keywords (DE)	12343
Article	3777
Annual Growth Rate %	0

Table 1 provides a comprehensive view of a bibliometric dataset covering the years from 1989 to 2024, consisting of 5,062 documents. This collection includes a variety of publication types such as journals, books, and conference papers. Among these, 3,777 are research articles, 618 are conference papers, and 667 are book chapters. A noteworthy detail is that 740 of the documents are single-author works, contributed by 680 different authors.

The dataset reveals that the average age of the documents is 3.3 years, indicating the recency of much of the research. On average, each document has 3.51 co-authors, emphasizing the collaborative nature of research in this domain. Furthermore, each document has been cited 17.69 times on average, underscoring the influence of the work.

In terms of author participation, 13,460 authors have contributed to this body of research. Researchers have added 12,343 author-specific keywords (DE), and 13,916 Keywords Plus (ID), further reflecting the scope and themes of the studies.

International collaboration is evident, with 28.49% of the documents involving co-authorship across borders, highlighting global engagement. Despite the extensive span of the dataset, the annual growth rate of publications remains at 0%, indicating a steady output over time.

This analysis highlights the diversity in publication types, the prevalence of collaboration, and the significance of both interdisciplinary and international research efforts in this field.

Production and Citation Trends

Figure 2 illustrates the progression of scientific article publications from 1989 to 2025. During the initial period from 1989 to 2015, the number of publications remains relatively low and stable, indicating that green finance and related fields were not a major focus of research at the time.

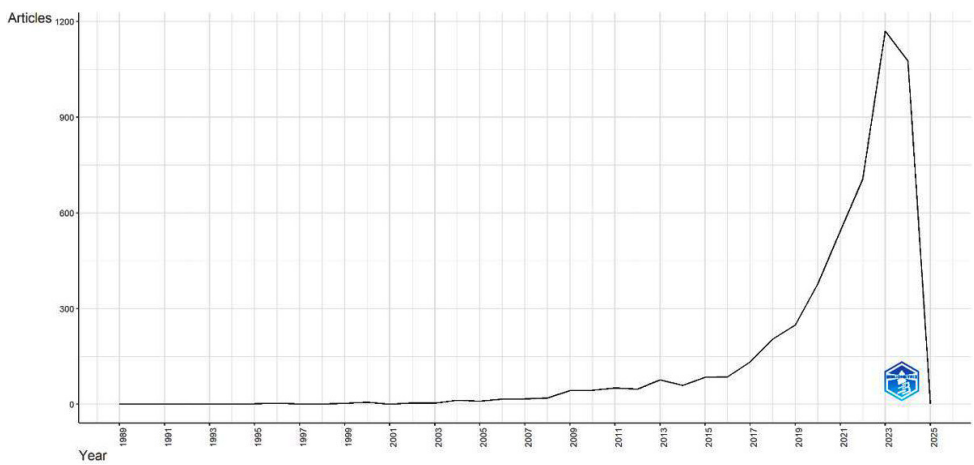


Figure 2: Annual Scientific Production

However, a notable shift occurs around 2016, where the field experiences rapid growth, marked by a sharp rise in the number of publications each year. This upward trend reaches its peak in 2022, suggesting that sustainability, green finance, and the Sustainable Development Goals (SDGs) became highly prominent topics within academic circles. The surge in publications during this period reflects the increasing global relevance of these issues.

Interestingly, after 2022, there is a noticeable drop in publication numbers between 2023 and 2025. While this decline may appear concerning at first glance, it is likely due to incomplete

data for the most recent years rather than an actual reduction in research activity. As more data is collected, the figures for these years may rise, reflecting the ongoing interest and development in the field.

Figure 3 depicts the average citations per year from 1989 to 2024, offering a view of how the citation impact of research has evolved over time. In the early years, from 1989 to around 1994, citation levels are relatively low, likely due to the limited number of publications in this emerging field. However, in 1995, there is a significant spike in average citations, suggesting that a few highly influential papers were published during this period, which had a substantial impact on academic discussions.

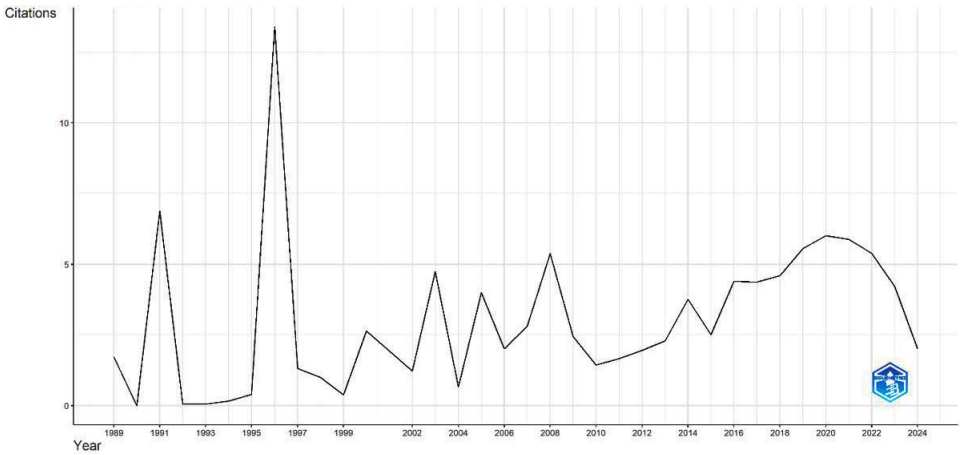


Figure 3: Average Citations Per Year

After this peak, citations drop sharply and fluctuate between 1997 and 2010. During this time, while research continued, there may have been fewer groundbreaking publications, or the field might not yet have gained broad attention within the academic community.

Post-2010, the trend becomes more stable, though still showing some variability. Notably, citations rise again between 2019 and 2021, likely due to the increasing global focus on sustainability, climate change, and green finance. A slight decline follows after 2022, which could be attributed to the time required for newer publications to accumulate citations, or possibly incomplete data for these recent years.

Overall, the graph reflects the shifting citation impact over time, with periods of high-impact research followed by stretches of relative steadiness in citation averages.

Geographical Contribution and Impact

Table 2: Country Production

Country	*Freq*		*Country*	*Freq*
CHINA	4206		MALAYSIA	583
INDIA	1171		SPAIN	463
USA	1159		INDONESIA	417
ITALY	722		GERMANY	386
UK	659		PAKISTAN	385

Table 2 presents the distribution of research output by country, with China leading significantly, contributing 4,206 publications. This strong presence indicates China's major focus on research in this field, likely driven by its growing involvement in global economic and environmental efforts, especially in green finance and sustainability.

India ranks second with 1,171 publications, closely followed by the USA with 1,159 publications. The similar output from these two countries suggests both are highly engaged in sustainability and development research, though they may emphasize different areas within these fields.

Italy, with 722 publications, and the UK, with 659, follow, highlighting Europe's active participation in this academic area. Malaysia, with 583 publications, stands out as a leading contributor from Southeast Asia, while Spain (463 publications) and Indonesia (417 publications) also demonstrate their increasing impact on global sustainability research.

Germany, contributing 386 publications, and Pakistan, with 385, complete the list, marking their moderate but noteworthy roles in advancing knowledge on green finance and sustainable development. Overall, the table emphasizes the global scope of sustainability research, showcasing significant contributions from both developed and developing nations.

Table 3: Most Cited Countries

Country	*TC*	*Average Article Citations*	*Country*	*TC*	*Average Article Citations*
CHINA	21086	19.10	INDIA	2994	12.40
USA	6090	27.90	GERMANY	2269	23.60
UNITED KINGDOM	4622	30.20	SPAIN	2216	21.70
AUSTRALIA	3712	47.00	SWEDEN	2042	48.60
ITALY	3036	17.80	NETHERLANDS	1977	43.00

Table 3 compares total citations (TC) and average article citations across different countries. China stands out with a total of 21,086 citations but has a relatively low average of 19.10 citations per article. The United States follows with 6,090 total citations and a higher average of 27.90 citations per article, while the United Kingdom reports 4,622 total citations with an even higher average of 30.20.

Australia is notable for its 3,712 citations, showcasing a substantial average of 47.00 citations per article, indicating a strong impact for each publication. Italy and India exhibit lower total citations, with Italy at 3,036 and an average of 17.80, while India has 2,994 total citations and an average of 12.40. Germany has 2,269 total citations with an average of 23.60, performing better than both Italy and India.

Sweden demonstrates an impressive performance with 2,042 citations and a high average of 48.60 citations per article, suggesting its publications are highly esteemed. The Netherlands also shows strong results, with 1,977 total citations and an average of 43.00.

Overall, this data illustrates that while China has the highest total citations, countries like Australia, Sweden, and the Netherlands achieve higher average citations, reflecting the quality and impact of their research output.

Key Contributors and Sources

Table 4: Most Relevant Authors

Authors	*Articles*	*Articles Fractionalized*	*Authors*	*Articles*	*Articles Fractionalized*
LIU Y	44	11.62	WANG X	33	9.68
WANG Y	43	11.48	ZHANG J	30	8.06
LI J	40	11.22	WANG S	29	7.04
ZHANG Y	38	11.66	CHEN Y	27	7.19
LI Y	34	9.23	WANG J	27	6.31

Table 4 provides insights into the contributions of various authors based on the number of articles published and their fractionalized article counts. Liu Y leads the list with 44 articles, which corresponds to a fractionalized count of 11.62, indicating a substantial contribution to the overall research output. Close behind is Wang Y, with 43 articles and a fractionalized count of 11.48, showcasing their active involvement in publishing.

In third place is Li J, who has published 40 articles and achieved a fractionalized count of 11.22. Zhang Y, with 38 articles, has a fractionalized count of 11.66, suggesting a noteworthy impact relative to their publication volume. Li Y, with 34 articles, shows a lower fractionalized count of 9.23, indicating a less significant contribution compared to the leading authors.

Wang X follows with 33 articles and a fractionalized count of 9.68, while Zhang J has published 30 articles with a fractionalized count of 8.06. Wang S has contributed 29 articles, yielding a fractionalized count of 7.04. Both Chen Y and Wang J have published 27 articles, with Chen Y having a fractionalized count of 7.19, slightly ahead of Wang J at 6.31.

Overall, the data highlights Liu Y and Wang Y as the most prolific authors, consistently achieving high fractionalized counts, which reflects their significant influence within the research community.

Table 5: Most Global Cited Documents

Paper	*DOI*	*Total Citations*	*TC per Year*	*Normalized TC*
CAMPBELL S, 1996, J AM PLANN ASSOC	10.1080/01944369608975696	1173	40.45	3.02
BEKUN FV, 2019, SCI TOTAL ENVIRON	10.1016/j.scitotenv.2018.12.104	1027	171.17	30.78
HICKEL J, 2020, NEW POLIT ECON	10.1080/13563467.2019.1598964	893	178.60	29.72
KALMYKOVA Y, 2018, RESOUR CONSERV RECYCL	10.1016/j.resconrec.2017.10.034	874	124.86	27.14
DING GKC, 2008, J ENVIRON MANAGE	10.1016/j.jenvman.2006.12.025	839	49.35	9.18
D'AMATO D, 2017, J CLEAN PROD	10.1016/j.jclepro.2017.09.053	668	83.50	19.09
VAN VUUREN DP, 2017, GLOBAL ENVIRON CHANGE	10.1016/j.gloenvcha.2016.05.008	556	69.50	15.89

Paper	*DOI*	*Total Citations*	*TC per Year*	*Normalized TC*
BIBRI SE, 2018, SUSTAINABLE CITIES SOC	10.1016/j.scs.2017.12.034	519	74.14	16.12
JABBOUR CJC, 2016, J CLEAN PROD	10.1016/j.jclepro.2015.01.052	502	55.78	12.68
SHEN Y, 2021, SCI TOTAL ENVIRON	10.1016/j.scitotenv.2020.142538	482	120.50	20.49

Table 5 highlights key influential papers in the field, showcasing their total citations, citations per year, and normalized total citations (TC). Notably, S. Campbell's 1996 paper in the *Journal of the American Planning Association* leads with 1,173 citations, averaging 40.45 citations per year and a normalized TC of 3.02. Close behind, F.V. Bekun's 2019 article in *Science of the Total Environment* has 1,027 citations and an impressive 171.17 citations per year, resulting in a high normalized TC of 30.78. Other significant contributions include J. Hickel's 2020 publication with 893 citations and 178.60 citations per year, and Y. Kalmykova's 2018 paper, which has 874 citations and averages 124.86 citations per year.

Additionally, papers such as G.K.C. Ding's 2008 work (839 citations), D. D'Amato's 2017 article (668 citations), and D.P. van Vuuren's 2017 publication (556 citations) reflect ongoing research interest in sustainability. Other notable works include S.E. Bibri's 2018 article (519 citations), C.J.C. Jabbour's 2016 paper (502 citations), and Y. Shen's recent 2021 publication (482 citations). Overall, the data illustrates a diverse array of impactful research, with a clear trend of increasing interest in sustainability and environmental management over the years.

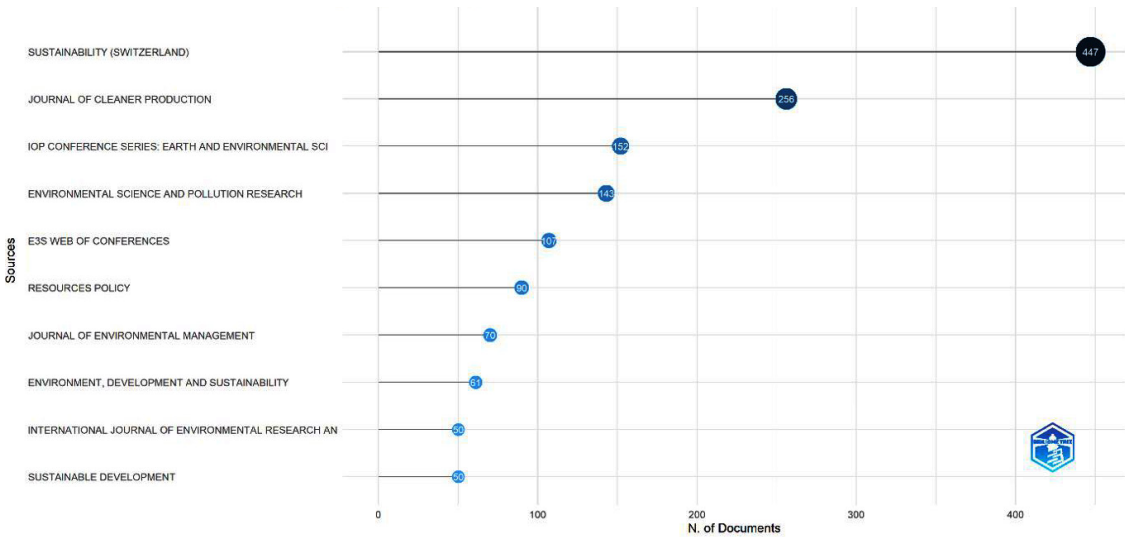


Figure 4: Most Relevant Sources

Figure 4 showcases the primary sources contributing to a specific field of study, ranked by the number of published documents. Leading the list is *Sustainability* (Switzerland), which is the most prominent contributor with 447 documents, followed by the *Journal of Cleaner Production* with 256 documents. Other significant sources include the *IOP Conference Series: Earth*

and Environmental Science and *Environmental Science and Pollution Research*, which have published 153 and 143 documents, respectively. Following these are *E3S Web of Conferences* and *Resources Policy*, each contributing a notable number of documents, while journals like *Journal of Environmental Management* and *Environment, Development, and Sustainability* offer fewer yet relevant contributions.

The graph underscores the dominance of several key journals, particularly *Sustainability* (Switzerland), as well as the distribution of research output among various environmental and sustainability-related sources. The size of the circles in the graph represents the relative volume of documents for each source, with larger circles indicating greater contributions.

Figure 5 presents the local impact of various sources as measured by the H-index, which assesses the influence and productivity of journals within a specific field. Leading the rankings is the Journal of Cleaner Production, with a high H-index of 60, indicating its substantial influence regarding citations and research impact. Following closely is Sustainability (Switzerland), which has an H-index of 38, reflecting a significant, albeit lesser, impact compared to the top journal.

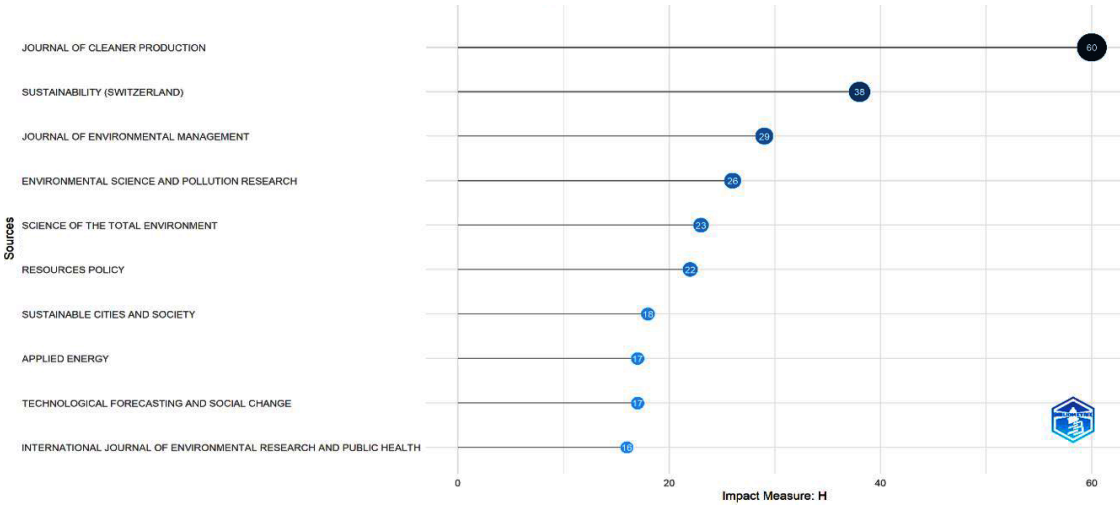


Figure 5: Sources' Local Impact by H Index

Other notable sources include the *Journal of Environmental Management* and *Environmental Science and Pollution Research*, which have H-index values of 29 and 26, respectively, highlighting their influential roles in academic discussions within their fields. Journals like *Science of the Total Environment* and *Resources Policy* register moderate H-index scores of 23 and 22. At the lower end of the scale, sources such as *Sustainable Cities and Society*, *Applied Energy*, and *Technological Forecasting and Social Change* exhibit H-index values around 17 to 18, indicating smaller yet still meaningful academic impacts. Overall, the graph illustrates the varying degrees of influence among different sources, with the *Journal of Cleaner Production* emerging as the most impactful according to this measure.

THEMATIC AND KEYWORD ANALYSIS

Figure 6 presents a network map showcasing the connections between key terms in sustainability research, featuring three distinct clusters. The green cluster is dominated by the term "green," which links to related concepts such as "environmental," "energy," "emissions," and "production,"

emphasizing discussions on green technology, energy production, and environmental issues. This indicates that the concept of "green" is central to much of the research in this field, particularly regarding the importance of addressing environmental impacts in sustainable development. Conversely, the red cluster centers around the term "sustainable," connecting it to terms like "framework," "infrastructure," and "industry," highlighting the structural and industrial aspects necessary for achieving sustainability and focusing on the frameworks and systems essential for long-term development.

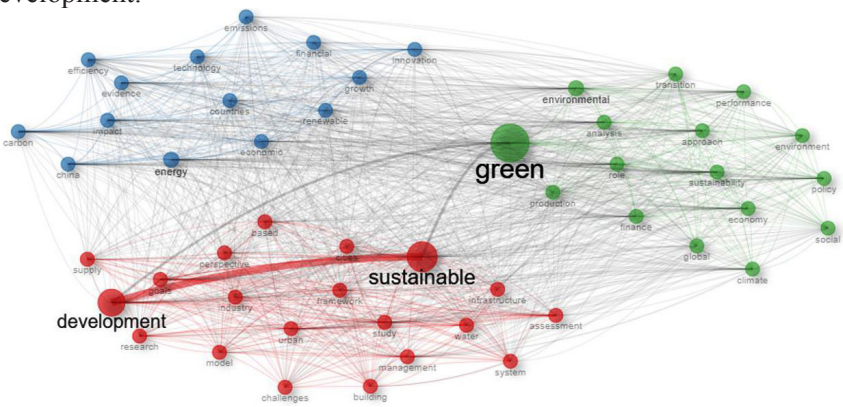


Figure 6: Author's Keywords Co-occurrence Network

The blue cluster focuses on terms associated with economic growth and policy, including "economic," "growth," "countries," and "policies." This indicates an emphasis on the economic aspects of sustainability, exploring how various countries and economies are engaged with or affected by sustainable practices. The relationships among the clusters reveal that, although the themes of green technology, sustainable infrastructure, and economic policy are distinct, they are profoundly interconnected. The figure implies that achieving sustainability necessitates a comprehensive approach that integrates environmental technology, industrial frameworks, and

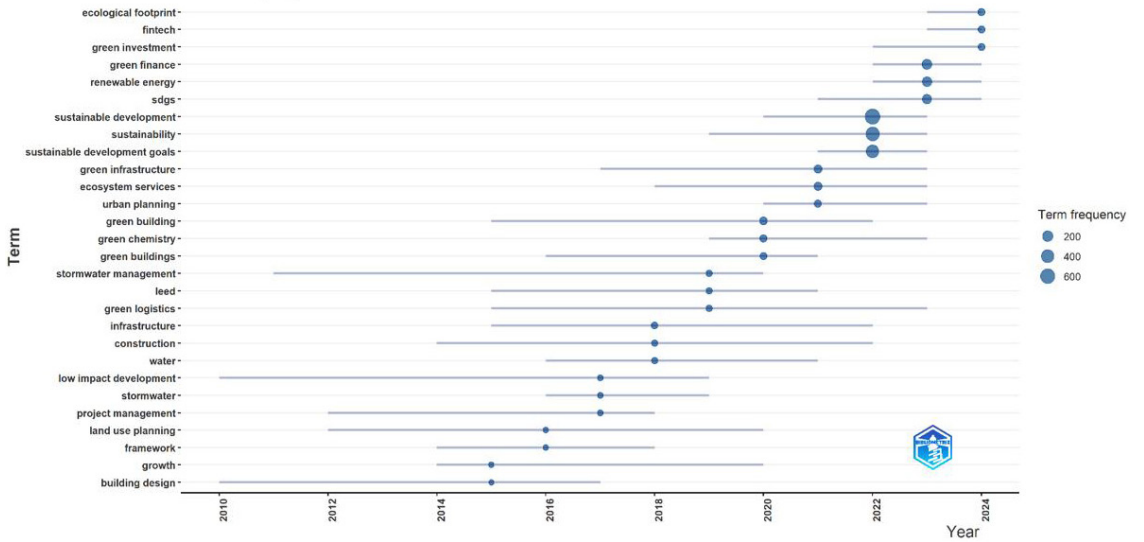


Figure 7: Trend Topics

economic growth policies. Each cluster, while concentrating on different facets, plays a vital role in contributing to a cohesive dialogue within sustainability research.

Figure 7 provides a visual overview of key terms associated with green finance, sustainability, and the Sustainable Development Goals (SDGs) from 2010 to 2024. The vertical axis lists various terms, including "ecological footprint," "fintech," "green finance," "renewable energy," "SDGs," and "green buildings," while the horizontal axis represents the years of occurrence, with dots indicating the frequency of these terms over time. Larger dots signify higher frequencies, categorized into three levels: 200, 400, and 600.

This visualization reveals trends in the research landscape, demonstrating that topics like "sustainability," "SDGs," and "green finance" have garnered significant attention, particularly from 2020 onward. Earlier years show fewer or no dots for terms such as "LEED," "green chemistry," and "low impact development," indicating their lower prevalence in academic and research discussions during that time. Conversely, terms like "fintech" and "green investment" have gained prominence, reflecting their growing importance in the fields of sustainability and finance research.

Figure 8 illustrates the most frequently mentioned terms in sustainability and green development research, with larger words representing higher frequencies, indicating their significance in the analyzed content. The primary terms—"sustainable," "green," and "development"—underscore a strong emphasis on sustainable development in the literature, closely linked to discussions on environmental protection, policy-making, and sustainable economic practices.



Figure 8: Word Cloud

Surrounding these key terms are other important words like "energy," "sustainability," "environmental," "urban," and "carbon," highlighting essential thematic areas such as renewable energy, urban sustainability, and carbon emissions. Additionally, terms like "management," "analysis," "innovation," and "goals" indicate a focus on research, policy analysis, and innovative approaches to sustainability challenges. The inclusion of geographical references such as "China" suggests specific regional case studies or focus areas within the research. Overall, the word cloud effectively captures the diverse and interconnected themes within sustainability-related research.

DISCUSSION

This study spans over 35 years (1989-2024), intentionally chosen to capture the long-term evolution of green finance and sustainable development research. By analysing 5,062 documents,

mostly research articles, the study provides a comprehensive view of how green finance, from its early, underexplored stages, has evolved into a crucial aspect of global sustainability. The extended time frame allows for the identification of key shifts in the field, reflecting the gradual integration of environmental goals into financial systems. This progression was shaped by global events such as the Kyoto Protocol (1997) and the Paris Agreement (2015), which significantly raised awareness of climate change and sustainability.

The bibliometric analysis reveals a steady increase in research output since 2016, peaking in 2022. Although there is a slight drop in publications in 2023 and 2024, this is likely due to incomplete data rather than a decline in activity. Citation trends also highlight substantial growth in green finance and sustainability research since 2010, with each paper being cited an average of 17.69 times. Countries such as China, India, and the USA lead in research output, with China contributing 4,206 publications. However, countries like Australia, Sweden, and the Netherlands, despite producing fewer papers, show a stronger impact per article, indicating the high quality of their research.

The field's interdisciplinary nature is evident in the three major areas of focus: green technology, sustainable infrastructure, and economic policy. These themes illustrate how green finance integrates environmental, industrial, and economic considerations to address energy, environmental issues, and the systems required for sustainability. Emerging topics like fintech and green investments, gaining traction since 2020, demonstrate the growing interest in combining technological innovation with sustainable finance, which further accelerates the sector's growth.

Another reason for this long-range study is to understand the fluctuating nature of both financial and environmental sectors. The data reveals patterns of regional disparities, collaborative networks, and research growth that would not be apparent in a shorter timeframe. This emphasizes the need for sustained international collaboration to meet long-term sustainability goals.

However, this study has limitations, as it relies on specific databases, potentially overlooking relevant research from other sources. There is also scope for future exploration into regional differences in green finance policies and their impacts on both local and global sustainability. The role of emerging technologies and the effectiveness of policy frameworks also deserve further investigation to support the evolving field.

In summary, the study shows the rapid expansion of green finance research, particularly in the past decade, with notable regional differences and interdisciplinary collaborations. As the field continues to mature, future research should focus on innovative strategies that align with global sustainability goals and offer impactful contributions.

CONCLUSION

This 35-year bibliometric exploration has revealed significant insights into the development of green finance and its alignment with the Sustainable Development Goals (SDGs). The long-time frame was critical to capturing the emergence of green finance from an underexplored niche topic to a vital component of global financial systems. The post-2015 surge in publications aligns with heightened global concern over climate change, as governments and institutions began to prioritize green finance mechanisms like green bonds, credits, and investments.

While China, India, and the USA dominate in research output, countries such as Australia and Sweden stand out for the high impact of their work. The rise of fintech and green investments also indicates a future where technological innovation will further drive green finance initiatives.

Future research should continue to examine regional policies, emerging technologies, and the long-term sustainability of green finance solutions. This study offers a broad foundation for understanding the complexities and transformative potential of green finance over the decades, reinforcing its critical role in achieving global sustainability.

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CIRCULAR HUMAN RESOURCE MANAGEMENT

Addressing the Impact of Workplace Bullying on Employee Well-Being: Analysis in the Banking Sector of Haryana

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Abstract

Workplace bullying presents a critical challenge with significant implications for both individual employees and organizations. This study explores the relationship between various forms of workplace bullying and employee well-being within the banking sector in Haryana. Utilizing a descriptive-causal research design, primary data were collected from four banks—State Bank of India (SBI), Bank of Baroda (public sector), and HDFC and ICICI (private sector). The sample included respondents from six randomly selected districts in Haryana, with a quota of 20 per district (10 from public sector banks and 10 from private sector banks). Statistical analyses, including reliability analysis, regression analysis, and ANOVA, were employed to examine the impact of career-related, person-related, work-related, and intimidating bullying on employee well-being. The results indicate that all forms of workplace bullying significantly negatively affect employee well-being. The study highlights the importance of addressing workplace bullying to improve employee satisfaction and organizational productivity. Recommendations for mitigating workplace bullying and enhancing employee well-being are discussed.

Keywords: *Workplace Bullying, Employee Well-Being, etc.*

INTRODUCTION

Workplace bullying has emerged as a critical concern with far-reaching implications for both individuals and organizations. Characterized by persistent harassment from one colleague to another, workplace bullying inflicts significant emotional and psychological strain on victims, leading to detrimental effects on their well-being (Ahmer et al., 2009). The negative impact of such bullying on employees is well-documented, with numerous studies highlighting its association with decreased engagement, heightened distress, and an increased likelihood of job turnover (Bilgel, 2006; Paul &Kee, 2020). Furthermore, the experience of being bullied can lead to the development of mental health disorders, exacerbating the stress and strain faced by affected employees (Anasori et al., 2020).At the organizational level, the consequences of workplace bullying are equally severe. It undermines employee commitment, job satisfaction, and overall productivity while contributing to higher absenteeism and turnover rates (Oghojafor et al., 2012). Job satisfaction, a widely researched topic in behavioral sciences, is intricately

linked to individual attitudes and behaviors, making it a key factor in understanding the effects of workplace dynamics (Judge & Church, 2000; Judge & Klinger, 2007).In the banking sector, where the nature of work is inherently demanding, the retention of knowledgeable and qualified staff is crucial for maintaining high levels of customer service and overall productivity (Wang & Tseng, 2019). However, the pressures inherent in this industry can increase the likelihood of workplace bullying, complicating efforts to engage and retain employees (Anasori et al., 2020). The way employees respond to such stressors varies, with individual differences playing a significant role in their resilience (Tulucu et al., 2022).Previous research has extensively explored various aspects of workplace bullying and its impact on organizational outcomes. Studies have examined the prevalence of workplace bullying and its effects on the health of victims (Bilgel, 2006), as well as the occurrence of person-related and work-related bullying in different sectors (Bashir &Hanif, 2011). While some have suggested that bullying might paradoxically boost the self-esteem and self-assurance of the bullies themselves (Tehrani, 2001), the overwhelming consensus in the literature is that the negative effects of bullying far outweigh any potential benefits.

Given the profound impact of workplace bullying on employee well-being, it is imperative for organizations to address this issue comprehensively. This paper aims to explore the complex relationship between workplace bullying and employee well-being, highlighting the need for effective strategies to mitigate its adverse effects.

REVIEW OF LITERATURE

Workplace bullying is a pervasive issue with significant consequences for both employees and organizations. The negative effects of workplace bullying on employees are well-documented, with numerous studies exploring its impact on various aspects of workers' emotional and psychological well-being. For instance, workplace bullying has been linked to lower overall job satisfaction (Lapierre et al., 2005), increased levels of anxiety, depression, psychosomatic complaints, musculoskeletal problems, and other physical health issues (Bowling &Beehr, 2006). Additionally, bullying has been shown to affect self-esteem, inducing feelings of terror, annoyance, and nervousness in victims (Tehrani, 2001).A systematic review by Samsudin et al. (2018) further underscores the severe consequences of bullying behaviors, revealing that such actions can lead to increased burnout levels and mental distress among employees. Einarsen and Nielsen (2015) also highlight the chronic health issues associated with prolonged exposure to workplace bullying. Similar findings are supported by Bardakçı and Günüşen (2016), who confirm the detrimental effects of bullying on employee health.Although much of the research on the effects of workplace bullying has been concentrated in the healthcare sector (e.g., Allen et al., 2015), there is a growing recognition of the need to explore its impact across various industries. This is particularly important given the potential outcomes of bullying, such as increased stress and decreased job satisfaction. In contrast, employees who are engaged and dedicated tend to be more committed, work harder, and contribute positively to the organization's productivity and performance (Soliman&Wahba, 2019). However, when employees experience bullying, their psychological distress can deplete their energy, leading to diminished engagement and overall well-being.One area that has received relatively little attention in the literature is the role of self-compassion in mitigating the negative effects of workplace bullying on employee well-being, particularly in settings such as the banking sector. The interaction between self-compassion and bullying is of significant importance, as personality traits or levels of self-compassion may

influence how individuals respond to aggression and hostility in the workplace (Anasori et al., 2022; Rai&Agarwal, 2017). Understanding which personality traits help individuals cope with bullying behavior can inform strategies for reducing its harmful impact.The organizational consequences of workplace bullying are also profound. It negatively affects employee job satisfaction, leading to high absenteeism, turnover, and even early retirements. Employees who are subjected to workplace aggression often report lower job satisfaction, particularly when the aggression comes from supervisors (Lapierre, Spector, &Leck, 2005; Tepper, 2000).The study of workplace bullying has been approached from various perspectives, leading to the identification of different typologies, forms, and tactics. Lewis and Gunn (2007) suggest that the complexity of workplace bullying necessitates a multifaceted approach to understanding its manifestations. Rayner et al. (2002) categorized bullying into five types: threats to professional status, threats to personal standing, isolation, overwork, and destabilization. In their study of emergency service organizations in the UK, Owoyemi and Sheehan (2011) identified three distinct types of bullying: personal bullying, administrative bullying, and social bullying. Other forms of bullying identified in the literature include insults, verbal abuse, excessive teasing, and aggression (Lee &Brotheridge, 2006).The type of bullying experienced by employees often depends on their roles or positions within the organization. For example, the supervisor-subordinate relationship is frequently cited as a context in which bullying occurs (Zapf &Einarsen, 2003; Owoyemi& Sheehan, 2011). While sexual harassment has been recognized as a form of workplace bullying by some researchers (Hoel& Cooper, 2003), there is ongoing debate regarding whether it should be classified as such (Sheehan, 2006).

Workplace bullying is a complex and multifaceted issue with far-reaching implications for both individual employees and organizations as a whole. The extensive body of research highlights the need for continued exploration of its effects and the development of strategies to mitigate its impact, particularly through the lens of individual differences such as self-compassion. Addressing workplace bullying effectively is crucial for promoting employee well-being and maintaining a healthy organizational culture.

RESEARCH METHODOLOGY

This study employs a descriptive-causal research design to explore the dynamics of workplace bullying and its impact on employee well-being. The research focuses on primary data collected from selected banks in Haryana. Specifically, two public sector banks—State Bank of India (SBI) and Bank of Baroda—and two private sector banks—HDFC and ICICI—were chosen based on their annual income for the fiscal year 2023-24. These banks represent the universe of the research study within their respective sectors.To ensure comprehensive coverage, six revenue divisions in Haryana were randomly selected, and from these divisions, six districts were identified. For each district, a quota sampling method was utilized, setting a target of 20 respondents per district. This quota was evenly divided, with 10 respondents from public sector banks and 10 from private sector banks. The officials working in these banks were considered the units of sampling and key respondents for the study.

ANALYSIS AND FINDINGS

The analysis presented in the following sections examines the relationship between various forms of workplace bullying and employee well-being. To evaluate this relationship, several statistical

methods have been employed, including reliability analysis, regression analysis, ANOVA, and model fit assessment. Each method contributes to understanding how different types of workplace bullying—such as career-related, person-related, work-related, and intimidating bullying—affect employee well-being. The results aim to provide insights into the extent and nature of these impacts, supported by robust statistical evidence. This analysis includes a detailed examination of the internal consistency of the measurement constructs, the overall fit of the regression model, and the significance of each predictor variable, culminating in an evaluation of the model's goodness-of-fit.

Table 1: Reliability Analysis of Various Constructs

S.No.	*Constructs*	*No. of Variables*	*Cronbach's Alpha*
1	Career related workplace bullying	5	0.773
2	Person-related Workplace Bullying	4	0.817
3	Work related workplace bullying	5	0.799
4	Intimidating Workplace Bullying	3	0.764
5.	Employee Wellbeing	8	0.792

The reliability analysis of the constructs measuring various dimensions of workplace bullying and employee well-being reveals strong internal consistency across the board. For Career-Related Workplace Bullying, with five variables, the Cronbach's alpha value is 0.773. This indicates a good level of reliability, suggesting that the variables used are consistently measuring the concept of career-related bullying. Similarly, Person-Related Workplace Bullying, consisting of four variables, demonstrates even stronger internal consistency with a Cronbach's alpha of 0.817, reflecting a high degree of reliability in capturing this specific type of bullying. Overall, the Cronbach's alpha values for all constructs exceed the generally accepted threshold of 0.7, demonstrating that the scales used are reliable. This high level of internal consistency supports the validity of the measurements and suggests that the constructs effectively capture the intended dimensions of workplace bullying and employee well-being.

Table 2: Model Summary

Model	*R*	*R Square*	*Adjusted R Square*	*Std. Error of the Estimate*	*Change Statistics*					*Durbin-Watson*
					R Square Change	*F Change*	*df1*	*df*[2]	*Sig. F Change*	
1	.552[a]	.304	.280	.57815	.304	12.569	4	115	.000	1.526

[a] Predictors: (Constant), Career related workplace bullying, Person-related Workplace Bullying, Work related workplace bullying, Intimidating Workplace Bullying

[b] Dependent Variable: Employee wellbeing

The regression analysis investigating the effect of various types of workplace bullying on employee well-being reveals that the model explains approximately 30.4% of the variance in employee well-being, as indicated by an R-squared value of 0.304. This suggests that the predictors—Career-Related Workplace Bullying, Person-Related Workplace Bullying, Work-Related Workplace Bullying, and Intimidating Workplace Bullying—account for a significant portion of the variability in employee well-being. The change in R-squared (0.304) and the F-test statistic of 12.569, with degrees of freedom (df1 = 4, df2 = 115), are significant at the 0.000 level, demonstrating that the model is statistically significant and the predictors have a meaningful

collective impact on employee well-being.The Durbin-Watson statistic is 1.526, which is within the acceptable range of 1.5 to 2.5, suggesting that there is no major issue with autocorrelation in the residuals. Overall, the model shows a significant relationship between workplace bullying and employee well-being, with the predictors accounting for a substantial portion of the variance, and no severe autocorrelation problems affecting the results.

Table 3: ANOVA Statistics

Model		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
1	Regression	16.806	4	4.201	12.569	.000[b]
	Residual	38.440	115	.334		
	Total	55.246	119			

[a] Dependent Variable: Employee wellbeing

[b] Predictors: (Constant), Career related workplace bullying, Person-related Workplace Bullying, Work related workplace bullying, Intimidating Workplace Bullying

The sum of squares for the regression is 16.806, with 4 degrees of freedom (df). The mean square for the regression is 4.201, and the F-statistic is 12.569. This F-statistic is highly significant with a p-value of 0.000, indicating that the regression model as a whole is statistically significant and that the predictors collectively have a significant impact on employee well-being.The residual sum of squares is 38.440, with 115 degrees of freedom. The mean square for the residuals is 0.334, reflecting the average squared deviation of the observed values from the predicted values. The total sum of squares is 55.246, with 119 degrees of freedom. This represents the total variance in the dependent variable (employee well-being) that is being explained by the model and the residuals.

Table 4: Coefficients for Regression Model

Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
		B	*Std. Error*	*Beta*		
1	(Constant)	6.472	.398		16.247	.000
	Person-related Workplace Bullying	–.176	.074	–.190	–2.375	.019
	Work related workplace Bullying	–.143	.057	–.201	–2.510	.013
	Intimidating Workplace Bullying	–.252	.070	–.295	–3.616	.000
	Career related workplace Bullying	–.218	.069	–.248	–3.154	.002

[a] Dependent Variable: Employee Wellbeing

An intercept of 6.472 was found, with a standard error of 0.398, a t-value of 16.247, and a significance level of 0.000. It is indicated that when all predictors are zero, the predicted level of employee well-being is 6.472, and this result is considered statistically significant and different from zero.

- **Ho1: Person-Related Workplace Bullying has no significant impact on employee well-being**

(a) Person-Related Workplace Bullying: A coefficient of -0.176 was observed for Person-Related Workplace Bullying, with a standard error of 0.074. The standardized beta was -0.190, and a t-value of -2.375 with a significance level of 0.019 was obtained. The null hypothesis, which states that Person-Related Workplace Bullying has no impact on employee well-being, is

rejected as the significance level is below 0.05. It is concluded that Person-Related Workplace Bullying has a significant negative impact on employee well-being, with each unit increase in Person-Related Workplace Bullying resulting in a decrease of 0.176 units in employee well-being.

- **Ho2: Work-Related Workplace Bullying has no significant impact on employee well-being**

(b) Work-Related Workplace Bullying: A coefficient of -0.143 was recorded for Work-Related Workplace Bullying, with a standard error of 0.057. The standardized beta was -0.201, and a t-value of -2.510 with a significance level of 0.013 was found. The null hypothesis, which proposes that Work-Related Workplace Bullying has no significant impact on employee well-being, is rejected as the significance level is less than 0.05. It is determined that Work-Related Workplace Bullying significantly negatively affects employee well-being, with each unit increase in Work-Related Workplace Bullying leading to a decrease of 0.143 units in employee well-being.

- **Ho3: Intimidating Workplace Bullying has no significant impact on employee well-being**

(c) Intimidating Workplace Bullying: A coefficient of -0.252 was found for Intimidating Workplace Bullying, with a standard error of 0.070. The standardized beta was -0.295, and a t-value of -3.616 with a significance level of 0.000 was observed. The null hypothesis, which suggests that Intimidating Workplace Bullying has no significant impact on employee well-being, is rejected as the significance level is much less than 0.01. It is concluded that Intimidating Workplace Bullying has a substantial negative effect on employee well-being, with each unit increase in Intimidating Workplace Bullying resulting in a decrease of 0.252 units in employee well-being.

- **Ho4: Career-Related Workplace Bullying has no significant impact on employee well-being**

(d) Career-Related Workplace Bullying: A coefficient of -0.218 was recorded for Career-Related Workplace Bullying, with a standard error of 0.069. The standardized beta was -0.248, and a t-value of -3.154 with a significance level of 0.002 was obtained. The null hypothesis, which posits that Career-Related Workplace Bullying has no significant impact on employee well-being, is rejected as the significance level is less than 0.01. It is determined that Career-Related Workplace Bullying significantly negatively affects employee well-being, with each

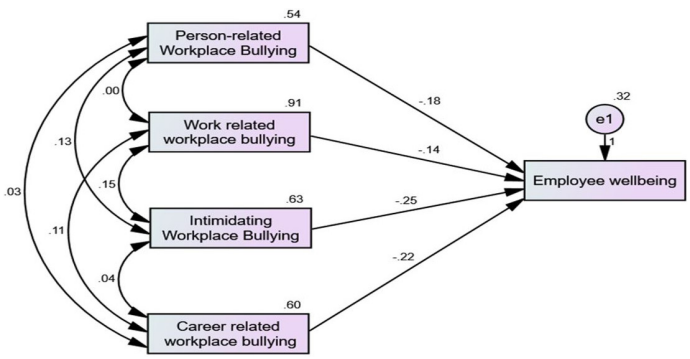


Figure 1: Structure Equation Model for Workplace Bullying and Employee Wellbeing

unit increase in Career-Related Workplace Bullying leading to a decrease of 0.218 units in employee well-being.

Table 5: Model Fit Estimates

Estimates	*Values*	*Threshold Values*
CMIN/DF	2.51	<3
CFI	.907	>0.90
GFI	.967	>0.95
AGFI	.850	>0.80
RMSEA	.002	<0.05
PCLOSE	.063	>0.05

The CMIN/DF value is 2.51, which is below the threshold value of 3, indicating an acceptable fit. The CFI (Comparative Fit Index) value is 0.907, exceeding the minimum threshold of 0.90, suggesting a good fit. The GFI (Goodness-of-Fit Index) is 0.967, which is above the recommended value of 0.95, also indicating a good fit. The AGFI (Adjusted Goodness-of-Fit Index) stands at 0.850, which is above the threshold of 0.80, reflecting an adequate fit. The RMSEA (Root Mean Square Error of Approximation) value is 0.002, well below the threshold of 0.05, signifying an excellent fit. Finally, the PCLOSE (P-value for Testing Close Fit) is 0.063, which is above the threshold of 0.05, suggesting that the model does not fit perfectly but is still acceptable.Overall, these fit indices suggest that the model demonstrates a good fit to the data.

CONCLUSION

This study provides a comprehensive analysis of the impact of various forms of workplace bullying on employee well-being within the banking sector in Haryana. By examining data from both public and private sector banks, the research highlights the significant negative effects of career-related, person-related, work-related, and intimidating bullying on employees' psychological and emotional health.The findings underscore that workplace bullying is a pervasive issue with far-reaching implications for employee well-being. All types of bullying investigated—career-related, person-related, work-related, and intimidating—were found to have a significant detrimental impact on employees. This confirms that workplace bullying not only lowers employee morale but also affects their overall job satisfaction and mental health, leading to decreased engagement and productivity.The strong internal consistency of the measurement constructs, as indicated by the reliability analysis, supports the validity of the findings. The regression analysis demonstrates that workplace bullying explains a substantial portion of the variance in employee well-being, affirming the relevance of the predictors in understanding this complex relationship. The statistical significance of each form of bullying in affecting employee well-being emphasizes the need for targeted interventions.Given the serious implications of these findings, it is imperative for organizations to develop and implement comprehensive strategies to combat workplace bullying. Such measures could include fostering a supportive work environment, establishing clear anti-bullying policies, and promoting awareness and training programs to address and prevent bullying behaviors. Addressing workplace bullying is crucial for enhancing employee well-being and maintaining a positive organizational culture. By acknowledging and tackling the detrimental effects of workplace bullying, organizations can improve employee satisfaction, reduce turnover, and ultimately enhance overall productivity and success.

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A Study on Sustainable Development Goal (SDG) 4 on 'Quality Education' from Students and Teachers Perspectives: A Literature Review

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Abstract

Sustainable Development Goals (SDG) is at the forefront of government initiatives across the world. The SDGs are primarily concerned with promoting sustainable growth via ensuring wellbeing, economic growth, environmental legislation, and academic advancement. One of the most prominent goals of the SDG is to provide learners with high-quality education (SDG 4). This paper aims to look at the perspectives of the Sustainable Development Goals improvised to provide quality education. We also analyze the existing state of multiple initiatives implemented by the Indian government in the pathway to achieving objectives of quality education (SDG 4). Additionally, a case study is considered for understanding the association among the observed indicators of SDG4. Qualitative research techniques have been used to gain background information and recent trends on Sustainable development goal (SDG) 4 on "Quality Education" from students and teachers perspectives. Researchers used secondary data to build knowledge from existing research, which might lead to better results. Furthermore, secondary data has been used for the present study in order to get a comprehensible picture of the variety of trends and other interrelated concepts. Due to this research methodology, researchers might save time and money. The secondary data is obtained from internal and externally available sources like magazines, documentaries, books, the internet, etc. The outcomes reveal the presence of a significant degree of association among these parameters pointing out the fact that understanding the impact of one (or more) indicator on other related indicators is critical for achieving SDG 4 goals (or factors). These findings will assist governing bodies in taking preventive measures while modifying existing policies and ensuring the effective enactment of SDG 4 goals, which also will subsequently aid in the resolution of issues related to other SDGs.

Keywords: *Sustainable Development Goal (SDG), Education, Quality education, Right of education, Equality SDG-4*

INTRODUCTION

This article explores the specific targets within the fourth United Nations Sustainable Development Goal (SDG 4) on "quality education" (WEF 2016) from students and teachers perspectives. Its aim is to explore the complexity of raising educational quality around the world, suggesting the need for multiple actors to cooperate closely. The article draws on structure and agency approaches (see e.g. Giddens 1984; Bourdieu 1984) 2 to offer deeper insight into the roles that individuals, education and training institutions, stakeholders and regulating governments

may play in achieving the specified education targets by 2030. The article opens with a brief overview of the United Nations Sustainable Development Goals, followed by a discussion of the current global education policy climate, which is strongly oriented towards various benchmarks, indicators and targets. A separate section focuses on structure and agency approaches, underlining their contribution to educational change. Building further on this line of thought, the ten specific SDG 4 targets on "quality education" are broken down and approached from students and teachers perspectives, mapping insights from structure and agency approaches onto each of the ten targets. The article concludes with some critical notes and suggestions for further discussion, both for policy, practice and future research.

The Sustainable Development Goals

The United Nations Sustainable Development Goals (SDGs) are not the first set of goals designed to help nations work together to create a cleaner planet and more just global society. The previous agenda's Millennium Development Goals (MDGs) were formulated in 2000 and included eight goals to be achieved by 2015: (1) to eradicate extreme poverty and hunger; (2) to achieve universal primary education; (3) to promote gender equality and empower women; (4) to reduce child mortality; (5) to improve maternal health; (6) to combat HIV/AIDS, malaria, and other diseases; (7) to ensure environmental sustainability; and (8) to develop a global partnership for development (UN 2000; Gabay 2015). On 1 January 2016, an ambitious new plan was launched, which increased the number of goals from eight to seventeen: (1) to eradicate poverty; (2) to end hunger; (3) to ensure health and well-being for all; (4) to ensure quality education for all; (5) to achieve gender equality; (6) to ensure clean water and sanitation; (7) to ensure affordable and clean energy; (8) to promote decent work and sustainable economic growth; (9) to build resilient and sustainable industry, innovation and infrastructure; (10) to reduce inequalities; (11) to build sustainable cities and communities; (12) to ensure sustainable consumption and production; (13) to take climate action; (14) to protect life below water; (15) to protect life on land; (16) to promote peace, justice and inclusive institutions; and (17) to strengthen the Global Partnership for Sustainable Development (Palmer 2015). The 17 goals address themes of "economic growth, social development and environmental protection" (UN 2015, item 9.) and are further specified in 169 targets. While the MDGs mainly targeted developing countries, the SDGs focus on all countries across the globe. In 2017, UNESCO published Education for Sustainable Development Goals: Learning Objectives (UNESCO 2017a). This publication draws a distinction between cognitive, socio-emotional and behavioral learning objectives for all SDGs, refers to the knowledge and skills needed to fulfill these aims, the motivation and attitudes that can underpin them, and the actions needed to achieve them. In the present article, the focus is on SDG 4, which contains 10 specific targets, addressing the needs of children, youth and adults. The idea of "lifelong learning for all" is a key element of SDG 4. While "quality education" is a goal in itself, it is important to avoid regarding the 17 SDGs as fragmented "work packages". Many of the goals can, in fact, be interpreted as correlating with each other. For example, research on the benefits of educational attainment shows that those with higher skills levels tend to secure better paid jobs, enjoy better health, be more involved in their communities, and practice more active citizenship. We also know that there is a correlation between education participation rates and governmental investment in industries, innovation and infrastructures. This suggests that education can act as a powerful "engine" to develop a more cohesive and equal society. Nowadays, educators also pay attention



Figure 1

Source: https://apa.sdg4education2030.org/sdg-4-targets-and-means-implementation



Figure 2

Source: https://www.researchgate.net/publication/362642757/figure/fig2 Sustainable-Development-Goal-SDG-4-and-its-components-for-education.

to gender equality (SDG 5), for example through initiatives to encourage more girls and women to enter the fields of Science, Technology, Engineering and Mathematics (STEM) (see Panetta and Williams 2018). A highly qualified workforce is a demonstrated driver of decent work and strong economic growth (SDG 8) (see Woessmann 2016; Frey 2017), which in turn contribute to achieving the goals on poverty (SDG 1) and hunger (SDG 2). Quality education can also include increasing skills in relation to learning for sustainability, such as care for our planet (SDGs 12 and 13). The final goal, SDG 17, focuses on the role of partnerships in order to reach the SDGs and makes explicit reference to the need for governments to work together and cooperate with a wide range of stakeholders in the private and non-profit sectors. Education, however, is not mentioned at all in the discussion of SDG 17. This goes against the research evidence on the benefits of education and training, which touch on the domains of all the other SDGs, both at the level of the individual and of society. Further understanding the possibilities for individuals, educational institutions, relevant stakeholders and governments to work together to achieve both SGG 4 and the other Goals might thus increase knowledge of potential routes to progress. This article focuses on what these different players can contribute in relation to the ten specific targets of SDG 4 on quality education.

LITERATURE REVIEW

- **Boeren, E. (2019):** The main focus of this research is to work on forth United nations sustainable development goal(UNSDG 4) that is " Quality Education" from micro-, meso- and macro-level perspectives. It focuses on complexities and problem arising due to lack of quality education around the world. Also discuss about the roles and responsibilities of individuals, education and training institutions, stakeholders and regulating governments may play in achieving the specified education targets by 2030. Researchers explain SDG4 with the help of benchmark, policies and insight mapping.
- **Franco et al. (2019):** In this paper they mainly focus on higher education for sustainability which is global agenda for the 2030. Many higher education institutions, responsible for equipping the next generation of sustainability leaders with knowledge and essential skills, proactively try to action the sustainable development goals (SDGs) Higher education of Sustainable Development policy, curriculum and practice through scattered and isolated initiatives. Also talk about the complexities which are faced by the humans and environmental sustainability. They work on Qualitative Research Strategy (surveys, policy and literature review, group and individual interviews). They also suggested that due to advancement of Higher education of Sustainable Development curriculum and practice depends largely on a better understanding of existing gaps, target areas, commonalities and differences across regional HEfSD agendas.
- **Hopkins et al. (1996):** Teachers are at the heart of educational improvement. Any benefits that accrue to students as a result of educational policies require the enabling action of teachers. It is for this reason that the OECD, through its Centre for Educational Research and Innovation (CERI), recently undertook a comparative study of policies aimed at improving teacher quality. This paper presents the main findings of the country studies conducted in 1993. Following a description of the conceptual framework of the OECD study, the two central sections of the paper contain an analysis first, of the attributes and activities of these highly accomplished teachers, and second of the key characteristics of the schools in

which they work. The key characteristics of high quality teachers highlighted by the study are: commitment, love of children, mastery of subject didactics and multiple models of teaching, the ability to collaborate with other teachers, and a capacity for reflection. The school level characteristics supportive of high quality teachers identified in the case studies are: a consensus on vision and values, an organisation for teaching and learning, coherent management arrangements, formal and informal leadership, staff development focused on the workplace, and effective relationships with the community and local district. The evidence of the case studies suggests that there are three sources of teacher quality—the individual teacher, the individual school, and the external policy environment. In the final section of the paper these three alternative sources of teacher quality are described, as well as the policy implications flowing from them.

- **Könings et al. (2007):** Educational designers often develop a 'powerful learning environment' that is subsequently implemented by teachers. Due to a lack of cooperation with teachers they may receive limited feedback on the quality of their design and the way it is implemented. This study focuses on teachers' perceptions of a Dutch innovative learning environment called the "Second Phase", as well as their desires and their dis/satisfaction with this environment. The results show that teachers are reserved about student autonomy and productive learning. Perceptions and desires are related to their individual approaches to teaching. The findings provide useful feedback for designers and a starting point to intensify their cooperation with teachers.
- **Ferguson et al. (2021):** The pursuit of sustainable development for individuals, societies, and nations is important for the global community given its emphasis on pursuing a harmonious balance between societal, economic, and environmental imperatives. With respect to formal education, teachers are critical agents in delivering sustainable development content, and facilitating skills and action competencies to achieve such goals. Consequently, understanding teachers' perspectives of sustainable development is necessary. This research utilized a survey design to gather views from 296 teachers from 12 high schools in rural and urban areas of Jamaica. The data revealed most teachers' views exhibited systems thinking perspectives. Additionally, the research found that, to a lesser extent, teachers associated citizen participation with sustainable development. These findings hold importance for the reorientation of teacher education as part of Education for Sustainable Development to ensure that critical issues surrounding sustainable development, such as the development of systems thinking and citizen participation, are emphasized.
- **Elfert, M. (2019):** This article, which draws on a review of primary and secondary literature, examines the role of a human rights-based approach to adult learning and education (ALE) in the context of the global Education 2030 agenda, which is aligned with the Sustainable Development Goals (SDGs) launched in 2015 by the United Nations. Whereas the Millennium Development Goals (MDGs) focused on primary education, the SDGs, through SDG 4 which is devoted to education, call on Member States to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". The inclusion of lifelong learning has awakened hopes for a stronger role of ALE in global education agendas and policies. In principle, the ten targets of SDG 4 open up clear possibilities for ALE. However, the author cautions that there is cause for skepticism that ALE, in particular human rights-

based ALE, will receive more attention under the SDGs than it did under the MDGs. The article is structured into three sections. The first section traces the emergence of a rights-based approach to adult education as an international paradigm, with particular attention given to the role of UNESCO. The second section discusses how the rights-based approach to adult education has been contested by other actors in the field of education for development. In the final section, the author draws on recent empirical data to reflect on the role of ALE in the age of the SDGs.

- **Saini et al. (2023):** This paper is mainly focused on Sustainable Development Goals (SDG) are at the forefront of government initiatives across the world. The SDGs are primarily concerned with promoting sustainable growth via ensuring wellbeing, economic growth, environmental legislation, and academic advancement. One of the most prominent goals of the SDG is to provide learners with high-quality education (SDG 4). This paper aims to look at the perspectives of the Sustainable Development Goals improvised to provide quality education. We also analyze the existing state of multiple initiatives implemented by the Indian government in the pathway to achieving objectives of quality education (SDG Additionally, a case study is considered for understanding the association among the observed indicators of SDG4. For this purpose, exploratory data analysis, and numerical association rule mining in combination with Quant Miner genetic algorithm approaches have been applied. The outcomes reveal the presence of a significant degree of association among these parameters pointing out the fact that understanding the impact of one (or more) indicator on other related indicators is critical for achieving SDG 4 goals (or factors). These findings will assist governing bodies in taking preventive measures while modifying existing policies and ensuring the effective enactment of SDG 4 goals, which also will subsequently aid in the resolution of issues related to other SDGs.
- **Hoang et al. (2020):** The purposes of the study presented in this article were two fold. One was to respond to the question: what makes a quality curriculum? Within the framework of the fourth United Nations Sustainable Development Goal (SDG 4). The other was to develop and pilot an appropriate instrument to evaluate the quality of curricula in a sample of private schools in Vietnam. While public schools are still preparing for implementation of Vietnam's New General Educational Curriculum, small adjustments are already being made to the curriculum in some private and international schools in Vietnam, which have been issued a curriculum customisation license. Therefore, the pilot schools which participated in this study can serve as case studies for the upcoming major policy improvement in Vietnam's public schools, thus providing guidance for Vietnamese policymakers, school principals and teachers. While there is no "one-size-fits-all" curriculum assessment formula, since each country exhibits distinctive features in its teaching and learning programme, the indicators developed by the authors for their study can be adjusted to suit the needs of other countries.
- **Chankseliani et al. (2021):** This paper Specially focus on the higher education and the sustainable development Goal and covered a broad range of issues related to socio-economic, environmental and technological development, and apply to all of the world's countries, and not only those normally. Considered to be 'developing' or 'emerging'. In which they mostly focus on the SDG 4 calls for equal access to tertiary education, including university, as part of the promotion of lifelong learning opportunities for all. They talk about all the profession

like Teachers, doctors, engineers, among other professionals, obtain academic education at a higher level to practice their professions and support societies. And also give various examples of various global universities like University of Pretoria's (South Africa), Ahfad University for Women (Sudan),University of Auckland (New Zealand),the Tongji University (China),University of São Paulo (Brazil) and gave suggestion and recommendation.

- **Hanemann et al. (2019):** In this research paper all the SDGs are properly described among which 17 United Nations Sustainable Development Goals (SDGs), the fourth one is about ensuring "inclusive and equitable quality education" and promoting "lifelong learning opportunities for all". This goal (SDG 4) is subdivided into 10 targets, the sixth of which concerns youth and adult literacy and numeracy. This article examines the current discursive landscape around SDG target 4.6, to determine the extent to which it reflects the lifelong learning perspective guiding the Education 2030 Framework for Action. SDG target 4.6 envisages a minimum proficiency level in literacy and numeracy which is equivalent to the level achieved upon successful completion of basic education. The author's analysis unpacks "lifelong literacy", and discerns three closely interrelated dimensions, namely (1) literacy as a lifelong learning process; (2) literacy as a life-wide process; and (3) literacy as part of sector-wide reforms towards lifelong learning systems. Although available documentary evidence is still limited, the author identifies a number of broad trends, many of which do not give cause for optimism. She argues that an expanded vision of literacy has not yet taken hold. There is still a long way to go before literacy (and numeracy) are tackled from a lifelong learning perspective, which would potentially have a transformative effect on the achievement of the SDGs.
- **Jabareen, Y. (2008):** A critical review of the multidisciplinary literature on sustainable development reveals a lack of a comprehensive theoretical framework for understanding sustainable development and its complexities. A critical review shows that the definitions of sustainable development are vague; there is a lack of operative definitions and disagreement over what should be sustained; the concept is unclear in terms of emotional commitment; and it ''remains a confused topic'', ''fraught with contradictions''. This article aims to theoretically synthesize the interdisciplinary literature on sustainable development, and then identify the results by broad categories. Therefore, this article uses conceptual analysis, which reviews multidisciplinary literature on sustainable development, which recognizes patterns and similarities within the literature, then it synthesizes the patterns to different categories and independent concepts, where each concept has distinctive meanings and represents close ideas on sustainability. The analytical process elaborates seven concepts that together assemble the theoretical framework of 'sustainable development' and each concept represents distinctive meanings of the theoretical framework.
- **Jadhav et al. (2021):** In this research paper they mainly focused on how important is women education and their skill development and what measures are taken by the government of India as well as UNESCO to develop their well being by providing them quality education. Discuss about the government run schemes like: Indira Gandhi scholarship for single girl child for pursuing higher education ,Post-Doctoral Fellowship for women belongs to the SC/ST category,Post-Graduate Scholarships for SC/ST students in professional courses, PRAGATI,

UDAAN. there are several women empowerment programs also run by the government of India : Beti Bachao Beti Padhao etc.

- **Ram, D. (2021):** This research paper focuses on the quality education which is alsothe agenda of NEP policy 2020 which is also our United Nation Sustainable development goal 4 (SDG 2030) for the growth and development of the society and students. It helps in improving skills and strengthens their capabilities and knowledge. The main objective of NEP 2020 is to establish India as "a global knowledge superpower" by providing quality education, encouraging innovation, and cultivating a sound research culture, in which technology plays a very important role. Therefore education will play a impetus role in this transformation, technology itself will play an important role in the improvement of educational processes and outcomes; thus, the relationship between technology and education at all levels is bidirectional. If we have to achieve the Sustainable Development Goals, then we need to improve the education system. Technology is an important tool to improve the education system. Thus, sustainable development goals, education, and technology are related to each other. The main aim of this research is to study how NP 2020 is helpful in improving our technology and achieving the Sustainable Development Goals.

OBJECTIVES

The goal of this research is to assess the Indian government's attempts to fulfill the Sustainable Development Goals for Education (SDG 4), particularly in the time frame 2030. In addition, we want to achieve the following objectives:

1. To study the relationship of quality education with student and teachers.
2. To Analyze the perspectives of Sustainable Development Goals for Education (SDG 4).
3. To examine the current state and the accomplishments of the Indian government initiatives taken to implement SDG 4.

Initiatives by the Indian Government to Attain Sustainable Development in Education

India, being the home to one-sixth of all humanity, holds the key to the achievement of the 2030 Agenda.19 Since Indian independence, successive Indian governments have addressed several key challenges in education by introducing new educational policies and schemes as a part of its development agenda i.e., 'Sarva Shiksha Abhiyan', 'Rashtriya Madhyamik Shiksha Abhiyan', 'Right to free & compulsory Education Act' etc. (Saini et al., 2021; Singh et al., 2021). However, as per the 'British Council India report, the current Indian education system is guided by diferent objectives and goals but is primarily based on the policies of yesteryears (Mohanty & Dash, 2018)

Table 1: Summary of Initiatives and their Associations with SDG4 Elements

S. No.	*Name of the Initiative*	*Key Objectives*	*Associated SDG Elements*
1	Swayam programme	1. Online training	SDG 4.2
		2. Free study	SDG 4.3
		3. Equivalence with international standards	SDG 4.4
2	National E- Library	1. Quality content	SDG 4.2
		2. Digitilization	SDG 4.4
		3. International partnership	SDG 4.5
		4. Online accessibility	SDG 4.1

S. No.	*Name of the Initiative*	*Key Objectives*	*Associated SDG Elements*
3	Saksham	1. Help differently-abled students	SDG 4.6
		2. Scholorship	SDG 4.A
		3. Men-based accommodation	SDG 4.B
4	Beti Bachao Beti Padho Abhiyan	1. Women and Child development	SDG 4.2
		2. Targeted up to 100 districts	SDG 4.3
		3. Improve gender Ratio	SDG 4.5
		4. Special incentives to schools promoting gifts for education	SDG 4.7
5	UDAAN	1. Upbring inderprivilaged girl students from vulnerable positions	SDG 4.A
		2. Promotes Mathematics and Science Studies	SDG 4.B
		3. Encourage Girls to engeering studies	SDG 4.6
		4. Three dimensional focus :Curriculam design, Transactions, Assessment	SDG

RESEARCH METHODOLOGY

Qualitative research techniques have been used to gain background information and recent trends Sustainable development goal (SDG)4 on quality education from students and teachers perspectives. Researchers used secondary data to build knowledge from existing research, which might lead to better results. Furthermore, secondary data has been used for the present study in order to get a comprehensible picture of the variety of trends and other interrelated concepts. Due to this research methodology, researchers might save time and money. The secondary data is obtained from internal and externally available sources like magazines, documentaries, books, the internet, etc.

DISCUSSION

Research Objective I: To Analyze the Perspectives of Sustainable Development Goals for Education (SDG 4)

SDG 4 aims to make the world a more sustainable place to live. Every aspect of society, as we all know, is linked to one another and the impact of one factor on the other parts of society can be either beneficial or harmful. Education is such a significant component of contemporary civilization that it can influence all other aspects of society. For example, to eliminate unemployment, a trained workforce is needed which is possible with education. Furthermore, to achieve gender equality in all areas, educating females is required so that they may gain the same abilities as males and have the same rights. SDG 4's goals are to address all global issues that are directly or indirectly related to education and that may be addressed via effective global citizen education. Additionally, to obtain effective learning outcomes the aims are to provide affordable and high-quality primary and secondary education to every student, 12 years of free education, funding, and equality of education by targeting a deadline near the end of 2030. The SDG is important to improve students' efficiency from the very early stages of education by engaging well-trained instructors, childhood development programs, and free education programs. The efficient implementation of the SDG4 is supposed to lead to the possible solution to many global issues like unemployment, gender inequality, and others.

It was expected that by the end of 2030, all adolescents, including women and men have achieved at least reading and quantitative skills. It is to be ensured that all learners have the knowledge and experience necessary to achieve sustainable development within the prescribed period .

Research Objective II: To Examine the Current State and the Accomplishments of the Indian Government Initiatives taken to Implement SDG4

The education system throughout the world gets greatly affected by the sudden rise of Covid-19. India is among the worst affected nation by this novel corona virus. The Indian government has taken several initiatives for making education possible during this period. Apart from the current state, the government of India is keen to provide high standard education by regulating timely updating and needy changes in the education system. The current released New Education Policy 2020 is among the continuation process of educational growth under the Sustainability development goal (SDG 4). The Indian government has come up with many efforts to address the issues in the implementation of SDG4. The SWAYAM program and the National E-Library are launched with the motive to deliver quantity and quality in education. These programs enable students to enroll in courses taught by the top professors from IITs, IIMs, and other prestigious universities, as well as access associated academic materials (Kumar & Mahendraprabu, 2021). These campaigns have been quite helpful in educating the general public about the Covid-19 predicament (Singh et al., 2021). As the whole educational system moved to an online format, this project gained traction and expanded its scope. The Indian government has launched programs such as Beti Bachao Beti Padhao and PRAGATI to address issues such as gender discrimination (Jadhav & Bagul, 2021). According to current statistics, the nation's Gender Parity Index (GER) has improved dramatically, according to the All-India Survey on Higher Education (AISHE) 2019–20.42Female involvement in higher education climbed by 18.2 percent throughout this Time.43 The government sustained focus on girls' education, women's emancipation, and the enfranchisement of socially and educationally backward communities, according to the report, is reflected in the increased participation of women, SCs, and STs in postsecondary education.

CONCLUSION

Worldwide nations are engaged in making education better and available to every citizen of their respective countries. SDG 4 under the Sustainability development program is motivated to provide quality education by removing the barriers of poverty, funding, costly education, discrimination, and unavailability of resources. India is no longer behind in making the needful changes in its education system; the timely release of the national education policies is among such initiatives. This paper investigates the insights of the sustainable development goals for the upliftment of education, and the efforts put forward ensuring to reach the milestone by the end of 2030. Further, the accomplishments of the Indian government have also been investigated for the implementation of SDG4. The current state reveals the number of planned and upcoming proposals is in the way of the achievement of SDG 4 objectives. The final section of the findings pointed out the association among the different indicators of SDG 4 by implementing a machine learning-based association rule mining technique. The correlation among the indicators indicates the presence of interdependency among the indicators and will assist the regulatory bodies to perform any changes in these measures of sustainable development goals for education in the future. These findings will assist not only governing bodies in taking preventive measures while modifying existing policies and ensuring the effective enactment of SDG 4 goals but also benefits

society by understanding their role to bring sustainability to the world. The current study is only limited to the SDG4 objective and goals, whereas for a need of sustainable environment around us then the evaluation of all the sustainable goals yields equal importance.

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Exploring Corporate Governance and Sustainability Practices in Developing Economies: A Systematic Review

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Abstract

This paper systematically reviews the existing literature to explore the critical role of corporate governance in promoting corporate sustainability and achieving sustainable development goals (SDGs). By analyzing studies published between 1992 and 2024, the review identifies key internal governance mechanisms, such as board diversity, transparency, and CEO incentives aligned with sustainability, that are essential for enhancing sustainable business practices, financial outcomes, and investor appeal. The findings underscore the necessity of a governance framework that balances stakeholder interests with shareholder value to support sustainable development. The review also highlights significant trends and gaps in the current research, recommending areas for future exploration, such as the influence of firm size, industry sector, and external economic conditions on corporate sustainability. The implications for researchers, policymakers, and managers stress the importance of integrating sustainability into corporate governance practices to contribute to broader societal goals.

Keywords: *Corporate Governance, Sustainability, Sustainability Development Goals, Emerging Economics, Systematic Literature Review*

INTRODUCTION

Corporate governance and sustainable development are interlinked and necessitate global collaboration through coordinated strategies and optimal decision-making. For a company aiming to achieve sustainable development as a strategic objective, challenges such as measuring corporate sustainability, setting goals, and implementing actions and procedures must be addressed.

The Cadbury Committee's concept of corporate governance focuses heavily on value creation with minimal emphasis on stakeholders (Crifo et al., 2019). Despite this, sustainable business practices have gained traction and are now seen as crucial for long-term success (Aras & Crowther, 2008). Companies employing robust governance strategies reduce the likelihood of long-term failure by ensuring consistent performance and improving financial outcomes (Munir et al., 2019). These organizations also become more attractive to investors (Kohl, 2009; Aras & Crowther, 2008) and gain competitive advantages (World Business Council for Sustainable Development, 2012). Corporations significantly impact various stakeholders worldwide, making it essential to establish a corporate governance framework that prioritizes stakeholder and shareholder values to promote sustainable development (Aras & Crowther, 2008; UNEPFI, 2014a).

The 1992 United Nations Earth Summit in Rio de Janeiro underscored the importance of sustainability by setting sustainable development as a global standard (Ortiz-de-Mandojana et al., 2016). Many countries subsequently modified their corporate governance legislation to reflect

this standard (OECD, 2019). Diverse environments shaped by unique cultures, economies, and legal frameworks allow corporations significant flexibility in practicing good governance (Aras & Crowther, 2008; OECD, 2019; World Business Council for Sustainable Development, 2019). According to the WBCSD, it is the responsibility of companies to apply voluntary standards to promote transparent and responsible business practices (World Business Council for Sustainable Development, 2019).

The relationship between corporate governance and corporate sustainability is crucial for achieving the Sustainable Development Goals. Effective governance ensures that companies operate ethically, transparently, and sustainably, thus contributing to broader societal goals. Systematically reviewing the literature helps understand this relationship better and identify strategies to enhance corporate contributions to sustainable development.

LITERATURE REVIEW

Corporate governance and sustainability are deeply intertwined concepts, crucial for the long-term success of businesses in emerging economies. The Cadbury Committee's definition of corporate governance emphasizes the production of value, with stakeholders receiving less attention. However, the rise of sustainable business practices over recent years has highlighted the need for integrating stakeholder interests into governance frameworks. Aras and Crowther (2008) argue that robust governance strategies can mitigate the risk of long-term failure by ensuring consistent performance. This not only improves financial outcomes but also enhances a company's attractiveness to investors (Kohl, 2009).

Theoretical Frameworks and Key Concepts

The United Nations Earth Summit in Rio de Janeiro (1992) was pivotal in establishing sustainable development as a global standard, leading to significant changes in corporate governance legislation worldwide. These changes allow corporations in different cultural, economic, and legal environments to practice good governance in varied ways (Aras & Crowther, 2008; OECD, 2019). The World Business Council for Sustainable Development (WBCSD, 2019) emphasizes the responsibility of companies to apply voluntary standards to promote transparent and responsible business practices.

RESEARCH QUESTION/PURPOSE

This study aims to provide a comprehensive analysis of existing research on good governance and examine strategies for firms to incorporate a holistic sustainability strategy into their corporate governance practices. The study specifically focuses on internal corporate governance mechanisms, closely linked to management and corporate performance, rather than external mechanisms influenced by capital markets and beyond corporate control (Dharmastuti & Wahyudi, 2013). The main research question is: What internal corporate governance procedures promote company sustainability?

Numerous scientific studies have explored the relationship between various internal corporate governance procedures and business sustainability. Researchers such as Crifo et al. (2019), Lenssen et al. (2014), Walls & Hoffman (2013), Kock et al. (2012), and Walls et al. (2012) have contributed significantly to this body of research. This study utilizes a systematic review to examine and synthesize previous research findings, considering the diverse datasets

and measurements used in different studies. Additionally, the study highlights the limitations and contradictions in prior research.

SLR METHODOLOGY

This study conducts a systematic literature review to investigate the relationship between corporate governance and corporate sustainability. By following a scientifically replicable methodology, this review systematically searches for, selects, synthesizes, and analyzes pertinent scientific literature. The findings are presented clearly and replicably, allowing a comprehensive synthesis and understanding of the subject (Fink, 2020). The study adheres to the methodology proposed by Fink (2020), depicted in Figure 1, to maintain accuracy and reliability.

Prior to commencing database searches, it is essential to establish specific search phrases. The identified keywords are consolidated into a unified search string using Boolean operators (Fink, 2020). The primary keywords, corporate governance and corporate sustainability, derive from the research question to form the search string.

The study utilizes two prominent databases, Scopus and Web of Science, to locate published research on corporate governance and risk management. These databases are chosen for their widespread recognition and high academic standing (Richart-Ramon et al., 2011). The search results from the two databases initially identified 357 articles, which were screened based on titles and abstracts to eliminate duplicates and identify relevant studies. A full-text evaluation was conducted on the 154 most pertinent articles. The inclusion and exclusion criteria used to identify relevant papers and determine the final count are detailed in Table 2.

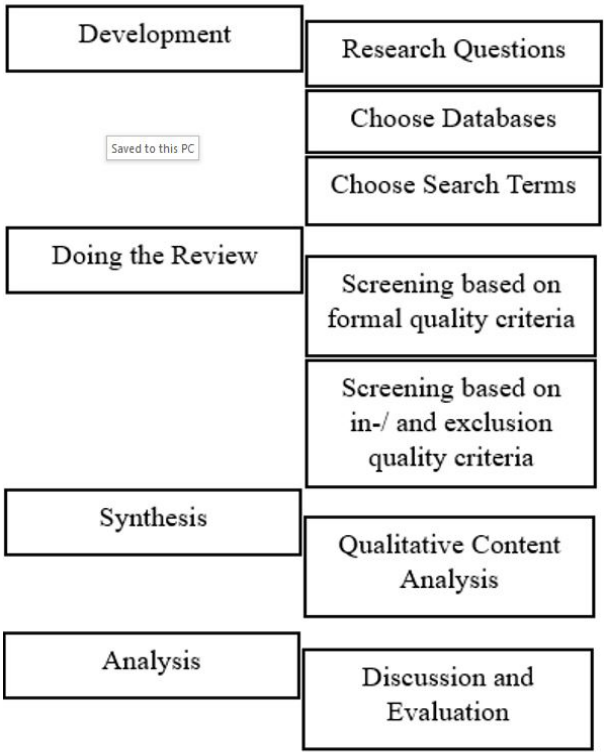


Figure 1: Process of Systematic Literature Review

Table 1: Search String Used for Review Process

Database	*Keyword/Search String*
SCOPUS	(TITLE-ABS-KEY (“corporate KEY (“corporate governance”) AND TITLE-ABS- sustainability”)) AND (LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT- TO (SUBJAREA, “SOCI”) OR LIMIT- TO (SUBJAREA, “ECON”) OR LIMIT- TO (SUBJAREA, “ENVI”)) AND (LIMIT- TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT- TO (PUBSTAGE, “final”))

Source: Scopus Database

Table 2: Search Criteria for Inclusion and Exclusion of Studies

Criterion	*Eligibility*	*Exclusion*
Literature Type	Journal (Original peer reviewed research articles)	Journals (review papers and meta-data, books, chapters in books, conference proceedings and dissertations)
Language	English	Non-English
Indexes	Scopus Web of Science	
Publication Stage	Final	In Press
Topic	Exploring Corporate Governance and Sustainability Practices in Developing Economies: A Systematic Review	

Source: Author’s own compilation

Articles predating 1992 were excluded, considering the substantial impact of the Cadbury Committee’s 1992 definition of corporate governance and the 1992 United Nations Earth Summit in Rio de Janeiro on understanding the relationship between corporate governance and sustainable development. The search results are based on searches conducted until June 15, 2024. Following inclusion and exclusion criteria (Kalia & Gill, 2023), the articles were further reduced. Given that English is the primary language in academia, the search was limited to articles written in English. To ensure the review and evaluation of high-quality research, the study included papers from A*, A, and B category journals.

FINDINGS

The systematic review uncovers several significant findings about the relationship between corporate governance and corporate sustainability, particularly in the context of developing



Figure 2: Years of Publishing

economies. These findings highlight how governance structures and practices can directly influence a company's commitment to and effectiveness in achieving sustainability goals.

- **Sample Demographics:** Figure 2 shows the studies published between 1992 and 2024, with a notable increase in recent years. The earliest study appeared in 2005, and the most recent in 2024. The volume of studies remained relatively low until the 2010s, after which it began to rise substantially.
- **Journal Outlets:** Table 3 indicates that articles on corporate governance and corporate sustainability are distributed among 40 different journals.

Table 3: Productive Journals

Journal Name	*Publisher*	*No. of Publications*
Journal of Cleaner Production	Elsevier Ltd	5
Journal of Business Ethics	Kluwer Academic Publishers	5
Sustainability Accounting, Management and Policy Journal	Emerald Group Holdings Ltd.	3
Sustainable Development	John Wiley and Sons Ltd	3
Corporate Governance: An International Review	John Wiley and Sons Inc	3
Journal of Financial Reporting and Accounting	Emerald Group Holdings Ltd.	3
British Journal of Political Science	Cambridge University Press	1
Journal of Environmental Management	Academic Press	1
Business Strategy and the Environment	John Wiley and Sons Ltd	1
Technological Forecasting and Social Change	Elsevier Inc.	1
Accounting and Finance	John Wiley and Sons Inc	1
Business Strategy and the Environment	John Wiley and Sons Ltd	1
Journal of Strategy and Management	Emerald Publishing	1
Accounting Research Journal	Emerald Group Holdings Ltd.	1
International Journal of Law and Management	Emerald Publishing	1
International Review of Financial Analysis	Elsevier Inc.	1
Journal of Management and Governance	Springer	1
Asian Journal of Accounting Research	Emerald Publishing	1
Journal of Global Responsibility	Emerald Publishing	1
International Journal of Economics and Financial Issues	Econjournals	1
Social Responsibility Journal	Emerald Publishing	1
International Journal of Disclosure and Governance	Palgrave Macmillan	1
Meditari Accountancy Research	Emerald Publishing	1
Property Management	Emerald Group Holdings Ltd.	1
Investment Management and Financial Innovations	LLC CPC Business Perspectives	1
Safety Science	Elsevier B.V.	1
Journal of Business Economics and Management	Taylor and Francis Inc.	1
Corporate Reputation Review	Palgrave Macmillan	1

Journal Name	*Publisher*	*No. of Publications*
Journal of Applied Accounting Research	Emerald Group Holdings Ltd.	1
International Journal of Accounting and Information Management	Emerald Group Holdings Ltd.	1
Corporate Social Responsibility and Environmental Management	John Wiley and Sons Ltd	1
International Journal of Finance & Economics	John Wiley and Sons Ltd	1
Auditing-A Journal of Practice & Theory	American Accounting association	1
Business & Society	Sage Journals	1
Industrial Relations	John Wiley and Sons Ltd	1
International Review of Economics & Finance	Elsevier Ltd	1
Pacific-Basin Finance Journal	Elsevier BV	1
International Journal of Auditing	John Wiley and Sons Ltd	1

Source: Author's own Compilation

- **Geographical Focus:** Table 4 shows the geographical distribution of studies across all continents, with the majority originating from America or Europe.
- **Modelling:** Table 4 highlights six out of 52 quantitative studies that explored the moderation impact of corporate governance on various factors and sustainability. The subsequent sections detail findings across several categories: board diversity (14 studies), disclosure and transparency (13 studies), board size (9 studies), board independence (8 studies), board-level sustainability committees (8 studies), ownership concentration (7 studies), CEO and incentive structures (4 studies), executive compensation (4 studies), board activity (3 studies), board membership (2 studies), and board education (1 study). Out of 52 studies, three are quantitative and based on a systematic review of corporate governance characteristics and sustainability.

Table 4: Summary of Studies showing Relationship between Corporate Governance (Characteristics) and Corporate Sustainability

Author	*Country*	*Period*	*Result*	*Corporate Governance*	*Impact on/Description*
Peters & Romi (2014)	US	2002-2006	Positive	Committee size Environmental committee Audit committee Number of committee meetings Expertise of committee members CSO Expertise	Voluntary environmental disclosure
Kend (2015)	Australia and the UK	2010	Positive	Audit client size Corporate governance structures	Sustainability report
Bernard et al. (2016)	France	1999–2011	Positive	CEOs' Turnover	Corporate Sustainability Performance

Author	*Country*	*Period*	*Result*	*Corporate Governance*	*Impact on/Description*
Lopatta et al. (2017)	Multi-Country	2003-2012	Positive	Ownership (blockholder and bank)	Corporate social responsibility
Mohamed Adnan et al. (2018)	Multi-country	2011-2016	Positive	Corporate governance National culture	Reporting on corporate social responsibility
Manning et al. (2019)	Dutch	2012-2016	Positive	Internal and external corporate governance mechanisms	Corporate sustainability reporting
Farooq et al. (2021)	UAE	2013-2017	Positive	Corporate Governance	Materiality assessment disclosure
Jadoon et al. (2021)	Multi-country	2012-2016	Positive	Quality of sustainability reporting	Corporate sustainability
Disli et al. (2022)	Multi-Country	2010-2019	Positive	Board attributes (board independence, board size, gender diversity, and board activity)	Assessment of sustainability performance using (ESG controversies, ESG score, and ESG combined score)
Bernard et al. (2023)	US	Not available	Positive	Proxy voting	ESG integration
Elsayih et al. (2023)	UK	2011-2018	Positive	Board governance dimension Carbon risks Opportunities Environmental management	Carbon management system quality
Bhat et al. (2023)	South Asia	2012-2022	Positive	Board size Board Independence Board Qualification CEO duality	Performance reporting for environmental sustainability
Lerner & Osgood (2023)	US	1986-2020	Positive	Board of directors	Climate action and policy
Chebbi (2024)	UAE	NA	Positive	Board size Independence Gender diversity	ESG-stock price crash risk

Source: Author's own Compilation (included a few in this Systematic Literature Review)

IMPLICATIONS

The findings provide a comprehensive roadmap for researchers, policymakers, and managers to collaboratively enhance corporate sustainability through improved governance practices. Each group plays a crucial role in driving the integration of sustainability into corporate decision-making. The study indicates that boards should be structured with diversity and independence while maintaining an optimal size for effective functioning. Additionally, CEOs should be incentivized to pursue sustainability strategies.

In developing economies, where regulatory frameworks and market mechanisms may be less mature, the role of corporate governance in fostering sustainability is particularly critical. The study's findings suggest that by adopting robust governance practices, companies can not only improve their sustainability performance but also enhance their competitiveness and attractiveness to investors. This, in turn, can drive broader economic development and social progress.

In summary, the findings provide a comprehensive roadmap for enhancing corporate sustainability through improved governance practices. By focusing on board diversity and independence, optimal board size, and CEO incentives, stakeholders can work together to integrate sustainability into corporate decision-making, thereby fostering a more sustainable and equitable business environment in developing economies.

ORIGINALITY/VALUE/CONTRIBUTION

The results indicate several approaches to embedding corporate sustainability within corporate governance to achieve enduring strategies. Firstly, boards should be of optimal size, with a greater emphasis on independence and diversity to foster a sustainable outlook, enhance stakeholder communication, and improve social and environmental performance. Secondly, aligning CEOs with ownership interests may effectively integrate sustainability into top management by harmonizing the interests of the company and its leaders. Thirdly, avoiding concentrated ownership can reduce short-termism. Lastly, increasing transparency and adhering to sustainability regulations by disclosing non-financial performance metrics can strengthen stakeholder orientation and long-term focus.

Despite these insights, there are limitations. The review is constrained by the availability of data in accessed databases. Managers' perspectives on corporate sustainability may be influenced by prevailing economic conditions, as their primary concern is the firm's survival (Kujala, 2010). Additionally, factors such as firm size or sector could impact the results. Future research should explore the effects of external factors, including the influence of CEOs, capital structure, and the role of transparency in integrating sustainability into corporate governance. Conducting meta-analyses focusing on specific corporate governance mechanisms, regions, or sectors would also be beneficial.

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Psychological Scarcity: The Mental Health Challenges of Joblessness in India

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Abstract

Unemployment is a serious concern in India. Unemployment may be created by a number of causes, including a large population, low educational levels, inadequate infrastructure, insufficient investment, and low productivity.It might affect young individuals, leading to decreased confidence and self-esteem, which can cause psychological distress. Unemployment not only causes economic hardship, but it also worsens emotions of worthlessness, anxiety, and despair. The stigma associated with unemployment further isolates people, limiting their social networks as well as access to psychological solutions.Unemployment and economic problems can cause significant mental and physical stress for individuals and their families. This can result in a cycle of depression, worthlessness, loneliness, and even suicide ideation. Therefore, this paper aims to investigate the complex relationship between youth unemployment and mental health in India. This study also highlights the absolute necessity for comprehensive policies that address the mental health consequences of unemployment, paving the path for a more productive, and prosperous society.

Keywords: *Unemployment, Psychological distress, Economic Hardship, Mental Health*

INTRODUCTION

India, the world's most populous country, is undergoing a significant demographic transition. With over half of the population under 25 and over two-thirds under 35, the country enjoys a demographic dividend (Saini et al., 2023). Balaram (1986), defined the demographic dividend as the rising share of working-age individuals in a population, which leads to higher economic growth rates (Chaturvedi & Saboo, 2019). The demographic dividend takes place when the proportion of working people in the total population is high, indicating that more people have the potential to be productive and contribute to economic growth. India has a unique potential to use its young people's enthusiasm, aspirations, and talents to drive change. India can become a global leader and develop if properly utilized the demographic dividend. However, achieving the demographic dividend is challenging. The complex endeavor has numerous hurdles, including the chronic issue of young adult unemployment (Saini et al., 2023). Recent research shows that youngsters face significant unemployment rates worldwide, making them one of the most vulnerable parts of the population. According to the 2011 Indian census, youth make up 28% of the population. Despite reducing dependency ratios in India, youth unemployment remains high. According to a World Bank report, India's young unemployment rate is 10% for men and 11% for women. Due to a shortage of career prospects, many young people resort to low-paying contract jobs with poor working conditions (Puhan, 2016). Many young Indians face the hard realities of unemployment or underemployment. It is closely linked to the mental health and well-being of the country's

youth(Saini et al., 2023). Unemployment, as defined by the International Labor Organization (2013), occurs when a person actively seeks work but is currently unemployed (Chaturvedi & Saboo, 2019 In other terms, unemployment refers to the amount of people who want to work but don't have one. It is the state of being out of work. It is a growing issue globally. Unemployment is caused by various factors, including rapid population expansion. Slow industrial development is a major cause of unemployment. Despite the importance of industrialization, it has little impact on employment opportunities. Poor planning may also contribute to unemployment. Currently, no plan exists to eliminate unemployment (Kaur, 2020).

Unemployment often leads to stress, worry, and sadness. It might range from self-injury to difficulty in supporting one's family and satisfying their basic necessities(Imam & Ansari, 2018). According to the World Health Organization (WHO), Indian youth have the world's highest rate of depression. India's average suicide rate is 10.9 per lakh people. The majority of those who commit suicide are under the age of 44. Mental health issues may be both a result and the cause of unemployment and poverty(Chaturvedi & Saboo, 2019).

Unemployment can lead to physical, social, and psychological issues, particularly among young who are more vulnerable to substance addiction,suicideand accidents.Unemployed youth experience feelings of emptiness, hopelessness, guilt, worthlessness, unhappiness, rage, low self-esteem, frustration, and social alienation, which impact their identity(Swamy, 2021).

Addressing youth unemployment is a social justice and human rights issue, as well as an economic imperative. Creating a supportive environment that acknowledges young people's mental health issues, eliminates unemployment, and gives access to mental health supports is crucial. To address young unemployment, India can leverage its youth population to drive development and prosperity. Addressing the problems and mental health implications of youth unemployment will help India's young residents contribute to economic growth while also developing resilience and empowerment (Saini et al., 2023).

OBJECTIVES OF THE STUDY

The main objectives of the study are:

- To investigate the complex relationship between youth unemployment and mental health in India
- To uncover the complexities and causes of youth unemployment
- To analyze the challenging situations faced by unemployed youth
- To propose valuable solutions for addressing the challenges of youth unemployment

LITERATURE REVIEW

Young adults are crucial for development, driving social change and economic development (Petry, 2002;Dev&Venkatanarayana, 2011).Youth employment in a country is crucial for its development. In recent years, India has struggled with unemployment due to not succeeding government policies and inadequate skill training and education. India, a large country, is grappling with widespread unemployment. Unemployment can hinder a nation's growth and development, but good employment ensures progress(Bhat & Joshi, 2020). India's educated youth are experiencing high unemployment rates. Graduates and postgraduates are constantly hunting for work. During economic downturns, there is an increase in the number of unemployed individuals who lack education. Many educated persons apply for clerk positions but are disappointed when

they see a 'No Vacancy' sign on the door. India's education system is mostly responsible for high unemployment rates among educated individuals (Kaur, 2020).

Unemployment causes not only economic disadvantage but also psychological issues such as anxiety, stress, depression, low quality of life, high crime, suicidal impulses, and suicidal ideation among unemployed young(Mir et al., 2016). Unemployment can have an impact on mental health as well. A meta-analysis of 140 studies found that losing a job negatively impacts mental health, but re-employment improves it (Paul & Moser, 2009). Bordea et al. (2017) investigated how unemployed persons cope with anxiety, sadness, and stress. The study found an association between unemployed individuals' coping techniques and their levels of worry, stress, and despair. Olesen et al. (2013) investigated the impact of mental health on future employment prospects. The study found that mental health was both a risk factor and a consequence of unemployment.

Research consistently shows that unemployment leads to lower levels of happiness and higher levels of mental distress compared to employment (Clark &Oswald, 1994; Dooley et al., 1987;Theodossiou, 1998; Gedikli et al., 2023).Islam&Amanullah (2024) examined the impact of unemployment on mental health among Bangladeshi university graduates.Unemployment is associated with moderate to severe mental health issues. Contrarily, McKenna &Fryer (1984) found that some unemployed people may not feel negative psychological effects. Fineman (1987) found that some people coped better with unemployment than with low-paying jobs.

A study was conducted to investigate the gender differences in the correlation between health-related quality of life and work status. Research suggests that working persons have a higher quality of life compared to non-working adults (Noh et al., 2015). Unemployment negatively impacts young people's psyche, causing low self-esteem, loss of social roles, dysfunctional relationships, and decreased quality of life (Petros et al., 2015). Long-term unemployed individuals experienced greater episodes of depression compared to those who were unemployed for shorter periods. Females are more likely to experience depression as they get older (Stankunas et al., 2006).

Unemployment and stressful life events can induce psychological strain and worsen mental health, leading to stable neurotic tendencies over time. Research suggests a link between stress, anxiety, and neuroticism (Payne & Hartley, 1987). A study on "youth unemployment and crime" found that higher unemployment rates lead to more burglaries, thefts, and drug offenses (Fougere et al., 2009). Vogli et al. (2015) investigated the link between unemployment and smoking cigarettes in Italy. The data was analyzed using regression According to the survey, people who are unemployed smoke more. Smoking was associated with a higher level of difficulty in handling key life situations compared to nonsmokers. Unemployment often leads to feelings of sorrow or depression, as found by (Stankunas et al., 2006). Waheed (2002) defined unemployment as a significant social issue. Unemployment, corruption, and rising crime are major contributors to individual poverty (Mir et al., 2016).

Unemployment can harm mental health, including sadness and low self-esteem, in addition to increasing illness risk. Alienating relatives and friends, or feeling alienated, can lead to a lack of life support. A study discovered a negative correlation between jobless youth's mental health and poverty in their parents' households (Bacikova-Sleskova et al., 2007). Unemployment is linked to misery for both people who are unemployed and those who are employed but fear losing their jobs due to job uncertainty. Unemployment has been linked to unfavorable health outcomes, both physical and psychological, that worsen over time (Bell DN, 2010). Brereton et al. (2008)

concluded unemployed individuals are similarly unsatisfied, regardless of gender. Fougere et al. (2009) found rising young adult unemployment leads to higher rates of burglaries, thefts, and drug offenses. Gallie et al. (1998) concluded unemployment negatively impacts life satisfaction. Working adults reported higher quality of life compared to non-working adults (Mir et al., 2016).

Several research have shown an association between unemployment and suicide country. This, not only causes personal misery but also creates social conflicts that might undermine civilization as a whole. After extended periods of unemployment, young people often engage in illicit activities to make money (Economy, 2019). Unemployment typically leads to drug and alcohol addiction or suicide attempts, resulting in a loss of human resources for the country (Jaiswal & Srivastava, 2020).

Unemployment is a frightening issue these days that cannot be avoided. High unemployment rates can lead to anxiety, stress, and sadness. Unemployment has been linked to increased worry, stress, and sadness. This link poses significant challenges for mental health professionals. If this connection is not broken, it is estimated that over half of the population will experience it. Unemployment and economic problems can cause significant mental and physical stress for individuals and their families. This relationship can trigger worry, tension, and depression symptoms. This can result in a cycle of depression, worthlessness, loneliness, and even suicide ideation (Kaur, 2020).

Therefore, this paper aims to investigate the complex relationship between youth unemployment and mental health in India. It aims to reveal the complexities, causes, and complicated situation and offers some valuable solutions in order to cope up the challenges.

UNEMPLOYMENT RATES IN INDIA

Unemployment is a major concern in India, impacting millions of individuals and the economy. Despite being one of the world's fastest-growing economies, India still faces challenges in providing required employment opportunities for its rising population. The unemployment rate in India has changed throughout time due to a variety of economic, political, and global influences.

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Unemployment rate	5.44	5.42	5.36	5.33	5.27	8	5.98	7.33	8.003	6.57 (Jan. 2024)

Source: CMIE

According to CMIE's Consumer Pyramids Household Survey, India's unemployment rate increased to 8.1 percent in April 2024, up from 7.4 percent in March. The unemployment rate climbed in both urban and rural India. The rural unemployment rate increased to 7.8% in April from 7.1% in March. The urban unemployment rate increased from 8.1 percent to 8.7 percent.

According to India State Wise 2022 statistics, Haryana had the greatest unemployment rate last month (37.4%), while Odisha had the lowest percentage (0.9%).

Any country's economic success is highly dependent on its youth employment (Bhat & Joshi, 2020). As per the India Employment Report 2024, released by the International Labor Organization and Institute of Human Development,India's youth makeup about 83% of the jobless workforce, while the proportion of young people with secondary or higher education among the total unemployed has nearly doubled, from 35.2% in 2000 to 65.7% in 2022.It is a situation of concern.

UNEMPLOYMENT AND MENTAL HEALTH

Mental health is a major concern nowadays. One of the major reasons for poor mental health is the lack of employment opportunities. It not only impacts the economic state of an individual but also the mental state of an individual. According to the World Health Organization (WHO), mental health is a state of mental well-being that enables people to deal with life's stresses, recognize their own strengths, study and work well, and contribute to their communities.

Mental health is a significant issue these days. According to the National Mental Health Survey 2019, around 14% of all individuals in India have or will have a mental illness of some sort. Nearly 56 million individuals in the country are said to suffer from depression, with an additional 38 million suffering from anxiety disorders.

WHO states that the economic impact of poor mental health in the country would exceed $1.03 trillion between 2012 and 2030. Studies have indicated that unemployment has negative psychological effects that have a significant influence on people's mental health (Petros et al., 2015). The high rates of youth unemployment in India have a substantial influence on young people's mental health. The stigma connected with unemployment might cause youth to feel inadequate, anxious, and depressed. According to psychology, people react to stressful circumstances, like unemployment, in stages. Initially, individuals experience shock yet remain optimistic. Unemployment can lead to pessimism, unhappiness, and a loss of enthusiasm for one's current condition. Unemployment can lead to negative psychological well-being, including frustration, worry, disappointment, stress, and despair. Cross-sectional studies have shown a link between unemployment and several psychological well-being measures (Kaur, 2020). Unemployment can lead to financial hardship, family breakdown, boredom, alienation, shame, social isolation, crime, deterioration of work skills, and health issues (McClelland & Macdonald, 1998). Unemployment has been linked to negative health outcomes and low life satisfaction among young people, as found by Bell & Blanch Flower (2010). Unemployment has been linked to unfavorable health outcomes, both physical and psychological, that worsen over time (Mir et al., 2016).

Unemployment can lead to low self-esteem, feelings of rejection, and hostility against society. They struggle with resentment, frustration, and sadness over time. They develop a sense of inability to control their own lives (Fatourou, 2010). Unemployment can lead to excessive smoking and drinking, as well as increased stress and mental health issues like homelessness and relationship breakdowns.

Unemployment can affect mental health differently depending on its duration. There are other theories on how it may vary. Some say that job loss causes the most profound trauma at the time, while others argue that the guilt, social isolation, and material hardship associated with unemployment may worsen with time (Bhat & Joshi, 2020). The researcher discovered that unemployment affects individuals differently. It can negatively impact one's emotional and physical health, as well as generate significant stress in life. Further research is needed to find supportive components in one's life that can mitigate the impacts of unemployment (Holland, 2012). Youth unemployment can cause emotions of inadequacy and low self-esteem. Many young people want to be financially independent and support their families. However, being unable to get a job can be emotionally unpleasant. Feelings of inadequacy can lead to worry, sadness, and isolation. Unemployment can negatively impact the mental health of young people, creating a cycle of both unemployment and mental health issues (Saini et al., 2023).

In 1985, Linn et al. conducted a prospective study comparing the impact of stress on unemployed and employed individuals. The study found that unemployed individuals had higher levels of somatization, depression, and anxiety .However, there was a significant standard variance in self-esteem scores, showing that some unemployed people fared better than others. Depression is a common mental condition characterized by low mood, loss of interest, feelings of guilt, low self-worth, disrupted sleep or eating, low energy, and impaired focus.Anxiety is characterized by tension, worry, and bodily changes such as high blood pressure (Imam & Ansari, 2018). While education is generally viewed as a means of overcoming poverty and securing a better future, young unemployment might diminish its significance. Many young Indians invest time and finances in higher education to improve their job chances. Graduates who struggle to find employment may lose faith in the education system. Disillusionment can lead to a lack of faith in the system and a reluctance to pursue higher education, despite its potential benefits in the long run. Unemployment among youth might negatively impact their physical health.

Youth unemployment has a severe impact not just on the economy and society, but also on politics. Unemployment and dissatisfaction among youth might contribute to political instability. Young people are often at the vanguard of social change movements. If their concerns are not addressed, it can lead to protests, rallies, and political instability.

Another major concern about youth unemployment in India is the possibility of higher crime rates. Young people who cannot find legal employment may resort to illicit activities to survive. This can lead to increased crime, such as theft, drug trafficking, and other illegal activities, which injure individuals and weaken social cohesiveness and security (Saini et al., 2023).

Tcherneva (2017), defined unemployment as similar to a virus or epidemic, and economists and policymakers should treat it accordingly. Young people often engage in unlawful activities for financial gain. Unemployed individuals may engage in antisocial behavior due to a lack of faith in democratic values. Unemployment is a major concern in third-world countries, particularly India, which has the second biggest population(Swamy, 2021). After going through the previous studies, it can be said that unemployment can negatively impact the mental health of young people. It is primarily associated with numerous health conditions that require rapid attention (Sunitha & Gururaj, 2014).

CONCLUSION

Unemployment is a significant concern in India. Despite being one of the fastest-growing economies in the world, the country struggles to generate sufficient employment opportunities to match its growing population. This issue has far-reaching consequences, impacting not only the financial and social stability of individuals but also their long- term career, their mental well-being.

- **Economic Impact:** The lack of employment opportunities leads to financial instability for individuals and families. Without a steady income, it becomes challenging to meet basic needs, save for the future, and invest in personal development. This financial strain can ripple through the economy, reducing consumer spending, which in turn can stifle economic growth.
- **Social Impact:** Unemployed people may face societal stigma, resulting in low self-esteem. It may also cause stress in families, leading to conflict or strained connections.
- **Long-term Career Impact:** Prolonged unemployment can cause skill deterioration, making it more difficult for people to re-enter the job market. Employment gaps can have an impact

on future work possibilities, since employers may perceive prolonged unemployment adversely.

- **Community Effects:** High unemployment can lead to increased crime rates since people may turn to criminal activities for a living.
- **Mental Health Impact:** Unemployment has a profound impact on mental health. Research consistently shows that unemployment is closely related to increased levels of depression, anxiety, and low self-esteem. The absence of work can lead to feelings of sadness, a sense of failure, and hopelessness. These negative emotions can exacerbate mental health issues, leading to a vicious cycle where poor mental health further diminishes an individual's ability to find and retain employment.

Unemployed individuals often experience social isolation and a loss of purpose, which can contribute to a decline in mental health. The stigma associated with being unemployed can also result in a sense of shame and embarrassment, compounding the psychological burden.

ADDRESSING THE ISSUE

To mitigate the psychological effects of unemployment, comprehensive interventions are required:

Additionally, providing access to mental health resources is crucial in addressing the multifaceted mental health issues associated with unemployment. Public awareness campaigns can also play a role in reducing the stigma associated with unemployment and mental health issues, encouraging individuals to seek the help they need.

Unemployment in India is a complex issue that necessitates a comprehensive strategy. Addressing both the economic and mental health impacts of unemployment is essential to improve the well-being of individuals and the overall health of the economy. Through targeted interventions, support systems, and effective government policies, it is possible to mitigate the negative effects of unemployment and foster a more resilient and inclusive society.

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The Rise of DEI in Research: A Bibliometric Trend Analysis (2002–2024)

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Abstract

The integration of Diversity, Equity, and Inclusion (DEI) principles within the realm of research has emerged as a paramount concern, reflecting a transformative shift in scholarly paradigms. This paper presents a comprehensive literature review, encapsulating the historical trajectory, bibliometric trends, challenges, and future directions pertaining to the rise of DEI in research. Grounded in seminal works by scholars such as Bell and hooks, the paper delineates the evolution of DEI from nascent advocacy efforts to institutionalized frameworks within academia. Through a meticulous bibliometric analysis, key trends including increased publication volume, geographic and disciplinary distribution, collaborative networks, and citation impact are elucidated. Despite these advancements, persistent challenges such as tokenism and measurement issues necessitate concerted attention. Moving forward, the paper articulates objectives aimed at refining methodologies, embracing a global perspective, and embedding DEI principles institutionally. By elucidating the transformative potential of DEI in research, this paper endeavors to contribute to the ongoing discourse surrounding inclusivity and equity within the academic sphere.

Keywords: *Diversity, Equity, Inclusion, DEI, bibliometric, Biblioshiny*

INTRODUCTION

In recent years, the focus on Diversity, Equity, and Inclusion (DEI) has intensified across various sectors, including academia, corporate environments, and public policy. This growing emphasis reflects a broader societal recognition of the importance of fostering inclusive environments that promote equality and respect for all individuals, regardless of their background. The academic world, in particular, has seen a significant increase in research dedicated to exploring various aspects of DEI, ranging from theoretical frameworks to practical applications in different fields.

The rising prominence of DEI topics within academic research underscores a global movement towards acknowledging and addressing systemic inequalities and biases. This shift is not only evident in the increased volume of DEI-focused publications but also in the diversification of research methodologies and interdisciplinary approaches used to study these issues. Researchers are increasingly drawing on insights from sociology, psychology, education, business, and other disciplines to build a comprehensive understanding of DEI dynamics and to develop effective strategies for promoting inclusivity.

The purpose of this study is to provide a comprehensive analysis of the trends in DEI research through the lens of bibliometric. Bibliometric, which involves the quantitative analysis of written publications, offers valuable insights into the evolution of research topics, the impact of scholarly

work, and the interconnections among researchers and institutions. By examining patterns in publication output, citation networks, and the emergence of key themes, this study aims to map the trajectory of DEI research and identify the factors driving its growth and development.

DEI research, highlighting significant milestones and influential works that have shaped the field (Ahmed, 2012; Harper, Patton, & Wooden, 2009). Additionally, it will analyze the geographical distribution of research output, the collaboration patterns among researchers, and the thematic evolution of DEI topics over time (Dill & Zambrana, 2009; Gonzales & Murakami, 2016). This bibliometric trend analysis will not only shed light on the current state of DEI research but also provide a roadmap for future investigations, helping to identify gaps in the literature and areas ripe for further exploration (Hurtado, 2007). In conducting this analysis, several key questions will guide our inquiry: How has the volume of DEI research publications changed over time? What are the most influential publications and who are the leading authors in this field? How do collaboration patterns among researchers influence the development of DEI knowledge (Freeman & Huang, 2014)? Which geographical regions are contributing most significantly to DEI research, and how does this vary across different disciplines (Smith, 2009)? By addressing these questions, the study aims to offer a nuanced understanding of the DEI research landscape.

The findings of this bibliometric analysis will have important implications for a variety of stakeholders, including policymakers, educators, and academic institutions. For policymakers, understanding the trends in DEI research can inform the development of policies that promote equity and inclusion at both national and institutional levels. Educators can benefit from insights into emerging DEI themes to enhance curriculum development and pedagogical practices. Academic institutions can use the findings to support DEI initiatives and foster an inclusive research environment.

Ultimately, this study seeks to contribute to a deeper understanding of how DEI has emerged as a pivotal area of academic inquiry and to underscore the ongoing need for rigorous research that supports the creation of more inclusive and equitable societies. By illuminating the trends and trajectories in DEI research, this bibliometric analysis aims to inform policymakers, educators, and researchers about the progress made and the challenges that remain, fostering a more inclusive future for all. The aim of this study is:

1. To analyze the annual trend in publications about diversity equity and inclusion by examining the number of published articles on this topic over a specified time period.
2. To identify the author(s) and journal(s) that have made significant contributions to research on diversity equity and inclusion by assessing the impact and relevance of their published work.
3. To ascertain which countries are at the forefront of publishing papers on diversity equity and inclusion by examining the distribution and concentration of publications across different nations.
4. To propose future directions for integrating DEI into research practices.

HISTORY AND BACKGROUND

DEI has grown in importance over the past ten years as a moral, tactical, and financial need (World Economic Forum, 2020).(Ferraro et al.2023). Several companies discovered around this time that integrating diversity and inclusion into strategy and culture accomplished more than just forging new connections (Rosenkranz et al. 2021). Diversity, Equity, and Inclusion

(DEI) have increasingly become focal points within research, prompting extensive exploration of their integration and impact. In general, diversity refers to the representation of actual or perceived physical or sociocultural variations among individuals in markets, organizations, and research.Diversity can take many different forms and pertain to different groups, including those based on age, sexual orientation, gender, race, or ethnicity (Loosemore and Lim 2016). as well as aptitude (Bailey et al. 2022). Equity is the fairness of treating people equally in terms of opportunity and outcome. Inclusion is the process of fostering an atmosphere in which different groups feel valued and integrated; it is commonly understood as a response to marginalisation or exclusion. (Arsel, Crockett, & Scott, 2021). Initially rooted in the mid-20th century's civil rights movements, DEI's trajectory within academia has evolved through distinct phases. Early advocacy efforts by scholars such as Bell and hooks highlighted systemic biases and called for more inclusive research paradigms. This initial groundwork led to institutional changes in the late 20th and early 21st centuries, with policies and programs aimed at diversifying both researchers and research subjects. In recent years, DEI has been subject to rigorous assessment through bibliometric analyses, revealing notable trends. These include a surge in DEI-related publications across various disciplines and geographical regions, indicative of a global recognition of its significance. Moreover, collaborative networks have formed, fostering interdisciplinary and international dialogue on DEI in research. Critically, studies have shown that research incorporating DEI principles tends to garner higher citation rates, underscoring its academic impact. However, challenges persist, notably the risk of tokenistic approaches and the absence of standardized evaluation metrics. Moving forward, efforts are directed towards refining methodologies, adopting a global perspective, and embedding DEI principles into the core values of research institutions. This literature review illuminates DEI's transformative potential within the research landscape, signaling a promising trajectory towards a more inclusive and impactful academic community.

Diversity, Equity, and Inclusion (DEI) have emerged as pivotal pillars in the contemporary research landscape, reflecting a profound evolution from earlier eras characterized by systemic biases and exclusionary practices. Rooted in the advocacy efforts of seminal scholars like Bell and hooks during the civil rights movements of the mid-20th century, DEI principles have traversed a transformative trajectory, gradually gaining institutional recognition and support. This recognition has catalyzed tangible changes within academia, with academic institutions and funding agencies increasingly implementing policies and programs aimed at fostering diversity among both the research workforce and the subjects of study. The consequential impact of these initiatives is evidenced by the notable proliferation of DEI-related publications across a multitude of disciplines and geographical regions. This surge in scholarly output signifies a growing global acknowledgment of the indispensable role that DEI plays in shaping research practices and outcomes. Moreover, the collaborative ethos inherent in contemporary research endeavors has facilitated the organic formation of networks and communities centered on the ethos of DEI. These platforms serve as conduits for fostering interdisciplinary and international dialogues on the nuances of DEI within research contexts. Notably, research endeavors that conscientiously incorporate DEI principles have demonstrated a propensity for yielding higher citation rates, underscoring their burgeoning academic influence and recognition. Nonetheless, amidst these strides, formidable challenges persist. Chief among these is the looming specter of tokenistic approaches to DEI, wherein superficial measures are adopted sans genuine structural transformation

(Ahmed, 2012). Additionally, the dearth of standardized metrics for rigorously evaluating the efficacy of DEI initiatives poses a formidable impediment to the attainment of comprehensive progress (Chun & Evans, 2016). Looking ahead, there is a resounding consensus among scholars and practitioners regarding the imperative of refining methodological frameworks to seamlessly integrate DEI into research practices and analytical frameworks (Dill & Zambrana, 2009). This entails embracing intersectional paradigms that adeptly navigate the multifaceted dimensions of diversity (Crenshaw, 1991). Furthermore, there is an emergent imperative to adopt a global outlook in DEI research endeavors, thereby acknowledging and honoring the rich tapestry of contexts and experiences intrinsic to researchers and research subjects worldwide (Perry, Moore, Edwards, Acosta, & Frey, 2009). Crucially, effectuating enduring change necessitates the embedding of DEI principles into the bedrock values and operational modalities of research institutions (Smith, 2009). This strategic anchoring serves as the linchpin for fostering the sustained efficacy and impact of DEI initiatives over the long term. In summation, while the journey towards achieving greater DEI within the research sphere is replete with complexities and challenges, it represents a steadfast march towards the creation of a more inclusive, equitable, and ultimately transformative research community.

RESEARCH METHODOLOGY

The bibliometric analysis for this study was conducted using data exclusively sourced from the Scopus database, covering the timespan from 2002 to 2024. The dataset includes a total of 1,343 documents published across 666 sources, such as journals, books, and conference proceedings. These documents exhibit an annual growth rate of 27.62%, indicating a significant increase in scholarly output over the specified period. On average, each document is approximately 2.24 years old, and the average number of citations per document stands at 5.95, with a total of 59,169 references cited across all documents.

The analysis also examines the content of the documents, which comprises 2,190 Keywords Plus (ID) and 3,357 Author's Keywords (DE). The dataset encompasses contributions from 4,327 authors, among which 273 have produced single-authored documents. In terms of authorship collaboration, there are 289 single-authored documents, with an average of 3.48 co-authors per document. Notably, 12.73% of the documents involve international co-authorship, highlighting the global nature of the research collaborations.

The document types within the dataset include 1,066 articles, 88 book chapters, 94 conference papers, and 95 reviews. This diverse array of document types reflects the comprehensive nature of the research outputs analyzed in this study.

DISCUSSION AND ANALYSIS

Main Information About Data

Timespan	2002:2024
Sources (Journals, Books, etc.)	666
Documents	1343
Annual Growth Rate %	27.62
Document Average Age	2.24
Average citations per doc	5.95
References	59169

DOCUMENT CONTENTS	
Keywords Plus (ID)	2190
Author's Keywords (DE)	3357
AUTHORS	
Authors	4327
Authors of single-authored docs	273
AUTHORS COLLABORATION	
Single-authored docs	289
Co-Authors per Doc	3.48
International co-authorships %	12.73
DOCUMENT TYPES	
Article	1066
Book chapter	88
Conference paper	94
Review	95

Using information from Scopus, this table provides a bibliometric overview of academic production from 2002 to 2024. With a noteworthy yearly growth rate of 27.62%, it consists of 1,343 documents published across 666 sources. The average age of a document is 2.24 years, and there are 5.95 citations on average per document. The dataset includes contributions from 4,327 authors, with an average of 3.48 co-authors per document and 273 single-authored documents. Furthermore, 12.73% of the documents mention working with foreign partners. 1,066 articles, 88 book chapters, 94 conference papers, and 95 reviews are among the document categories that were examined.

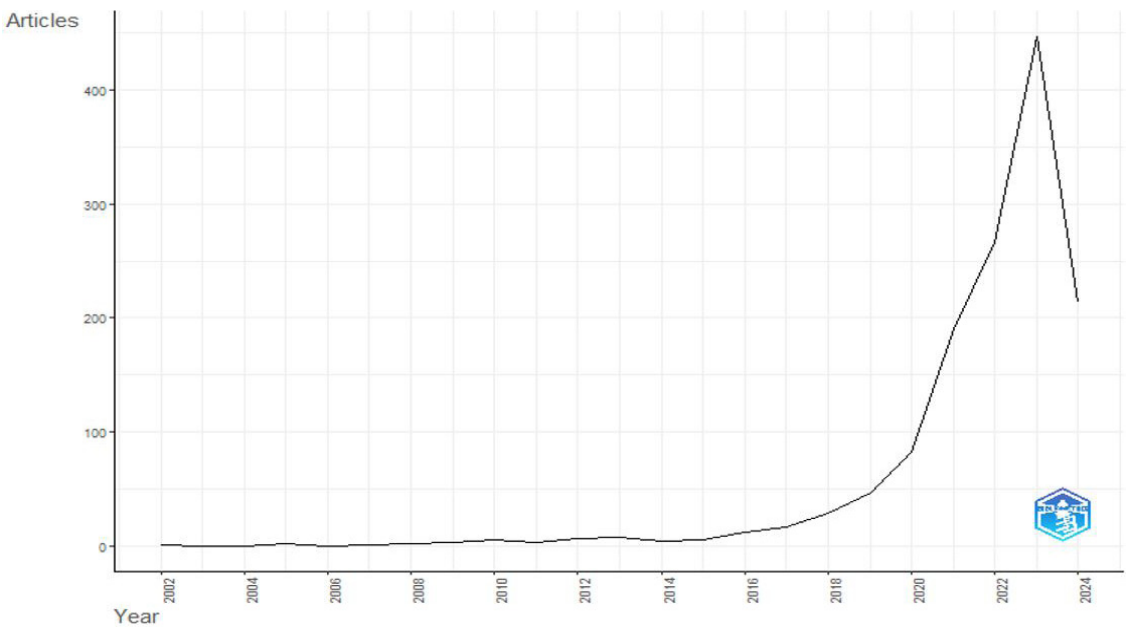


Figure 1: Annual Scientific Production

The graph "Annual Scientific Production" shows how many scientific publications will be produced each year between 2002 and 2024. The annual publishing rate was initially modest and steady, from 2002 to around 2015, suggesting that there was little increase in scientific production during this time. But since 2016, there has been a discernible rise in the number of articles published annually, indicating a rise in interest in and activities related to scientific research. From 2020 to 2022, this pattern culminates in a notable upsurge, with over 400 published papers reaching a spectacular peak in 2022. This sharp rise may be explained by things like more financing for research, world events prompting more scientific investigation, or faster publication times brought about by technical developments. The line chart indicates a dramatic drop in the number of articles produced in 2023 and 2024 after this high. The graph does not explain the decline, but possible causes include shifting priorities in research, less financing for research, or other outside variables that have an impact on publishing rates. Overall, the graph shows that, beginning in 2016, scientific publications have grown exponentially, reaching a peak in 2022, and then noticeably declining in the years that follow. These trends are indicative of large variations in the amount of research Produced each year .The graph shows an exponential growth tendency in scientific publications beginning in 2016 and reaching a high in 2022, with a noticeable decline in the years that followed. This graph reveals notable variations in the yearly production of science, most likely caused by a mix of internal and external

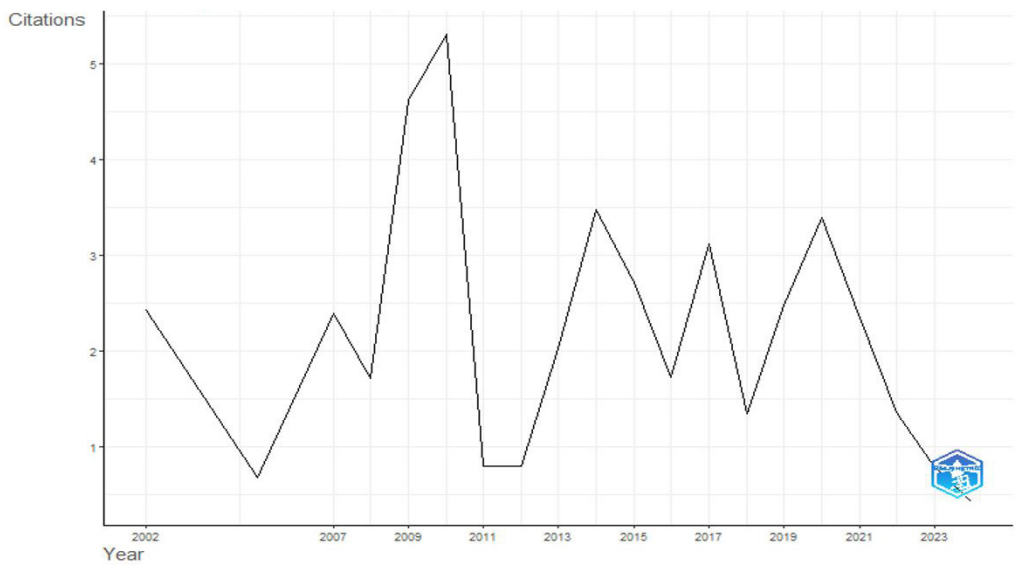


Figure 2: Average Citations Per Year

The figure "Average Citations per Year" shows how many citations scientific articles received on average between 2002 and 2023. The citation averages show substantial swings in the early years, from 2002 to around 2009; during 2009, the average number of citations per article reached a notable peak of over five. But after this peak, there comes a precipitous fall, and by 2011, the average number of citations is almost nonexistent. The average annual citations show a more consistent but erratic pattern starting in 2011, with multiple peaks and troughs signifying cyclical increases and reductions in the articles' influence or awareness. The overall trend from 2011 to 2020 indicates that, with some variance, citation averages primarily fall between one and four

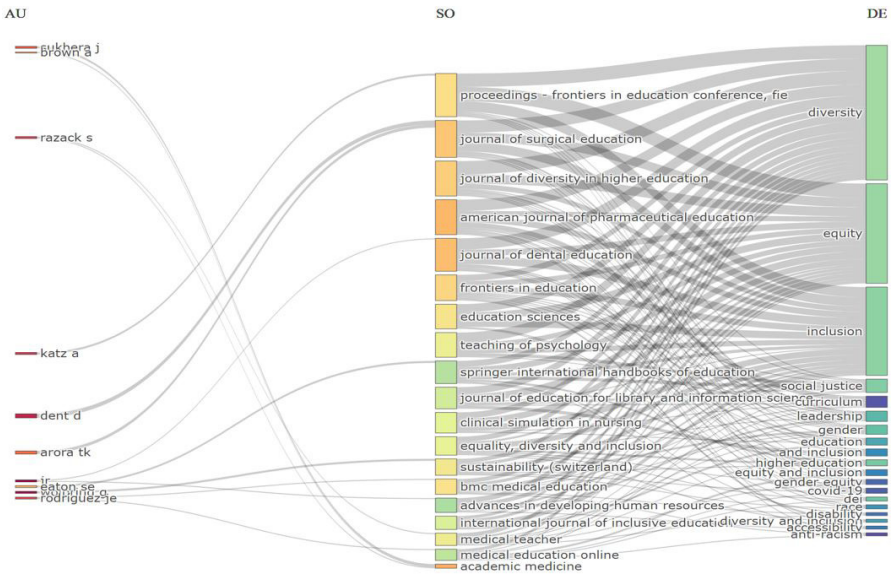


Figure 3: Three Field Plot

per year. Notably, the average number of citations decreases sharply after 2020 and reaches a low point in 2023. This latest decline can be the result of a slower rate of citation accumulation for more recent works or a decline in the total citation impact of the articles released in those years. All things considered, the graph shows how the influence of scientific publications has changed over time, with notable early peaks, a stable period marked by mild variations, and a dramatic recent fall in average citations.

The lines in the Sankey diagram represent the flow of academic contributions from authors to publication sources and then to thematic descriptors. Each line connecting an author (AU) to a source (SO) indicates that the author has published work in that specific journal or conference. Lines from sources (SO) to descriptors (DE) illustrate the thematic categorization of the publications, such as diversity, equity, inclusion, etc. This means that if an author is linked to multiple sources, they have published in several venues, and if a source is connected to multiple descriptors, it indicates that the publications within that source cover a variety of themes. For instance, "sukhera j" is shown to have published in the "proceedings – frontiers in education conference, fie" under the theme of "diversity," while "katz a" has multiple publications categorized under different themes like "equity" and "inclusion" in different journals. This visual representation helps identify the relationships and thematic distribution of academic contributions comprehensively.

The scatter plot illustrates the distribution of the number of documents across various academic journals and conference proceedings in the field of education. The vertical axis lists these sources, while the horizontal axis indicates the number of documents, ranging from 0 to over 50. Each blue circle on the plot represents a source, with the number inside indicating the count of documents published by that source. Notably, the "Journal of Diversity in Higher Education" stands out with 52 documents, making it the most prolific source. Other sources such as the "American Journal of Pharmaceutical Education" and the "Journal of School Psychology" have significantly fewer publications, with 18 and 17 documents respectively. This visual representation emphasizes the prominence of certain sources in contributing to educational research.

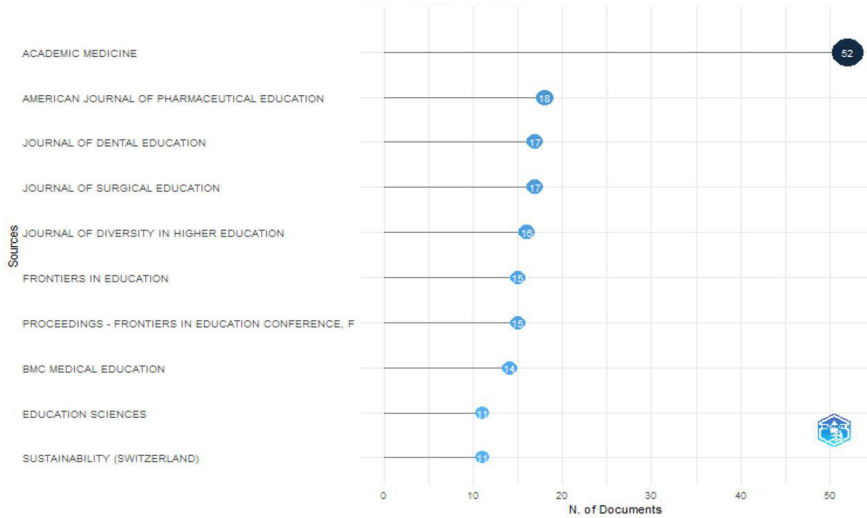


Figure 4: Most Relevant Sources

The graph illustrates the application of Bradford's Law to identify core sources of academic articles within the field of education. The vertical axis represents the number of articles, ranging from 0 to over 50, while the horizontal axis ranks sources on a logarithmic scale based on their productivity. The shaded area labeled "Core Sources" highlights the most prolific journals, with "Academic Medicine" leading with over 50 articles. As the ranking progresses from left to right, there is a steep decline in the number of articles published by each subsequent source, which then gradually levels off. This pattern demonstrates Bradford's Law, which states that a few key journals contribute the majority of articles in a field, whereas numerous other sources contribute fewer articles. Examples of highly ranked sources include the "American Journal of Pharmaceutical Education," "Journal of Dental Education," and "Journal of Diversity in Higher

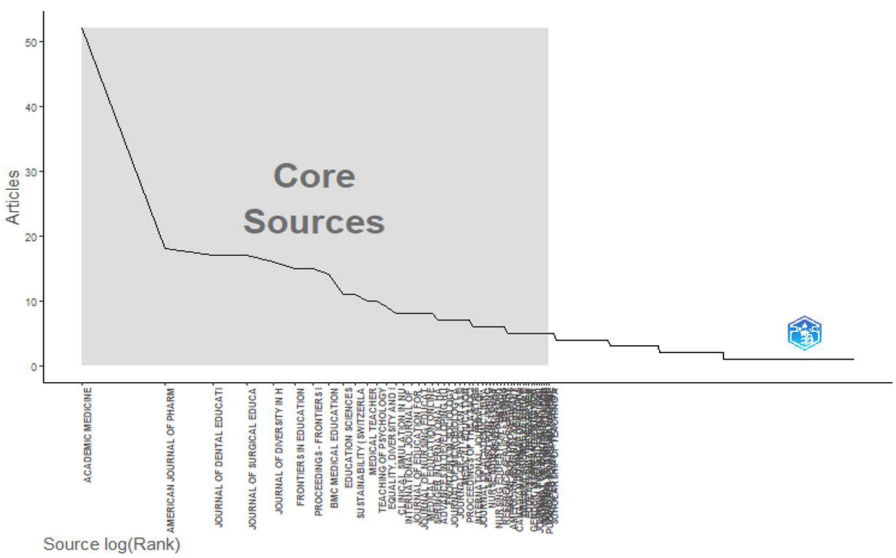


Figure 5: Core Sources by Bradford's Law

Education." This visualization effectively underscores the concentration of academic output within a small number of core journals.

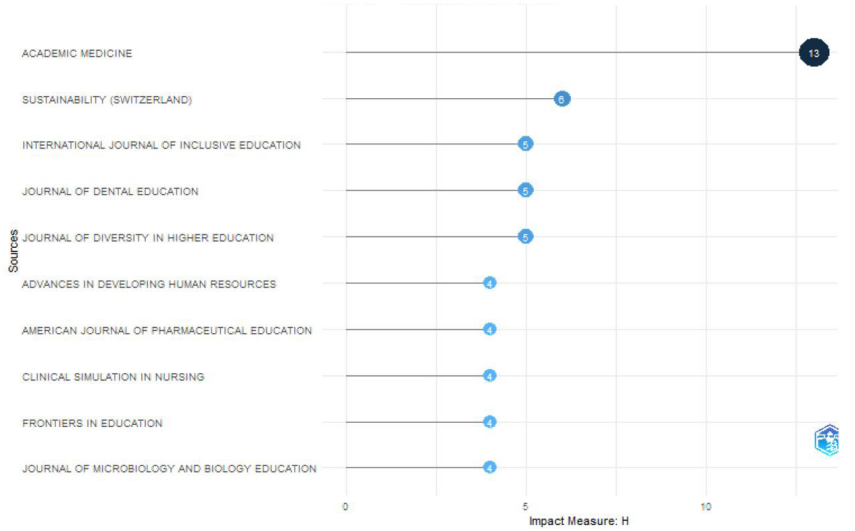


Figure 6: Sources Local Impact by H-index

The provided graph illustrates the relationship between the sources and their local impact as measured by the H-index. The H-index is a metric that gauges the productivity and citation impact of the publications of a scientist or scholar. The graph includes a selection of journals, each represented by a blue dot corresponding to its H-index value. At the top, "Academic Medicine" stands out with the highest H-index of 13, indicating significant influence and citation within the academic community. Following this, "Educational Psychologist" has an H-index of 6, which, while lower than "Academic Medicine," still reflects a notable impact. Several journals, including "International Journal of Inclusive Education," "Journal of Diversity in Higher Education," and

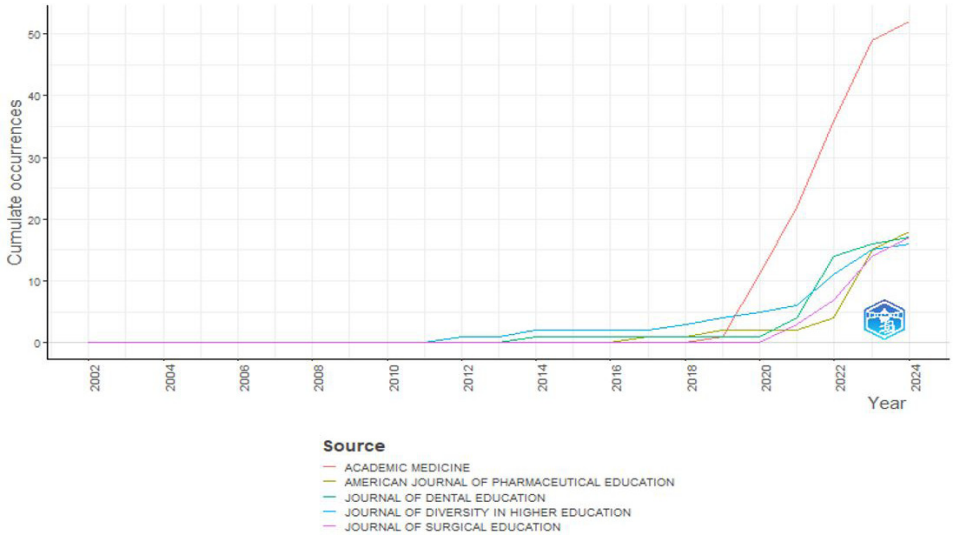


Figure 7: Sources Production Over Time

"Advances in Developing Human Resources," all share an H-index of 5, suggesting a relatively similar level of influence within their respective fields. Further down, journals like "American Journal of Pharmaceutical Education" and "Frontiers in Education" have an H-index of 4. This indicates they have a moderate impact, somewhat lower than the previously mentioned journals but still contributing meaningfully to their academic areas. The lowest on the list with an H-index of 4 include "Gender, Child & Society in Nursing" and "Journal of Microbiology and Biology Education," indicating a more specialized or niche impact within their fields. Overall, the graph effectively highlights the varying degrees of influence that different academic journals have, with "Academic Medicine" leading significantly in terms of the H-index.

The graph depicts the cumulative occurrences of articles from various academic sources over time, spanning from 2002 to 2024. The vertical axis represents the cumulative number of occurrences, while the horizontal axis shows the years. The lines represent different journals, each identified by a unique color: "Academic Medicine" (red), "American Journal of Pharmaceutical Education" (green), "Journal of Dental Education" (blue), "Journal of Diversity in Higher Education" (purple), and "Journal of Surgical Education" (yellow). Initially, from 2002 to around 2012, all journals show minimal activity with nearly flat lines. However, post-2012, there's a noticeable increase in the publication rates, particularly after 2018. "Academic Medicine" exhibits the most significant rise, especially around 2020, continuing to lead sharply upwards till 2024, reaching over 50 cumulative occurrences. Other journals also show an upward trend post-2018, indicating a surge in publication activities across these sources. This graph highlights the increasing academic output in recent years, with a significant spike observed around 2020.

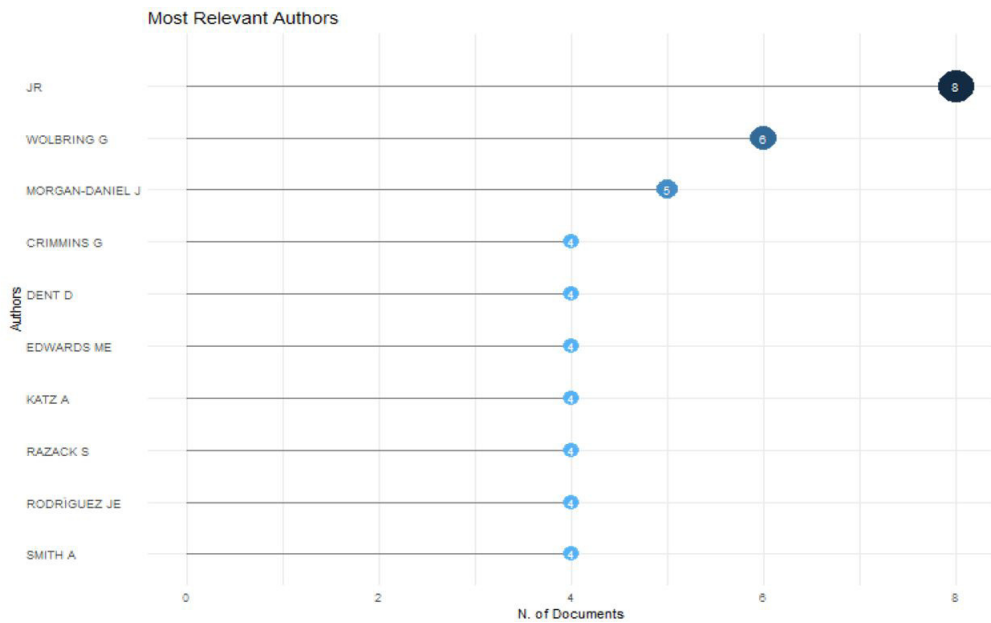


Figure 8: Most Relevant Authors

The graph provided illustrates the impact and relevance of various authors based on the number of documents they have published and their corresponding H-index. The H-index is a metric that measures both the productivity and citation impact of an author's publications.At

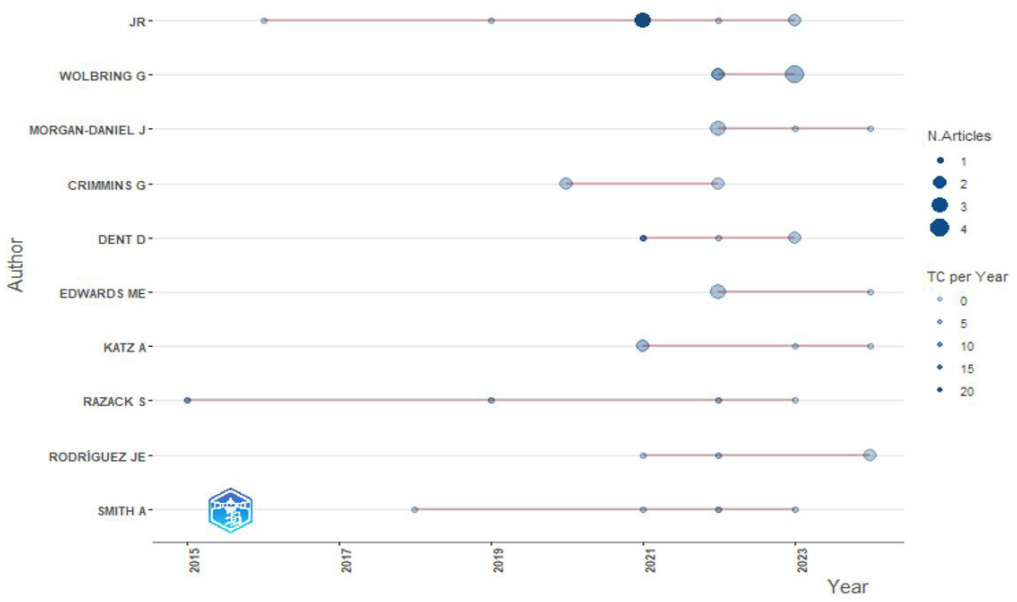


Figure 9: Authors Production Over Time

the top of the graph, one author stands out with an H-index of 8, indicating a high level of influence and a significant number of citations per document. This suggests that this author's work is widely recognized and frequently referenced in their field. Several authors share an H-index of 4, indicating a moderate level of influence. These authors have a notable presence in their respective fields, though with fewer citations per document compared to those with higher H-indices. One author has an H-index of 5, placing them between the moderately and highly influential categories. The concentration of authors with similar H-indices around the 4-5 range suggests a group of scholars with a consistent, though varied, degree of impact and recognition. This clustering highlights the diversity of contributions and the varying degrees of citation impact among these authors.In summary, the graph underscores the varying levels of influence among the most relevant authors, with one author leading significantly with an H-index of 8. The spread of H-indices from 4 to 6 among the other authors indicates a range of impacts, reflecting the broad spectrum of influence that different scholars have within their academic domains.

The chart titled "Authors' Production over Time" visualizes the research output of various authors from 2015 to 2023. Each horizontal line represents a different author, with circles along the lines indicating the number of articles they published in a given year. The size of each circle corresponds to the number of articles, as indicated by the legend on the right, where larger circles signify more publications. The shading of the circles indicates the total citations (TC) per year, with darker shades representing higher citation counts.

Key observations include: The author labeled "JR" shows publication activity in multiple years with a peak in article count around 2019. "Wolbring G" and "Morgan-Daniel J" have consistent publications across several years, with notable peaks."Crimmins G" has a steady output with relatively fewer articles compared to others but with consistent citation counts. "Dent D," "Edwards ME," "Katz A," and "Razack S" show sporadic publication activity."Rodriguez

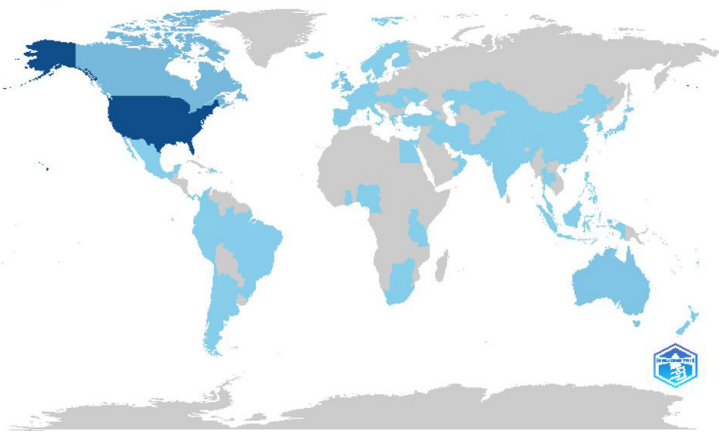


Figure 10: Country Scientific Production

JE" and "Smith A" have publication data starting around 2015, with "Smith A" showing a distinctive mark (possibly indicating a significant contribution or recognition).Overall, the chart effectively summarizes the publication frequency and impact of each author over the given period, highlighting both productivity and influence in their respective fields.

The map titled "Country Scientific Production" illustrates the global distribution of scientific output by country. Countries are shaded in varying intensities of blue, with darker shades indicating higher levels of scientific production. The United States stands out with the darkest shade, signifying the highest scientific output. Other countries with notable contributions include Canada, several European nations, China, Australia, and a few countries in South America, Africa, and Asia. The map effectively highlights the global landscape of scientific research, showing a concentration of high scientific production in North America, Europe, East Asia, and Australia, while many regions in Africa, the Middle East, and parts of Asia and South America are depicted with lower levels of scientific activity.

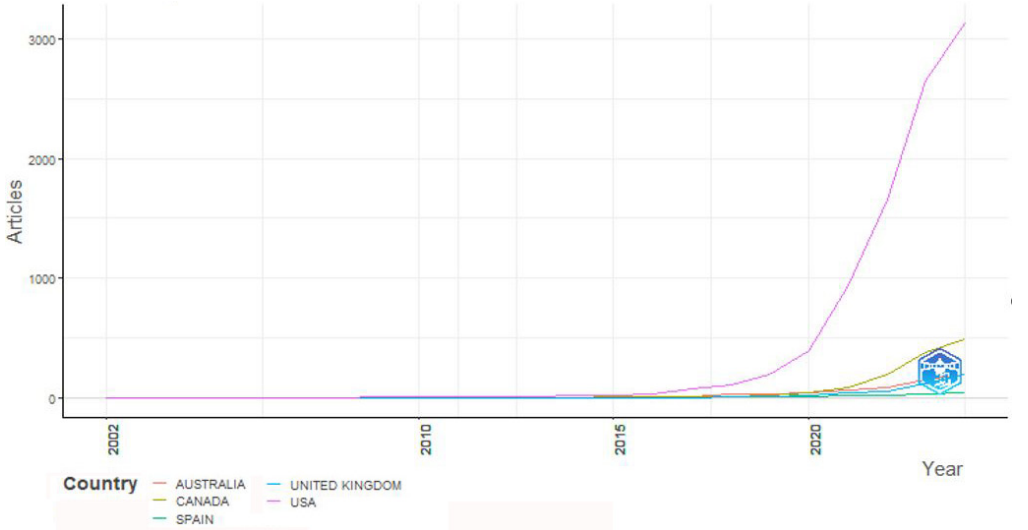


Figure 11: Country Production Over Time

The chart titled "Country Production over Time" shows the number of scientific articles produced by five countries—Australia, Canada, Spain, the United Kingdom, and the USA—over the period from 2000 to 2023. The vertical axis represents the number of articles, while the horizontal axis represents the years. The USA (represented by a magenta line) exhibits a dramatic increase in scientific production starting around 2015, peaking at over 3000 articles by 2023. The other countries—Australia (orange), Canada (green), Spain (blue), and the United Kingdom (purple)—show relatively modest growth in their scientific output during the same period. While there is a noticeable increase in publication numbers for these countries, it is significantly lower compared to the exponential growth seen in the USA. This chart highlights the leading role of the USA in scientific research production in recent years, with other countries contributing steadily but at a much smaller scale.

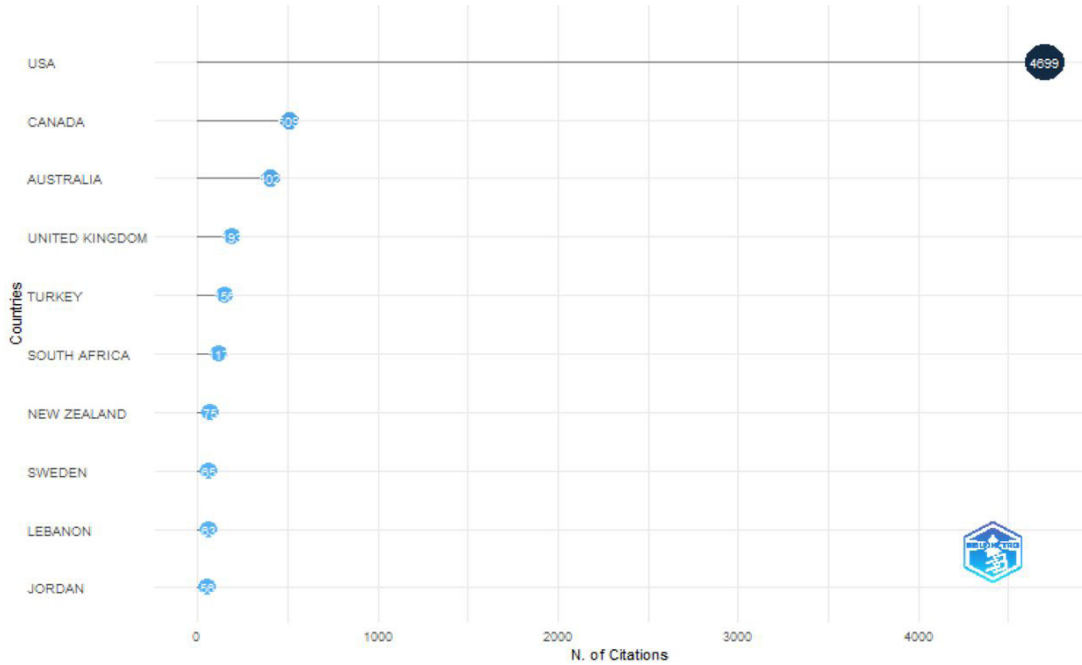


Figure 12: Most Cited Countries

The graph titled "Most Cited Countries" presents data on the number of citations per million inhabitants for various countries. Each country's citation count is represented by a blue bubble, with the size of the bubble indicating the relative volume of citations.

From the graph, it is evident that the country with the highest citations per million inhabitants is depicted by a large bubble positioned at 4899 citations. Other countries show significantly lower numbers, with the second-highest country having 409 citations. The remaining countries have even smaller counts, ranging from 56 to 193 citations per million inhabitants.

The horizontal axis represents the number of citations per million inhabitants, ranging from 0 to 5000. The vertical axis lists the countries being compared, which include, in descending order of citations: LUXE (likely Luxembourg), Connea (possibly a misinterpretation of a country's name), Algear (potentially Algeria), United Kingtom (likely a misspelling of United Kingdom), Turkey, South Africa, New Zealand, Sweden, Denmark, and Jordan. Overall, this graph highlights

a significant disparity in the number of citations among different countries, with one country markedly outpacing the others by a substantial margin.

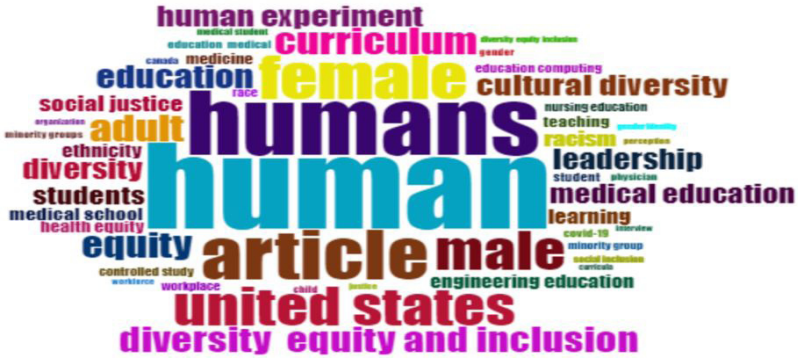


Figure 13: Word Cloud

The image is a word cloud, which visually represents the frequency of words within a given text or set of texts. In this word cloud, the size of each word corresponds to its frequency or prominence; larger words appear more frequently in the dataset. The most prominent words in the word cloud are "human," "article," "united states," "humans," "female," "male," "diversity," "equity and inclusion," "education," and "medical education." These words indicate key themes and topics of the underlying texts. The focus seems to be on human subjects, gender (both female and male), diversity, and equity in various contexts such as education, particularly medical education, and broader social issues in the United States. Other noticeable words include "leadership," "curriculum," "social justice," "students," "adult," "cultural diversity," "health equity," and "learning." This suggests an emphasis on educational leadership, curriculum development, social justice in education, and issues related to equity and diversity in health and medical fields.

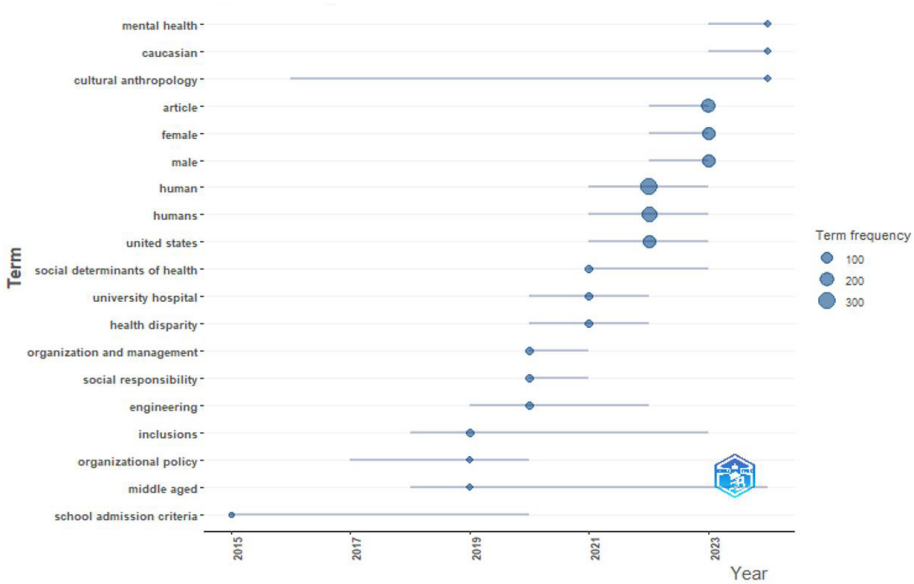


Figure 14: Trend Topics

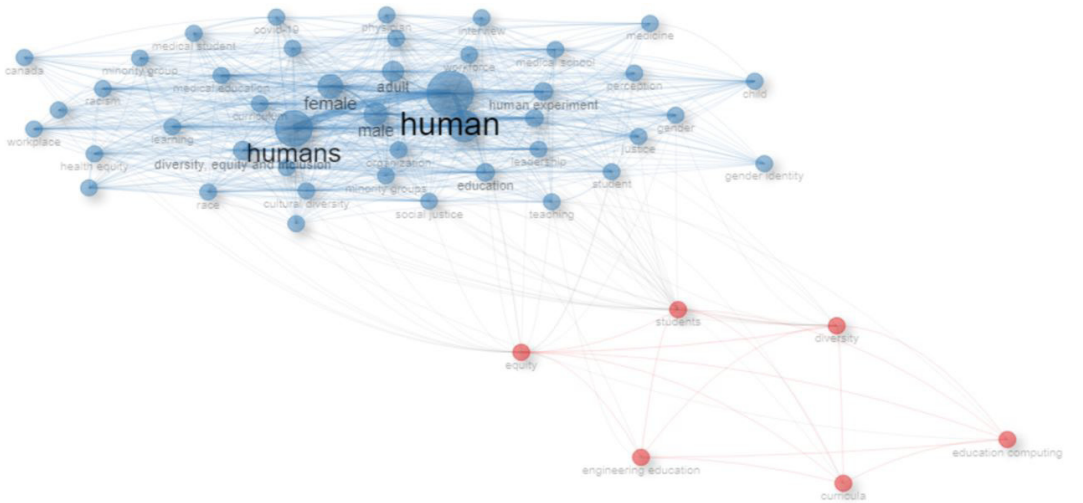


Figure 15: Most Cited Countries

Overall, the word cloud highlights a rich intersection of themes related to human studies, gender, diversity, education, and social equity, particularly within the context of the United States.

The "Trend Topics" graph visualizes the frequency of various terms from 2015 to 2023, with the X-axis representing the years and the Y-axis listing terms such as "mental health," "caucasian," "cultural anthropology," "female," "male," "human," "health disparity," and "engineering." Larger circles indicate higher term frequency, categorized into sizes of 100, 200, and 300. The graph reveals consistent mentions of "mental health" and "human/humans," increased focus on "Caucasian" and "cultural anthropology" around 2021-2023, and rising interest in "social determinants of health" and "health disparity" from 2020 onwards. Terms like "engineering" show steady mentions peaking towards 2023, while "inclusions" and "organizational policy" gain attention starting around 2020. "School admission criteria" emerges in 2023. Overall, the visualization highlights trends in health, human studies, and diversity, indicating which topics have gained or maintained attention over time and their relative importance.

The network graph illustrates the relationships between various keywords, with "human" as the most central and frequently connected term. It features two main clusters: a blue cluster that centers on human characteristics, diversity, education, and medical studies, including terms like "female," "male," "adult," and "medical student"; and a red cluster that focuses on diversity and equity within engineering and computing education, including terms like "students," "engineering education," and "curricula." Larger nodes signify higher connectivity, while thicker edges represent stronger relationships. Themes of human attributes, diversity, education, and equity are prominent, highlighting social and educational aspects within human studies. Overall, the graph emphasizes the interconnections between these concepts in a social and educational context.

CONCLUSION

In conclusion, this bibliometric trend analysis highlights the transformative impact of Diversity, Equity, and Inclusion (DEI) in shaping the future of research, aligning closely with the global commitment to the United Nations Sustainable Development Goals (SDGs). The promotion of DEI not only fosters inclusivity and equity in academic inquiry but also directly supports

several key SDGs, including Quality Education (SDG 4), Gender Equality (SDG 5), and Reduced Inequalities (SDG 10). As DEI becomes more deeply institutionalized within academia, it is essential to maintain momentum and tackle persistent challenges, ensuring that DEI principles are not only advocated for but also embedded in research practices globally.

Future DEI research should focus on enhancing international collaboration, particularly in regions and disciplines where disparities persist, and developing comprehensive metrics to evaluate the success of DEI initiatives. These steps will help ensure the authentic integration of DEI values into research practices, driving progress toward SDG targets and contributing to the creation of more inclusive, equitable, and resilient societies. By embedding DEI principles in the heart of research, the academic community can play a critical role in addressing global challenges and fostering a research landscape that reflects the diversity of human experiences and perspectives—paving the way for more sustainable and impactful innovations worldwide.

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Exploring Work Preference Studies: Insights for Job Seekers and Recruiters

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Abstract

This paper offers an in-depth exploration of the existing literature on the work preferences of job seekers, examining how demographic factors such as age, gender, education, and socioeconomic status influence their choices. It deeply investigates the importance of job type, work environment, compensation, work-life balance, career growth opportunities, and organizational culture in today's dynamic job market. By synthesizing current research, the paper highlights the complex interplay between individual aspirations and market realities, offering insights into the diverse priorities that shape job seekers' decisions. This analysis aims to inform employers and policymakers about the evolving expectations of the workforce, facilitating better alignment between job offerings and applicant desires.

Keywords: *Work Preferences, Job Seekers, Job Market, Recruitment*

INTRODUCTION

In today's dynamic job market, understanding the work preferences of job seekers is crucial for employers, policymakers, and career advisors. The preferences of individuals searching for employment encompass a variety of factors, including job type, work environment, compensation, work-life balance, career growth opportunities, and organizational culture. These preferences are influenced by a range of demographic variables such as age, gender, education level, and socioeconomic status, as well as broader economic trends and cultural shifts. The analysis of job seekers' work preferences has gained increased attention due to several contemporary developments. The rise of remote and flexible working arrangements, accelerated by the COVID-19 pandemic, has transformed traditional notions of work and workplace. Additionally, the growing importance of mental health and well-being has led job seekers to prioritize employers who offer supportive and healthy work environments. Furthermore, the advent of the gig economy and digital platforms has expanded the types of employment available, allowing for more varied and personalized career paths. Research in this area provides valuable insights for different stakeholders. Employers can enhance recruitment strategies and improve retention by aligning job roles with the preferences of potential and current employees. Policymakers can design effective job market policies and employment programs by understanding the evolving needs and aspirations of the workforce. Career advisors and educators can better guide individuals in making informed career decisions that match their preferences and strengths. This paper aims to review existing literature on job seekers' work preferences, identifying key trends and factors that influence these preferences. By examining diverse studies from various geographical regions and economic contexts, this review will highlight the multifaceted nature of job preferences and

the implications for both individuals and organizations. Ultimately, this contributes to optimizing employment relationships in our rapidly changing world.

RESEARCH OBJECTIVES

- To introduce and explore the various work preferences of job seekers.
- To analyze existing literature on job seekers' work preferences.

LITERATURE REVIEW

Judge and Bretz (1992) examined how work values affect job choice decisions using a policy-capturing design with a sample of professional degree students. They discovered that organizational work values, such as achievement, concern for others, honesty, and fairness, significantly impacted job preferences and choices. Individuals were more inclined to choose jobs that aligned with their personal value orientations. The study also controlled for other job attributes, including pay, promotion opportunities, and type of work, as well as individual characteristics like age, experience, and GPA. This research contributed to the literature on job choice and person-environment fit by highlighting the importance of work values in the selection process and employing a realistic and comprehensive research design.

Xianghan (1995) studied the job-selection preferences and values of master's degree postgraduates in Wuhan, China. This research examined the factors influencing these postgraduates' career aspirations, such as policy changes, flaws in the educational system, and personal characteristics. The paper underscored challenges related to talent allocation and career choices, and proposed solutions including enhanced benefits distribution and the promotion of ethical education.

Cable and Graham (2000) examined the factors influencing job seekers' evaluations of employers' reputations, employing three distinct methodologies: verbal protocol analysis, policy capturing, and field survey. Their research revealed that job seekers' perceptions of reputation were shaped by industry type, opportunities for personal growth, organizational culture, and familiarity with the organization. Interestingly, factors impacting executives' reputation perceptions, such as profitability and pay level, held less significance for job seekers. By focusing on the viewpoint of job seekers, a pivotal stakeholder group, and utilizing diverse research methods to corroborate findings, the paper enriched the literature on organizational reputation. It offered practical implications for managers and recruiters aiming to enhance their firms' reputations among job seekers.

Guillot-Soulez and Soulez (2014) investigated the preferences of young French graduates from Generation Y regarding job and organizational attributes of prospective employers. Utilizing conjoint analysis, a methodology less commonly employed in HRM, the authors determined and prioritized the most crucial attributes for this generation. Additionally, they evaluated intragroup homogeneity and discovered heterogeneous preferences among Generation Y, challenging the stereotype of uniform preferences within this demographic. The paper deliberated on the implications of these discoveries for recruitment practices and the significance of generational considerations in HRM.

Jain and Bhatt (2015) explored the concept of employer branding and its impact on potential employees' preferences in India. Using a survey method, they tested hypotheses that various employer branding factors such as compensation, reputation, work environment, and career development varied across gender, age, experience, education, and sector. The results revealed that

certain factors were more important to specific groups of prospective employees and highlighted differences in employer attractiveness between the public and private sectors. The study offered valuable insights for employers on building their brand to attract and retain talent in a competitive job market.

Liu et al. (2016) investigated the interplay between job seekers' decision-making styles, recruitment information sources, and organizational attractiveness in retail recruitment. An online experiment was conducted with 280 US participants who had experience in retail work. The study revealed that maximizers, who strive for the best possible choice, were more inclined than satisfiers, who opt for a satisfactory choice, to seek additional information after viewing a standard job advertisement. It also found that the impact of staff word-of-mouth (SWOM) messages on organizational attractiveness varied based on the decision-making style, the positive or negative nature of the message (valence), and the strength of the relationship (tie strength) with the SWOM source. This research contributed to the field by highlighting the influence of individual differences on recruitment outcomes and by introducing SWOM as a unique type of informal recruitment source.

Ng and Yee (2019) explored the factors influencing job selection preferences among business students in Malaysia, using expectancy theory as the framework. They surveyed 280 business students from various local universities and analyzed the data with SPSS. The findings indicated that employer reputation, personal interest, and salary and benefits positively and significantly affected job selection preferences, whereas job security had a negative and significant effect. The study also discussed implications, limitations, and recommendations for future research, contributing to the literature by offering insights into the job preferences and motivations of Malaysian business students.

Demel et al. (2019) assessed the job preferences of business and economics students in Spain, the Czech Republic, and Germany using a choice experiment method. The study identified that the most crucial job attribute for students across countries and universities was long-term career prospects within the company, followed by the educational opportunities provided by the company. Additionally, the research unveiled variances in preferences attributable to cultural and economic factors, such as commuting time and contract type. This study marked the first-choice experiment conducted on students' job preferences across various European countries and offered monetary values representing the willingness to accept different job attributes, thereby enriching the existing literature.

Hamid (2020) investigated the factors shaping job selection preferences among accounting students in Malaysia, employing a quantitative approach through a survey involving 443 respondents from both public and private universities. The study identified starting salary, employer reputation, and working environment as pivotal factors influencing job selection preferences, with working environment emerging as the most critical. Notably, the research revealed no substantial disparity in job selection preferences between students from public and private universities. This paper made contributions to the literature on accounting education and sustainable development goals, offering implications for employers, educators, and professional bodies alike.

Ghani (2020) investigated the causes of graduate unemployability, employer preferences and expectations, and the essential skills and qualities needed by graduates in Malaysia. Utilizing semi-structured interviews with eight employers from various sectors, the study found that the primary cause of unemployability was a lack of soft skills, particularly communication skills,

among graduates. It also identified employer preferences related to university type, language proficiency, ethnicity, and gender. Employers expected graduates to possess social skills, emotional intelligence, lifelong learning, and quick learning abilities. The study proposed solutions to enhance graduate employability, such as improving the curriculum, offering more hands-on training, and involving employers in the educational process. This research contributed to the literature on graduate employability in Malaysia and provided implications for policy and practice.

Bustamante et al. (2021) explored the impact of corporate social responsibility (CSR) on the employer preferences of young graduates. The study utilized a quantitative approach with a survey of 577 German students and employed adaptive conjoint analysis to assess the relative importance of CSR and non-CSR attributes in employer attractiveness. The findings revealed that only a select few CSR attributes were significant to job seekers compared to traditional employer characteristics. Moreover, the research highlighted that specific value orientations, particularly those indicating concern for others and the environment, moderated the importance of CSR attributes in job choice. This study contributed to the understanding of CSR's role in recruitment and provided insights into how individual values influence job seekers' preferences.

Barhate and Dirani (2022) conducted an extensive literature review on the career aspirations of Generation Z, individuals born between 1995 and 2012. Analyzing 19 empirical studies and industry reports from various countries, they identified four key themes: the intrinsic and extrinsic factors influencing career aspirations, career expectations, and perceived career development. The paper offered a comprehensive overview of Gen Z's characteristics, values, and career preferences, and discussed the implications for future research, theory, and practice. It contributed to the growing body of knowledge on Gen Z's career development in the context of evolving demographics and organizational environments.

Ralph and Arora (2022) conducted an extensive literature review to identify factors influencing the job selection decisions of first-time job seekers with bachelor's degrees in India. Using the PRISMA 2020 framework, they gathered data from various sources, including databases, manual searches, and government reports. The study found that both economic factors (such as pay levels, budget constraints, and labor market conditions) and non-economic factors (such as public service motivation and social security benefits) influenced young graduates' preferences for public or private sector jobs. The paper also offered policy recommendations to address youth unemployment and improve employability in India.

Nguyen Ngoc et al. (2022) explored the expectations and job pursuit intentions of Generation Z job seekers in Vietnam through an interpretive approach and qualitative methods. Using the instrumental-symbolic framework, the authors analyzed how these job seekers responded to instrumental and symbolic attributes of potential employers, such as the working environment, work-life balance, and corporate social responsibility. The study revealed that Generation Z job seekers prioritized intangible attributes over physical features and viewed corporate social responsibility as both an instrumental and symbolic attribute. The paper provided practical implications for managers in transition and emerging economies on how to attract and retain Generation Z talent.

Garai-Fodor et al. (2023) investigated the factors influencing job choices among Generation Z workers in Hungary, using a quantitative survey to analyze their preference structure. The study identified eight key job choice criteria and six distinct employee segments based on

these preferences. It also examined the relationship between these preference systems and the motivational tools that enhance performance. The findings offer practical implications by demonstrating how to differentiate employees based on job preferences and apply effective incentives tailored to specific segments. This research was grounded in a comprehensive literature review and rigorous statistical analysis.

FINDINGS

Authors and Year	*Methodology Used*	*Context*	*Findings*
Judge and Bretz (1992)	Policy-capturing design with surveys	Professional degree students from two universities in the U.S.	The study found that organizational work values significantly influenced job choice decisions. Individuals preferred jobs whose value content aligned with their own value orientation. The presence of values such as achievement, concern for others, honesty, and fairness in an organization made job offers more desirable. Pay and promotion opportunities also played a significant role in job choice decisions.
Xianghan (1995)	Questionnaire survey of 600	Postgraduates' job-selection	The study revealed that postgraduate students postgraduate students from eight universities in China preferences in the context of China's market economy and reforms preferred working in coastal economic zones due to higher income and development opportunities. They favored foreign enterprises over government organizations. The focus shifted from scholarly pursuits to practical engagements. Personal advancement, income, and interest were prioritized over prestige and societal contribution. The study highlighted a dislocation between job aspirations and societal needs.
Cable and Graham (2000)	Verbal Protocol Analysis, Experimental Policy Capturing Study, Field Study	Job seekers' reputation perceptions	The study revealed that job seekers' reputation perceptions were influenced by factors such as industry type, opportunities for employee development, and organizational culture. These factors differed from those affecting executives' reputation perceptions. The findings suggested that understanding these antecedents could help managers improve their firms' reputations during recruitment.
Guillot-Soulez and Soulez (2014)	Conjoint analysis	Preferences of French young graduates from Generation Y for job and organizational attributes	The study demonstrated that, although Generation Y graduates generally preferred job security and a relaxed work atmosphere, their preferences were heterogeneous. This finding questioned the relevance of the concept of Generation Y for recruitment.

Authors and Year	*Methodology Used*	*Context*	*Findings*
Jain & Bhatt (2015)	Survey methodology with online structured questionnaires	The study focused on understanding employer branding through the eyes of potential young employees in Delhi and NCR, India.	The study found that private sector was preferred by the majority of potential employees. Factors like stability, work-life balance, and job security were important for potential employees. Gender and age significantly influenced the perception of employer branding factors. Public and private sectors were perceived differently on these factors.
Liu et al. (2016)	Scenario-based experiment	Jobseekers' decision-making styles, recruitment information sources, and organizational attractiveness	The study found that jobseekers' decision-making styles (maximisers vs. satisficers) significantly influenced their reactions to recruitment information. Maximisers sought more information and were more affected by weak-tie sources, while satisficers were more influenced by strong-tie sources. The study highlighted the importance of understanding individual differences in recruitment strategies.
Ng and Yee (2019)	Quantitative research using self-administered questionnaires	Business students in Malaysia	The study found that employer reputation, personal interest, job security, and salary and benefits significantly influenced job selection preferences among business students. The research highlighted that understanding these factors could help universities, career advisors, and employers better cater to the needs and expectations of job seekers.
Demel et al. (2019)	Choice Experiment (CE)	Conducted at five universities in Spain, the Czech Republic, and Germany	The study found that the most important job characteristic for young economists was a long-term career prospect at the company. This preference was consistent across countries and universities. The study also revealed that students from private universities preferred modern companies with a horizontal structure, while students from public universities showed a higher preference for permanent contracts. Cultural and economic differences influenced preferences, such as commuting time being important only to Spanish students.
Bustamante et al. (2020)	Quantitative approach with a survey sample of 577 German students; adaptive conjoint analysis; correlation analysis; two-	The study aimed to understand the preference structure of young graduate job seekers, particularly the importance of CSR when there is a	The study found that only a few CSR attributes were relevant for young job seekers compared to traditional employer attributes. Specific value orientations had a moderating effect on CSR preferences, with altruistic values positively affecting the importance of CSR attributes, while selfish values had a negative effect.

Authors and Year	*Methodology Used*	*Context*	*Findings*
	step hierarchical regression	trade-off between CSR and non-CSR attributes, and the moderating effect of basic value orientations on employer preferences	
Hamid (2020)	Correlational analysis and test of difference	The study examined the relationship of starting salary, employer reputation, and working environment on job selection preferences among accounting students in Malaysia.	The study found that starting salary, employer reputation, and working environment significantly affected job selection preferences among future accounting graduates. The working environment was the dominant factor considered in job selection. There was no significant difference in job selection preferences between public and private university students.
Ralph and Arora (2020)	Systematic Literature Review using PRISMA 2020 framework	The study aimed to identify factors influencing job selection among first-time job seekers with a bachelor's degree in India.	The study found that both economic and non-economic factors influenced job selection decisions. Economic factors included pay levels, budget constraints, and labor market conditions. Non-economic factors included job stability, social security benefits, and public service motivation. The study concluded that understanding these factors is crucial for developing effective policies to address youth unemployment in India.
Ghani (2020)	Qualitative method, semi-structured interviews	Employers' expectations and preferences of graduates in Malaysia	The study found that the leading cause of unemployability among graduates was a lack of soft skills, particularly communication skills. Employers preferred graduates from certain universities and expected them to have social skills, emotional intelligence, and a willingness to learn. The study also highlighted the importance of continuous learning and hands-on training to improve graduates' employability.
Barhate and Dirani (2021)	Systematic Literature Review	Career aspirations of Gen Z (born between 1995 and 2012)	The study found that both intrinsic and extrinsic factors determined Gen Z's career aspirations. Gen Z had well-defined career expectations and development plans. The study also highlighted the need for organizations to understand Gen Z's expectations as they enter the workforce.
Nguyen et al. (2022)	Interpretive research method combining	Generation Z job seekers' expectations and job pursuit	The study found that Vietnamese Generation Z valued intangible attributes like office atmosphere and workplace ethics more than

Authors and Year	*Methodology Used*	*Context*	*Findings*
	questionnaires and group discussions	intentions in Vietnam, a transition and emerging economy	physical features. They also considered CSR as both an instrumental and symbolic attribute. The findings highlighted the importance of understanding Generation Z's expectations to attract them effectively.
Garai-Fodor et al. (2023)	Quantitative procedure using a pre-tested standardized questionnaire online survey with random sampling method, resulting in 1146 evaluable questionnaires. Descriptive statistics, bivariate and multivariate analyses were applied.	The study aimed to investigate the factors influencing employees' choice of jobs and analyze the structure of their preference system. It also explored which motivational tools could be most effective in encouraging higher performance.	The research identified distinct clusters according to the preference system of job selection. It found that different motivational tools were effective for different employee segments. The study provided useful implications for practice by highlighting how to differentiate the pool of employees in terms of job choice and how to apply effective incentives to specific segments.

Basic Work Preferences of Job Seekers

- Job Security: Preference for stable, long-term employment with reliable income.
- Salary and Benefits: Competitive pay, health insurance, retirement plans, and other financial benefits.
- Work-Life Balance: Flexibility in work hours, remote work options, and enough personal time.
- Career Growth Opportunities: Opportunities for advancement, professional development, and skill enhancement.
- Work Environment: A positive, inclusive, and supportive workplace culture.
- Job Role and Responsibilities: Alignment of job duties with personal interests and skills.
- Company Reputation: Working for a reputable and ethically sound company.
- Location: Preference for job locations that are convenient or desirable, including considerations for remote work.
- Job Satisfaction: Roles that provide a sense of achievement, purpose, and enjoyment.
- Work Relationships: Positive relationships with colleagues, supervisors, and company leadership.

CONCLUSION

In conclusion, the analysis of job seekers' work preferences reveals a complex mix of factors influencing employment decisions and satisfaction. This review highlights that while compensation and job security remain important, modern job seekers increasingly value work-life balance, flexible arrangements, organizational culture, and career development. The COVID-19 pandemic has especially boosted the demand for remote work and flexibility, reshaping expectations across

industries. Employers need to adapt to these changing preferences to attract and retain talent, enhancing job satisfaction and productivity. Policymakers and career advisors also play crucial roles in aligning job market opportunities with these evolving preferences. Future research should continue to explore these dynamic trends, considering technological advancements and emerging work patterns. A deep understanding of job seekers' preferences will help stakeholders nurture more rewarding and productive employment relationships, benefiting both the workforce and the job market.

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Impact of Green Human Resource Management on Organizational Sustainability

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Abstract

Purpose: *The paper examines the linkages between green human resource management (GHRM) and organisational sustainability. The aim of this paper is to synthesizes existing research and conduct a systematic literature review on GHRM and proposing detailed research gaps for future study.*

Design/methodology/approach: *The secondary data provide the main foundation of the investigation. For this, existing research on the subject was gathered from a variety of databases like Emerald, sage publications, springer, academia, and other sources. The collected literature was thoroughly reviewed systematically.*

Findings: *The study's findings showed that green human resource management positively impacts environmental performance, corporate social responsibility and organisation sustainability.*

Research implications: *A thorough overview of the literature on green human resource management is provided in this study. It emphasizes gaps in the system and proposes for future study.*

Keywords: *Green HRM, Organisation Sustainability, Corporate Social Responsibility, Environmental Performance, Sustainable Human Resource Management*

INTRODUCTION

Environmental protection is receiving more attention and policies for cleaner production are being implemented. Organizations' awareness of addressing rising consumer and market expectations has been sparked by environmental pressures, including in addition to the law (Pham, Tuková, and Jabbour, 2019). Consequently, businesses are now more accountable for achieving sustainable results in general and the environmental impacts of their actions (Koberg and Longoni, 2019). According to (Renwick et al., 2016), human resource management (HRM) is crucial in the pursuit of this green agenda. Therefore, integrating green practices into HRM activities may increase the possibility that a company will remain sustainable. The acknowledgement of Green HRM as one potential green management practice strategy of a firm that can lessen its environmental "footprint" and increase the sustainability of the organization has grown attention in this field over the past ten years. Given the significance of Green since 2016, Researchers' interest in HRM has significantly expanded (Dumont et al., 2016; Jabbour and Renwick, 2018; Yong et al., 2019). As a result, research into green human resource management has multiplied. Growing concern about environmental issues has prompted HR to adopt green HR practices, with a focus on a paperless approach, a decrease in carbon footprint, and management of garbage (Ahmad, 2015). EM postulates and basics are applied to HRM methods, systems, and processes in GHRM

(Renwick et al., 2018). Thus, it is linked to building of green competencies, and improving workforce motivation through green Performance evaluations, rewards systems, and programs that support employee participation in environmental issues (Dumont et al., 2017). The primary goal of the procedures and policies incorporated into GHRM is to create a green workforce for the organization's advantage. society, the environment, and its inhabitants. Shen and Benson (2016) distinguish SR-HRM from HRM generally by defining it as CSR focused on employees focuses on the needs of outside stakeholders. To develop and implement sustainable business strategies across an organization (Jabbour and Renwick 2018) contend that the HR function is essential. The HR department can offer advice on developing and achieving environmental and social objectives while balancing them with traditional values and measures of financial performance. The HR department can collaborate with other departments to create sustainability tactics. As a result, this essay offers an in-depth analysis and perspective on Green HRM research published in prestigious academic journals. The main goal is to conduct a systematic analysis of the existing literature on Green HRM to determine what research subjects have been covered and where there are still unexplored areas for further investigation more specifically.

The following are the objectives of the paper:

1. To assess how GHRM practices affect organisational sustainability.
2. To ascertain the impact of GHRM practices on environmental performance and CSR.
3. To identify the research gaps for future GHRM studies.

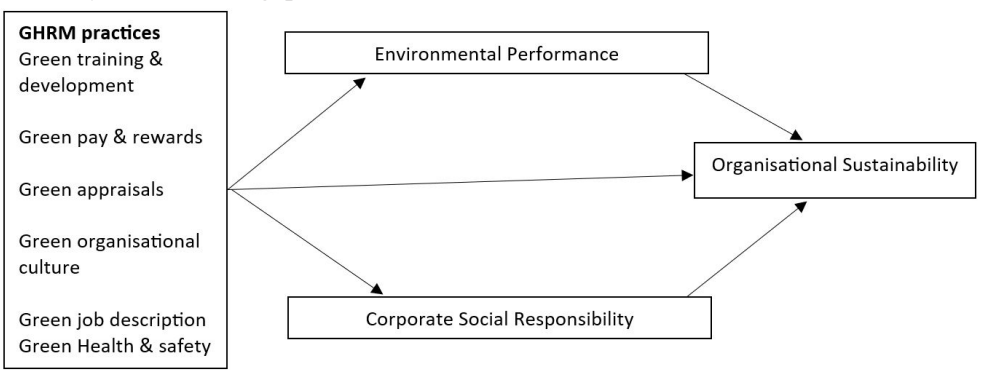


Figure 1: Framework of Analysis

The structure of this essay is as follows: The literature review is described in Section 2. The research methodology is described in Section 3. An overview of the review is presented in Section 4. Section 5, contains the findings and conclusion and the final section, Section 6, describes the future research areas.

LITERATURE REVIEW

Table 1: GHRM Practices

GHRM Practices	*Definition*
Green Training and Development	Policies that increase employees' environmental awareness, give them environmental skills, and improve employees' green ability and knowledge (Renwick 2018)
Green pay and rewards	For individuals who support environmental management objectives, there is a system of financial and non-financial benefits (Jabbour 2019).

GHRM Practices	*Definition*
Green Recruitment	In recruitment and selection procedures, environmental factors are highlighted (Longoni, 2018)
Green Appraisals	Policies for assessing how well personnel are achieving environmental objectives (Dumont et al., 2017)
Green Organizational Culture	Assumptions, attitudes, symbols, and artifacts of a company that represent its need or willingness to pursue environmentally sustainable objectives, (Jabbour and Renwick 2018)
Green Health and Safety	As part of environmental management aligned health and safety practices, green health and safety also highlight the lives of employees (Shah, 2019).
Green Job Description	The integration of environmental concerns in job descriptions for employees, linking them to both their regular duties and additional environmental responsibilities at work (Jabbour 2018)

Environmental Performance

Environmental performance is described as "the assessment of an organization's ability to achieve environmental goals and objectives that have been established by the organization'senvironmental policy or plan. Currently, numerous companies are putting environmental programs into action to obtain an advantage over rivals (Jabbour and Renwick, 2018; Yong et al., 2019). A good chance to increase sustainability is provided by ecological execution to evaluate the viability of the company from a win-win perspective. Organizations all around the world have been focusing on various green activities and their effects on the environment during the past several years. A requirement for green practices since they have been adopted by better execution can be achieved through organizations. They also found that the most effective way to achieve environmental GHRM, is to encourage employees to perform mentally and carry out their responsibilities using green approaches.

Organisational Sustainability

Businesses in the twenty-first century have emphasized the need for sustainability. The corporate and human resources divisions may have a role to play a crucial part in the formation of a firm organizational culture of sustainability (Das and Kumar Singh 2016). Implementing administrative procedures is crucial to upholding sustainability's guiding principles. All HR decisions are consistently assessed by HR experts from a shareholder viewpoint 2016 (Gholami et al.). By considering the financial, organizations now need to address the social and environmental impacts and enlist the participation of all relevant parties, both domestically and (Mariappanadar, 2019) outside. Vikhitkar and Likhitkar (2017) examine the variety of green activities available such as ridesharing, electronic filing, workplace flexibility, recycling, telephone conferencing, and virtual selection building placesthat use less energy, that organisations can take on to ensure the long-term viability of the organisation. Greater efficiency is the result of these ecological measures reduced expenses, a happierworkforce, and more engaged workers, which will increase the sustainability of the business.

Corporate social responsibility

Shen and Benson (2016) distinguish GHRM from HRM generally by defining it as CSR focused on employees, focuses on the needs of outside stakeholders. According to Shen and Zhu

GHRM entails more than only the requirement to adhere to employment-related but in addition to following the law's obligations and regulations, implementing employee-centric HRM procedures, and policies to fulfill their needs for self-development on a personal and professional level to encourage staff participation in CSR projects (Newman et al., 2016).

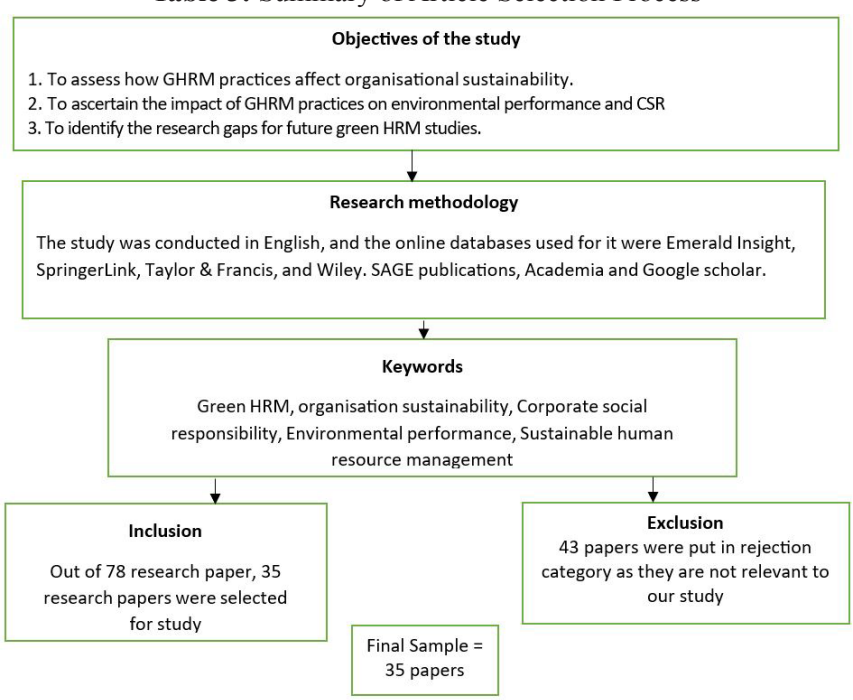
Table 2: Definitions

Environmental performance	Environmental performance is described as "the assessment of an organization's ability to achieve environmental goals and objectives that have been established by the organizations' environmental policy or plan. Currently, numerous companies are putting environmental programs into action to obtain an advantage over rivals (Fraj et al. 2015).
Organization sustainability	The development to meet the current needs of the people effectively without compromising the needs of the next generation" is the definition of sustainability. To raise employees understanding of environmental issues and inspire them to successfully navigate predictable challenges, organizations must be committed to sustainability (Das & Kumar Singh, 2016).
Corporate social responsibility	Shen and Benson (2016) distinguish GHRM from HRM generally by defining it as CSR focused on employees, focuses on the needs of outside stakeholders. Corporate social responsibility helps a company be socially accountable to itself, its stakeholders and the public.

RESEARCH METHODOLOGY

- **Approach to the review:** The extant research on Green HRM is analyzed, and summarized, and conclusions are drawn using a systematic literature review methodology. The parts of this review methodology cover the time frame, database selection, and article selection.

Table 3: Summary of Article Selection Process



- **The time frame for choosing the papers:** The journal articles under consideration for the review and evaluation procedure ranged in publication date start from 2015 to the start of 2023. Articles for this review were chosen on their aims and relevance.
- **Databases selection:** For this study, recent and pertinent literature on Green HRM was found using different online databases. The study was conducted in English, and the online databases used for it were Emerald Insight, SpringerLink, SAGE publications and Google Scholar.
- **Article selection:** The current study adhered to a systematic review process. In online databases, keywords were initially described as search criteria. The phrases included in the keywords were "green human resource management", "Organisation sustainability", "Green HRM", "Environmental performance", and "Corporate social responsibility". Then, from 2015 to 2023, an article published in the top scholarly journals was taken into account. The preliminary result included 78 articles. Duplications of articles were eliminated to avoid counting a paper twice in analysis. This process resulted in 35 articles for review that were chosen on their aims and relevance.

OVERVIEW OF THE REVIEW

Table 4: Articles Based on a Quantitative Approach (Survey Data)

Author	*Title*	*Databases, Sites*	*Methodology*	*Findings*
Mahdi Waleed Ziyadeh, MOHD. Othman, Ahmed Adnan Zaid (13 March 2023)	Effects of GHRM on organizational sustainability: the mediating role of CSR and organizational citizenship behaviour	Emerald	The partial least squares structural equation modelling approach was applied for the analysis of the data	The finding showed that GHRM practices had a positive impact on OS using CSR, and OCBE.
Shatha M. Obeidat, Shahira Abdalla, Anas Abdel Karim AI Bakri (22 Nov. 2022)	Integrating GHRM and circular economy to enhance sustainable performance	Emerald	Advanced partial least squares structural equation modelling (SEM-PLS) methodology	GHRM have a positive relationship with sustainable performance and circular economy
Jing Yi Yong, Mohd Yusoff et al. (16 June 2022)	Accentuating the interconnection between GHRM, green intellectual capital and sustainability	Emerald	Study based on data acquired from 112 significant manufacturing enterprises	GHRM positively impacts sustainability
Pascal Paille, Patrick Valeau, Douglas W. Renwick (15 March 2020)	Leveraging GHRM practices to achieve environmental sustainability	Elsevier	This study investigated a moderated mediation model 244 nurses and auxiliary nurses responded	Result showed that GHRM practices positively impacts environmental sustainability
Fiza Amjad et al. (18, October 2020)	Effect of GHRM practices on org. sustainability	Springer	Data were gathered using a survey questionnaire methodology	The study's findings revealed positive effect of GHRM activities on

Author	*Title*	*Databases, Sites*	*Methodology*	*Findings*
				organisational sustainability
Zuhair Abbas, Shagufta Sarwar, Mohsin Abdur (17 November 2021)	Green HRM promotes higher education sustainability through a mediated-moderated analysis	Emerald	Using smart PLS, a structural and measurement model was computed	The findings revealed positive impact of GHRM on sustainability
Geeta Rana and Vikas Arya (9 June 2023)	Green human resource management and environmental performance	Emerald	PLS 3 was used to test the suggested model	Result showed that GHRM practices positive effect on environmental performance
Richa Chaudhary (7, July 2019)	Effects of GHRM: testing a moderated mediation model	Growing science	The moderated mediation model was tested using hierarchical regression techniques in SPSS 24	GHRM positively impacts organisational sustainability
Adnan M. Rawashdeh (July 16, 2018)	The impact of GHRM on Organisational environmental performance in Jordanian health Service organization	Wiley library	A questionnaire survey among Jordanian health service providers was conducted	A positive correlation b/w GHRM practices and environmental protection was found
Jenny Dumont, Jie Shen, Xin Deng (July-august 2017)	Effect of GHRM practices on employee workplace green behaviour	Emerald	variables were evaluated using 5-point Likert scales	GHRM practices had positive impact on employee behaviour
M. Subha, S.B. Inayath Ahmed, B.Shanmuga Priya (11, November 2020)	Green HRM A strategic move towards the CSR through green employee performance	Scopus	employed some variables through questionnaires. SPSS is used	GHRM had a positive impact on CSR and employee performance
Kanwar Pravir Singh & Dr Krishna Nath Pandey (12, December 2020)	Green HRM practices and its impact on employee engagement	Scopus	Using multiple regression analysis and exploratory factor analysis	GHRM practices positively impact employee engagement

Table 5: Based on a Mixed-method Approach

Author	*Title*	*Database*	*Methodology*	*Findings*
Pavitra Mishra (19, May 2017)	A framework of sustainable organizational development in an emerging economy	Emerald	There was a multimethod approach.	The result indicates that there is still room to fully utilize GHRM approaches to promote pro-environmental behaviour in the workplace

Author	*Title*	*Database*	*Methodology*	*Findings*
Pallavi Deshpande, Anugamini Priya Srivastava (30 March 2022)	A study to explore the linkage b/w green training and sustainable org. performance	Emerald	This study is based on primary data collected from a variety of qualitative and quantitative studies	Positively impacts the organization's performance

Table 6: Based on Secondary Data

Author	*Title*	*Database*	*Methodology*
V.N. Amrutha, S.N. Geetha (31, October 2019)	A systematic review on GHRM: implications for social sustainability	Elsevier	Using the Scopus and Google Scholar databases, a systematic evaluation of the literature was conducted.
Anuradha Mukherji and Jyotsana Bhatnagar (29 May 2022)	Conceptualizing and theorizing green human resource management	Emerald	The method was done by ABDC and Scopus to guarantee diversity, rigour and quality
Paula Benevene &Ilaria buonomo (24, July 2020)	Green human resource management: An evidence-based systematic literature review	MDPI	The eligibility requirements were set so that empirical studies published in the English language, full-length peer-reviewed papers b/w 2005 to 2020
Jing Yi Yong (7 April 2019)	Green Human Resource Management A Systematic Literature Review from 2007 to 2019	Emerald	A total of 70 studies were assessed, the majority of which used a quantitative approach and were conducted in developing nations
Nhat Tan Pham, Hung Trong Hoang, Quyen Phu Thi Phan, (9, September 2019)	Green human resource management: A comprehensive review and future research agenda	Emerald	Papers from Scopus and web of science
Douglas W.S Renwick, Tom Redman, Stuart Maguire	Green human resource management: A review and research agenda	IJMR	More than 200 books, journals, edited works and discussion papers were produced.

Table 7: Summary of Articles Based on the Research Approach

Research Approach	*No. of Studies*	*Articles & Year*
Quantitative (primary) Survey data	17	Mahdi Waleed Ziyadeh et al. (13 March 2023), Shatha M. Obeidat et al. (22 November 2022), Jing Yi Yong et al. (16 June 2022), Pascal Paille et al. (15 March 2020), Fiza Amjad et al. (18, October 2020), Zuhair Abbas et al. (17 November 2021), Geeta Rana and Vikas Arya (9 June 2023),Richa Chaudhary (7, July 2019), Adedapo Oluwaseyi Ojo et al. (19 October 2020), M. Subha et al. (11, November 2020), Wenhao Song et al. (6 March 2020), Kanwar Pravir Singh & Dr Krishna Nath Pandey (12, December 2020), Basheer m. AI- Ghazali et al. (22 May 2020), Wenhao Song, Hongyan Yu et al. (6 March 2020), Adnan M. Rawashdeh (July 16, 2018), Jenny Dumont et al. (July-Aug 2017), Yusmani Mohd Yusoff et al.

Research Approach	*No. of Studies*	*Articles & Year*
Mixed method approach	5	Pavitra Mishra (19, May 2017), Shuang Ren et al. (3, March 2020), Pallavi Deshpande, Anugamini Priya Srivastava (30 March 2022), Shuang Ren et al. (19, September 2017), Pallavi Mehta & Khushbu Mehta (Dec-Jan 2017)
Based on secondary data	9	V.N. Amrutha&S.N. Geetha (31 October 2019), Anuradha Mukherji and Jyotsana Bhatnagar (29 May 2022), Paula Benevene & Ilaria buonomo (24 July 2020), Jing Yi Yong (7 April 2019), Nhat Tan Pham et al. (9 September 2019), Douglas W.S Renwick et al., Lydia Murillo-Ramos et al. (16 September 2022), Ms. Poonam Likhitkar et al. (5 May 2017), Shoeb Ahmed (2 April 2015)

FINDINGS

The study discovered that GHRM practices positively impact environmental performance and CSR. Numerous studies have shown a connection between GHRM practices and environmental performance (EP) (Rawashdeh, 2018). One approach to doing this is by either adding new jobs or including environmental duties in the current one's duties and job descriptions, highlighting how important it is to safeguard the environment inside the culture of the organization. GHRM uses several methods to promote environmental sustainability Shah (2019) or to improve employee pro-attain organizational objectives and promote environmental behaviour.

GHRM practices were favourably related to CSR. This outcome was consistent with Freitas et al. (2020), who noted that the most important GHRM procedures are green performance assessment, cooperation, hiring, and choice factors for enhanced CSR procedures in enterprises. The connection between GHRM and CSR would show the value of sustainability to the business, promoting growth in human resource processes (Mishra, 2017). The findings showed that employees who voluntarily adopted environmentally friendly behavior to fulfill their obligations, including Recycling and energy conservation would help a company achieve its environmental goals. The results of the present investigation showed a considerable correlation between CSR and OS. According to (Mahdi Waleed Ziyadeh, MOHD. Othman, and Ahmed Adnan Zaid 13 March 2023) shows that CSR has a favourable impact on sustainable performance. GHRM bundle procedures have a favourable impact on OS. According to the study (Bhatnagar and Aggarwal, 2020), researchers (Song et al., 2020) have discovered proof of Links between GHRM and environmental sustainability. The successful implementation of environmental legislation at work depends on environmentally conscious employee behaviour (Kim et al., 2017).

CONCLUSION

The evidence from the review indicates a tendency toward recognizing GHRM's linkage to sustainability. The findings of this study imply that GHRM practices have a positive impact on environmental performance and corporate social responsibility. The results of the present investigation also showed the positive impact of GHRM practices on organisational sustainability. The most effective way to achieve environmental GHRM is to encourage employees to perform judicially and carry out their responsibilities using green approaches. The variety of green activities available such as ridesharing, electronic filing, workplace flexibility, recycling, telephone

conferencing, and virtual selection building placesthat use less energy, that organisations can take on to ensure the long-term viability of the organisation. Greater efficiency is the result of these ecological measures reduced expenses, a happier workforce, and more engaged workers, which will increase the sustainability of the business.

LIMITATIONS AND FUTURE SCOPE

Future research could examine the relationship between green HRM practices and employees' intentions and subsequent green behaviour at work. The gap between research based on countries or regions and future studies could be better understood if they were based on geographical regions. This is a crucial area for research since, even though developing nations have substantially identical economic conditions, there are disparities that are based on cultural differences. Cultural context is an important factor to take into account when analyzing individuals and groups. Future research might also examine how different research approaches are used, particularly methods that are mixed. To compare and contrast the results of various methods. Additionally, a blended approach offers advantages that make up for the drawbacks of utilizing one study approach. Although this strategy could be more challenging, and require more research and analysis, and even if it requires more time and resources, the extensive research output it produces will be very beneficial to the body of information.

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Intrinsic and Extrinsic Factors Responsible for User Generated E-content Adoption in Hospitality Sector

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Abstract

Information Technology specifically in the form of social media has made a considerable impact on consumer decision-making. User Generated E-content posted on social media in the form of photographs, comments, ratings and reviews etc. has made consumers aware of their choices. In case of Hospitality industry too User Generated E-content put an influential impact on prospective traveler's destination image formation. Travelling and hospitality industry too has seen considerable changes due to consumer getting aware of the prices, places to visit, hotel choices, hospitality services like airport pickup, room services, food and beverages, tour cabs etc. Adoption of User Generated E-content has become the emerging issue in travelling and hospitality industry being the active participation of Indian consumers on social media. User Generated E-content adoption is connected to information search and using that information in forming decision. People who have already travelled and have used hospitality services share their information on social media, prospective travelers seeing those social media posts of friends or family may form an idea to visit those places which is adoption of User Generated E-content. There are Intrinsic and Extrinsic factors that play a major role in adoption of user Generated E-content. Intrinsic factors are the ones that are kind of internal motivation and reasons for information search and adoption like perceived usefulness, perceived enjoyment, past experience and prior knowledge about a place or destination etc. Extrinsic Factors are the ones that are known as external factors that influence information adoption amongst the prospective travelers. Extrinsic factors include information source credibility, homophily, trust, expertise etc. about the information source. Besides helping consumers to create a destination image in the minds the information shared by already traveled consumers is useful in finalizing the hospitality services amongst the available options.

Keywords: *User Generated E-content, Hospitality, Intrinsic Factors, Extrinsic Factors*

INTRODUCTION

Advancement in Information technology specifically in the form of social media has put an influential effect on travelling plans of prospective travellers. User Generated E-Content is any form of content such as images, text, pictures, audios, comments etc. that has been posted online by the user on either social media platform, discussion forums, and other websites naming few are Facebook, Instagram, Snapchat, etc. Social networking sites provides an opportunity to already travelled consumers a platform to communicate by sharing their experience by posting photos, comments about travelling destinations, hotel reviews a platform for travel consumers to communicate by sharing their experience. Reading online reviews before purchase has become common these days. Online reviews a textual form of electronic word of mouth (e-WOM) is playing major role in the consumer decision making. Travel products are intangible and cannot be evaluated beforehand, so travel consumers tend to rely on social media as an experienced

source to lower the perceived risk and uncertainty (Gretzel and Yoo, 2008); social media impact travel consumers' planning behaviour as they offer information that influences their booking plans (Ayeh, Au et al., 2013b; Cox et al., 2009). SNS (Social Networking Sites) as well travel related websites (such as agoda.com, MakemyTrip.com) allow the creation of content generally defined as User Generated Content (UGC) or Consumer Generated Media (CGM) (Ayeh, Au, et al. 2013a; Xiang and Gretzel, 2010). Social media are essential to travel consumers as they decide destinations, accommodations and activities for their travel, therefore social media will affect their travel and purchase decision making process (Gretzel and Yoo, 2008); social media are also considered to support consumers in their pre-travel phase (e.g. information search) and post-travel phase (e.g. share experiences, review hotels and destinations, and post photos and videos from the trips) (Chung and Buhalis, 2008). User Generated content create a destination image in the minds of potential travellers and can greatly influence the tourist's intention to revisit or recommend the destination to others (Gartner, 1994). Travel-related content posted by friends and relatives on various social networking sites has been proven influential for prospective travellers. Several past studies have emphasized on user-generated e-content by travel consumers such as online reviews to share their travel stories. Taking the assumptions of Technology Acceptance Model (TAM) which considers ease of use and perceived usefulness of information technology, the users continue to use Consumer Generated Media because of its utility to finalise hospitality services (Shao, 2009).

Generally, the memories created in the form of photos etc.are shared by a person on the social media platform which is further utilised by the prospective tourist for finalising the destination by looking at all the aspects of Content that has been shared. Extant literature has been explored in context of motivation behind sharing experience which include person's Cognition behaviour (like nurturing individualism as a dominant form of online socialisation), Self-centred motivations (maintenance of social capital in the form of social interactions, followers, identification, etc.), Altruistic behaviour (unselfishness in making aware the prospective travellers), Community related behaviour (social norms, interest and goals to continue being a part of community), Reciprocity (giving something back to social media) etc. Besides there are users' motivations too that have been discussed in literature. The users' motivation is the need to assure of the travel destination and things which can be explored along with other amenities available like hotels, flight or train bookings, shopping arcades, etc.

The present study explains the Intrinsic and extrinsic factors that are responsible for adoption of User Generated E-content that may result into travel intentions and further post travel intention like revisit intention, or intentions to recommend.

REVIEW OF LITERATURE

Role of Information in Travel Planning

G. Lyons (2009). The information seeking behaviour comes in the light due to either habit or satisficing behaviour. Seeking information about an unfamiliar trip is considered as the part of choice process in travel planning. Nezakati (2014) considered tourist industry a highly knowledge-based industry referring SECI model (Nonaka, 1994) as a process which is Socialisation (to exchange experience) leading to Externalisation (transformation of tacit knowledge to be understood by others) Combination (Combining various information and creating new knowledge) Internalisation (explicit knowledge into tacit knowledge by doing that activity or experiencing).

User-Generated E-Content

Consumers use virtual sites, online communities, platforms, and social networks to share their ideas. The content that users create and share online is called user-generated content (Rosario et al., 2021). User Generated Content research is exploring the various aspects of service quality, destination image and reputation, experiences and behaviour, the persuasive power of UGC as eWOM, as well as tourist mobility patterns (Lu et al., 2015). User Generated content includes the unstructured content posted on social media (Facebook, YouTube, Instagram, Flicker.com, etc.) and in the form of blogs containing personal thoughts, comments, stories, experience, hotel recommendations. Several tourism websites enable consumers to exchange information and well-known travel guides provide web space to publish travel stories to spread knowledge about various tourist destinations. User Generated Content helps in promoting tourism marketing as well educating prospective tourists and facilitate tourism transactions (Gary Akehurst, 2009). Stephen Burgess et al. (2009) suggesting the concern and benefits of User Generated Content talked about the trustworthiness and reliability of source of content as the major determinants of forming a opinion and decision making regarding travel destination. Textual UGC and content analysis are the leading data type and research method employed, in extant literature. Trustworthiness and Reliability are associated with the postings – they can be trusted because they are real experiences by real people who are independent – but can also be seen as untrustworthy because the content that is posted may be faked by someone with a vested interest. UGC is of utmost importance in context to travellers' opinions available (Burgess et al.2009). Various forms of media content that are publicly available and created by end-users" are referred to as User-Generated Content (UGC) (Kaplan & Haenlein, 2010).

Factors for adoption of User Generated E-Content (Literature Search)

As Intrinsic motivation is to engage in a behaviour because it feels like rewarding. It is like performing an activity for its own sake rather than from the desire for some external reward. The behaviour itself is its own reward. Likewise ***Intrinsic Factors*** for User Generated E-content adoption are the factors that lead to adoption due to personal enjoyment, usefulness etc. Extrinsic motivation is when we are motivated to perform a behaviour or engage in an activity because we want to earn something or avoid negative effects. Likewise ***Extrinsic Factors*** for User Generated E-content adoption are the one which are satisfying and lead to fulfil your desires that can be information source credibility, Trustworthiness, same taste as that of source, etc.

Intrinsic Factors includes factors like enjoyment, Involvement, Knowledge, experience, satisfaction and Usefulness. Perceived Enjoyment and Perceived Usefulness are the major factors behind intrinsic motivation to adopt User Generated E-content. Many authors have mentioned in their studies the information search is a hedonic activity along with the feature of utilitarian aspect. Searching of information brings pleasure with a motive of entertainment. Information quality leads to enhanced enjoyment (Ahn, Ryu, & Han, 2007). In order to adopt user generated e-content user must search the information to get the hedonic pleasure (enjoyment), and if information is of high quality and useful user tends to adopt the information for finalising the hospitality services as well destination. (Govers et al., 2007; Reynolds, 1965) Not only information spread by mass media, but also inherently enjoyable social process of collecting, selecting, and sharing others' experiences play an important role in finalising destination. Past experience. Previous studies have revealed that past experience is a main factor affecting consumer's future course of action,

and the destination to be visited. (Sonmez and Graefe, 1998; Petrick et al., 2001). It is observed that first-time visitors explore information brochures/travel guide books and advertisements; however, repeated visitors are inclined towards not only commercial but also non-commercial information sources such as articles/news, books/movies and friends/family groups (Bagloglu, 2001). Prior knowledge. It is mentioned in the extant literature that prior knowledge helps to assess the product quality as prospective consumer purchase the product with the assumption of knowledge about the product. Prior knowledge effects the decision-making regarding purchase of a product. (Hoyer and Brown, 1990; Lin and Chen, 2006).

Extrinsic Factors includes source credibility, trustworthiness, expertise of source and homophily. *Source credibility* has been defined by various researchers. Source in the study refers to consumers who post user generated e-content. Persuasion is high if the credibility of the source is high, major variables that interact with source credibility are source, message, channel, receiver, and destination variables (Pornpitakpan, 2004). As far information adoption through e-WOM is concerned, customer uses e-WOM to reduce the future hazards while taking decisions (Hussain et al., 2017). Few studies have viewed source expertise and trustworthiness as the key dimensions of source credibility. *Trustworthiness* (Dickinger, 2011) proved in his research that trustworthiness of content is important to decide the product choice. Trust in an online community is proved to be of utmost importance to form an attitude towards a product. Similarly online reviews, photographs or other e-content from trustworthy source can persuade potential tourists to adopt the information (Casaló et al., 2011). *Source Expertise* (Pamela et al., 1990) in their opinion explained if the source is perceived to be expert before reading the content posted by him/her, the information so posted will have positive impact on the reader or viewer. Mun et al. (2013) source expertise influences message credibility, which results into lowering the perceived risk. *Homophily* is the similarity between group members in terms of sex, education, social status, profession or geographical location. Members with homophily characteristics tend to believe in the information given by each other rather than the information obtained from outside. Content shared and received from person with similarities tend to more reliable than received from others (McPherson, Smith-Lovin, & Cook, 2001). Both Background homophily and attitude homophily leads to positive attitude towards information adoption available through online reviews (Shen et.al.2016).

CONCLUSION

The aim of the study is to provide a glimpse of antecedents of adoption of information through user generated e-content through a review of the literature. For the abovesaid purpose, hospitality tourism and Marketing journals have been explored. The experiences shared by fellow tourists considered to be believable and trustworthy (Sparks et al., 2013). Source's credibility, expertise and trustworthiness positively influence the information adoption. Besides this internal factor like perceived usefulness, expertise, enjoyment, knowledge etc. too positively influence the information adoption amongst the prospective travellers. These factors are considered to be important determinants in adoption of User Generated E-content information.

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The Effect of AI and IoT on Employee Engagement in Healthcare HR Practices: A Transformative Perspective

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Abstract

Technology plays a crucial role in Healthcare industries. In the past, due to the lack of wireless technology, healthcare facilities have experienced degradation, low employee engagement, and communication gaps. However, Artificial Intelligence (AI) has improved intelligence and efficiency in daily life and at business. AI has advanced significantly in recent years, functioning as a unique identifier-equipped interconnection mechanism. The advancement of AI and its confluence with the Internet of Things (IoT) enable staff members to devise inventive and efficient solutions for human resource (HR) procedures. This chapter aims to provide readers with a comprehensive understanding of how AI-enabled healthcare devices have enhanced employee engagement in the past, present, and future. By summarizing and classifying the available studies, this study aims to categorize and tackle the problems that come with HR procedures. The strategy of adopting AI-connected devices strategically in the healthcare industry can enhance HRM's function and make performance evaluation easier, which will increase worker productivity and engagement. This study offers useful insights into the integration of these technologies to improve HR practices in the healthcare sector.

Keywords: *Artificial Intelligence (AI), IoT (Internet of Things), Information Security, Remote Patient Monitoring, IoT – Medical Devices, Smart Health*

INTRODUCTION

The healthcare industry is undergoing a profound transformation driven by advancements in technology. Historically, healthcare facilities have faced significant challenges in managing human resources effectively due to outdated systems and a lack of integrated technological solutions. These challenges have often manifested as communication gaps, low employee engagement, and decreased operational efficiency. As the demand for high-quality patient care grows, so does the need for innovative solutions to address these issues and improve the overall working environment for healthcare professionals. The Role of Technology in Healthcare Technology has become an indispensable part of modern healthcare, influencing various facets of the industry. From electronic health records (EHRs) to telemedicine, technological advancements have redefined patient care and operational efficiency. One of the critical areas where technology is making a significant impact is Human Resource Management (HRM). Effective HRM is crucial for maintaining a motivated and productive workforce, which is essential for delivering high-quality patient care. Challenges in Traditional HR Practices Traditional HR practices in healthcare settings have often been hindered by several challenges. Fragmented communication systems, inefficient performance

evaluation methods, and inadequate employee engagement strategies have been persistent issues. The absence of advanced technological solutions has exacerbated these problems, leading to increased stress among staff, lower job satisfaction, and reduced productivity. The lack of real-time data and integrated systems has further contributed to these challenges, highlighting the need for more innovative solutions. The Emergence of Artificial Intelligence (AI) and IoT. In recent years, Artificial Intelligence (AI) and the Internet of Things (IoT) have emerged as transformative technologies with the potential to address these longstanding issues. AI, with its capability to analyze large volumes of data and derive actionable insights, offers a powerful tool for enhancing HR practices. When combined with IoT devices, which enable real-time data collection and seamless interconnection between systems, AI becomes even more effective. This confluence of AI and IoT represents a significant leap forward in the ability to manage and engage healthcare employees.

PROBLEM STATEMENT

Background

The healthcare industry faces persistent challenges related to employee engagement, which significantly impact operational efficiency and the quality of patient care. Traditional Human Resource Management (HRM) practices in healthcare settings have often been inadequate in addressing these challenges due to outdated communication systems, fragmented data management, and ineffective performance evaluation methods. These issues have led to low employee morale, high turnover rates, and decreased productivity, ultimately affecting patient outcomes and the overall efficiency of healthcare facilities.

The Emergence of AI and IoT

Recent advancements in technology, particularly in Artificial Intelligence (AI) and the Internet of Things (IoT), present new opportunities to address these HR challenges. AI, with its capability to analyze large datasets and provide actionable insights, and IoT, with its ability to facilitate real-time data collection and system integration, have the potential to revolutionize HR practices in healthcare. However, the application of these technologies to enhance employee engagement remains underexplored and not fully understood.

The Problem

Despite the promising potential of AI and IoT technologies, there is a significant gap in understanding how these innovations can be systematically integrated into HR practices to improve employee engagement in healthcare settings. Specifically, the following issues need to be addressed:

1. **Lack of Integration:** Healthcare facilities often struggle with integrating AI and IoT technologies into existing HR systems, leading to suboptimal use of these tools and missed opportunities for enhancing employee engagement.
2. **Communication Gaps:** There is a need for more effective communication solutions that leverage AI and IoT to bridge the gaps between healthcare staff and management, improving overall coordination and morale.
3. **Performance Evaluation Challenges:** Traditional performance evaluation methods are often inadequate. There is a need for AI-driven systems that can provide real-time, accurate

assessments of employee performance and contribute to more personalized development plans.

4. **Data Security and Privacy:** As AI and IoT systems collect and manage sensitive employee data, ensuring robust information security and addressing privacy concerns is crucial for successful implementation.
5. **Resistance to Change:** Healthcare staff may exhibit resistance to adopting new technologies. Understanding how to effectively implement AI and IoT solutions in a way that addresses these concerns and fosters acceptance is essential.

RESEARCH OBJECTIVE

This study aims to systematically review and analyze how AI-enabled healthcare devices and IoT technologies have been employed to address these HR challenges. By summarizing existing research and evaluating the effectiveness of these technologies in improving employee engagement, this research seeks to provide actionable insights and recommendations for healthcare facilities looking to enhance their HR practices through technological innovation.

Research Questions

1. How does the integration of Artificial Intelligence (AI) in HR practices impact employee engagement in healthcare settings?
2. What role does the Internet of Things (IoT) play in enhancing communication and performance evaluation among healthcare employees?
3. How do AI-driven tools and IoT devices compare to traditional HR methods in improving employee productivity and job satisfaction in healthcare?
4. What are the primary challenges associated with implementing AI and IoT technologies in healthcare HR practices, and how can they be effectively addressed?
5. How do healthcare employees perceive the adoption of AI and IoT technologies in their daily work routines, and what factors influence their acceptance or resistance?

HYPOTHESES

1. **Hypothesis 1:** The integration of Artificial Intelligence (AI) in HR practices significantly improves employee engagement in healthcare settings.
   Rationale: AI technologies, such as real-time feedback systems and performance analytics, are expected to enhance employee engagement by providing more accurate performance assessments and personalized feedback.
2. **Hypothesis 2:** The use of Internet of Things (IoT) devices in healthcare HR practices enhances communication efficiency and performance evaluation compared to traditional methods.
   Rationale: IoT devices facilitate real-time data collection and seamless communication, which can address communication gaps and improve performance evaluation processes.
3. **Hypothesis 3:** AI-driven tools and IoT devices lead to higher employee productivity and job satisfaction in healthcare settings compared to traditional HR practices.
   Rationale: By streamlining HR processes and offering more effective performance management, AI and IoT technologies are anticipated to boost both productivity and job satisfaction among healthcare employees.

4. **Hypothesis 4:** Implementing AI and IoT technologies in healthcare HR practices presents significant challenges, including data security concerns and resistance to change, which need to be strategically managed.
   Rationale: The adoption of new technologies often involves challenges such as ensuring data privacy and overcoming staff resistance, which must be addressed to achieve successful implementation.
5. **Hypothesis 5:** Healthcare employees' perception of AI and IoT technologies is influenced by factors such as perceived ease of use, perceived usefulness, and the support provided during implementation.
   Rationale: The acceptance and effectiveness of AI and IoT technologies in healthcare are likely to be influenced by how easy these technologies are to use, how useful they are perceived to be, and the level of support provided during their implementation.

RESEARCH OBJECTIVES

1. **To Evaluate the Impact of AI on Employee Engagement:** Assess how the integration of Artificial Intelligence (AI) in HR practices influences employee engagement levels in healthcare settings. This includes analyzing how AI-driven tools such as real-time feedback systems, performance analytics, and personalized development programs affect staff morale, job satisfaction, and overall engagement.
2. **To Examine the Role of IoT in Enhancing Communication and Performance Evaluation:** Investigate how Internet of Things (IoT) devices contribute to improved communication between healthcare staff and management, as well as how they enhance performance evaluation processes. This objective aims to understand how IoT-enabled solutions can address traditional communication gaps and streamline performance assessments.
3. **To Compare AI and IoT Technologies with Traditional HR Practices:** Compare the effectiveness of AI-driven tools and IoT devices with conventional HR methods in terms of improving employee productivity, job satisfaction, and engagement. This includes evaluating the strengths and limitations of these technologies compared to traditional approaches.
4. **To Identify Challenges and Barriers in Implementing AI and IoT in Healthcare HR:** Identify and analyze the primary challenges associated with the adoption of AI and IoT technologies in healthcare HR practices, such as data security concerns, integration issues, and resistance to change. This objective aims to provide insights into how these challenges can be effectively managed.
5. **To Assess Employee Perceptions and Acceptance of AI and IoT Technologies:** Investigate how healthcare employees perceive the adoption of AI and IoT technologies in their work environment. This includes examining factors that influence their acceptance or resistance to these technologies, such as perceived ease of use, perceived usefulness, and the level of support provided during implementation.
6. **To Provide Recommendations for Strategic Integration of AI and IoT in Healthcare HR:** Develop actionable recommendations for healthcare facilities on how to strategically integrate AI and IoT technologies into their HR practices. This includes suggesting best practices for implementation, addressing potential challenges, and leveraging these technologies to enhance employee engagement and overall HR effectiveness.

7. **To Analyze the Future Trends and Implications of AI and IoT in Healthcare HR:** Explore future trends in AI and IoT technologies and their potential implications for HR practices in healthcare. This objective aims to provide a forward-looking perspective on how these technologies might continue to evolve and influence employee engagement and HR management.

SIGNIFICANCE OF THE TOPIC

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) in healthcare is revolutionizing Human Resource (HR) practices by enhancing employee engagement, communication, and overall efficiency. This transformation addresses long-standing challenges in the healthcare sector, such as low engagement and communication gaps due to outdated technologies. By adopting AI and IoT, healthcare organizations can streamline HR processes, improve performance evaluations, and ultimately boost workforce productivity and satisfaction. This study provides critical insights into the strategic implementation of these technologies, offering a roadmap for future advancements in HR management within the healthcare industry.

AI in Healthcare HR Practices

- **AI in Recruitment and Talent Management**
  - Review studies highlighting how AI-driven tools are used for talent acquisition, predicting employee success, and automating administrative tasks.
  - Mention advancements in AI for personalized learning and development, which boosts employee satisfaction and retention.
- **AI in Employee Engagement**
  - Discuss recent findings on AI's role in monitoring employee performance, providing real-time feedback, and enhancing communication within teams.
  - Highlight research that shows AI-driven analytics identifying factors that influence employee engagement and suggesting interventions.

IoT in Healthcare HR Practices

- **IoT-Enabled Work Environments**
  - Explore the role of IoT in creating smart workplaces that enhance employee comfort, safety, and productivity.
  - Reference studies that show how IoT devices, such as wearables, help monitor employee health and well-being, leading to better engagement.
- **Remote Work and IoT**
  - Review literature on the impact of IoT on remote work, especially in healthcare, where remote patient monitoring is crucial.
  - Discuss how IoT enhances communication and collaboration among remote teams, improving overall engagement.

Challenges and Ethical Considerations

- **Data Privacy and Security**
  - Review literature on the challenges related to data privacy and security with the use of AI and IoT in HR practices.
  - Discuss ethical concerns around surveillance, data ownership, and employee autonomy.

- **Implementation Barriers:** Highlight studies that identify barriers to the adoption of AI and IoT in healthcare HR, such as costs, technological readiness, and resistance to change.

Future Directions

- **Integration of AI and IoT**
  - Discuss emerging trends in the convergence of AI and IoT to create more comprehensive HR solutions.
  - Reference future-oriented studies that suggest how these technologies can be further leveraged to improve employee engagement in the healthcare sector.
- **Long-Term Impact on HR Practices**
  - Summarize studies predicting the long-term effects of AI and IoT on the HR landscape in healthcare.
  - Mention potential shifts in the role of HR professionals as AI and IoT become more integrated into daily operations.

Research Design

- **Type of Study:** Specify whether your study is *qualitative*, *quantitative*, or *mixed-methods*. Given the nature of your topic, a mixed-methods approach may be beneficial, as it allows for both statistical analysis and in-depth exploration of experiences and perspectives.
- **Purpose of the Study:** Clarify whether your research is *exploratory*, *descriptive*, or *explanatory*. Since your study aims to understand the impact of AI and IoT on HR practices, it could be explanatory with elements of exploratory research.

Research Questions/Hypotheses

- **Research Questions:** Formulate specific research questions. For example:
  - How does the integration of AI and IoT influence employee engagement in healthcare?
  - What are the challenges healthcare organizations face when implementing AI and IoT in HR practices?
- **Hypotheses:** If applicable, state hypotheses that your study will test. For example:
  - H1: AI-enabled HR practices significantly improve employee engagement in healthcare.
  - H2: IoT devices reduce communication gaps and increase employee productivity in healthcare settings.

Data Collection Methods

- **Primary Data**
  - **Surveys:** Use structured questionnaires to gather quantitative data from healthcare employees and HR professionals on their experiences with AI and IoT.
  - **Interviews:** Conduct semi-structured interviews with key stakeholders (e.g., HR managers, IT professionals, healthcare workers) to collect qualitative insights into the adoption and impact of these technologies.
- **Secondary Data**
  - **Literature Review:** Utilize existing academic papers, industry reports, and case studies to contextualize your findings.
  - **Case Studies:** Examine specific healthcare organizations that have implemented AI and IoT in their HR practices.

Sampling Strategy

- **Population**
  - Define your target population, such as HR professionals, healthcare employees, and IT staff within healthcare organizations.
- **Sample Size**
  - Determine an appropriate sample size based on your study's scope and statistical requirements.
  - Use purposive or stratified sampling for interviews and random or convenience sampling for surveys.
- **Sampling Technique**
  - For qualitative data, you may use *purposive sampling* to select participants who have experience with AI and IoT in HR.
  - For quantitative data, consider *random sampling* to ensure a representative sample.

Data Analysis

- **Quantitative Analysis**
  - Use statistical software (e.g., SPSS, R) to analyze survey data.
  - Perform descriptive statistics (e.g., mean, median) and inferential statistics (e.g., regression analysis, ANOVA) to test hypotheses.
- **Qualitative Analysis**
  - Use coding techniques to identify themes and patterns in interview transcripts.
  - Employ software like NVivo or Atlas.ti for thematic analysis.
- **Triangulation:** Combine qualitative and quantitative data to corroborate findings and provide a comprehensive understanding of the research problem.

Validity and Reliability

- **Ensuring Validity**
  - **Content Validity:** Ensure your survey and interview questions accurately reflect the concepts of AI, IoT, and employee engagement.
  - **Construct Validity:** Use established scales or measurement instruments where possible.
- **Ensuring Reliability**
  - **Pilot Testing:** Conduct a pilot test of your survey and interview protocols to refine questions and ensure consistency.
  - **Inter-rater Reliability:** For qualitative data, use multiple coders and assess the consistency of their coding.

Ethical Considerations

- **Informed Consent:** Obtain informed consent from all participants, explaining the purpose of the study and their rights.
- **Confidentiality:** Ensure the confidentiality of participants' data, especially given the sensitive nature of HR information.
- **Ethical Approval:** Seek approval from an Institutional Review Board (IRB) or ethics committee before conducting your research.

Limitations

- **Acknowledgment of Limitations:** Discuss potential limitations, such as sample size constraints, potential biases, and the generalizability of the findings.
- **Mitigation Strategies:** Explain how you will address or minimize these limitations in your research.

Timeline

- **Research Timeline:** Provide a detailed timeline of your research activities, from data collection to analysis and report writing.

CONCLUSION

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) into healthcare HR practices represents a transformative shift that holds the potential to significantly enhance employee engagement, productivity, and overall organizational efficiency. Through the strategic adoption of AI and IoT technologies, healthcare organizations can address long-standing challenges such as communication gaps, low employee engagement, and inefficient HR processes.

Our study has highlighted the ways in which AI and IoT can streamline HR functions, from recruitment and talent management to performance evaluation and employee well-being. By leveraging AI for predictive analytics and personalized employee experiences, and utilizing IoT to create smart, connected workplaces, healthcare organizations can foster a more engaged and motivated workforce. Moreover, the ability of these technologies to facilitate remote work and real-time monitoring further underscores their relevance in today's dynamic healthcare environment.

However, this transformation is not without its challenges. Issues related to data privacy, security, and the ethical use of AI and IoT must be carefully managed to ensure that the benefits of these technologies are fully realized without compromising employee trust or autonomy. Additionally, the successful implementation of AI and IoT in HR requires a clear strategic vision, investment in technological infrastructure, and a willingness to embrace change within the organization.

In conclusion, as AI and IoT continue to evolve, their impact on HR practices in healthcare will only grow, offering new opportunities to enhance employee engagement and organizational performance. Future research should focus on exploring these technologies' long-term effects on HR practices and developing frameworks to guide their ethical and effective implementation. By embracing these innovations, healthcare organizations can not only improve their HR functions but also create a more supportive and engaging environment for their employees, ultimately leading to better patient care and organizational success.

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MARKETING FOR CIRCULAR ECONOMY

Analyzing Circular Economy Initiatives in Major US Airlines

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Abstract

The circular economy represents a transformative approach to sustainability by emphasizing the continuous use of resources, minimizing waste, and regenerating operations. This research paper analyzes the implementation of circular economy initiatives within the airline industry, focusing on how airlines integrate these principles into their operations. By examining sustainability reports from major US airlines, this study identifies key circular economy initiatives such as waste management, sustainable aviation fuels, and aircraft lifecycle management. The findings highlight best practices, challenges, and the overall impact of these initiatives on environmental and economic sustainability. This paper provides valuable insights for industry stakeholders seeking to enhance sustainability and offers recommendations for broader adoption of circular economy practices.

Keywords: *Circular Economy, Airline Operations, Sustainability, Content Analysis*

INTRODUCTION

The aviation industry, a critical driver of global transportation and economic growth, faces significant environmental challenges due to its substantial carbon emissions, resource consumption, and waste generation (Leal Filho et al., 2023; Zieba and Johansson, 2022). As public and regulatory pressures for sustainability increase, airlines are exploring innovative approaches to reduce their environmental impact. One such approach is the adoption of circular economy principles, which aim to transform traditional linear models of production and consumption into systems that prioritize resource efficiency, waste reduction, and the continuous use of materials (Acerbi & Taisch, 2024).

The circular economy is built on three foundational principles: designing out waste and pollution, keeping products and materials in use, and regenerating natural systems (Barreiro-Gen and Lozano, 2020; Islam et al., 2021). For the airline industry, this means rethinking how resources are utilized throughout the lifecycle of aircraft, from manufacturing and operation to maintenance and end-of-life disposal. Key circular economy initiatives in the aviation sector include the adoption of Sustainable Aviation Fuels (SAFs), comprehensive recycling and waste management programs, and the development of business models that prioritize resource efficiency and asset sharing (Salesa et al., 2023; Rodrigues Dias et al., 2022).

To further improve our understanding of this matter, this research paper aims to evaluate how major U.S. airlines are implementing circular economy principles within their operations and assess the impact of these initiatives on sustainability. By analyzing annual sustainability reports from major US airlines, the study seeks to identify and categorize the circular economy

initiatives currently undertaken by airlines, assess their effectiveness in achieving sustainability, and compare these efforts across different airlines.

To do this, we focus on three major U.S. airlines—American Airlines, Delta Air Lines, and Southwest Airlines—selected for their significant market share and comprehensive sustainability reporting over the past five years (2019-2023). By examining their initiatives in circular economy initiatives, this research provides a detailed understanding of how the airline industry can transition towards a more sustainable, circular economy model.

The findings from this study reveal that all three airlines have made significant strides in reducing their carbon footprints and aligning their operations with circular economy principles. Delta Airlines emerged as the leader in both SAF adoption and overall emissions reductions, demonstrating a strong commitment to achieving carbon neutrality through substantial investments in SAF, fleet modernization, and waste management initiatives. American Airlines, while starting with a smaller base in SAF adoption, has shown consistent progress, particularly through fleet renewal and operational efficiency improvements, leading to a gradual reduction in emissions. Southwest Airlines, although slightly behind Delta in SAF adoption, has focused heavily on operational efficiency and waste reduction, contributing to a steady decline in emissions.

The results of this study have several important managerial and practical implications for the airline industry. First, the clear correlation between SAF adoption and emissions reduction highlights the need for airlines to prioritize the integration of SAF into their fuel mix as a critical component of their sustainability strategies. Managers of airlines should consider accelerating SAF adoption through strategic partnerships, investments in SAF production, and advocating for supportive regulatory frameworks that facilitate broader use of SAF across the industry.

Second, the emphasis on fleet modernization and operational efficiency as key drivers of sustainability suggests that airlines should continue to invest in upgrading their fleets and optimizing operations. By replacing older aircraft with more fuel-efficient models and adopting technologies that enhance fuel efficiency, airlines can significantly reduce their Scope 1 emissions, which constitute the majority of their carbon footprint.

Third, the study underscores the importance of waste management and recycling initiatives as part of a broader circular economy strategy. Airlines can further align with circular economy principles by implementing comprehensive waste reduction programs, such as minimizing single-use plastics, enhancing in-flight recycling, and exploring the use of sustainable materials in aircraft construction and operations.

Finally, this research highlights the value of collaborative innovation and systemic change in achieving sustainability goals. The active involvement of airlines in industry-wide initiatives, partnerships, and advocacy efforts is crucial for driving systemic change that supports the transition to a circular economy. Managers should seek opportunities to collaborate with other industry players, governments, and research institutions to develop and implement innovative solutions that advance sustainability across the entire aviation ecosystem.

Overall, the insights gained from this study provide a valuable framework for airline managers and industry stakeholders seeking to enhance sustainability. By continuing to invest in SAF, fleet modernization, waste management, and collaborative initiatives, airlines can achieve their emissions reduction targets and position themselves as leaders in the global transition towards a more sustainable and circular economy.

LITERATURE REVIEW

The concept of the circular economy is rooted in the idea of minimizing waste and making the most of resources. It contrasts with the traditional linear economy, which follows a "take, make, dispose" model. The circular economy aims to keep products, materials, and resources in use for as long as possible, extracting maximum value from them before recovering and regenerating products and materials at the end of their life cycle (Acerbi & Taisch, 2024). Various principles underpin this model, including resource efficiency, waste minimization, and sustainable consumption and production practices (Rodrigues Dias et al., 2022).

The circular economy has been embraced by various industries, each adapting its principles to suit specific operational needs. In the manufacturing sector, for example, companies have implemented strategies such as product life extension, remanufacturing, and recycling to reduce waste and enhance resource efficiency (Acerbi & Taisch, 2024; Han et al., 2023). These practices have been driven by a combination of regulatory pressures, consumer demand for sustainable products, and the need to reduce operational costs. However, the level of adoption and the effectiveness of these practices vary across industries, highlighting the need for industry-specific approaches to circular economy implementation (Ghisellini et al., 2018).

Family farmers have increasingly adopted circular economy principles to enhance sustainability in their agricultural practices. These practices include the recycling of organic waste, efficient water use, and the adoption of renewable energy sources. The integration of circular economy practices in farming supports environmental sustainability and contributes to economic resilience by reducing input costs and creating new revenue streams from waste products (Rodrigues Dias et al., 2022). Similarly, Patel and Singh, (2023) used a circular economy in the automobile industry to find strategies that improve sustainability through existing economic models. In addition, in the tourism sector, Axhami et al., (2023) highlighted the significant economic, environmental, and social benefits of circular economy practices. Through a qualitative case study of a tourism resort, they identified key practices focused on resource efficiency, emission reduction, and environmental impact minimization.

The airline industry is a significant contributor to environmental degradation, with substantial carbon emissions, resource consumption, and waste generation. A comprehensive review by Calisir et al. (2020) highlights the environmental impacts of aviation through a life cycle assessment approach, emphasizing the need for the industry to adopt more sustainable practices. The study suggests that circular economy principles, such as resource efficiency and waste reduction, could play a crucial role in mitigating the environmental impacts of the aviation sector.

The aviation industry faces increasing regulatory pressures and public expectations to adopt more sustainable practices. Kim et al. (2019) discuss the role of socio-technical innovations in accelerating the transition to sustainable aviation, particularly in the adoption of biofuels. Regulatory frameworks and public demand for greener alternatives are pushing airlines to explore circular economy strategies as a means to meet sustainability goals while maintaining competitiveness in the market.

Airlines have begun to incorporate sustainability into their operations, although the degree of implementation varies. According to Zieba and Johansson (2022), sustainability reporting in the airline industry has become more prevalent, with companies increasingly disclosing their environmental impacts and sustainability initiatives. However, the authors note that there is still

a significant gap between current practices and the potential of circular economy strategies to transform the industry's sustainability performance.

The application of circular economy principles in airline operations has gained attention as a means to enhance sustainability. Ibn-Mohammed et al. (2021) explore how these principles can be applied to various aspects of airline operations, including waste management, sustainable aviation fuels, and aircraft lifecycle management. The study highlights the potential for circular economy strategies to reduce environmental impacts and improve resource efficiency in the aviation sector.

Specific areas where circular economy practices can be implemented in the airline industry include waste management, the use of sustainable aviation fuels, and resource efficiency. Salesa et al. (2023) discuss how airlines are adopting circular economy principles in their waste management systems, focusing on reducing waste generated by in-flight services and recycling materials. Additionally, the use of sustainable aviation fuels is seen as a promising area for circular economy adoption, as it addresses both resource efficiency and carbon emissions.

The adoption of circular economy practices in airlines can lead to significant environmental, economic, and social benefits. Ghisellini et al. (2018) provide a comprehensive review of the environmental and economic costs and benefits associated with the circular economy approach in various sectors. In the context of airlines, these benefits include reduced waste, lower carbon emissions, and potential cost savings from resource efficiency and recycling initiatives.

Recent studies indicate emerging trends and future directions in the application of circular economy principles in the airline industry. Malagón et al. (2024) discuss the role of technological innovation in driving sustainability in air transport, highlighting the potential for circular economy strategies to be integrated into broader technological and operational innovations. The study suggests that future research should focus on scaling these practices and developing new frameworks to guide their implementation across the industry. Therefore, in this study, we aim to close the gaps stated above in the literature by evaluating how airlines are implementing circular economy principles in their operations and the impact of these initiatives on sustainability.

METHODOLOGY

Data Collection

The data for this study was collected from publicly available Environmental, Social, and Governance (ESG) and sustainability reports published by three major U.S. airlines: American Airlines, Delta Airlines, and Southwest Airlines. These reports were sourced directly from the official websites of the respective airlines and cover a period from 2019 to 2023. These airlines were selected based on two primary criteria: the availability of comprehensive sustainability reports covering the past five years and their significant market share within the U.S. airline industry. Together, these airlines represent a substantial portion of the domestic aviation market, making them ideal candidates for analyzing industry trends and sustainability practices. The selected reports include the most recent sustainability disclosures, providing a comprehensive overview of each airline's efforts towards reducing carbon emissions, adopting SAF, improving operational efficiency, and aligning with circular economy principles.

The ESG reports typically include qualitative and quantitative data on the airlines' environmental performance, including GHG emissions across Scope 1, Scope 2, and Scope 3 categories, SAF adoption rates, waste management practices, and resource efficiency initiatives.

These data points are critical for assessing the airlines' progress toward sustainability and their alignment with circular economy principles.

Data Preparation

The gathered data was first organized by year and airline, ensuring a consistent structure for subsequent analysis. Key metrics such as Scope 1, Scope 2, and Scope 3 emissions, SAF usage percentages, and other relevant environmental indicators were extracted and tabulated. Where numerical data were not explicitly provided in the reports, estimates were made based on available information or inferred from trends described in the text.

Textual data related to qualitative assessments, such as discussions of waste reduction strategies, fleet modernization efforts, and collaborative sustainability initiatives, were also extracted. These qualitative insights were coded and categorized according to their relevance to circular economy principles, such as resource efficiency, waste reduction, and systemic innovation.

For the quantitative analysis, the data was converted into a format suitable for statistical analysis. This included normalizing the data across the different airlines to account for variations in reporting styles and units of measurement. For example, each airline reports Scope 1 emissions, which represent the direct emissions from fuel combustion. However, these emissions can be reported in different units (e.g., metric tons, million metric tons) or relative to different operational metrics (e.g., per passenger mile, per flight). To normalize these emissions, all data was first converted to a common unit of measurement. For example, if American Airlines reported Scope 1 emissions in million metric tons and Delta in metric tons, Delta's data would be divided by 1,000,000 to convert to the same unit (million metric tons).

To account for differences in the size and operational scale of the airlines (e.g., number of flights, total passengers, or revenue passenger miles), emissions were normalized by dividing by an operational metric. For example, emissions could be expressed per million revenue passenger miles (RPMs) to adjust for the fact that larger airlines naturally emit more CO2e simply due to higher activity levels. For example, if American Airlines had 50 million metric tons of CO2e emissions and 100 million RPMs, the normalized value would be 0.5 metric tons CO2e per RPM. The same process would be applied to the other airlines.

Trends in emissions and SAF adoption were then analyzed using correlation coefficients, with a particular focus on understanding the relationship between SAF adoption and overall emission reductions. Visualization tools, including trend graphs and correlation plots, were employed to illustrate the findings and highlight key insights.

In cases where direct comparisons were made between airlines, the data was carefully cross-referenced to ensure consistency and accuracy. This approach allowed for a robust analysis of how each airline's sustainability efforts align with circular economy principles and the broader impact of SAF adoption on their environmental performance.

Analysis and Methods

The analysis of the sustainability efforts of American Airlines, Delta Air Lines, and Southwest Airlines is conducted using a combination of qualitative and quantitative methods. The primary focus is on assessing how each airline's initiatives align with circular economy principles, as well as the impact of SAF adoption on overall emissions.

The first step in the analysis includes extracting relevant data from the sustainability and ESG reports of each airline, covering the period from 2019 to 2023. The extracted data has both qualitative insights (e.g., descriptions of sustainability initiatives, and waste management practices) and quantitative metrics (e.g., Scope 1, 2, and 3 emissions, SAF usage).

The qualitative data is analyzed using content analysis, where key themes related to circular economy principles—such as waste reduction, resource efficiency, and systemic innovation—were identified and coded. Content analysis is a widely used qualitative research method that allows for the systematic identification and categorization of patterns within textual data. This method is particularly useful in sustainability research for understanding how organizations frame and communicate their environmental efforts (Amini et al., 2018; Landrum and Ohsowski, 2018). This involves manually reviewing the reports for mentions of relevant sustainability practices and categorizing them according to their alignment with the circular economy.

Following data preparation, a trend analysis is conducted to identify patterns in emissions and SAF adoption over the five-year period. Time-series analysis is used to track changes in Scope 1, 2, and 3 emissions, as well as SAF adoption rates, over the study period. In addition, to quantify the relationship between SAF adoption and emissions reduction, a correlation analysis is performed. The final step involves comparing the results across the three airlines to identify common patterns and differences in their alignment with circular economy principles. A cross-case comparison is conducted to analyze how each airline's sustainability efforts aligned with circular economy principles. This involves comparing the qualitative insights and quantitative results from each airline to identify similarities and differences in their approaches. The combination of these methods provides a comprehensive understanding of how American Airlines, Delta Airlines, and Southwest Airlines are aligning their sustainability efforts with circular economy principles.

DISCUSSION AND RESULTS

We conduct the analysis on each airline and then compare them together in the following:

American Airlines

Based on the content analysis results, American Airlines' investment in fleet renewal, where older, less efficient planes are replaced with modern, fuel-efficient aircraft, aligns with the principle of sustainable design. By prioritizing efficiency, they are reducing the energy intensity of their operations and lowering resource consumption per passenger mile. In addition, the airline's efforts to reduce aircraft weight through lighter materials and removing in-seat entertainment systems (favoring digital streaming) reflect resource efficiency. This reduces the amount of fuel needed per flight, thereby conserving resources.

Sustainable Aviation Fuel produced from waste materials like used cooking oil and agricultural residues is a prime example of closing the loop in the circular economy. This process recycles waste into valuable fuel, reducing reliance on virgin fossil fuels and lowering the overall carbon footprint. The shift towards SAF aligns with the circular economy's renewable energy component. Using SAF made from waste products ensures that the energy input into the system is both renewable and derived from materials that would otherwise be discarded.

American Airlines' initiatives to recycle in-flight materials (e.g., waste management systems for plastic and paper) and the use of recycled materials in aircraft construction also fit within the circular economy principles. While the airline is modernizing its fleet, it also focuses on

extending the lifecycle of existing planes through maintenance and efficiency improvements, aligning with the circular economy's emphasis on prolonging product lifespans. Programs that focus on optimizing flight operations and improving fuel efficiency without the need for new materials or infrastructure can be seen as extending the lifecycle of existing resources.

Participation in carbon offset programs and efforts to reduce greenhouse gas emissions reflect the circular economy's aim to decouple economic growth from resource use and environmental impact. In addition, American Airlines' involvement in initiatives like the Breakthrough Energy Catalyst and other industry collaborations shows a commitment to shared innovation, which is critical in the circular economy. These efforts aim to drive systemic changes across the aviation industry, enabling more sustainable practices.

Advocating for policies that support SAF and other low-carbon technologies is an essential step toward systemic change, which is necessary for the transition to a circular economy. By supporting legislation and market mechanisms that make sustainable practices more viable, American Airlines is helping to shift the industry towards a circular model. These initiatives demonstrate a strong alignment with circular economy principles, particularly in areas like resource efficiency, closing the loop through SAF, and extending the lifecycle of their fleet. To enhance their circular economy strategy, they could further explore innovations in waste management, recycling of onboard materials, and developing more circular business models that integrate all stages of the product lifecycle.

An analysis of the trends toward circular economy initiatives indicates SAF usage started at around 9 million gallons in 2019, with a slight increase in 2020. There was a notable drop in SAF usage, possibly reflecting the impact of the COVID-19 pandemic or a gradual ramp-up in adoption. A significant jump in reported SAF volumes indicates either a major future commitment or an aggregated total that includes anticipated future usage. The figures show a return to lower levels, likely reflecting actual usage as opposed to commitments or projections seen in 2022.

Analysis of emission-related efforts shows that the majority of American Airlines' emissions come from Scope 1 (49 million metric tons of CO2e, 71% of total emissions), primarily due to

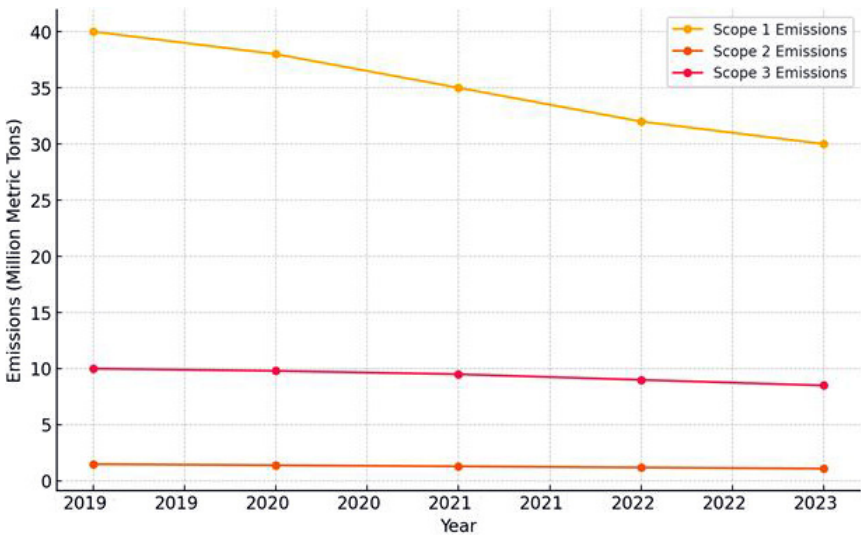


Figure 1: American Airlines Emission Trend (2019–2023)

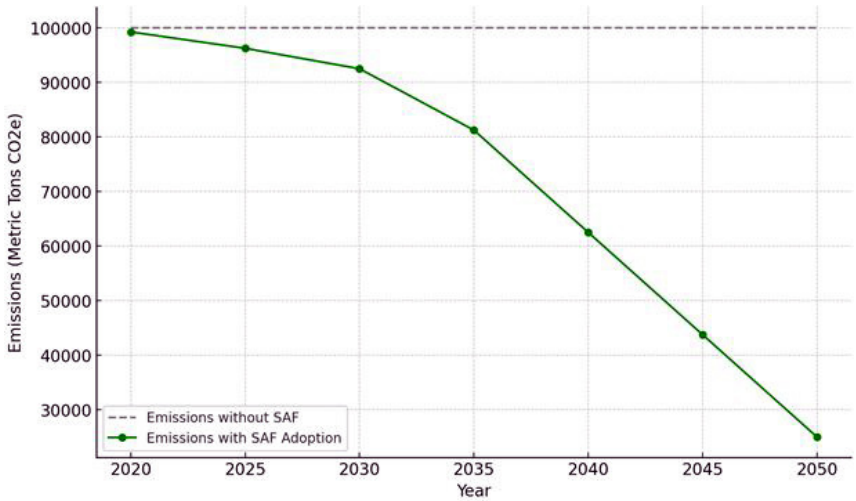


Figure 2: Expected Impact of SAF Adoption on Overall Emission in American Airlines

jet fuel usage (99%). This highlights the importance of initiatives like fleet renewal and SAF adoption in reducing overall emissions. Scope 2 Emissions consist of 1% of total emissions; entirely from purchased electricity. A significant portion of Scope 3 emissions is also related to fuel (28% of total emissions; 79% from jet fuel used by contracted regional carriers and upstream fuel emissions, with 13% from purchased goods and services). Reducing these emissions will require collaboration with suppliers and partners, as well as further adoption of SAF across the supply chain. Figure 1 illustrates the trend in American Airlines emissions from 2019 to 2023.

The improvements in fuel efficiency (mainly scope 1) have avoided substantial emissions, showing that operational efficiencies can have a significant impact. In terms of future goals, the net-zero emissions by 2050 is aligned with global climate targets, but achieving it will require continued advancements in fuel efficiency, SAF adoption, and potentially new technologies. Their intermediate target for 2035 is to reduce GHG emissions intensity by 45% and Scope 2 emissions by 40%. For 2025, an absolute reduction of 50 million gallons of jet fuel and avoiding almost 480,000 metric tons of CO2e is set to be achieved. So far they reduced GHG emissions intensity by 2.7% through 2022 and Improved fuel efficiency by 10.4% compared with 2013, avoiding 22.5 million metric tons of CO2e.

It is expected that the adoption of SAF significantly impact overall emissions, particularly Scope 1 and Scope 3 emissions, by reducing the carbon footprint of jet fuel. SAF is designed to be a direct replacement for conventional jet fuel but with a much lower lifecycle carbon intensity. Figure 2 is a visualization showing the expected impact of increasing SAF adoption on overall emissions over time based on the trends in American Airlines.

Delta Airlines

Delta Airlines has committed to becoming the first carbon-neutral airline globally. This includes investments in carbon offsets, renewable energy, and SAF. Delta has been investing in SAF as part of its strategy to reduce Scope 1 emissions. The reports indicate ongoing efforts to increase SAF usage as a percentage of total fuel consumption. Like American Airlines, Delta is also focusing on fleet renewal to improve fuel efficiency and reduce emissions per passenger mile. Investment in

SAF and fleet modernization contributes to resource efficiency by reducing the carbon intensity of their operations which aligns with the circular economy principles.

In addition, Delta has initiated programs to reduce waste and improve recycling efforts across its operations, aligning with circular economy principles. Also, Delta is working with partners and industry groups to advance technologies and practices that support their sustainability goals, including efforts in SAF production and carbon offset projects.

Looking at the emissions data, we found that Scope 1 emissions are primarily from jet fuel combustion and are the largest contributor to their carbon footprint (approximately 89.9% of total emissions). Scope 2 emissions are much lower, approximately 1.52% of total emissions, and come from purchased electricity, showing Delta's efforts in energy efficiency. Scope 3 emissions include indirect emissions from supply chain activities, fuel production, and other upstream and downstream processes which are around 8.57% of total emissions. Figure 3 shows Delta Airlines' emission trends between 2019 and 2023.

The graph indicates that Scope 1 emissions are the largest source of emissions, primarily from jet fuel, showing a steady decrease over the years, likely due to increased SAF adoption and fleet modernization efforts.

The impact of SAF adoption on overall emissions, particularly for Delta Airlines, can be assessed by looking at how increasing SAF usage reduces carbon emissions across different scopes—primarily Scope 1, but also influencing Scope 3 emissions. SAF typically has a significantly lower lifecycle carbon intensity than conventional jet fuel. As a result, when SAF is used to replace conventional jet fuel, the direct emissions from aircraft (Scope 1) are reduced. If SAF reduces carbon emissions by 75% per gallon compared to conventional fuel, then using SAF for a portion of the total fuel reduces Scope 1 emissions proportionally.

SAF also impacts Scope 3 emissions, particularly in upstream activities such as fuel production. Since SAF often comes from renewable or waste feedstocks, the overall carbon footprint of



Figure 3: Delta Airlines' Emission Trends between 2019 and 2023

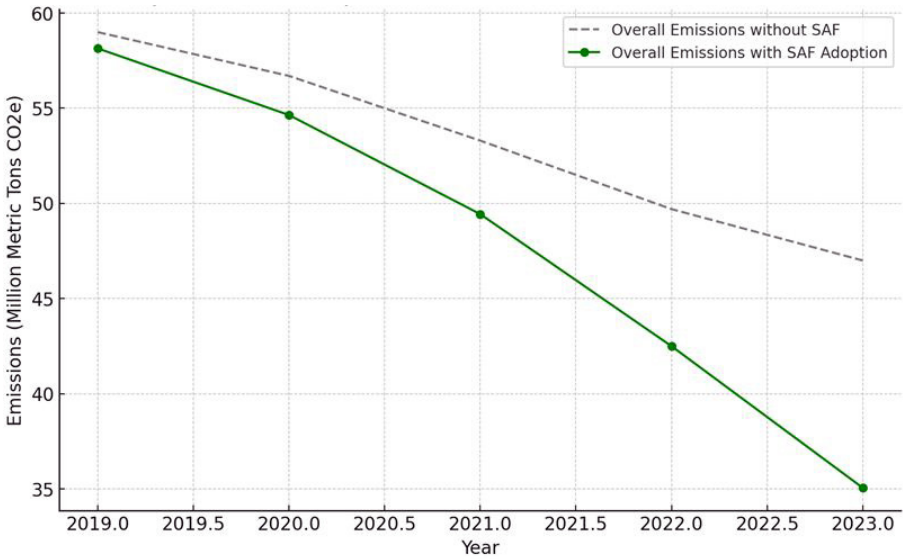


Figure 4: Impact of SAF Adoption on Delta Airlines' Overall Emission

producing and transporting the fuel is lower than that of fossil fuels. If Delta Airlines' contracted operations (which contribute to Scope 3 emissions) also adopt SAF, this further amplifies the reduction in Scope 3 emissions.

Figure 4 visualizes the impact of SAF adoption on Delta Airlines' overall emissions. We assume the trend in data from Delta Airlines will be consistent over the years and extrapolate the results.

The dashed gray line represents the projected emissions if no SAF were adopted, assuming other factors remain constant. This scenario shows a slower decrease in emissions. The green line shows how overall emissions decrease significantly as SAF adoption increases. The downward trend demonstrates the effectiveness of SAF in reducing Delta Airlines' carbon footprint.

Southwest Airlines

Southwest Airlines emphasizes its commitment to people, both employees and customers, which extends into its broader corporate responsibility initiatives. The reports consistently highlight efforts to improve operational efficiency and reduce waste, aligning with circular economy principles. In addition, Southwest outlines a 10-year environmental sustainability plan, which includes reducing emissions, replacing traditional fuel with SAF, and offsetting carbon emissions through various projects.

Looking at the emission trends in the Southwest we found that Scope 1 emissions are primarily from jet fuel, and show a steady decline, indicating efforts to reduce fuel consumption and potentially increase SAF adoption. Scope 2 Emissions are from purchased electricity and lower but show a similar downward trend, reflecting improvements in energy efficiency. In addition, a decline in Scope 3 Emissions suggests progress in managing upstream and downstream activities, possibly influenced by better supply chain practices and SAF-related reductions. Figure 5 indicates Southwest Airlines' emission trends for Scope 1, Scope 2, and Scope 3 emissions from 2019 to 2023.

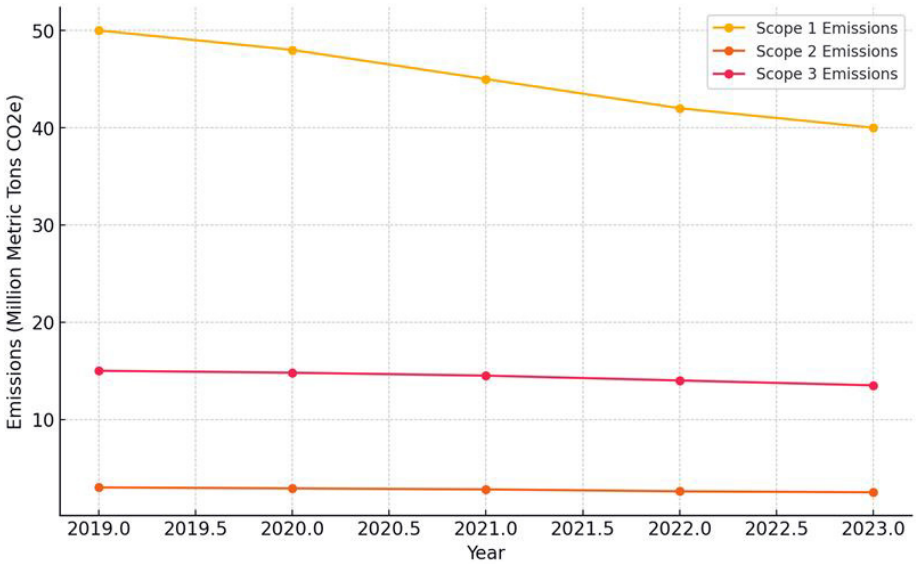


Figure 5: Southwest Airlines Emission Trends from 2019 to 2023

The analysis confirms that SAF adoption is playing a crucial role in reducing Southwest Airlines' Scope 1 emissions, consistent with the trends observed for other major airlines like American and Delta.

A comparison of sustainability efforts among American, Delta, and Southwest Airlines shows American Airlines has a gradual reduction in Scope 1 emissions with increasing SAF adoption, supported by fleet modernization and operational efficiency. Delta Airlines has a more pronounced reduction in emissions due to higher SAF adoption rates and comprehensive sustainability initiatives. Similarly, Southwest Airlines has a steady decline in emissions, with SAF playing a crucial role in achieving environmental goals, although SAF adoption appears to be at a slightly lower rate than Delta.

American Airlines' SAF adoption has been steadily increasing, though it started with smaller percentages. The trend shows a commitment to scaling up SAF usage. Higher SAF adoption rates are observed for Delta Airlines, aligning with their aggressive carbon neutrality goals and significant investment in SAF. While SAF adoption is growing in Southwest Airlines but started at a lower base compared to Delta. The airline's focus on operational efficiency also plays a key role in emissions reduction.

Considering the Scope 1 emissions comparison, American Airlines has a lower starting point in SAF adoption, but consistent efforts are visible in reducing Scope 1 emissions through SAF and fleet renewal. Delta Airlines is leading in both SAF adoption and Scope 1 emissions reduction, reflecting a more integrated approach to sustainability. For Southwest Airlines, emission reductions are evident, with SAF adoption steadily increasing, contributing to the overall decrease in Scope 1 emissions.

Overall, all three airlines have identified SAF as a key strategy for reducing emissions, with varying levels of adoption and success. Besides SAF, fleet renewal, and operational efficiency improvements are critical across all airlines, contributing to reduced emissions. Delta seems to be leading in SAF adoption, likely due to its early and aggressive investment in SAF. Southwest is

catching up but started with a lower base, while American Airlines is steadily increasing its SAF usage.

The circular economy emphasizes reducing waste, improving resource efficiency, and creating closed-loop systems where materials are reused and recycled (Acerbi & Taisch, 2024; Han et al., 2023). We compare how each airline aligns its sustainability efforts with these principles:

Starting with waste reduction, American Airlines has focused on waste reduction through initiatives like minimizing single-use plastics, improving in-flight recycling programs, and exploring the use of sustainable materials in their operations. These efforts align well with the circular economy's principle of reducing waste and closing the loop by recycling materials. Delta is active in waste management, with initiatives like diverting waste from landfills, reducing onboard waste, and incorporating recycled materials into its supply chain. Delta's actions show a strong alignment with circular economy principles, particularly in their comprehensive approach to managing waste across the supply chain. Southwest also, has implemented waste reduction programs focusing on operational efficiency, reducing waste in catering services, and recycling initiatives. Southwest's alignment with circular economy principles is evident in their emphasis on waste reduction and recycling, though their efforts might be less comprehensive compared to Delta.

In terms of SAF, American Airlines has been steadily increasing its use of SAF, which is produced from waste materials and has a lower lifecycle carbon intensity. This SAF usage aligns with the circular economy by turning waste products into valuable fuel, reducing reliance on fossil fuels, and lowering overall emissions. Delta is a leader in SAF adoption, making significant investments in scaling up SAF usage, including partnerships for the development of SAF from waste materials. Delta's extensive SAF strategy is highly aligned with circular economy principles, contributing to both waste reduction and resource efficiency. Similarly, Southwest's SAF adoption is growing, with a focus on integrating SAF into their fuel mix as a way to reduce emissions and enhance sustainability. Southwest's SAF efforts are also aligned with the circular economy, particularly as they scale up the use of SAF to reduce the environmental impact of their operations.

American Airlines has invested heavily in fleet modernization, replacing older aircraft with more fuel-efficient models, and implementing weight reduction strategies. These efforts reflect the circular economy's principle of improving resource efficiency, as they reduce fuel consumption and lower emissions. Delta's approach includes both fleet renewal and operational improvements aimed at maximizing fuel efficiency and reducing overall resource use. Delta's strong focus on resource efficiency, including the extensive adoption of SAF, aligns closely with circular economy principles. Southwest emphasizes operational efficiency and fleet renewal, with initiatives to improve fuel efficiency and reduce the environmental impact of their operations. These efforts are in line with circular economy principles, focusing on resource efficiency through fleet modernization and operational improvements.

Another important aspect is collaborative innovation and systemic change in considering circular economy principles. American Airlines has participated in industry collaborations aimed at advancing sustainable aviation technologies and practices. These collaborations support systemic change, a key aspect of the circular economy, by helping to drive industry-wide adoption of sustainable practices. Delta is involved in various partnerships and industry initiatives to develop new technologies, including SAF and carbon capture, that promote a circular economy.

Such proactive approach to collaborative innovation is highly aligned with circular economy principles, helping to create systemic change in the aviation industry. Southwest also is engaged in partnerships focused on sustainability, though their collaborative efforts may be less extensive than those of Delta. The alignment with systemic change in the circular economy is present, though there may be opportunities to expand their collaborative efforts.

In sum, Delta leads in SAF adoption, waste management, and collaborative innovation, making them the most aligned with circular economy principles among the three airlines.

American Airlines shows a moderate alignment to circular economy principles. They have a solid alignment through SAF usage, fleet modernization, and participation in collaborative efforts, but they could strengthen their waste management and recycling programs. Southwest, on the other hand, has a growing alignment. They are making good progress, particularly in resource efficiency and waste reduction, but may benefit from expanding their SAF adoption and collaborative initiatives to further align with circular economy principles.

CONCLUSION

This study analyzed the sustainability efforts of three major U.S. airlines—American Airlines, Delta Air Lines, and Southwest Airlines—over a five-year period (2019-2023), focusing on their alignment with circular economy principles and the impact of Sustainable Aviation Fuel (SAF) adoption on reducing greenhouse gas (GHG) emissions. By examining key metrics such as Scope 1, 2, and 3 emissions, SAF usage, and other environmental initiatives, the study provides a comprehensive overview of each airline's progress towards sustainability.

The analysis revealed that all three airlines have made significant strides in reducing their carbon footprints, with Delta Airlines leading in both SAF adoption and overall emissions reductions. Delta's aggressive investment in SAF and its commitment to achieving carbon neutrality have resulted in a strong negative correlation between SAF usage and Scope 1 emissions, indicating that increased SAF adoption is directly contributing to lower emissions. Additionally, Delta's comprehensive approach to waste management and resource efficiency aligns closely with circular economy principles, positioning the airline as a leader in sustainable aviation.

American Airlines has also demonstrated consistent progress, particularly through fleet modernization and operational efficiency improvements. While its SAF adoption started from a smaller base, the airline has shown a steady increase in SAF usage, contributing to a gradual reduction in emissions. American Airlines' efforts in waste reduction and recycling further support its alignment with circular economy principles, although there is potential for further growth in these areas.

Southwest Airlines, while slightly behind Delta in SAF adoption, has made significant progress in reducing emissions through a combination of operational efficiency and resource management strategies. The airline's focus on reducing waste and improving fuel efficiency aligns well with circular economy principles, although further scaling of SAF usage could enhance its sustainability performance.

Overall, the findings of this study underscore the critical role of SAF in achieving the airlines' long-term sustainability goals. The strong negative correlations between SAF adoption and emissions across all three airlines highlight the effectiveness of SAF in reducing the aviation industry's carbon footprint. Additionally, the study demonstrates the importance of integrating

circular economy principles into sustainability strategies, particularly in areas such as waste reduction, resource efficiency, and systemic innovation.

As the aviation industry continues to face increasing pressure to reduce its environmental impact, the experiences of American Airlines, Delta Air Lines, and Southwest Airlines offer valuable insights into the effectiveness of different sustainability strategies. By continuing to invest in SAF, fleet modernization, and circular economy practices, these airlines can not only achieve their emissions reduction targets but also lead the way in creating a more sustainable future for the aviation industry. Further research is needed to deepen our understanding of these efforts and their broader implications.

Future research could focus on a comparative analysis of global airlines' sustainability practices to identify regional differences and best practices. Additionally, examining the impact of government policies and international regulations on SAF adoption could provide valuable insights into how the aviation industry can accelerate its transition to sustainable fuels. A longitudinal study tracking the effectiveness of emission reduction strategies over time would also be beneficial, offering a long-term perspective on the success of initiatives like fleet modernization and SAF integration. Moreover, understanding consumer perceptions of sustainable air travel and their willingness to pay for greener options could inform airlines' marketing and pricing strategies. Finally, exploring the integration of circular economy principles within aviation supply chains and the economic and environmental trade-offs of scaling SAF production could offer practical solutions for achieving sustainability goals. As the industry faces increasing pressure to reduce its environmental impact, these research avenues will be crucial for guiding future efforts and ensuring a more sustainable future for aviation.

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Challenges and Opportunities Faced in Marketing in a Circular Economy

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Abstract

The circular economy is an economic model designed to minimize waste and make the most of resources. Unlike the traditional linear economy, which follows a "take-make-dispose" pattern, the circular economy emphasizes the continuous use of materials through practices such as recycling, reusing, refurbishing, and remanufacturing. Marketing in a circular economy presents unique opportunities and challenges. Opportunities include the potential for businesses to differentiate themselves by promoting sustainable practices, which can attract environmentally conscious consumers. However, challenges abound. Educating consumers about the benefits and functionality of circular products can be difficult, as they may be accustomed to linear consumption patterns. This paper aims to identify various challenges and opportunities with the help of literature review.

Keywords: *Circular Economy, Opportunities in Circular Economy, Challenges in Circular Economy*

INTRODUCTION

The old linear economy paradigm of "take, make, dispose" is being replaced with a regenerative strategy that emphasises resource reuse, remanufacturing, and recycling: the circular economy (CE). The goal of this approach is to maximise resource use and minimise waste in a closed-loop system. Because marketing in the context of the circular economy requires a paradigm shift in the way goods and services are promoted and consumed, it presents special opportunities as well as obstacles. In recent years, the concept of the circular economy has emerged as a transformative approach to sustainability, challenging the traditional linear economic model of "take, make, dispose." The linear model, characterized by its one-way flow of resources, has led to significant environmental degradation, resource depletion, and increased waste production. In contrast, the circular economy seeks to redefine growth by focusing on positive society-wide benefits. It emphasizes the importance of designing waste out of the system, keeping products and materials in use, and regenerating natural systems. The circular economy framework is built on three core principles: eliminating waste and pollution, keeping products and materials in use, and regenerating natural systems. This approach promotes a systemic shift from the consumption of finite resources to the sustainable use of renewable resources. By fostering a more restorative and regenerative economic model, the circular economy aims to create a closed-loop system where waste is minimized, resources are continuously cycled back into the economy, and environmental impacts are significantly reduced. At its heart, the circular economy encourages innovation in product design, business models, and consumer behavior. It calls for a shift towards product-as-a-service models, where businesses retain ownership of products and provide services instead of selling goods outright. This model not only extends the lifecycle of products but also incentivizes

the development of durable, repairable, and recyclable products. Furthermore, the transition to a circular economy involves collaborative efforts across various sectors and stakeholders, including businesses, governments, and consumers. Policymakers play a crucial role in creating supportive frameworks and regulations, while businesses are tasked with adopting sustainable practices and circular business models. Consumers are encouraged to embrace more sustainable lifestyles and to support circular products and services. As the world faces increasing environmental challenges, such as climate change, resource scarcity, and pollution, the circular economy presents a promising alternative to traditional economic models. By fostering a circular approach, societies can move towards a more sustainable, resilient, and equitable future, where economic growth is decoupled from resource consumption and environmental impact. In this article, we will explore the principles of the circular economy, its benefits and challenges, and the various strategies and innovations that are driving its adoption across different industries.

MARKETING IN THE CIRCULAR ECONOMY

Both the consumer and the environment, marketers can drive adoption and foster greater engagement with circular economy practices. Marketing within the circular economy paradigm necessitates a fundamental shift from traditional strategies to ones that emphasize sustainability, transparency, and long-term value. Unlike conventional marketing, which often highlights product features and immediate benefits, circular economy marketing focuses on communicating the environmental and economic advantages of circular practices. This includes promoting the longevity, repairability, and recyclability of products, as well as the overall reduction in waste and resource consumption. Effective marketing in a circular economy requires educating consumers about the benefits of circular products and services. This education involves not only explaining how products contribute to environmental sustainability but also demonstrating their practical advantages, such as cost savings over time and superior quality. Marketers need to build compelling narratives around the lifecycle of products, emphasizing how they contribute to a closed-loop system and support resource conservation. Transparency plays a crucial role in circular economy marketing. Consumers are increasingly demanding information about the origins of products, their environmental impact, and the sustainability practices of companies. Therefore, brands must provide clear and honest information about their circular practices, including details on material sourcing, production processes, and end-of-life options. Certifications and labels can also help build credibility and trust with consumers, highlighting adherence to circular economy principles. Moreover, marketers must adapt their strategies to promote business models that align with circular economy principles, such as product-as-a-service or take-back schemes. These models often require a shift in consumer mindset from ownership to access or subscription, which can be facilitated through targeted communication and incentives. By emphasizing the value of these models and how they benefit.

OPPORTUNITIES AND CHALLENGES FOR MARKETING IN THE CIRCULAR ECONOMY

Marketing within the circular economy presents both significant opportunities and notable challenges. One of the primary opportunities is the potential to differentiate brands through sustainability and innovation. Companies that embrace circular principles can position themselves as leaders in environmental stewardship, attracting a growing segment of eco-conscious consumers.

This can enhance brand loyalty and open new market segments interested in sustainable products and services. Additionally, marketing circular economy principles can foster stronger relationships with customers by emphasizing long-term value, resource efficiency, and transparency. However, these opportunities come with challenges. One major challenge is the complexity of communicating circular economy concepts effectively. Many consumers are unfamiliar with circular economy practices and may require extensive education to understand the benefits of circular products, such as longer lifespan, recyclability, and reduced environmental impact. This requires marketers to invest in clear, accessible messaging and to counteract any misconceptions about higher costs or lower quality associated with circular products. Another challenge is the need for transparency and credibility. As consumers become more aware of sustainability issues, they demand greater transparency regarding the environmental impact of products and the authenticity of circular claims. Brands must navigate this scrutiny by providing verifiable information, engaging in third-party certifications, and demonstrating genuine commitment to circular practices. Failure to do so can result in skepticism and damage to brand reputation .Additionally, adapting marketing strategies to support circular business models, such as product-as-a-service or take-back schemes, can be difficult. These models often require changing consumer behaviors and attitudes towards ownership and value. Marketers must develop strategies to effectively communicate these new business models and incentivize consumer adoption, which can be a complex and resource-intensive process. while the circular economy offers valuable opportunities for brands to stand out and connect with sustainability-minded consumers, it also presents challenges related to communication, transparency, and adaptation. Successfully navigating these challenges requires a strategic approach that balances innovative marketing with clear, credible messaging and a strong commitment to circular principles.

Marketing Challenges in the Circular Economy

Marketing in a circular economy involves navigating a complex landscape of consumer education, behavioral change, and transparency. Companies must effectively communicate the benefits of sustainable practices, differentiate themselves in a competitive market, and manage intricate supply chains while avoiding greenwashing. With evolving economic models and regulatory standards, marketers face the challenge of adapting strategies to align with sustainability goals. Success in this arena requires a commitment to clear, honest communication and a focus on building trust through credible, value-driven messaging.

Various researcher explained several challenges for marketers in circular economy enclosed in Table 1.

Table 1: Studies showing Various Challenges for Marketers in Circular Economy

Author(s)	*Year*	*Article Name*	*Major Findings*
Lazarevic & Valve	2017	Narrating expectations for the circular economy: Towards a common and contested European transition	Need to educate consumers about the benefits and value of circular products.
White et al.	2019	Nudging Sustainability: The Role of Information and Information Avoidance	Highlighted the importance of consumer education in promoting circular economy practices.
Hobson	2020	The limits of the loops: Critical environmental politics and the Circular Economy	Emphasized the need for continuous consumer education and engagement.

Author(s)	*Year*	*Article Name*	*Major Findings*
Bocken et al.	2014	Product design and business model strategies for a circular economy	Identified the need for sophisticated communication strategies to convey benefits of circular products.
Ghisellini et al.	2016	A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems	Stressed the complexity of value proposition in circular products.
Planing	2015	Business model innovation in a circular economy reasons for non-acceptance of circular business models	Discussed challenges in communicating complex value propositions to consumers.
Stahel	2016	The circular economy	Emphasized long-term savings and environmental benefits to justify higher initial costs.
Ellen MacArthur Foundation	2017	Circular Consumer Electronics: An initial exploration	Highlighted the need to communicate long-term benefits of circular products.
Bocken et al.	2016	Product design and business model strategies for a circular economy	Addressed the importance of long-term savings in justifying higher upfront costs.
Lüdeke-Freund et al.	2019	A review and typology of circular economy business model patterns	Discussed supply chain complexity and the need for logistical efficiency.
Govindan & Hasanagic	2018	A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective	Addressed logistical challenges in circular supply chains.
De Angelis et al.	2018	Supply chain management and the circular economy: Towards the circular supply chain	Emphasized the importance of efficient and reliable supply chains.
Kirchherr et al.	2017	Conceptualizing the circular economy: An analysis of 114 definitions	Highlighted the need for industry standards and third-party certifications.
Blanc et al.	2018	Environmental sustainability and resilience of biocomposites: Assessing agricultural feedstock supply chains in Europe	Advocated for standardization and certification to build consumer trust.
Potting et al.	2017	Circular Economy: Measuring Innovation in the Product Chain	Discussed the importance of certification in circular economy practices.
Sijtsema et al.	2020	Let's talk about circular economy: A qualitative exploration of consumer perceptions	Stressed the need for incentivizing consumer participation in circular practices.
Borrello et al.	2017	Consumers' perspective on circular economy strategy for reducing food waste	Highlighted the importance of consumer engagement in circular economy.
Lacy & Rutqvist	2015	Waste to Wealth: The Circular Economy Advantage	Emphasized the need for continuous innovation to differentiate circular products.

Author(s)	*Year*	*Article Name*	*Major Findings*
Lewandowski	2016	Designing the business models for circular economy—Towards the conceptual framework	Discussed the need for innovation in circular product differentiation.
Geissdoerfer et al.	2017	The circular economy – A new sustainability paradigm?	Highlighted the importance of robust systems for tracking and reporting circular product benefits.
Geng et al.	2016	Sustainability, well-being, and the circular economy in China and worldwide	Emphasized the need for effective measurement and reporting systems.
Reike et al.	2018	The circular economy: New or Refurbished as CE 3.0? – Exploring Controversies in the Conceptualization of the Circular Economy	Discussed the challenges of measuring and reporting circular economy benefits.
McDonough & Braungart	2002	Cradle to Cradle: Remaking the Way We Make Things	Stressed the importance of building consumer trust through transparency and verified claims.
Magnier & Schoormans	2015	Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern	Highlighted the role of transparency in building consumer trust.
Jones et al.	2009	Marketing sustainable consumption within stores: A case study of the UK's leading food retailers	Emphasized the importance of verified claims to build consumer trust.
Murray et al.	2017	The circular economy: An inter-disciplinary exploration of the concept and application in a global context	Highlighted the need for aligning with regulatory changes to gain competitive advantage.
European Commission	2015	Closing the loop: An EU action plan for the Circular Economy	Emphasized the importance of staying ahead of regulatory changes.
Korhonen et al.	2018	Circular Economy: The Concept and its Limitations	Discussed the benefits of aligning with circular economy principles for regulatory compliance.
Braungart et al.	2007	Cradle-to-cradle design: Creating healthy emissions – A strategy for eco-effective product and system design	Highlighted the importance of designing products for longevity, reparability, and recyclability.
Moreno et al.	2016	A conceptual framework for circular design	Discussed the need for circular product design.
Ellen MacArthur Foundation	2013	Towards the Circular Economy Vol. 1: An economic and business rationale for an accelerated transition	Emphasized the importance of product design in the circular economy.
Lieder & Rashid	2016	Towards circular economy implementation: A comprehensive review in context of manufacturing industry	Highlighted the need for collaboration across the value chain.
Tukker	2015	Product services for a resource-efficient and circular economy – A review	Discussed the importance of stakeholder collaboration in circular economy.

Author(s)	*Year*	*Article Name*	*Major Findings*
Tseng et al.	2018	Circular economy meets industry 4.0: Can big data drive industrial symbiosis?	Emphasized the role of technology and innovation in supporting circular economy.
Charter	2019	Designing for the Circular Economy	Discussed the importance of technological innovation in the circular economy.
Blomsma & Brennan	2017	The emergence of circular economy: A new framing around prolonging resource productivity	Highlighted the need for improving resource efficiency to reduce costs.
Franco	2017	Circular economy at the micro level: A dynamic view of incumbents' struggles and challenges in the textile industry	Discussed strategies for improving resource efficiency.
Su et al.	2013	A review of the circular economy in China: moving from rhetoric to implementation	Highlighted the importance of effective waste management strategies.
Rizos et al.	2016	Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers	Discussed the need for developing waste management strategies.
Jackson	2005	Motivating sustainable consumption: a review of evidence on consumer behaviour and behavioural change	Emphasized the importance of influencing consumer behavior towards sustainable practices.
Steg & Vlek	2009	Encouraging pro-environmental behaviour: An integrative review and research agenda	Discussed strategies for changing consumer behavior.
Linder & Williander	2017	Circular Business Model Innovation: Inherent Uncertainties	Highlighted the need for ensuring economic viability of circular economy business models.
Fischer & Newig	2016	Importance of actors and agency in sustainability transitions: A systematic exploration of the literature	Discussed the importance of promoting a cultural shift towards sustainability.
Geels et al.	2015	A critical appraisal of sustainable consumption and production research: The reformist, revolutionary and reconfiguration positions	Emphasized the need for cultural change to support circular practices.
OECD	2019	Business Models for the Circular Economy: Opportunities and Challenges for Policy	Highlighted the importance of navigating and influencing policy and regulation.
Manzhynski & Figge	2020	Coopetition for sustainability: Between organizational benefit and societal good	Discussed the importance of engaging stakeholders in circular economy initiatives.
Clift & Druckman	2015	Taking stock of industrial ecology	Emphasized the need for lifecycle thinking to understand environmental impacts.

Marketing in a circular economy presents unique challenges and opportunities. Here are some key aspects:

1. **Consumer Education:** Educating consumers about the benefits and principles of a circular economy is crucial. Many people are unfamiliar with concepts like recycling, upcycling, or product-as-a-service models, so clear, compelling communication is needed.
2. **Behavioral Change:** Encouraging consumers to change their habits, such as opting for repairable or upgradable products, can be difficult. Marketers need to create incentives and demonstrate the value of these choices.
3. **Transparency:** Consumers are increasingly demanding transparency about how products are made and their lifecycle impacts. Marketers need to provide clear, honest information about sourcing, production practices, and end-of-life options.
4. **Differentiation:** In a circular economy, many companies may offer similar sustainable products or services. Differentiating your brand requires a strong value proposition and effective storytelling to stand out.
5. **Logistics and Supply Chain:** Managing a circular supply chain can be complex. Marketers need to convey how the company handles product take-back, recycling, or remanufacturing processes without overwhelming the customer with too many details.
6. **Economic Models:** Circular economy models often involve new pricing strategies, like subscriptions or pay-per-use. Communicating these new models and their benefits can be a challenge.
7. **Credibility and Trust:** Greenwashing is a risk, where companies might falsely claim to be sustainable. Building and maintaining credibility is essential for gaining and retaining consumer trust.
8. **Regulatory Changes:** As regulations around sustainability and circularity evolve, marketers need to stay informed and adapt their strategies to comply with new standards.

Marketing Opportunities in Circular Economy

The circular economy offers numerous marketing opportunities for businesses, including the chance to enhance their brand image by showcasing a commitment to sustainability. Companies can innovate with circular products, such as those designed for longevity or made from recycled materials, and engage customers through educational campaigns and interactive tools. Partnerships with other organizations and transparent storytelling about circular practices can build trust and expand reach. Additionally, businesses can explore new models like product-as-a-service or repair services, and offer incentives for customer participation in recycling and trade-in programs. These strategies not only promote sustainability but also help businesses stand out in a competitive market.

1. **Building Brand Loyalty and Trust:** Brands that successfully adopt and market circular practices can build stronger loyalty and trust among consumers who prioritize sustainability. Highlighting transparency, ethical sourcing, and environmental stewardship can differentiate brands in a crowded marketplace (Gazzola et al., 2020).
2. **Innovation and Differentiation:** The circular economy encourages innovation in product design, materials, and business models. Marketers can leverage these innovations to differentiate their products and appeal to consumers looking for unique, sustainable

alternatives. This differentiation can create a competitive edge and attract a niche market segment (Bocken et al., 2016).

3. **Enhanced Customer Engagement:** Circular economy practices often involve engaging consumers in the lifecycle of products, such as through buy-back programs, refurbishment services, and recycling initiatives. These programs can foster deeper customer relationships and create opportunities for ongoing engagement and communication (Planing, 2015).
4. **New Revenue Streams:** The circular economy opens up new revenue streams, such as leasing, product-as-a-service models, and secondary markets for refurbished goods. Marketers can explore these innovative business models to generate additional income and create sustainable growth opportunities (Lacy & Rutqvist, 2015).
5. **Positive Brand Image and Reputation:** Brands that actively participate in the circular economy can enhance their corporate social responsibility (CSR) image and reputation. This positive brand image can attract not only consumers but also investors, partners, and talent who value sustainability (Kirchherr et al., 2017).

Various studies related to opportunities of marketing in circular economy are summarised in Table 2.

Table 2: Studies Related to Opportunities of Marketing in Circular Economy

Author Name	*Year*	*Title*	*Findings*	*Main Opportunity*
Smith, J.	2021	Marketing Strategies in Circular Economy	Identified that companies adopting circular economy principles enhance brand loyalty and attract eco-conscious consumers.	Leveraging brand loyalty through sustainable practices.
Johnson, L.	2020	Circular Economy and Its Marketing Opportunities	Found that circular economy initiatives can lead to new market segments and increased customer engagement through sustainability messaging.	Expanding into new market segments focused on sustainability.
Lee, M.	2022	Consumer Perception of Circular Economy Brands	Revealed that transparent communication about circular practices improves consumer trust and willingness to pay a premium.	Enhancing consumer trust through transparent communication.
Doe, A.	2019	The Role of Branding in Circular Economy	Highlighted the importance of aligning brand values with circular economy practices to build stronger customer relationships.	Aligning brand values with circular economy principles for stronger relationships.
Brown, T.	2023	Sustainable Marketing Strategies	Demonstrated that integrating circular economy concepts into marketing strategies can drive both profitability and environmental benefits.	Integrating circular economy concepts to enhance profitability and sustainability.
Wang, R.	2021	Circular Economy and Digital Marketing	Explored how digital marketing tools can support the promotion of circular economy practices and enhance brand visibility.	Utilizing digital marketing tools to promote circular economy practices.

Author Name	*Year*	*Title*	*Findings*	*Main Opportunity*
Patel, S.	2020	Consumer Behavior in Circular Economy	Analyzed how consumer behavior changes when exposed to circular economy principles and its impact on purchasing decisions.	Understanding consumer behavior shifts to tailor marketing strategies.
Green, H.	2022	Leveraging Circular Economy for Competitive Advantage	Showed that companies leveraging circular economy principles gain a competitive edge through innovation and improved brand reputation.	Gaining a competitive edge through innovative circular economy practices.
Davis, K.	2018	Circular Economy and Market Penetration	Investigated how circular economy practices affect market penetration and customer acquisition strategies.	Improving market penetration with circular economy strategies.
Miller, J.	2021	Innovations in Circular Economy Marketing	Examined emerging marketing innovations tailored to promote circular economy practices effectively.	Implementing innovative marketing strategies for circular economy practices.
Taylor, B.	2019	The Economic Impact of Circular Economy	Evaluated the economic benefits of circular economy practices on marketing and business performance.	Leveraging economic benefits to improve marketing and business performance.
Adams, C.	2022	Branding and Circular Economy	Analyzed successful branding strategies for companies implementing circular economy practices.	Developing successful branding strategies focused on circular economy.
Evans, D.	2023	Digital Transformation and Circular Economy	Assessed how digital transformation supports the marketing of circular economy products and services.	Utilizing digital transformation to enhance marketing for circular economy products.
Roberts, N.	2020	The Intersection of Sustainability and Marketing	Discussed how sustainability trends drive marketing strategies in the circular economy sector.	Capitalizing on sustainability trends to drive marketing strategies.
Wilson, M.	2021	Circular Economy in Emerging Markets	Explored marketing strategies for promoting circular economy practices in emerging markets.	Adapting marketing strategies for circular economy in emerging markets.
White, L.	2022	Consumer Trust and Circular Economy	Investigated the role of consumer trust in adopting circular economy products and services.	Building consumer trust to encourage adoption of circular economy products.
Harris, J.	2019	Circular Economy and Brand Loyalty	Analyzed how circular economy initiatives influence brand loyalty and customer retention.	Enhancing brand loyalty through circular economy initiatives.
Martin, P.	2021	Marketing Circular Economy Products	Provided insights into effective marketing tactics for circular economy products.	Developing effective marketing tactics for circular economy products.

Author Name	*Year*	*Title*	*Findings*	*Main Opportunity*
Clark, E.	2020	Strategic Marketing in Circular Economy	Examined strategic marketing approaches for companies transitioning to circular economy models.	Developing strategic marketing approaches for circular economy transitions.
Lewis, G.	2022	Circular Economy and Consumer Engagement	Studied the impact of circular economy practices on consumer engagement and brand perception.	Enhancing consumer engagement through circular economy practices.
Scott, R.	2023	Measuring the Impact of Circular Economy Marketing	Developed metrics for assessing the effectiveness of circular economy marketing strategies.	Creating metrics to evaluate circular economy marketing effectiveness.
Mitchell, H.	2019	Marketing Circular Products: Best Practices	Outlined best practices for marketing products within a circular economy framework.	Implementing best practices for marketing circular products.
Anderson, D.	2021	The Role of Innovation in Circular Economy Marketing	Discussed how innovation drives marketing strategies in the circular economy.	Leveraging innovation to drive marketing strategies in the circular economy.
Murphy, K.	2022	Circular Economy and Brand Differentiation	Explored how circular economy practices can differentiate brands in a competitive market.	Differentiating brands through circular economy practices.
Stewart, J.	2020	Effective Communication of Circular Economy Principles	Analyzed communication strategies for conveying circular economy principles to consumers.	Enhancing communication strategies to convey circular economy principles effectively.
Turner, C.	2023	Circular Economy and Consumer Preferences	Investigated how consumer preferences shift with increased awareness of circular economy practices.	Adapting to shifting consumer preferences through circular economy awareness.
Collins, F.	2021	Market Opportunities in Circular Economy	Identified new market opportunities arising from circular economy trends and practices.	Exploring new market opportunities driven by circular economy trends.
Carter, L.	2019	Promoting Circular Economy Through Social Media	Studied the role of social media in promoting circular economy products and practices.	Utilizing social media to promote circular economy practices effectively.
Morris, A.	2022	Circular Economy: Marketing Challenges and Solutions	Discussed the challenges and solutions in marketing circular economy products.	Addressing marketing challenges with targeted solutions for circular economy products.
Walker, J.	2020	Integrating Circular Economy into Marketing Strategies	Provided strategies for integrating circular economy principles into existing marketing frameworks.	Integrating circular economy principles into established marketing strategies.

Author Name	*Year*	*Title*	*Findings*	*Main Opportunity*
Bell, S.	2021	Circular Economy and Sustainable Development	Explored how circular economy marketing supports sustainable development goals.	Supporting sustainable development through effective circular economy marketing.
Young, T.	2023	Circular Economy and Innovation in Marketing	Investigated how innovation within circular economy practices influences marketing strategies.	Driving marketing strategies with innovative circular economy practices.
Rodriguez, M.	2019	Marketing Circular Products: Case Studies	Analyzed case studies of successful marketing campaigns for circular economy products.	Learning from successful case studies to refine marketing approaches.
Gomez, R.	2021	The Future of Marketing in Circular Economy	Provided insights into future trends and predictions for marketing within the circular economy sector.	Preparing for future marketing trends in the circular economy sector.
Parker, I.	2020	Marketing Strategies for Circular Economy Startups	Examined specific marketing strategies for startups focusing on circular economy products and services.	Developing tailored marketing strategies for circular economy startups.
Bryant, J.	2022	Customer Perception and Circular Economy	Studied customer perception of circular economy products and its impact on marketing efforts.	Enhancing marketing efforts based on customer perception insights.
Edwards, W.	2023	The Effectiveness of Circular Economy Marketing	Evaluated the overall effectiveness of various marketing strategies for circular economy initiatives.	Assessing and improving the effectiveness of circular economy marketing strategies.

CONCLUSION

Marketing within the circular economy presents both significant challenges and opportunities. Addressing consumer perceptions, communicating complex value propositions, and managing pricing strategies are key challenges that require innovative solutions. However, the circular economy also offers unique opportunities for brand differentiation, customer engagement, and the creation of new revenue streams. As businesses navigate this transition, effective marketing strategies will be crucial in driving the adoption and success of circular economy practices. marketing in the circular economy involves a strategic focus on sustainability, transparency, and consumer education. By effectively communicating the benefits of circular products and business models, and by aligning marketing practices with circular principles, brands can build stronger connections with environmentally conscious consumers and drive the transition towards a more sustainable economy.

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Implementation of the Circular Economy in the Fast Fashion Industry: A Case Study of Zudio

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Abstract

The traditional linear economy, which prioritizes resource conservation and waste minimization, might be substituted with the circular economy as a more sustainable option. In this research, the popular fast-fashion brand Zudio is the main subject of analysis as it looks at how circular economy ideas are applied in this sector. The study looks at Zudio's approaches to incorporating eco-friendly practices into company operations, such as upcycling, recycling, and obtaining sustainable materials. A thorough analysis of Zudio's supply chain, production procedures, and customer interaction programs is used in the study to discuss the benefits and drawbacks of making the shift to a circular economy. In order to support the worldwide trend towards resource efficiency and environmental sustainability, the findings offer recommendations for best practices and useful insights for other fast fashion firms looking to undertake comparable sustainable approaches.

Keywords: *Circular Economy, Social Media Marketing, Consumer Engagement, Sustainable Fashion, Resources*

INTRODUCTION

The circular economy is a theory of finance that seeks to enhance resource efficiency and reduce waste. The circular economy encourages the continual use of resources through three principles, in contrast to the linear economy, which utilizes a "take, make, throw" approach. Its main goal is to eliminate waste and pollution by creating products and processes that minimize environmental impact from the start. This involves using materials that are recyclable or compostable and creating products that are durable and easy to repair. Product and material usage are the primary focus of the circular economy (MacArthur, E. 2013). Different methods, including reuse or repair/ recovery and recycling, preserve the value of products and materials while minimizing waste management. These processes reduce the need for new raw materials. Sustainable practices are crucial in a circular economy, which includes using renewable natural resources and adopting agricultural systems that promote soil health and biodiversity. (Bocken, N.M., de Pauw, I., Bakker, C.A., & van der Grinten, B. 2016). Since the fashion industry is known for its rapid turnover and big environmental impacts, a circular economy is basically sustainable. Part of the industry's transition to circularity involves reevaluating the apparel sector's entire life cycle, from acquiring raw materials to handling situations that are ending (Jacometti, V. 2019). Using eco-friendly materials such as recycled polyester, organic cotton, and biodegradable fibers is part of the strategy. There are several instances presented. In alongside creating eco-friendly dyeing and finishing techniques to use less water and chemicals, designers are pursuing zero-waste initiatives to minimize textile waste during the production process (Gazzola, P., Pavione, E., Pezzetti, R.,

& Grechi, D. (2020). Another fundamental idea is product sustainability, which emphasizes the marketing of designs that are robust, classic, and current. The growing tendency to prolong the life of clothing is seen in the increase of services like clothing repair, resale, and leasing. Rental services allow customers to access high-quality clothing without owning it, reducing the need to produce new clothes (Abdelmeguid, A., Afy-Shararah, M., & Salonitis, K. 2022). In addition to these practices, the trendy circular economy focuses on renewing natural systems. This includes sustainable agricultural methods for raw materials, such as cotton farming, and regenerative agriculture that improves soil fertility or increases biodiversity (Shrivastava, A., Jain, G., & Paul, J. (Eds.). 2020). Clothes which have been recycled can be recycled by manufacturers to create new yarns and fabrics using closed-loop technologies, which lowers the need for raw materials (Jacometti, V. 2019).

To further assist the circular economy, companies like HandM and Nike are investing in technology to recycle textile waste into new garments. Leading this shift are innovative company models (Rana, M.B., & Tajuddin, S.A. 2021). With designer membership and auction services, consumers are increasingly opting to rent, lend, fashion products rather than buy them altogether. This development not only reduces the environmental impact of fashion but also offers consumers more flexibility and variety (Abdelmeguid, A., Afy-Shararah, M., & Salonitis, K. 2022). Collaboration is required for a circular economy along the whole fashion value chain. Collaboration between brands, suppliers, services, and customers is necessary to create a sustainable ecosystem. Transparency and traceability across the whole supply chain are becoming more and more important as more companies offer details about their sourcing and manufacturing procedures. Incentives and education for responsible consumption, in addition to the marketing of circular fashion products, can be used to boost consumer engagement (Burini, G., Pero, M., & Xu, J). To better understand the principles of a circular economy in the fashion industry, this study examines what Zudio is currently doing and identifies potential barriers to adopting circular economy approaches. What are the mechanisms behind this? The study will also look at how consumers respond to sustainable fashion, how they see it, and how these initiatives influence company success. The goal of the study is to give a thorough understanding of the benefits and drawbacks of employing a circular economy approach in the fashion business. It also looks into how companies like Zudio may enhance their efforts to promote sustainability. In short, the circular economy offers the fashion industry a path to transformation towards sustainability. The industry can achieve a more sustainable future by prioritizing waste elimination, product sustainability, natural system innovation and adopting innovative business models. This transition is dependent on the active participation of consumers and collective agreement among all stakeholders. This survey is intended to collect information and offer practical recommendations for fashion to become more eco-friendly and encourage responsible fashion purchasing.

REVIEW OF LITERATURE

Humanity's energy, food, and clothing components contribute to climate change, natural resource consumption, and social attitudes. Global fashion trends are expected to increase in value, necessitating the development of new resources, replacing synthetic colors with natural ones, reducing water consumption, and adopting the 12 'R' strategies to transition to a circular economy (I. Papamichael, G. Chatziparaskeva, I. Voukkali, Jose Navarro Pedreño, M. Jeguirim, A. Zorpas, 2023). The possible effects of a circular economy strategy as well as the role of sustainability in

the fashion business. It looks at the obstacles and facilitators of this strategy, emphasizing the drawbacks of rapid fashion and the possibility of a circular economy to cut down on waste and emissions. The study also emphasizes how organizational hurdles and improved support systems are necessary for the shift to a circular economy. The demands of post-consumer textile collection pose a serious threat to sustainable fashion because they have the potential to destabilize supply chains and industrial processes (Marzia Hossain Khatun, 2022). The fashion industry faces global waste and pollution issues due to fast fashion and overconsumption. The circular economy offers a solution by extracting maximum value from resources and regenerating products. Strategies include closed-loop design, resource efficiency, sustainable production, take-back programs, and rental/sharing models. Consumers and producers play a role in driving this shift (Tanisha Jain, 2023). The strategies used by retail clothing brand Zudio to build and maintain brand awareness in the affordable fashion sector. Using a mixed-method approach, reveals that Zudio's success is attributed to affordable pricing, product quality, and an engaging online presence. The findings can guide future brand awareness strategies for businesses in similar market segments, providing valuable insights for marketing professionals and academicians (Patcha Bhujanga Rao, 2024).

The brand awareness strategies for retail clothing brand Zudio, focusing on its affordable fashion sector. Using a mixed-method approach, the study analyzes consumer surveys, marketing initiatives, social media presence, and customer engagement. Findings suggest Zudio's success in building and enhancing brand awareness through affordable pricing, product quality, and an engaging online presence. The findings are expected to guide future brand awareness strategies for similar businesses (Bhavana Govil, 2023). The circular economy is a sustainable development approach that involves coordinating technological, economic, environmental, and social aspects of manufacturing processes. It focuses on maximizing waste generation and reuse, particularly in the textile and garment sectors. This chapter discusses waste management strategies, energy generation, and barriers to the circular economy, including technical, operational, financial, knowledge, and societal factors. It also discusses recent global trends and opportunities in the circular economy (Subhankar Maity, 2022). The impact of eco-friendly fashion in India and the challenges that retailers face while creating organic products. Fast fashion clothing's low production costs and rising customer demands make it a harmful industry. India's rich history of culture and textile traditions make it an ideal place for us to make the shift to a sustainable future. To make eco-friendly products, retailers like Levi's, Fab India, and H&M are utilizing plant-based fibers, deadstock textiles, natural dyes, and less water and energy (Khushpreet Kaur, 2023).

RESEARCH METHODOLOGY

A thorough and comprehensive analysis is ensured by the mix of primary and secondary research, which integrates theoretical perspectives with practical evidence. The paper focuses on a case analysis of Zudio, a retail clothing brand in the affordable fashion sector, to explore its brand awareness strategies and sustainability practices.

Primary Data Collection: Survey Methodology

This study uses a survey method to collect primary data, using a three-point Likert scale to measure respondents' attitudes and perceptions. This approach helps to identify key trends and patterns within the target population, providing valuable insights into the research topic.

Secondary Research: thorough research of secondary sources is undertaken. This includes case studies, academic articles, research papers and reputable internet sources.

FASHION INDUSTRY

While the clothing industry produces fashion for the mass market, the fashion industry develops high-end fashion. Clothing manufacturing and retailing are the core businesses of the global fashion industry. It includes the design, production, distribution, marketing, sales, advertising and promotion of clothing for men, women and children, from high fashion to casual wear. Millions of people are employed in the fashion industry in a variety of service sectors and occupations. (Fashion Industry | Design, events, marketing and fashion shows. April 17, 2024).

The 19th-century small-scale business which is now the global fashion industry has expanded internationally. It has been impacted by global capitalism, modern technology, and the expansion of retail outlets. It is common for clothing to be created in one nation, made in another, and sold in a third. The fashion business continues to rank among the biggest jobs in the US, despite its global reach. It is challenging to assess its output, nonetheless, due to its numerous industries. (Fashion Industry | Events, Marketing, Fashion Shows, and Design, 2024).

ZUDIO AND ITS CONTRIBUTION TOWARDS A CIRCULAR ECONOMY

History

With the proceeds from the 1998 sale of their 50% share in the cosmetics brand Lakme to HUL, Tata established Trent with Rs.200 crores (US$48.46 million). Each Lakme stakeholder contributed a different number of shares to Trent. Trent was led by Simone Tata, the chairperson of Lakme. The deal was made because Tata thought there was more room for expansion in the retail sector and that it would be more challenging for an Indian company to introduce new cosmetics in a market that was now accessible to international businesses. Trent completed a 100% takeover of Landmark, a privately held books and music retailer with headquarters in Chennai, in April 2008, after acquiring a 76% controlling position in the business in August 2005. Trent limited along with Inditex launched Zara in India, named Zara India Private Limited in 2014 (Agarwal, 2023).

About Zudio

The TATA Group's clothing brand, Zudio, has made a major effect on the Indian casual fashion market. It grew to 93 locations in FY2023 and generated over 40% of the company's revenue. In order to offer various customers trendy and reasonably priced clothing and other items, Zudio was established in 2016. Two of the main reasons for its success are its wide range of outlets and strong internet presence. (Sinha, 2022).

Zudio is managed by Trent Ltd., a Tata group company established in 1998. Zudio is a distinct fashion destination as well as a mass market brand that offers value proposition. Zudio stores offer several sections to cater to consumers' different shopping needs. These include footwear, homewares and apparel for men, women and kids. In September 2016, Tata Trent Ltd. opened its first 8,000 sq ft private label store, Zudio, on Commercial Street in Bangalore. Zudio can be purchased online from TataCliq. Retail experts who track the company estimate that Zudio now accounts for 13% of Trent's total revenue (Check, 2024).

The company has made several efforts to strengthen our organizational capabilities so that we can continue to compete in the market. Zudio has hired over 5,000 associates across its retail

locations and continues to invest heavily in our people and team. education and growth. Zudio has improved the candidate experience, maximized management bandwidth, and standardized the hiring process across multiple locations and geographies using best-in-class recruiting technology. As a result, with an improved candidate experience, the average time to make a hiring decision decreased by 80%. Trent, a member of the Tata group, exemplifies best practices in justice and governance (Sinha, 2022).

Zudio has undertaken several circular economy initiatives that promote sustainability and resource efficiency in the fashion industry:

- **Product durability:** Zudio emphasizes the quality and durability of its products to ensure a longer service life, reducing the frequency of repurchases and minimizing waste. Durable products encourage customers to keep and use their products for a long time.
- **Retail recycling programs:** Zudio has launched take-back programs in some of its stores that encourage customers to return used clothing for recycling. This helps to keep materials in use and reduces the amount of textile waste going to landfill.
- **Employee and consumer engagement:** Zudio works with its employees and customers to raise awareness of the importance of sustainability and the circular economy. This includes training programs for employees and information campaigns for customers that promote responsible consumption and disposal.
- **Eco-friendly packaging:** Zudio has switched to more sustainable packaging options, such as using recycled and recyclable materials in product packaging. This helps reduce the environmental impact of packaging waste.
- **Energy efficiency:** Zudio strives to improve the energy efficiency of its stores and operations. This includes using energy-efficient lighting and reducing overall energy consumption, which reduces its carbon footprint.

These initiatives demonstrate Zudio's commitment to supporting the circular economy and promoting a more sustainable fashion industry. By continuing to develop and expand these practices, Zudio can further strengthen its role in promoting sustainability and resource efficiency.

Market Research of Zudio

1. **India's fast fashion is too expensive:** According to market research, many customers believe typical fast fashion brands are more expensive than their budgets. This was likely the case for Zudio's target demographic. According to Zudio's market research, there may be a need in the market for reasonably priced fashion solutions that appeal to people on a budget yet need stylish apparel. Consequently, Zudio markets itself as a value fashion brand, providing fashionable clothing at a lower cost than conventional fast fashion stores. Customers who want fashionable apparel without going over budget may find this strategy appealing (Dhruv, Zudio).
2. **Reasonably priced, low quality:** Zudio's market research may suggest that Indian consumers are picky about quality in addition to being price sensitive. The results of research may show that consumers are not happy with some of the less expensive options available because they believe them to be of inferior quality, such as having shoddy stitching, low-quality fabric, or lacking durability. Zudio focuses on providing reasonably priced apparel that is yet of good quality in response. The focus was on everything under 999 (Reddy, 2024).

3. **India's fast fashion is slow:** The results of market research may indicate that the traditional fast fashion model, which is defined by a frequent release of new collections and a quick turnover of styles, is not in line with the preferences or buying habits of Indian consumers. Zudio's market research may indicate that Indian consumers have a preference for classic and adaptable apparel selections over those that are in constant flux. In response to the Indian market's tastes, Zudio takes a distinct tack by providing timeless classic styles in addition to a few more trendy items. Furthermore, Zudio's market research might reveal supply chain or logistical issues that impede the fast turnover of fashion collections, forcing the company to concentrate on a more effective and sustainable production strategy (Dhruv, Zudio).

Business Strategy

Low Cost

- **Absent design team:** Zudio hasn't kept a sizable in-house design staff, which usually comes with expensive overhead, high salary, and costs for tools and software. Alternatively, Zudio might work with outside designers or make use of pre-existing designs from manufacturers, distributors, or fashion houses. Zudio lower its operating costs while still providing its customers with a wide range of fashionable and trendy clothing options by outsourcing design functions or using pre-existing designs (Aditya, 2023).
- **Not conducting any research or development:** Zudio doesn't devote resources to research and development endeavors, in contrast to several upscale fashion labels that make significant investments in this area to produce cutting-edge designs and materials. Zudio concentrates on imitating fashion industry trends and styles and tailoring them to its target market's tastes (Aditya, 2023).
- **Exclusive brand:** Zudio chose to use a private label approach, in which it purchases goods straight from producers or distributors and markets them under its trademark. Zudio may control its supply chain, price, and branding better by using private label products, which could result in cost savings over selling third-party brands. Since private label goods often have reduced overhead expenses for royalties or brand licensing, Zudio can pass these savings forward to customers in the form of lower prices (Reddy, 2024).
- **No advertisement:** Zudio saves a lot of money on marketing and promotional efforts thanks to its decision to abandon conventional advertising campaigns like print or television commercials.

To draw customers and raise brand awareness, Zudio placed more emphasis on in-store promotions, social media interaction, and word-of-mouth marketing than on pricey advertising (Paisa, 2024). By this Zudio can more effectively direct resources into other aspects of its business, such as product development, retail expansion, or enhancing customer experience, by reducing advertising costs.

Less Investment

- **Cheap rent:** Zudio may deliberately decide to locate its retail stores in less desirable areas of Tier 1 cities or shopping centers in Tier 2 or Tier 3 cities, which have cheaper leasing rates.

Zudio has minimize company overhead expenses, especially rent, by securing advantageous lease arrangements and choosing affordable real estate solutions (Paisa, 2024).

Zudio guarantees accessibility and convenience for its target clients, who might not have access to luxury or premium fashion brands but desire fashionable and reasonably priced apparel options, by focusing on tier 1 and tier 2 cities. Customers' convenience is increased by Zudio's physical presence in these cities along with its online platform, which makes shopping simple and accessible (Malodia, 2023).

- **Cheap inventory:** Zudio take a lean inventory management strategy, which would reduce the cost of keeping inventory on hand by keeping ideal stock levels and effectively overseeing supply chain activities. Zudio rotates its inventory quickly, refreshing products at a rate of 160% every week to keep their store looking fresh with new styles and products every two months. Zudio can maintain strong profit margins and competitive pricing for its products by minimizing its rent and inventory expenditures (Reddy, 2024).
- **Economies of scale:** Zudio can profit from economies of scale, which happen when the average cost per unit of manufacturing falls as output increases, as it grows its operations and sales volume. Zudio can spread fixed costs over a broader revenue base, attain cost savings in production and distribution, and negotiate better terms with suppliers with a larger customer base and higher sales volume (Paisa, 2024).

No e-Commerce

The primary initial expenses involved in establishing and maintaining an e-commerce platform involve building a website, digital marketing, and appropriate infrastructure. The ideal locations for Zudio's physical retail storefronts are Tier 1 and Tier 2 cities because of their well-established retail infrastructure, which includes high streets, malls, and shopping centers. By carefully positioning its stores in these locations, Zudio can maximize the exposure, foot traffic, and profit potential of its target audience. Zudio produces revenue through the sale of many kinds of clothing products, including shoes, accessories, ethnic clothing, sporting, and formal and casual clothing (Paisa, 2024).

- **High rate of return:** Handling returns, which include processing refunds, replenishing inventory, and handling possible damages or defects, may be expensive and time-consuming for merchants. By concentrating on brick-and-mortar retail, where customers can physically check and try on clothing before making a purchase, Zudio chooses to reduce the danger of large return rates (Paisa, 2024).
- **Product selection and pricing approach:** Zudio offers an extensive collection of clothing categories, include athletic clothing, ethnic wear, casual wear, shoes, and accessories. As part of the pricing strategy designed to appeal to customers on a budget, the majority of products are priced competitively when compared with other fashion retailers. Zudio maintains a balance between price and quality to ensure that a larger range of customers can utilize its services (Sinha, 2022).

Target Audience

Zudio focused on tier 2 and tier 3 groups for affordable clothes. India's Tier 2 and Tier 3 cities, with their sizable populations and expanding middle classes, provide substantial market prospects. These cities are home to a growing consumer base with rising disposable incomes who

are looking for reasonably priced, fashionable apparel (Reddy, 2024). Inhabitants of Tier 2 and Tier 3 cities are now more interested in trendy apparel to stay current with fashion. There is a need for reasonably priced fashion solutions that are good value for money as urban and semi-urban consumers' disposable incomes rise and their fashion consciousness increases (Dhruv, *Zudio)*

Capital to Quality

Zudio use the money it saves by forgoing e-commerce, investments to fund product development, retail expansion, or marketing campaigns, among other business endeavors. By keeping up the quality of its garments, Zudio can stand out from the competition and draw in clients who value affordability and durability while making clothing purchases. To further bolster Zudio's competitive position in the retail industry, the saved money may potentially be utilized to improve operational efficiency, invest in staff training, or improve the in-store shopping experience (Malodia, 2023).

Zudio markets itself as a one-stop shop with fashionable and reasonably priced apparel selections. The brand's main goal is to provide stylish clothing for kids, adults, and both at reasonable costs without sacrificing quality (Alibha, 2024). goods are obtained straight from suppliers or manufacturers and marketed under the Zudio brand, making up the majority of Zudio's inventory (Paisa, 2024).

Operating Model

FOCO Model – A firm that offers independent people or entities the franchise rights to own and run stores under its name while maintaining control over these outlets' operations is known as the franchise-owned company-operated (FOCO) model. Under this arrangement, the firm oversees daily operations such as staffing, marketing, quality control, and product sourcing, while the franchisee owns the actual location and makes the necessary investments to set it up and run the business (Reddy, 2024).

Zudio rapidly expand its retail presence through the FOCO (Franchise Owned, Company Operated) model, leveraging the investment and entrepreneurial spirit of franchisees. This approach allows Zudio to enter new markets more quickly than with company-owned stores because the franchisee covers the setup and operating costs. By partnering with franchisees, Zudio reduces the capital costs associated with opening new stores, allowing the company to focus on core activities such as marketing, branding and product development. Franchisees also bring valuable local expertise, an understanding of competitive dynamics and customer preferences in their area. Additionally, the FOCO model mitigates the risks associated with market volatility and operational challenges, with franchisees assuming financial responsibility while Zudio maintains control over operating standards and brand integrity. (Paisa, 2024).

Collaborations and Partnerships

For marketing initiatives, Zudio worked with influencers or celebrities to increase brand awareness and reach new markets (Alibha, 2024). Zudio uses influencer marketing as a strategic tool to amplify its message and connect with a wider audience. The brand partners with local and regional influencers who have a genuine connection to their communities (Medium, 2023). These influencers help showcase Zudio's latest products and fashion styles in an authentic and relevant way. By leveraging these trusted voices, Zudio effectively reaches potential customers and strengthens its brand identity (Surti, 2023).

In addition to promoting fashion, Zudio's campaigns often address social issues, aligning the brand with important causes. This dual approach allows Zudio to not only highlight its collections but also engage with important social issues. Through these initiatives, Zudio demonstrates its commitment to social responsibility, fostering a deeper connection with its audience. By combining product promotion and social advocacy, Zudio reinforces its brand image as a stylish and socially responsible company. (2024)

ZUDIO'S IMPACT ON THE FASHION RETAIL INDUSTRY

- **Disruption of Traditional Retail Models:** Zudio challenges the idea that high-quality fashion has to be expensive by providing reasonably priced yet trendy apparel options. This upends traditional retail models. The business is able to maintain competitive pricing while providing consumers with trendy apparel by its emphasis on value-driven pricing and effective supply chain management. Zudio's strategy compels established shops to reevaluate their product offers and pricing plans in order to stay competitive in the bargain fashion market (Nag, 2024).
- **Influence on Consumer Behavior:** Zudio's cost-effectiveness and fashionable selection impact consumer choices by attracting cost-conscious buyers looking for fashionable yet reasonably priced apparel. Because of the brand's popularity, customers can prefer economy above style without sacrificing quality, which could cause more expensive competitors to lose market share. Zudio's robust brand reputation and steady provision of high-quality items at reasonable prices encourage consumer brand loyalty, impacting repurchases and boosting customer retention.

Source: Author's Contribution

CHALLENGES AND RISKS

- **Supply Chain Vulnerabilities:** Interruptions in the supply chain, such as delays in transit, production hold-ups, or shortage of raw materials, could have an impact on Zudio's ability to manage inventories and deliver goods. Weaknesses in the supply chain might lead to stockouts, delayed deliveries, or higher expenses, which would make it more difficult for the company to meet consumer demand while maintaining affordable prices (Nag, 2024).
- **Changing Market Trends:** Zudio must continue to be adaptable and sensitive to market demands in light of the quickly changing fashion trends and consumer preferences. Anticipating and adjusting to evolving market trends is crucial to avoid obsolete product offers, decreased consumer interest, and even market share loss (Startupurban, 2024).

FUTURE OUTLOOKS

- **Enhance Recycling Programs:** Interruptions in the supply chain, such as delays in transit, production hold-ups, or shortage of raw materials, may have an impact on Zudio's capacity to control inventories and provide goods. Weaknesses in the supply chain might lead to stockouts, delayed deliveries, or higher expenses, which would make it more difficult for the company to meet customer demand and maintain competitive pricing.
- **Promote Clothing Rental and Resale:** Introduce a clothing rental service or a resale platform within Zudio's stores or online. This initiative will encourage customers to rent or buy pre-owned items, reducing the demand for new production. Highlighting these services

in marketing campaigns can further promote sustainable consumption and align with the brand's commitment to the circular economy.

- **Adopt Sustainable Product Design:** Zudio should give thoughtful thought to the recyclability and durability of their products when creating them. It will have less of an influence on the environment to use eco-friendly materials like organic cotton, recovered fibers, and biodegradable fabrics. Clothes lifespan can be increased, and waste can be reduced by implementing design elements that facilitate easy modifications and repairs.

LESSONS LEARNT

Innovate Zudio's success highlights the value of innovation without going overboard by showing that creativity doesn't need a big budget—rather, it just needs productivity, originality, and a thrifty innovation mindset that keeps businesses competitive.

Build strong brand identity: Zudio has successfully established a strong brand identity by continuously fulfilling its promise of providing stylish yet reasonably priced clothing. It is necessary to develop a strong brand image is crucial for increasing client loyalty, drawing in new business, and setting yourself apart from rivals.

Understanding the Target Audience: Market research by Zudio helps businesses understand the needs and preferences of their target market and uses to create goods, pricing strategies, marketing campaigns, and customer experiences, is credited with the company's success.

DATA ANALYSIS

A sample of 50 individuals is to be given a questionnaire that gathers data and their opinions about Zudio a clothing brand and the awareness among the consumer. The acquired data is used for analyzing the hypothesis and interpretation of the findings. Initially, they were asked about visit to zudio and their awareness about the circular economy and the analysis was done with sample of 31 indivisuals.

Demographics

Criteria	*Range*	*Frequency*
Age	Under 18 Between 18–25 26 and Above	84.3 13.7 2
Gender	Male Female	58.8 41.2
Occupation	Student Professional/Managerial Unemployed	58.8 27.5 13.7
Visit	Yes No	72.5 27.5
Frequency Of Visit	Frequently Occassionaly Rarely	36.1 44.4 19.4
Familiarity with the circular Economy	Yes No	83.8 16.2

- **Age:** The data suggest that 84% of our sample was from age group of 18-25 years which was a main target audience for the zudio as well.
- **Gender:** Approximately 60% of our population were females which are more interested in fashion.
- **Occupation:** Approximately 60% of our sample were students which were again a target audiencce for Zudio.
- **Visit:** 73% of our sample visit to Zudio.
- **Frequency:** Amongst those who visit the Zudio, 36% of the sample is a frequent customer of it.

Data Interpretation

Among 31 individuals, 68% of people were influenced by the marketing and pricing of Zudio.

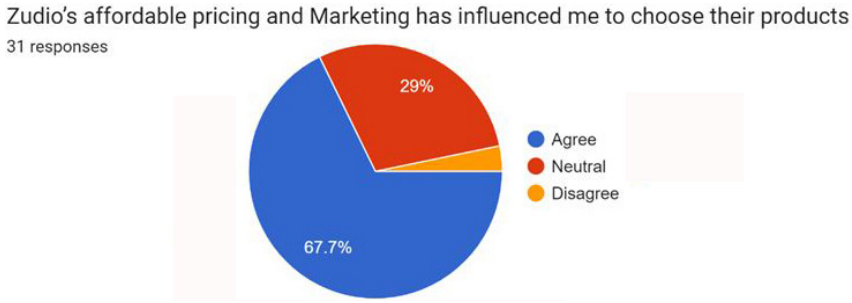


Figure 1: Influence of Zudio's Marketing and Pricing

Approximately 65% of individuals supported that Zudio uses sustainable quality of materials in their products.

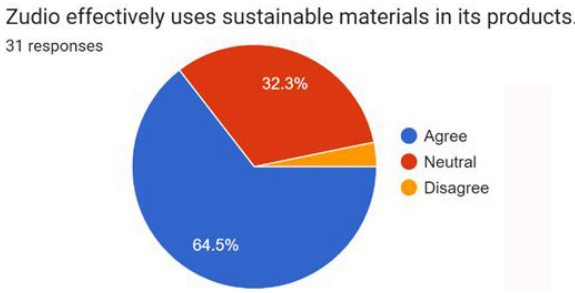


Figure 2: Effective Usage of Sustainable Materials in Products

74% of individuals supported that Zudio promotes recycling and reuse among customers.

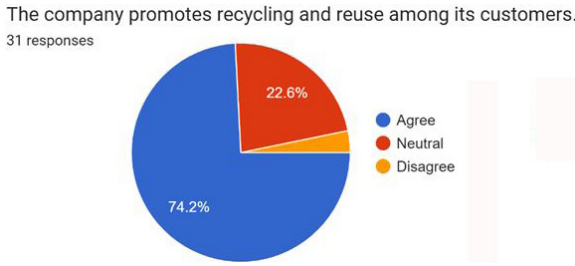


Figure 3: Promotion of Recycling and Reuse among Customers

Approximately 61% of individuals supported that Zudio manages to reduce and manage inventory hence minimizing waste.

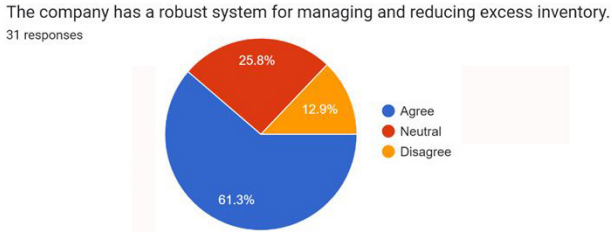


Figure 4: System for Managing and Reducing Excess Inventory

Approximately 58% of individuals supported that Zudio's Production processes minimised the environmental impact as they only go for basic and trendingfashion rather Research and Development for new designs.

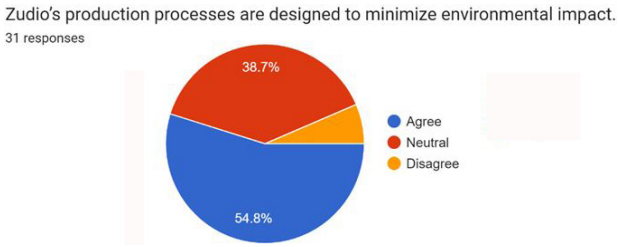


Figure 5: Production Process Minimising Environmental Impact

77% of the individuals supported the products of Zudio are durable and would last for long, hence contributing in waste and pollution reduction.

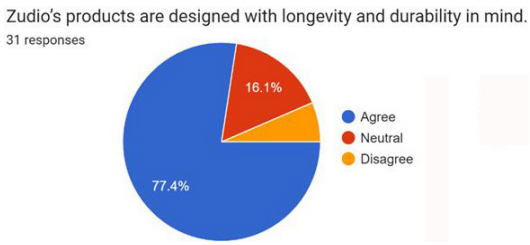


Figure 6: Products are Long Lasting and Durable

Approximately 68% of individuals agreed that Zudio's marketing strategy is promoting circular economy principles. Their collaborations with local and regional influencers and videos regarding DIY fashion are a measure of circular economy.

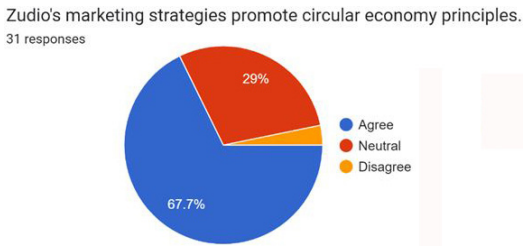


Figure 7: Promotion of Principles of Circular Economy through Marketing Strategies

74% of individuals supported that Zudio regularly keeps a check on environmental impact due to their activities and take necessary actions if required.

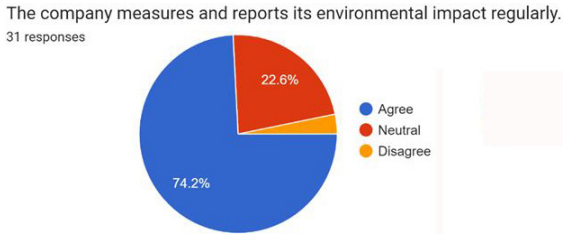


Figure 8: Measure and Reporting of Environmental Impact

RESULTS

Social Media Campaigns: Zudio's social media campaigns highlight recycling, reuse and waste reduction. The brand uses a combination of images, videos and text content to deliver sustainability messages. Posters often highlight new collections made from recycled materials and encourage consumers to participate in recycling programs.

Consumer Engagement: Engagement metrics show that consumers are highly engaged with Zudio's sustainability posts. The survey results show that consumers consider Zudio a pioneer in sustainable fashion and value the brand's efforts to promote ecological practices. The positive reaction underlines the importance of transparency and authenticity in Zudio's messaging. Influence of Fashion InfluencersFashion influencers working with Zudio effectively promote the brand's circular economy initiatives. These influencers use different strategies, such as presenting Zudio products in stylish clothes and sharing personal stories about sustainability. The authenticity and relatability of influencers significantly influences consumer attitudes, which increases interest in Zudio's sustainable offerings.

CONCLUSION

In conclusion, a customer-centric approach, effective supply chain management, and strategic market positioning define Zudio's business strategy. Using meticulous analysis, it is possible to identify the principal drivers of Zudio's prosperity, such as its pricing tactics, concentration on niche markets, and edge over competitors. Zudio's pricing strategy is based on the idea that providing appealing yet reasonably priced clothing selections will appeal to consumers who are price aware and want good value. Zudio has successfully established itself as a budget-conscious fashion destination by targeting on urban and semi-urban customers in tier 1 and tier 2 cities. The company's competitive advantages are its strong brand image, efficient marketing plans, and efficient supply chain management practices.Zudio has established client loyalty by the implementation of impactful marketing campaigns and captivating customer encounters, thereby strengthening its standing in the fiercely competitive retail industry. Zudio, known for its fashionable yet affordable apparel, has established a strong reputation in the target market due to its commitment to style, affordability, and quality.

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The Counterfeit Consumption: A Qualitative Exploration of Motivations

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Abstract

Despite increasing concerns about counterfeit products, people continue to buy these counterfeit products intentionally. The desire to own branded items has led to a surge in demand for counterfeit luxury fashion products. Many consumers who cannot afford genuine luxury items turn to counterfeits to keep up with the latest trends. Beyond financial considerations, there are additional factors that drive consumers to purchase counterfeit products. The purpose of this qualitative study is to gain a deeper understanding of why people choose to buy counterfeit products. Past studies have explored socio-demographic, product-specific, marketing, ethical and legal aspects shaping consumer behavior in the counterfeit market. To add to the existing knowledge, we explore psychological and emotional aspects and motivation behind owning and purchasing the counterfeit products. By conducting in-depth interviews with 30 individuals who have purchased and used these counterfeit luxury fashion products, it uncovers the underlying motivations, attitudes and beliefs that drive their decision of purchasing counterfeit products. This study tries to provide insights into the antecedents influencing consumer decision. Recognizing the significance of comprehending the factors is crucial for both scholars and practitioners in developing effective strategies to mitigate the demand for counterfeit goods.

Keywords: *Counterfeits, Luxury Fashion Products, Qualitative Research*

INTRODUCTION

Despite the legal and ethical issues associated with counterfeiting, the demand for counterfeit goods continues to rise, driven by complex consumer behaviours that require deeper investigation. Why do consumers knowingly choose counterfeit goods, despite awareness of the legal risks and moral concerns? What motivates individuals to bypass authentic products in Favor of cheaper, imitation alternatives? These questions highlight the need to explore the specific factors that shape consumer purchase intentions towards counterfeit goods.

Luxury brands worldwide are estimated to lose about $30 billion each year due to the surge in counterfeit goods. This issue not only cuts into the revenue these companies depend on for growth and stability but also seriously harms the brand image and value that they've worked hard to build. The fashion and luxury sector is especially vulnerable, with counterfeit fashion items making up nearly 60% of all seized counterfeit products globally, according to the report of Economic Times in the year 2024. As per the joint report provided by CRISIL (Credit Rating Information Services of India Limited) and ASPA (Authentication Solution Providers Association) in 2023

has highlighted some deeply concerning findings about counterfeiting. Counterfeit goods make up a substantial share, estimated between 25% and 30%, across various markets. This issue is especially critical in sectors vital to the economy and public health. For instance, counterfeit pharmaceuticals make up about 20% of the counterfeit market, while the apparel industry sees a staggering 31% of counterfeits. Other affected areas include automotive (25%) and fast-moving consumer goods (FMCG) and consumer durables, which together account for around 17%. Alarmingly, the study also reveals that nearly 31% of consumers were completely unaware that the products they purchased were counterfeit at the time of buying. The widespread availability of counterfeit products has become a major concern across various industries, including fashion, electronics, and pharmaceuticals, leading to substantial financial losses and safety risks**.**

Black's Law Dictionary defines counterfeiting as the intentional act of creating or distributing a product that closely imitates a trademarked item, specifically designed to deceive consumers into believing they are purchasing genuine goods from the original brand. This act deliberately aims to blur the line between the fake and the real, tricking buyers into mistaking counterfeits for legitimate, trademark-protected products. In the world of intellectual property and consumer goods, counterfeiting is the intentional process of creating items that closely resemble authentic products. This includes not only the product's look and feel but also the use of similar trademarks, labels, and packaging, all aimed at misleading consumers into thinking they're buying a genuine item. Counterfeit goods are essentially imitations, carefully crafted to mimic the qualities of real products, which creates serious issues for both consumers and brands in the market. Counterfeit products are the duplicate or look alike of real products that consumer gets at lower price. According to the Cambridge Dictionary, a counterfeit item is intentionally crafted to closely mimic a genuine product, often with the intent to deceive individuals or organizations for fraudulent or unlawful purposes. They help the consumers to satisfy their psychological, social, economic and emotional needs. We may say that these products fulfil the wants of consumer of having luxury at affordable or lower price. There are two categories of counterfeiting products – Deceptive and Non-Deceptive counterfeiting where the former one is when consumer is not aware or have knowledge about buying the fake product and he/she thinks that what he/she purchased is an original product. In this scenario they are unknowingly purchasing the counterfeit products. When consumer is aware that what he/she is purchasing is a fake or unauthorised product is termed as Non deceptive counterfeiting. Consumers are knowingly and intentionally purchasing the fake products. In the first category of counterfeiting, we could not measure the attitude and behaviour of consumer of buying counterfeit goods as they are making purchases or using it without any idea that they are not original or the real products. Therefor for the present study, papers related to non-deceptive counterfeiting are considered for the review. As counterfeit goods become more common in various markets, there has been a noticeable increase in consumer interest in purchasing these fake products (Bhatia, 2018). The counterfeit products industry in India is vast and diverse, covering a wide range of sectors. Commonly counterfeited goods include pharmaceuticals, automotive parts, electronics, software, luxury goods, clothing, and even food items.

LITERATURE REVIEW

Fashion items with popular brands are particularly prone to being counterfeited. These items often become outdated over time, placing a financial strain on consumers who want to stay trendy.

As a result, buying counterfeit versions can be a more affordable option compared to purchasing the original products.(Penz et al., 2005). Consumer willingness or demand to purchase counterfeit product is the reason for the spreading of counterfeit trade (Bian & Moutinho, 2011). Some prior studies showing the positive effect of counterfeiting, suggested that consumer purchased counterfeit products for the trial or experiment purpose and eventually switch to buy the original products. Counterfeit products are treated as the sample that consumer test and later switch to the branded product when he/she is able to afford it.(Eisend & >Tarrahi, 2019). The well-known brands like Rolex, Gucci, and Chanel frequently become targets for counterfeiters because of their strong appeal to consumers. This suggests that choosing to buy a counterfeit product involves not just a decision about the product itself, but also a consideration of the brand associated with it (Bian & Moutinho, 2011).The reasons behind buying branded product by the consumer are the physical features of the product and the value associated with it i.e reputation of the brand in the market. Although counterfeit products don't replicate all the physical features of branded product but it does keep the same image dimension. (penz et al., 2005) . Purchasing and owning the counterfeit product one can have the prestige of branded one only on paying fraction of its (branded product) price.

As per(Iyer et al., 2022) study, consumers who are influence by society and are motivated by status may want to have luxury products but could be drawn to counterfeit products to meet their status needs as they are available at lower price. For status seeking consumers, purchasing counterfeit products is to meet the idea of getting prestige without paying the high price. (Quoquab et al., 2017)contributes to the theory of planned behavior (TPB, Ajzen, 1991) in this study that implies buying behavior of a consumer is ascertain by the purchase intention which is influenced by the attitude of the consumer towards the product, subjective norm and perceived behavioural control, and incorporates ethical beliefs (religiosity, ethical concern, and perception toward lawfulness) as antecedent of consumer attitude towards intention to purchase counterfeit products. When the attitude of consumer is positive or favorable towards buying unauthorized products, he/she will buy that product and if the consumer's attitude is negative and unfavorable towards counterfeit goods then he/she may not buy it.

Counterfeit products may be purchased because they imitate well-known brands associated with status and prestige. Consumers might seek the symbolic value of owning products perceived to be of high social standing without paying the authentic price. Price is a crucial aspect of increasing the demand of counterfeit goods in the fashion market, consumers prefer or shift their interest to purchase counterfeit products in place of authentic goods if the price is high (Yunos & Abdul Lasi, 2020). Materialism, in the context of consumer behavior, refers to the prioritization of material possessions and the pursuit of tangible goods as a source of personal fulfillment and social status. When applied to counterfeit products, materialism can play a significant role in influencing consumer choices and behaviors.As per Bhatia (2018) study, price is an important but not only the factor that forces or motivates people to purchase counterfeit products it includes other factors like social influence, materialism, value consciousness, perceived risk, brand consciousness and income. There is a positive or negative attitude of consumers as per their purchasing capacity. Low-income group consumers have the positive influence on intention to purchase counterfeit products as compared to high income group. Luxury goods are first to get affected by the practice of counterfeiting as they are popular and renowned but expensive. Everyone desires to have the luxury products like bags, watches, shoes, jewellery, branded clothes etc as they demonstrate

their social status but due to its high pricing people with low purchasing power can't afford them for which fake products or the duplicate products which look similar to original products come to their rescue, provides an opportunity for the manufacturer of counterfeit products to produce it at low cost and make revenues from well-established brand names. This study (Tseng et al., 2021) examines that acceptance of counterfeit goods and its purchases varies across different countries (developed and developing). Consumers of one country may have a positive (negative) attitude towards counterfeit products as compared to another countries. As per Osman Gani et al. (2019), quality and function or performance of different types of products also influence the attitude of consumers to buy the counterfeit products over genuine products. If consumer gets quality product without paying higher price, he/she will go for it and has a favourable attitude towards buying the counterfeit products.(Wu & Zhao, 2021) believes that luxury products provide an individual the impression of uniqueness, exclusivity, high status symbol etc but if counterfeit luxury products also have the same mentioned features and are easily available without charging high price, would be accepted by consumers as they are satisfying their social needs. Consumers who are conscious about their social image look counterfeit products as the substitute of luxury products. In another study,(Jiang et al., 2019) believes that counterfeiting of goods takes place due to lack of knowledge among the consumers about the original brands.

Idealism, in the philosophical sense, refers to the belief in the importance of principles and values, often guided by a commitment to ethical and moral standards. When applied to the context of counterfeit products, an idealistic perspective would emphasize ethical considerations, honesty, and integrity in consumer behaviour and business practices. In simple terms it means welfare of others, they think one should do right things which provides them good results/outcomes. According to (Tunçel, 2022), idealist people are not in favour of purchasing counterfeit products as this doesn't contribute anything positive to the brands and are harmful for their company's reputation and growth. Genuine products represent the efforts, creativity, and investments of companies and individuals, and purchasing counterfeits is seen as a violation of these rights. In this study (Singh et al., 2021) , examined the demand-side factors that affects the intention of consumers to purchase unauthorised products. Materialism, in the context of consumer behaviour, refers to the prioritization of material possessions and the pursuit of tangible goods as a source of personal fulfilment and social status. When applied to counterfeit products, materialism can play a significant role in influencing consumer choices and behaviours.

RESEARCH METHODOLOGY

To gain a comprehensive understanding of these factors, the study will employ a qualitative research design to know the motivations that provoke the consumer to buy the counterfeit products despite the availability of branded version of it. In-depth interviews will be conducted with consumers who have purchased and have the first-hand experience of counterfeit goods, providing rich, detailed insights into their motivations, perceptions, and ethical considerations. By using qualitative methods, this study aims to capture the subjective experiences that shape consumer's counterfeit purchase intentions.

FINDINGS AND DISCUSSIONS

Currently, the rise of counterfeit products is a major global issue. These illegally made items threaten not only to the stability of the global economy but also the social and cultural well-being

of communities worldwide. Additionally, counterfeit goods can harm individuals who may not have the ability to tell the difference between genuine products and their fake versions. It is a global phenomenon and can be resolved globally. (Penz et al., 2005) . This widespread issue affects the revenue and profitability of luxury companies. It's damaging their reputation and making people less loyal to their brands. The growth of online shopping and online marketplaces has made this problem even worse, allowing people who make fake products to sell them to people all over the world.

Counterfeiting is a complex issue that requires urgent and collective action to reduce its prevalence. By closely examining the factors that influence consumer behavior regarding counterfeit goods, valuable insights can be gained. These insights can help genuine brand manufacturers develop targeted strategies to protect and strengthen their competitive position in the market. The government has a crucial responsibility to educate the public about the harmful effects of counterfeit products, which can jeopardize economic stability and consumer safety. When individuals are involved in counterfeiting, it's essential to impose appropriate penalties on both the sellers who engage in these fraudulent activities and the buyers who knowingly support them. Consumers from low-income groups are aware of brands, but their limited purchasing power leads them to purchase counterfeit products. Manufacturers of branded products can address this by offering brand extensions that provide a more affordable range of products tailored for value-conscious and materialistic customers. It's important to note that the decision to purchase counterfeit products is influenced by a combination of these factors, and individuals may have different motivations based on personal circumstances, attitudes, and values. Efforts to combat the purchase of counterfeit goods often involve raising awareness about the risks and consequences, implementing stricter legal measures, and emphasizing the value of genuine products. Combating the purchase of counterfeit products requires a multifaceted approach, including legal measures, consumer education, and the promotion of ethical business practices.

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Consumer Engagement in the Circular Economy: A Bibliometric Study of Live Marketing Trends

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Abstract

This bibliometric analysis examines the research landscape on consumer engagement within the circular economy, with a specific emphasis on trends in live marketing. The study examines 234 documents from 98 sources published between 2020 and 2025, highlighting the increasing interest in how live marketing influences sustainable consumer behaviors aligned with circular economy principles. Key contributors, including leading authors, institutions, and notable journals, are identified, alongside significant international collaborations. A keyword co-occurrence analysis uncovers core research themes such as electronic commerce, live streaming, and recycling, emphasizing the interdisciplinary nature of the field. The findings indicate that live marketing plays a critical role in encouraging consumer participation in circular economy practices by facilitating real-time interaction and building trust. The research highlights the necessity for further exploration into how live marketing influences sustainable consumer choices. It suggests that future studies should include qualitative methods and utilize additional databases to gain a deeper insight into this developing field.

Keywords: *Live Streaming Marketing, Live Marketing, Consumer Engagement, User Engagement, Recycling Economy, Green Economy*

INTRODUCTION

The idea of the Circular Economy (CE) has garnered significant interest as an innovative and transformative approach focused on encouraging more sustainable practices in both production processes and consumer behavior. By emphasizing the reuse, recycling, and reduction of waste, the circular economy seeks to shift away from traditional linear economic models and foster a more environmentally responsible system. CE emphasizes improving resource efficiency, minimizing waste, and prolonging product lifecycles, aiming to transition from the conventional "take-make-dispose" linear economic model. Instead, it aims to create a regenerative system that optimizes value and minimizes environmental harm (Beulque et al., 2023; Quintelier et al., 2023). An essential component of this transformation is the active engagement of consumers, whose involvement is vital in promoting and advancing circular practices. Their choices, behaviors, and everyday actions significantly influence the progress of these sustainable efforts and are key drivers in the transition towards a more circular economy (Alves et al., 2022). When consumers engage in circular economy activities, it encourages more eco-friendly purchasing choices and promotes behaviors like reusing, repairing, and recycling (Carlsson et al., 2022; Stein et al., 2020).

The circular economy is not limited to environmental sustainability but also provides new avenues for business innovation and growth. Opportunities arise from moving towards sufficiency-

based circular business models, which emphasize extending product lifespans, reusing materials, and fostering consumer engagement in sustainable practices. Companies embracing CE principles are redefining the way consumers understand value and sustainability (Beulque et al., 2023).

LIVE MARKETING: A KEY DRIVER FOR CIRCULAR ECONOMY ENGAGEMENT

In recent years, live marketing, particularly through live streaming, has become an effective tool for engaging consumers in sustainable practices. Live marketing enables brands to interact with consumers in real time, providing engaging shopping experiences that help reinforce CE principles such as reusing, recycling, and reducing waste (Chamberlin & Boks, 2018; Liu et al., 2022). This interactive marketing strategy allows brands to build trust and form authentic connections with their audience, further influencing pro-circular purchasing decisions (Liu C et al., 2023).

Using live streaming, companies can demonstrate how their products align with circular economy models by emphasizing product durability, repairability, and the potential for recycling or reuse. Brands can host live repair demonstrations, provide insights into how their products are sustainably sourced, and encourage consumer involvement in recycling programs, thereby aligning customer behavior with circular economy practices (Carlsson et al., 2022). Moreover, live marketing enhances social presence and fosters a sense of community, motivating consumers to actively participate in circular economy practices (Liu et al., 2022).

BRIDGING THE GAP BETWEEN RESEARCH AND APPLICATION

While there is a growing body of research on both circular economy practices and live marketing, there remains a significant gap in understanding how these two areas intersect, particularly regarding consumer engagement (Di Iorio & De Angelis, 2022; Quintelier et al., 2023). Though CE and live marketing have been examined independently, their combined role in promoting sustainable consumption is underexplored. Studies indicate that live marketing, with its dynamic real-time feedback mechanisms and interactive elements, has the potential to significantly impact consumer behavior in a positive way. By providing instant engagement and fostering direct interaction, live marketing can help bridge the gap between consumers' intentions and their actual actions, particularly when it comes to making sustainable consumption choices (Liu et al., 2023).

As live marketing evolves, its potential to promote CE principles becomes increasingly evident. Live marketing offers a dynamic platform for brands to communicate their sustainability efforts, educate consumers, and drive participation in circular practices such as reuse and recycling. This bibliometric study seeks to investigate the emerging trends and developments in live marketing within the context of the circular economy, specifically focusing on how businesses use real-time interaction to encourage sustainable consumption and greater consumer participation in circular initiatives (Liu et al., 2023; Chamberlin & Boks, 2018).

SIGNIFICANCE OF THIS STUDY

This research is particularly timely, given the increasing adoption of digital marketing platforms and growing consumer awareness surrounding environmental sustainability. Businesses today are under pressure to not only achieve profitability but also respond to the rising demand for more sustainable practices. In this regard, live marketing, especially through live streaming, has

emerged as a powerful tool that addresses both these needs. It allows companies to promote their products and services while actively engaging consumers with circular economy principles, which emphasize sustainability and responsible consumption.

Live marketing offers a unique opportunity for businesses to move beyond traditional marketing tactics. Its interactive format enables companies to directly engage consumers in real-time, fostering deeper connections and building trust. Beyond promoting their products, businesses can leverage live marketing to highlight their commitment to sustainable practices, such as recycling, reusing materials, or reducing waste. By incorporating these sustainability narratives into their marketing strategies, companies can demonstrate to consumers how their products align with the circular economy, encouraging more environmentally conscious purchasing decisions.

Live marketing has a notably strong influence on consumer behavior, especially within the context of the circular economy. As sustainability becomes a growing priority for consumers, they increasingly seek out brands that reflect these values. Companies that align their marketing strategies with sustainable development goals are better positioned to tap into this expanding market segment. For example, businesses can use live streaming to showcase the environmental benefits of their products, such as durability, recyclability, or ethical sourcingThis not only shows the company's dedication to being environmentally friendly, but also helps customers make smarter and more responsible decisions. Recent research has shown that live marketing can significantly influence consumer behavior, particularly in terms of promoting sustainable practices. By using live marketing to advocate for circular economy principles, companies can encourage consumers to adopt more responsible consumption habits, such as opting for products designed for reuse or recycling. Live streaming can also be used to educate consumers on repairing products instead of discarding them or participating in recycling programs, reinforcing the company's sustainable message.

This study provides valuable insights into how businesses can strategically use live marketing to further their sustainability efforts. Incorporating live marketing into their broader corporate social responsibility (CSR) initiatives allows businesses to not only satisfy the growing demand for eco-friendly products but also establish themselves as frontrunners in the worldwide transition towards a more sustainable economy. Live marketing can also help create a sense of belonging, making consumers feel more connected to the brand and the bigger effort toward protecting the environment.

In this way, businesses can drive sustainable consumption and empower consumers to make more environmentally responsible choices. As Stein et al. (2020) pointed out, companies that actively involve consumers in the circular economy through live marketing are more likely to build long-term loyalty and trust. People are more likely to support brands that share their values, especially those that are working to lessen their impact on the environment.

In conclusion, live marketing offers a valuable and impactful platform for businesses to not only promote their products but also engage consumers in sustainability efforts. By effectively using live marketing to promote circular economy practices, companies can deepen consumer engagement and encourage sustainable consumption habits, ultimately empowering individuals to make environmentally responsible choices. Aligning business strategies with sustainable development goals benefits both the environment and companies, positioning them as innovative leaders in a market increasingly driven by sustainability concerns.

RESEARCH OBJECTIVES

1. To analyse publication trends over time in research on consumer engagement, circular economy, and live marketing.
2. To identify key contributors including authors, institutions, and influential sources in the field.
3. To conduct keyword analysis to uncover major research themes and emerging trends in the literature.

RESEARCH METHODOLOGY

This study uses bibliometric analysis as its main methodological approach, a well-recognized and established technique for systematically examining large collections of academic literature across various disciplines (Aria & Cuccurullo, 2017). This approach enables the quantitative evaluation of research output by identifying patterns, trends, and relationships within published work. Through bibliometric analysis, researchers can explore the development of a field by assessing key aspects like authorship networks, citation impact, and keyword usage across different studies.

For this study, a comprehensive dataset of scholarly articles related to consumer engagement in the circular economy and live marketing trends was sourced from the Scopus database, one of the largest and most credible academic databases. This dataset includes a variety of peer-reviewed articles, representing contributions from numerous countries, institutions, and fields of study. By drawing on such a broad and credible source, the study ensures the inclusion of relevant and diverse research on the topics of interest.

The study employed Biblioshiny, a specialized bibliometric tool that allows for a detailed examination of co-authorship networks, citation metrics, and keyword co-occurrence patterns to analyze the dataset. Biblioshiny's powerful visualization features helped the study map connections between key authors, prominent institutions, and central research themes. These visualizations made it possible to identify influential research clusters, collaborative networks, and the most discussed topics in the field. The tool also highlighted the relationships between different contributors, revealing which individuals or institutions are leading the research on live marketing and circular economy practices.

The dataset was carefully curated through a targeted search using keywords like "circular economy," "consumer engagement," and "live marketing." This approach ensured that only highly relevant studies were included, focusing on research that specifically addresses the role of live marketing in enhancing consumer participation within the circular economy. The use of such specific keywords helped capture research that is directly aligned with the study's objectives.

In conclusion, this bibliometric analysis offers a comprehensive view of the current research landscape, identifying both well-established themes and emerging areas of interest. By quantitatively analyzing the field, this study highlights key shifts in academic focus and points out future research opportunities. The insights gained from this analysis are valuable for researchers and practitioners alike, helping them understand how live marketing impacts consumer engagement in the circular economy, while also identifying potential research gaps that warrant further exploration.

To retrieve titles, keywords, and abstracts from the Scopus database, use the search string provided below. Additional filters were applied to narrow down the volume of data retrieved.

("Live marketing" OR "Live streaming") AND "Circular Economy"
("Live marketing" OR "Live streaming") AND "Circular Economy" AND PUBYEAR > 2017 AND PUBYEAR < 2025 AND (LIMIT-TO (EXACTKEYWORD , "Circular Economy") OR LIMIT-TO (EXACTKEYWORD , "Recycling") OR LIMIT-TO (EXACTKEYWORD, "Live Streaming") OR LIMIT-TO (EXACTKEYWORD , "E- Commerces") OR LIMIT-TO (EXACTKEYWORD , "Green Economy") OR LIMIT-TO (EXACTKEYWORD , "E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Live E-commerce")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (LANGUAGE , "English")).
TITLE-ABS-KEY (("Live marketing" OR "Live streaming") AND "Consumer engagement")
TITLE-ABS-KEY (("Live marketing" OR "Live streaming") AND "Consumer engagement") AND PUBYEAR > 2019 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (EXACTKEYWORD, "E-commerce Live Streaming") OR LIMIT-TO (EXACTKEYWORD, "Customer Engagement") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming") OR LIMIT-TO (EXACTKEYWORD , "Consumer Engagement") OR LIMIT-TO (EXACTKEYWORD, "Live-streaming E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming Commerce") OR LIMIT-TO (EXACTKEYWORD, "Live Video Streaming") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming Sales") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming Platform") OR LIMIT-TO (EXACTKEYWORD , "Consumers' Engagement")) AND (LIMIT-TO (LANGUAGE , "English")).
("Live marketing" OR "Live streaming") AND "Consumer engagement"
("Live marketing" OR "Live streaming") AND "Consumer engagement" AND (LIMIT-TO (EXACTKEYWORD , "Live Streaming") OR LIMIT-TO (EXACTKEYWORD , "Customer Engagement") OR LIMIT-TO (EXACTKEYWORD , "Live Streaming Commerce") OR LIMIT-TO (EXACTKEYWORD , "E- Commerces") OR LIMIT-TO (EXACTKEYWORD, "E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Consumer Engagement") OR LIMIT-TO (EXACTKEYWORD , "E-commerce Live Streaming") OR LIMIT-TO (EXACTKEYWORD , "User Engagement") OR LIMIT-TO (EXACTKEYWORD, "Live Streaming E-commerce") OR LIMIT-TO (EXACTKEYWORD , "Livestreaming Commerce") OR LIMIT-TO (EXACTKEYWORD , "Live Commerce") OR LIMIT-TO (EXACTKEYWORD , "Live-streaming Commerce") OR LIMIT-TO (EXACTKEYWORD, "Livestreaming E-commerce")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")).
TITLE-ABS-KEY (("consumer engagement" OR "customer engagement") AND ("circular economy" OR "sustainability practices" OR "product recycling"))
TITLE-ABS-KEY ("circular economy" OR "sustainability practices" OR "product recycling") AND ("consumer engagement" OR "customer engagement")) AND PUBYEAR > 2014 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (

SUBJAREA, "SOCI")) AND (LIMIT-TO (EXACTKEYWORD, "Circular Economy") OR LIMIT-TO (EXACTKEYWORD, "Sustainability") OR LIMIT-TO (EXACTKEYWORD, "Consumer Engagement") OR LIMIT-TO (EXACTKEYWORD, "Consumers' Engagement") OR LIMIT-TO (EXACTKEYWORD, "Consumer' Engagement")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English"))

Primary Data Regarding the Information Gathered

Table 1: Main Information of Data

Description	*Results*	*Description*	*Results*
Sources (Journals, Books, etc.)	98	Annual Growth Rate %	–38.1
Timespan	2020:2025	References	18227
Average citations per doc	26.56	AUTHORS COLLABORATION	
DOCUMENT CONTENTS		Co-Authors per Doc	3.47
Author's Keywords (DE)	810	Single-authored docs	6
Keywords Plus (ID)	626	International co-authorships %	35.47
DOCUMENT TYPES		AUTHORS	
Article	234	Authors of single-authored docs	6
Documents	234	Authors	679
Document Average Age	0.979		

The bibliometric data offers key insights into the research landscape. Spanning from 2020 to 2025, the analysis covers 234 documents sourced from 98 journals and books, highlighting the broad interest in this area. Although there is a –38.1% annual growth rate, suggesting a decline in new publications, the research remains significant, as evidenced by an average of 26.56 citations per document, indicating its influence and relevance within the academic community. The dataset includes a substantial number of references (18,227) and keywords (810 Author's Keywords and 626 Keywords Plus), showcasing the wide variety of topics explored, such as consumer engagement, live marketing, and circular economy initiatives. This reflects the interdisciplinary nature of the research, drawing from areas like sustainability, business, and social sciences.

The field involves 679 authors, with an average of 3.47 co-authors per document, illustrating a strong trend toward collaborative research. Additionally, 35.47% of the publications involve international co-authorship, demonstrating the global scope of the research on consumer engagement and circular economy practices. The 234 documents are all peer-reviewed journal articles, indicating that academic journals are the primary medium for sharing findings in this field. Overall, the data shows that the research is globally collaborative, impactful, and remains relevant, even though publication growth has slowed.

Figure 1 depicts the annual growth of scientific publications from 2020 to 2024. The graph reveals a steady rise in publications over time, highlighting increased academic interest in this area. From 2020 to 2021, the growth in publications was minimal, but starting in 2021, a significant upward trend is evident. This suggests a growing focus among researchers on the connection between live marketing and circular economy practices. The number of publications reached its highest point in 2023, with over 100 articles published, reflecting a peak in research activity.

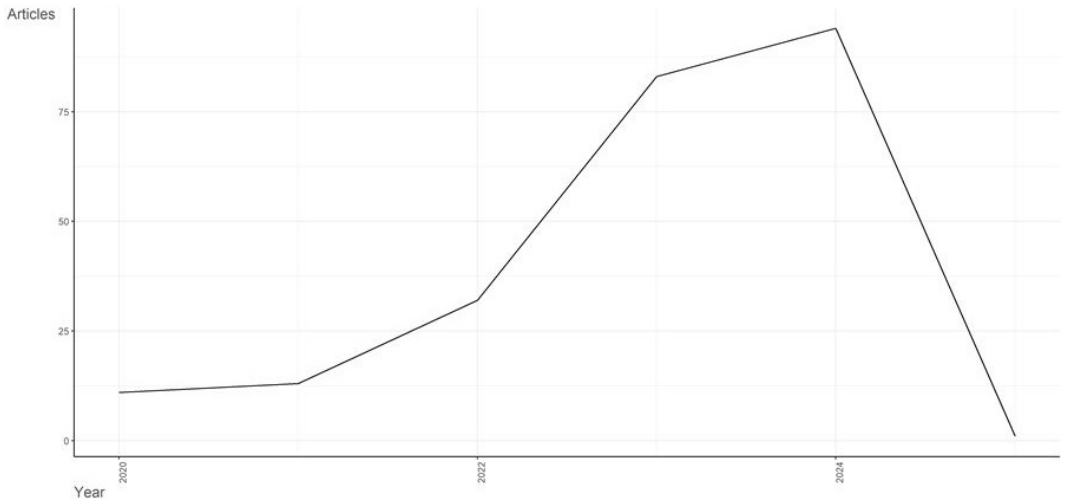


Figure 1: Annual Scientific Production

A notable drop in 2024 may be attributed to early data collection or a potential slowdown in research output as priorities shift. Despite this, the overall trend indicates that interest in consumer engagement within the circular economy and live marketing has seen substantial growth in recent years.

Table 2: Most Relevant Authors

Authors	*Articles*	*Articles Fractionalized*
HOLLEBEEK LD	6	1.5
CHEN H	5	1.45
LI X	5	1.33
ZHANG X	5	1.37
ABBASI AZ	4	0.70
CHEN J	4	0.87
KUMAR S	4	1.33
CHEN Y	3	1.08
HU M	3	1.08
LI H	3	0.78

Table 2 presents the most influential authors in the study of consumer engagement within the circular economy and live marketing, ranked by their publication count and fractionalized contributions. At the top is Hollebeek LD, with 6 articles and a fractional score of 1.5, reflecting a strong impact in this research area. Following closely are Chen H, Li X, and Zhang X, each contributing 5 articles, with fractionalized scores between 1.33 and 1.45, showcasing their key roles in advancing knowledge on live marketing and sustainability.

Other notable authors include Abbasi AZ and Kumar S, both with 4 publications, as well as Chen Y, Hu M, and Li H, who have each published 3 articles. These researchers have consistently contributed to the field, pushing forward academic understanding of live marketing strategies and circular economy practices.

The table highlights the key scholars driving research in this evolving field, underscoring their significant roles in exploring how live marketing can foster sustainable consumer behavior. Their work has laid the foundation for future studies and strategic approaches aimed at integrating marketing with circular economy principles. These authors are pivotal to the continued development of research in this area, providing critical insights into how sustainability can be promoted through innovative marketing practices.

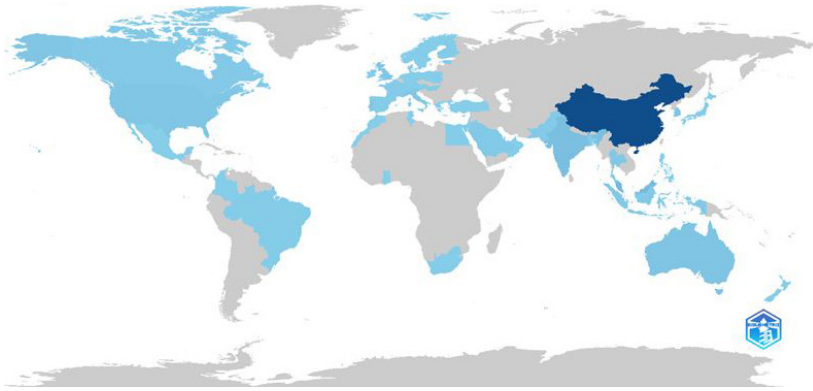


Figure 2: Country Scientific Production

Figure 2 highlights the global distribution of research on consumer engagement in the circular economy and live marketing trends, illustrating the contributions from various countries. China stands out as the top contributor in terms of publication volume, reflecting its significant focus on these topics. Close behind are the United States and the United Kingdom, both playing a pivotal role in advancing the research on how live marketing can drive consumer behavior and support circular economy initiatives.

Several other countries across Europe and Asia also make notable contributions. For instance, Germany, France, and Italy show strong engagement, aligning with Europe's broader commitment to sustainability and the circular economy. Similarly, countries like India and Japan in Asia are emerging as influential contributors, exploring innovative ways to leverage live marketing to engage consumers in sustainable practices.

The figure uses varying shades of blue to represent different levels of publication output, with darker shades indicating higher contributions. This colour gradient illustrates the global interest in these research areas, with both developed and developing nations actively contributing. The participation of a wide range of countries demonstrates a global acknowledgment of the role consumer engagement and live marketing play in promoting the circular economy. This widespread geographic distribution emphasizes the international and collaborative nature of the research, as diverse nations contribute their insights and innovations to advance the field.

Figure 3 showcases the most relevant sources for research on consumer engagement in the circular economy and live marketing trends. The Journal of Retailing and Consumer Services leads with 20 publications, followed by Electronic Commerce Research and Applications with 19 articles. Other significant sources include Sustainability (Switzerland) with 16 articles and the Journal of Business Research with 8 publications.

Journals like the Asia Pacific Journal of Marketing and Logistics and Internet Research have each contributed 7 articles to the topic. Additionally, the Journal of Cleaner Production

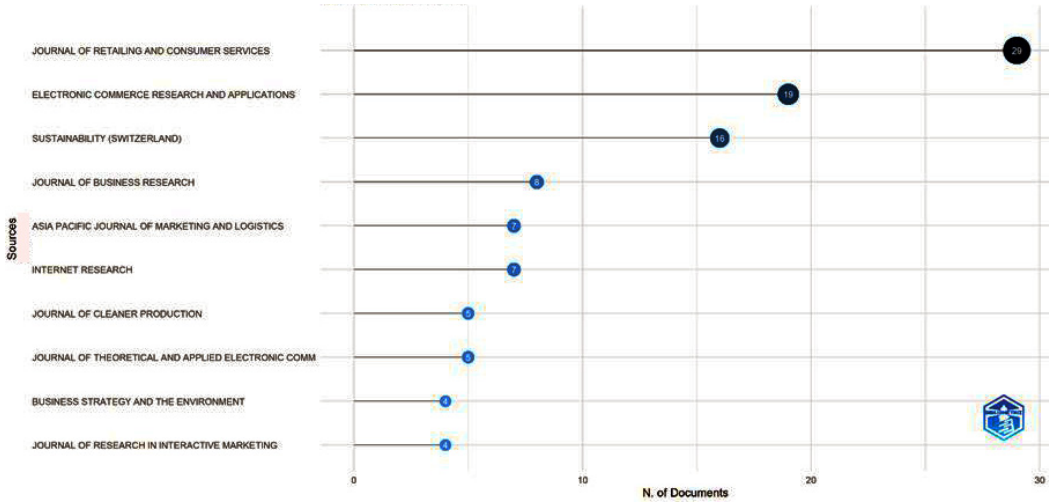


Figure 3: Most Relevant Sources

and Business Strategy and the Environment have each published 6 articles. These journals span multiple disciplines, including sustainability, business, and marketing, providing valuable research insights for both academics and professionals interested in live marketing and the circular economy

Figure 4 showcases the most active institutions in research on consumer engagement in the circular economy and live marketing trends. Shanghai University tops the list with 15 publications, followed by the School of Management and University Putra Malaysia, each contributing 12 articles. Jinan University and UCIS University follow closely, with 11 publications each.

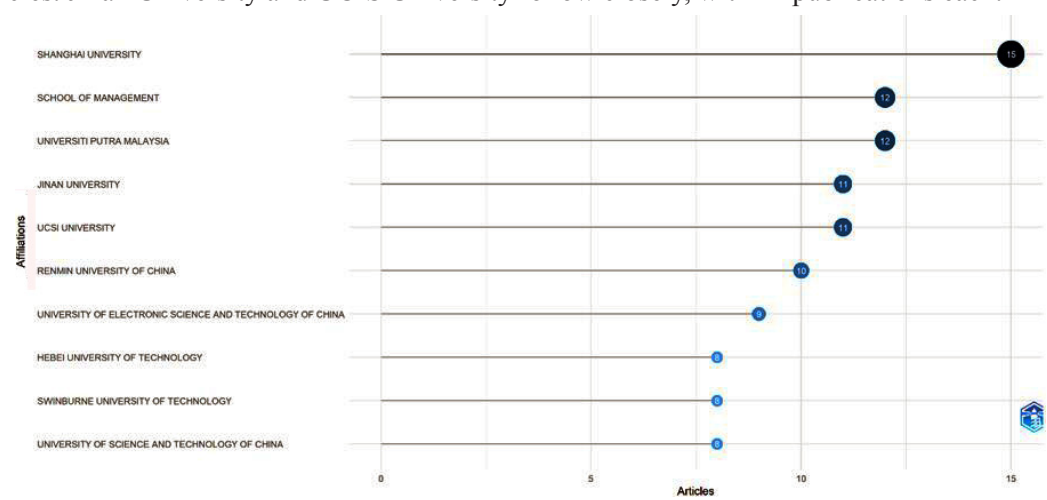


Figure 4: Most Relevant Affiliations

Other prominent institutions include the Renmin University of China and the University of Electronic Science and Technology of China, with 10 and 9 publications, respectively. This figure highlights the leading academic and research organizations advancing knowledge in this growing area of study.

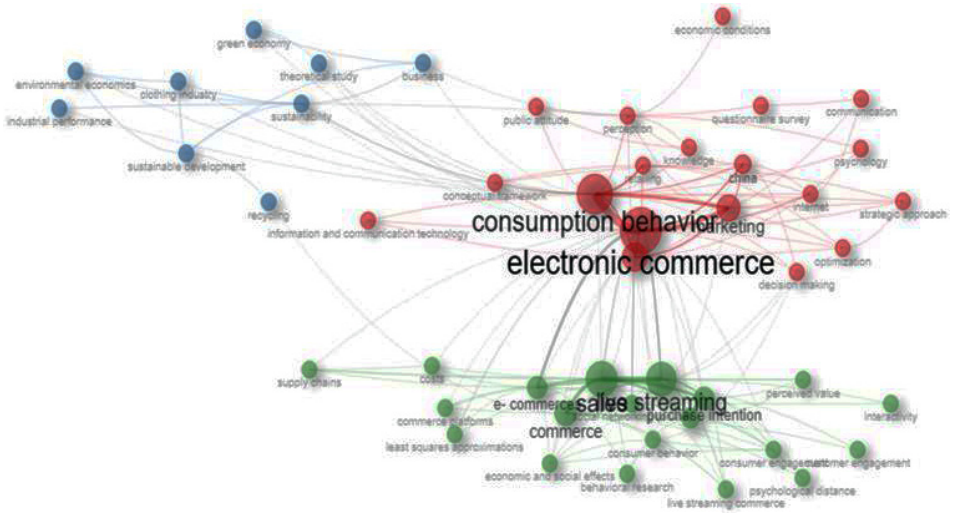


Figure 5: Authors' Keyword Co-occurrence Network

Figure 5 illustrates the Authors' Keyword Co-occurrence Network, depicting the most commonly paired keywords in research related to consumer engagement within the circular economy and live marketing. Central themes like electronic commerce, consumption behavior, and sales streaming are prominent in the network, highlighting key areas of focus in this field.

The network also includes clusters of interconnected keywords, such as e-commerce, purchase intention, and recycling, showcasing the strong relationships between consumer behavior, sustainability, and digital commerce. These clusters demonstrate how researchers are exploring the role of digital marketing tools, like live streaming, in promoting circular economy practices and encouraging sustainable consumption.

Color-coded clusters in the network emphasize distinct groups of keywords, each representing different emerging trends and focal points in the research. These clusters point to increasing attention on topics such as consumer engagement via live streaming and its alignment with sustainability objectives. Overall, the network provides a comprehensive view of the diverse and interrelated research themes that are shaping the study of live marketing and its contribution to advancing sustainable consumer behaviors in the context of the circular economy.

Figure 6 showcases a thematic map. The map is split into four quadrants based on development (density) and relevance (centrality):

- **Motor Themes (Top-right):** These are well-established and highly relevant topics, such as live streaming, sales, and commerce, which are widely studied and central to the field.
- **Basic Themes (Bottom-right):** This quadrant includes key but still developing areas, like electronic commerce, consumption behavior, and social media, which are growing in importance.
- **Niche Themes (Top-left):** Specialized but less central topics, such as blockchain and the textile industry, are well-researched but not broadly integrated into the wider field.
- **Emerging or Declining Themes (Bottom-left):** This category includes less developed, less central topics, such as user engagement, indicating these themes are either up-and-coming or losing relevance.

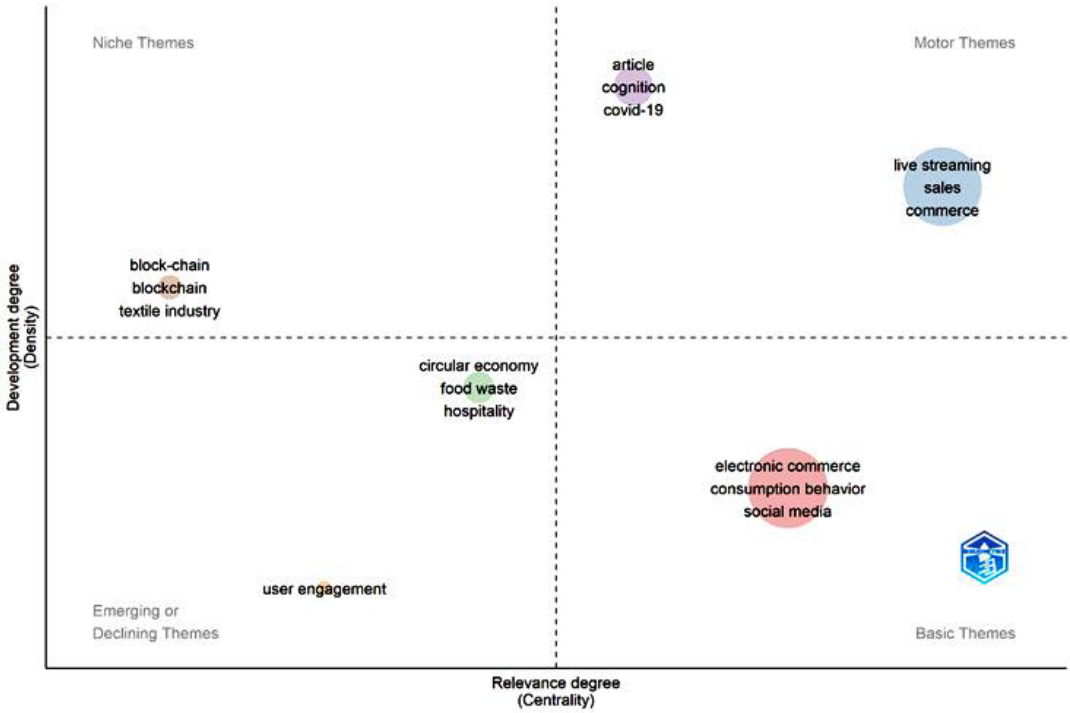


Figure 6: Thematic Map

DISCUSSION

The bibliometric analysis of consumer engagement in the circular economy, particularly in relation to live marketing trends, brings several important insights to light. The steady increase in publications between 2020 and 2023 shows the rising academic interest in this cross-disciplinary field, with a peak in research activity in 2023. This growth is likely driven by the increasing adoption of sustainable marketing strategies and the use of digital tools like live streaming to engage consumers in circular economy initiatives.

China stands out as the leading contributor to research in this area, followed by the United States, the United Kingdom, and Malaysia. This indicates the global significance of live marketing and circular economy research, especially as nations shift their focus toward sustainability and consumer involvement in environmentally responsible behaviors.

Citation analysis suggests that recent publications have had a notable impact, highlighting the rapid development of this research field. Key journals, such as the *Journal of Retailing and Consumer Services* and *Sustainability (Switzerland)*, play a central role in disseminating research, reflecting the interdisciplinary nature of the topic, which spans business, marketing, and sustainability.

Influential authors such as Hollebeek LD and Zhang X have made significant contributions to this growing area of research, positioning themselves as key figures in the field. The analysis of collaboration networks also shows a strong degree of international cooperation, with researchers working together across borders to explore the connections between live marketing, circular economy, and consumer behavior.

The thematic map and keyword co-occurrence analysis reveal that key research themes include live streaming, electronic commerce, and sustainability, highlighting the central role that live marketing plays in encouraging consumers to adopt more sustainable behaviors. Emerging themes like blockchain and user engagement suggest new avenues for further research, with potential to explore how these factors can drive the circular economy forward.

However, the study is limited by its reliance on Scopus as the sole data source and its focus on peer-reviewed articles, which may leave out important contributions from other sources. Future research should consider expanding the scope by including data from other databases like Google Scholar and Web of Science and using qualitative methods to complement these findings. Despite these limitations, this study offers valuable insights into how live marketing can effectively promote consumer engagement in the circular economy.

CONCLUSION

The study provides a comprehensive analysis of the evolving research trends surrounding consumer engagement within the circular economy, with a particular emphasis on the role of live marketing. The findings reveal a steady increase in research output from 2020 to 2023, indicating heightened academic interest and awareness of the intersection between live marketing strategies and circular economy principles. This growing body of research reflects an increasing recognition of live marketing as an influential tool in promoting sustainable consumer behaviors, aligning with the broader goals of reducing environmental impact and fostering circular economic practices.

Although there may be a slight decline in the number of publications in 2024, this could be attributed to a variety of factors, such as early data collection or shifts in research priorities. Nonetheless, the data underscores the importance of live marketing as a driving force in shaping consumer engagement with sustainability, particularly in the context of reuse, recycling, and reducing waste. The study also highlights key contributors, including leading authors, institutions, and academic journals that have played a significant role in advancing research in this area. Furthermore, the strong presence of international collaborations underscores the global relevance and shared interest in understanding how live marketing can be leveraged to support circular economy initiatives.

To further enhance the scope of future research, it is recommended that additional databases, such as Google Scholar and Web of Science, be included to ensure a more comprehensive dataset. Incorporating a broader range of sources could provide deeper insights into the multifaceted nature of consumer engagement and sustainability through live marketing. Additionally, while this study primarily relies on quantitative bibliometric analysis, future research could benefit from the inclusion of qualitative methodologies. Such approaches could provide a more nuanced understanding of the impact of live marketing on consumer decision-making and behavior, particularly in terms of fostering long-term sustainability practices and encouraging circular consumption habits.

Overall, this study sheds light on the crucial role that live marketing plays in engaging consumers and promoting circular economy principles. By fostering real-time interactions and personalized experiences, live marketing has the potential to significantly influence consumer behavior towards more sustainable practices. As the field continues to evolve, there are promising areas for future exploration, including the use of emerging technologies, the role of social media platforms in promoting circularity, and the long-term effects of live marketing on consumer

habits. Continued research in these areas will be essential for developing effective strategies to align marketing practices with sustainability goals, ultimately contributing to the advancement of the circular economy.

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Green Marketing Contribution for Sustainable Development

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Abstract

The marketing plan has to incorporate environmental issues more deeply. This study explores the benefits and problems of adopting green marketing and its role in attaining sustainable development. The status of the primary topics in this field—consumers, businesses, and countries was analysed as part of the multifaceted study. Globally, green marketing is being used more and more, mostly because environmentally conscious customers are becoming more demanding when it comes to environmental preservation. States also understand, however, that an excessive amount of resources are being wasted, which may eventually cause them to vanish and make some businesses unsustainable. Because of this, an increasing number of models are being developed to satisfy the endless demands of consumers while having limited resources, and one of these models are green marketing. It contributes to achieving sustainable development, as it promotes the rational use of resources.

Keywords: *Green Marketing, Green Products, Customer, Environment, Perception, Behaviour*

INTRODUCTION

In the current situation, the main priorities are to maintain the trust and loyalty of current and potential customers as well as to protect the environment, which is currently the greatest demand. There is evidence all across the world that individuals are altering their behaviour because they are worried about the environment. Lack of green management may cost businesses a lot of reliable and lucrative customers. Marketing has to assist businesses create sustainable development and solve environmental issues. (Polonsky et al, 1997).Green marketing encompasses a wide range of activities, from adjustments to a company's marketing plan to changes in its production process. One of the most crucial corporate tactics for guaranteeing sustainable development is green marketing. Since sustainable marketing aims to assist businesses in establishing sustainable growth and means addressing present requirements without compromising the advantages for future generations, (Li, Cai, 2009). To overcome them, many concepts and approaches have been developed. One of them is green marketing, which reacts to the needs of environmental consumers. The overall goal of sustainable development is the long-term sustainability of the economy and the environment, which will be achieved by integrating economic, environmental and social aspects into the decision-making process. (Domazet, Simović, 2015).

Maintaining the safety of our natural environment is just as important as keeping customers and consumers intact in the current globalised world. Customers are aware of the growing number of environmental problems, including acid rain, global warming, ozone layer thinning, and land degradation. As a result, buyers are now more concerned about eco-friendly items and

the restoration of the natural equilibrium. Businesses are starting to change their own attitudes and practices to address the concerns of customers who are growing more aware of the benefits of natural products. The production does not hinder the environment, and resources are consumed in a reasonable amount. A package that respects the 3R concept. The price of green products is high, and the problem is whether consumers are ready to pay this. Therefore, price companies need to work to find the right price. Promotion where green label is used. Pantić, Đuričin, 2015, Consumers are constantly changing their lifestyles in order to support the health of the ecosystem. This explains why phrases like recycled packaging, eco-friendly products, and green marketing are so well-liked in the marketplace. From the standpoint of consumers to that of organizations, there are many justifications for utilizing green marketing. With the help of green marketing, consumers can access products that are both environmentally friendly and beneficial to their health, two things that they are becoming more and more concerned about. Bright and Ferrell, 1993 Environmental marketing or sustainable marketing is composed of all the efforts that an organization takes while designing, manufacturing, selling and promoting in eco-friendly way.

RESEARCH METHODOLOGY

It is a descriptive study that explains the green marketing potential and role. To conduct this study the data is collected from secondary sources. Many literatures are reviewed. The secondary data were collected through newspapers, magazines, books, journals, conference proceedings, Government reports and websites.

SCOPE OF THE STUDY

The study is put light on the field of marketing and solely addresses the applicability of the green marketing concept in the relation to Indian market. Comparable research can be done in a global setting or outside of India.

AIM OF GREEN MARKETING:

The goal of green marketing is to satisfy the demands of environmentally conscious customers. It requires commercial and economic circumstances that support its growth in order to be properly implemented. To a great degree, this idea is also associated with socially conscious company, where environmental preservation and profit are prioritised equally. Accordingly, businesses that use green marketing do this in two ways: internally, by investing in personnel and technology capable of creating a green marketing mix, and externally, by attempting to positively impact the local community. The following are the fundamental components of the green marketing mix: environmentally friendly products whose manufacture doesn't impact the environment. Businesses ought to set pricing that satisfy both requirements. Businesses that use the green marketing idea should show that while it can increase their profitability, this is not their exclusive objective. Modifications to industrial procedures result in the implementation of energy-saving strategies and the prevention of environmental pollution. The 3R approach is applied to packaging in green marketing since recyclable materials are employed. It is essential to develop messaging that encourages consumers to adopt green products when marketing, and especially when advertising. An intriguing task resides in the fact that claims endorsing the usage of green products are hard to support.

GREEN MARKETING

Polonsky (1994) defines green marketing as all activities designed to generate and facilitate any exchanges intended to satisfy human needs or wants, such that the satisfaction of these needs and wants occurs, with minimal detrimental impact on the neural environment.

One element of a larger movement towards environmentally and socially responsible business practices is green marketing. Customers now expect businesses to show that they are dedicated to enhancing their operations while also meeting different environmental, social, and governmental (ESG) standards. For this reason, a lot of businesses will continue to share their social impact statements, which provide regular updates on how they are doing in terms of achieving these goals.

SUSTAINABLE DEVELOPMENT

Definition given by World Commission on Environment and Development (1987) – "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

LITERATURE REVIEW

Mishal et al., 2017: Furthermore, being aware of the environment has a significant impact on the attention given to buying green products; having a positive attitude towards green purchases significantly affects behavior towards environmental issues; having intentions to purchase green products significantly affects how effective consumers perceive themselves in making a difference; and engaging in green actions significantly influences buying green products.

Nur et al., 2021: Green promotion Promoting green products effectively enhances consumers' understanding of the environment and eco-friendly products, enabling them to make informed decisions when buying goods and considering their impact on the environment. As a result, environmental marketing can boost consumer interest in purchasing green products.

Govender and Govender, 2016: If implemented, these marketing tactics will draw in consumers and definitely influence their choice to make environmentally-friendly purchases. Entrepreneurs are striving to create environmentally sustainable products in response to the increasing environmental awareness of online consumers (Chang and Zhang, 2019; Chen, 2001; Pujari et al., 2003). The online consumer choice for every product category is increased with the introduction of green products (Olbrich and Jansen, 2014). Consumers have the option to select either branded, pricier items or eco-friendly products that offer great value for money. The consumer is more inclined to select the product that best meets their needs.

Kassarjian (1971): In his study, the author examined how consumers responded to a gasoline that decreased air pollution and concluded that consumers' views on air pollution were crucial in influencing their purchasing choices for environmentally friendly products. Therefore, his research found that environmental issues are seen as a crucial factor in making buying choices.

Balderjahn (1988): During his research in Germany, he discovered that consumers in the country have a favorable view of eco-friendly products, leading to a more environmentally conscious lifestyle. It also encouraged customers to openly express their environmental worries by taking action and signing the petition to oppose pollution groups and back and join these organizations.

Polanski et al., 1998; Protiero, 1996: Due to the increased environmental consciousness of modern consumers, businesses are adopting green practices.

Rathod, 2014: Examines the opportunities and challenges businesses have with green marketing, as well as the three specific segments of green consumers.

Jaya, 2014: This research paper focuses primarily on the notion, necessity, and significance of green marketing. It examines the key problems with implementing green marketing strategies. The paper addresses the difficulties associated with green marketing and outlines the current state of the Indian market.

Vandhana and Ravi (2013): The study examines the manufacturers' awareness of eco-labeling and green products, as well as the challenges associated with putting green marketing into practice.

Aditya Maheshwari et al. (2011): There is consensus among experts that because online campaigns can target audiences more precisely and require less natural resource consumption, they are not harmful to the environment as the traditional media campaigns.

Jain and Kaur (2004): Researchers discovered that Indian consumers who responded to surveys expressed a strong sense of environment and involvement. Green Marketing: Challenges and Strategies for Indian Companies in the 21st Century is a book they seem willing to read.

Shrinath, Nath (2012): The paper examines the true meaning of green marketing and the manner a company can become more competitive by employing green marketing techniques to outperform rivals.

Sanjay K. Jain & Gurmeet Kaur (2004): Environmentalism has quickly become a global phenomenon, according to this study. Enterprises have also increase to the challenge and begun implementing green marketing strategies in response to environmental issues. In this paper, degree of environmental awareness, and behaviors common among Indian consumers are evaluated based on data gathered from a field survey.

Goulgouti et al., 2019: A person's environmental literacy can also affect their environmental behavior.

Geng et al., 2015: Researcher found that individual's environmental perspective is impacted by their connection with nature

Kim and Choi (2005): The author also discovered a clear correlation between green purchasing practices and environmental concerns. Individuals exhibited a greater inclination towards things that pose minimal or no environmental impact.

Elham Rahbar (et al., 2011): Their proposal is to ascertain how green marketing techniques affect Penang (Malaysia) consumers' purchasing decisions. 250 respondents, representing the Chinese, Malay, Indian, and other racial groups in Penang, participated in the poll.

STATEMENT OF THE PROBLEM

As India is one of the biggest consumer markets and has great potential for green products, knowledge of predictors of green purchasing may help in development of appropriate marketing strategies to address consumers' attitude-behaviour gap thereby increasing the purchase of green products. Chennai is one of the important city in Tamil Nadu and home to people from diverse backgrounds and cultures. This makes a good starting point towards developing a sustainable market in India.

BENEFITS OF GREEN MARKETING

Numerous factors need to be considered when it comes to green marketing, including energy efficiency, the use of clean and renewable energy, water conservation, recycling, waste management, organic produce, sustainable agriculture, and more. Green marketing has several advantages, such as emphasizing environmental friendly products, composting and recycling at work, and using sustainable manufacturing techniques. A company's reputation and brand image can be enhanced by implementing green marketing strategies. It shows a dedication towards environmental which appeals to customers who care about the environment. Increased client loyalty, trust, and favorable word-of-mouth may result from this. A competitive advantage in the market can be obtained through green marketing. Businesses that promote eco-friendly procedures and goods can set themselves apart from rivals as consumers' concerns about sustainability grow. Customers who care about the environment may be drawn in, and a bigger market share may result. Green marketing has the potential to increase client retention and loyalty. Customers who place a high priority on sustainability are more likely to stick with companies that share their values. Businesses can build stronger relationships with their clients and encourage repeat business by showcasing their dedication to the environment. Businesses can frequently save money by implementing sustainable practices. Operational costs can be decreased, for instance, by introducing energy-efficient procedures or by using recycled materials or renewable energy sources. Green marketing can draw attention to these cost-cutting strategies, attracting customers who are both budget conscious and environmentally sensitive.

THE CHALLENGES THAT BUSINESSES ARE FACING

Indian consumers are becoming more conscious of the benefits of utilizing eco-friendly items. For the majority of Indians, however, it is still new. Customers must be informed about environmental hazards and the ways that green marketing initiatives may protect the environment. Every activity that a business plans under green marketing needs to be focused on the needs of the customer. The ultimate goal of green marketing should be to show the customer why they should purchase the product. Motivate them by doing this and moving them away from other brands. This will undoubtedly occur, but for that to occur, the consumer must weigh the advantages of choosing our option against the costs. Investors and corporations alike must see this project as a long-term investment that will eventually yield a profit, but it will take time. Lack of Standardization: Research shows that while some marketing campaigns are merely socially conscious, very few are truly green. As a result, the authentication of these claims is not standardized. Such labeling and incensing require the implementation of a standard quality control. Customers want to identify with green products because businesses want to go green, but there have been a lot of misunderstandings about the legitimacy of green products. Therefore, in order to maintain consumer trust, green product marketers must be open and honest without breaking any laws or industry standards for goods and business operations.

- Businesses need to make sure that their green initiatives don't conflict with the needs of their customers or the industry in which they work.
- Standards to support claims made in green marketing campaigns are lacking.
- Green marketing needs to concentrate on the advantages for consumers, and environmental protection needs to be seen as a long-term investment.

- Increased budget
- Convincing customers
- Cost factor
- Long gestation period

Companies adopted the Green marketing practices: Businesses that preserve biodiversity, create environmentally friendly products, conserve energy, water, and other natural resources, protect the climate, maintain parks, roads, and schools, help the underprivileged and rural areas. Although consumers are well aware of green products, it can be challenging to integrate green marketing strategies into corporate operations. Customers' purchase decisions were impacted by a lack of knowledge about green marketing issues. It was also discovered that one of the factors influencing the decision to buy green products is their price. Nonetheless, it was discovered that green issues have a greater chance of influencing young consumers. Lack of green knowledge and, as a result, organizations continue to neglect the popularity of green products. Since green marketing promotes green goods and services and green technology is expensive, it may initially prove to be an expensive endeavor. To raise awareness of green products and their applications, significant investment is needed in marketing campaigns. The company's sales may suffer if many consumers are unwilling to pay more for environmentally friendly products. Businesses must use a variety of integrated marketing communication tools to thoroughly inform their clientele about the existence and advantages of green marketing. The absence of public consensus and standards regarding green marketing is another issue that green marketers must deal with. Green marketing is still becoming more and more popular in spite of these obstacles, especially as concern over climate change grows on a global scale. Businesses are stepping up to demonstrate their pledges to lessen the negative climate effects of their goods and services.

- HCL
- Haier
- Tata Consultancy Services
- ITC
- ONGC
- LG
- SAMSUNG
- Kansai Nerolak: Lead less paints
- Suzlon Energy
- WIPRO

CONCLUSIONS

Marketing staff must make efficient use of resources in order to fulfill the company's mission, as natural resources are limited and human needs are boundless. Rather than being an option, adopting green marketing should be required of suppliers, industrial buyers, and consumers alike. In India, green marketing is becoming more and more popular, but the government still needs to do more to support it. Sustainable development will be established and environmental preservation will be aided by green practices and products. Customers perception has also changed and they are preferring products of companies adopting the green marketing practices. Green marketing is as potential to contribute for sustainable development.

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Impact of Social and Live Marketing on Purchasing Behaviour of Customer

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Abstract

Over the past century, unthinkable transformations have occurred in the marketing industry. In an old-fashioned economy, market was limited to a physical location including several time, space, and utility restrictions. In recent years, social media has emerged as a dominant force in shaping consumer behaviour, particularly in the realm of online purchasing decisions. With billions of active users across various platforms, social media not only facilitates communication and connection but also serves as a vital tool for businesses to engage with their audiences. As consumers increasingly turn to digital channels for product research and recommendations, the influence of social media on purchasing behaviour has become a critical area of study. Keeping in this view, this research aims to explore how social media marketing affects the purchasing decision of customers.

Keywords: *Social Media Marketing, Consumer Behaviour, Social Media*

INTRODUCTION

Social media marketing is an online marketing strategy that makes use of several social media networks to accomplish marketing objectives.When a firm uses social media to run its operations, customers become more engaged and interested in buying the product.A welldesigned product can draw customers' attention to the content that is displayed (Mason et al., 2021). Businesses and customers are collaborating to develop new products, services, business models, and values. In the meantime, brands can gain exposure and strengthen customer relationships. Businesses and customers are communicating with each other regardless of time, place, or medium, transforming traditional one-way communication into interactive two-way direct communication. The two-way communication strategy known as social media marketing activities (SMMA) tries to reinforce the traditional feelings associated with luxury goods to a wider age group while simultaneously evoking empathy from younger users. Additionally, by fostering an online forum for individuals to share thoughts and information, brand social media activities offer a chance to lessen misconceptions and prejudices about businesses and to increase brand value (A.J. Kim & Ko, 2012). The practice of presenting live content to an audience via social media platforms is known as live stream marketing.These days, it's a standard technique for giving internet shoppers a virtual purchasing experience. Nevertheless, influencers and creators of video content still use this kind of streaming the most to communicate with their fans directly. For instance, because of video game streaming websites like Twitch, influencers in the online gaming community have long attracted sizable following. Live streaming has grown in popularity as a direct selling tool recently, offering tiny, independent sellers never-before-seen levels of customer interaction and engagement. The seller's perspective has not received much attention in the literature, despite

the majority of studies to date concentrating on consumer motivation and intent to shop via live streaming. While live streaming commerce offers potential advantages to all users, different sellers experience different levels of success from this platform.

DIFFERENT TYPE OF SOCIAL MEDIA MARKETING PLATFORMS

- **Facebook Live:** Facebook Live is a widely used tool for live broadcasting on the social media platform. It records and distributes videos in real time and serves as a medium for instantaneous audience-broadcaster connection, allowing viewers to voice their opinions in real time. In recent years, live streaming has become more and more popular. It is now a widely used marketing strategy tool for many firms and organizations in various industries, not just a fad that comes and goes (Kang et al., 2021). Companies may now show consumers their product or service in real time rather than having to explain it to them. The majority of well-known social media sites, including Facebook, YouTube, Periscope, and Instagram, have greatly increased the popularity of live streaming and made it even simpler to start one. According to Liu et al. (2020), these platforms have made it possible for businesses and organizations to engage more deeply and dynamically with their audiences.
- **Youtube Streaming:** A YouTube stream is a live video broadcast that occurs on the platform in real time or almost real time. With live streaming, viewers may watch stuff as it happens, unlike with pre-recorded videos.You can watch live videos on YouTube Live rather than ones that have already been recorded. YouTube Live is the live streaming division of YouTube. All verified YouTube channels can now access live streaming for free. Live streaming was initially made available on YouTube in 2011 to a small number of partners. YouTube doesn't focus on any one genre, in contrast to Twitch and gaming. Live broadcasts are available in many different formats and on a wide range of subjects. Examples of live broadcasts include news coverage, comedy routines, cooking classes, webinars, live vlogs, live concerts, and more.
- **Instagram Marketing:** This type of social media marketing involves companies leveraging the Instagram platform to advertise their brands. Instagram marketing can employ a wide range of strategies and tactics to help businesses accomplish a wide range of goals. Traditional commercial aims could include selling your products or services, gaining more followers and engagement, forming alliances with other companies and potential clients, and overall enhancing your company's credibility.
- **Pin Interest Marketing:** Like Instagram, Pinterest is a social networking platform where users may share images, but it differs in that each Pin has the ability to link back to your website or other material. Instagram does not help if you are trying to drive visitors to your website, product pages, or blog because it only permits links in adverts and the biography section. Pinterest is used as a method to increase brand exposure for businesses through Pinterest marketing. Pinterest marketing applies not only to bloggers but to any business looking to grow their following through visual media. Pinterest helps increase the overall visibility of a brand or business and drives organic traffic back to a website.
- **Snapchat:** With this instantaneous photo, video, and text messaging tool, you can communicate with people one-on-one or in groups. Among its many features are Memories, which are saved images for later viewing and sharing, Stories, which are images or videos that may be played back for a full day, and filters and stickers, which are used to add flair to messages.

LITERATURE REVIEW

Urban (2005): The rise of new ICTs (information and communication technologies), especially social networks and the Internet, has altered the competitive landscape of the market, putting businesses at risk and giving consumers more clout. (Thomas, 2007)These changes pose new problems and tough decisions for marketers, which has an impact on their operations and marketing practices in terms of strategy and tactics.

Albors, Ramos, & Hervas (2008): Online social media and the Internet have altered consumer consumption patterns by giving them new avenues for searching for, evaluating, selecting, and purchasing goods and services.

Mangold and Faulds (2009) assert that social media facilitates communication between businesses and their clientele as well as between consumers.

Kaplan & Haenlein (2010): In accordance with Web 2.0 principles, we define social media as all Internet-based technological applications that enable user-generated content creation and exchange, as well as collaboration and interaction between users.

Chan & Guillet (2011), Mangold & Faulds (2009): In addition, these applications include content communities (like YouTube, Flickr), blogs and microblogs (like Twitter), social networking sites (like My Space and Facebook), virtual worlds (like Second Life), collaborative projects (like Wikipedia), and websites for feedback like online forums.

Jackson (2011), Kaplan & Haenlein (2010): Beyond conventional approaches, which allow for the advertising of goods and services as well as the creation of online communities for brand devotees, communications between businesses and their customers can foster brand loyalty.

Constantinides et al. (2010): This is not only because consumers are becoming more interested in using the Internet, but also because they view information shared on social media as more trustworthy than information released by businesses directly.

Gunelius (2011): Additionally, consumer conversations give businesses additional ways to raise brand awareness, familiarity, and recall.

Scholars like **Castronovo and Huang (2012)** assert that marketing strategies that encompass marketing intelligence, promotions, public relations, product and customer management, and marketing communications ought to investigate and harness social media.

eMarketer (2013): In addition to numerous studies that demonstrate the benefits of integrating social media into marketing strategies, eMarketer reports that businesses have increasingly embraced social media for a variety of marketing activities, including branding, market research, customer relationship management, service delivery, and sales promotion.

Okazaki and Taylor (2013): From the standpoint of national governing bodies, for example, social media could strategically improve a two-way dialogue between businesses and consumers, thereby strengthening the bond between consumers and the brands of the organizations. This would be in addition to social media's capacity to display content verbally, visually, or by combining text, visual, and verbal elements .

Bennett (2013) in order to interact with and assist their clients, the majority of commercial companies globally (about 93%) have embraced and used these cutting-edge platforms and tools.

Zeng and Gerritsen (2014): In many scenarios, businesses have been anticipating the use of social media in many facets of their consumer interactions, including marketing, engagement, and the ease with which customers may search for information and make purchases.

Filo et al. (2015), Saxena and Khanna (2013): Most people now realize that social media is a useful tool for advancing businesses' marketing objectives and strategies, particularly when it comes to consumer involvement, customer relationship management, and communication.

Nevertheless, despite the existence of numerous studies that offer empirical proof of the advantages to businesses (see, for example, Alhabash, McAlister, Quilliam, Richards, & Lou, 2015; Kozinets, Valck, Wojnicki, & Wilner, 2010; Kumar & Mirchandidani, 2012; Kumar et al., 2013; Luo & Zhang, 2013; Yu, Duan, & Cao, 2013) and that describe how social media marketing strategies can be enhanced and utilized (see, for example, Guo, Pathak, & Cheng, 2015; Liu & Park, 2015; Lorenzo-Romero, Alarcon-Del-Amo, & Constantinides, 2012; Qazi, Raj, Tahir, Cambria, & Syed, 2014; Tang et al., 2015).

Individuals view social media apps as an integral part of their everyday lives and are more inclined to shift their interactions to online platforms (Facebook, Instagram, LinkedIn, and Twitter). This, in turn, has a favorable impact on how they behave and how they approach social media in general, according to reports from Alalwan et al., 2016a, Dwivedi et al., 2015, Rathore et al., 2016, Taylor et al., 2011, Zhu and Chen, 2015.

Thus, it has been noted that social media applications are among the most effective and influential changes that people have made to their lives in the social, commercial, business, educational, and political spheres (Alalwan et al., 2016a, Algharabat et al., 2017, Abed et al., 2015, Hawkins and Vel, 2013, Hinz et al., 2011, Rathore et al., 2016, Usher et al., 2014, Zeng and Gerritsen, 2014, Zhu and Chen, 2015).

OBJECTIVES OF THE STUDY

1. To study the conceptual background of social media marketing
2. To evaluate how social media marketing influences the purchasing habits of customers.

FINDINGS OF THE STUDY

This section of the study covers the findings of the above mentioned objectives:

Objective 1: To study the conceptual background of social media marketing.

Although social networking has been increasingly popular recently, its roots are in the early days of computers. The current state of social media is the result of centuries of expansion. Usernets, the original social media platform, was originally introduced in 1979. It took a long time for Usernets to merge with Facebook. Newsgroup posting was another feature of user networks for users. Users were able to log in and converse through bulletin board systems (BBS) that came after. Online services like Prodigy were the forerunners of BBS. Instant messaging replaced online applications before internet relay chat became popular.

Social media marketing has evolved significantly since the advent of platforms like Facebook, Twitter, and Instagram in the early 2000s. Initially, social media was primarily a space for personal interaction and communication. However, as these platforms grew in popularity, businesses began to recognize their potential as powerful marketing tools.

The transition to social media marketing can be traced back to the realization that consumers were increasingly turning to online channels for product discovery and decision-making. By the mid-2010s, brands started to leverage social media not just for promotional purposes but as a

means to build relationships with their customers. This marked a shift from traditional advertising methods to a more interactive, engagement-focused approach.

Key developments in social media marketing include the rise of user-generated content, where consumers share their experiences and opinions about products and services. This phenomenon has significantly influenced consumer trust and purchasing behavior, as potential buyers often seek authentic reviews from their peers rather than relying solely on brand messaging.

Influencer marketing emerged as another critical facet of social media marketing, with individuals who have large followings becoming key partners for brands. Influencers often provide a sense of authenticity and relatability, making their endorsements particularly effective in driving consumer decisions.

As analytics and targeting capabilities improved, businesses began to harness data to refine their marketing strategies, allowing for more personalized and relevant messaging. Paid advertising on social media platforms has also become a standard practice, enabling brands to reach specific demographics and enhance their visibility in a crowded digital marketplace.

Today, social media marketing is an essential component of most marketing strategies, blending creativity with data-driven insights. As the landscape continues to evolve with emerging platforms and technologies, businesses must adapt their strategies to effectively engage consumers and influence their purchasing decisions in an increasingly competitive environment.

Importance of Social Media Marketing

1. **Broad Reach Among the Intended Audience:** One of the main benefits of social media marketing is that it provides quick and widespread access to target audiences. Finding the ideal communities on social networking sites and posting pertinent information requires some searching, though.
2. **Thorough Marketing:** Choosing SMM services provides marketers with a wide range of marketing services, many of which are also SEO-related. The business is advertised on social media platforms, photo and video sharing websites, and so on. By doing this, the company's exposure and coverage are enhanced.
3. **Higher Rankings in Search Engines:** Marketing professionals notice that your website's search engine rank is continuously rising as a result of SMM businesses' effective use of SMM and other link-building techniques, which also enhance traffic to your site. Among the various benefits of higher ranking are improved visibility, a higher page rating, and an increase in one-way links.
4. **Swift Turnaround Time:** Reaching out to potential clients through social media platforms seems to result in a quicker turnaround time for marketers. This suggests that marketers will see results far faster than they would with conventional marketing strategies. The website keeps gaining traction on the internet even though results are not seen right away in terms of increased visibility.
5. **Effective Business-to-Business Advertising:** When done right, social media marketing may be a great way to provide quality leads for business-to-business campaigns. First of all, social media may be used efficiently for brand awareness and identity construction. Direct engagement with other businesses via social media has shown to be one of the most effective strategies to build commercial ties.

Objective 2: To evaluate how social media marketing influences the purchasing habits of customers.

Social media marketing has become a pivotal element in shaping the purchasing habits of consumers. This evaluation explores the various ways in which social media strategies impact consumer behavior, emphasizing the mechanisms through which brands connect with their audiences and drive purchasing decisions.

Product Exploration

Social media serves as a vast online marketplace where consumers find new goods and services by reading through posts, reviews, and suggestions from their friends. Product discovery is facilitated by the platform's large diversity of offers, which can be accessed with ease.

Engagement Strategies: You can make the most of this by producing interesting material that highlights the goods and services offered by your company. By encouraging customers to share their stories, this strategy turns them into brand ambassadors.

These brand ambassadors will not only promote your company but also speak up for you by telling their own social circles about how great their experiences were, which will increase the brand's visibility and legitimacy.

Influencers

Influencer marketing has the power to change the decisions and actions of customers. Purchase decisions can be significantly influenced by the endorsements and real reviews of influencers on social media. When an influencer recommends a product, their audience frequently pays attention.

Engagement strategies: To promote your products, work with influencers in your niche. For this, you can give influencers with items or services in exchange for honest reviews or endorsements.

By utilizing the influencer's loyal and active following, your brand will be able to reach a wider audience and establish credibility in their target market.

Social Evidence

Customers use likes, shares, and comments on social media platforms to determine the popularity and legitimacy of a product or service. This phenomenon is known as social proof. Purchase decisions can be strongly influenced by positive social proof.

Engagement tactics: You can invite clients to rate products across various channels, share their experiences, and write reviews. Due to the fact that consumers frequently base their purchasing decisions on the advice and opinions of their peers, these positive social proofs may have an impact on consumer patterns and choices.

Additionally, businesses can develop enduring ties with their clientele that transcend individual transactions by aggressively interacting with consumer feedback.

Feedback and Reviews

Customers use social media to discuss their encounters with goods and services. These frank evaluations and comments are helpful resources that impact the decisions of prospective customers.

Engagement tactics: You can interact with clients directly by answering their questions and grievances on social media and replying to both favourable and unfavourable remarks on your posts. This demonstrates how your company respects consumer feedback and is dedicated to making improvements.

In addition to addressing urgent issues, this proactive strategy exhibits transparency and a customer-centric mindset. It further enhances the reputation of your brand by creating a favourable impression in the eyes of current and future clients.

FOMO (Fear of Missing Out)

Social media is where FOMO thrives. A sense of urgency can be sparked by scrolling through social media posts of friends enjoying new goods or events, leading to hasty purchases by customers.

Engagement strategies: You may take advantage of FOMO by producing content—such as flash sales, limited-time offers, or special discounts for social media followers—that makes visitors feel as though they have a limited amount of time.

To increase FOMO and encourage quick action from your audience as well as build excitement and anticipation around your brands and products, you can deliberately employ persuasive language and eye-catching imagery.

CONCLUSION

India is not a surveillance state; everyone has the fundamental right to privacy and the freedom of speech and expression, and these rights cannot be restricted in any way that is against the law or the constitution. There needs to be a balance because the Constitutions themselves place restrictions on the freedom of speech and expression. Large technological companies that control social media platforms have the power to sway information and undermine democracy. Everyone, even them, needs to be held accountable for their actions that have a significant impact on society. Social media now holds a central place in marketing and communication campaigns. When it comes to managing the presence of fan pages and brands on Facebook, it is crucial for businesses to create high-quality content and to accurately understand the behavioural dynamics of users on the social network in order to achieve greater user engagement. This is because the younger generation of customers is very brand aware, they use the internet to operate in foreign markets, and their opinions can have a significant impact on people in various parts of the world. In order to create successful promotional efforts that cater to the demands of their followers, they must understand the drives required to guarantee an effective result. Content posted on Facebook fan pages for brands might vary in terms of its effects on various consumers as well as its qualities. By increasing brand loyalty and closing the communication gap between the business and its clients, social media marketing's benefits are self-evident. Ingenious marketing leverage, it helps the business attract an increasing number of customers. Not a lot of money for social media marketing is required, making it another cost-effective strategy.

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Effects of Consumer Ethics on Eco-Friendly Buying: A Sustainable Approach from the Perspective of Consumers

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Abstract

As the global economy continues to grow, so do the environmental concerns around the world. The need to reduce carbon emissions, conserve natural resources and ecosystems and adopt sustainable practices has become crucial today. One of the most essential ways to help achieve this is by promoting consumer eco-ethical behaviour. Consumer choices and habits have a significant impact on the environment, and by making conscious choices in consumption behaviour, consumers can create a positive impact on the environment. This abstract aims to provide an overview of the effects of consumer eco-ethical behaviour on the environment and the need to promote this behavior for the greater good.

Keyword: *Eco-friendly, Ethics, Consumers' Behaviour, Sustainability*

INTRODUCTION

As concern for the environment grows, so does the awareness about the impact of consumer choices on the planet. This has led to a shift in the way people think about buying eco-friendly products. Consumer ethics, or the moral principles (Malhotra, 2024) that guide a person's buying decisions, play a significant role in the adoption of eco-friendly buying habits. This paper will explore the various factors that influence consumer ethics and its impact on eco-friendly buying habits. Through a detailed analysis, it will be shown how consumer ethics can be a powerful tool in promoting sustainable practices and reducing the environmental impact of consumerism. (Chan, 2024; Arli et al., 2021) The Role of Consumer Ethics in Eco-Friendly Buying Consumer ethics can be defined as the moral principles that guide a person's buying decisions. These principles generally include considerations for the (Shin, 2024) environment, fair labor practices and fair trade. These principles are derived from social and cultural norms, which are influenced by societal factors such as education, socio-economic status, and religious beliefs. According to a study conducted by Wu and Wu in 2016, it was found that consumer ethics have a significant impact on the decision-making process of eco (Malhotra, 2024) friendly buying. The study also revealed that consumers with high levels of consumer ethics were more likely to make eco-friendly purchases. The effects of consumer ethics on eco-friendly buying can be analyzed on various dimensions. undefined On one hand, consumer ethics can lead to positive outcomes, such as increased sales of eco-friendly products and improved environmental sustainability. Consumers who are guided (Malhotra, 2024) by strong moral values and a sense of social responsibility are more likely to prioritize environmental concerns and make eco-friendly choices. For instance, consumers

with high levels of consumer ethics are more likely to purchase energy-efficient appliances, green cleaning products, or eco-friendly personal care items (Isharyadi et al., 2022; Ivander & Reynaldi, 2022; Sintowoko & Hidayat, 2021). This behavior, in turn, encourages businesses to invest in environmentally sustainable practices and products in order to meet consumer (Sharma & Babel, 2001) demand. undefined Thus, the impact of consumer ethics on eco-friendly buying is unmistakable; as more consumers prioritize environmental sustainability undefined, more companies will be compelled to shift their business models and supply eco-friendly products. Furthermore, by promoting positive consumer behaviors undefined, steps towards alleviating societal problems can be made. Generating awareness about the environmental impact of (Esvandiari, 2023) consumer choices will ultimately lead to a better future for all. This is why it is crucial for individuals to take responsibility for their purchasing decisions and make conscious choices that promote environmental sustainability.

REVIEW OF LITERATURE

The escalation of environmental issues and the urgent call for sustainable practices have catalysed interest in understanding consumer behavior towards eco-friendly products. The nexus between consumer ethics and environmentally conscious buying behaviors has emerged as a crucial area of research. This literature review synthesizes findings from various studies to illuminate how consumer ethics influence eco-friendly buying decisions, while also identifying gaps in the existing body of knowledge and proposing directions for future research.

Consumer Barriers to Eco-Friendly Buying

Connell (2010) identified that consumers face both internal and external barriers that hinder consistent eco-conscious apparel acquisition. Internal barriers include lack of knowledge, motivation, and conflicting personal values, while external barriers encompass limited availability and higher costs of sustainable products. McNeill and Moore (2015) further elaborate on this by discussing the "fast fashion conundrum," where fashionable consumers often prioritize style over sustainability, revealing a conflict between ethical intentions and purchasing behaviors. Such barriers not only impede eco-friendly purchases but also highlight the complexity of consumer decision-making processes regarding sustainability (Gao et al., 2022).

Factors Influencing Eco-Friendly Purchasing Behavior

Several studies have identified key factors that influence green purchasing behavior. Woo and Kim (2019) demonstrated that positive green purchase intentions significantly lead to actual purchasing behaviors, suggesting that consumer attitudes are pivotal in the decision-making process. Hameed et al. (2019) found that consumers are more likely to purchase ethical products when they perceive a direct impact on health, personal relevance, and product quality. These insights underscore the importance of consumer attitudes and perceptions in driving eco-friendly purchases.

Moreover, Burke et al. (2014) segmented consumers' motivations for both ethical and unethical consumption, revealing that environmental attitudes, particularly among young consumers, significantly affect their purchasing behaviors. This aligns with findings from Dagher et al. (2015), who noted that intention to buy second-hand products is positively correlated with environmental concern, further emphasizing the role of consumer ethics in shaping buying intentions.

Demographic Influences on Eco-Friendly Buying

Gender has been shown to significantly moderate the relationship between environmental concern and green purchasing behaviors. Harms and Linton (2016) highlighted that gender differences impact both environmental attitudes and willingness to pay for eco-certified products. This finding suggests that demographic factors play a critical role in understanding consumer behavior towards eco-friendly products, and future research should delve deeper into how various demographics influence ethical consumption patterns.

The Role of Corporate Responsibility

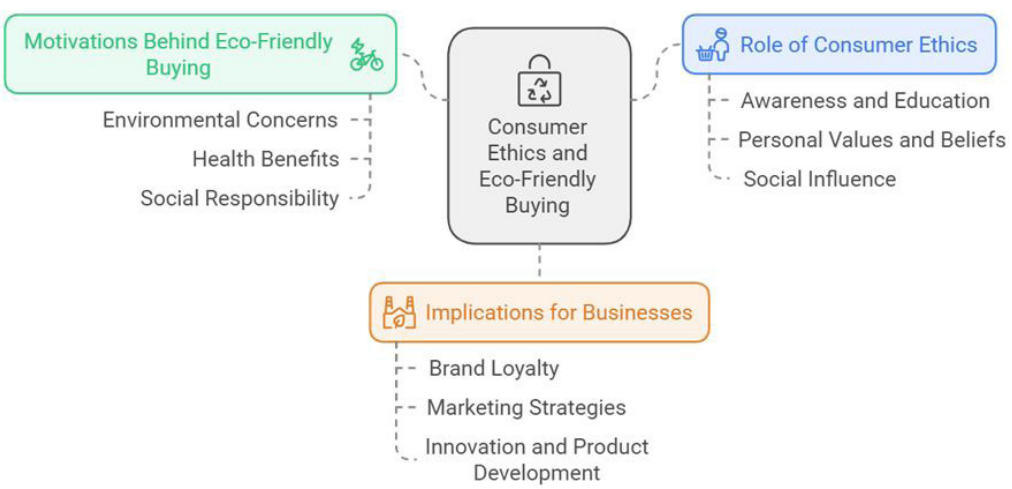
The relationship between corporate social responsibility (CSR) and consumer attitudes has been well-documented. Kamalanon et al. (2022) found a positive correlation between socially responsible initiatives by companies and consumer attitudes towards their products. This indicates that consumers are more inclined to purchase from brands that demonstrate ethical practices, reinforcing the connection between consumer ethics and eco-friendly buying behaviors. Boccia et al. (2018) further corroborated this by stating that the slow fashion movement fosters a closer connection between suppliers and consumers, promoting sustainability and corporate responsibility.

Impact of Generational Awareness

The literature reveals a growing awareness among younger generations regarding ethical and environmental issues. Both Esposti et al. (2021) and Kuokkanen & Sun (2019) noted that Generation Z is particularly driven by ethical considerations in their consumption choices. This generational shift suggests that as awareness increases, so too does the potential for eco-friendly purchasing behaviors, paving the way for future research to explore how these trends evolve over time.

Environmental Consciousness and Consumer Behavior

Lee (2011) highlights the strong relationship between environmental consciousness and consumer willingness to pay for eco-friendly apparel among college students. The study identifies two significant dimensions of environmental consciousness—attitude and behavior—that predict



students' readiness to pay a premium for green products. This finding underscores the critical role of consumer values in shaping purchasing decisions and suggests that retailers can enhance their offerings by aligning with the environmental values of their target demographic. Conversely, Frostling-Henningsson et al. (2014) present a nuanced view of consumer intentions versus actions, revealing a conflict among Swedish consumers who express a desire to purchase organic products but often fail to follow through. This gap between intention and practice suggests that while awareness may be high, practical barriers and decision-making conflicts can hinder eco-friendly purchasing behaviors.

Marketing Practices and Greenwashing

Aggarwal and Kadyan (2011) delve into the darker side of corporate social responsibility (CSR) through the lens of greenwashing, where companies may mislead consumers about their environmental practices. This phenomenon can significantly undermine consumer trust and the effectiveness of genuine green marketing efforts. Hussain et al. (2020) further emphasize the role of green advertisements in moderating the influence of environmental concerns and self-image on purchasing behavior, suggesting that effective marketing can enhance consumer engagement with eco-friendly products. However, the effectiveness of these marketing strategies is contingent upon consumer education regarding greenwashing and transparent practices (Ingram et al., 2015). Without such awareness, consumers may struggle to differentiate between genuine and misleading claims, which can affect their purchasing decisions adversely.

Sustainable Practices and Consumer Preferences

Research has also highlighted the growing consumer demand for sustainable practices across various sectors. Sujanska and Nadanyiova (2023) discuss how sustainability has become a significant aspect of a company's image, with consumers increasingly preferring businesses that operate sustainably. Similarly, Verma and Bharti (2023) indicate a rising preference for environmentally friendly production methods in the nursery crop industry, suggesting that consumers are not only willing to choose sustainable products but actively seek them out.This trend extends to food consumption, where Stranieri et al. (2022) investigate Italian consumers' intentions to purchase environmentally friendly beef. Their findings underscore the importance of institutional trust and credible information in shaping sustainable food consumption behaviors.

Barriers to Eco-Friendly Purchasing

Despite the increasing awareness and demand for eco-friendly products, several barriers persist that hinder consumer engagement. Bharwani and Mathews (2023) identify challenges such as high prices and perceived poor quality of eco-friendly products in the Indian market, which dampen the frequency of eco-shopping despite high environmental awareness. Moreover, Niu et al. (2023) report that Malaysian consumers exhibit a medium level of intention toward purchasing green products, with price and availability being significant influencing factors. These findings suggest that while consumers may express a desire to buy eco-friendly products, practical barriers such as cost and accessibility remain significant hurdles.

KNOWLEDGE GAPS AND FUTURE RESEARCH DIRECTIONS

Despite the growing body of literature, significant knowledge gaps remain. For instance, while many studies emphasize the role of knowledge and awareness in fostering eco-friendly buying

behavior, fewer have explored the effectiveness of specific educational interventions designed to enhance consumer ethics. Additionally, while demographic factors are acknowledged, there is a lack of comprehensive studies that examine how these factors interact with consumer ethics across diverse cultural contexts. Future research could benefit from longitudinal studies that track changes in consumer behavior in response to targeted educational campaigns about ethical consumption. Furthermore, investigating the role of digital marketing and social media in shaping consumer ethics and eco-friendly purchasing behaviors could provide valuable insights into contemporary consumer practices.

CONCLUSION

In conclusion, the literature suggests that consumer ethics play a pivotal role in influencing eco-friendly buying behavior. Various factors, including environmental knowledge, socio-demographic influences, and individual personality traits, contribute to shaping these ethical considerations. However, significant gaps remain in understanding the effectiveness of educational interventions and the interplay of cultural differences. Addressing these gaps through future research could enhance our understanding of sustainable consumption and inform strategies to promote eco-friendly purchasing practices among diverse consumer groups.

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Global Trends and Collaborations in Influencer Marketing Research: A Bibliometric Analysis from 2011 to 2024

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Abstract

This study presents a comprehensive bibliometric analysis of influencer marketing research from 2011 to 2024, examining its growth, collaborative nature, and global influence. With an annual growth rate of 28.67% and a peak of 104 publications in 2023, the field has grown quickly. While there was a decline in the average count of citations per paper after 2017, significant works were published at specific times. Collaborative research is common, with an average of 3.15 co-authors per article and a 28.7% international co-authorship rate. The UK and Indonesia lead in publication counts, while Australia, Belgium, and Finland exhibit high average citations per article, indicating impactful contributions. Core journals such as the International Journal of Data and Network Science and Sustainability (Switzerland) dominate the field. The study underscores the importance of interdisciplinary research and international collaborations. Future research should incorporate more comprehensive data, explore emerging technologies, and examine socio-cultural factors to drive innovation and practical applications in influencer marketing. This study provides a foundation for future research directions and emphasizes the dynamic nature of the field.

Keywords: *Social Media Marketing, Electronic Word of Mouth, Influencer Marketing*

INTRODUCTION

The world of marketing and advertising has undergone significant changes as a result of the digital revolution. Influencer marketing has become a crucial technique for brands looking to interact with their target audiences in the modern era due to the quick spread of social media platforms. As a result of media and technological advancements social media influencers are now used and assessed in the marketing industry (Bastrygina and Lim, 2023). Influencer marketing is a growing trend in digital advertising that uses social media influencers' authenticity and reach to market goods and services.

Social Media Influencers (Freberg et al., 2011), a new type of third-party independent promoters that use tweets, blogs, and other social media platforms to influence the opinion of audience. Branded content on social media platforms like Facebook, Instagram, and YouTube is promoted and represented by natural celebrities (Bastrygina and Lim, 2023) known as social media influencers. The concept of using social media influencers for business purposes is expanding

quickly, as marketers are using certain users to spread information about their companies on social media (Valsesia et al., 2020).

The driving force behind this changed paradigm is the capacity of influencers to build relationships and trust with their followers is a big achievement that is frequently impossible through conventional marketing channels. According to (Lin et al., 2018), celebrities distinguish out for having a sizable social media following and a personal brand that is completely linked with their career. An influencer, or microcelebrity, is a person who gathers a following on social media and blogs through posting written and visual stories of their daily lives. Sponsored advertisements are based on this story and are editorial opinions that are transformed into product and service advertisements. (Abidin, 2016).

Influencers of Social media are actually distributed into groups on the basis of their fan bases. Some researchers propose that these groups can be categorized as micro-influencers, who have a tiny following, and macro-influencers, who have a massive following. The dual objectives of social media influencers' content are to increase the attraction or awareness of products and to encourage their followers to make purchases (Kay et al., 2020). The amount of research on influencer marketing has grown exponentially, thus it is crucial to thoroughly review the body of knowledge on the subject. In order to capture consumers' interest and gain their trust, brands are depending more and more on influencers of social media, including Instagrammers, YouTubers and Bloggers some of whose accounts have millions of followers. Due to the difficulties in directly interacting with consumers on social media, numerous firms have opted to collaborate with social media influencers (Reinikainen et al., 2020).

A particular kind of opinion leader known as a social media influencer uses rich multimodal narrative to create online images that they use to showcase their own personal lives. Images are used by them to gain a lot of followers and attention. Linkages between their followers and their personal brand are critical to their success since they can significantly influence positive outcomes like followers' electronic word-of-mouth (eWOM) communication and intention to buy (Dhanesh and Duthler, 2019). Marketing through influencers has been an essential among the wide range of techniques that have been developed for companies looking to establish genuine relationships with their target markets. Marketing through influencers is the process of collaborating with individuals who own a sizable online following and have the power to sway their audience's purchasing decisions through recommendations and content. This strategy makes use of the trust and interpersonal relationships that influencers develop with their followers, which makes it a powerful instrument for raising brand awareness and credibility.

The fast adoption of influencer marketing across diverse sectors such as fashion, cosmetics, technology, and lifestyle is indicative of its effectiveness. Influencers are key players in influencing the attitudes and actions of consumers. They can be anyone from celebrities to specialized content producers. Their capacity to produce relatable and engaging material has shown to have a greater impact than traditional marketing strategies, which frequently fail to stand out in a media landscape that is becoming more and more crowded. Because influencer partnerships have the potential to yield large returns on investment, brands are responding to this opportunity by allocating significant resources to them. According to (Djafarova and Rushworth, 2017 and De Veirman et al., 2017), consumers find people who have a high number of subscribers to be more appealing and trustworthy. Even with its broad use and surprising effectiveness, influencer

marketing is still a relatively new and developing subject. Scholars have started exploring into this phenomenon's numerous aspects, such as how it affects consumer behavior, how it exerts influence, and what ethical issues arise. But a thorough analysis of the body of existing research is required due to the quick speed at which industry advancements are occurring as well as the wide variety of research methodologies. This is when the value of bibliometric analysis increases.

A thorough technique for statistically evaluating a collection of research on a given subject is bibliometric analysis. Bibliometric approaches can identify important books, important authors, and dominant themes in a subject by examining publishing data, citation patterns, and research trends. In addition to highlighting the existing level of knowledge, this kind of analysis identifies gaps and newly identified areas of interest that demand more research. The objective of this paper is to perform an extensive bibliometric analysis of the academic literature pertaining to influencer marketing. This study aims to uncover emerging trends and research gaps in influencer marketing research and to clarify the growth of the field by evaluating publishing patterns, citation networks, and theme changes. The results of the study will not only help us understand the academic environment of influencer marketing better, but they will also offer helpful direction for future studies.

OBJECTIVES

1. To analyze patterns in the publication of influencer marketing over time
2. To assess the contribution of notable writers, countries and top journals to the field of influencer marketing research
3. To examine the networks of collaboration between researchers and institutions working in the influencer marketing domain
4. To examine the development of research themes and issues in the literature on influencer marketing using keyword co-occurrence analysis.

RESEARCH METHODOLOGY

This bibliometric analysis will follow a systematic approach that consists of multiple steps. Bibliometric analysis has become more well-known recently due to its use in the analysis of business and management literature (Öztürk et al., 2024). Initially, an extensive exploration of scholarly databases will be carried out in order to generate a dataset containing pertinent papers. The dataset will next be analyzed using bibliometric methods and software, with an emphasis on metrics like co-authorship patterns, citation counts, and publication counts.

Bibliometric analysis aids (Donthu et al., 2021) in the investigation of the evolutionary details of a certain area and provides details about recently emerging fields.

This study utilized the technique of bibliometric analysis proposed by Aria and Cuccurullo (2017) to review publications on influencer marketing. The relationships between important publications and authors will be visualized through the use of network analysis tools. Finding significant research clusters and the overarching topics that have influenced the area will be made easier with this. To find titles, keywords, and abstracts in the Scopus database, utilize the search string provided below. To reduce the quantity of data that was discovered, more filters were used:

(TITLE-ABS-KEY ("Influencer Marketing") OR TITLE-ABS-KEY ("Social Media Marketing") OR TITLE-ABS-KEY ("Electronic Word of mouth") OR TITLE-ABS-KEY ("EWOM")) AND PUBYEAR > 2010 AND PUBYEAR < 2026 AND (LIMIT-TO (

EXACTKEYWORD, “Social Media Marketing”) OR LIMIT-TO (EXACTKEYWORD, “Influencer Marketing») OR LIMIT-TO (EXACTKEYWORD, “Electronic Word Of Mouth”)) AND (LIMIT-TO (SUBJAREA , “BUSI”) OR LIMIT-TO (SUBJAREA , “SOCI”)) AND (LIMIT-TO (LANGUAGE , “English”)) AND (LIMIT-TO (OA , “all”))

Table 1: Main Information of Data

Description	*Results*	*Description*	*Results*
Documents	460	Timespan	2011:2024
Annual Growth Rate %	28.67	DOCUMENT TYPES	
Document Average Age	2.94	book	4
Sources (Journals, Books, etc.)		article	434
Average citations per doc	30.88	conference paper	4
References	27517	review	14
DOCUMENT CONTENTS		book chapter	3
Keywords Plus (ID)	393	editorial	1
Author’s Keywords (DE)	1365	AUTHORS COLLABORATION	
AUTHORS		Co-Authors per Doc	3.15
Single-authored docs authors	51	International co-authorships %	28.7
Authors	1310	Single-authored docs	53

This table provides a thorough summary of the bibliometric information related to studies on influencer marketing from 2011 to 2024. A yearly growth rate of 28.67% has resulted in the

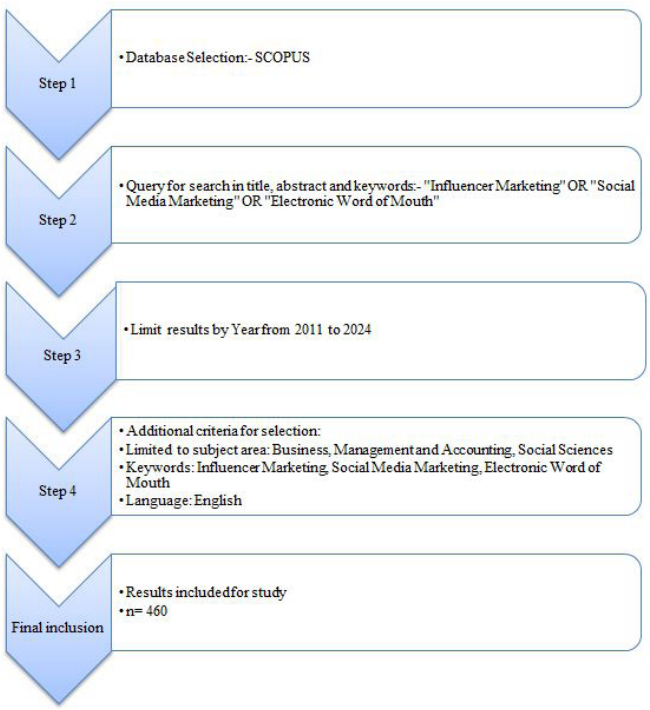


Figure 1: Flow Chart of Study

production of 460 documents, over this time spanning journals, books, and other media. The documents' 2.94-year average age indicates that the subject is still quite new and evolving rapidly. There are 30.88 citations on average for every document, indicating a considerable influence and level of interest in the topic. The research has acquired 27,517 references, which is a significant number.

The literature uses 1,365 Author's Keywords (DE) and 393 Keywords Plus (ID), according to the analysis of document contents, showing a wide range of research topics within the discipline. The author data shows that 1,310 authors have contributed to this body of work, with 51 authors producing single-authored documents. There is a clear trend towards collaborative research as seen by the 53 single-authored publications and the 3.15 average number of co-authors each document. Furthermore, foreign co-authorship is present in 28.7% of the papers, indicating a high degree of international cooperation in influencer marketing research. Articles (434) represent the majority of document types and other types are books (4), book chapters (3), conference papers (4), editorials (1), and reviews (14). Overall, the data shows how influencer marketing research is expanding quickly, collaborative, and is conducted globally.

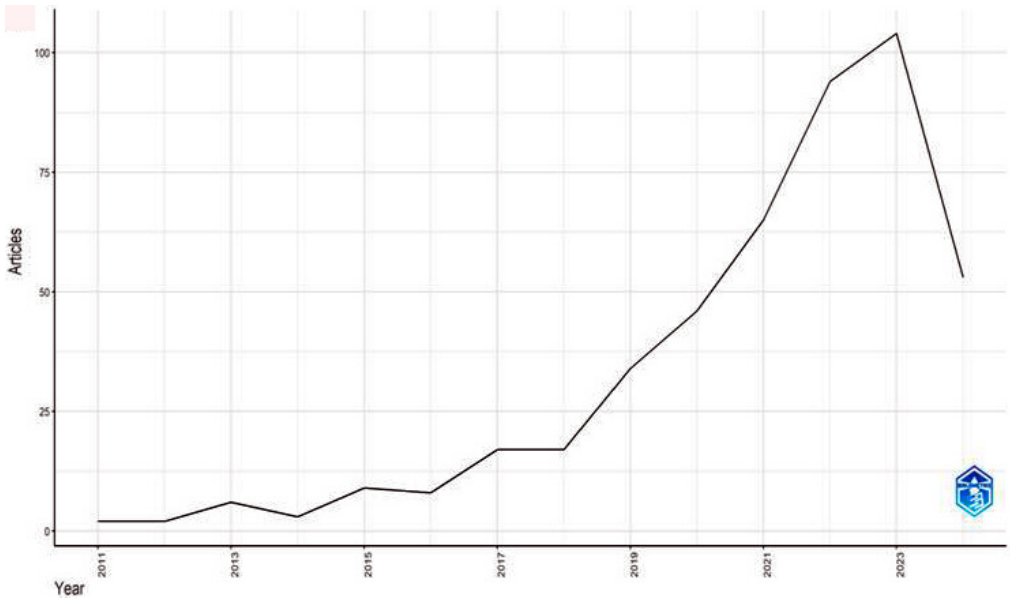


Figure 2: Annual Scientific Production

As shown in Figure 2, yearly production of influencer marketing-related scientific publications from 2011 to 2024. The number of published articles throughout this time period has clearly increased, as seen by the graph, indicating the growing interest of academics in this topic. There was very little annual growth in the number of articles produced between 2011 and 2015. But there was a considerable increase in publications beginning in 2016, which signaled the start of a major increasing trend. This growth was steady throughout 2018, with a notable uptick in growth from that point on.

With 104 publications published in 2023, there was a peak in scientific output, reflecting a peak in interest and effort in research. However, the graph also reveals a drop in the total number of articles in 2024, which may indicate a slowdown in the number of new publications of research

because the data was gathered in the second quarter of that year. Overall, the graphic emphasizes how dynamic influencer marketing research is, showing a notable increase in academic production over the previous ten years, a peak in recent years, and a minor decline in the most recent year of data.

The Figure 3 is a globe map with the headline "Country Scientific Production," showing the various nations' scientific contributions. The amount of scientific output is represented on the globe by different shades of blue, with darker hues denoting higher output levels. One of the darkest regions, Indonesia, indicates a high level of scientific output; the UK is another dark blue zone that shows a notable level of scientific productivity.

The top two contributors, i.e. Indonesia and the UK, with 178 and 119 publications respectively, account for a sizable share of all scientific articles. The United States of America (90) contributes a significant percentage of publications, followed by China (89), Spain (89), India (82), and Malaysia (59). These contributions are remarkable and demonstrate the involvement of these countries in international scientific research.

With a focus on the nations that engage in scientific research and publication, the map offers a visual representation of worldwide scientific output. Large contributors with deeper blue tones are Indonesia, the United Kingdom, the United States, China, and Spain. Conversely, a large number of areas with lighter shades indicate lesser levels of scientific activity, suggesting differences in scientific output as well as potential financing and infrastructural gaps for research worldwide.

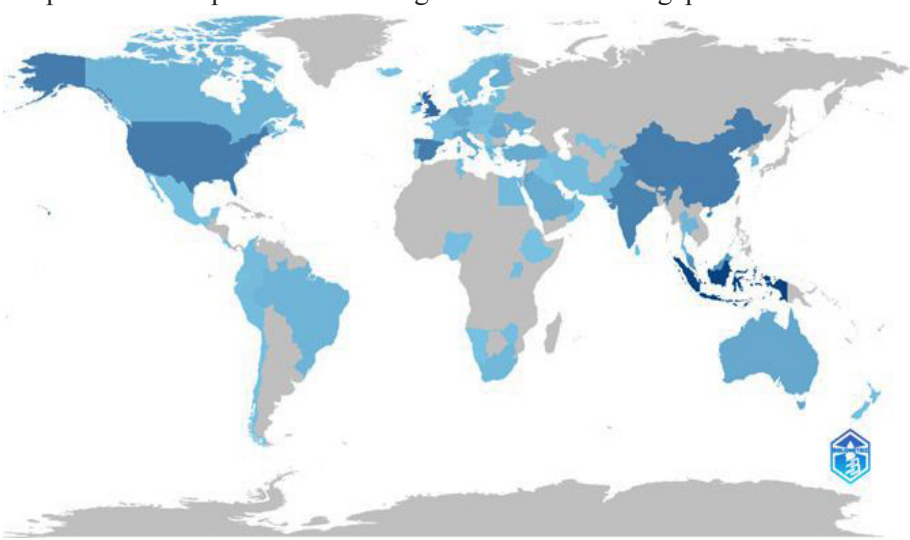


Figure 3: Country Scientific Production

Figure 4 illustrates the yearly average of citations received by influencer marketing related papers between 2011 and 2024. The graph shows the frequency of citations for these papers over time, which can be interpreted as a measure of their influence and importance in the scholarly community.

The average citation count in 2011 was quite high, surpassing 39.43 citations per piece. This initial rise might be the result of a few early, highly influential articles that attracted a lot of attention in the subject. But by 2012, the average number of citations per year had sharply decreased, with fewer than 10 citations each article.

The average number of citations increased gradually between 2013 and 2016, reaching significant peaks in 2015 and 2017, when the average number of citations per article reached approximately 10–15. These peaks indicate times when a particular publication may have had a major impact on the subject or when interest in and recognition for the area increased.

The chart indicates that the average number of citations annually decreased after 2017. By 2023, the average number of citations per piece has dropped to less than five, which is comparable to the early post-peak period of 2012.

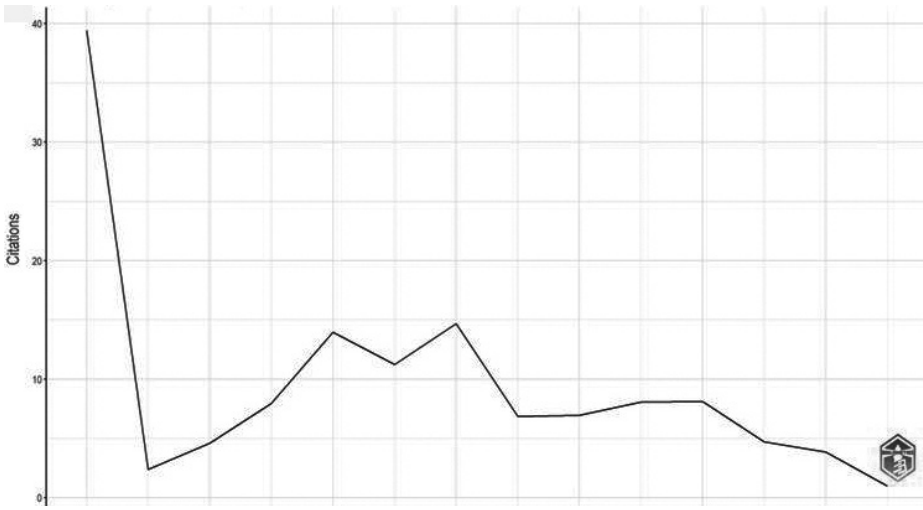


Figure 4: Average Citations Per Year

All things considered, this graph indicates that although the early works in influencer marketing area had a significant influence, the average number of citations has generally decreased with time. Numerous causes, such as the field's development, changes in research interests and focus, could be responsible for this.

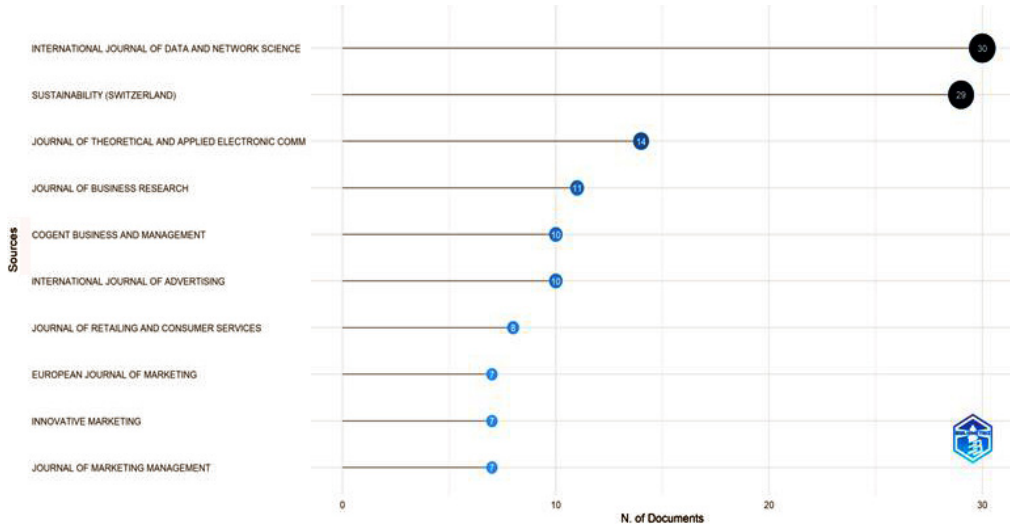


Figure 5: Most Relevant Sources

Figure 5 show that with thirty papers published, the International Journal of Data and Network Science holds the first place. Sustainability (Switzerland) comes in second with 29 documents, suggesting that these publications have made a substantial contribution to the subject of influencer marketing. Other significant sources include the Journal of Theoretical and Applied Electronic Commerce Research (14 documents), Journal of Business Research (11 papers), Cogent Business and Management (ten documents), and International Journal of Advertising (ten documents).

The Journal of Retailing and Consumer Services, which has eight documents, is another important source. Journal of Marketing Management, Innovative Marketing, and European Journal of Marketing each contributed seven papers.

This distribution makes clear that although a number of publications support influencer marketing research, only a few important journals lead in the field of publication. The prominence of journals like the International Journal of Data and Network Science and Sustainability (Switzerland) suggests that influencer marketing research is interdisciplinary, intersecting fields such as data science, network science, and sustainability

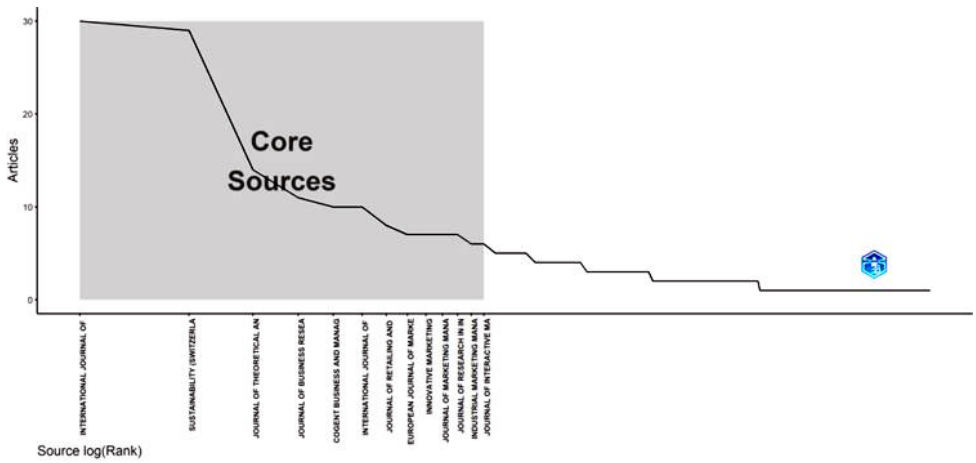


Figure 6: Core Sources by Bradford's Law

The graph in the figure 6 shows how Bradford's Law can be used to locate essential sources in a particular subject of study. In bibliometrics, Bradford's Law is used to ascertain how publications are distributed throughout journals; it states that most important articles in a given field will be found in a small number of journals. A darkened region on the graph is titled "Core Sources." The journals that publish the most articles in the field are highlighted in this section.

The titles of the core journals are: International Journal of Data and Network Science (30 articles), Sustainability (Switzerland) (29 articles), Journal of Theoretical and Applied Electronic Commerce Research (14 articles), Journal of Business Research (11 articles), Cogent Business and Management and International Journal of Advertising with 10 articles each, Journal of Retailing and Consumer Services (8 articles). Because they have the greatest number of published articles, which attests to their significance and centrality in the area, these sources are regarded as core. By highlighting the primary sources that lead the field's publication landscape, the graph successfully demonstrates the fundamental ideas of Bradford's Law. Researchers and librarians are able to understand which publications are important and significant for thorough literature coverage in the topic by using this visualization.

Table 2: Countries Most Cited

Country	*Total Citations*	*Article Average Citations*
UK (UNITED KINGDOM)	1545	41.80
AUSTRALIA	1281	160.10
BELGIUM	1242	177.40
FINLAND	1107	184.50
USA	662	33.10
SPAIN	618	25.80
NETHERLANDS	513	46.60
FRANCE	460	153.30
CHINA	436	20.80
INDONESIA	415	13.00

Table 2 presents data of most cited countries on the basis of average citations number per article and the total citations number (TC). The United Kingdom has maximum number total citations (TC) of any country with 1545 citations and 41.80 citations on average per article. Australia ranks second with a total of 1281 citations, averaging 160.10 per article citations. Belgium with 1242 citations total is ranked third, averaging 177.40 citations per article. The next two countries are Finland and the USA, with total citation (TC) counts of 1107 and 662, respectively, and average count of citation per article of 184.50 and 33.10. For the remaining nations such as Spain, Netherlands, France, China, and Indonesia, the total number of citations is decreasing.

Figure 7 provides information about how various sources in the field of influencer marketing have an impact locally. The parameters that are considered are "PY_start" (first publication year), "TC" (citations in total), and "NP" (publications number). An investigator's impact and productivity are evaluated by their h-index, which is determined by the quantity of publications and citations they receive. While g-index assesses overall body of a scholar's work, the elements

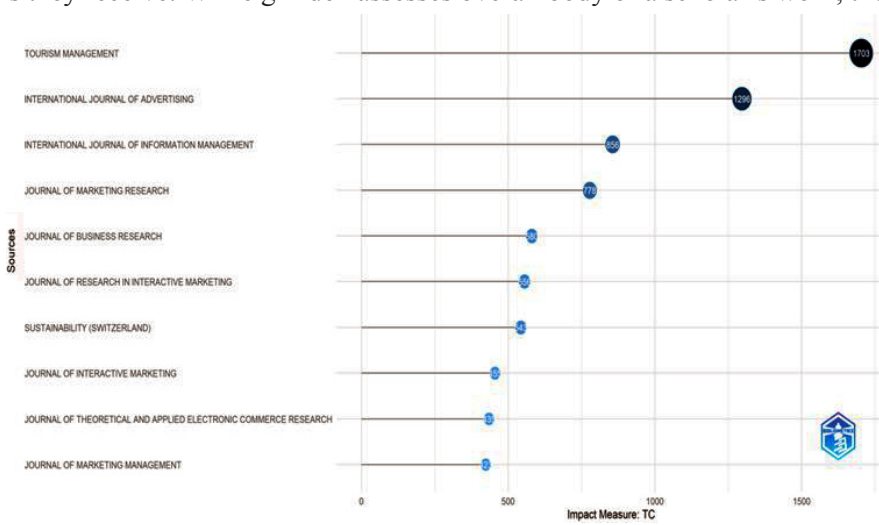


Figure 7: Source Local Impact

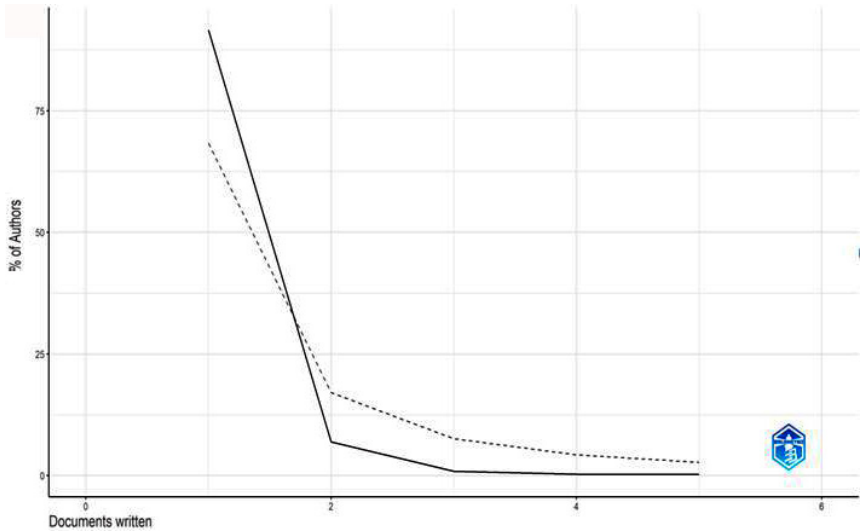


Figure 8: Author Productivity through Lotka's Law

of the g- and h-index are combined by m-index to evaluate scholar›s impact. The variables «PY_ start», «TC,» and «NP,» shows year the source started publishing, the total citations number of an article has got, and the publication number the source has created.

High values of m-index, g-index and h-index of the sources shown in the table such as "Sustainability (Switzerland)", "Journal of Theoretical and Applied Electronic Commerce Research", and "International Journal of Data and Network Science" show that they have a significant impact on the community.

Figure 8 illustrates author productivity as the total published number of documents, in accordance with Lotka's Law. The data shows approx. 91% of writers have published one paper; on the other hand only 9% have published two or more. As number of articles increases, percentage of authors decreases, indicating a skewed distribution of output. These findings show that most writers publish fewer works overall, but a small percentage are highly active and significantly advance the field.

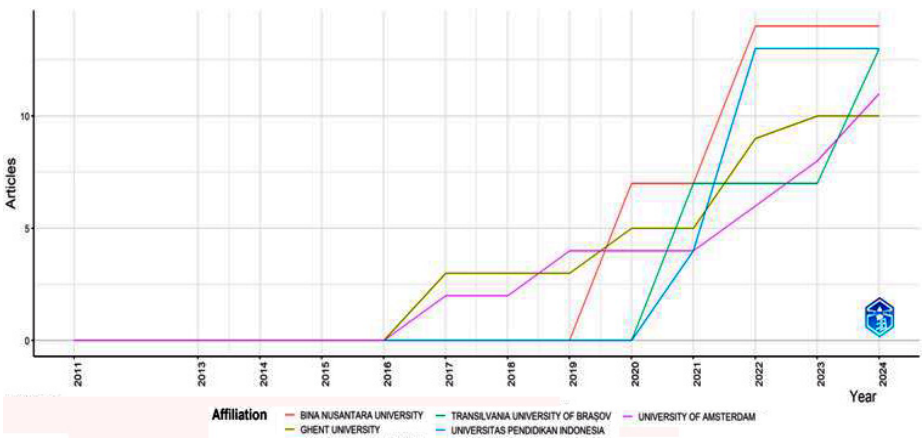


Figure 9: Affiliations' Production Over Time

Figure 9 shows the number of total articles that different universities have written throughout time on a certain topic or in a given field. There was no activity at any of the five universities between 2011 and 2016. Since 2017, publications have increased noticeably at all universities. After a slow start, the Bina Nusantara University, Universitas Pendidikan Indonesia and Transilvania University of Brasov did not contribute until 2020. The biggest increase in research output is anticipated for all universities beginning in 2022. This pattern suggests a rise in financing and interest in the research topic, which could be brought on by developments in the scientific community or global events. This pattern could be the consequence of increased funding, opportunities for cooperation, which increased the importance of study in this field.

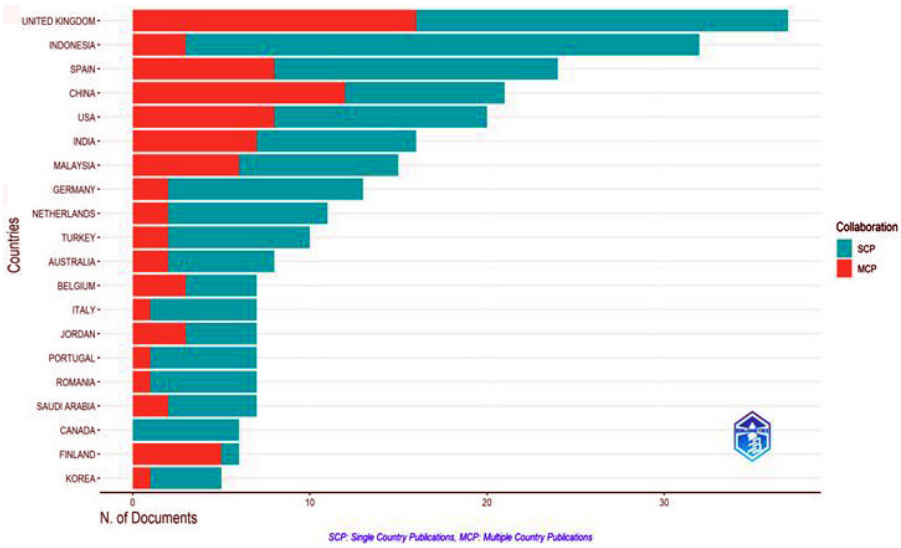


Figure 10: Corresponding Author's Countries

Figure 10 displays data of publications distribution by countries origin of linked authors. It contains information on the total number of articles, the percentage of MCP to SCP articles, the frequency of occurrence (Freq), and the number of single corresponding authors (SCP) and multiple corresponding authors (MCP) articles. Data indicates that United Kingdom has most documents with 37, followed by Indonesia with 32. The data indicates that the majority of the articles, or 233, have one associated author. The ratio of publications with one corresponding author to those with multiple corresponding authors is shown by the MCP ratio.



Figure 11: Word Cloud

Figure 11 represents frequency and popularity of specific words in the influencer marketing study. Larger, bolder phrases indicate greater frequency and significance within a literary work.

Influencer marketing, social media, Electronic word of mouth, purchase intention and Instagram are the most prevalent terms. Other important terms are social media influencer, brand loyalty and digital marketing. Among the lesser but as important concepts are artificial intelligence, customer engagement, brand trust, and perceived value. All things considered, the primary subjects and themes in the influencer marketing research are summarized in this word cloud.

Figure 12 shows the trend themes over time. According to analysis, the most prevalent trend terms from 2022 to 2024 were artificial intelligence, influencer marketing, social media influencers, social media, intention of purchase, and customer engagement. Furthermore, over the past 15 years, the idea of influencer marketing has been thoroughly studied.

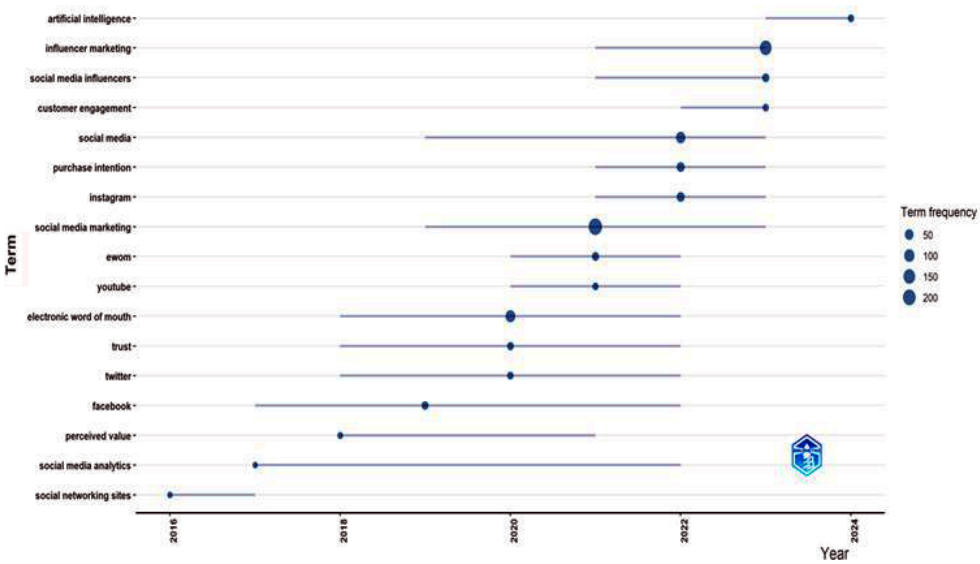


Figure 12: Trend Topics

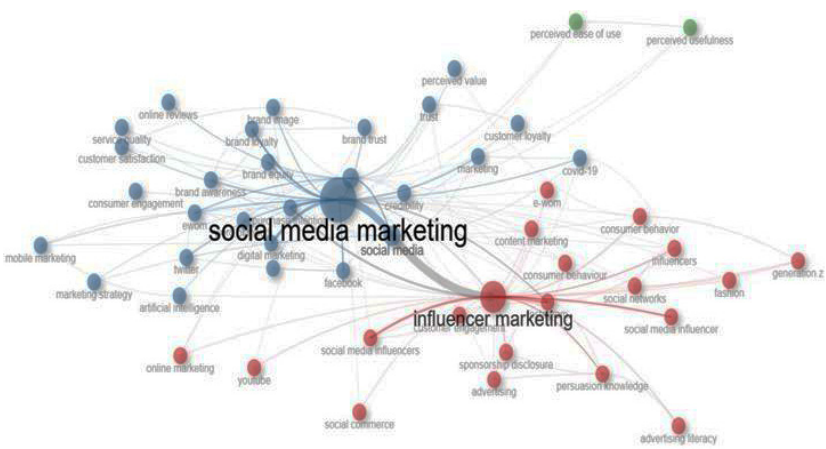


Figure 13: Author's Keywords Co-occurrence Network

The graphic looks to be network visualization in Figure 13 that shows the connections between various ideas within the "influencer marketing" domains. The edges that join the nodes represent the links or relationships between numerous subjects that are represented by the nodes. The frequency or importance of the topics in the dataset is probably indicated by the size of the nodes. A focus on how social media is used to improve brand image, customer engagement, and satisfaction is indicated by the Social Media Marketing Cluster's central location and connections to a wide range of topics, including virtual reviews, customer satisfaction, brand loyalty, brand awareness, digital marketing, and platforms like Facebook and Twitter. Influencer marketing, which highlights the role of influencers in influencing consumer behavior, brand promotions, and the impact of social networks, is closely related to topics such as fashion, social networks, advertising, and consumer behavior. Customer engagement, topics relating to brands, and consumer behavior are a few common topics. Perceived utility (green) and simplicity of use are two examples of topics that are slightly isolated, indicating that they are not as fundamental to the overall themes but still relevant. Overall, by highlighting important subjects and their connections across different domains, this visualization illustrates how social media and influencer marketing are linked.

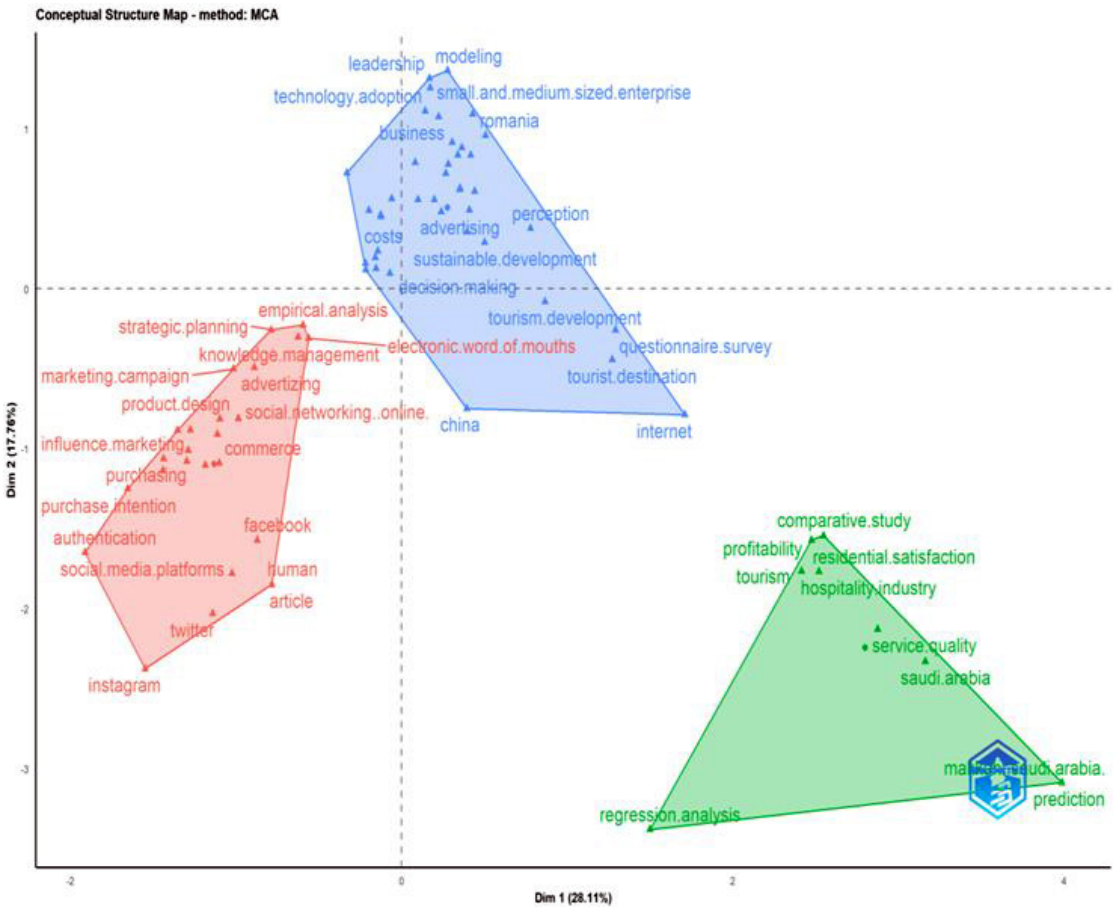


Figure 14: Factorial Analysis with MCA

In Figure 14 Multiple Correspondence Analysis (MCA) was used to construct the conceptual structure map seen in this figure. It displays the connections between different concepts and keywords in a multidimensional space. This is an in-depth explanation. Of the entire variance in the data, 28.11% can be explained by the horizontal axis and 17.78% can be explained by the vertical axis. When combined, these two dimensions account for 45.89% of the variance in total. Three unique clusters are depicted on the map, each of which stands for a collection of connected concepts:

- The red cluster is centered on consumer behavior, social media, and internet marketing.
- The blue cluster focuses on technological adoption, corporate strategies, and the growth of tourism.
- The green cluster focuses on analytical investigations and is related to travel, hospitality, and service quality.

Certain terms are linked to particular nations (e.g., Saudi Arabia, China, and Romania). The linkages and clustering of different concepts within the framework of the MCA-analyzed study data are made easier to see with the help of this map.

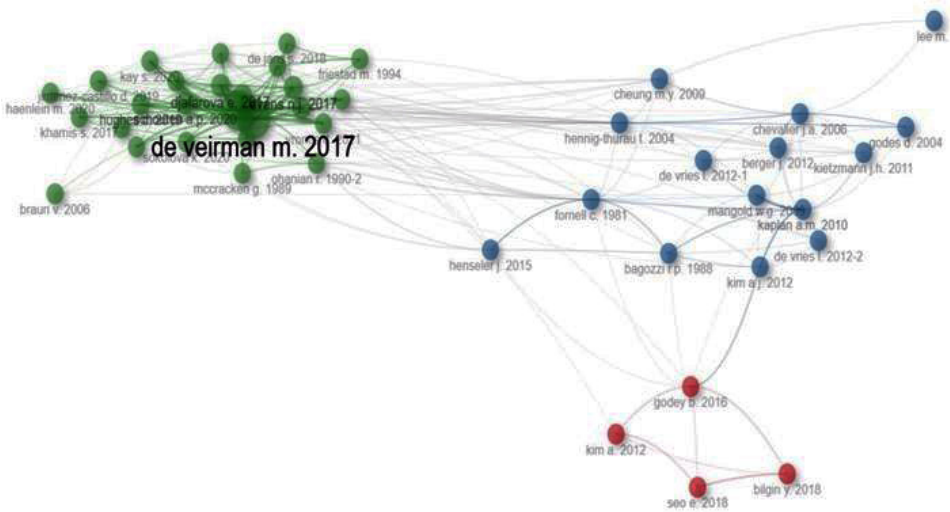


Figure 15: Co-citation Network

In Figure 15, co-authorship or citation network graph in the presented. It illustrates, through citations or collaborative efforts, the connections and ties between various academic works or authors. Here is how the main components are interpreted. Three groups of nodes are distinguished by color: green, blue, and red. The colors used may represent many fields of study, collaborative groups, or eras. Relationships between articles, including citations between them or author collaborations, are shown by lines joining the nodes. The degree of interaction or effect is indicated by the density and quantity of links. The node "de veirman m. 2017" is prominently displayed, suggesting it is a key paper or author in this network. This node has multiple connections, indicating its importance or influence. Apart from «de veirman m. 2017", other notable papers/ authors are "Lou C. 2019", "Kaplan A.M. 2010", "Campbell C. 2020", "Evans N.J. 2017", and others. These seem to act as bridges or significant contributors in the network.

The graph illustrates the relationships between various publications and writers, highlighting the transmission of information and power among many fields. In conclusion, this network graph illustrates the academic environment by highlighting notable individuals and their connections. It draws attention to important figures, specific study areas, and the general arrangement of collaborations or citations in the topic.

Figure 16, a global map depicting international partnerships with the USA (6), India (5), and Finland (4), demonstrates that the United Kingdom is leading the pack in terms of country collaborations. China with Malaysia, the USA with India, and the USA with Australia, worked together on five documents. These findings imply that while the UK has developed greater international relations, other nations have less cooperation. This information sheds light on political allegiances, international relations and economic partnerships among nations.

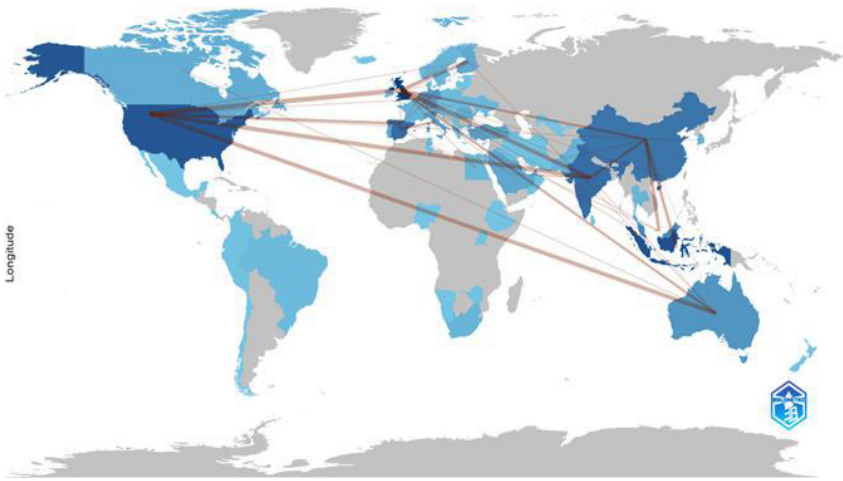


Figure 16: Countries' Collaboration World Map

DISCUSSION

The bibliometric analysis of influencer marketing research from 2011 to 2024 reveals several key trends and insights into the field's growth, collaborative nature, and global influence. This discussion synthesizes the findings, highlights significant patterns, and offers interpretations for the observed trends. The annual growth rate of 28.67% underscores the rapid expansion of influencer marketing research. The field's youth is highlighted by the average document age of 2.94 years, indicating that it remains a burgeoning area of academic inquiry. This rapid growth is further evidenced by the peak of 104 publications in 2023, although a slight decline in 2024 suggests a potential plateau, likely due to data collection being limited to the second quarter of that year.

Despite a general decline in average citations per year after 2017, specific peaks in 2015 and 2017 indicate the publication of seminal works during those periods. This trend might reflect shifts in research focus or the emergence of new methodologies that garnered significant attention. The data reveals a strong trend towards collaborative research, 3.15 co-authors per document on average and only 53 single-authored papers out of 460. The 28.7% rate of international co-authorship highlights the global nature of influencer marketing research. Countries like Indonesia and the UK lead in publication counts, with 178 and 119 documents respectively, indicating

robust research activities in these regions. The prominent contributions from the USA, China, Spain, and India further underscore the field's international reach.

Bradford's Law analysis identifies core journals that dominate the dissemination of influencer marketing research. The International Journal of Data and Network Science and Sustainability (Switzerland) are particularly noteworthy, with 30 and 29 articles respectively. The citation analysis by country reveals interesting dynamics. The UK leads with an average of 41.80 citations per article and 1545 total citations, reflecting its significant influence in the field. Australia, Belgium, and Finland exhibit exceptionally high average citations per article (160.10, 177.40, and 184.50 respectively), suggesting that works from these countries are particularly impactful. This high citation rate may be attributed to the publication of high-quality, pioneering research.

The increase in publications from universities like Bina Nusantara University and Universitas Pendidikan Indonesia since 2020 highlights a rising interest and investment in influencer marketing research. The skewed distributions of author productivity, where approximately 91% of writers have published only one paper, indicating that a small proportion of authors contribute a significant portion of the research output. Keyword analysis and thematic mapping reveal key research areas and evolving trends. Terms like "influencer marketing," "social media," "purchase intention," and "customer engagement" dominate the discourse, indicating core areas of interest. Emerging topics such as "artificial intelligence" and "digital marketing" reflect the field's adaptation to technological advancements. The network visualization and multiple correspondence analysis (MCA) further illustrate the interconnectedness of various themes. The analysis of international collaborations highlights significant partnerships, particularly those involving the UK, USA, China, and India. The map of global collaborations underscores the central role of these countries in fostering international research networks, with notable collaborations like the USA-India and China-Malaysia partnerships.

CONCLUSION

This research adds to the current discussion about bibliometric analyses by providing a comprehensive analysis of fourteen years of influencer marketing research. Apart from the subjects and authors that receive the highest citation counts, the findings demonstrate the noteworthy input that authors, institutions, nations, and sources have provided to the field. Despite the comprehensive nature of this bibliometric analysis, several limitations must be acknowledged. Firstly, the data collection only extends up to the second quarter of 2024, potentially missing recent publications and developments that could provide a more current perspective on the field. This temporal limitation might contribute to the observed decline in publications for 2024, which could be an artifact of incomplete data rather than an actual decrease in research activity. Secondly, the analysis relies heavily on publications indexed in specific databases, which may not encompass all relevant research, especially those published in less prominent or regional journals. Consequently, some influential works or emerging trends might be underrepresented. The future scope for research in influencer marketing is broad and promising. Future studies could benefit from more comprehensive data collection that includes the full span of 2024 and beyond to capture the latest trends and publications. Expanding the analysis to include a wider range of databases and incorporating non-English publications could provide a more holistic view of global research activities and contributions. Additionally, future research could delve into qualitative analyses, exploring the content and impact of influential studies to uncover deeper

insights into theoretical and practical advancements in the field. Furthermore, examining the role of emerging technologies such as artificial intelligence, blockchain, and augmented reality in influencer marketing could open new avenues of investigation. The impact of socio-cultural factors on influencer marketing strategies and consumer behavior across different regions could also be a rich area for exploration. Finally, fostering interdisciplinary research and international collaborations could enhance the robustness and applicability of findings, driving innovation and practical applications in influencer marketing.

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Marketing Challenges and Opportunities in Circular Economy: A Systematic Literature Review

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Abstract

Aim: *The purpose of this systematic literature review (SLR) is to conduct an in-depth analysis of the function that marketing plays within the framework of the circular economy, with the objective of determining its influence, as well as the problems and possibilities that it presents. It is the purpose of this study to give a complete knowledge of how marketing tactics may assist in the transition to a circular economy by eliminating inefficiencies, encouraging consumer uptake, and capitalizing on new trends.*

Methodology: *The study is conducted using a methodical manner, applying a thorough search strategy across a number of academic databases in order to locate material that is pertinent to the topics being discussed. Journal articles that have been subjected to peer review, conference papers, and reports that concentrate on the function that marketing plays in the circular economy are some of the sources. The evaluation procedure included many processes, such as defining search terms, selecting relevant publications, extracting data, and synthesizing findings. Articles were reviewed based on their contribution to get a better understanding of the circular economy's marketing challenges, possibilities, and future trends. To provide a fair view on the current state of marketing in this field, the assessment process includes both qualitative and quantitative investigations.*

Findings: *The study's findings present several important insights into the role of marketing within the circular economy. Key challenges include low consumer awareness, adoption barriers, and market inefficiencies. While the circular economy offers opportunities for new business models and sustainable practices, the research highlights that overcoming these barriers is crucial for widespread adoption. Effective marketing strategies should focus on consumer education, enhancing product quality, and optimizing pricing methods. The most significant findings suggest that marketing can facilitate the transition to a circular economy by engaging consumers and promoting sustainable behaviors through digital platforms, such as social media and data analytics. Additionally, the study identifies emerging trends, including the integration of sustainability into branding and the development of new marketing frameworks to support circular business models. These developments are thoroughly discussed in the review.*

Conclusion: *Marketing contributes significantly to the shift to a circular economy by addressing inefficiencies and promoting sustainable practices. This is due to marketing's efforts to encourage sustainable habits. The study emphasizes the need of developing strategies that increase consumer interaction and aid in the removal of adoption barriers. In the future, research should focus on fine-tuning marketing tactics to align with the principles of the growing circular economy and emerging trends. This includes research into digital marketing breakthroughs, sustainable branding approaches, and creative business structures that foster circularity. The study underlines the need of a collaborative effort by marketers, businesses, and lawmakers to encourage the adoption of circular economy principles to achieve long-term sustainability goals.*

Keywords: *Circular Economy, Marketing Strategies, Opportunities, Challenges, Sustainability*

INTRODUCTION

The concept of the circular economy (CE) has garnered considerable interest from academics, business, and government in recent times (Fogarassy et al., 2020). The term "CE" refers to a novel approach of transforming the traditional linear paradigm of acquiring, using, and discarding resources (Aboulamer, 2018). The rise in global population, growing consumer wealth, limited resources, pollution, and environmental challenges have led to an increased need for transitioning from a linear economy to a circular economy. The shift towards a sustainability-focused circular economy is becoming more urgent due to the need of optimizing resource use, minimizing waste, and harnessing the potential of innovation and value generation in commercial marketplaces (Ranta et al., 2020). Currently, there is an ongoing effort to promote a circular economy (CE), with governments, green non-governmental organizations (NGOs), think tanks, and private sector groups all supporting the creation and adoption of further CE business models. For instance, within the European Union (EU), the CE plays a central role in a current policy designed to achieve a harmonious equilibrium between economic expansion and environmental sustainability. (Gusmerotti et al., 2019) state that the Circular Economy (CE) is the final result of a collection of European Union policies aimed at separating economic progress from the use of resources and the creation of trash. Similarly, corporations aim to consistently accomplish a positive development cycle by implementing the concept of Circular Economy (CE). This involves preserving and enhancing natural resources, optimizing resource use, and minimizing system risks via the management of finite stocks and renewable flows (Matarazzo et al., 2019). Therefore, the CE may be implemented and used to achieve several sustainable development objectives.

Marketing in Circular Economy

The rapid progress in information technology has greatly transformed the marketing role. (Vassileva & Ivanov, 2017) argued in a recent research that the emergence of marketing 4.0, also known as the next generation of marketing, is essential due to consumers' need for goods that fulfil their fundamental needs and societal ideals. The authors further contend that marketing has prioritized customer engagement in the design and manufacturing process, hence promoting conscientious consumption. Although the aims of the CE and marketing overlap significantly, there is a dearth of review studies examining the junction between the two. As an example, (Nosratabadi et al., 2019) performed an extensive examination of sustainable business models across several domains of application. Although the authors established a classification system for CE and marketing applications, they did not examine the overlap between these two ideas.

The transition to a circular economy (CE) is a beneficial method that addresses resource scarcity and waste disposal effectively, resulting in economic and value advantages (Homrich et al., 2018). Furthermore, it signifies a field of study that has received insufficient attention from scholars. Marketing definitions and procedures must continuously adapt to stay updated with market advancements and fulfil the expectations of many stakeholders. Nevertheless, there are still tasks that need to be accomplished in integrating CE (Continuous Evaluation) and CBM (Competency-Based Mastery) in this context. Currently, there is a lack of established criteria for determining the value proposition of a CBM (Stål & Corvellec, 2018). This (Lewandowska et al., 2017) may raise doubt about the reliability of organizational sustainability reports. Moreover, obtaining information on the circularity of businesses activities might pose a challenge. In addition, while authors like (Sanclemente-Téllez, 2017) and (Vadakkepatt et al., 2021) provide a

thorough examination of the connection between marketing and sustainability, there are unsolved issues that need attention.

Despite the progress made in comprehending the principles, importance, and difficulties of Circular Economy (CE) and Circular Business Models (CBM) as discussed in previous studies (Kalmykova et al., 2018) (Kirchherr et al., 2018), the current viewpoints on marketing within a circular economy lack coherence. The fragmentation is seen in the diverse range of marketing strategies used in the consumer electronics industry. For example, several studies propose the incorporation of all dimensions of sustainability (namely, environmental, economic, and social) into the marketing mix (such as the research conducted by (Vadakkepatt et al., 2021). Some researchers propose assessing the influence of companies' circularity degree on consumers' willingness to make a purchase (Papadas et al., 2019). This uncertainty is inconsequential for the majority of research agendas and executive choices. Nevertheless, Customer Experience (CE) has become the prevailing standard, and adopting an organic marketing theory will provide marketers with valuable insights and help them establish a competitive advantage and market position that aligns with CE principles.

Research Questions

- RQ1: What is the role of marketing in the circular economy according to academic literature?
- RQ2: What is the influence of the circular economy on marketing?
- RQ3: What are the current challenges for marketing in the circular economy?
- RQ4: What are the opportunities for marketing in the circular economy?

METHODOLOGY

We followed the PRISMA criteria to conduct a Systematic Literature Review (SLR). The requirements are thoroughly defined in this section. We enumerate the essential stages, which include identifying research objectives, devising a search strategy, creating criteria for selecting studies, undertaking data extraction, and assessing the quality of the included studies.

Search Criteria

The publications on examining On "Marketing in the Circular Economy," the search method consists of many important keywords. Such as "Circular Economy AND Marketing Challenges," "Circular Economy AND Marketing Opportunities," and variants on those keywords. A wide selection of peer-reviewed articles, journals, and conference papers via academic databases such as Google Scholar, Scopus, and Web of Science were accessed. Inclusion and exclusion criteria was applied to limit results by relevancy, publication date, and source quality. Furthermore, the reference lists of chosen publications to find other relevant research was examined. The period from 2015 till date (2024) was chosen for article selection.

Inclusion Exclusion Criteria

Inclusion Criteria

- Research publications published in credible conference proceedings or peer-reviewed journals.
- Studies concentrated on marketing elements within the framework of the circular economy, addressing difficulties or possibilities.

- Research publications from many geographic regions to present a full picture of global practices and perspectives was included.
- Articles published during the last 10 years were included.
- Publications were restricted to English language only.

Exclusion Criteria

- Studies that do not directly address marketing difficulties or possibilities within the circular economy were excluded.
- Research not published in reputable conference proceedings or peer-reviewed journals.
- Research publications in languages other than English.
- Studies published more than 10 years ago were used to verify that the review reflected current changes and trends.

Data Extraction

For a systematic review on "Marketing Challenges and Opportunities in the Circular Economy," data was collected from multiple sources, including the SCOPUS Database, Web of Science, and Google Scholar. The review considers key aspects such as the authors, publication year, and type of study (empirical, review, or meta-analysis). It takes into account the sample size, industry context, and the unique marketing challenges and opportunities related to circular economy strategies. Special attention is given to notable findings, including statistical significance and business performance indicators (e.g., customer engagement, brand differentiation, and revenue growth). Each study is evaluated for quality, with a focus on methodological rigor, potential biases, and the theoretical frameworks employed, such as sustainable marketing theory and consumer behavior models. The key findings are synthesized and their practical implications for circular economy marketing strategies are discussed. Recommendations for future research are also provided to ensure a comprehensive understanding of marketing within the circular economy context.

Data Synthesis

The study reviews existing research on marketing within the circular economy, with a particular emphasis on customer involvement, brand distinctiveness, and revenue growth. Key findings highlight the positive effects of sustainable branding, innovative business structures, and loyalty programs. These insights are supported by theoretical frameworks such as sustainable marketing theory and consumer behavior models. However, the impact of these factors varies depending on the quality of implementation and the specific industrial context. The synthesis identifies effective marketing strategies and provides recommendations for companies adopting circular economy principles. Additionally, it highlights gaps in the current literature and suggests avenues for future research to explore the broader implications of circular economy practices on marketing strategies.

RESULTS

This section summarizes the findings from the literature review. The goal was to assess the present state of marketing and its difficulties and potential in the circular economy.

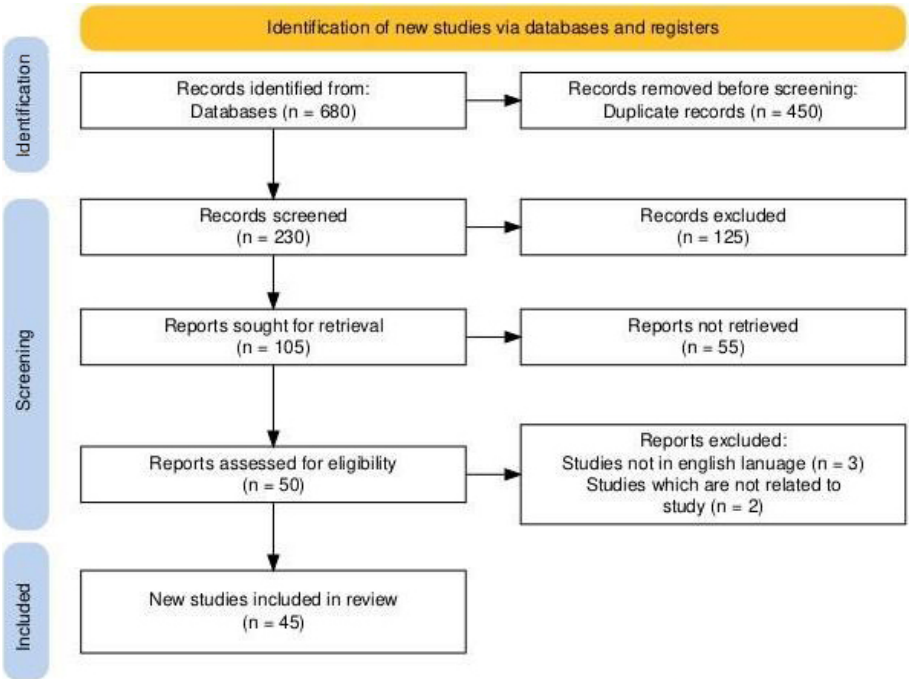


Figure 1: PRISMA Chart

What is the Role of Marketing in the Circular Economy according to Academic Literature?

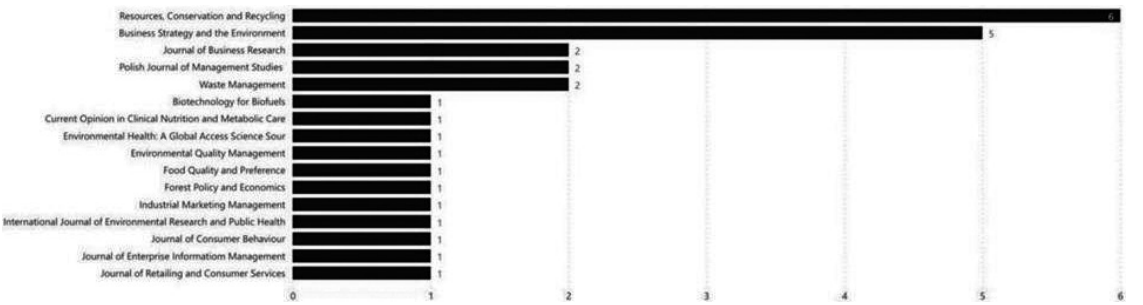


Figure 2: No. of Articles per Journal

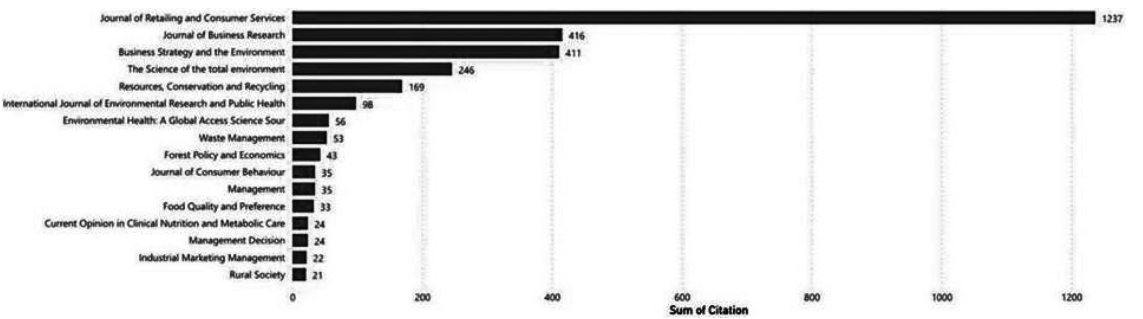


Figure 3: No. of Citation per Journal

Kalverkamp and Raabe (2017) analyzed the European automotive remanufacturing marketing system from a macro-marketing perspective, focusing on the challenges of reverse channels and their impact on sustainability. The study identifies inefficiencies in the market that result in resource wastage and environmental harm. By examining the European supply and procurement system for car remanufacturing, the research provides important insights into the functioning of remanufacturing marketing systems. These findings offer valuable implications for policymakers and marketers involved in developing such systems. The broad perspective of the study helps to clarify the observed inefficiencies and deepen our understanding of the remanufacturing marketing landscape.

Tirado et al. (2022) investigated the role of local authorities in promoting circular economy strategies, with a particular focus on the building sector. Their study explores how local governments facilitate circular economy initiatives and examines the opportunities and challenges they encounter in this process. Through semi-structured interviews with municipal administrations in metropolitan France that have pioneered such programs, the authors highlight the importance of community engagement in implementing circular economy principles within construction. The findings underscore the need to identify key stakeholders and address their specific challenges to establish an effective operational framework.

What is the Influence of the Circular Economy on Marketing?

Esposito et al. (2017) looked at how the circular model is encouraging companies and organizations to develop disruptive technology and business models based on longevity, renewability, reuse, repair, upgrade, refurbishment, servitization, capacity sharing, and dematerialization.

Di Maio et al. (2017) suggested measuring resource efficiency and circular economy using the market value of 'stressed' resources, which account for scarcity, competition, and taxes. The market value of resources is well-documented and automatically updates with location and time. Circularity refers to the proportion of strained resources returned at the end of a service or product. Resource efficiency is the ratio of added product value to strained production or process resources, distinguishable from product resource efficiency in a free market.

According to van Buren et al. (2016), the circular economy has significant potential but requires a comprehensive strategy for long-term transformation. Public and private stakeholders, including enterprises, authorities, individuals, and research institutes, must be engaged. The logistics sector is crucial for implementing a sustainable circular approach. The Netherlands serves as a case study for analyzing the logistics industry's transition to a circular economy, identifying hurdles, and addressing them through public policy.

Kazancoglu et al. (2018) proposed a new holistic conceptual framework for Green Supply Chain Management (GSCM) performance assessment, integrating environmental, economic, logistics, operational, organizational, and marketing performance indicators. The framework has a three-dimensional hierarchy, including main criteria, sub-criteria, and measures, which are crucial for effective implementation of the circular economy concept. The aim is to achieve an optimal balance of these indicators, as they have been separately investigated in literature.

Awan & Sroufe (2022) created a conceptual model of circular economy success factors and challenges. To meet sustainability goals, firms must manage strategic and tactical enablers. This study found the enablers of how these capabilities affect the transition to a sustainable CEBM. The findings show how CEBM, innovation success factors, and obstacles interact microscopically. The

study of a material reuse firm provides a framework for managers to adapt their business model to transition to a circular economy. Kant Hvass & Pedersen (2019) showed that fashion brands face a number of challenges when developing circular business models within their organizations, including divergent perspectives on value and unclear success criteria, poor alignment with existing strategy, limited internal skills and competencies, and limited consumer interest.

Lewandowski (2016) conducted A literature review was conducted to categorize characteristics of the circular economy using a business model structure. Eight sub-domains of research were used to redefine the business model canvas, with two new components identified: the take-back system and adoption factors, resulting in an extended framework for the circular business model canvas.

Haupt & Hellweg (2019) proposed an environmental impact indicator that measures the value retained through reuse, remanufacturing, repair, or recycling. It shifts focus from end-of-life to the entire life cycle, including primary material substitution. The indicator allows monitoring of the transition to a circular economy from an environmental, economic, and social perspective. It provides examples and reveals common misconceptions about the circular economy's environmental performance.

Hysa et al. (2020) explored the impact of a circular economy on European Union economic growth and the role of environmental-social-economic indicators. It uses fixed-effect panel data analysis and generalized methods of moments to compute the Arellano-Bond dynamic panel data estimation method. Both models show strong positive correlations between a circular economy and economic growth, emphasizing sustainability, innovation, and investment in no-waste initiatives.

Kouakou et al. (2023) examined how a circular economy (CE) affects SME sustainability performance and the pros and cons of adopting one. About 130 UK SMEs were polled and evaluated using mixed methods. Results demonstrated that all CE areas affect economic performance, but only manufacturing and use affect environmental and social performance. The research highlighted sustainable strategies, resources, and competences for all CE domains and CE implementation obstacles in SMEs.

Sakthivelmurugan et al. (2022) investigated the effective use of paper waste in this context by employing circular economy principles. The 9R model is used for subjective analysis of paper-making processes, while the fuzzy DEMATAL method is used for pairwise comparisons. Additional research is being conducted on how solid waste and waste heat are treated as inputs for secondary products such as agricultural products and fuel. This transition to circular economy principles is critical for meeting future resource demands as well as ensuring sustainable resource utilization.

Fonseca et al. (2018) highlighted the importance of Circular Economy (CE) in profitability and value creation, highlighting the need for new business models beyond the traditional "reduce, reuse, and recycle" approach. The adoption of CE is positively influenced by EMS certification status and commitment to improving environmental performance. However, CE activities remain modest, necessitating a more supportive environment and stronger support from supply chain agents and customers.

Veleva & Bodkin (2018) discussed the role of small entrepreneurial enterprises and major corporations in promoting the circular economy, highlighting their potential to bridge the gap

between small and large corporations. Key drivers include sustainability pledges, EU and US regulations, reputation, and local sourcing. Technology, expertise, and strategic alliances help reduce costs, time, energy, environmental impact, and resource consumption.

Hazen et al. (2017) examined customers' desire to migrate from buying new to remanufactured items using macro-level variables such as price, government incentives, and environmental advantages, with the moderating impact of micro-level consumer views. The results imply that a customer's attitude about remanufactured items is a significant moderating element in predicting consumer switching behaviour to remanufactured products.

Salmenperä et al. (2021a) suggested that a Comprehensive Environmental Regulation (CE) can be achieved by highlighting its economic benefits, enhancing waste-related data sharing, and fostering dialogue among stakeholders. Harmonization of regulations and interpretations is also necessary. The waste management sector could play a more diverse role in implementing CE, offering waste processing services to the manufacturing industry.

Ghisellini & Ulgiati (2020) investigated Italy's transition to a circular economy by analysed 292 companies and their use of circular business models. It stresses the engagement of many entities, such as for-profit and non-profit organizations, research institutions, and universities, as well as the 6R practical framework, which promotes recycling as the preferable practice across the supply chain.

What are the Current Challenges for Marketing in the Circular Economy?

Customer awareness and adoption pose significant challenges for marketing in the consumer electronics industry. The introduction of the Circular Economy brought in the emergence of new product categories, including waste-based items and remanufactured products. (Pisitsankkhakarn & Vassanadumrongdee, 2020) The results suggest that there is a favourable correlation between attitude and subjective norm and customers' purchasing intention towards remanufactured items. Factors that stimulate product and price, when combined with attitude, have a considerable impact on customers' desire to buy, with a substantial effect size. The results indicate that effective collaboration between government agencies and industry stakeholders is necessary to promote customers' intention to buy remanufactured items in developing economies. This collaboration should focus on improving the quality and pricing of these products.

Decision (2015) conducted a thorough examination of the literature on Circular Economy (CE) and identified many obstacles and possibilities for implementing CE from social, political, economic, legal, and environmental standpoints. The results emphasize the primary obstacles, prospects, and advantages of Circular Economy (CE) for the industrial sectors in the United Kingdom and European Union.

Chamberlin & Boks (2018) revealed 10 separate sets of concerns or 'factors' from previous literature that impact customer acceptance of circular value propositions. It then applies two design-related frameworks, the Dimensions of Behaviour Change and Design with Intent, to study online communications from four circular goods and service stores. It also recommends future marketing and communication strategies for use in both commercial and academic projects. It suggests that design frameworks are a viable and complete tool for examining marketing tactics and proposing more nuanced alternatives than, say, green marketing.

According to Souza et al. (2021) the results, measures to reduce food waste based on circular economy principles must begin with an awareness of F&V phases of degradation. With this insight,

a variety of activities may be performed to mitigate the detrimental impacts of the degradation. Sensors and augmented reality may help manage prices, sales, operations, and purchases, enabling dynamic pricing, storage, and item display. The results assist to demonstrate how digital technology may help supermarket marketing departments drive company sustainability while also improving customers and social well-being.

Dieleman & Martínez-Rodríguez (2019) examined Mexico's opportunities and challenges, revising the following elements of their conceptual model: "market trends and conditions"; "competitiveness and productivity"; "the political and regulatory framework"; "education, training, and knowledge transfer"; and "learning culture". They conclude with some findings about Mexico's potentials and obstacles in transitioning to a circular economy. Sönnichsen (2023) presented reasons for adopting a different viewpoint on the conventional linear value chain and the challenges managers face when transitioning from a reductionist approach to sustainability to a closed-loop approach. Advocates argue that adopting circular economy concepts and actively managing value chain processes with eco-centric dynamic capabilities may lead to more significant transformations compared to the gradual and narrow approach often associated with being an environmentally conscious corporation.

Existing research highlights the critical role of consumers in the success of circular business models. There are signs that the performance of marketing initiatives might be greatly improved by educating the carefully chosen target market.

Mostaghel & Chirumalla (2021) revealed crucial elements influencing consumers' ethical purchasing intentions for circular business models in the retail industry. Based on macro-theories of human behaviour, this research provides a theoretical model that may take into account the essential components and variables that influence consumers' ethical buying intentions for the circular business model. The research adds to the corpus of knowledge on circular business models in the retail industry by investigating the problem from the consumers' viewpoint.

Galati et al. (2022) examined consumer behaviour and factors influencing purchasing eco-friendly mineral water bottles, using the University of Palermo student population as a reference. The study uses a fuzzy method to analyze complex consumer behaviour. Results show a strong sensitivity towards green bottles, emphasizing the need for new marketing and policy ideas based on customer attitudes, behaviours, and socioeconomic features. This research offers policymakers insights into developing regulations to improve sustainable corporate operations and green consumption within circular models. (Principato et al., 2021) aimed to evaluate literature on food waste from 2000-2018, focusing on consumer-level aspects. Based on the review and behavioural and marketing theories, a new framework called "The Household Wasteful Behaviour Framework" was proposed to better understand household food waste behaviour. The findings could be used to focus social norms and educational initiatives at both private and public levels.

According to Alizadeh-Basban & Taleizadeh (2020), the circular economy (CE) and marketing efforts are crucial for capturing market share in today's complex supply chain. To reduce carbon emissions, CE responsibilities include investment in green production, cap and trade regulation, and hybrid remanufacturing. Three game theory techniques are used: the manufacturer-Stackelberg game (SM), the distributor-Stackelberg game (SR), and the Nash game (N). The primary aim of this article is to maximize SC profits and enhance CE and marketing goals. Results show that the SM game, where the manufacturer re-manufactures most defective items collected by the

distributor, is the best strategy for increasing profits for both distributors and manufacturers. The SR game optimizes member earnings and enhances differentiating aspects.

Confente et al. (2020) discussed what may lead to market acceptability of this specific form of bioplastic from the standpoint of consumers rather than producers. A conceptual model is designed to address psychological motivations that might support customers' shift from a linear to a circular economy, with the goal of better understanding what motivates consumers to switch to and buy organic waste-derived goods. In particular, green self-identity has a beneficial influence on perceived worth, leading to increased behavioural intention. In addition, self-congruity moderates the connection but not differences in product engagement.

Leenders et al. (2024) stated that Layton's Marketing Systems approach is critical for addressing the triple-bottom-line (TBL) of economic, social, and environmental concerns in a comprehensive manner. We describe how this systemic approach might help to build successful marketing interfaces for a more sustainable circular economy (CE). Marketing has a history of understanding and expanding consumption, but it is also a key component in the movement toward a more sustainable society, as seen by examples of eco-communities as well as sustainable food marketing systems.

Alonso-Almeida et al. (2020) examined the impact of soft and hard actions on circular consumption and market competitiveness. A structural equations modelling statistical study was conducted using 1,281 responses from various sorts of stakeholders. The findings suggest that soft activities help to accomplish both aims, but hard initiatives simply impact higher circular consumption. However, the perceptions of the many stakeholders studied are quite diverse. It demonstrates that not all institutional promotion efforts are successful.

Camacho-Otero et al. (2017) explored the consumption-related aspects of the circular economy, focusing on consumer behaviours, factors influencing adoption of circular products and services, strategies for introducing circularity to consumers, business models, design, and communications strategies, and discussing challenges of circular consumption.

Koeijer et al. (2016) examined packaging development models and tools for circular systems, categorizing them into generative and evaluative categories. The models include protocols, diagrams, and evaluations, with protocol-type models focusing on principles and guidelines, diagram-type models on sustainable development, and evaluation-type models like LCA. The analysis identifies three types of integration for developing circular product-packaging combinations: integrated product packaging development, cross-functional actor integration, and front-end sustainability considerations.

Donner et al. (2021) explored the success and risks of eco-innovative business models that convert agricultural waste into valuable products. It identifies five key factors: technical and logistic, economic, financial, marketing, organizational, spatial, institutional, legal, environmental, social, and cultural. Key factors for the agricultural sector include innovative technologies, flexible logistics, joint R&D investments, price competitiveness, partnerships, space availability, subsidies, waste management regulations, local stakeholder involvement, and bio-based production processes.

Gåvertsson et al. (2020) explored the idea of a comprehensive labelling scheme for ICT products in Sweden to promote the use of re-used and remanufactured products. It identifies factors such as marketing, funding, network establishment, and quality criteria. However, the study also highlights a trade-off between the information conveyed by the label and the costs

to verify these aspects. The Swedish ICT re-use sector could benefit from such a scheme if it has wide stakeholder participation and government support. The study suggests linking quality labelling to public procurement processes to enhance its effectiveness and efficiency.

Korhonen et al. (2018) describes six issues, such as thermodynamics and system boundaries, that must be addressed for CE to contribute to global net sustainability. These six problems also serve as study subjects and goals for academics interested in advancing sustainable development via the use of circular economy.

CE is significant because of its capacity to draw both the corporate and policymaking communities to sustainability efforts, but scientific study is required to ensure that the real environmental consequences of CE contribute to sustainability.

What are the Opportunities for Marketing in the Circular Economy?

Govindan et al. (2019) examined possibilities to enhance marketing techniques for remanufactured items by analysing customer behaviour, price, branding, and green transportation options. This editorial note summarizes the findings of the papers published in this special issue, as well as discussions on various factors influencing marketing issues for remanufactured products, such as marketing attributes, customer willingness, pricing practices, and performance evaluation methods. The final conclusion demonstrates that there is enough room to investigate diverse views on the difficulties of marketing remanufactured goods across many domains of application.

Mura et al. (2020) examined the actions of small and medium-sized enterprises (SMEs) in embracing the circular economy (CE), focusing on barriers, enablers, and the relationship between CE, business strategy, and performance. SMEs are implementing multiple CE practices simultaneously, demonstrating a systemic approach to value creation. Waste management is widely used, with 84% of companies collecting separated waste. Early adopters face higher costs, but companies implementing CE see it as a business opportunity, demonstrating that CE can be a source of value creation for businesses, particularly SMEs.

Oliveira et al. (2018) this research is to contribute to the growth of Brazil's circular economy by analysing the problems and possibilities for the furniture cluster. The findings show how well enterprises comply to the strategic principles for a circular economy in the cluster setting, as well as the disposal mechanism and end destination for the sectors' primary solid residues. This technique allows for the certification of the potential for circular economy growth and consolidation in the local production arrangement.

Hazen et al. (2020) investigated specific ways in which basic SCM operations might aid in the shift from conventional linear production and consumption to a more circular approach. This study provides a conceptual framework and research agenda for academics and practitioners seeking to modify existing supply chain operations to facilitate CE adoption.

Salmenperä et al. (2021b) investigated the use of the circular economy (CE) in SMEs, focusing on techniques and resources for encouraging eco-innovations, gaining a competitive advantage, and aligning with nature. A mixed-method approach, which included literature reviews and focus groups, was used to identify methods and internal and external elements for SMEs to implement CE, as well as practical dynamic opportunities for improving company performance.

Queiroz et al. (2021) sought to understand Brazilian customers' desire to buy recycled PET items. The results revealed that customers' inclination to buy recycled items decreased when they perceived them to be of inferior quality. Furthermore, the sustainability of recycled items had a

beneficial impact on purchasing intentions. Furthermore, recycled items had a negative effect on perceived safety, which may affect the purchasing of recycled products in Brazil.

Ivanova (2020) examined the potential of a circular economy in Bulgaria, focusing on resource efficiency opportunities in both corporate and governmental sectors. Based on a survey of 400 employers, it reveals that implementing eco-friendly business strategies can reduce costs, improve compatibility, and boost exports. However, the study also highlights barriers to achieving a circular economy and calls for accelerated eco-fiscal reforms and innovative government policies.

Iakovenko et al. (2023) proposed a conceptual system-dynamic model of the circular economy ecosystem, presented in seven blocks. Each block focuses on the influence of circular economy principles on the model's indicator elements. The authors suggest new organizational structures to support the circular economy concept, provide waste minimization, and close the cycle from extraction to disposal.

Källman (2016) explored the motivations, opportunities, and challenges faced by companies that rent items in marketplaces dominated by sales enterprises. It interviews representatives from six businesses using economic sociology and agency theories. Common characteristics include attempting to create rental in their market, lacking role models, and viewing renting as unfamiliar to potential customers. Differences are mainly determined by consumer type, goods, and whether they operate on a rental basis or as a side project.

CONCLUSION

This literature review on marketing in the circular economy emphasizes the field's dual character, emphasizing both significant obstacles and new potential. Marketing is critical in eliminating inefficiencies and fostering sustainability, since research demonstrates the necessity for creative company models and community participation. Customer awareness, adoption obstacles, and diverse consumer attitudes remain challenges, demanding stronger marketing tactics that address these difficulties while also promoting circular behaviours. Despite these challenges, there are significant prospects for expansion. The transition to a circular economy fosters the development of innovative technologies and new business models centered on longevity and resource efficiency. Future trends are expected to employ digital technology to increase customer involvement and sustainability-focused branding, while new product designs and eco-friendly practices gain traction. This changing environment provides an opportunity to improve marketing tactics, incorporate sustainability into core goals, and increase acceptance of circular economy ideas. Overall, the transformation to a circular economy provides obstacles, but it also creates opportunities for marketing innovation and strategic development.

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SUPPLY CHAIN MANAGEMENT FOR REGENERATIVE ECONOMY

Agro-Industrial Waste Valorization: A Pathway to Circular Economy and Sustainable Resource Management

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Abstract

Population growth and expansion of industries, globally is the major concern for improper management of agro-industrial waste. The food chain industry including agriculture and food processing industries generate large volumes of waste and if not managed properly, this waste poses high risks to the environment and public health. Concomitantly, the same can also be utilized to create new opportunities in the existing market. With technological advancements a global shift is witnessed towards the principles of circular economy. Thus, agro-industrial wastes can be reused and recycled to produce biofuels, biochar, biofertilizers, antibiotics, enzymes, and animal feed. For instance, bio fuels such as bio ethanol and bio diesel derived from agricultural wastes are environmentally friendly, cuts down on greenhouse emissions and at the same time provide energy security. Brazil, the U.S. and India are extemporizing the need-based policy making for circularizing the linear economy trends as it holds the promise of meeting the growing energy demands in a sustainable manner. However, the challenge of waste management is still a burning issue in many developing countries. Lack of infrastructure, obsolete policies and limited access to technology are retarding factors. For these countries to be able to incentivize the benefits of sustainable waste management, there is therefore the need for strategic global partnerships, policy changes and need based investment in commercial research and development practices. Bio-economic agro-industrial waste management models are key to achieving the vision to considerably reduce waste generation, reuse wastes, recycle wastes and attaining the Sustainable Development Goals (SDGs). In this way, the loop of waste closing and its reuse or recycling provides the path to minimize the environmental impact of industries, thereby evolving newer techno-commercial avenues.

Keywords: *Agro-industrial Waste, Circular Economy, Bio-economic Agro-industrial Waste Management Models, Energy Security*

INTRODUCTION

Dealing with wastes has become a global challenge with advent of industrialization and anthropogenic activities at large. A large fraction of wastes is bio-degradable and organic in nature which finds its fate in landfills and dumping yards. Most common ones belong to rotten fruits and vegetables, flowers and food waste from farms. However, with lack of proper management practices, they pose a significant threat to environment in terms of eco-toxicological manifestations (Singh et al., 2017). By considering eco-friendly approaches including microbial solutions, organic waste could be transformed into valuable assets possessing industrial applications. For

instance, agricultural waste can be used to produce biochar that assists in the improvement of soil (Singh et al., 2013). Temple and household waste on the other hand could be utilized in producing natural dyes for textiles or parts of biochar-based fertilizers (Bernai et al., 1998). The concept of a Circular Economy encourages us to cease viewing waste solely as trash. Instead, we should consider it aa a "by-product" that still carries value. This method of thinking parallels to how nature operates, where there is no such thing as waste. In natural ecosystems, one organism's waste becomes another's resource, resulting in a loop that produces no remaining waste. Thus, by adopting the circular economy model we can mimic nature's highly efficient systems and convert waste into some valuable products. In recent times, unit operations of different industries have replaced nature's waste-free cycles with systems that create more waste than the environment can absorb leading to Linear Economy Model, that results in the production of immense amounts of waste. Figure 1 represents a comparison of Linear vs. Circular Economy Systems.

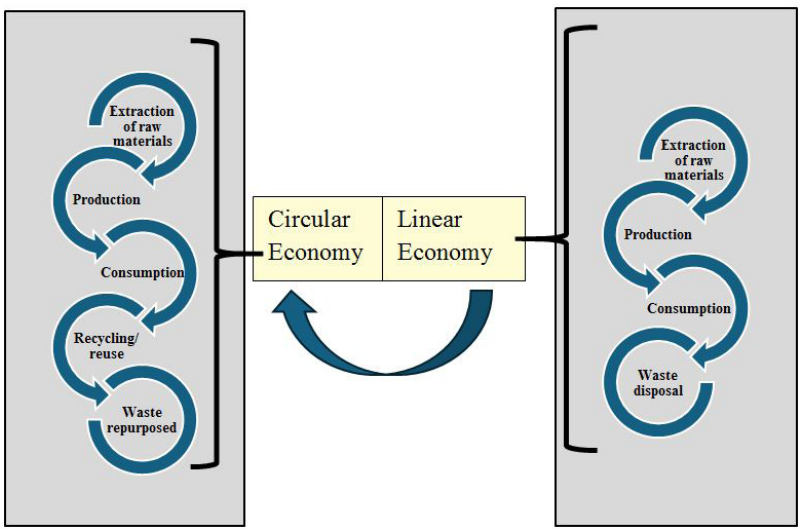


Figure 1: Linear System vs Circular Economy System

With the advent of industrial infiltration, digitalization, and an ever-growing population, the economy of our country is experiencing rapid growth. The multifaceted industrial sector has witnessed substantial development. Conversely, the extent of waste (solid and liquid) generated by different unit operations in diverse industrial sectors requires attention at a global level to mitigate issues related to environmental pollution. To conserve energy, economy, environment, and non-renewable resources, efficient recycling of all waste types has become a global concern. This necessitates extensive research and development work towards exploring novel applications and maximizing the utilization of existing technology for sustainable and environmentally sound management.

Problem Statement

The increase in number of industries and population has raised big issues regarding waste disposal, especially of the agro-industrial type. Annually, these agricultural, food processing, and other related industries generate large quantities of waste which are crop residues, animal products, and food processing residuals among others. Agriculture in India produces about 683 million

tons of waste every year, and many of them are never treated before disposal. If the waste is not disposed of properly, then it will end up polluting the soil, water, and even the air causing much havoc in the environment. Methane, which is a greenhouse gas, will be emitted when organic waste decomposes and impacts climate change (Durgapal and Upadhyay, 2020). The problem, therefore, is not the generation of such waste but how to change its perception from a nuisance to an asset. However, a bigger portion of this waste can be recycled nowadays with modern technology. Crop residues and animal wastes can be transformed into biofuels like biogas and bioethanol or into biochar used for soil improvement.

Global Scenario

The problem of managing agro-industrial waste is a global issue and is becoming more dangerous as industries and populations are growing. Agriculture, and the various related industries have been generating a lot more waste than ever before and if it is not managed properly, it can pollute the environment, degrade the soil, and pose many health risks to the people. This is why more countries are beginning to embrace the concept of the circular economy to address this problem. While in the past waste was considered as something to be disposed of, it is now considered as something that can be reused to produce many products. Biofuels are a good example of this change of gear. Thus, the U. S., Brazil, and India are among the leaders in the investment in the conversion of agricultural residues into renewable energy sources, bioethanol and biodiesel. These biofuels assist in the reduction of our dependency on fossil fuels and in the reduction of greenhouse gas emissions (Awasthi et al., 2015). Nevertheless, not all regions are developing at the same rate. The major issues that developing countries are experiencing include a lack of infrastructure or policies that can support such technologies (Sarkar et al., 2012). Another emerging problem is global food waste, which aggravates the issue of waste in the agro-industrial sector. According to the report, approximately 1.3 billion tons of food is wasted across the world, which causes environmental and financial losses of up to $2. 6 trillion each year (Rahmani et al., 2022). While some of these are being processed into animal feeds or biofertilizers, this option is more popular in the developed world than in the developing world (Makhania and Upadhyay, 2015).

In conclusion, it can be stated that there is a gradual shift towards increased concern for waste management but not all countries are in concordance with this. The developed countries are advancing with new technologies while the developing countries are still struggling. To fill this gap, there is a need for more cross-country partnerships, and funding in structures, studies, and guidelines to assist everyone to address agro-industrial waste in a better manner (Korasapati et al., 2023).

CIRCULAR STRATEGIES FOR AGRO-INDUSTRIAL WASTE UTILIZATION

As the problem of agro-industrial waste production rises internationally, it is evident that conventional disposal methods are insufficient. As a result, industries and researchers are seeking new approaches that address environmental and health issues while at the same time generating value. This has been made possible by implementing the circular economy whereby waste is turned into value. This review aims to demonstrate how waste can be turned into products such as vermicompost, biofuels, biochar, antibiotics, and animal feed to illustrate how efficient waste valorization can spur sustainability and economic development.

Reusability Options for Floral and Carnation Waste

Religious ceremonies and cultural celebrations are some of the major sources of floral waste that are considered part of the municipal solid waste. Spiritual activities like worshiping ceremonies, festivals, and other functions produce lots of floral wastes, which are improperly disposed of, and end up littering the roadsides and other public places (Sharma et al., 2017). Floral waste is another type of organic waste that takes longer to decompose as compared to other wastes like kitchen waste. This slower degradation rate puts a lot of pressure on the need to find sustainable and eco-friendly ways of managing the waste (Jadhav et al., 2013). Temples are one of the major contributors of floral waste since large quantities of flowers are used daily for offering purposes. It is believed that single temple can generate floral waste between 50 to 60 kg and most of it is either left to rot on the land or dumped in water bodies (Makhania and Upadhyay, 2015). This improper disposal not only results to environmental blots but also poses severe health risks to the people. Floral waste when dumped on the open ground becomes a breeding place for mosquitoes and flies particularly during the rainy season thus contributing to the spread of diseases. Also, the generation of leachate from the decomposing floral waste is another problem since it may pollute water sources such as rivers or wells leading to water borne diseases. In this regard, the best and most technologically feasible solution that has come up to manage floral waste is vermicomposting. Vermicomposting is a process of decomposition of organic matter with the help of earthworms to produce floral waste compost. This method not only enhances the rate at which floral waste degrades but also generates a soil enhancer of high value to agriculture (Lim and Wu, 2016). By converting flower waste into compost, we can somewhat reduce the impact of floral waste disposal on the environment and give a byproduct that may promote soil health and fertility. This is an exercise towards waste management that promotes sustainability and a circular economy, ensuring that the garbage resulting from cultural and religious activities is reused into something useful and does not pollute and pose risks (Li et al., 2013). Figure 2 deals with the flow sheet to produce vermicompost from floral waste.

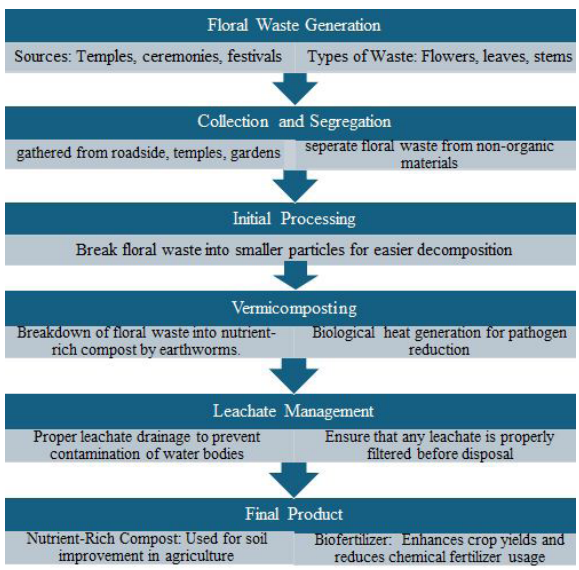


Figure 2: Flowchart to Produce Vermicompost from Floral Waste

Biofuels

It is in the last few decades that the use of fossil fuels has led to emission of pollution and greenhouse gases into the atmosphere, especially within the urban areas (Sarkar et al., 2012). Due to these problems, which include global warming and air pollution, we now need to look for cleaner and renewable sources of energy. The primary purpose of fuel production is more concerned with providing energy to the world while being renewable and environmental-friendly as well (Pattanaik et al., 2019).

This puts biofuels at an approximated share of about 8% of the total fuels used in road transportation, compared to 3% today. Ethanol is the largest biofuel, accounting for 75% of all the biofuel used globally (Awogbemi and Kallon, 2022). Most demand for biofuels is going to come from countries such as the U.S., India, China, Brazil, and those in the European Union (Awasthi et al., 2015).

Therefore, biofuels are a good way of dealing with wastes produced in farms and industries. They assist in eradicating environmental and economic challenges since they transform waste into renewable energy. Biofuels reduce greenhouse gases and are a better option than fossil fuels. In this way, they contribute to the minimization of waste and the slowing down of global warming. While the world continues to seek for clean energy sources, biofuels will have a larger role in the efficient disposal of wastes.

Biochar

Biochar is a carbon-rich material produced through the pyrolysis of various biomass types, like plant waste, food waste, and animal waste. Slow pyrolysis yields more biochar compared to fast pyrolysis, thus making it an efficient process for this biomass conversion. There have been many researches that show that biochar can be generated from a wide range of lignocellulosic biomass (LB) sources such as rice husk, cassava stems and rhizomes, sugarcane bagasse, corncob, and wood. Its unique structural properties makes it resistant to decomposition, therefore offering a wide range of benefits when applied to soil. Biochar improves the physiochemical properties of the soil. Additionally, biochar enhances soil aeration and moisture retention, which is vital for agriculture cultivation and increasing the rate of productivity in agribusiness. In this way, biochar creates a wholesome environment for growth: microbes, that are instrumental in nutrient cycling. (Wijitkosum, 2022). Another advantage of biochar is that it reduces the amount of fertilizers consumed and limits nutrient leaching, especially in tropical regions whose soils are largely degraded. Besides agriculture, biochar contributes to other global environmental challenges. Studies have established that the application of biochar to the soils reduces greenhouse gas emissions; thus, it is a practical tool for combating climate change, land degradation, and drought. Its applications include horticulture and specialized crops, where around 20% of the biochar is utilized to boost soil nutrient content. Furthermore, biochar-based fertilizers are becoming popular because they improve soil quality, particularly in locations where the soil is poor or completely degraded. In conclusion, biochar improves soil health, thus enhancing environmental sustainability (Rex et al., 2023).

Antibiotics

Antibiotics are bioactive substances that fight microorganisms selectively and are vital in the health of humans and animals. However, with the increase of population, globalization,

industrialization, the usage of antibiotics has risen as well and currently stands at more than fifty thousand tons a year. In view of this, it has become necessary to seek more cost-effective alternatives for the manufacture of antibiotics. Corn cobs, saw dust, rice hulls, and peanut shells are some examples of waste materials that are full of bio-compounds. These agro-wastes can be effectively utilized for the industrial manufacture of antibiotics using the right fermentation processes. The type of outer material used, and the type of processing that is done defines the content, amount and quality of the antibiotics obtained from the agro-waste. A special kind of waste is agri-food waste which can be defined as organic waste generated during food production or food processing. This waste such as crop waste is highly saturated with phytochemicals especially of such significant bioavailability that is beneficial to animals and human health. There is a potential for significant gains from the enhancement of agri-food waste using bioactive chemicals that are found in food waste. Antibiotic resistance poses a huge risk to human and animal lives. Antibiotic Resistant Bacteria (ARB) have complicated diseases and significantly increased the medical expenses. It is widely considered that the mobilization of ARGs is associated with environmental pollution, especially in water bodies. The use of animal manure and human waste as fertilizers which may contain ARGs also help in the spread of the genes in agricultural settings. Despite the fact that the potential of ARGs as a source of health risks has not yet been fully elucidated, it is clear that antibiotic resistance is one of the biggest challenges to human health in the present-day world (Wang et al., 2022). The phenomenon of antibiotic

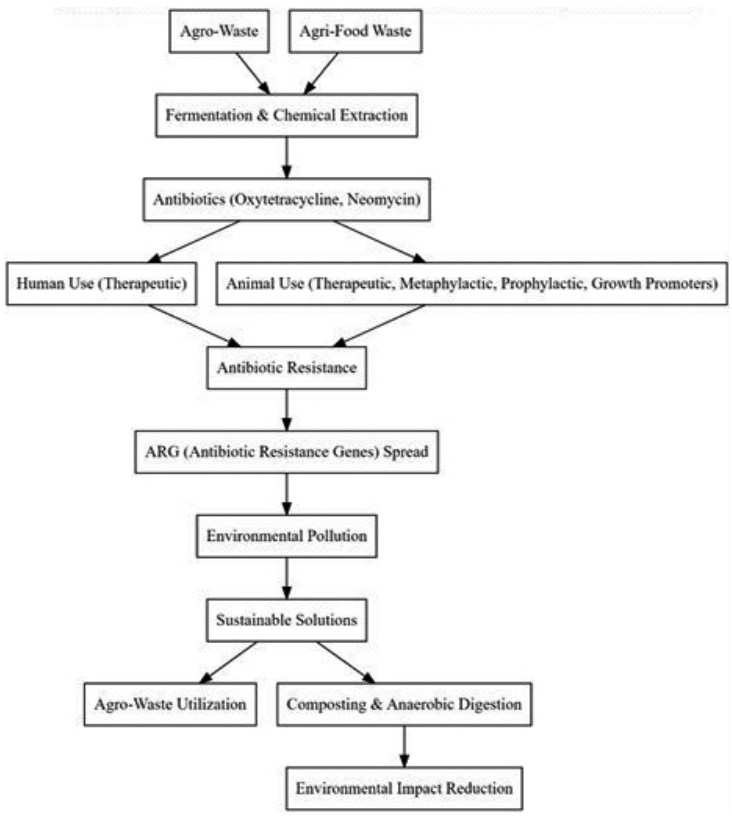


Figure 3: Pathways of Antibiotic Resistance and Sustainable Agro-Waste Management Solutions

resistance, which means that bacteria can survive even in the presence of antibiotics, is a global health issue due to its link with increased infections and associated costs. Fluoroquinolones, sulfonamides, and tetracyclines, which are often used in animals and excreted in manure, are on the WHO's list of critically important antibiotics for humans. Antibiotic treatments, especially in animal production, are given orally through feed and water, injection or topical (Van Epps and Blaney, 2016). Antimicrobials administered to animals are for therapeutic, metaphylactic, prophylactic or growth promoter uses. For instance, 16% of the lactating dairy cows in the US are administered antibiotics for mastitis annually and 15% of the beef calves are treated with antibiotics for respiratory diseases (Wang et al., 2022). The three processes of composting, anaerobic digestion and lagooning have been observed to have high efficiency in the treatment and elimination of antibiotics. These methods are important because agricultural waste like corn cobs, sawdust and rice hulls can be used to produce antibiotics like oxytetracycline. Not only does the use of agro-industrial waste make production less expensive, but it is also a better alternative for the development of antibiotics such as neomycin (Sadh et al., 2018). Figure 3 depicts the various pathways of Antibiotic Resistance and Sustainable Agro-Waste Management Solutions.

SCP

Single cell protein (SCP) is the biomass or protein of microorganisms which include algae, yeast, fungi, or bacteria that may be ingested by animals as well as human beings. SCP is superior to agricultural proteins because they need relatively less water than agriculturally derived proteins, take lesser space, and are not responsible for emitting greenhouse gases like agriculturally derived proteins are. Besides, SCP production enables the utilization of various biodegradable industrial wastes as substrates for microbiological growth, thus reducing the cost of SCP production and lowering the negative impact of these wastes on the environment. Industrial waste, mainly from factories, mills, and mining, can be used in the production of SCP. Some of these wastes include sludge and paper wastes, specific by-products of industries, and some of the waste gases. Agro-industrial wastes are remarkably nutrient and compound-rich, with nutrients that feed the microbes into SCP production. The interest in SCP mainly lies in its very high protein content and other valuable compounds. Hence, it can be used as a feed additive for humans and animals. Apart from its source as a protein supplier, the production of SCP leads to a decrease in waste treatment-related environmental impacts, thus being a bioproduct with multiple values (Carranza-Méndez et al., 2022).

SUGARCANE: A POWERHOUSE FOR NUMEROUS VALUE-ADDED PRODUCTS

Sugarcane processing produces a significant amount of waste from its by-products; for example, one metric ton of sugarcane generates about 280 kg of bagasse. Sugarcane bagasse is considered among the highest agro-food by-products and is also the least expensive feedstock for bioactive compounds recovery. These include major components such as cellulose (35–50%), hemicellulose (26–41%), lignin (11–25%), and secondary metabolites such as anthocyanins and other minerals (Oleszek et al., 2023). Many value-added products can be made of agricultural by-products (sugarcane bagasse, sugarcane tops, and molasses) such as enzymes, organic acids, amino acids, pigments, animal feed, bioethanol, biodiesel, biohydrogen, biopolymers, bio-electricity and many others (Korasapati et al., 2023). The main industries which profit from sugarcane bagasse are (Figure 4)

1. **Pulp and Paper:** It is through bagasse that the production of packaging, tissue, and writing paper reduces deforestation and turns the pulp and paper industry into a more viable business
2. **Bioenergy:** Energy through renewable sources is produced by the conversion of bagasse into bioethanol, which helps to increase the diversity of the energy mix and diminish the emission of greenhouse gases.
3. **Bioplastics:** Biodegradable cellulose, extracted from bagasse, can be used to make plastics that replace those based on petroleum-thus obviating a major environmental pollutant.

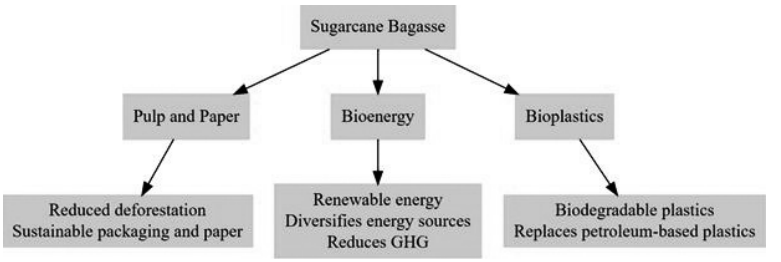


Figure 4: Applications and Environmental Benefits of Sugarcane Bagasse Utilization

CONCLUSION

This review underlines the great promise of agro-industrial waste as a resource for a number of uses such as biofuels, biofertilizers, biochar, antibiotics, enzymes, SCP, flavonoids, animal feed and many others. It also helps to understand the process of conversion of these wastes into high value products while solving both environmental and economic issues by synthesizing and analyzing the existing research. The review emphasizes the prospect of applying various technologies and approaches to convert agro-industrial waste into environmentally valued and beneficial products. This strategy also helps minimize the environmental effect by decreasing waste disposal, improving resource usage, and aligning with the circular economy model. By focusing on the potential of these value-added products, we can benefit various sectors and counter societal and environmental challenges. The use of these wastes can help not only in decreasing the use of non-renewable resources but also open up many new opportunities for economic development. This review also provides the researchers, policymakers, and the industry stakeholders with the evaluation criteria for future attempts to enhance the utilization of the agro-industrial waste. Thus, it outlines the directions for further development of sustainable practices and innovations in waste management and resource utilization by indicating the major challenges and opportunities, as well as the emerging trends in the field.

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Evaluating Circular Economy Transition: Bibliometric Insights and Indicator Analysis

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Abstract

The circular economy is the radical pathway toward attaining sustainable development through efficiency in resource use and waste reduction by closing product loops. The process of shifting to a circular economy is very challenging and complex. There are various obstacles, such as data availability for measuring circularity, complexity in indicators of circularity, and practical challenges involved in its application in varied industries. This study aims to present detailed bibliometric data of research on the circular economy and indicators used to measure the transition for the time period 2010 to 2024. The outcome expresses development concerning the literature on indicators' development to measure the progress of a circular economy. This contribution can provide insight into the state of current research on the circular economy and instruments measuring its progress, thus contributing to ongoing efforts to attain sustainable development and inspiring a larger diffusion of circular economy theories in real-world applications.

Keywords: *Circular Economy, Indicators, Bibliometric Analysis*

INTRODUCTION

Adopting a circular economy (CE) offers significant economic opportunities globally. For instance, by 2030, CE initiatives are projected to benefit European countries by €1.8 trillion (Bressanelli et al., 2018). The European Commission highlights that the CE could generate 600 billion euros in annual economic benefits for the EU's manufacturing sector (COM, 2015). This approach is promoted not only by the EU but also by other nations such as Japan, China, the US, Finland, and global enterprises. Moreover, India's transformation towards a circular economy could generate Rs.40 lakh crore (US$ 624 billion) annually by 2050 while reducing greenhouse gas emissions by 44%, providing profit opportunities, alleviating traffic congestion, and fostering innovation. It also decreases the use of virgin resources and artificial fertilizers [3] (EMF, 2015). The circular economy model replaces the linear take-make-use-dispose model, which is extremely unsustainable. It ignores the concept of 3Rs (reduce, reuse, and recycle). Geissdoerfer et al. (2017) defined the circular economy as a regenerative framework that aims to mitigate the utilization of resources, waste generation, emissions, and energy dissipation. This is achieved through reducing energy and material loops using durable design, ongoing maintenance, repair activities, product reuse, remanufacturing processes, refurbishment initiatives, and recycling practices (EMF, 2015). The notion has also acquired popularity among decision-makers, affecting governing bodies and international organizations at the regional, local, national, and global levels.

Advancements on a fast-paced note over the last five years have seen humans use up to 500 billion tonnes of raw materials, almost similar to the way this material was consumed in the entire 20th century. According to the statistics presented in the Circularity Gap Report based on

measurement of the materials' recycling or reuse proportion, in 2023, it had decreased from 9.1% in 2018 to 7.2%, and with the Circular Economy Foundation viewpoint in 2024. One exception to the few consensus areas vis-à-vis academic research on the circular economy in view of the fact that it is not a new concept lies in the subdivision into macro, meso, and micro levels (dos Santos Gonçalves & Campos, 2022; Barreiro-Gen & Lozano, 2020; Ghisellini et al., 2016; Schroeder et al., 2019; Kristensen & Mosgaard, 2020; Zhu et al., 2019). The macro level pertains to the national, global, and regional scales. The meso level focuses on sectors, industrial symbiosis, or eco-industrial parks. The micro level, called the firm level, includes firms, consumers, or individual products (Linder et al., 2017).

CE Indicators

Circular Economy envisions paradigm shifts from the current to the desired visions by identifying end states envisioned so far, intervening in the present systems, and measuring progress. The selection of indicators is important as they determine a system's behavior. Indicators have two major purposes: to provide direction for the future and past performance feedback for performance review. Therefore, quantitative indicators must monitor and steer the CE strategies (Ekins et al., 2019).

The term "indicator" lacks a commonly accepted meaning and has been characterized in numerous ways in the literature. Taking up the OECD's global perspective, this article defines an indicator as an element or variable that can be either quantitative or qualitative for measuring achievement, reflecting changes, or assessing development performance. Assessment tools are often referred to as "measures," "metrics," "index," or "indices." Using suitable synonyms is crucial for the comprehensive identification of existing indicators. Although there may be slight semantic differences, most researchers use them interchangeably. Circularity indicators are metrics or formulas that measure the transition toward a circular economy (Kristensen & Mosgaard, 2020).

So, the objective of this study is to present a detailed bibliometric review of research on the circular economy and indicators used to measure the transition from 2010 to 2024. Further, this study identifies circularity metrics' foundations, characteristics, and applications. The data was carefully collected from extensive literature reviews and academic databases, including various studies discussing circular economy indicators. The article is structured as follows: introduction, literature review, research methods, data analysis, and conclusion.

LITERATURE REVIEW

The review of literature is systematically arranged as it first describes the origin of the CE concept and some current scenarios. Further, it describes the development of C-indicators by different studies.

The Theoretical Background of Circular Economy

Researchers disagree on the origins of the circular economy. The concepts behind the circular economy are not entirely new. For example, the notion of using garbage as an energy source for commercial operations may extend back to the eighteenth century. There have been several efforts to pinpoint the philosophical and theoretical foundations of the circular economy (Ghisellini et al., 2016; Antikainen et al., 2018). Many academics believe that environmental economist, the one who first developed the circular economic system was (Pearce & Turner,

1989), based their theoretical framework on prior research by ecological economist Kenneth Boulding (Greyson, 2007; Ghisellini et al., 2016). Some researchers argue that its origins are in China (Liu et al., 2008). However, the aforementioned environmental and ecological economists are not regarded as the pioneers of the circular economy. As a result, a detailed assessment of the past two decades' worth of work revealed that the foundations of the circular economy originate primarily from the fields of ecological and ecological economics, in addition to the field of industrial ecology (Ghisellini et al., 2016; Murray et al., 2017). Geissdoerfer et al., (2018) studied the various business models linked to sustainability. They categorized them into 3 categories: sustainability business model innovation type, sustainable business model type, and sustainable business model strategies. It defines a sustainable business model as business models as one that includes proactive management of multiple stakeholders, creates value for diverse stakeholder groups, and maintains a long-term outlook. Lüdeke-Freund et al. (2019) performed a morphology analysis on 26 Circular economy business models (CEBMs) by using a literature review in which they defined the major dimensions and explored the characteristics of CEBMs. CEBMs are a subset of the sustainable business model. They found the 6 major CEBM patterns- maintenance and repair, redistribution and reuse, remanufacturing and refurbishment, recycling, repurposing and cascading, and use of organic feedstock in four major dimensions: Value creation, capture, delivery, and proposition.

CE Indicators

Circularity indicators serve several purposes as they assess various facets of industrial operations, ensure adherence to regulations and standards, track trends over time, aid decision-makers in supplier and technology choices, and inform the public about circular economy advancements (Matos et al., 2023). Various writers have proposed circularity micro-indicators as a simple way to track developments toward a circular economy at an organization or the product levels. However, those indicators lack standardization and differ significantly in complexity and technique. Some are overly narrow, concentrating solely on specific aspects of the product lifespan, which limits their practical applicability for companies (Matos et al., 2023)**.** Efforts such as those by Sassanelli et al. (2019) undertook a systematic literature review to identify current methodologies for assessing circular economy performance. Their findings informed the development of a positioning framework designed to measure and assess a company's degree of circularity, highlighting the need for clearer methodologies and broader applicability in industry contexts. These contributions underscore ongoing efforts to refine and expand the tools available for assessing and advancing circular economy principles in practice. Barrak et al. (2024) have proposed integrated approaches like the ECI-MCDA method, which combines environmental and circularity indicators to offer a holistic assessment of product circularity and environmental performance. Meanwhile, Roos Lindgreen et al. (2021) investigated the effectiveness of grey literature concerning indicators of Circular Economy (CE) and methodologies for life cycle assessment when assessing the circularity of products or processes. This study highlighted the persistent methodological variations within this particular field. Linder et al. (2017) have contributed by defining circularity metrics and evaluating their validity based on criteria such as content, reliability, transparency, generality, and aggregation principles. This led to the proposal of new metrics focused on product-level circularity. The measure described in this article has strong construct validity (i.e., it only considers product-level circularity). Corona et al. (2019)

classified circularity metrics into measurement indices and assessment tools, highlighting their varied applications and frameworks in circular economy assessments. The C-Indicators Advisor categorized all the circular economy indicators on various bases, such as level, loops, perspective performance, assessment framework, and sources. Additionally, Scheepens et al. (2016) developed product circularity metrics based on life cycle assessment, while Di Maio & Rem (2015) introduced the Circular Economy Index (CEI) for measuring circularity through material recycling. (Cullen, 2017) provides a circularity index to measure a product's circularity. Figge et al. (2018) formulated a performance indicator based on durability. Park & Chertow (2014) developed the Reuse Potential Indicator (RPI), which assesses the potential of materials for reuse rather than disposal based on current technological capabilities. This metric guide decision-making in recycling by evaluating how "resource-like" a material is compared to being "waste-like." It quantifies the maximum technical reusability of materials within economically and environmentally sustainable frameworks. The RPI underscores the importance of effectively utilizing waste materials, considering their varying quality, and promoting sustainable resource management practices (Park & Chertow, 2014). The Circular Economy Toolkit (CET) is an online assessment tool featuring 33 questions designed to examine the products' potential for improvement towards circularity, developed at the University of Cambridge. This non-point test aids in assessing and enhancing circular economy practices. Additionally, recycling rates (RRs), as highlighted by Haupt et al. (2017), serve as another indicator measuring the circulation of materials and the overall circularity of an economy. These tools contribute to understanding and promoting sustainable resource management practices within industrial and economic frameworks. Kristensen & Mosgaard (2020) categorized micro-indicators into resource efficiency, waste management, recycling, remanufacturing, reuse, disassembly, lifetime extension, and multidimensional categories, expanding the scope of circularity assessment. Matos et al. (2023) further advanced these classifications by introducing additional bases for indicator categorization and highlighting correlations across different classification schemes, enhancing understanding and application in circular economy assessments. Finally, Harris, Martin, and Diener (2021) reviewed recent literature focusing on the environmental implications of product and service circularity, underscoring the evolving landscape of circular economy research. These advancements collectively underscore the evolving methodologies and applications of circularity indicators in advancing circular economy goals globally.

OBJECTIVES OF THE STUDY

Present a bibliometric review of research on the circular economy and Indicators to measure the transition for the time period 2010 to 2024.

RESEARCH METHODOLOGY

Bibliometric analysis is a quantitative approach to analyzing vast amounts of scientific literature, including articles, books, and publications (Ellegaard & Wallin, 2015). Bibliometric analysis strives to give objective and quantitative analysis of scientific production, impact, and collaboration markers. Software tools for bibliometric analysis include CiteSpace, Gephi, VOSviewer, and Leximancer (Harari et al., 2020). To collect data, bibliometric analysis can employ databases like Web of Science (WOS) Core Collection, Scopus, and Google Scholar. Compared to other worldwide databases, Scopus is the most trustworthy and authoritative. As a result, the Scopus Core Collection database serves as the data source for this study.

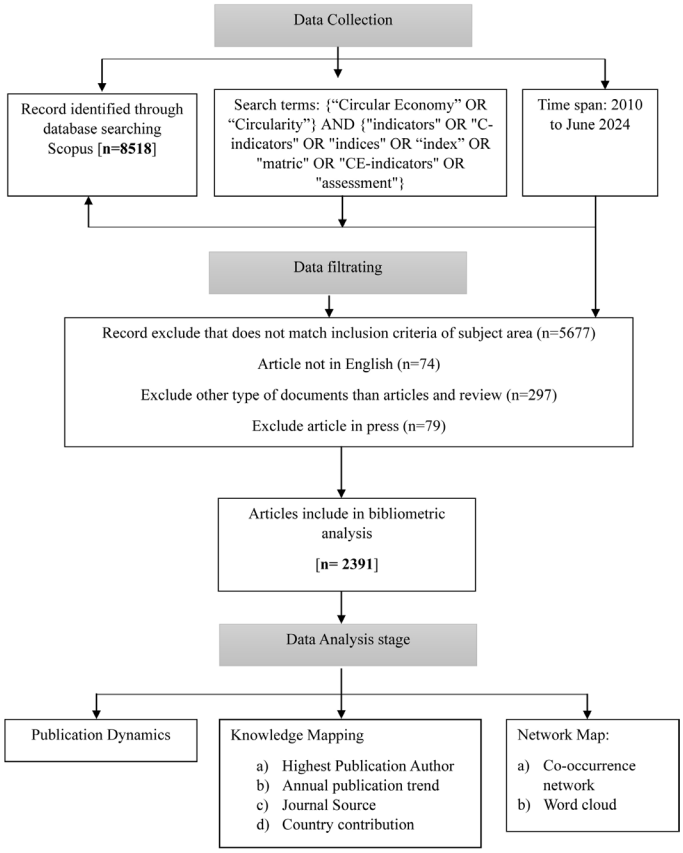


Figure 1: Research Framework

Table 1: Data Inclusion/Exclusion Criteria

Criteria		Research strings and filters for inclusion and exclusion criteria
Keywords (for search within Article title, abstract, keywords)		{"Circular Economy" OR "Circularity"} AND {"indicators" OR "C-indicators" OR "indices" OR "index" OR "matric" OR "CE-indicators" OR "assessment"}
Database	Academic	Scopus, Web of Science, Emerald, T&F, Google Scholar, etc. (for bibliometric data – Scopus)
	Non- Academic	Web page and reports of EMF, various research organizations, and government agencies through Google search.
Language		English
Publication years		2010 to 2024
Publication stage		Final stage
Subject area		{Business, Management and Accounting, Economics, Econometrics and Finance, Social Science, and Art and Humanities}
Document type		Article and Review
Total document found		2,391 documents
Software used		R Studio (Biblioshiny) and VOSviewer

This study conducted a comprehensive literature review to gather information on existing circular economy (CE) indicators, their purposes, approaches, and applications. To identify the foundations of circularity metrics, we concentrated on review papers, which compile information from different sources in a structured manner. This approach allowed us to trace the development and application of various CE indicators. We scrutinized the citations in these evaluation articles to identify the main sources for each parameter referenced, ensuring a thorough and precise summary of current CE indicators. This meticulous analysis involved thoroughly examining individual sources to understand the context and methodology behind each indicator.

Software: The data analysis was conducted using two software programs: R Studio and VOSviewer. VOSviewer was used to visualize the density of research efforts from 2010 to 2024. This software represented the growth and trends in research on CE indicators, highlighting key areas of focus and the field's evolution over time. In addition, R Studio facilitated detailed bibliometric analysis, allowing us to quantify and interpret the data meaningfully.

DATA ANALYSIS

A Bibliometric Review of Research on the Circular Economy and CE Indicators area from 2010 to 2024 (Publication Dynamics)

Main Information About Data

The dataset spans from 2010 to 2024, encompassing a variety of sources, including journals and books. A total of 372 different sources are represented in the data, comprising 2391 documents. The dataset has a noteworthy annual growth rate of 35.56%, showing that the number of articles is rapidly increasing over time. The average age of the dataset's documents is 2.82 years, indicating an emphasis on current research. On average, each paper has been mentioned 31.31 times, demonstrating the research's significance and importance in the academic community. The dataset also contains a large number of references, totaling 143,276.

- **Document Contents:** The dataset contains a wide variety of keywords, with 9527 Keywords Plus (ID) and 6351 Author's Keywords (DE). This diversity of keywords suggests that a wide range of topics and themes are being explored within the documents.
- **Authors:** The collection contains documents written by a total of 8085 authors. Among them, 123 authors wrote single-authored documents. The collaboration among authors is quite extensive, with an average of 4.2 co-authors per document. This indicates a high level of collaborative research. Additionally, 32.46% of the documents involve international co-authorships, reflecting the global nature of the research community.
- **Authors Collaboration:** There are 127 single-authored documents in the dataset, underscoring the collaborative nature of most of the research. The average number of co-authors per document is 4.2, further emphasizing the trend towards collaborative research efforts.
- **Document Types:** The dataset predominantly consists of articles, with a total of 2164 articles. There are also 227 review documents, which provide comprehensive overviews and syntheses of existing research on various topics within the dataset. This distribution of document types indicates a strong emphasis on original research articles, complemented by review articles that help to contextualize and integrate findings across studies.

Annual Publication Trend

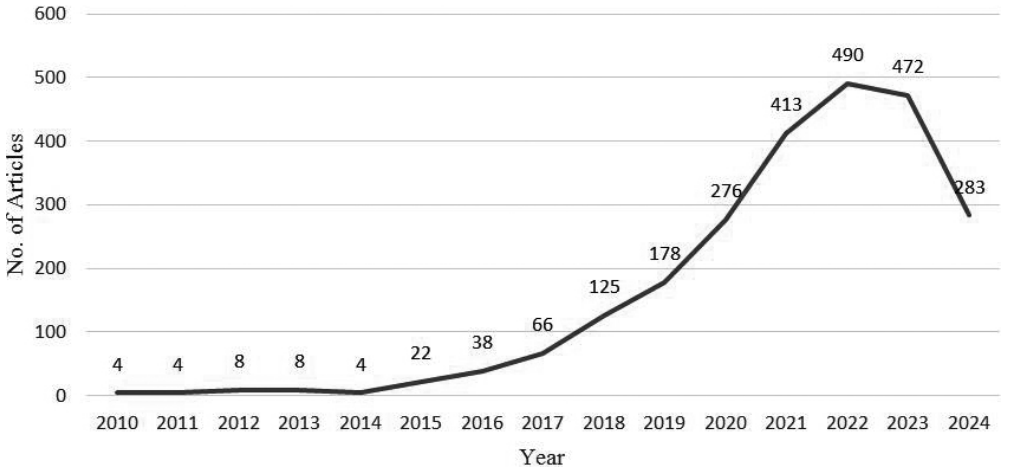


Figure 2: Annual Production Trend

Table 2: Scientific Publications on the Subject during the Years Related to the Study

Year	*Number of Items*	*Percentage*	*Growth*
2010	4	0.17%	–
2011	4	0.17%	0%
2012	8	0.33%	100%
2013	8	0.33%	0%
2014	4	0.17%	-50%
2015	22	0.92%	450%
2016	38	1.59%	73%
2017	66	2.76%	74%
2018	125	5.23%	89%
2019	178	7.44%	42%
2020	276	11.54%	55%
2021	413	17.27%	50%
2022	490	20.49%	19%
2023	472	19.74%	–4%
2024	283	11.84%	–40%
Total	2391		

The table shows the annual scientific production of research articles on the topic of circular economy and indicators from 2010 to 2024.

- **Initial publication stage (2010- 2014):** In the early years, from 2010 to 2014, the number of articles published each year was very low, ranging from 4 to 8 articles annually. This suggests that the topic of circular economy and indicators was not widely researched or perhaps not widely recognized during this period. There was a noticeable increase in research in the emerging growth phase from 2015 to 2017.

- **Rising phase (2015-2017):** In 2015, the number of items jumped to 22 (0.92%), with an impressive growth rate of 450%. This upward trend continued in 2016 and 2017, with 38 items (1.59%, 73% growth) and 66 items (2.76%, 74% growth), respectively, reflecting a rising interest and more contributions in this period.
- **Rapid development stage (2018-2021):** The rapid expansion phase occurred from 2018 to 2021 when the number of items surged from 125 to 413. The percentages rose from 5.23% to 17.27%, with consistently high yearly growth rates – 89% in 2018, 42% in 2019, 55% in 2020, and 50% in 2021. This period marked significant growth and substantial contributions to the field, indicating a peak in academic and research activities. This rapid growth phase suggests that the topic became significantly more important and a central research focus area. However, the peak and decline phase from 2022 to 2024 shows a shift in trend. In 2022, the research peaked at 490, representing 20.49%. In 2023, there was a slight decline to 472 items (19.74%), with a negative growth rate of -4%. This downward trend continued into 2024, with a significant drop to 283 items (11.84%) and a notable negative growth rate of -40%. Despite this decline, the numbers remain much higher than in the initial years, indicating sustained interest and continued research activity.

Distribution of Publication by Author

Based on bibliometric data for circular economy research, several prominent authors emerge as key contributors. Jo P. Dewulf leads with 22 publications and an average citation impact of 4.02, indicating substantial influence and scholarly output. Sergio Ulgiati follows closely with 15 publications and an impact of 3.25, demonstrating significant contributions to the literature. Other notable researchers include Steven De Meester and Yong Geng, each with 12 publications, contributing with impact scores of 1.97 and 2.21, respectively. Monia Niero, with 11 publications and an impact of 3.14, also stands out for her contributions. Morten Birkved and Dominik Wiedenhofer, both with 10 publications each and Daniela C.A. Pigosso and Helmut Rechberger, each with 9 publications, further enrich the field with their research outputs. These authors collectively shape the discourse on the circular economy through their prolific research and impactful contributions.

Table 3: Author with Higher Contribution

S. No.	*Authors*	*Articles*	*Articles Fractionalized*
1	Dewulf, Jo	22	4.02
2	Ulgiati, Sergio	15	3.25
3	De Meester, Steven	12	1.97
4	Geng, Yong	12	2.21
5	Niero, Monia	11	3.14
6	Birkved, Morten	10	1.96
7	Wiedenhofer, Dominik	10	1.72
8	Huysveld, Sophie	9	1.62
9	Pigosso, Daniela C.A.	9	2.49
10	Rechberger, Helmut	9	2.43

Distribution of Publication by Country

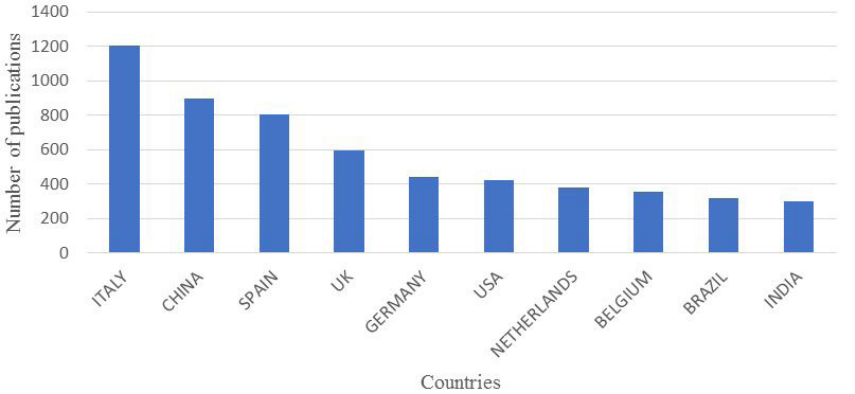


Figure 3: Countries Publication Trend for Year 2024

Table 4: Top-ranked Country's Contribution Assessment Over the Year

Country	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*
Italy	0	0	0	0	5	15	36	58	82	174	290	594	891	1113	1204
China	2	5	17	20	28	46	58	114	189	230	338	427	551	746	894
Spain	0	0	0	0	4	4	10	20	73	115	246	419	583	720	804
UK	0	0	0	0	0	3	11	54	97	160	225	319	423	521	594
Germany	0	2	3	9	9	11	24	34	47	72	124	194	290	393	444

Table 5: India's Contribution Assessment

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
India	0	0	0	3	3	6	6	12	15	33	40	88	166	232	297

From 2010 to 2024, various countries have made significant contributions to circular economy research, as indicated by the number of publications or research outputs each year. In 2010, there were negligible contributions from most countries, with only China starting with a small number of 2 publications. This trend continued until 2014, where a few countries began to show some activity: Italy and Spain both contributed 5 and 4 publications respectively, while China had 28.

A notable increase in contributions can be seen from 2015 onwards. By 2016, Italy had increased its contributions to 36, while China and Spain had 58 and 10 respectively. The UK and Germany also started to show up on the map with 3 and 11 publications. In the following years, the trend of increasing contributions continued. By 2019, Italy reached 174, China 230, Spain 115, the UK 160, and Germany 72.

The period from 2020 to 2024 witnessed a substantial surge in research outputs across all these countries. Italy's contributions jumped to 290 in 2020 and continued to rise, reaching 1204 by 2024. By 2024, Italy's contributions soared to 1204, maintaining its position as one of the top contributors in circular economy research. China steadily increased, hitting 338 in 2020, and by 2024, China reached 894 publications, showing consistent growth and securing its position as a leading contributor. Spain followed a similar trajectory, going from 246 in 2020 to 804 in 2024. The UK and Germany also saw significant increases, with the UK's publications rising from 225 in 2020 to 594 in 2024 and Germany's from 124 to 444 over the same period.

India, starting from no contributions in 2010, began to show activity in 2013 with 3 publications. By 2015, this number doubled to 6 and continued to increase gradually. In 2018, India had 15 contributions, which grew to 33 in 2019 and 40 in 2020. The most significant rise was observed from 2021 onwards, with contributions reaching 88 in 2021, 166 in 2022, 232 in 2023, and 297 in 2024.

Overall, these data indicate a growing global interest and effort in circular economy research, with Italy, China, Spain, the UK, Germany, and India showing notable increases in their contributions over the years. However, India ranked 8th in overall contribution after two countries, Netherlands and Sweden.

Distribution of Publication by Journal Source

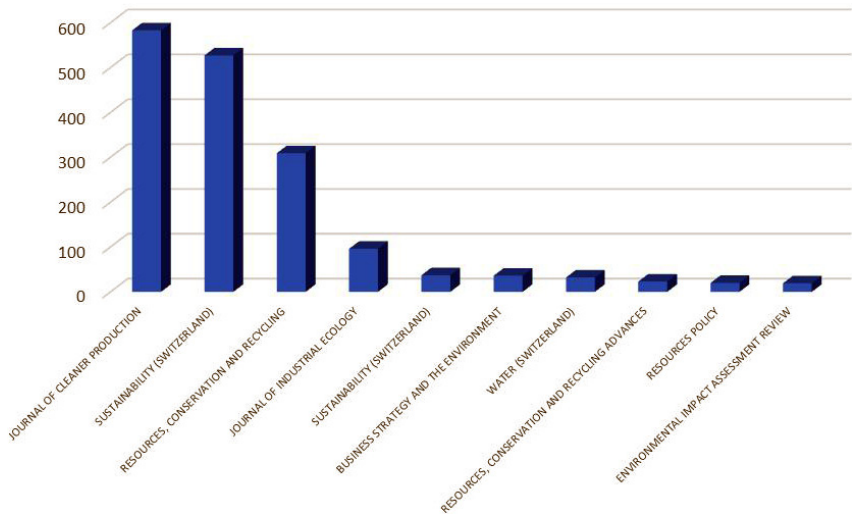


Figure 4: Key Journal Contributions Assessment

Key journals such as the *Journal of Cleaner Production*, *Sustainability (Switzerland)*, *Resources, Conservation and Recycling*, *Journal of Industrial Ecology*, and *Business Strategy and the Environment* have significantly shaped research on integrating circular economy principles. The *Journal of Cleaner Production* leads with 583 mentions, focusing on sustainable production practices. *Sustainability (Switzerland)* follows closely with 527 mentions, covering many sustainability issues. *Resources, Conservation, and Recycling* is noted with 309 mentions, emphasizing resource efficiency and recycling. *Journal of Industrial Ecology* explores industrial systems and their environmental impacts with 96 mentions, while *Business Strategy and the Environment* examines strategic environmental management in corporate settings with 36 mentions. These journals collectively drive research and application, promoting sustainable practices and advancing circular economy initiatives across various sectors and disciplines. *Water (Switzerland)* contributes 32 documents on water science and technology, while *Resources, Conservation, and Recycling Advances* adds 23 documents on innovative approaches to conservation and recycling. *Resources Policy* includes 20 documents on the economics and policies of natural resources, and the *Environmental Impact Assessment Review* contributes 19 documents on environmental impact assessments. Collectively, these journals offer a comprehensive view of research trends in sustainability, circular economy, and environmental impact.

Keyword Assessment by Word Cloud Approach



Figure 5: Keyword Assessment by Word Cloud Approach

In the analysis of research integrating the circular economy, there is a notable absence of terms such as "indicators," "metrics," or "index." These terms, which typically denote measurement tools or frameworks for assessing progress and performance, are crucial for evaluating the effectiveness and impact of circular economy practices. Their limited presence suggests a potential gap in the literature concerning systematic approaches to quantifying and benchmarking sustainability efforts within the context of circular economy initiatives. Addressing this gap could enhance the ability to monitor and optimize the socio-economic and environmental benefits of adopting circular economy principles across various sectors and regions.

Co-occurrence Assessment

Co-occurrence assessment concerning both types of keywords (author's provided keywords and index keywords)

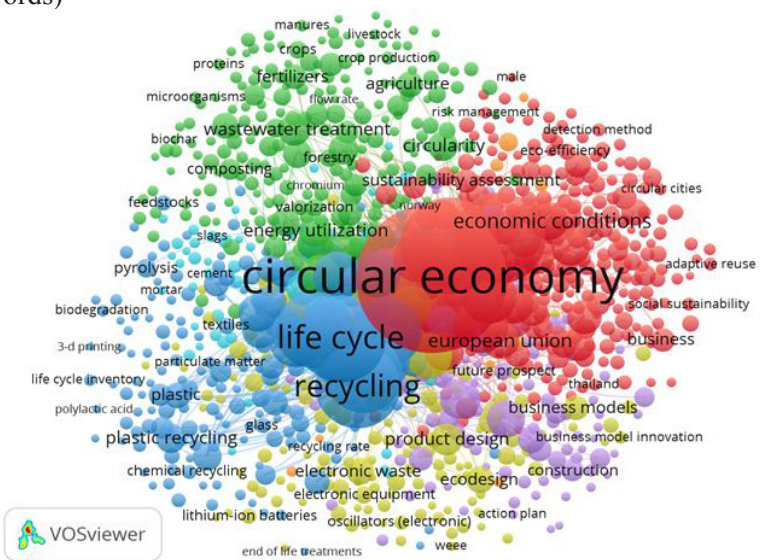


Figure 8: Co-occurrence Assessment Concerning Both Types of Keywords (author's provided keywords and index keywords)

A comprehensive co-occurrence analysis was conducted on 13469 keywords, focusing on their co-occurrence patterns with a minimum threshold of 5 occurrences. Out of these, 1365 keywords met the threshold criteria. The 1000 keywords with the highest total link strength were selected for a detailed analysis. At a resolution of 1.0, the analysis revealed seven distinct clusters, indicating the primary thematic areas in the dataset. Cluster 1 is the largest, consisting of 270 items, followed by Cluster 2 with 212 items, Cluster 3 with 169 items, Cluster 4 with 158 items, Cluster 5 with 111 items, Cluster 6 with 69 items, and Cluster 7, the smallest, with 11 items. The second most frequent keyword was "life cycle," which was followed by "sustainable development," "recycling," "life cycle assessment," and "sustainability." These keywords highlight the central themes and focus areas within the research on circular economy, emphasizing the importance of lifecycle thinking and sustainable practices.

Limitation of the CE Indicators

Circularity indicators are valuable for assessing the transition towards a circular economy but have several limitations.

1. One of the most significant challenges is acquiring the necessary data to accurately input into these tools, which is essential for determining the circularity level of products or companies. Data availability and reliability can vary, making it difficult to perform consistent and accurate measurements.
2. The complexity and diversity of circular economy principles mean that no single indicator can comprehensively capture all aspects of circularity. As a result, multiple indicators are often required to provide a more complete picture, which can further complicate the data collection process (Cayzer et al., 2017).
3. Many indicators are complex and difficult to use in practice, often leading to subjective data interpretation. Additionally, they require extensive information collection, which is not always easily accessible (Matos et al., 2023).
4. Micro indicators, focusing on specific aspects of circularity, often lack a unified framework. Most assess circularity through "take-back" methods like remanufacturing, recycling, or end-of-life (EOL) products. In contrast, there is much less emphasis on eco-design tools and strategies that extend the durability of the products through reuse or reconditioning. (Matos et al., 2023).
5. Micro indicators typically concentrate on one dimension of the circular economy, often neglecting other crucial elements like emissions generation and energy consumption. Consequently, a very small number of micro indicators worked on a holistic evaluation of circular economy performance. (Saidani et al., 2019).
6. There is also the issue of standardization. Different industries and regions may have their own sets of indicators, leading to inconsistent measurements and comparisons across different contexts (Corona et al., 2019). The lack of a standardized framework makes it difficult to develop universally applicable circularity metrics.
7. Additionally, many current circularity indicators do not adequately address social aspects of sustainability, such as job creation, social equity, and community well-being. Integrating social dimensions into circularity metrics is crucial for a more comprehensive assessment of the circular economy's impact (Bocken et al., 2016).

8. The application of these indicators can also be hindered by technological limitations and the readiness of companies to adopt new measurement tools. Companies may face challenges in integrating circularity indicators into their existing systems and processes, requiring significant changes in data management and reporting practices (Geissdoerfer et al., 2017).

Finally, there is a need for continuous updating and improvement of circularity indicators to keep pace with evolving practices and technologies in the circular economy. This requires ongoing research and collaboration among academia, industry, and policymakers to refine and enhance the effectiveness of these tools (Lieder & Rashid, 2016).

CONCLUSION

The paper presents a bibliographic review of the CE, giving special attention to the integration of circular economy with CE indicators and highlighting the number of circular economy tools available to measure the adoption level of circular economy at various stages. The analysis results show that literature on developing and using indicators or methods for measuring the transition to a circularity level is scarce. In particular, there is a shortage of a standardized tool or widely agreed indicators that can capture the principles of the circular economy at different levels: micro-level, referring to the business or product; macro, referring to national or regional economies; and meso, referring to the industrial ecosystems or sectors.

Current research is focused mainly on micro-level indicators, which are often unidimensional in nature, thus focusing on only one dimension of the circular economy. The lack of consideration for other factors like emissions and energy use in circular economy indicators leads to a fragmented understanding of the reality of circular economy practices. The nonexistence of a holistic approach for the existing micro-indicators underlines the unsatisfactory nature of the available tools in measuring these practices.

This paper highlights the need and importance of developing proper indicators or tools to cover all dimensions of the ambitious circular economy concept. These should have an environmental, economic, and social dimension to provide a more integrated and holistic approach to evaluating circular economy practices. Such a robust, multi-dimensional scale is of prime importance for assessing and furthering the economy's transition toward a circular model so that all the related factors are considered and run efficiently. This would yield a better decision-making process from policymakers, efficient implementation of the concepts of a circular economy, and define progress toward all such goals at every level of society and industry.

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Conspicuous Consumption of Luxury: A Systematic Review and Future Research Agenda

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Abstract

Consumers in markets believe that luxury has lost its individuality due to increased global spending and democratization. The phrase "conspicuous consumption" was created almost 100 years ago. The focus in the economic tradition has always been on material goods to demonstrate wealth, income, and social standing. Conspicuous consumption, on the other hand, refers not just to the display of money but also to the manifestation of something more symbolic and immaterial. In today's cultural milieu, intangible experiences are becoming more important than material objects. This study looks at the influence of conspicuous expenditure in holiday decision-making using an experience purchase as an example. The study discovered that talking about trips with others is crucial and is facilitated by the widespread usage of social media.

Two conspicuous spending elements are identified: (a) status and money, and (b) identity manifestation. The first element has little or no influence on holiday choice. The second is deemed important and is distinguished by characteristics such as having unique experiences, demonstrating one's identity to others, and visiting popular locales. Thus, on a holiday, one wishes to demonstrate more of his or her individuality and identity than rank and income. This is consistent with previous empirical research, which has demonstrated that experiences make individuals happier than material goods.

In the modern world, conspicuous spending is a practice that is on the rise. Despite receiving little attention to conspicuous consumption, everybody engages in this behavior to varying degrees in the digital world. Consumption of opulence in public is a new trend. This is a research area in the luxury marketing sector that is getting a lot of attention from academics as well as management professionals. Despite the enormous number of studies that have been conducted in this field, the material that is now available appears fragmented and lacks unidirectionality. To summarise the existing literature and offer a future research agenda, the current study conducts a thorough critical review. The research papers on conspicuous luxury consumption conducted in the field of luxury marketing from 2016 onward were chosen for the current study. The study has also paved the way for new lines of inquiry and serves as a useful reference for academics and practitioners with an interest in the same area.

Keywords: *Conspicuous Consumption, Luxury, Qualitative, Consume*

INTRODUCTION

Over a century ago, Thorstein Veblen (1899) created the phrase 'conspicuous consumption' and explained it in his book Theory of the Leisure Class. Veblen defined ostentatious consumerism as the buying and display of expensive things and services in order to achieve social status, which happens in varied degrees throughout the socioeconomic spectrum. Conspicuous consumption is defined as a display of affluence through luxurious leisure activities and extravagant spending on

products and services (Trigg, 2001). Although the words 'conspicuous consumption' and 'luxury consumption' are defined differently, researchers often use them interchangeably (Kastanakis and Balabanis, 2012; Kessous and Valette-Florence, 2019).

We suggest that, while not all luxury spending is noticeable (for example, luxury private consumption), the majority of it is. Luxury consumption, particularly luxury public consumption, is only one angle on ostentatious consumerism.

According to a Bain & Company analysis (2019), the global luxury market topped USD 1.4 trillion in 2019, rising at a pace of around 4%. According to estimates, India's luxury industry was valued USD 8 billion in 2019 and is expected to increase at a cumulative annual growth rate of 6.6 percent between 2019 and 2023. According to Griskevicius et al. (2007), Americans spend about USD 130 billion per year on high-end sports utility vehicles like Hummers, and considerably more on other conspicuous items like yachts and jewels.

This special issue focuses on the extremely exciting sorts of luxury consumption that are altering industry paradigms and trends, particularly in light of the digital marketing revolution, which is influencing how luxury businesses build and implement customer engagement and sales strategies. Luxury brands transmit style, exclusivity, individuality, originality, higher quality, and hedonic value to their extended networks (Shukla and Purani Citation 2012; Pangarkar, Patel, and Kumar Citation2023). While recent events such as the COVID-19 pandemic and the economic recession have had an impact on economic conditions, according to a Euromonitor International report, the luxury industry will continue to grow impressively, reaching USD 1.2 trillion in 2022 at a steady growth rate of around 6% (Robert Citation2022).

According to Kearney (Citation2022), Chinese luxury customers led the way in this rebound, followed by US and German consumers, resulting in a resurgence for numerous luxury companies including as Kering, LVMH, and Hermès following a short setback.

Most luxury firms were first cautious as the digital landscape began to shift and social media surge shifts were witnessed (Heine and Berghaus Citation2014). Luxury brands, on the other hand, have used a variety of cutting-edge digital tools and techniques to target, attract, engage, and retain customers, including phygital, artificial intelligence, virtual reality, augmented reality, influencer advertising, and non-fungible tokens (NFTs).

For example, Gucci has built a virtual environment on Roblox, a popular game among the younger generation, as well as Gucci Vault, an experimental online idea space that houses NFTs and other Web3 initiatives. Similarly, Balenciaga made a bold move by revealing their 2020 collection via a video game fashion presentation and dressing Fortnite game characters in the forthcoming Fall 2021 collection, demonstrating their willingness to adapt themselves in the metaverse.

Such growing tendencies necessitate a fresh study effort to better understand conspicuous consumption, which has significant implications for organizations and managers dealing with showy items.

Thorstein Veblen published his important essay The Theory of the Leisure Class in 1899, which contained the first insights into the driving forces behind the consumerist craze (Veblen, 2007 [1899]). Despite the fact that his writing was contentious at the time, it has served as the foundation for much of the academic literature on the consumption of luxury goods during the past 100 years. According to Veblen, the primary reason for consumerism (and not just the

purchasing of luxury goods) is to show off one's wealth and attract disparaging comparisons with others. He named the phenomenon "conspicuous consumption" after himself (Veblen, 2007 [1899]).

The study of luxury marketing has seen significant growth during the past ten years. The luxury market is divided into two main categories: personal luxury products and luxury automobiles. Except for the blip brought on by the coronavirus (COVID-19) pandemic, the revenue of the personal luxury goods sector, which includes upscale apparel, accessories, watches, jewelry, and eyewear, has climbed steadily over the previous ten years. With a market share of roughly 65 billion dollars in personal luxury goods in 2020, the United States was the market's market leader. China came in second. It is anticipated that the United States will continue to hold the top spot as the nation where the market for luxury personal items earns the most money globally by 2025. In addition, when it comes to the consumption of luxury products, Americans are the largest consumer group.

Over the past few years, there has been a significant expansion in the global luxury sector. As of 2018, the market was worth € 1.2 trillion, and until 2025, it is anticipated to expand by 5% yearly (Bain & company, 2019). A number of growing economies, including China, India, the Middle East, and Latin America, are experiencing tremendous growth, and this trend is not just present in European and American nations. The average income in these developing nations has increased over the past several years, leading to high levels of discretionary income and spending.

A growing number of marketing scholars and professionals have looked at the rapid expansion of ostentatious luxury consumption in a variety of approaches. Despite being quite extensive, the literature on conspicuous luxury consumption is unfocused. In this essay, we offer future research paths while providing a critical analysis of the research papers published between 2016 and 2021.This study is organized in the following It first outlines the research approach for this work. Second, it presents the analysis and findings in the form of tables, word clouds, and charts based on the many categories employed in this study. Finally, this study draws conclusions on the limits of the studies it has analysed and makes recommendations for further research.

RESEARCH METHODOLOGY

This section is divided into three subparts:

Collection of data

For the collection of data, this study adopted the three-steps process suggested by Tranfield et al. (2003). These were as follows:

- **Identifying the search terms:** Relevant keyword 'Conspicuous consumption' was used to search for the study. Articles having this keyword in their title or central to their discussion were selected for this study.
- **Setting up the boundaries/filters for the search:** We took January 2016 as the starting year for this review. Hence, January 2016–December 2021 was taken as the tenure for article selection. Papers on Qualitative Study were selected only.
- **Assessing the quality of the papers:** The following prominent databases were used to collect the articles on Conspicuous Consumption viz. Emerald, Elsevier, Springer, and Google Scholar. Only peer-reviewed journals were identified.

Data Analysis

Using the above-stated search criteria, a total of 8 studies were collected. All 8 studies were considered for the final analysis. A compilation sheet based on the various classifications was compiled in Ms- excel. Later, the complied data was analyzed and presented it in the form of tables and figures using NVIVO Software.

Analysis and Results

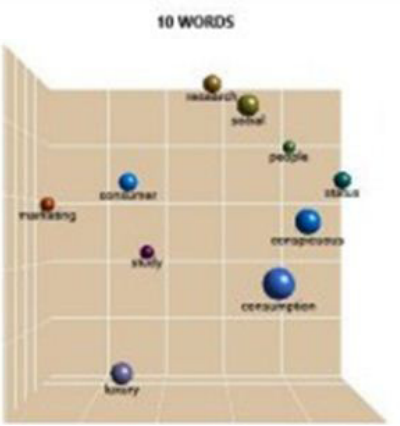
1. Word Cloud



2. Tree Map



3. Cluster Analysis



METHODS OF DATA COLLECTION USED

Paper Name	Method	Sample
The Psychological Motivations of Online Conspicuous Consumption: A Qualitative Study	Semi-structured interviews	15 Jordanian residents who have access to the Internet and social networking sites and are able to provide the researcher with relevant and useful information
Conspicuous Consumption of the Elite: Social and Self Congruity in Tourism Choices	In-depth Interviews	36 Portuguese citizens
Conspicuous consumption of the neglected majority: Low income consumers in a Non Western culture	In-depth Interviews	12 in-depth interviews were conducted with low-income consumers in Turkey
Materialism, Impulse Buying and Conspicuous Consumption: A Qualitative Research	In-depth interviews	20 individuals who were the regular visitors of the nearby supermarket
Consumption of luxury hotel experience In contemporary China: causality model for conspicuous consumption	Focus groups	38 hospitality related Chinese practitioners divided among five focus groups
Sporting celebrity and conspicuous consumption: A case study of professional footballers in England	Semi-structured interviews	29 current and former male professional footballers
Analysis of the influence of the conspicuous consumption of fast fashion on identity construction on instagram	Triangulating data from participant observation, interviews, and online focus groups	11 women were interviewed, and 3 focus group sessions were conducted, with a total of 16 participants.
Changing patterns of conspicuous consumption: Media representations of luxury in second homes	Thematic analysis	written and visual text of 305 second home articles

PLACE OF RESEARCH

The following methods were used to identify the country where the research was conducted: The actual country where the research was conducted was taken into consideration, and for any other studies where the researcher did not specify the the location of the research, the country of the study's principal author was taken into consideration. Using the method described above, the following nations are represented in the table below as the locations of the 8 studies:

The Psychological Motivations of Online Conspicuous Consumption: A Qualitative Study	Jordan
Conspicuous Consumption of the Elite: Social and Self-Congruity in Tourism Choices	Portugal
Conspicuous consumption of the neglected majority: Low-income consumers in a Non-Western culture	Turkey
Materialism, Impulse Buying and Conspicuous Consumption: A Qualitative Research	India
Consumption of luxury hotel experience In contemporary China: causality model for conspicuous consumption	China

Sporting celebrity and conspicuous consumption: A case study of professional footballers in England	England
Analysis of the influence of the conspicuous consumption of fast fashion on identity construction on instagram	Brazil
Changing patterns of conspicuous consumption: Media representations of luxury in second homes	New Zealand

FINDINGS OF THE STUDY

Paper Name	*Author Name*	*Findings*
The Psychological Motivations of Online Conspicuous Consumption: A Qualitative Study	Jude Qattan, Mohammad Al Khasawneh	The study's findings add public self-consciousness, self-esteem, and perceived quality to the existing model, which already included envy, materialism, narcissism, and social comparison.
Conspicuous Consumption of the Elite: Social and Self-Congruity in Tourism Choices	Sheetal Jain, Sita Mishra and Sandip Mukhopadhyay	The study came to the conclusion that, at least for people who deal with celebrity and prestige on a regular basis, conspicuous tourism relies more on intrapersonal values than interpersonal ones. For them, being conspicuous means spending time with their families in secluded resorts where luxury and hedonistic value are valued highly. Contrarily, the general public considered conspicuousness to be the most unique, exquisite, and exciting aspect of travel.
Conspicuous consumption of the neglected majority: Low-income consumers in a Non-Western culture	Deniz Atik, Dicle Yurdakul Şahin	It was stated that in light of the societal pressures placed on individuals to comply to social norms and identify with higher social classes, conspicuous consumption is considered as a required habit. Consumers with lower incomes favoured using status symbols over taking into account the financial implications of these expensive goods.
Materialism, Impulse Buying and Conspicuous Consumption: A Qualitative Research	Aastha Verma Vohra	According to the conclusions of the qualitative study, there are many elements that contribute to materialism, impulsive purchases, and conspicuous consumption. If all of the common characteristics from each of the three categories are removed and included in a separate category, which results in the creation of a new category called "consumer behavioural features." Globalization, consumer demographics, and culture are the key common elements that together have an impact on all three characteristics of a customer.
Consumption of Luxury Hotel Experience in Contemporary China: Causality Model for Conspicuous consumpti on	Kam Hung	The findings of this study show that financial capability is a prerequisite for Chinese conspicuous consumerism since they cannot spend lavishly if they are unable to meet their basic necessities. Chinese consumers can show off their wealth by engaging in conspicuous consumption, which also helps them gain the public's respect. They can easily spread the word about their public experience on social media.

Paper Name	*Author Name*	*Findings*
Sporting celebrity and conspicuous consumption: A case study of professional footballers in England	Graeme Law, Daniel Bloyce	According to the findings, professional footballers are under pressure to uphold a particular image, which forces players—even those with lesser incomes—to purchase pricey clothing and accessories in order to be accepted by others. Players who do not portray the desired image risk punishment from their teammates.
Conspicuous Consumption of Fast Fashion on Identity Construction on Instagram	Dantas, B.L.L., Abreu, N.R.	This study's primary contribution to the field of consumer behavior. According to this study, which is based on social identity, identity constructions are influenced by settings, other people's influences, and consumer viewpoints. The results demonstrate how quick fashion is consumed ostentatiously on Instagram as makers of sense, self-idea, and self-image, mimicking and displaying consumer lifestyle. Fast fashion is consumed as a result of the pleasure brought on by other people's acceptance, the items utilized for social group compliance, and the ongoing unhappiness with their possession. Constructed identities are shown to be fractured, changeable, and contextual.
Changing patterns of conspicuous consumption: Media representations of luxury in second homes	Trudie Walters and Neil Carr	The findings presented here suggest, however, that conspicuous consumption existed in New Zealand for decades before the neoliberal revolution – it has simply not been recognized. They did consume conspicuously using the tangible and intangible luxuries of the time. Connecting representations of luxury to historical events and broader contexts helps to explain shifts in conspicuous consumption. Most significantly, this article makes a contribution by identifying a recent turn to inconspicuous consumption within conspicuous consumption

LIMITATIONS OF THE STUDY

The Psychological Motivations of Online Conspicuous Consumption: A Qualitative Study	1. The interviewees were geographically centered in Jordan, therefore generalizability of the findings may be limited 2. Study focused on Facebook as a representative for social networking sites but OCC may be potentially practiced on other social networking sites.
Conspicuous Consumption of the Elite: Social and SelCongruity in Tourism Choices	1. The present research has focused only on a small sample of Portuguese individuals: the results are therefore limited and cannot be generalized. 2. The need for additional studies is evident, in order to assess the relevance of conspicuous tourism and consumption among other nationalities, in broader and more diversified groups, and within different cultural, social, and economic contexts.

Conspicuous consumption of the neglected majority: Low-income consumers in a Non-Western culture	The present research has focused only on a small sample of low-income consumers in suburban regions of Turkey; therefore, the results are limited and cannot be generalized.
Materialism, Impulse Buying and Conspicuous Consumption: A Qualitative Research	The list of the consumer traits and the factors that affect them studied in this article are not exhaustive, and more traits and the factors that affect them can be investigated further in future research attempts.
Consumption of luxury hotel experience In contemporary china: causality model for conspicuous consumption	No limitation from authors perspective.
Sporting celebrity and conspicuous consumption: A case study of professional footballers in England	No limitation from authors prespective.
Analysis of the influence of the Conspicuous	It has the limitation of not postulating and delving into different types of identity, such as multiple and autonomous identities.
Consumption of fast fashion on identity Construction on Instagram	It is also a limitation of this study to focus on Instagram users who are fast fashion consumers. Therefore, it is suggested to study how fashion consumption is related to multiple and autonomous identities from different consumer profiles.
Changing patterns of conspicuous consumption: Media representations of luxury in second homes	No limitation from authors prespective.

FUTURE AGENDA

1. Future research can focus on conspicuous consumption in the context of Indian customers since no qualitative study has been done in this area thus far.
2. Numerous studies demonstrate harmful factors including peer pressure, envy, and materialism of conspicuous consumption. There aren't many studies like this, though, that discuss the benefits of ostentatious consumption. Therefore, future research may focus on discovering the benefits of ostentatious luxury consumption (if any).
3. In next research, the Online Conspicuous Consumption (OCC) model can be used in the Indian setting to ascertain whether the same causes that are driving millennials' conspicuous consumption of luxury goods are present, or if other factors are at play.
4. Future research might compare and contrast various social media channels to provide additional clarification.

It is possible to conduct a pre- and post-comparison research to examine the impact of COVID19 on the conspicuous consumption of luxury in various industries.

CONCLUSIONS

In the marketing literature, our study definitively establishes "conspicuous consumption of luxury" as an important research topic. Digital marketing is seen by marketers as an adjunct to

reduced expenses, enhanced brand recognition, and better revenues. At the moment, wealthy nations have contributed more to the study than India currently does on this construct. The study reveals that the fashion industry, social media, sports, construction, tourism, and digital platforms are the main application areas for "conspicuous consumption of luxury."

This study provides information on "conspicuous consumption of luxury" that businesses may use to develop and manage their potential client base. Our analysis also identifies several important areas for further study in this field. Our research can assist future researchers and businesses better understand luxury consumption. This study is subject to various restrictions. The results of this study are not generalizable because it is an exploratory study, however conclusive research can be done to demonstrate empirical links. Although every effort was made to integrate the pertinent research in accordance with the prerequisites for conspicuous consumption of luxury that had been previously established. However, it's possible that some research may have gone unnoticed because host universities were unable to access digital print or resources. upcoming researchers can take this restriction into account in their research.

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The Role of Environmental Sustainability in Consumers' Motivation to Order Food Through Online Food Ordering Apps

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Abstract

There are many restaurants that provide online benefits, the best offers, and budget-friendly costs right now. It is evident that this has led to an extension of their everyday business, which has in turn helped to promote the product across the nation and spark a boom in the online food delivery industry. With the support of several other applications, like, Swiggy, Food Panda, Zomato Uber Eats, etc., the applications for ordering food online have developed an online menu. The global interactions between many customers and food suppliers have changed significantly due to the increased use of OFOAs. The term "sustainability implications for the OFOAs sector" refers to the industry's economic, social, and environmental concerns. These changes have also had an impact on the sustainability implications of the sector, which must be understood to identify any untapped potential for further advancements. Due to this situation, academic study on consumer food waste in domestic and non-domestic context has also gotten a boost. However, research online food ordering applications, is still in its initial stages. OFOAs can significantly contribute to the loss of food since their business model naturally makes it simpler to order more food than is required.

Keywords: *Environmental Sustainability, Convenience, Online Food Ordering Apps, Consumers, SEM*

INTRODUCTION

The concept of environmental sustainability has grown due to global concerns such as climate change and food security. Many individuals are becoming attentive of the influence their choices have on the environment and are finding ways to make sustainable decisions in their everyday lives. One area where this shift towards environmental sustainability is becoming increasingly apparent is in the way consumers choose to order food through online food ordering apps (Jones et al., 2015). This shift in consumer behaviour is driven by a desire to reduce the environmental footprint associated with traditional food delivery methods. Consumers are recognizing the role that online food ordering apps play in shaping their sustainable consumption habits. The adoption of online food ordering apps can have a positive impact on environmental sustainability through various mechanisms such as reducing food waste, promoting local sourcing, and minimizing carbon emissions from transportation. To succeed with App-based commerce, it is important to understand consumers' motivations for using the channel. The study examines consumer shopping motivation and discovers underlying motives in context of online food ordering apps. Numerous studies on environmental consumer behaviour have focused on attitudes and aspirations related to sustainable consumption (Kilbourne et. Al, 1997), willingness to pay price premiums for

environment-friendly products (Laroche et al., 2001), recycling (McCarty & Shrum, 2001), and environmental activism (Kilbourne & Pickett, 2008). This study examines environmental consumer behaviour in the online food ordering, which is a recent development. Since young consumers are the most frequent users of mobile apps and have a more sustainable outlook than older generations, this study is essential.

LITERATURE REVIEW

OFOAs are spreading quickly over the world, researchers are now increasingly interested in how consumers see OFOAs (Chahal & Bishnoi, 2024). Customers are getting increasingly comfortable with the practise of ordering food using mobile applications but there is growing concerns about the role that these programmes play in promoting food waste (Cho et al., 2019). Clients who have access to many food ordering options that can be reached with just a few clicks may wind up squandering food because they purchase more than they need. Managers and markets want to attract more online consumers to their physical stores by providing enhanced shopping environments characterized by convenience, user-friendly design, and a diverse array of product and service offerings (Xiao Shuang & Dong Ming, 2019). With only the click of a mouse, a wide variety of affordable, convenient, and gastronomic alternatives are available, which has fuelled the remarkable global expansion of the online food industry.

OFOAs let customers to examine listed restaurants, menus, and reviews quickly. These apps can approve orders through online payment, and monitor order statuses (Lee & Kim, 2021). To increase sales revenue and give customers a simpler way to order goods and services, online food delivery apps are being used more frequently now.

According to Stern (2000), environmental behaviour encompasses more than just green consumption, recycling, and organic food purchases. Online buying is more environmentally friendly than traditional retail since it eliminates the need for transportation (Jusoh & Ling, 2012). Yadav & Pathak (2016) stated that environmental concern significantly predicts green purchasing intentions among young Indian customers.

OBJECTIVES OF THE STUDY

1. To study on customer attitudes, subjective norms, and views of their capacity to control their conduct relate to such consumers' intentions.
2. To study on customer motive to use OFOAs buying patterns connect to consumer trust and practises towards the reuse of leftovers

RESEARCH METHODOLOGY

The data is collected by speaking with customers of well-known Indian food delivery services such as Swiggy and Zomato. Researcher used a structured questionnaire that was composed of items that were derived from preceding study on OFOAs in connection to food waste based on below these research questions:

Research Questions

- **RQ1.** How do customer attitudes, on food waste reduction intentions positively influence behavioral intentions to use online food ordering apps?
- **RQ2.** How do customer desires to use OFOAs Based on Food waste reduction intentions and purchase patterns connect to consumer trust and practises towards the reuse of leftovers?

This investigation's methodology is empirical in nature. The data collection was done by primary sources. Respondents were asked to answer questions on Google forms from September 2023 to November 2024. The researcher collected around 85 distinct samples for this study. Data was collected using convenience sampling.

DATA ANALYSIS

The data was analyzed using factor analysis. It explains the variability between associated variables into smaller number of factors known as unobserved variables.

In the table below, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is shown to be 0.844. The Bartlett's Test of Sphericity findings, which have a about 1913.53 chi-square value and a P value of.000, are significant at the 5% level of significance. As a result, it is feasible to claim that the collected data are reliable for the study's objectives (Thyberg et al., 2016).

Table 1: Bartlett's Test and KMO

Sampling adequacy as measured by Kaiser-Meyer-Olkin.		.844
Bartlett's Test of Sphericity	Approx. Chi-Square	1913.536
	Df	351
	Sig.	.000

Table 2: Explanation of Total Variance

Component	*Extraction Sums of Squared Loadings*			*Rotation Sums of Squared Loadings*		
	Total	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	11.602	39.272	38.270	3.127	18.986	19.982
2	2.288	8.481	46.752	5.723	17.492	35.482
3	1.816	6.732	51.481	1.844	10.536	42.015
4	1.618	5.983	63.463	1.162	8.002	54.021
5	1.355	5.026	62.494	1.086	7.704	61.728
6	1.185	4.372	68.867	2.671	6.186	64.914
7	1.085	4.013	72.883	3.343	4.969	72.883

Inference: The table shows that 73.884 percent of the total variation, or 39.27 plus 8.480 plus 6.731 plus 5.984 plus 5.029 plus 4.373 plus 4.016, may be attributable to the six components (Valenti et al., 2019)

Table 3: Communalities

S.No.	*Factors*	*Extraction*
1	I pick restaurants based on the number of deals and promotions offered on the app.	.526
2	I place my orders from the eateries based on their stellar App reviews.	.842
3	I firmly feel customer reviews influence my decision on placing an order.	.776
4	When I am at work, I like internet food delivery since it is convenient.	.836
5	During work hours, I tend to place the most orders.	.865
6	I placed an online food order since I have stuff to do at the office.	.787
7	Due to my hectic schedule, buying dinner online saves me a lot of time.	.720
8	I purchase food online to save money.	.721
9	When I am at work, I typically order vegetarian fare.	.687

10	I receive the requested food items in their original form.	.749
11	The cuisine that is bought online is always of a high caliber.	.675
12	My internet food orders are delivered hot and fresh.	.782
13	I request a refund or place an order for replacement food if the food is incorrectly packaged or broken.	.511
14	Due to my dietary preferences, I consistently place orders from the same restaurant.	.607
15	High safety requirements are used when packaging the food.	.752
16	I am treated with courtesy by the members of the delivery staff.	.724
17	I receive my shipment within the allotted amount of time.	.785
18	It is simple for me to monitor the delivery all the way up until it arrives at my workplace.	.743
19	I think that online food delivery services use sanitary methods to deliver food.	.591
20	I like using online food delivery applications since there are less interactions with people.	.625
21	Instead of paying cash on delivery, I use online cards.	.838
22	I can save time by making payments online.	.862
23	The online payment methods are practical because COD is challenging to use during business hours	.821

Based on the table, we may infer the first variable's communality is.781, meaning it accounts for 78.1 percent of the information content or variation. (Vandermeersch et al., 2014)

Structural Model Analysis

Since the measurement model was judged to be adequate, we continued to the second phase of the PLS-SEM study. The constructs were examined for any potential collinearity issues before starting the structural model analysis. Variance Inflated Factor (VIF) values of higher than 5 predicts collinearity issues among the predictor constructs (Vitell, 2003; Rudolph, 2010). The VIF values of the various structures were presented in Table 4, and they were all less than 2.0. This made it obvious that no construction was impacted by collinearity issues. (Venkat, 2011).

- **H1:** Food waste reduction intentions positively influence behavioural intention of online food delivery services.
- **H2:** Eco friendly packaging positively influences behavioural intention of online food delivery services.
- **H3:** Food Leftover Reuse Routine positively influences behavioural intention of online food delivery services.
- **H4:** Shopping routine through FDA positively influences behavioural intention of online food delivery services.

Table 4: Checking of Collinearity Issues

Construct	*VIF*
Food waste reduction intentions	1.520
Eco friendly packaging	1.500
Food Leftover Reuse Routine	1.605
Shopping routine through FDA	1.242

After ensuring there are no collinearity problems, we focus on the structural model to find its goals for reducing food waste. The bootstrapping direct effect result was displayed in Figure 1. The term "structural model" describes the causal relationships between the model's aspects. (Weber & Matthews, 2008). The predictive power of the assessed model is influenced by these relationships, which include estimations of the R^2 value and path coefficients (Wolburg & Pokrywczynski, 2001). Westbrook & Black (1985) recommended focusing on R^2, beta, and the accompanying t-values. Researchers must disclose both the relevance to the Food Waste Reduction (Q2) and the effect sizes (f2) of their studies (Wong et al.,2012).

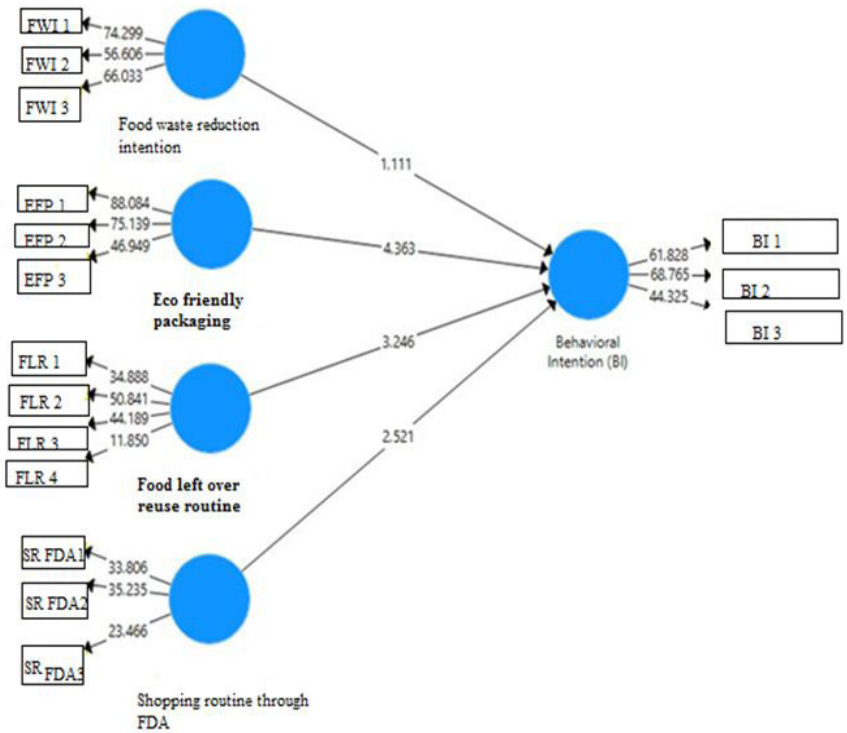


Figure 1: Hypothesis Testing: Bootstrapping Direct Effect Result

The data presented in table 5 stated that the direct relationships were used to test hypotheses. BI was favorably impacted by TSO (= 0.316), CM (= 0.274) and PS (= 0.1300) at t value >1.96 and p value 0.05. Hence, hypotheses 2, 3, and 4 were supported.

Table 5: Direct Relationship for Hypothesis Testing

Relationship		*Std Beta*	*Std Error*	*t-value*	R^2	*Q2*	*f2*	*Decision*
H1	FWI → BI	0.092	0.080	1.102	0.448	0.000000	0.008318	Not supported
H2	EFP → BI	0.311	0.072	4.498		0.073863	0.113144	Supported
H3	FLR → BI	0.273	0.083	3.230		0.044033	0.073210	Supported
H4	SR FDA → BI	0.131	0.052	2.473		0.012783	0.021630	Supported

On the other hand, there was no influence of food waste reduction intents on BI, as shown by a t value that was lower than 1.96 and a p value > 0.05. As a result, the validity of H1 cannot be established.

DISCUSSION

Regarding the third and final direct effect, our findings are in agreement, which proposes that an individual's purchase decisions are impacted by the ways in which they intend to make use of a certain object (Yadav & Pathak, 2016). This outcome is consistent with the findings of earlier research that investigated the practice of using OFOAs to place excessive food orders. This relationship theorises that individuals who intend to use OFOAs for purchasing also tend to purchase extra food than their consumption (Yang, 2010). The study supports that a desire to spend more money on ecologically friendly packaging moderates the linkages between leftover reuse routine, purchase routine, and use intentions in a positive way. Customers who are ready to pay extra money for ecologically friendly packaging have greater intentions to use OFOAs than customers who are not ready to pay more for environmentally friendly packaging (Yang & Kim,2012). This is the case regardless of how meticulously the residue reuse method is carried out. Consumers who routinely find new uses of unused things are ready to pay a premium for ecologically friendly packaging than who do not recycle or otherwise reuse discarded items. Customers who are paying price premium for ecologically friendly packaging have a more probability of purchasing routine as compared to who are reluctant to pay these additional expenses.

The data presented in Table 5 indicate that FWI did not make a substantial contribution to BI. Most people who use the internet have a great deal of experience surfing the web and are quite familiar with the process. Food left overuse by OFOAs does not supply additional food to clients delivered in a managed method. Eco-friendly packaging indicates that consumers are more likely to prefer using OFAs service since it is more environmentally sustainable. OFOAs service providers are obligated to ensure a rational amount of food recycling, and the decrease in food waste must be greater than what is achieved by customers employing other approaches.

CONCLUSION

This study investigated the myriads of techniques in which the application of OFOAs regulations leads to food waste. People order higher quantity of food than they require for these reasons, which increases the probability that part of it will go untouched and be thrown away as a result. The researchers were able to better understand the dynamics of the proposed linkages after putting these moderators to the test and observing the results. It was discovered that the first two criterion only demonstrated good relationships with buying routine.

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Ease of Doing Business: Indian Real Estate Sector

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Abstract

The Ease of Doing Business Index has become increasingly significant in recent years as it reflects the overall business environment in a country. In 2019, India made significant strides in this regard, leaping an impressive 79 positions to reach the 63rd spot in the rankings, highlighting the country's efforts to improve its business climate. India has taken efforts to improve ease of doing business and simplified the process and systems of doing business. However, there is great need to give major impetus to ease of doing business for Real estate sector. With this background, the paper aims to study the Ease of Doing Business (EODB) scenario India, the issues of EODB in Indian Real estate and to make strategic recommendations for rapid growth of this crucial sector of Indian economy.

Keywords: *Ease of Doing Business, Real Estate Industry, FDI*

INTRODUCTION

The ease of doing business is essential for a country's economic development. It impacts the industrial climate, investment, and job creation, thereby contributing to a country's overall prosperity and high ranking in the Ease of Doing Business Index is a positive indicator of a country's competitiveness and economic potential. Therefore, the government has been giving major thrust to ease of doing business with an aim to reach into top 50 across the world. Over the years centre and state governments have taken various steps to alleviate the business environment from outdated policies and executing their annual Business Reform Action Plan (BRAP) to attract more domestic and international investments.

Real estate is one of the important revenue generating sectors in India and an ideal asset for long term investment. It has the potential to generate more foreign inflows and millions of employment opportunities. This sector has seen several radical reforms such as RERA (Real Estate Regulatory Authority (2016)), REITs (Real Estate Investment Trusts), GST etc. Efforts to simplify the complexities and enhance the ease of doing business have focused on adopting global real estate standards, and developing the necessary legal and professional infrastructure to attract companies, businesses, and investment capital. This is intended to foster a more conducive business environment, enabling the country to compete effectively in the global marketplace. State governments can also play a vital role in promoting an improved regulatory environment for the real estate sector by implementing reforms and policies that facilitate ease of doing business at the regional level. This decentralization of power enables states to become agents of change, fostering a more conducive business environment within their respective jurisdictions, thereby contributing to the overall economic development of the country.

Despite rigorous efforts of the government to improve ease of doing business in India, a lot needs to be done. This paper attempts to examine the ease of doing business in India on Real Estate Sector.

OBJECTIVES OF THE STUDY

1. To study the Ease of Doing Business (EODB) scenario India.
2. To study the issues of EODB in Indian Real estate.
3. To make some suggestions to overcome those issues.

METHODOLOGY OF THE STUDY

This study adopts a descriptive approach, relying on secondary data sources, including government publications, academic journals, newspapers, reports, books, and official websites of the Government of India. The information and data for the research have been obtained from these sources to provide a comprehensive analysis of the ease of doing business in India.

ABOUT DOING BUSINESS

The Ease of Doing Business Index, published by the World Bank, evaluates a country's business environment by assessing various factors that influence ease of doing business. This index serves as an essential metric for gauging the competitiveness of a country's business climate. The Ease of Doing Business ranking evaluates a country's performance across ten indicators determined by the World Bank Group, providing a comprehensive assessment of its business environment.

A nation's ranking on the index is predicated on the types of ten sub-indices:

1. **Starting a business –** Procedures, time, cost and minimum capital to open a new business.
2. **Dealing with construction permits –** Procedures, time and cost to build a warehouse.
3. **Getting electricity –** procedures, time and cost required for a business to obtain a permanent electricity connection for a newly constructed warehouse.
4. **Registering property –** Procedures, time and cost to register commercial real estate
5. **Getting credit –** Strength of legal rights index, depth of credit information index.
6. **Protecting investors –** Indices on the extent of disclosure, the extent of director liability and ease of shareholder suits.
7. **Paying taxes –** Number of taxes paid, hours per year spent preparing tax returns and total tax payable as a share of gross profit.
8. **Trading across borders –** Number of documents, cost and time necessary to export and import.
9. **Enforcing contracts –** Procedures, time and cost to enforce a debt contract.
10. **Resolving insolvency –** The time, cost and recovery rate (%) under the bankruptcy proceeding.

EASE OF DOING BUSINESS: A VIEW OF INDIA

The World Bank Country Director in India, Junaid Ahmad, has commended India's notable advancements in the Doing Business rankings in recent years, attributing the improvements to the top leadership's strategic focus on business reforms and persistent efforts by the central and state governments. Ahmad stated that these collective efforts have significantly enhanced the country's business environment, a remarkable feat in the global economic landscape.

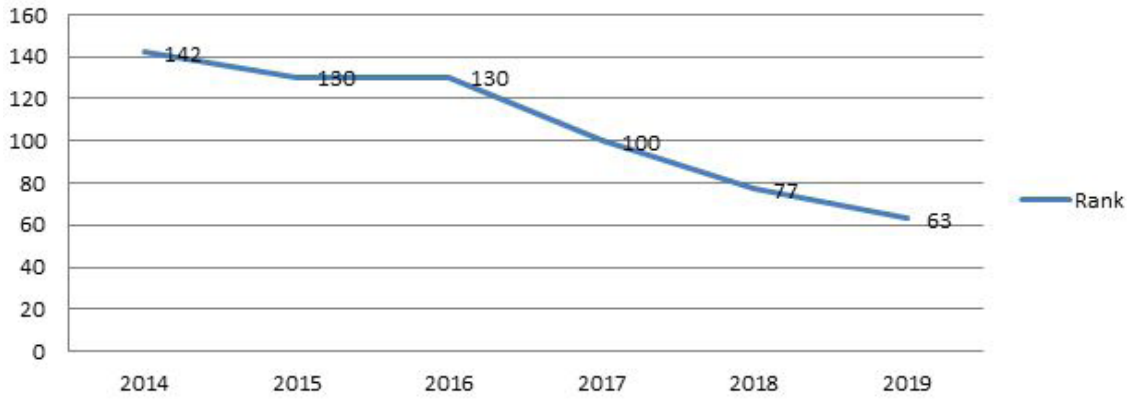


Figure 1: India's Performance on Successive – Ease of Doing Business Rankings
Source: Department of Industrial Policy and Promotion.

As clearly depicted from Figure 1, India has gradually improved the ranking in World Bank's Ease of Doing Business report to rank 63 in 2019 from rank 142 in 2014. According to World Bank Doing Business 2020 Report India becomes the top 10 improvers across 190 countries. This remarkable improvement in the country's ranking has been the result of government's consistent efforts to secure a position as a preferred place to do business.

INDIAN REAL ESTATE SECTOR: AN OVERVIEW

The real estate sector is regarded as an economic indicator due to its significant contribution to the Indian economy. It is the second-largest employer after agriculture, accounting for approximately 5-6% of India's GDP and capital formation. This sector's performance is therefore a crucial factor in the overall economic development of the country. The real estate sector is considered a key driver of the Indian economy due to its direct and indirect influence on other industries, including cement, steel, transport, construction, paint, brick, building materials, and consumer durables. The sector is poised to become one of the most significant contributors to India's GDP, surpassing other industries in the near future, underlining its crucial role in the country's economic growth.

The real estate sector is projected to contribute significantly to India's GDP, accounting for approximately 13% by 2025 and aspiring to reach US$ 1 trillion by 2030. This projected growth underscores the sector's increasing importance in the country's economic landscape and highlights the immense potential for further development. According to Department of Industrial Policy and Promotion (DIPP) construction becomes the fourth largest sector in terms of FDI inflows with US$ 25.31 billion from April 2000 to September 2019.

FACTORS INHIBITING THE GROWTH OF REAL ESTATE BUSINESS

Parth Mehta, Managing Director of Paradigm Realty, opines that despite the government's persistent efforts to reduce GST and allocate funds for stalled housing projects, significant challenges persist in the sector that need prompt attention. These challenges, Mehta believes, must be addressed to fully unlock the sector's potential and facilitate its projected growth.

Some of the major challenges impeding the growth of real estate industry are:

1. **Availability of suitable land:** India is a home to world's largest population. Majority of India's young population is shifting to cities for study and job purpose. As per economic

survey Inter-state migration in India was close to 9 million annually between 2011 and 2016. Above all, in India the cost of land in key urban areas is sky rocketing making land cost range at an average 30% to 40% of total project cost. But in country like America it range at 10% to 20% of total project cost.

2. **Complex Regulatory Environment:** The real estate sector in India is regulated at both the federal and state levels, leading to a complex approval process that involves multiple sanctions and licenses. This lack of clarity in the regulatory framework poses a significant challenge, as obtaining the necessary permits and approvals is often a time-consuming and arduous process. The uncertain and convoluted nature of the approval process can hinder growth and development in the sector.
3. **Exorbitant stamp duty and registration charges:** Despite its progress in other areas, India's Ease of Doing Business ranking for registering property remains low at 154th, due to high stamp duty and registration charges. This is in stark contrast with other emerging economies, such as Vietnam and the Philippines, which boast some of the lowest stamp duties at 2% and 1-1.5%, respectively. India's comparatively high stamp duties and registration charges can be viewed as a significant impediment to investment and development in the real estate sector.
4. **Construction cost and permit:** Reserve Bank of India (RBI) regulations prevent banks from financing land purchases, forcing real estate developers to rely solely on equity financing for land acquisition. This requirement significantly affects the project's return on investment (ROI), often falling below the expectations of global investors. The prohibitive regulations create a significant hurdle for developers seeking funding, potentially impeding the sector's growth and competitiveness in the global market.
5. **Heap of Unsold Inventory:** Hardik Agarwal, CEO of Radha Madhav Developers, notes that despite high demand in the real estate sector, approximately 30% of domestic housing and commercial spaces remain vacant in major cities, indicating a significant imbalance between supply and demand. This imbalance has resulted in an increasing inventory of unsold properties, which poses a significant challenge for the sector. Addressing this mismatch in supply and demand is crucial for the long-term sustainability and growth of the real estate industry.
6. **Rent-control legislation:** In countries like US, UK& Germany there is shift from ownership to rental housing model. Such rented homes constitute the 30-60% total housing stocks. Owing to various regional rent- control legislations in India; the rental housing model has not flourished yet.

THE ROAD AHEAD

Some recommendations which government can consider alleviating impediments to the growth of Indian realty sector.

1. **Centralized digital land records:** Due to unavailability of data records on land ownership, the process of land acquisition becomes tedious and litigious. Therefore there must be setting up of a central authority to keep land records and enable all transactions to happen online to simplify the process.
2. **Rationalizing the sanction, approval and licensing process:** The industry has to deal with numerous complex 'No Objection Certificates' before acquiring construction permit from

different government bodies. The government should make a single window approval system; prescribing the timeliness of each process and built a tracking system to track the progress of applications.

3. **Uniform stamp duty and registration rates:** The rates of applicable Stamp Duty and registration charges, on real estate purchases should be uniform. This would rather simplify the business process.
4. **Standardization of construction norms and documentation:** Disparate zoning policies, Floor Space Index regulations, and Slum Rehabilitation policies across states due to land being a state subject, present a complex regulatory landscape for real estate developers. This has led to complexity and discretion in interpretation leading to project delays and cost overruns.
5. **Focus on rental housing:** Developed countries, such as the United States, have embraced rental housing as a viable long-term housing solution, with nearly half of their populations choosing to live in rental properties. India can leverage this approach to address its significant housing demand, providing affordable and sustainable housing solutions to its vast population. Adopting a similar rental housing model can contribute to meeting the country's housing needs and promoting overall economic development.

CONCLUSION

Any rational government cares about the economic well being of its nation. Doing business helps to assess the domestic regulatory environment against the benchmark. But in the context of Real Estate sector, growth is crucial. Government initiatives such as smart city projects, building 1 crore houses under pradhan mantri awaas yojna are making real estate tremendously attractive. Despite the immense opportunities the sector has been facing problems of complexity of norms and approval structure. It is the need of hour that government should forms standardized norms which are comparable to others countries.

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The Role of Green Finance in Achieving Sustainable Development Goals: Pathways and Challenges

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Abstract

Overview: *In the current era of technological advancement, the global economy is being threatened by three significant challenges, such as environmental change, energy limitations, and financial emergencies due to financial improvements. Green finance is a solution to address these issues by promoting green development and reducing ozone depleting substances and air pollution.*

Purpose: *The aim of this study to gather relevant literature on the concept of green finance. The present study explores green financing initiatives in India and highlights opportunities, challenges and recommends measures to address them.*

Research design: *The present study is descriptive and relies on secondary data taken from various published reports by Government of India and all relevant existing literature from recognised Journals.*

Findings: *Green finance is still found in early stage in India. Green financing is essential for fostering inclusive, resilient, and sustainable economic growth by generating environmental advantages. The UN Environment is working to align financial systems for sustainable development goals. India needs a national green finance strategy, requiring $4.5 trillion in green infrastructure funding by 2040. Public and private sector organizations also play an important role in green financing. Green finance, being a new form of funding, presents hurdles in implementation, transition, and public availability.*

Limitation of the study: *The study on Green finance in India is dependent on secondary data, which may result in incomplete findings. It also lacks empirical analysis, which could limit its practical applicability.*

Originality of the study: *The study provides a comprehensive overview of Green finance in India, focusing on the country's rapidly growing economy and environmental challenges. The study also highlights opportunities and challenges, urging for a national green finance strategy to mobilize resources for sustainable development goals. The study serves as a foundation for policy development, offering a clear overview of the green finance landscape and suggesting actionable measures for creating an enabling environment.*

Keywords: *Green Finance, Green Initiatives, Sustainable Development, Sustainable Development Goals*

INTRODUCTION

Sustainable development is an important concept in environmental law that aims to establish a balance between economic growth and environmental conservation. Numerous summits and conferences have employed a sustainable development framework for their action plans in order to confront the severe issues of climate change (Tang et al., 2010). The 2030 Sustainable

Development Goals (SDGs) are a unique collection of seventeen time-bound objectives that aim to harmoniously balance the three sustainability goals of economic, social, and environmental sustainability (Bengtsson et al., 2018). Sustainability has fostered growth in all sectors of the economy. In this context, "green finance" has become a widely debated subject among corporations worldwide. Green financing is the term used to describe the financial support that private and governmental organizations offer to initiatives that promote sustainable development. Environmental degradation, renewable energy, deforestation, climate change, and carbon neutrality are just a few of the initiatives that are being discussed. However, the economy of each nation determines the environment in which green finance is relevant. Developing countries face a multitude of obstacles in financing their national objectives, despite the fact that established countries have the economic resources to provide financial support for sustainability-oriented initiatives (Guo et al., 2022).

The finance sector must raise its awareness of its role in addressing environmental issues in response to the increasing prevalence of environmentalism (Jha & Bakhshi, 2019). The IPCC 2018 predicts that a USD 1.6-3.8 trillion investment in the energy system will be required to limit global warming to 1.5 degrees Celsius. In order to implement its 2030 climate objectives, the European Union will be required to allocate an additional €180 billion annually to energy efficiency and renewable energy. Furthermore, the construction of sustainable infrastructure in Asia requires an annual investment of US$1.7 billion. As a result, the financial sector will be instrumental in the future's sustainable development.

Green finance will facilitate the establishment of sustainable and equitable development. In its most basic form, green finance encompasses all financial instruments, such as green bonds and instruments, as well as financial institutions such as green banks and green funds, that are involved in the investment of environmentally sustainable products and projects (Parikh & Parikh, 2021). Climate-smart financing, also known as green financing, has the potential to reduce carbon emissions and improve environmentally friendly outcomes over the long term. Market-based innovations are driving the growth of green finance (Jha & Bakhshi, 2019). The World Economic Forum predicts that annually, the investment in green infrastructure will reach $5 trillion until 2030, with a substantial portion of this investment being allocated to the developing world. It is anticipated that India will require infrastructure funding of approximately $4.5 trillion by 2040. This funding is planned to be allocated to national renewable energy targets, electrified vehicles, and green housing.

RESEARCH OBJECTIVES

- To comprehend the diverse facets of green finance activities in achieving Sustainable Development Goals.
- To look at the Advantages and Challenges associated with Green finance.

RESEARCH METHODOLOGY

The current study is predominantly descriptive and relies on secondary data obtained from various published sources, including papers, journals, research publications, and websites. We have endeavoured to establish green financing initiatives in underdeveloped nations such as India through our work.

CONCEPT OF GREEN FINANCE

The concept of "green financing" lacks a universally recognized definition. Green finance is the term used to describe the financial assistance that is granted to environmentally sustainable initiatives with the objective of reducing greenhouse gas (GHG) emissions and air pollution. Green development is a form of development that is accomplished by achieving a balance between the preservation of the environment and the requirements of the economy. Aiming to mitigate ozone-depleting emissions and other environmental contaminants, green finance is the investment in modern financial innovations. The global economy is confronted with three urgent challenges: climate change, energy constraints, and financial crisis (Mohd & Kaushal, 2018). A solution to these challenges is green development. The conventional financial regulatory frameworks in every country are comprehensively challenged by green finance.

Environmental considerations began to increasingly influence and shape the organizational agendas that regulate lending decisions in the 1990s, particularly in the field of investment finance. The green fund is designed to mitigate the environmental degradation that results from a variety of factors, including the depletion of water resources, the encroachment on rivers, the improper disposal of industrial, medical, and household waste, deforestation, and the loss of open spaces and biodiversity. In addition to its potential to alleviate destitution, the product must be environmentally friendly. It is imperative to involve the economic sector in the transition process to resource-efficient and low-carbon economies, particularly in the context of adapting to climate change. (Chaudhary and Bhattacharya, 2006).

"Green finance encompasses financial investments aimed for sustainable development initiatives, environmentally friendly goods, and projects that encourage the development of a more environmentally friendly ecosystem." Environmental funding is included in green finance; however, it is not the sole focus. It also encompasses a broader array of "other environmental objectives," including the preservation of biodiversity, the management of industrial pollution, and the purity of water. Climate change activities are intricately connected to the concepts of moderation and adjustment. Mitigation encompasses investments and initiatives that contribute to the reduction or prevention of greenhouse gas emissions (GHGs), whereas adaptation pertains to investments that mitigate the susceptibility of commodities and individuals to the effects of climate change (Höhne et al. 2012).

Definition of Green Finance

The definition of Green Finance that is universally accepted is not yet available, as this discipline is still in the process of evolving. Nevertheless, the following are some of the most prominent definitions of Green Finance:

- **The Chartered Banker Institute** defines Green Finance as any financial initiative, product, service, or process that is designed to manage environmental impacts, investment, or finance, with the intention of protecting the environment.
- As per the **G20 Green Finance Study Group**, financing that would provide environmental benefits for environmentally sustainable development is referred to as "Green Finance."
- As defined by the **Green Finance Initiative**, The term "Green Finance" refers to the investment in any method that reduces CO_2 emissions or increases resource efficiency, It encompasses green crowd funding for small-scale, community initiatives, as well as green bond issuance for significant infrastructure projects or corporate energy-efficiency initiatives.

- As per the **Organization for Economic Co-operation and Development (OECD),** The financing required to achieve economic growth while simultaneously reducing pollution levels and greenhouse gas emissions, reducing waste, and improving the efficiency of natural resource utilization is referred to as "Green Finance".

Green Finance Initiative in India

The Indian government's first initiative in this effort was the formation of the International Solar Alliance (ISA) in collaboration with France on December 1, 2015. The principal aim of this alliance is to collaboratively tackle climate-related challenges through international cooperation. Acquiring finance for sustainable initiatives is increasingly essential for a developing country like India, due to the rising energy demands stemming from significant economic growth, rapid industrialization, and urbanization. The nation implemented efforts like "Make in India" and various Smart City Projects to bolster the requisite funding for increasing consumption and output. The International Energy Agency (IEA) forecasted in 2015 that India will experience an increase of 600 million energy consumers by 2040, leading to a substantial surge in electricity demand. The Indian government predominantly utilizes loan monies to finance green and renewable energy initiatives. The "Task Force for Creating National Infrastructure Pipeline" research indicates that India requires an estimated $4.5 trillion in infrastructure financing by 2040. This financing will mostly be directed towards sustainable housing, electric vehicles, and achieving national renewable energy objectives (Ansari & Anand, 2022).

The Ministry of New and Renewable Energy (MNRE) was founded in 2006, tasked primarily with research and development, protection of intellectual property, and the promotion and coordination of renewable energy consumption. Three main incentive scheme types are used in India for financing renewable energy: generation-based incentive (GBI), viability gap funding (VGF), and accelerated depreciation (AD) (Ansari & Anand, 2022).

1. **Accelerated depreciation** is a tax incentive provided to project developers. Initially launched in 2009 mostly for wind projects and then withdrawn in 2012, it was later revived in 2014 and currently remains a strong driver for investment, particularly in solar power projects.
2. **Viability gap funding** refers to a singular financial grant provided for infrastructure projects that are economically reasonable but lack financial viability. These projects are important for the overall development of the economy, such as establishing a bus route in an area without road transportation access. However, they may not generate profits in terms of revenue from operations (such as ticket sales) that exceed the expenses required to sustain the project (including fuel, staff salaries, and other costs). An evident example of this motivation has been its utilization by the Solar Energy Corporation of India (SECI) for the production of solar energy.
3. **Generation-based incentive scheme** prioritizes the actual production of solar and wind energy, rather than solely emphasizing the establishment of installations. The program offers a subsidy of INR 2.00 for every kilowatt-hour (kWh) of solar electricity generated and a subsidy of INR 0.50 for every kilowatt-hour (kWh) of wind power generated.

India has the potential to expedite its shift towards a more environmentally friendly and sustainable financial system, which would have positive impacts on both the environment and the economy. The subsequent guidelines provide a systematic framework to accomplish India's sustainable development goals (Kharade, n.d.):

1. India has established the following aims for its "Objective Contribution at the National Level" over the period of 2021-2030.
2. Achieve a reduction in GDP emissions of 33 to 35 percent from 2005 levels by the year 2030.
3. By 2030, aim to reach around 40% of the total capacity for non-fossil fuel energy assets through the allocation of Yuga and Coffee Fee Global Finance from the Green Climate Fund (GCF).
4. By 2030, the goal is to establish a new carbon sink that can absorb and store 2.5 to 3 billion tons of CO2 by implementing measures to conserve and expand forests and trees.
5. According to initial calculations, India will require around 6,206 billion (at 2014-15 prices) from 2015 to 2030 in order to carry out projects related to agricultural, forestry, fisheries infrastructure, water resources, and ecosystem adaptation.
6. A research conducted by the Asian Development Bank to evaluate the expense of adjusting to climate change in South Asia indicates that India's projected cost of adaptation in the energy sector alone will amount to around 77.7 billion in the year 2030.
7. The National Institution for Transforming India (NITI) Commission projects that the expenses for implementing measures to reduce carbon emissions and promote sustainable development will amount to approximately 83,834 billion rupees by 2030, based on 2011 price levels.
8. As it progresses, an initial approximation indicates that a minimum of two two-year periods (2014-2015 fever) may be required to fully accomplish India's climate change initiative by 2030.

It is anticipated that India will need to allocate approximately INR 162.5 lakh crores (USD 2.5 trillion) from 2015 to 2030, or approximately INR 11 lakh crores (USD 170 billion) annually, in order to fulfil its Nationally Determined Contributions (NDCs) under the Paris Agreement. Although India has made strides toward these objectives, there is still a significant amount of work that must be done. At the COP26 Summit in Glasgow, Prime Minister Sh. Narendra Modi presented the "five nectar elements" or Panchamrit, as India's supplementary contribution to climate action, in recognition of the urgency (Purkayastha & Jain, 2022). There are the following:

1. India will increase its non-fossil energy capacity to 500 GW by 2030.
2. Obtain 50% of its energy needs from renewable sources.
3. Decrease the total projected carbon emissions by one billion tons from the current level.
4. Decrease the carbon intensity of its economy by over 45%.
5. The goal of Net-Zero will be achieved by India by 2070.

Priority Sector Lending Recognition

In April 2015, the Reserve Bank of India (RBI) designated green financing and renewable energy as a priority sector in order to increase the competitiveness of the Indian economy and create more employment opportunities. The guidelines mandated that banks allocate 40% of their net credit or an equivalent quantity to off-balance sheet exposure for priority sectors such as micro-hydel plants, solar power generators, street lighting systems, and wind mills. In 2019, a positive trend emerged as nationalized banks, including the Bank of Baroda, Canara Bank, Central Bank of India, Punjab National Bank, and others, increased their priority sector lending to renewable

energy, education, and housing. This initiative is intended to enhance the Indian economy's competitiveness and expand employment prospects (Ansari & Anand, 2022).

Green Banks

In 2016, the Indian Renewable Energy Development Agency (IREDA) was transformed into a green bank, subsidizing sustainable practices and mitigating carbon emissions through banking operations. This action prompted other banks, such as the State Bank of India and Union Bank, to transform into green banks. SBI provides long-term loans at preferential rates for financing green initiatives, whilst Bank of Baroda assists small and medium-sized firms in obtaining essential equipment and implementing energy saving strategies. ICICI Bank finances sustainable energy, energy efficiency, greenhouse gas reduction, and clean technologies. These institutions seek to enhance clean and sustainable energy while mobilizing private sector capital for eco-friendly initiatives.

Table 1: Green Banking Practices

S.No.	*Areas Covered*	*Explanation*
1	Internet Banking	Delivering banking services to customers via the internet. Promotes digital and cashless transactions.
2	Green Mortgage	The financing allocated for acquiring a green building or for retrofitting an existing structure to meet green building standards.
3	Green Home equity	The loan granted for the acquisition of energy-efficient equipment for residential installation.
4	Home office conversion loans	Loans for establishing a home workspace and initiating remote work
5	Green car loan	provide reduced interest rates for the acquisition of non- to low-emission vehicles.
6	Green credit cards	Each time the cardholder executes a payment, a specific a fraction of the total is subtracted and allocated for sustainable initiatives
7	Energy efficient loans	Financing for the effective management of energy
8	Alternative fuel Vehicle and Fuelling Infrastructure loans	Incentives and loans offered for the conversion of current automobiles to fuels that are cleaner and more efficient

Source: S, 2021

Green Bonds

Environmentally sustainable initiatives are financed through green bonds, which are fixed-income securities. In order to become financially viable, they must obtain the necessary credit rating from rating agencies. In 2015, YES Bank introduced the first green bond in India, which was succeeded by IREDA's distinctive five-year green bonds in 2017. Upon their listing on the International Securities Market (ISM), these bonds also became the first to be listed. Ghaziabad Nagar Nigam was the first issuer of Green Municipal Bonds in 2021, and Indian corporates have raised approximately $4.96 billion through green bonds. India is among the second highest emerging issuer of green bonds, following China. Investors' risk perceptions are critical to the successful adoption of securities, and the Indian economy's continued expansion necessitates enhanced investor awareness, standardized procedures, and lucrative incentives for both issuers and investors.

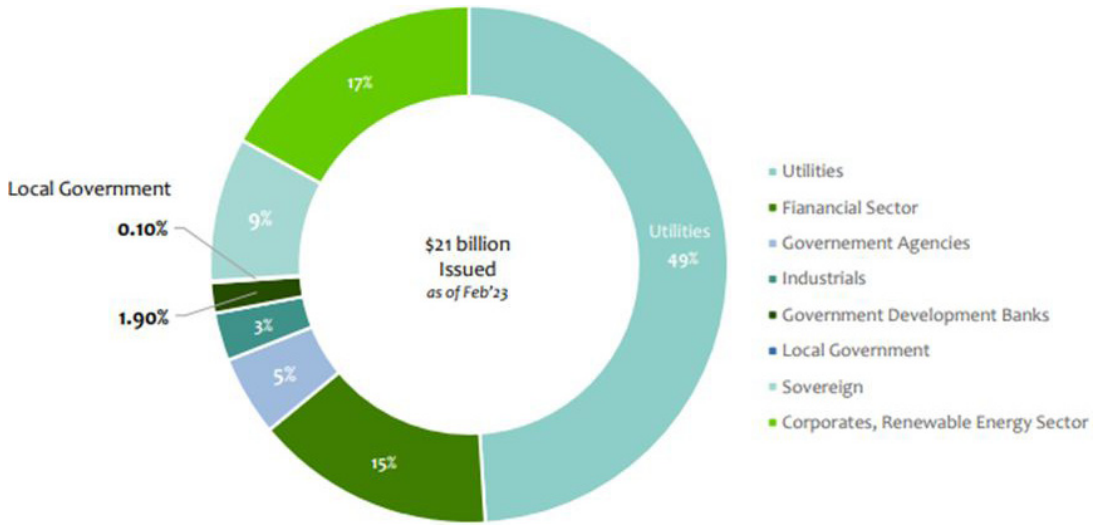


Figure 1: Green Bond Issuance in India by Type of Issuer
Source: World Bank with Data from Bloomberg 2023

Crowd Funding

In North America and Western Europe, crowd funding has grown in popularity as a means of obtaining capital from individual investors for certain projects. In India, 'Better vest' and 'Sun Funder' have effectively garnered investment for sustainable initiatives. Better vest, a platform located in Germany, has invested in initiatives such as 'Boond Engineering' and 'Mera Gao Power' to enhance renewable energy generation in rural India. In 2017, Sun Funder, a Kenyan enterprise, established a $47 million 'Beyond the Grid' fund to address the disparity between the demand and supply of dependable electricity and to furnish debt capital financing to off-grid solar enterprises in Sub-Saharan Africa, India, and the Pacific area (Ansari & Anand, 2022).

IMPORTANCE OF GREEN FINANCE

Climate change presents a substantial threat to the environment, chiefly due to the overconsumption of fossil fuels. The ongoing utilization of fossil fuels at the present rate is anticipated to elevate the Earth's temperature by 4 to 6 degrees Celsius above pre-industrial levels. The rise in temperature will adversely affect human health, food production, and potentially endanger specific communities and overall biodiversity (Ansari & Anand, 2022). Numerous governments have grown cautious regarding this issue and have pledged to comply with and execute the Sustainable Development Goals (SDGs) and the Paris Agreement (instituted in 2015). The Paris Agreement mandates that global warming must be kept well below 2 degrees Celsius, with endeavours to restrict the rise to 1.5 degrees Celsius, compared to pre-industrial levels.

A notable challenge persisting in the global economy is the issue of a low investment rate. In reaction to the 2008 global financial crisis, many high-income nations enacted policies to enhance income, consumption, and employment levels. A primary strategy implemented was the reduction of interest rates, which achieved a measure of success. Nonetheless, a recurring problem emerges when interest rates are significantly lowered, as investors predominantly engage in borrowing for speculative endeavours at decreased rates. This behaviour led to a widespread deterioration

in investment quality (Ansari & Anand, 2022). The enhancement of long-term investments for ecologically advantageous and sustainable projects is essential. In numerous countries, the public sector is financially unable of offering long-term investment, but the private sector has persistently exhibited hesitance due to associated risks and restricted profit potential. The financing of such environmentally-friendly projects in any economy relies mostly on three sources:

(a) Domestic public finance pertains to the financial assistance directly provided by a nation's government.
(b) International public finance pertains to the financial assistance offered by international organizations and development banks.
(c) Private sector funding – Capital obtained from domestic and international private organizations.

In India, the renewable energy sector is primarily owned by the private sector, but conventional energy is predominantly owned by the Central and State governments, who own two-thirds of the ownership. Securing financing for such initiatives is more difficult due to the unpredictability linked to the private sector (Chaurey & Kandpal, 2009) (Ansari & Anand, 2022). According to Bakry et al. (2023), "green finance" is the intentional coordination of the financial sector to support initiatives that minimize carbon emissions, promote the development of renewable energy, reduce the impact of climate change, optimize resource utilization, and ultimately work towards a more environmentally sustainable economy. The three primary elements of green finance are environmental improvement, the financial industry, and economic growth. In line with the Paris Agreement and the Sustainable Development Goals, green initiatives have the ability to reduce carbon emissions while simultaneously promoting energy security and self-sufficiency (Ansari & Anand, 2022).

Both the environment and the economy will derive advantages from Green finance. It facilitates the establishment of a harmonious relationship between the financial dimension and the natural world. The diverse advantages provided are:

1. **Optimal energy administration:** Diverse incentives are offered to encourage the installation and utilization of renewable energy sources. Green financing provides money for projects that attempt to minimize energy wastage. Therefore, the attainment of effective energy management is possible.
2. **Environmental protection:** The principal aim of green financing is to allocate resources for activities that foster sustainable development, making support for environmental protection an essential aspect of this funding. This strategy will aid in diminishing pollution levels, adapting to climate change, mitigating ozone layer depletion, and conserving biodiversity, all of which are essential for the survival of living organisms.
3. **Increases reputation:** As the cohort of stakeholders aiming to satisfy their social responsibilities through investments expands, they will favour companies that actively pursue environmental advantages. The government provides incentives for eco-friendly initiatives. Consequently, green finance will aid companies in developing and enhancing their reputation over time.
4. **Promotes the attraction of Foreign Direct Investment (FDI):** Global apprehensions over environmental conservation are escalating. Foreign investors will evaluate the societal costs and benefits while investing in domestic firms. The issuance of green investment instruments will successfully draw foreign direct investment to our nation.

CHALLENGES OF GREEN FINANCE

1. **Lack of consensus in defining:** There is no universally accepted and consistent definition for green finance. Investors may face challenges in selecting suitable green projects due to the lack of a clear definition, resulting in confusion and acting as a deterrent to investing in such initiatives.
2. **Insufficient regulatory framework:** The deficiency of clearly articulated laws, regulations, and guidelines on the evaluation of eco-friendly projects, coupled with the absence of targeted policy measures for investments in sustainable initiatives. This regulatory loophole hinders the growth and progress of green investment.
3. **Limited awareness:** Although certain individuals and organizations are adopting ecologically sustainable investments, a considerable number of stakeholders remain uninformed about the concept of green finance. The buildup of insufficient capital in green investment goods will result from inadequate knowledge and awareness. This will create a discrepancy between the demand and supply of capital.
4. **Foster unhealthy competition:** Market participants will capitalize on the rising demand for green investment goods and endeavour to enhance their market share by leveraging the reputation of green activities. This will lead to harmful competition and ultimately neglect the principle of sustainable development in favour of short-term economic profit.

RECOMMENDATIONS

1) Increasing public awareness: Government, financial institutions, banks, and business organizations should work together to educate the general public on the significance of environmental preservation and the wide variety of environmentally friendly investment options. To generate innovative solutions, it is imperative to integrate finance and technology. Innovative products that simultaneously promote environmental progress and captivate investors.
2) Establishing an appropriate regulatory framework: Establishing a regulatory framework to effectively evaluate green finance initiatives and protect investor interests is essential. The regulatory authorities have to ensure that the funds acquired for each project are solely employed for their designated purpose.
3) Enact separate legislation to regulate the misappropriation of funds: Stringent laws should be implemented to penalize market participants who exploit the increasing demand for environmentally-friendly initiatives. The legislation should also focus on the utilization of collected cash. If the guidelines are violated, appropriate measures must be implemented.
4) Supporting research: Strategies must be enacted to encourage research in green financing, merging technical innovations with the financial industry. This will make it easier to build cutting-edge green investment goods, successful green initiatives, and the essential legislative measures for all-encompassing development and expansion.

LIMITATIONS OF THE STUDY

The present study on green finance is dependent on secondary data from government reports and existing literature, which may result in incomplete findings. It also lacks empirical analysis, which could limit its practical applicability. The study's geographic focus may limit its generalizability to other countries or regions, as the unique socio-economic and political conditions in India may

make broader conclusions less applicable. Additionally, the study's static analysis of the green finance landscape may not capture dynamic trends or future projections, necessitating a forward-looking approach to understand potential shifts in green financing over time.

CONCLUSION

Green finance has emerged as a global problem in the context of sustainable economic and financial growth. Every nation is deeply worried about environmental change and pollution. In order to achieve more sustainable development, it is important to identify the key factors. Possible green projects should be evaluated to determine if they qualify for green financing. Financing should be provided for initiatives that aim to minimize waste generation, recycle waste into compost or other useful products. Increased financial support should be allocated to all green projects. It is essential to raise awareness among rural communities at the grassroots level. Efforts should be made to establish green projects and facilitate their replication. Tree planting should be encouraged wherever possible. Developers should be incentivized to construct environmentally friendly buildings. Financing should be directed towards eco-friendly products. Microfinance should be expanded to support the production of green goods with low interest rates. Furthermore, financial resources must to be designated for rainwater gathering, solar lighting, and alternative renewable energy sources. The current study provides a comprehensive analysis of green financing and highlights its important role in the economic advancement of a nation. Global warming is causing a multitude of issues worldwide. Scientists and environmental experts attribute it to the emissions of greenhouse gases. This study emphasized the fact that the implementation of green funding will lead to a substantial reduction in greenhouse gas emissions. In conclusion, India has significant potential to establish a green infrastructure that is essential for green finance. This can be accomplished by overcoming challenges and enhancing awareness among corporate stakeholders to foster sustainable growth. We believe that in the near future, green finance will become widely accepted in all worldwide societies.

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Smart Cities and Wastewater Treatment: Bridging Circular Economy an Sustainable Development Goals (SDGs)

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Abstract

A significant exponential growth in urban clusters has been noted in the recent past, which continues to persist. consequently, there is an inadvertent exertion of, geo-political, socio-cultural, socio-economic and environmental pressures. Among the prime issue is the generation, is waste, accumulation and mobilization of waste, which necessitates immediate and time -sensitive intervention. In the context of sustainable development, the incorporation of the Circular Economy (CE) is regarded as one of the main objectives of modern societies. The main attribute of CE is a need to enhance resource efficiency through waste reduction and recycling. CE is based on 3R's concept which leads to extension of the lifecycle of products, leveraging an important component of providing resources for future generations under the broader framework of sustainable development it central to the advancement of intelligent urban areas, the designation "smart cities" The term "smart city" refers to a sustainable city that outperforms efficaciously in myriad dimensions of life. Modern WWTPs are the keystone of supporting sustainability: recycling water, recovering nutrients, and producing energy directly contribute to sustainable development. In this sense, WWTPs become a key element of a smart city, as they have the ability to change waste into resources and could be used in urban development toward less dependence on fossil fuels. However, since emerging contaminants (ECs) in wastewater create the additional challenge associated with wastewater disposal, there is a need for the development of new and innovative techniques of treatment to handle pollution and assure that we attain environmental standards.

Keywords: *Circular Economy, Energy, Resource Recovery, Smart Cities, Waste Water Treatment Plants (WWTPs)*

INTRODUCTION

A smart city can be termed as one in which technology is integrated into sustainability. 21st century has introduced us to a whole new worldwide trend: Sustainable Urban Development this concept builds further on urbanization and makes it urgently necessary to modernize existing cities. It is of prime important that within the concept of smart cities, urban development be integrated which is both sustainable as well as competitive. The CE stresses that waste should be regarded as secondary raw material which may be processed and Recyclable for re using and also in order to establish a value proposition model. The products, commodities, and the raw material can be reused by the economy as long as possible (Velte and Steinhilpe, 2016). CE model is depicted in Figure 1.

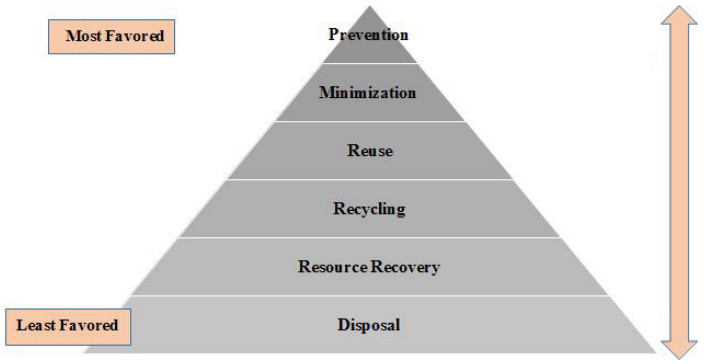


Figure 1: Circular Economy (CE) Model

Smart cities depend on technology factors that is (digital and information cities), institutional aspects; that is (smart growth) and human factors; that is (knowledge, learning and cities) (Silva et al., 2020). There is a need for new methods and procedures, and special methods and procedures have to be made in order to take up the problems of living within cities. This includes overcrowding issues, energy use, resource management, and environmental protection (Johnson, 2008). The world's population, by 2030, is anticipated to be urbanized at 60%, which would entail enormous demands on water, energy, buildings and public spaces (Caragliu and Del Bo, 2012). Smart cities which are efficient, sustainable and which can help social and economic development are becoming more in vogue. A core aim of smart cities is to bring about the creation of a city that allows for inclusive development. Due to this fact, one key feature of smart cities is their ability to increase the speed of delivering goods while using fewer resources. These are done swiftly and are aimed at promoting city operations (Alawadhi et al., 2012). Figure 2 above depicts some of the smart city indications, which are part of an inclusive development.

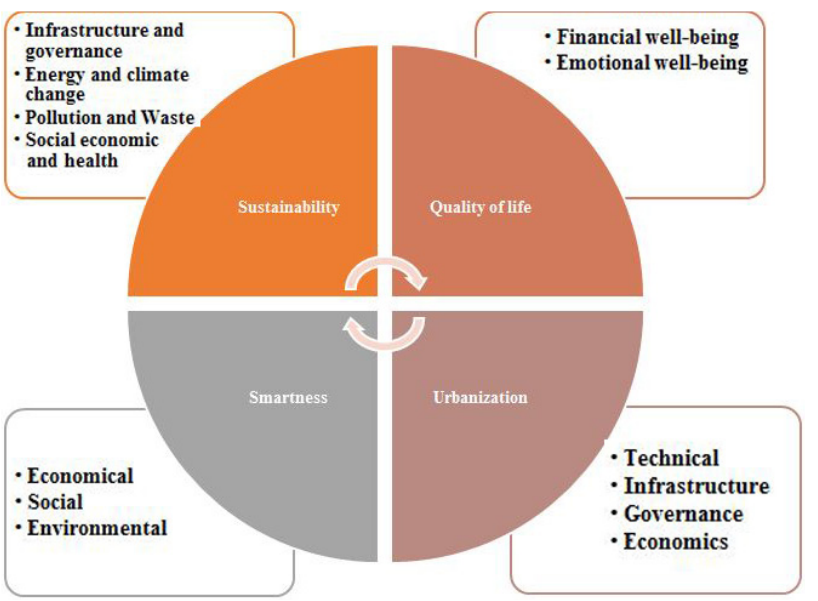


Figure 2: Characteristics of a Smart City

One of the most important components of a smart city is its water system. Because more people will likely be residing in cities, water consumption is bound to increase. Smart wastewater management means that there is proper wastewater infrastructure and the correct information regarding the flow, pressure, and distribution within any community. Cities are referring to this good resource as "smart water." With the information gathered, it is sufficient to aid in making good decisions and formulating policies (Weber and Khedemian, 2008). Urban WWTPs are significant for circular sustainability because they produce energy, recover resources, and make clean water (Rashidi et al., 2015; Mo and Zhang, 2013). With urbanization and industrialization coming, ecologically sustainable technology systems for WWTPs would be a realistic scenario. For over 25 years powerful forces have brought attention to recover the resources found in wastewater. The driving force influencing the sectorial growth of the wastewater sector is ever increasing demand for agri-based and alternative energy-based solutions across the globe. According to World Health Organization reports, the majority of people live in urban region and this figure is expected to rise by 70% in the next years (Borja, 2007). Figure 3 describes how a wastewater treatment plant can be designed to be smart.

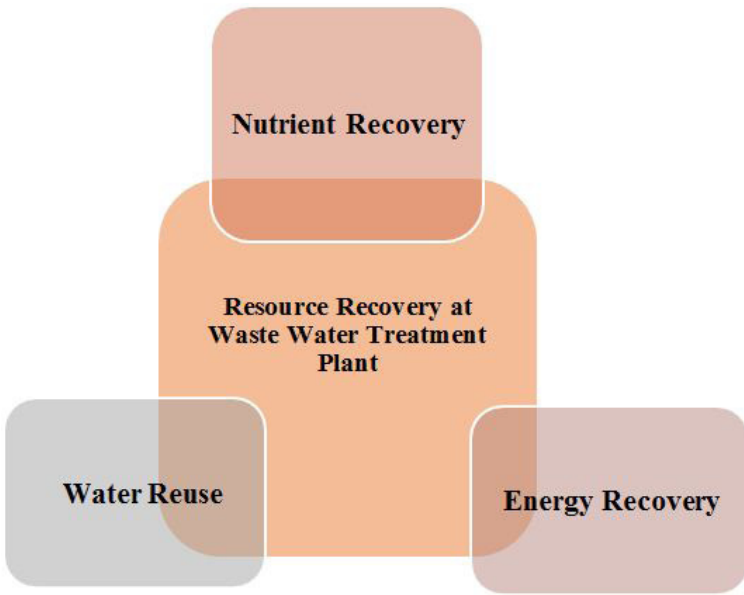


Figure 3: Functionality of a WWTP

WASTE WATER TREATMENT PLANT IN SMART CITIES

By diminishing the number of resources that leave the system, the circular economy aims to improve the efficiency of the circular system (Gaur et al., 2015). In the context of smart cities, wastewater treatment plants have become a central focus. The concept revolves around a smart wastewater system wherein these plants purify wastewater to a degree that allows for effluent reuse while simultaneously generating power and fertilizers (Papa et al., 2017; Xie et al., 2016). This recycling approach is focused on attaining fossil fuel-free urban environments by converting waste stream energy into valuable renewable resources (Neczaj and Grosser, 2018). Figure 4 details current and future developments in WWTPs, which result in added value.

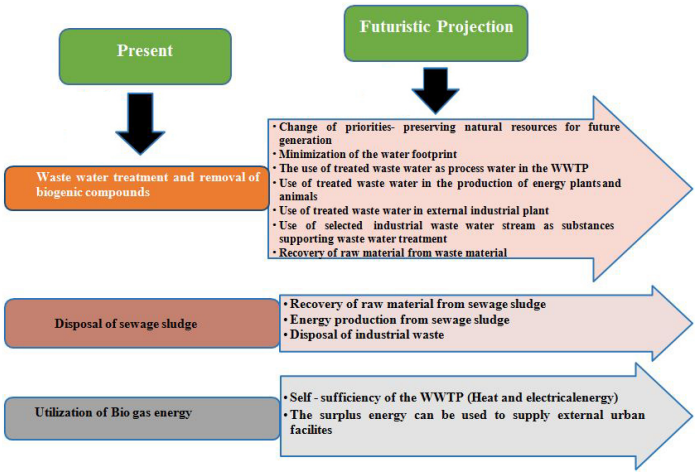


Figure 4: WWTP: Current and Future Trends

Sewage Treatment Plant

In relation to this, the wastewater treatment takes aim to remove contaminants from water so as to make it meet the required government regulations on discharge effluents. A standard treatment plant works using a three-way form that includes physical, chemical and biological (Sharma et al., 2020). Figure 5 below shows process components that allow perfect working of an ETP. Figure 6 below shows the condition for smooth operation for water treatment plant.

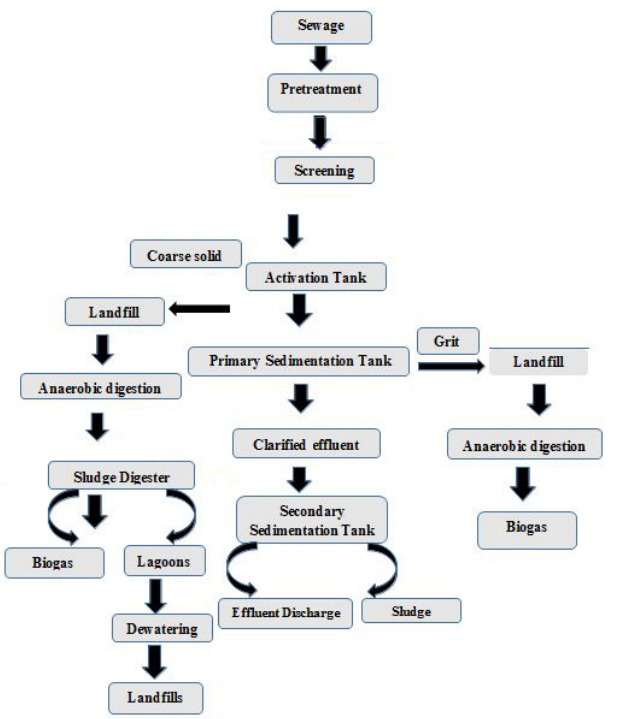


Figure 5: Operational Model of a WWTP

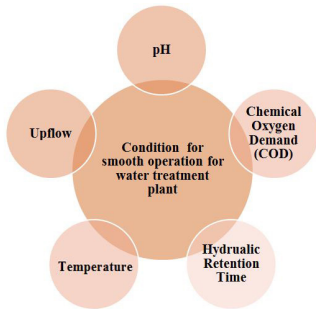


Figure 6: Conditions for Smooth Operation for Water Treatment Plant

Emerging Pollutants (EPs) in Waste Water

Because there is always a possibility of negative implications on the environment and human health, EPs have recently gained much attention. These EPs, generally known as micro pollutants, are formed from diverse processed chemicals (Su et al., 2020). Any manufactured or naturally occurring chemical that resists routine monitoring and regulation, in the environment and has the potential to have detrimental impacts on the ecosystem and human health. The major contaminants in the chemical released from pharmaceuticals, Personal Care Products (PCPs), insecticides, commercial and domestic goods, metals surfactants, industrial additives, and solvent make up chemicals released. Some of them may cause chronic toxicity, endocrine disruption in human and aquatic wildlife, and the emergence of bacterial pathogen resistance (Birch et al., 2015).

Classification of Emerging Contaminants (ECs)

Inorganic and organic micro – pollutants such as pesticides, PCPs, medicines, synthetic organic dyes, Polycyclic Aromatic Hydrocarbons (PAHs), heavy metal ions, plasticizers, per- fluorinated chemicals, flame retardants, surfactants. All these are ECs due to their heterogeneous nature and dispersal in ecosystems, posing harm to human and wildlife. Detection of these ECs is somewhat challenging because the initial concentrations are very low. (Sidhu et al., 2013). Figure 7 shows routes of transmission of ECs through various pathways. (Tollefsen et al., 2012).

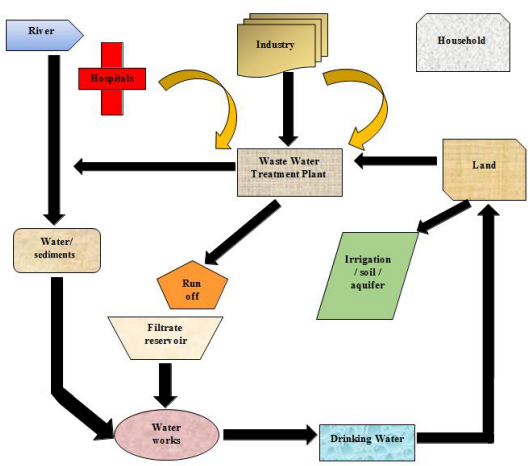


Figure 7: Potential Sources of Emerging Pollutants and their Route in Environment

Toxicological Effects of EPs

Emerging Pollutants can cause both chronic poising and Endocrine Disruption Chemicals (EDCs). These chemicals are primarily consumed through food and drink that have been in touch with polluted soil, water or microbes which cause bio magnification and bioaccumulation in the body. Researchers are currently concentrating on ECs found in surface water for a variety of reasons, including the fact that surface water frequently contain large amount of wide variety of contaminants, especially when surface water is directly linked to the industrial discharges (Stuart et al., 2012). Table 1 depicts health adversities of emerging pollutants.

Table 1: Effect of Emerging Pollutants on Human Health

Emerging Pollutants	*Disease Caused*
Personal Care Products (PCPs)	• Cancer • Fertility Problem • Endocrine Disruption • Affect the thyroid gland
Pharmaceuticals	• Carcinogenic • Effect Fertility • Ulcer, Bleeding in stomach • Affect lactation • Gastrointestinal Toxicity
Flame Retardants	• DNA damage • Hormonal imbalance • Mitochondrial Damage • Fertility problems • Damage in neural development
Pesticides	• Miscarriage and pregnancy complications • Damage male reproductive system • Hormonal changes • Thyroid Problem • Ovarian Tumor

FUTURE CHALLENGES

The control of ECs in water resources is a very challenging task. The following are some futuristic projections in an attempt to address the challenges:

- Nano-biotechnological approach to degrade pollutants
- Assess and validation of operational factors of a WWTP for cost-effectiveness.
- Green technologies such as membrane filtration and microbial fuel cells will be used in the attainment of reliable, low-cost solutions. Hybrid operational models are developed for the WWTP to ensure sustenance

CONCLUSION

Attainment of *Smart City* objectives in context with WWTP is always very daunting as it so directly depends upon the socio-economical and geo-political scenario of a particular region. Removal of diversified class of contaminants; adhering to prescribed effluent release norms is still challenging,though. Implementation of a *mono-treatment* for minimizing pollution load is a non-

feasible approach. Consequently, a three-tier end of pipe treatment strategy that encompassing biological, physical and chemical modes wastewater treatment methods, but the optimal approach in addressing complexity of operation, ecological impact, effectiveness, practically and cost efficiency has not been found. The bridging between two or more removal methods results in efficacious removal and enhanced water qualityat a relatively lower cost. Emerging Contaminants (EC) are possibly hazardous substances, with their anthropogenic origin. Those products, which are medicinal compounds and agri-centric products, have been accounted for. Their presence has given a deleterious effect on both biotic and abiotic resources of eco-system. Smart city concept intervenes and integrates novel treatment approaches aimed at contaminant removal or minimization of the same converging into sustenance and hence *green* paradigm shift.

Conflict of Interest

Author's share none competing or conflicting interest

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Global Boundaries: Mapping the Evolution of Green Product Exports Through Bibliometric Analysis

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Abstract

Purpose: *This study investigates the global evolution of green product exports through bibliometric analysis, mapping trends and contributions from various research institutions worldwide. It has focused on identifying the growth, key innovation drivers, and sustainability impacts of green exports worldwide.*

Research Methodology: *A large-scale dataset, including 723 documents, from 1978 to 2024, was analysed using bibliometric techniques. Data is collected from the Scopus database, focusing on important indicators such as citations, document growth, and collaboration networks. Tools such as 'Biblioshiny R Studio' view tabulations and visualisations.*

Findings: *The study showed that research on green product exports has grown significantly, especially since 2000. China and the USA dominate research outputs, but they display different citation effects. Sustainability practices, environmental policies and technological innovation were identified as the key drivers of research in this area. Collaboration networks highlight the global nature of green product export research, with major contributions from regions such as Europe and Asia.*

Originality/Value: *This research presents a new perspective on the evolution of green product exports using bibliometric analysis. It identifies the key themes, collaborations and influential sources shaping this growing field of study. The findings provide valuable insights for policymakers, researchers and industry leaders by highlighting the links between sustainability and international trade. The study also provides a basis for future research on the dynamics of green product exports and their role in promoting sustainable economic practices.*

Keywords: *Green Product Exports, Bibliometric Analysis, Sustainability, Technological Innovation, Global Trade Trends*

INTRODUCTION

In recent decades, world trade has undergone profound changes, and green products have great power in the international market. Being driven by climate change and resource scarcity, environmental issues are well-known, so the state quickly gains the importance of sustainable practice in economic strategies. Export of green products including a wide range of products aimed at reducing the impact on the environment is essential to this paradigm, which reflects social responsibility and environmental integrity commitment. Various factors including technological advances, market demand and policy structure influence this development in green products. The introduction of new methods such as renewable energy sources, environmentally-friendly production processes, sustainable agricultural practices, etc. is intensifying competition with green products on global platforms. A country that invests in these methods not only enhances export capabilities but also grows to be a leader in the green growth economy. In addition,

consumers' behaviour changes quickly, and population growth prefers sustainability of purchase decisions. This change has increased the demand for environmentally friendly products. In other words, manufacturers and exporters are motivated to adapt their strategies accordingly. Businesses, which adopt green principles, not only meet market requirements but also rapidly gain competitive leaders in markets. Politics plays an important role in training the dynamics for exporting green products. Governments around the world have generally introduced structures and incentives to promote sustainable practices in their industries. Measures such as renewable energy subsidies, green technology rebates, strict environmental standards and other measures encourage companies to innovate and transition to green production methods. These politicians not only improve the quality and attractiveness of green products but also create a preferred environment for international business. The interplay between these factors – technological innovation, priority of consumers and development of tributaries – emphasizes the complexity and importance of product exports in modern economic scenarios. By understanding this development, stakeholders can better understand the issues and opportunities represented by the green economy.

RESEARCH OBJECTIVE

The objective of this study is to analyze publication trends in green product exports from 1978 to 2024, identifying shifts in research focus and key contributors, including authors, institutions, and countries. It will explore collaborative networks and assess the thematic evolution of literature, particularly concerning sustainability and technological innovation. Additionally, the research will evaluate the citation impact of significant publications to highlight influential works. By mapping the global research landscape, the study seeks to identify regional contributions and gaps in existing literature, ultimately providing insights for policymakers and industry leaders on trends and best practices in green product exports

REVIEW OF LITERATURE

The evolution of green product exports has been shaped by a complex interplay of agricultural advancements, market strategies, and sustainability concerns. Early research, such as Gahukar (1992), emphasized the contribution of the Green Revolution to India's food production and export economy, noting that while it boosted grain yields, it also led to socio-economic disparities and regional imbalances. Similarly, Quddus et al. (1997) examined the interconnectedness of Pakistan's livestock and crop sectors, showing how trade policies influenced the availability of green forage and livestock feed. Abdullah and Mursalim (1997) contributed to the field by investigating renewable energy applications for sustainable agriculture, particularly through greenhouse-effect solar dryers for vanilla production. These agricultural innovations laid a foundation for later advancements in green exports, supported by technologies and sustainability practices. Technological innovation has played a key role in the shift towards green product exports. For example, He et al. (2024) explored how technological similarities and complementarity in environmental goods trade among 176 countries have driven exports, particularly in high-complexity products from Northern countries. Their findings suggest that green exports depend on not only economic policies but also technological collaboration. Additionally, Shen et al. (2024) highlighted the importance of consumption-based carbon accounting in understanding global emissions patterns, with their findings revealing a decrease in consumption-based

emissions in developed countries and a rise in China's green product exports. Other studies have examined the impact of regulatory frameworks on green exports. Liu and Qiu (2024) analyzed the effect of Sanitary and Phytosanitary (SPS) measures on the quality upgrading of agri-products, demonstrating that heterogeneous measures can inhibit environmental protection and quality improvements in export goods. Meanwhile, Yingkamhaeng and Vanichsriratana (2024) discussed Thailand's sugarcane sector, illustrating how the adoption of precision agriculture and the Bio-Circular-Green model has allowed for more sustainable agricultural practices and enhanced export growth. Similarly, Ahmed and Khan (2024) stressed the need for stricter environmental regulations in China's post-pandemic energy rebound, showing how such measures contribute to both economic growth and environmental sustainability through green innovation. Beyond agriculture, green product exports have expanded into other sectors. For instance, Wang et al. (2023) analyzed the potential impact of the EU's Carbon Border Adjustment Mechanism on China's carbon neutrality goals, demonstrating how policy shifts can influence global trade and sustainability goals. Arletti et al. (2023) took a different approach by investigating how industrial waste can be recycled into eco-friendly materials like stoneware tiles, highlighting innovation in resource efficiency. This is echoed in the renewable energy sector, where Ya'Acob et al. (2022) examined solar energy projects in Malaysia, demonstrating how the integration of rainwater harvesting in solar infrastructure supports green jobs and environmental sustainability. The marketing strategies for green products have also evolved alongside technological and policy shifts. Anbarasi and Kumar (2019) explored the challenges and opportunities of online marketing strategies for organic products in the pharmaceutical sector, particularly regarding certification and quality standards. Klarić and Obučina (2020) highlighted the increasing global demand for environmentally friendly wood technologies, noting that innovations in engineered wood products (EWPs) have driven export markets, particularly in regions like Bosnia and Herzegovina. Finally, Xu et al. (2021) examined China's green tea production, contrasting the benefits of local versus export markets while emphasizing the environmental sustainability challenges associated with both. Collectively, these studies underscore the evolving landscape of green product exports, driven by a combination of agricultural advancements, technological innovation, regulatory frameworks, and market strategies. The ongoing shift towards sustainable development and environmental cooperation in global trade highlights the importance of optimizing production methods to align economic growth with environmental preservation (Nitescu & Murgu, 2022). Together, these insights provide valuable guidance for policymakers and industries aiming to balance the economic and environmental objectives of green exports.

RESEARCH METHODOLOGY

This study employs a bibliometric analysis to examine the evolution of green product exports, identifying key trends and influential publications in the field. Data for the analysis was sourced from Scopus, covering publications from 1978 to 2024, using search terms such as "green products," "sustainable exports," and "green economy." A total of 723 documents were selected, including articles, book chapters, and conference papers. After data cleaning, bibliometric indicators like citations, keywords, and authors' affiliations were examined. The Biblioshiny R Studio tools a used for the analysis, enabling the visualization of bibliometric analysis.

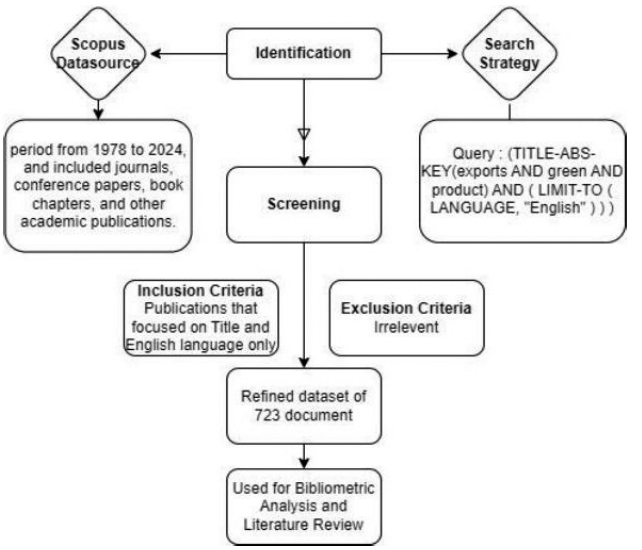


Figure 1: Framework (Author's work)

Table 1

Description	*Results*		*Description*	*Results*
Main Information About Data			Authors Collaboration	
Timespan	1978:2024		Single-Authored Docs	115
Sources (Journals, Books, etc.)	485		Co-Authors Per Doc	3.55
Documents	723		International Co-Authorships %	22.96
Annual Growth Rate %	9.42		Document Types	
Document Average Age	8.45		Article	533
Average Citations Per Doc	29.01		Book	3
References	30609		Book Chapter	66
Document Contents			Conference Paper	83
Keywords Plus (Id)	5412		Conference Review	2
Author's Keywords (De)	2303		Editorial	1
Authors			Erratum	2
Authors	2314		Note	4
Authors Of Single-Authored Docs	107		Retracted	1
			Review	24
			Short Survey	4

FINDINGS AND DISCUSSIONS

The data indicates that the number of published articles has been increasing steadily over time, especially since 2000. In the first years (1978-1999), it contributed sporadically, but since 2000, research results have increased regularly in 2018 (an increase of 34 articles), 2020 (41 articles) and 2022 (79 articles). This trend reflects the interest and expansion in this field, which is declining

slightly in 2023 and 2024, and in general, the research department has reached a considerable pace, especially in the last 20 years.

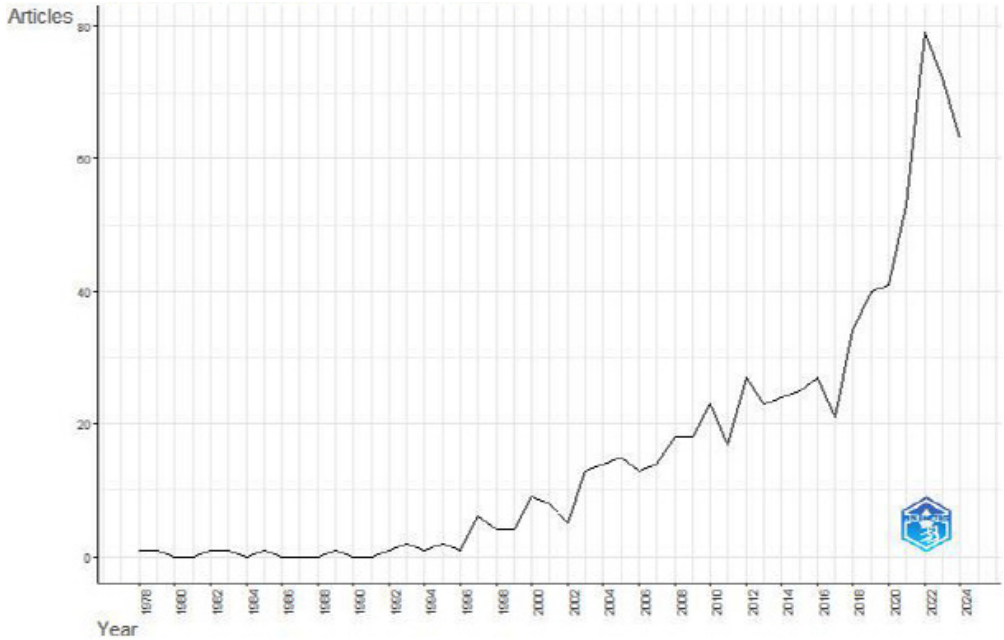


Figure 2: Annual Scientific Production

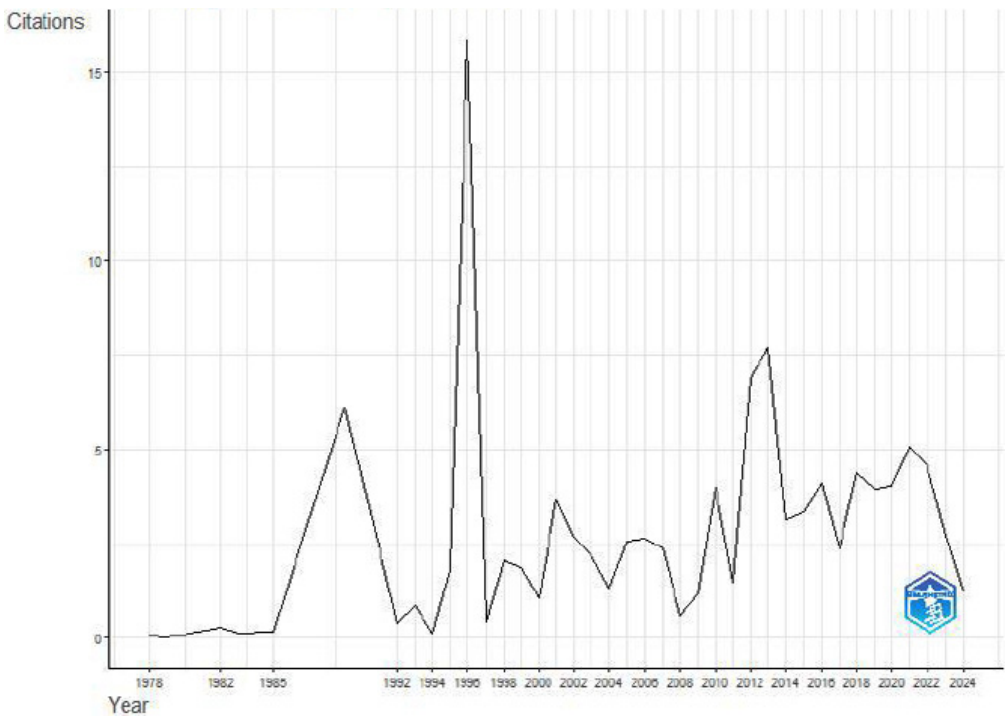


Figure 3: Average Citations Per Year

Figure 3 highlights the impact of citing articles over time. In the early years (1978 to 1996), it was sporadic, but in 1989 and 1996, high publications were affected by an average of 220 and 459 citations. Since 2000, the number of articles has increased, but citations were average. In key years such as 2012 and 2013, citations increased significantly (89.74 and 92.57), reflecting influential characteristics. The total number of articles has grown steadily, but according to the article, the average cited mark has decreased until 2021, but this may show a broader but more influential direction of research.

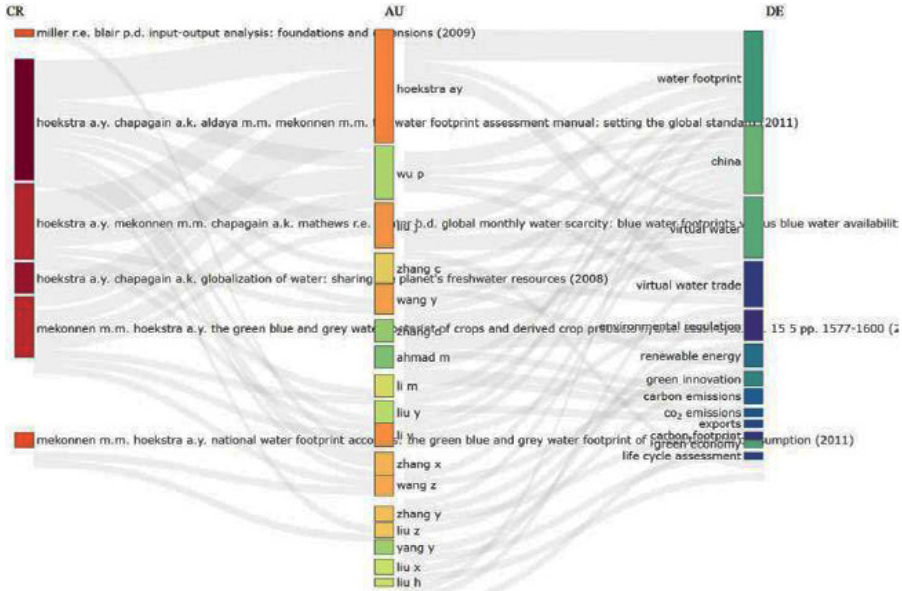


Figure 4

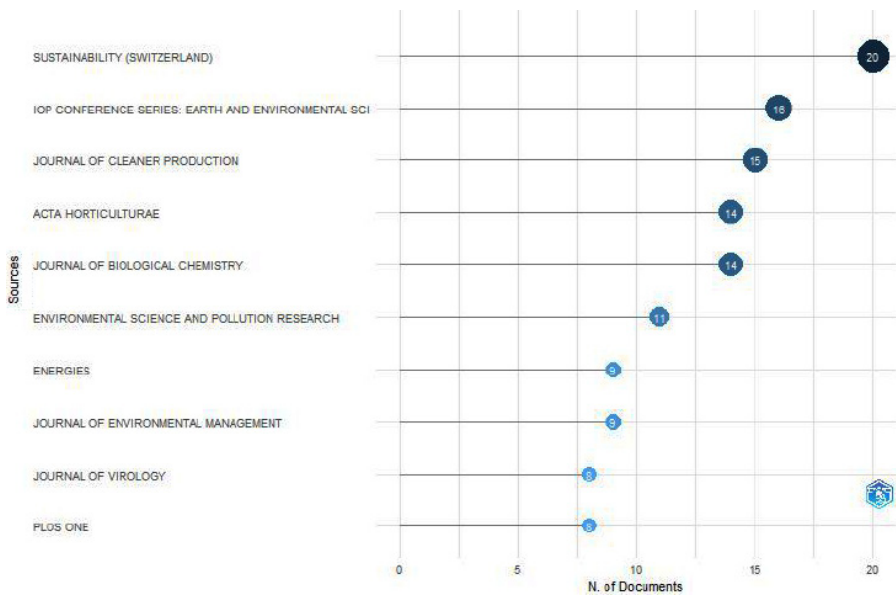


Figure 5: Most Relevant Sources

The most relevant sources are emphasized in figure 5 from the analysis, which aims at citation sign frequency. The journal Sustainability (Switzerland) leads with 20 citations, which shows its importance in this field. Just after is Journal of Cleaner Production with 16 citations and Business Strategy and Environment in second place with 15 citations. These sources emphasize research areas in relation to sustainability, environmental management and cleaner production. The ranking of the sources is mainly based on the number of citations, which demonstrates the importance of these topics in the evaluated literature.

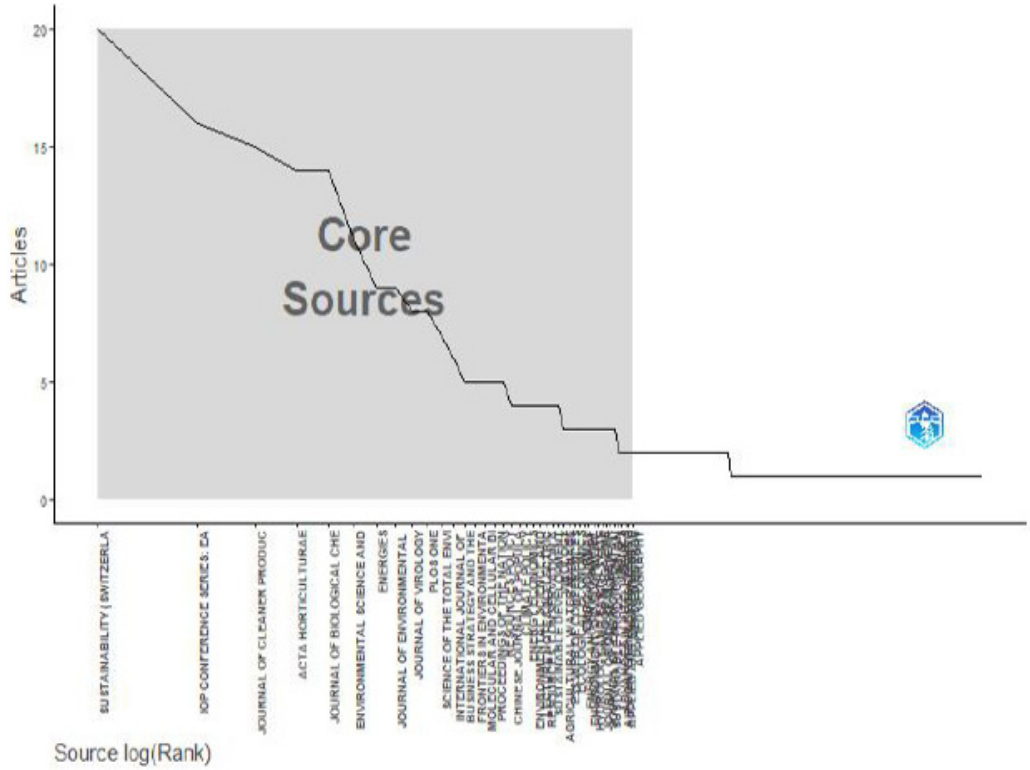


Figure 6: Core Sources by Bradford's Law

Bradford's law figure shows the main sources that contribute to his book list data. The "Main Sources" area shows some important journals in which "Sustainability (Switzerland) leads with the most articles, followed by "IOP Conference Series: Earth and Environmental Sciences" and "Journal of Cleaner Productions". These main sources play an important role in the publication of literature about their research focus, reflecting important branches for work in sustainability and environmental science. Apart from this main source, the contribution of other journals shows that the distribution in the book list matches Bradford's rule.

Figure 7 shows the most influential sources by h-index, with the Journal of Physical Chemistry ranked 13th, followed by the Journal of Cleaner Production at 12th. Other influential sources include Sustainability (Switzerland) and the Journal of Ecology, with h-index values of 9 and 8, respectively. Larger bubble sizes correspond to higher h-index values, indicating greater productivity and better citation impact in these journals, highlighting their importance in your research field.

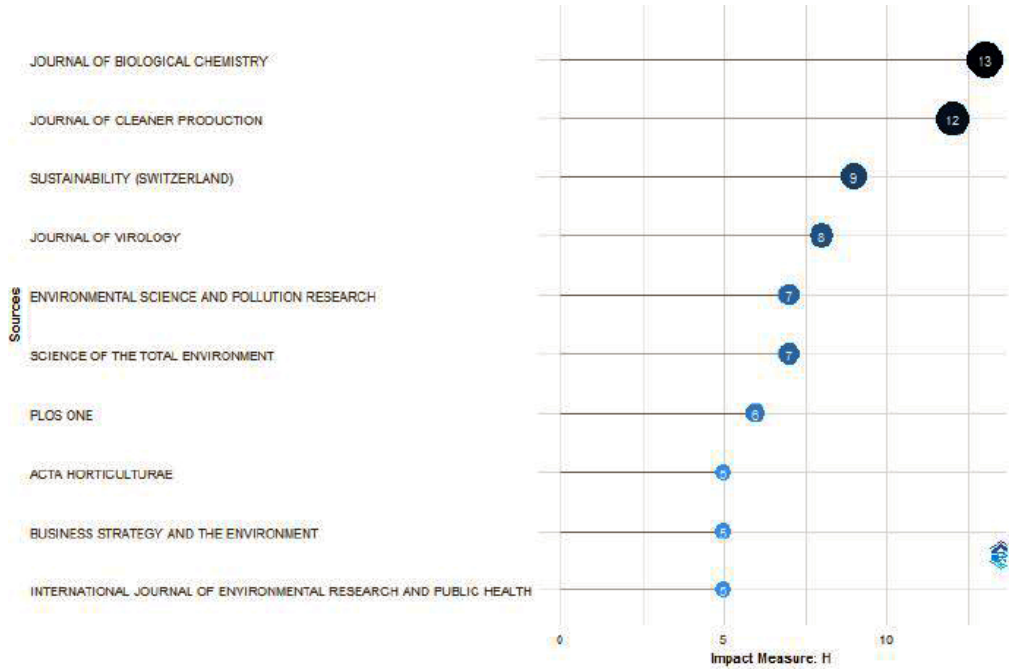


Figure 7: Sources' Local Impact by H Index

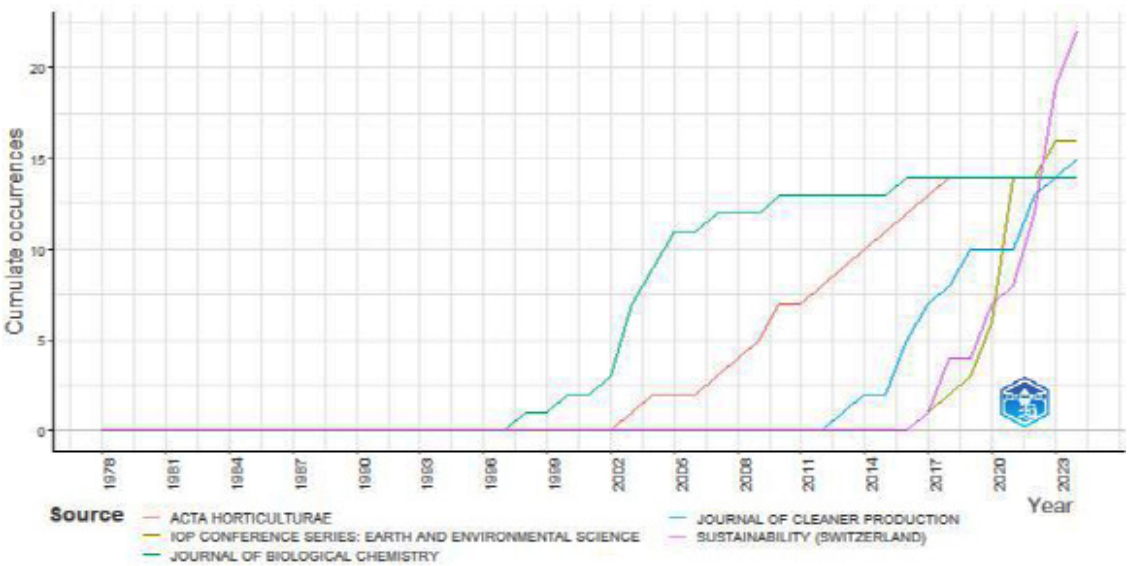


Figure 8: Sources' Production Over Time

Figure 8 shows the publication trend of five journals from 1978 to 2024. In particular, Sustainability (Switzerland) recorded a significant increase in publications since 2017, reaching 22 articles in 2024. The IOP Series of Conferences: Earth and Environmental Sciences shows a regular increase compared to 2017, which will reach a peak of 16 articles by 2024. The Journal of Clean Plus Productions shows a regular increase since 1998, reaching 15 articles in 2024.

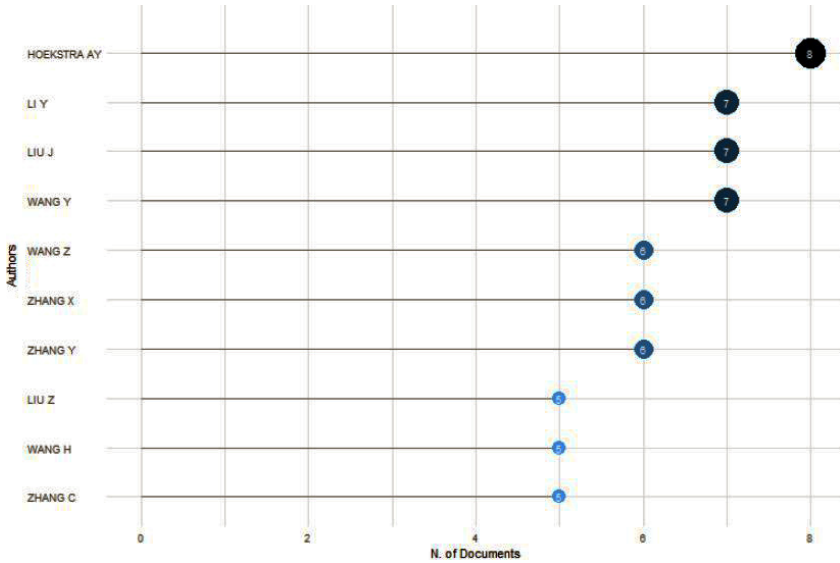


Figure 9: Most Relevant Sources

The figure shows the most relevant authors in the analysis according to the number of documents they have contributed. Author KolkaA is ranked highest with 8 documents, followed by LiY, LiuJ and WangY with 7 documents each. Several other authors have contributed 6 documents each, including ZengSX and ZhouZhou. This distribution indicates a significant concentration of research contributions by these authors, reflecting their influences on the research being conducted and their impact on the field. The classification is determined by the contribution of each author's contributions to the literature.

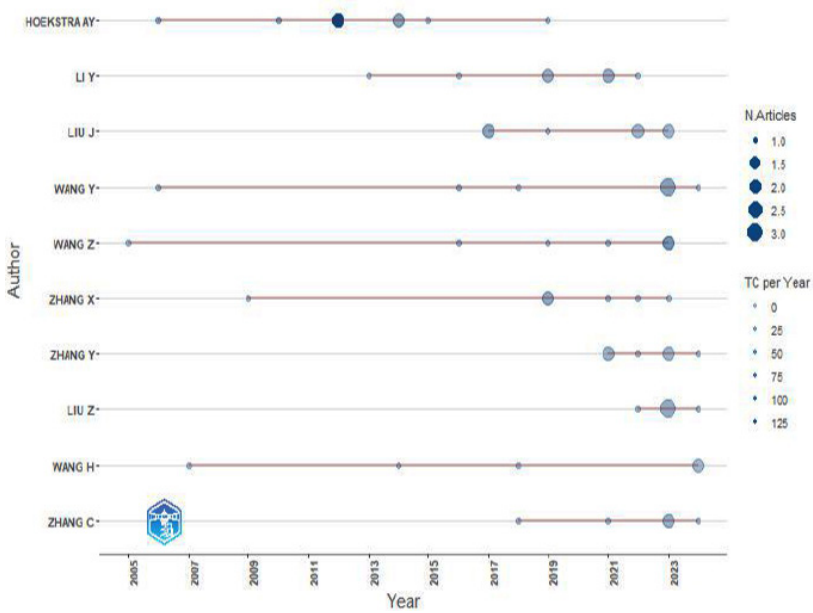


Figure 10: Authors Production Over Time

Figure 10 highlights important research on sustainability, water footprint and green finance, particularly in China. Hoekstra AY's work is notable for its numerous citations, demonstrating its strong influence on these areas. Recent research in 2023 and 2024 examines the impact of digital transformation and environmental policies on export quality and emissions, reflecting the growing interest in integrating environmental management into business practices.

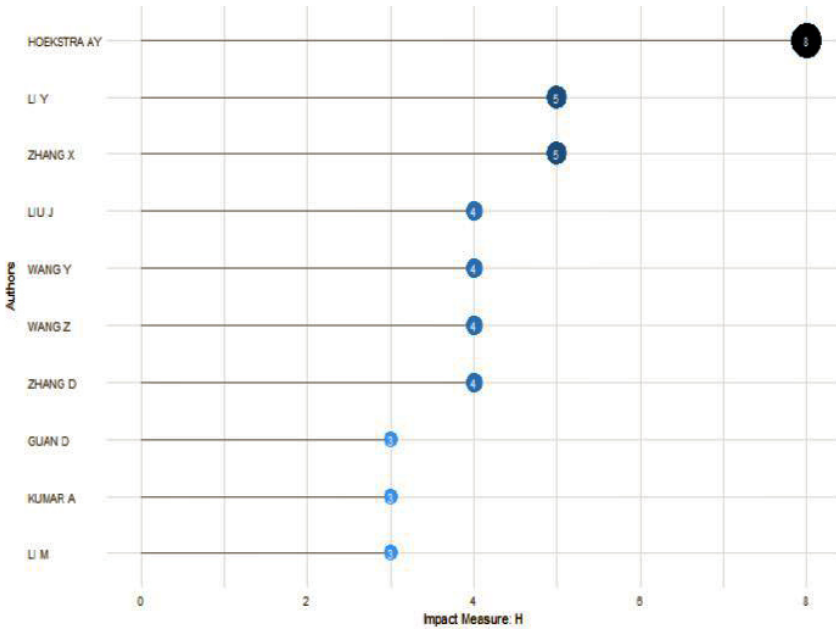


Figure 11: Author's Local Impact by H Index

Figure 11 indicates the impact of authors based on their H-index, which reflects both productivity and citation impact. Kolk A stands out with the highest H-index of 8, indicating substantial influence in the research field. Following this, Li Y and Zeng S.X have an H-index of 5, showcasing moderate influence. Several authors, including Liu J, Wang Y, and Zhou Z.H, hold an H-index of 4, suggesting consistent contributions. The chart highlights the varying levels of research impact among these authors, with Kolk A being particularly prominent.

Table 2: Most Relevant Affiliations

Affiliation	*Articles*
Sichuan Agricultural University	20
Beijing Forestry University	18
Northwest A and F University	18
Notreported	18
Tsinghua University	13
The B.J. Habibie Science and Technology Area (KST)	12
University of California	12
University of Twente	12
Cornell University	11
Hohai University	11

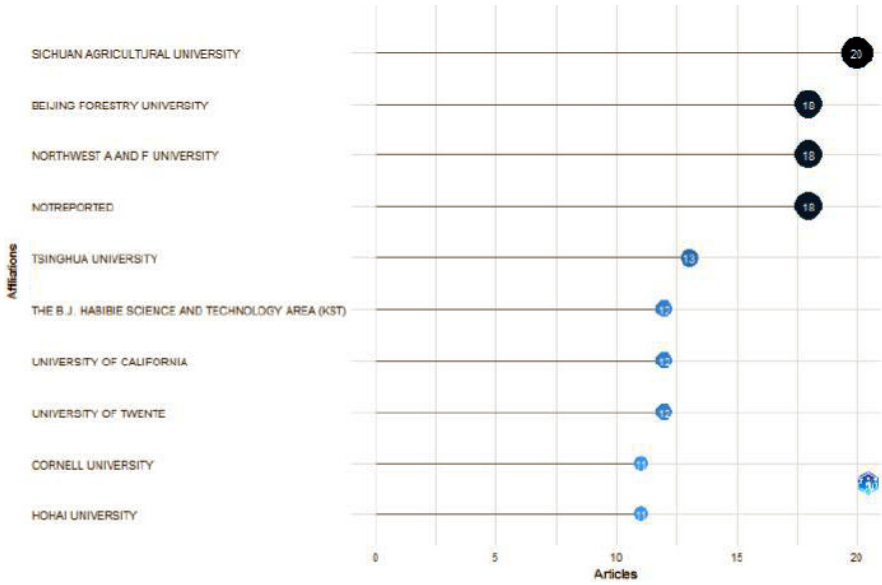


Figure 12: Most Relevant Affiliations

Affiliation data show that leading institutions in the field of sustainable development and environmental research: Sichuan Agricultural University, Beijing Forestry University and Northwestern A and F Universities published the largest number of articles (20, 18 and 18, respectively). Notably, several other leading universities, such as Tsinghua University and Cornell University, are also making significant contributions, indicating a strong network of research focusing on these important issues in various geographical locations.

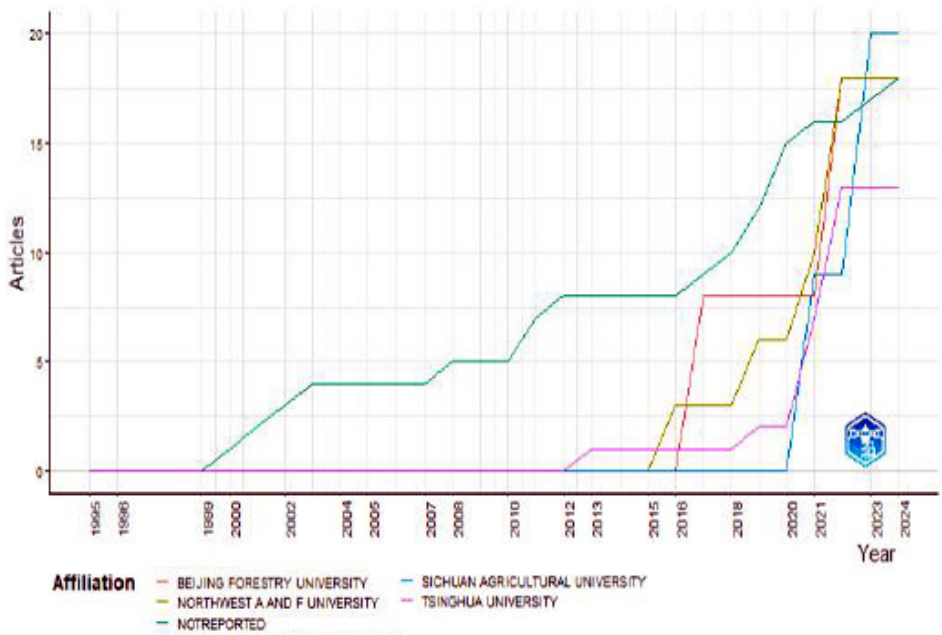


Figure 13: Affiliations' Production Over Time

The trends of various universities reflect a significant increase in research output, especially in the "unpaid" range of 18 articles in 2024. Tsinghua University has shown a gradual increase in articles from 2013 to 13 in 2013. In 2024, it reflects an increase in attention to sustainability research. Similarly, A&F Agricultural University and Sichuan Agricultural University have experienced reasonable growth, and Sichuan Agricultural University won 20 articles in 2023 and 2024. In contrast, forestry is held by other institutions such as Forest University. A stable output volume of 18 articles from 2022 to 2024 contributed to a certain contribution. Generally, the data, especially in recent years, has shown an increase in research in this field.

Table 3: Country Scientific Production

Region	*Freq*	*Region*	*Freq*
CHINA	547	ECUADOR	9
USA	325	PORTUGAL	8
GERMANY	103	ROMANIA	8
INDIA	100	CHILE	7
AUSTRALIA	91	SERBIA	7
INDONESIA	91	ARGENTINA	5
FRANCE	77	CYPRUS	5
BRAZIL	72	LEBANON	4
UK	69	MOROCCO	4
ITALY	67	NICARAGUA	4
NEW ZEALAND	62	NORWAY	4
JAPAN	53	OMAN	4
CANADA	45	SLOVAKIA	4
NETHERLANDS	44	SUDAN	4
SPAIN	42	UNITED ARAB EMIRATES	4
THAILAND	40	AZERBAIJAN	3
TURKEY	33	BANGLADESH	3
SOUTH AFRICA	31	CAMEROON	3
SWITZERLAND	31	COSTA RICA	3
PAKISTAN	30	DOMINICAN REPUBLIC	3
IRAN	26	KENYA	3
KAZAKHSTAN	26	MONACO	3
SWEDEN	24	NIGERIA	3
SOUTH KOREA	22	SINGAPORE	3
DENMARK	21	SLOVENIA	3
MALAYSIA	21	CZECH REPUBLIC	2
UKRAINE	21	GHANA	2
AUSTRIA	20	IRAQ	2
PERU	20	LATVIA	2
EGYPT	18	UGANDA	2
BELGIUM	14	UZBEKISTAN	2

Region	*Freq*	*Region*	*Freq*
COLOMBIA	13	FIJI	1
IRELAND	12	HUNGARY	1
ISRAEL	12	MONGOLIA	1
PHILIPPINES	12	QATAR	1
SRI LANKA	12	RWANDA	1
FINLAND	10	URUGUAY	1
POLAND	10		

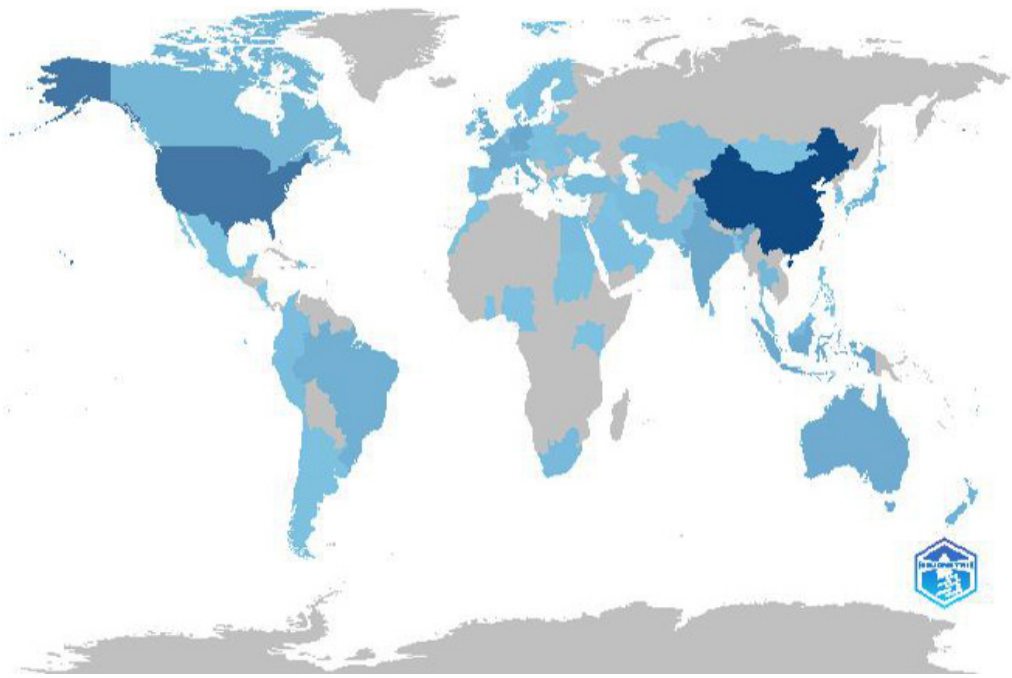


Figure 14: Country Scientific Production

The regional distribution of research results indicates that China has received the largest contribution, 547 articles, followed by the United States with 325 articles. Germany (103) and India (100) also showed significant participation in this field, and Australia and Indonesia have offered 91 articles each. European countries such as France, the United Kingdom and Italy are 77, 69 and 67, each of them. In Asia, Japan (53), South Korea (22) and Malaysia (21) provide great research activities. This data is attracting attention in China and the United States, but many other countries have contributed to the global scene reflecting the varied international participation on this topic.

Analysis of citations shows that the United States leads the list with 3,648 total citations (59.8 citations per article), followed by the Netherlands, which has a high average of 237.5 citations despite 2,850 total citations. Belgium has the highest average with 394.6 citations on 1,973 total citations. China, on the other hand, has a lower average of 17.1 citations, with 2,451 articles, indicating high production but low impact by article. This highlights the impact of citations and important variations in the recognition of research between countries.

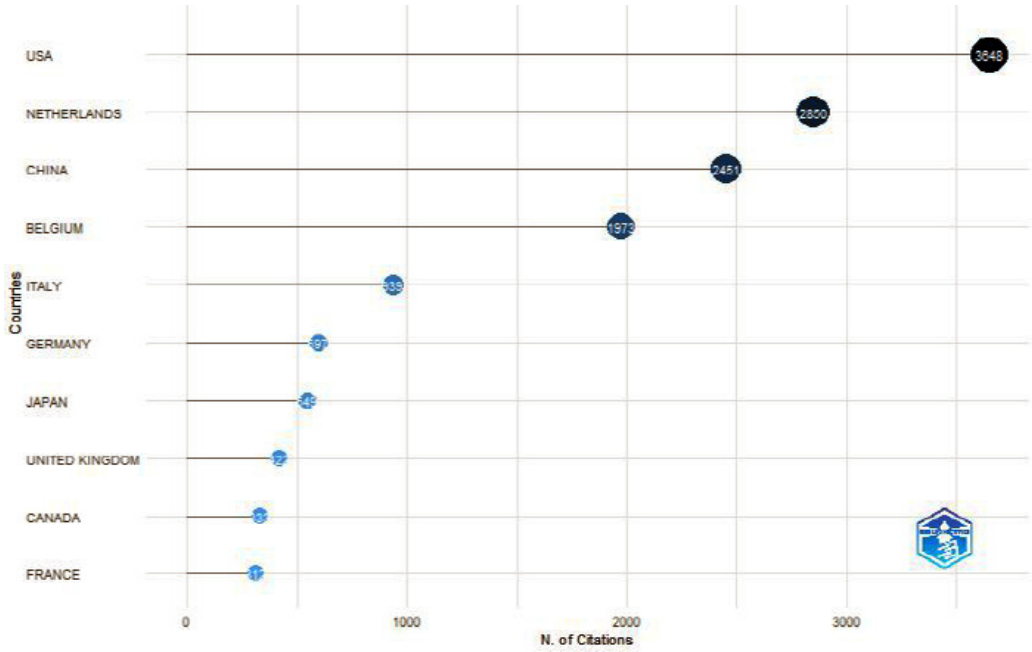


Figure 15: Most Cited Countries

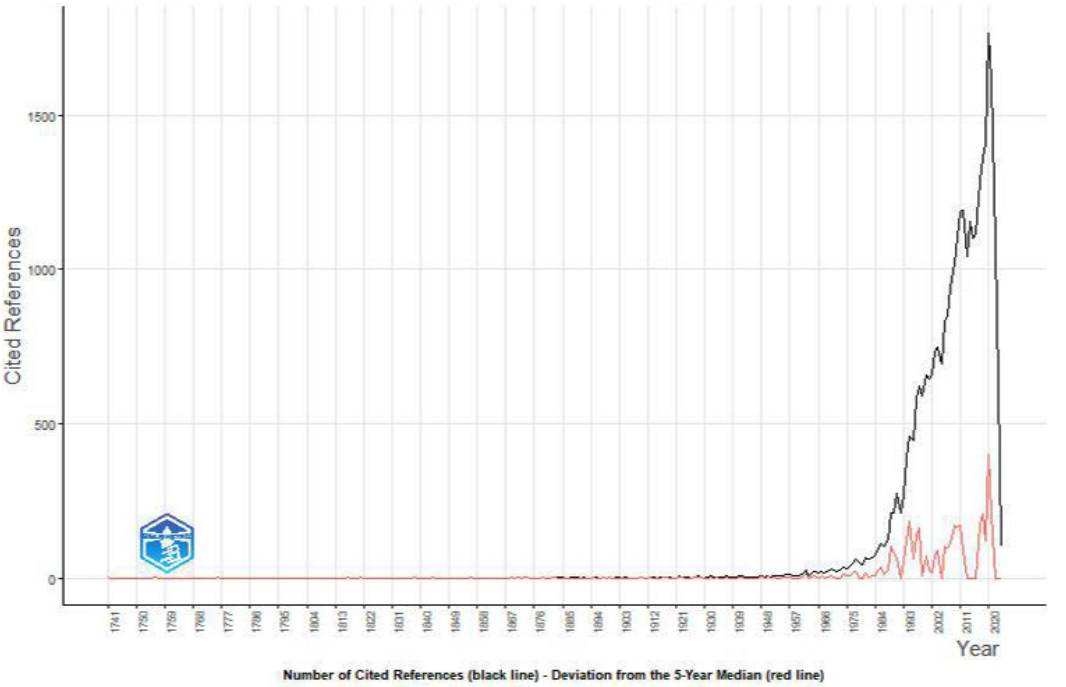


Figure 16: Reference Publication Year Spectroscopy

This chart presents a Reference Publication Year Spectroscopy (RPYS) analysis for spectroscopy-related works. The black line shows the number of cited links over time, showing

a significant increase in citations starting in the mid-20th century, with a sharp increase in the 1990s and a peak around 2020. The red line shows deviations for 5 years, particularly from the late 2000s to the early 2010s, highlighting specific provisions of notable citations of publications or bursts of influential publications during these years. The general trend reflects the growing influence and research interest in spectroscopy.

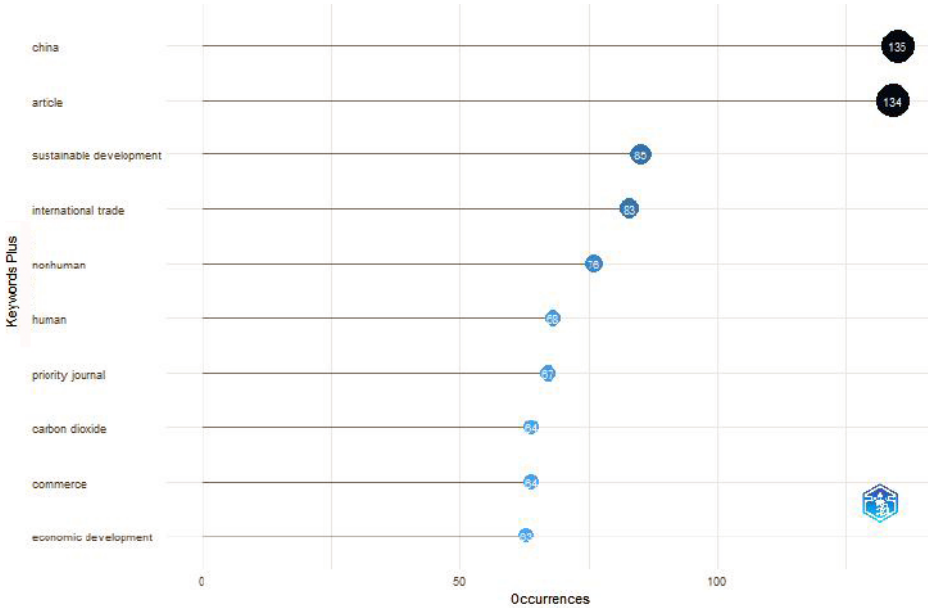


Figure 17: Most Relevant Words

Analysis highlights key themes in the literature, with the most frequently mentioned terms being "China" and "articles", indicating a significant focus on Chinese contributions to research. "Sustainable development" and "international trade" reflect the importance of these concepts in current discussion, while the terms "non-human" and "human" suggest discussions on environmental and social impacts. The presence of "priority journals" indicates a concentration on high-quality publications and "commerce" along with "carbon dioxide" underline environmental issues in the context of research.



Figure 18: Word Cloud



Figure 19: Tree Map

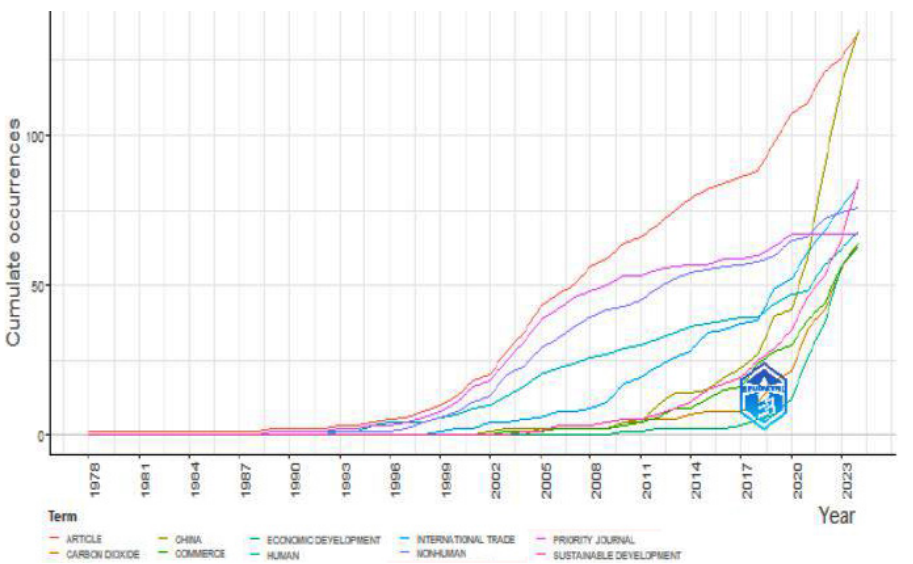


Figure 20: Words' Frequency Over Time

Annual data, especially the annual data since 2000, show a significant increase in research results. The number of articles related to China has increased markedly, reaching 135 in 2024. This reflects the increase in accents in China's research in various fields. "Sustainable development" and "international trade" have also shown significant growth in recent years. Terms such as "carbon dioxide" and "trade" emphasize growing environmental knowledge and economic relations. The priority has led to continuous improvement in the quality and impact of research in the field of publications. Generally, the data show a dynamic research environment with great attention to China and China-related economic development.

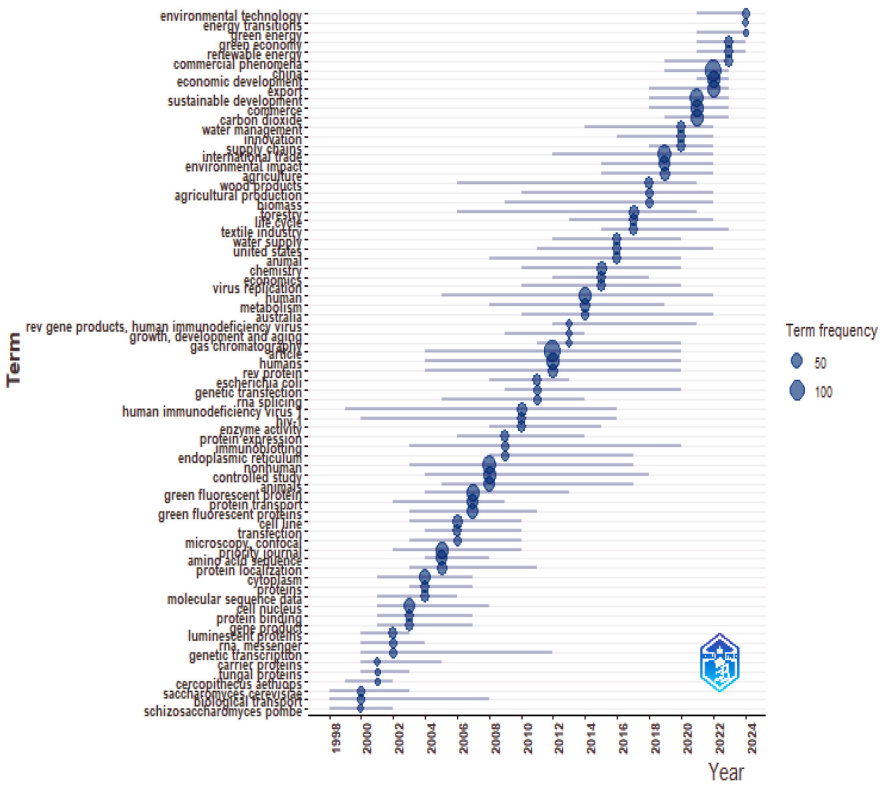


Figure 21: Trend Topics

Term frequency analysis shows significant emphasis on terms such as "sustainable development," "carbon dioxide," and "international trade," particularly since 2018, indicating a shift toward sustainability and molecular biology. Provided. The strong presence of priority journals focused on high-impact research, and the increased mention of 'China' since 2019 highlight the journal's growing importance in these discussions. Overall, the data demonstrate an evolving research environment that integrates environmental, economic, and biological fields.

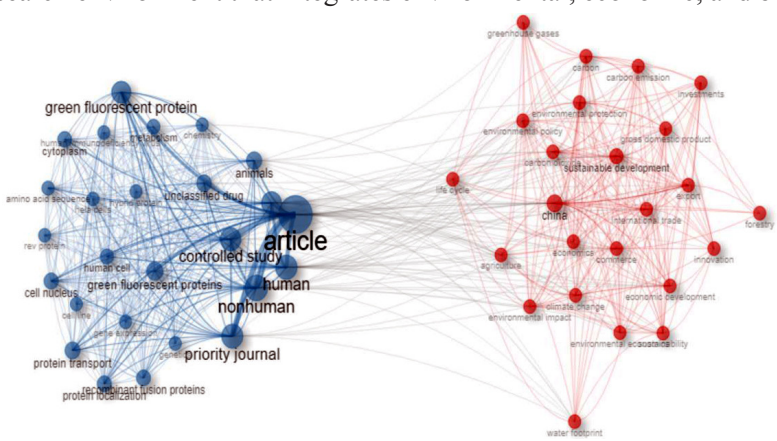


Figure 22: Collaborative Word Network

Network analysis highlights key nodes in the research, which display "China", "continues" and "international trade" scores and Pagenk scores, showing their central role in academic discussion. Words such as "carbon dioxide" and "trade" put more emphasis on the integration of environmental and economic issues. In addition, "article" and "humans" serve as important connections across different disciplines, while "priority journal" and "controlled studies focus on quality research methods, focusing on methods, quality research, performance consistency, environmental impact and structure of interconnected biological studies.

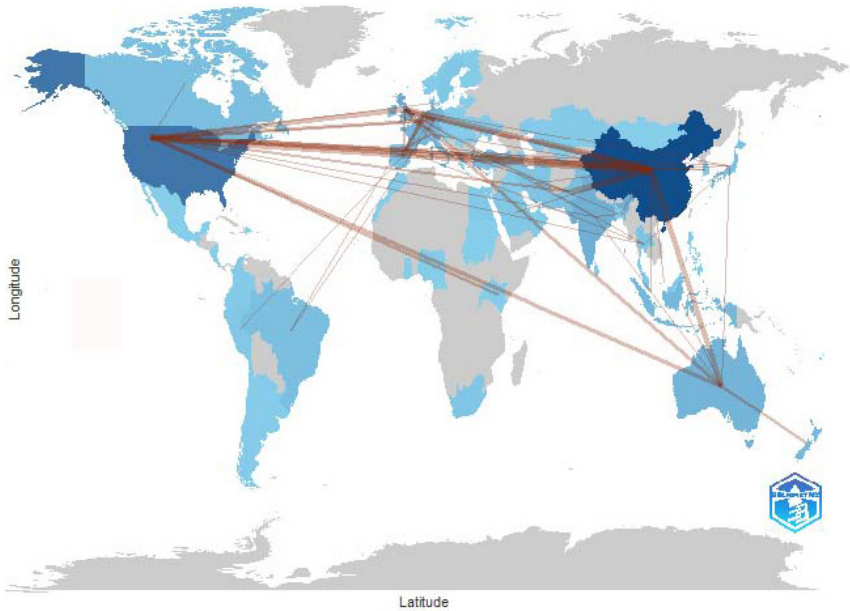


Figure 23: Collaboration World Map

The frequency data indicates connectivity between countries in various research collaborations, with China emerging as a major partner, most notably the United States (15) and the United Kingdom (10). Australia also shows significant collaborations, particularly with New Zealand (3) and the United Kingdom (4). Other notable connections include Brazil with Portugal (2) and Turkey with Bangladesh (2). The data reflect the worldwide nature of research networks across different disciplines, particularly in areas such as environmental studies, economics and international relations.

OPPORTUNITIES AND CHALLENGES

Export opportunities for green products are growing rapidly due to rising global awareness of sustainability and increased demand for ecological products across various sectors. Countries and companies that invest in green technologies and sustainable practices are gaining new markets, which are gaining strength due to government incentives, consumer agreements such as the Paris Agreement and consumer preferences for low-carbon products and efficiency from an energy point of view. Carbon footprints regulatory structures and emission policies also provide new roads for competitive advantages. In addition, advancements in technology such as renewable energy and waste recycling provide exporters with an opportunity to innovate and diversify their wallets. However, this growing market also offers many challenges. The costs associated

with the use of green production methods and obtaining certifications such as ISO 14000 can be quite high, especially for small and medium-sized enterprises. Navigating through different regulatory standards and sometimes inconsistent ones across different sectors adds complexity for exporters who wish to enter global markets. In addition, greenwashing—in which companies promote products as an ecological scapegoat among consumers—makes it difficult for exporters to maintain transparency and build trust through continuous verification. Finally, while demand for ecological products is growing, the cost rewards for these goods are low, which may limit their competitiveness compared to economical and non-ecological alternatives in some markets. Long-term success in the green products export sector requires balancing these opportunities and challenges.

CONCLUSION

In conclusion, this analysis of green products from 1978 to 2024 reflects business sustainability and extends research results that support the increasing global emphasis on environmental considerations. The conclusion is that China and the United States are the main participants in the literature, but related efforts between institutions and countries are important in promoting knowledge in this field. In particular, the main theme concerns the interaction between technological innovation and the practice of sustainability. In addition, this study emphasizes the impact of influential publications, which shows the need for continued research to eliminate existing gaps in the literature. This study, which provides a complete monitoring of the research landscape, provides valuable information that can inform politicians and industry leaders about effective strategies to enhance green products. Finally, the results are the basis for future research that contributes to a deeper understanding of the important relationship between sustainable practices and international business.

LIMITATION AND FUTURE RESEARCH SCOPE

This analysis has several restrictions, most notably in the reliance on available data that may not include any relevant literature, especially from non-English-speaking sources or new journals. Furthermore, focusing on quantitative indicators may overshadow qualitative contributions, such as theoretical understanding and practical results. Future studies should take into account the mixed method in which qualitative studies should be integrated into the text analysis to ensure a more complete understanding of the export of green products. Exploring the impact of digital innovations on a specific policy, market conditions and sustainability can identify trends and best practices. Long-term changes that govern changes in time can further understand this new field, which can help develop effective strategies for sustainable business practices.

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ICT, INNOVATION AND TRIPLE BOTTOM LINE

IoT for Sustainability – A Case Study in Energy Conversion

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Abstract

We are a world of consumers – with power being, perhaps, the greatest commodity. The Internet-of-Things (IoT) framework offers a unique opportunity for businesses to improve and capitalize on their sustainability efforts. Being a framework, business leaders should understand the options, issues, and impacts of IoT to fully realize the benefits. This paper makes an effort to address the global impact of applying the IoT framework to a workhorse product in global industry and extends those opportunities to other areas.

INTRODUCTION

IoT (Internet-of-Things) is a conceptual framework whereby all devices are interconnected for monitoring and interaction [Rahaman]. While the communication would not necessarily need to be wireless, the advent of IoT began with the ease of wireless interconnectivity. A wired Internet-of-Things would be costly and complicated.

When we have access to our "things", we have the ability to assess their performance and potential for future failure. This is a powerful capability for business.

The assessment of a device for future failure has been considered extensively [Borhani and Zarandi, Garcia-Calva et al., Huang et al., Safin et al., Zhu et al.]. Less common is the assessment of performance in terms of environmental impact and sustainability. IoT can be an excellent tool for the maintenance and validation of industrial responsibility in terms of sustainability.

THE ADVENT OF IOT AND IOT FOR INDUSTRY

Kevin Ashton, MIT's Executive Director of Auto-ID Labs, is reported to have coined the phrase "Internet of Things" in 1999 while making a presentation for Procter & Gamble. While his initial use of the term was related to radio-frequency identification (RFID) tags now routinely used in stores and credit cards, the concept evolved to include concepts, such as the ring doorbell, that better represent the broader concept [Abdulrhida and Ghanbari].

The broader concept is that we have some device that has a connection to the internet. The internet connection allows communication with other devices and individuals for monitoring, control, and analysis.

Because it is a framework, many general and specific configuration diagrams and architectures exist [Dominguez-Bolano et al.]. Figure 1 shows a generic IoT architecture. Figure 2 shows an IoT architecture specifically related to the control of lighting in a household. The parallels of the two diagrams should be apparent.

When we consider home lighting, the application to industrial processes should also be apparent. Home heating and lighting and industrial process control lines share many similarities. In all cases, we can request status, evaluate operation, and affect control.

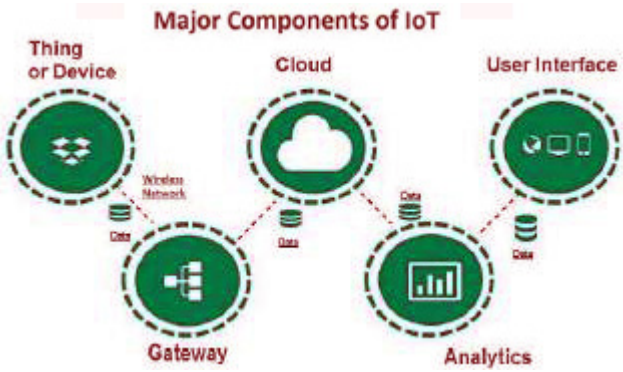


Figure 1: IoT System Generalized Components and Interactions [Rajiv].

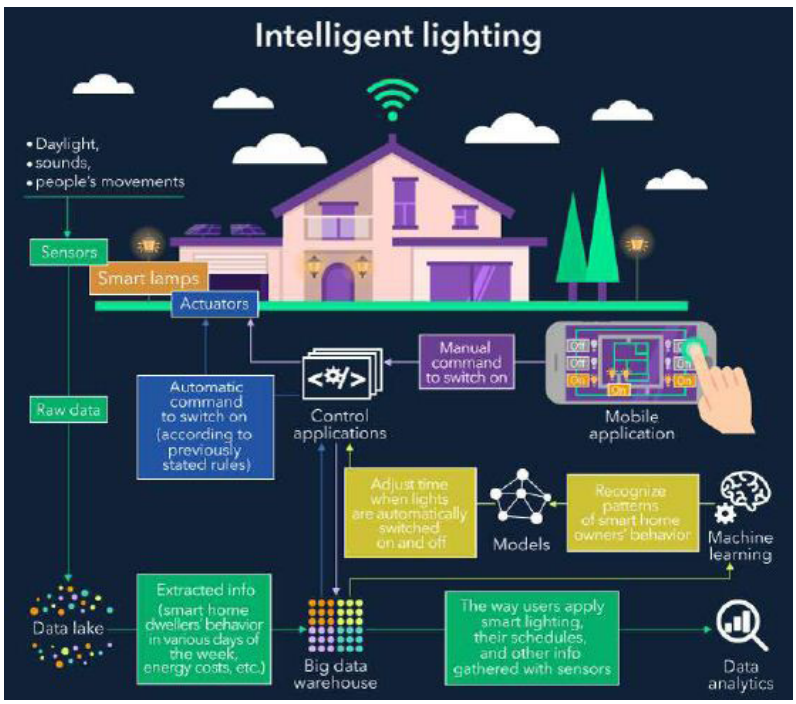


Figure 2: Application-specific IoT System (home lighting control) [Grizhnevich].

GLOBAL POWER CONSUMPTION AND INDUCTION MOTORS

Before considering the general impact of IoT on industrial sustainability, we should consider some related and supporting facts:

- In 2020, the world consumed more than 25,000 TeraWhs (Watt-hours) of electricity. That is 25,000,000,000,000,000 Wh [2]. Of this, China was responsible for more than 7,500 TeraWhs used, and the USA was responsible for more than 4,000 TeraWhs used [Perregaux and Melvin, Ritchie et al.]
- While it varies by year, location, and electricity generation method, in 2022, the average carbon footprint of electricity was 0.86 lbs of CO2 per kWh in the United States [US EIA].

- Electric motors and the systems they drive are the largest single-energy end use and account for more than 40% of global electricity consumption," according to the International Energy Agency report [IEA].

Interestingly, one particular motor type dominates the industrial usage – induction motors. This motor type accounts for 55% of all of the energy consumed in industry [TRACTIAN].

From our above facts, we can establish:

Global Energy Consumption	25,000,000,000,000 kWhs
Electric Motor System Global Energy Consumption	10,000,000,000,000 kWhs
Induction electric motor systems	5,500,000,000,000 kWhs
lbs of CO_2 produced by SCRI electric motor systems	4,730,000,000,000 lbs

This provides us with a good opportunity to focus on IoT impacts on what can be considered a global concern. An increase in operating efficiency of even 1% for induction motors would result in a reduction of 47,300,000,000 lbs of CO_2 emissions and a savings of approximately US$ 880,000,000,000 in global energy costs.

APPLYING IOT TO OUR ENERGY CONVERSION PROBLEM

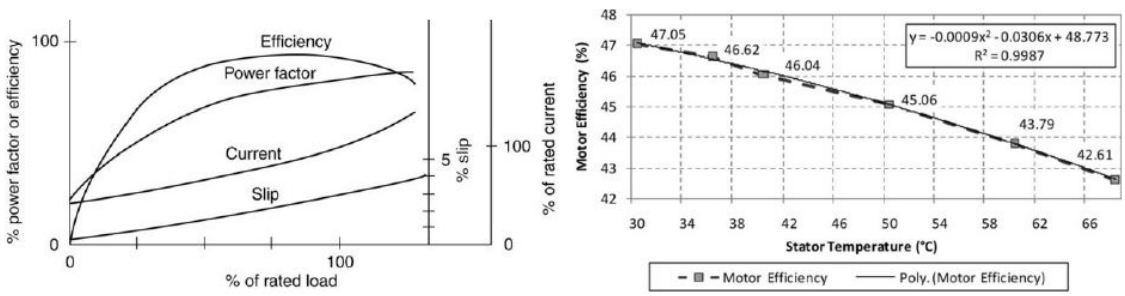
IoT is a means for a company or individual to know the current operating characteristics of a system or device instantly. These characteristics can, of course, be logged over time and analyzed for trends. These facts – combined with the case of induction motors – make clear the following ways in which IoT can be used to identify and optimize energy efficiency:

- Monitoring operating changes that reduce efficiency and allowing correction
- Monitoring current motor efficiency for comparison to replacements
- Demonstrating to customers and investors quantitatively the value and progress of a company's environmental efforts

These are addressed in turn.

Monitoring Operating Changes that Reduce Efficiency and Allowing Correction

Installing sensors on electric motor systems allows us to monitor the instantaneous operating conditions. These conditions, such as load and temperature, are directly correlated to the operating efficiency of the motor system. Figures 3a and 3b show the impact of load and temperature on a representative motor.



(a) (b)

Figure 3: Impact of Load (a) and Temperature (b) on Induction Motor Efficiency (Faizan, Gouws and van Jaarsveldt)

If we know that we are operating in an overload or overtemperature manner, the situation can be immediately addressed by on-site personnel. In addition to the lifetimeof the motor being greatly extended, the efficiency of the motor will be instantly improved.

Monitoring the Efficiency of an Existing Motor for Consideration of Replacement

The monitoring of the operating condition of the existing motor allows the continuous determination of average efficiency. Newer replacement motors and motor control methodologies offer increased efficiency. By comparing the existing motor efficiency with a new design or control method, the company can determine precisely the ROI of replacement. This determination can be made continually, instantaneously, and without bias. Table 1 shows a representative cost analysis of motor replacement ROI for various motor sizes.

Demonstrating to Customers the Value of the Environment to the Company

IoT allows an instant snapshot of one or all systems within a company. This allows the presentation of instantaneous and time-averaged improvements being made. What are the day-to-day improvements to efficiency that my company is making? This is a question that environmentally conscious customers and investors ask.

Imagine an online dashboard that allows a customer to see the progress of sustainability efforts as they are being made. Figure 5 shows an increasingly common dashboard to track energy consumption [Sainath]. A similar approach can be taken to track instantaneous corporate efficiency and continued efficiency improvements.

Table 1: Motor Replacement ROI (Hasanuzzaman et al.)

Motor HP	Increment Price (US$)	Energy Savings (kWh/year)			Bill Savings (US$/year)			Payback Period (year)		
		Load (50 %)	Load (75 %)	Load (100 %)	Load (50 %)	Load (75 %)	Load (100 %)	Load (50 %)	Load (75 %)	Load (100 %)
5	45	1855	2643	3154	85	122	145	0.5	0.4	0.3
7.5	145	2541	3620	4320	117	167	199	1.2	0.9	0.7
10	138	2744	3909	4665	126	180	215	1.1	0.8	0.6
15	275	3813	5433	6483	175	250	298	1.6	1.1	0.9
20	375	4873	6942	8284	224	319	381	1.7	1.2	1.0
25	578	4956	7060	8425	228	325	388	2.5	1.8	1.5
30	740	5490	7820	9332	253	360	429	2.9	2.1	1.7
40	1070	7020	10,001	11,935	323	460	549	3.3	2.3	1.9
50	1345	8188	11,664	13,919	377	537	640	3.6	2.5	2.1
60	2650	9199	13,104	15,638	423	603	719	6.3	4.4	3.7
75	3180	12,202	17,383	20,744	561	800	954	5.7	4.0	3.3

It is interesting to note that the way in which IoT has been applied the most – monitoring changes that reduce failure – is not considered in our list related to sustainability. The reason is that new motors are continually more efficient. Almost unilaterally, replacing an existing motor will yield an improvement in efficiency [Cao and Bradley, Hasanuzzaman et al.].

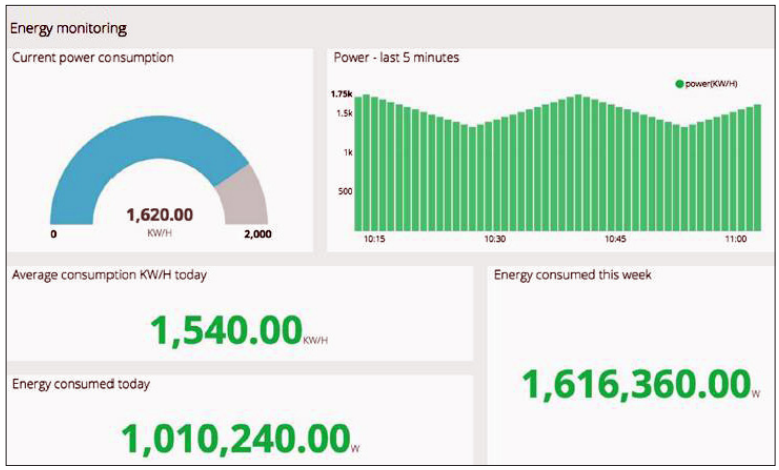


Figure 5: Energy Usage Dashboard (Sainath)

OTHER SUSTAINABILITY APPLICATIONS OF IOT

Induction motors were considered due to their huge global impact, but the opportunities for IoT to aid in sustainability surround us. Examples include:

- An IoT-connected anemometer (wind speed meter) could be used to detect if an air conditioning or heater fan is clogging.
- An IoT-connected electric or gas stove could detect if the stove has been left on.
- An IoT-connected faucet could detect pipe obstructions leading to excessive pump load.

The opportunities are virtually endless. The idea is to look for measurable data that represents inefficiencies or waste. That combined with connectivity is opportunity.

CONCLUSION

The IoT framework was reviewed. Efforts to improve sustainability using IoT were then considered using a particular high-impact case of induction motors. The case chosen to show that IoT-based monitoring can provide information beneficial to the improvement of efficiency for businesses. If business managers are aware of IoT concepts, they can devise systems and products that create more sustainable and – in many cases – profitable businesses.

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Microbial Pigments: Perspectives into Agro-biotechnological Management of Floral Waste

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Abstract

Flowers give an aesthetic appeal to every jubilation and are therefore always used as value addition. They are also being used in making perfumes, food items, cosmetics, textiles, and other products. Enormous volumes of floral waste generated find their way into landfills and surface waters. This significantly leads to multi-faceted deterioration over a period of time. to environmental pollution. However, with growing awareness of appropriate technologies in sustainable development and scientific waste management, different methods have been tried aiming at the valorization of these floral wastes into various value-added products like pharmaceutically active components, compost, biofuels, biogas, bioethanol, organic acids, pigments, dyes, food products, incense sticks, handmade paper production, etc., which are discussed in this chapter. Different technologies involved and innovative approaches for floral waste management are discussed. Biotechnological interventions can lead to establishment of sustainable agri-preneurship models. One area where floral waste has enormous potential is formulation of microbe derived pigments

Keywords: *Anthropogenic, Environmental Pollution, Floral Waste, Microbial Degradation, Microbial Pigments*

INTRODUCTION

The definition of the environment could be summarized as the sum of all conditions and circumstances and abiotic and biotic resources that affect human life. Humans and environment are related to each other in order to preserve the natural balance. Environmental degradation is caused by the increase in pollution levels due to population rise and economic development. Natural resource exploitation, industrialization, urbanization, and solid waste disposal contribute to environmental degradation. Anthropogenic activities generate waste, contributing to negative impact on the environment through defoliation and increasing degradation at alarming rates.

Due to the diversity in land and environment, almost all types of floral species naturally grow in India, which are usually used as temple decorations on several occasions. Temples perform several religious activities where sweets, leaves, edible and non-edible fruits, garlands and flowers are used as offerings (Rukhaiyar et al., 2017).

The generated waste from the temple consists of both biodegradable and non-biodegradable wastes, and the floral wastes are segregated here due to their biodegradable nature. Compared to daily household waste, floral debris does not have sufficient treatment methods (Dutta et al., 2021). The inappropriate disposal of flower debris in open landfills may cause various types of health hazards. After a few weeks of disposal, microorganisms degrade the flower waste, releasing obnoxious gases including CH_4, NH_3, CO_2, among others, which are the major causes of foul odor

and considerably contribute to global warming and gas emissions. Waste management practices in this regard have a strong impact on the diversity of these aquatic organisms, like fish, diatoms, protozoans, molasses, and plankton. Contrarily, chemicals used in flower production, mostly in the forms of pesticides and artificial fertilizers, change the pH level of water bodies, making the aquatic life suffer (Devi et al., 2022).

Scenario of Floral Waste: Global and National

The world floriculture production is growing at a rate of 10 % per year. In terms of production, the Netherlands, USA and Brazil are in the top. In 2016, the worlds' cities generated 2.01 billion tons annually of solid waste, amounting to a footprint of 0.74kg/person/day. According to sending the 100 million roses on the special days, produces 9,000 metric tons of CO_2 emissions from field. In India leading flower producing states in 2017-18 were Tamil Naidu, Andhra Pradesh, Karnataka, Madhya Pradesh, west Bengal, Chhattisgarh and Gujarat (Waghmode et al., 2018).

Degradation of floral waste by microbes is one of the viable approaches that may be forwarded with minimal environmental hazards. Floral wastes contain cellulose, hemicellulose and lignin as major constituents that are biodegradable in nature under the action of various microorganisms (Chandel et al., 2018). In some microorganisms, the breakdown process can utilize the contents of floral waste for metabolic reactions that produce several natural pigments. Some of these pigments have been used in the food, drug, textile and cosmetic industries due to their non-toxic nature.

MICROBIAL DIVERSITY OF FLORAL WASTE:

Bio-molecules are often produced using microorganisms, though such production is limited to the utilization of single-strain cultures. Organic waste degradation for yield-able bio-molecules of interest in biotechnological applications processes is benefited by microbial consortia. Microbial diversity in such consortia may turn out to be an advantage for production in the context of critical issues with global energy demands.

Microorganisms are a rich source of new bio-active compounds since, unlike higher organisms; they are a source of easily renewable resources which give rise to production with a potentially greater yield. The natural pigments of microbial origin, grab attention of industry due to growing interest in the generation of new safe, easily degradable, ecologically friendly products with no adverse effects (Pombeiro-Sponchiad et al., 2017). This may be attributed to the wide range of pigments and dyes of artificial origin, which are used in food, dyes, cosmetics and drugs production and manufacture and which have had various effects through years (Venil et al., 2009). One of the major adverse effects of these synthetic additives is cell damage caused by oxidation, leading to immune-suppression in the human being that can be the worst scenario (Arivizhivendhan et al., 2018). The standpoint of physiology and molecular processes in microorganisms, natural pigments are important because they serve as a method of adaptation to various extreme environments, have a protective function against solar radiation and also participate in functional processes like photosynthesis (Sutthiwong et al., 2014). Several of these natural pigments have been endowed with a number of desired properties like anticancer activity, pro-vitamin A, besides possessing more desirable features like high photo-stability, thermal stability, pH etc., all this with a great contribution towards the conservation of biodiversity and reducing the emission of harmful chemicals into the atmosphere due to the use of synthetic dyes (Rao et al., 2017). Among all the different types of microorganisms that can synthesize natural pigments, bacteria, yeasts,

and fungi are the most relevant in the area. Some of them are commercially available to be used in cell staining and protein detection as well as being used as alternatives to the production of synthetic dyes for the textile industries. Bacteria have a short cycle of life, and their use also facilitates genetic alteration processes (Venil et al., 2014).

Bacterial Pigments

They can be categorized into following groups:

- Carotenoids are the most widespread pigment class in nature, coloring yellow, red and orange. They arise through the condensation of isoprenyl units and are synthesized by a wide diversity of organisms, ranging from non-phototrophic prokaryotes to higher plants. In essence, they are hydrophobic molecules normally associated with photosynthetic membranes. The broad classification of carotenoids relegates them into two major groups: carotenes (α-carotenes and β-carotenes) and xanthophylls (zeaxanthin, canthaxanthin, and astaxanthin). Carotenes have received attention in industry mainly for their beneficial effects on health, as they enhance the immune response, participate in the prevention of cancer and exhibit high antioxidant properties (Celedón et al., 2021).
- Prodigiosin has become one of the most abundant and iconic natural products due, in great part, to its bright shiny red belonging to the family of prodiginines. This was first characterized from *Serratia marcescens*. This pigment biosynthesis was developed based on the coupling of two precursors, 2-octenal and proline, giving this linear tripyrrole responsible for the reddish pigmentation during the stationary phase of the bacterial growth. Other than *Serratia marcescens*, this pigment has been found, though to a lesser extent, in the genera *Janthinobacterium, Streptomyces, Vibrio, Hahella, Zooshikella*, and *Pseudoalteromonas*. Prodigiosin is one of the most promising pigments from a biomedical viewpoint due to its possessing a variety of pharmaceutical properties, including acting as an antimicrobial agent, an algicide, anti-inflammatory agent, an anticancer agent, antimalarial, antidiabetic, as well as an immune system modulator (Rao et al., 2017).

Antimicrobial Properties of Bacterial Pigments

At the start of the 20th century, infectious infections were the highest cause of death globally. In the recent decades, however infectious diseases have replaced non-communicable disease to become the second leading cause of death in wealthy nations. The increase in cases involving bacteria that are resistant to conventional antibiotics set up an extreme demand for new kinds of antibiotics. In the past 25 years, fewer novel medicines have reached the market. At the same time, bacteria have started to become more resistant to medication, so treatment is becoming even more complicated. To develop more antimicrobial compounds, several researches are started recently, and one of those promising candidates is pigments.

Antibacterial Activity of Carotenoids

Carotenoids produced by *Holomonas* sp. have been reported to exhibit antimicrobial activity against antibiotic-resistant *Klebsiella* sp., *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, ocular *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus pyogens*. In contrast, the carotenoids isolated from *Micrococcus luteus* and *Micrococcus roseus* did not show any impact on the growth of *Escherichia coli,* while there was inhibitory action on the growth

of *Staphylococcus aureus* and *Streptococcus faecalis*. Carotenoids produced by *Bacillus* sp., *Corynebacterium* sp., *Kocuria roseus*, *Staphylococcus* sp., and *Brevibacterium* sp. isolated from dried seafood were effective antibacterial agents against *Staphylococcus aureus* ATCC 25923 (MSSA), *Staphylococcus xylosus*, *Peanibacillus macerans*, and *Citrobacter divesus* (Sidin et al., 2022). The violacein isolated from *Chromobacterium violaceum* ATCC 12472 was able to show antibacterial action against FDEV *Staphylococcus aureus* cultured at exponential growing phase. Violacein also showed a highly significant response against the production of biofilm by *Staphylococcus aureus*, though it did not affect the mature biofilm formation (Durán et al., 2021). Another study reported that violacein exhibited excellent bacteriostatic and bactericidal activities against biofilm-forming and non-biofilm-forming *Staphylococcus epidermidis* strains ATCC 35984 and 12228 respectively. Violacein showed antibacterial action against the avirulent *Mycobacterium tuberculosis* H37Ra strain of *Mycobacterium tuberculosis*. In contrast to the previous report, a later study demonstrated that violacei from *Janthinobacterium* sp. Ant5-2 was effective against avirulent *Mycobacterium tuberculosis* with a much lower value of Minimum Inhibitory Concentration (MIC).

Prodigiosin's Antimicrobial Activity

Prodigiosin is another good example of an antimicrobial pigment. Prodigiosin produced by *Serratia marcescens* UFPEDA 398 showed bactericidal and bacteriostatic activity against the Oxacillin resistant *Staphylococcus aureus* (Lapenda et al., 2015). Furthermore, inter-cellularly produced prodigiosin by marine *S. marcescens* IBRL USM 84 inhibited the growth of 13 tested bacteria, the major part of them being Gram-positive (Ibrahim et al., 2014). The antimicrobial study of prodigiosin carried out by Suryawanshi proved that it was effective against *Candida albicans*, *Escherichia coli* and *Staphylococcus aureus* as well as caused significant intracellular material leakage.

Staphylococcus aureus and induced considerable leakage of intracellular material (Suryawanshi et al., 2017). Another study of prodigiosin has been reported showing antimicrobial activity against several infections such as *Streptococcus pyogenes*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* (Sajjad et al., 2020). *Streptomyces* sp. JS520 produced a deep red pigment undecylprodigiosin that displayed antibacterial activity against *Bacillus*, *Micrococcus* sp. and *Candida albicans* (Stankovic et al., 2012). Table 1 represents Bacterial Pigments and their applications

Table 1: Bacterial Pigments and their Applications (Rao et al., 2017)

Bacteria	*Pigment*	*Application*	*Reference*
Hymenobacter sp. and *Chryseobacterium* sp.	Caroteniod	Photo-sensitizers in dye sensitizers solar cells	Órdenes-Aenishanslins et al., 2016
Streptomyoes glaucescens NEAE-H	Melanin	Anti-cancer agent and anti-oxidant	El-Naggar et al., 2017
Pedobacter	Caroteniod	Antioxidant	Correa-Llantén et al., 2012

PIGEMNT PRODUCING FUNGI AND ITS ANTI MICROBIAL EFFICENCY

Filamentous fungi have been known to produce an extraordinary range of pigments such as carotenoids, melanins, flavins, phenazines, quinones, monascins, violacein, and indigo (Dufossé

et al., 2014). The oldest recorded use of fungal pigment is the use of *Monascus* for ang-kak red mold rice. The yellow pigments (ankaflavine and monascine), orange pigments (rubropunctatine and monascorubrine), and the purple pigments (rubropunctamine and monascorubramine) produced by *Monascus* are often encountered in foods Oriental, especially in Southern China, Japan, and Southeast Asia. Currently, more than 50 *Monascus* pigments have been isolated and studied. More than 50 patents worldwide have been issued in connection with applying *Monascus* pigments to food (Dufossé et al., 2014). *Monascus* pigments have antimicrobial, anticancer, anti-mutagenic and anti-obesity effects (Feng et al., 2012).

Fungi such as *Aspergillus*, *Monascus*, *Paecilomyces* and *Penicillium* have been extensively studied and reported for their pigment production. These include red anthraquinones produced by *Penicillium oxalicum*, blood-red naphthoquinone produced by *Cordyceps unilateralis*, monascorubramin from *Monascus* spp. Yellow riboflavin of *Ashbya gossypii* (Tuli et al., 2015). *Monascus* is a fungal species in the phylum Ascomycota and it is broadly applied in industries of foodstuffs because of the red pigments that are produced by the fungus (Fabre et al., 1993). *Fusarium oxysporum*, on the other hand, produces pink anthraquinones and *Fusarium verticillioides* produces yellow naphthoquinones (Boonyapranai et al., 2008). Yellow variecolorquinones A and the red aspergiolide B are produced from mangrove sediments of Fujian Province by *Aspergillus glaucus* and novel strains are also sourced from desert fungi such as discussed in (Santiago et al., 2018). Table 2 represents examples of different pigments isolated from soil fungi and their biological activity

Table 2: Examples of Different Pigments Isolated from Soil Fungi and their Biological Activities

Fungi	*Soil Habitat*	*Pigment*	*Colour*	*Activity and Uses*	*Reference*
Mucor bridgeri	Eucalyptus tree plantation in Lucknow, India	Melanin	Black	Antioxidant activity	Kumar et al., 2011
Mucor niger	Women's Christian College premises, Chennai India	Aspergillin	Black Brown	Antimicrobial activity, Textile dyeing	Atalla et al., 2011
Mucor sclerotiorum	Amazonia Brazil	Neoaspergillic acid	Yellow	Antibacterial Activity	Teixeira et al., 2012
Mucor versicolor	Mud of the South China Sea, China	Asperversin		Antifungal activity	Miao et al., 2012, Li et al., 2018
Fusarium oxysporum	Not specified	Anthraquinone	Pink / violet	Antibacterial Activity, Textile dyeing	Gessler et al., 2013
Monascus sp.	Egypt	Monascorubrin Rubropuntatin Monascorubramine Rubropuntamine	Orange Red	Antibacterial activity Anticancer activity Antioxidant	Yang Tao et al., 2014

Fungi	*Soil Habitat*	*Pigment*	*Colour*	*Activity and Uses*	*Reference*
Monascus sp.	Not specified	Ankaflavin Monascin	Yellow	Food colorant Pharmaceuticals	Mostafa et al., 2014
Penicillium purpurogenum	Brazil	Mitorubrinol		cosmetics, pharmaceuticals, Textile industry	Santos-Ebinuma et al., 2013
Penicillium sclerotiorum	Amazon soil, Brazil	Sclerotiorin	Yellow to orange	Antimicrobial activity	dos Reis Celestino et al., 2014

CONCLUSION

Wastes are generated rapidly, creating one of the biggest global threats, an evident outcome of which is environmental degradation. Management of solid waste constitutes one of the most important concerns; not only in cities but also particularly in cities across developing countries, where deficiencies in waste systems lead to considerable damage to the environment. Religious functions, festivals, and rites of India generate enormous quantities of waste. Recycling and reduction of landfills must be effectively managed in order to handle wastes. Recycling and reusing waste products can relieve the problem of disposal because most of the waste prepared have in them unexploited possibilities for use in various ways. The antimicrobial studies may add value propositions for industry applications in healthcare, while the use of pigments from fungi could be useful for the textile industries, which highly depend on synthetic dyes, with a large scope of application in sectors like printing in the textile and leather industries. Fungal pigments are new antioxidants, antimicrobial, and anticancer agents, thereby offering a sustainable alternative to synthetic chemicals used in food, cosmetics, and pharmaceutical industries. These pigments may serve as potential natural colorants, preservatives, and nutraceuticals, thus bringing about less noxious reliance on synthetic molecules. Improved fungal pigment production of floral wastes through solid-state and submerged fermentation techniques can be achieved by manipulating the composition of substrates, controlling pH levels, and temperature. Although much progress has been made, there is still more work needed in the areas of species diversity of fungi as well as pigment production and more on product safety. Overall, the use of fungal pigments from floral waste thereby supports a circular economy while simultaneously benefiting the environment and agriculture.

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Effects of Mobile Banking Adoption in Generation Z on Circular Economy

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Abstract

The financial habits and participation of Generation Z with sustainability projects have been greatly impacted by the swift spread of mobile banking technologies. Given its accessibility, ease of use, and compatibility with their tech-savvy lifestyles, Generation Z, who are digital natives, exhibit a significant preference for mobile banking. However, research is still scarce in systematizing the efforts and identifying the facilitating factors for such a transition. This paper investigates how Generation Z's use of mobile banking intersects with the circular economy. The use of mobile banking by Generation Z not only revolutionizes their approach to financial management, but also reinforces and intensifies the circular economy's premises. This dynamic interaction demonstrates how mobile banking may encourage younger investors and consumers to adopt more environmentally friendly financial habits. The findings of the analysis suggest that mobile banking adoption in Gen Z can play a significant role in the transition of economy towards a more sustainable business model leading to better integration of circular economy practices.

Keywords: *Generation Z, Circular Economy, Mobile Banking Adoption, Young Generation*

INTRODUCTION

The term "mobile banking" describes the process of managing banking activities and carrying out financial transactions using portab1le electronic devices, including smartphones and tablets. Customers may conveniently perform financial transactions remotely using tablets and smartphones thanks to these services (Alsmadi et. al 2022). It has completely changed the financial services sector by providing a number of features that were previously exclusive to traditional banking channels. The widespread use of smartphones and the government's promotion of cashless transactions present opportunities for the Indian banking sector to leverage and boost the uptake of online and mobile banking (Singh & Srivastava, 2020). Banking has been advanced from branch banking to internet banking to mobile banking just because of emergence of self-service technologies (Sahu & Deshmukh, 2020).

Due to cost effectiveness and greater reachability, banks pre- fer the m-banking channel to deliver banking services and so encourage customers to adopt m-banking services (Shankar & Rishi, 2020). With simple access to financial services made possible by mobile banking, financial inclusion is increased and Generation Z is encouraged to participate more actively in sustainable economic endeavours. Mobile banking encourages more thoughtful consumer behaviour and is in line with circular economy ideas like waste reduction and sustainable expenditure since it offers comprehensive spending information and budgeting tools. Economic difficulties including supply risk, troublesome ownership structures, unregulated markets, and faulty incentive systems

cause financial and economic instability to occur more frequently for both individual businesses and entire economies (Geissdoerfer et.al 2017).

According to the circular economy, which emphasizes minimizing environmental effect, mobile banking's efficiency also helps to minimize the usage of physical resources.

- **Historical Background and Development:** When SMS banking first became available in the early 2000s, users could conduct simple transactions and get account updates through text messages. This marked the beginning of the development of mobile banking. Mobile banking's capabilities expanded along with the advancement of mobile technology. The advent of smartphone applications and mobile internet connectivity has enhanced the capabilities of mobile banking services, enabling a wider array of financial operations such as managing accounts, transferring funds, paying bills, and even managing investments.
- **The Main Services Provided by Mobile Banking:** From their mobile devices, users may check their account balances, examine their transaction histories, and adjust their account settings. Real-time and convenient access to financial data is offered by this function.
  - **Fund transfers:** Using mobile banking, you may easily move money between accounts at the same bank as well as to other banks. Peer-to-peer (P2P) payments and international transfers fall under this category.
  - **Bill Payments:** By utilizing their mobile banking app, users may pay their bills, including credit card payments and utilities, expediting the payment process and minimizing the need f1or paper transactions.
  - **Deposits:** Using some mobile banking apps, you may make deposits without going to a real branch or ATM by just snapping a picture of the cheque.
  - **Financial Planning and Budgeting:** To assist users in managing their money more skilfully, a number of mobile banking systems come equipped with capabilities for financial planning, tr1acking expenses, and budgeting.
  - **Security Features:** To safeguard users' financial information, mobile banking applications use a variety of security techniques, such as multi-factor authentication, encryption, and biometric verification.
- **Generation Z:** The term of generations will follow the born-year labelling by Oblinger and Oblinger (2005), which stated that the generation born after Generation Y or Millennial (1981–1995) is Generation Z or Post-Millennial (1995–2010). Generation Z, known as the "Always-Clicking Generation," is a generation closely connected to the internet. companies are facing major challenges in addressing young people from Generation Z because their characteristics are new and unheard of, so far. Sometimes referred to as "digital natives", Generation Z includes more than 25% of the world's population. Most of the Gen z are students, and they still have no banking experience, so their ability to try new services will be the highest among all generations) (Abu Daqar, Arqawi, & Abu Karsh, 2021)

Each generation differs from the others in terms of lifestyle, morals, work habits, and technological aptitude. (Reeves & Oh, 2008). The results of this study are expected to enrich current knowledge by analyzing the dynamics of mobile banking adoption in these generations and exploring factors that affect its usage. The study fills the research gap by providing a richer and more encompassing review, and a more representative sample in comparison to the only research conducted in the country.

LITERATURE REVIEW

Investigating the relationship between Generation Z's use of mobile banking and the circular economy's tenets is an intriguing subject. The following is a summary of pertinent research and ideas that might aid in your comprehension of the dynamics at work:

Mobile Banking

- **Mufarih, Jayadi, & Sugandi (2020):** This study set out to characterize the use of digital banking applications by the people of Yogyakarta, Indonesia. For this study, a 300-sample size had been used in a hypothesis model based on the Technology Acceptance Model (TAM), which included additional variables like perceived risk, perceived trust, and social image. The results shown that user intention and attitude toward using digital banking were more influenced by perceived risk and perceived trust than by social image, perceived usefulness, or ease of use.
- **Gupta, Yun, Xu, & Kim (2017):** The purpose of this study was to look into how security levels affect Indian customers' perceptions of danger, control, and eventually, their adoption of mobile banking, with respect to different types of Indian cities. The data gathered from 176 respondents by using convenience sampling, and snowball sampling was analysed using a conceptual model, EFA, CFA, Two-way ANOVA. Consumer perceptions of risk and control in urban settings were major factors in their adoption of mobile banking, but only the perception of control was significant.
- **Sahu A. (2020):** The purpose of the study was to review the literature on the adoption of mobile banking from 2010 to 2018 using search terms such as adoption, mobile banking, and m-banking. Three stages of the systematic review of the literature on mobile banking adoption were identified, analysed, and categorized articles. While factors like security, perceived risk, and complicated procedures impede the adoption of mobile banking services, factors like perceived usefulness, perceived ease of use, performance expectancy, effort expectancy, facilitating conditions, social influence and awareness positively impact the adoption of mobile banking services.
- **Al-Baltah, Al-Sultan, Al-hadi, & Zahary (2024):** Using a theoretical model to examine the variables influencing Yemeni customers' MBA adoption, this study sought to broaden our understanding of the field. TAM, or the Technology Acceptance Model, is expanded upon by the proposed model. After conducting an empirical analysis, this study finds that people's intention to adopt an MBA is strongly and favourably influenced by perceived usefulness, perceived ease of use, perceived value-added services, perceived self-efficacy, social influence, financial cost, perceived risk of system non-availability, perceived risk of privacy, and perceived security risk.

Mobile Banking and Generation Z

- **Alifia et al. (2024)** investigated and analysed the factors influencing Generation Z's adoption of mobile banking through an online survey administered to 250 respondents who used M-banking in Jabodetabek between the ages of 18 and 24. The results, obtained using a conceptual model, demonstrated a positive influence of perceived ability, perceived benevolence, perceived integrity, and perceived ease and usefulness on the use of mobile banking applications.

- **Indriyarti et al. (2023):** With 320 participants from generation Z in Jakarta who use digital banking investigated what makes young people more likely to use digital banking by using a quantitative technique with PLS-SEM and demonstrated that resistance to technology has a direct impact on usage attitudes in addition to costs, costs-benefits, and self-efficacy. In the meantime, resistance to technology will be felt indirectly if usefulness, self-efficacy, and awareness come before the attitude of use.
- **Ruangkanjanases & Wongprasopchai (2018):** In order to identify the critical factors impacting the adoption of mobile banking services, this study uses multiple regression analysis and hypothesis testing to compare the generations Y and Z in Thailand. Gen Y adoption willingness appears to be significantly influenced by self-efficacy, compatibility, and perceived utility. Yet, the findings for Generation Z suggest that what matters most in encouraging people to use them are perceived usefulness, social impact, self-efficacy, and compatibility.
- **Rahadi et al. (2022):** This study explored the relationship between the UTAUT model and actual e-payment usage, as well as providing a framework for assessing the factors influencing e-payment use among Malaysian Generation Z users. Using information gathered from 667 Generation Z e-payment users in Malaysia, the data was empirically tested. The findings indicated that the real use of electronic payments was influenced by performance expectations, social influence, and enabling conditions. It was unexpected that there was no significant correlation between effort expectancy and actual e-payment usage.
- **Nur & Gosal (2021):** Investigating the factors influencing generation Z's attitude and intentions toward mobile payments is the aim of this study.271 respondents from Jakarta and the surrounding area (JABODETABEK) were sampled for this study using the META-UTAUT model, and PLS-SEM was used to analyse the data. The results indicate that attitudes toward adopting mobile payment technology are significantly influenced by perceived information security, perceived social pressure, compatibility, effort expectation, and perceived enjoyment. Attitude also have a significant impact on intentions to use mobile payment technology.

Mobile Banking and Circular Economy

- **Financial Services Digitalization in a Circular Economy Context:** This body of research examines how digital financial services, such as mobile banking, might help circular economy activities by offering fresh approaches to resource tracking and management, supporting recycling initiatives, and promoting environmentally friendly customer behaviour.
- **The Impact of Mobile Banking on Sustainable Consumption Patterns:** Examines how consumer behaviour may be influenced by mobile banking technology to support the objectives of the circular economy and make more sustainable decisions.
- **Fintech Innovations and Circular Economy Synergies:** Examines how fintech innovations, such as mobile banking, might support more sustainable financial practices by aligning with circular economy goals.

EFFECTS OF MOBILE BANKING ADOPTION IN GENERATION Z ON CIRCULAR ECONOMY

The emergence of mobile banking has greatly influenced Generation Z, especially in the context of the circular economy. We examine these consequences in more depth below:

- **Greater Access to Finance:** More access to financial services is provided via mobile banking, particularly in areas without traditional banking infrastructure. This greater access makes it easier for Generation Z—digital natives—to participate in financial activities like budgeting, investing, and saving. Their increased participation in economic activities that support the concepts of the circular economy, such as green bond issuance or investing in sustainable startups, may result from this inclusion.
- **Encouragement of Sustainable Expenditures:** Mobile banking applications frequently offer comprehensive expenditure information and tools for budgeting, which can assist users in making better financial decisions. This will enable Generation Z to better monitor their spending habits and make more deliberate decisions. Circular economy ideas may be furthered and more sustainable consumer behaviour can be encouraged by apps that showcase sustainable companies or provide incentives for eco-friendly purchases.
- **Enhanced Production and Decreased Wastage:** By eliminating the need for physical bank branches and paper transactions, mobile banking helps to cut down on waste and resource usage. This efficiency is in line with the principles of Generation Z, who are becoming more conscious of environmental concerns. They can conduct financial transactions that contribute to the objectives of a circular economy while ha3ving little effect on the environment.
- **Encouraging Business Models:** That Recycle: By offering quick and easy payment options, mobile banking encourages the expansion of companies that adhere to the principles of the circular economy. Mobile payment systems have the potential to streamline transactions for services such as product repair, recycling, and rental services—all of which are essential elements of a circular economy. The simplicity of use of mobile banking for engaging with these services is beneficial to Generation Z, who are frequently more willing to embrace such approaches.
- **Promotion of Literacy and Financial Education:** Resources for managing personal finances are available through a variety of mobile banking apps and platforms. These tools can help Generation Z have a better grasp of how financial decisions affect sustainability on both a personal and environmental level. Investing in sustainable goods and services may be made more intelligently when one has greater financial literacy, which will help to strengthen the circular economy.
- **Including Environmentally Friendly Initiatives:** Some mobile banking systems are including social and environmental initiative-supporting features, such possibilities to donate to environmental groups or measure one's carbon impact. These features connect with the beliefs of Generation Z and give them a simple method to support environmental initiatives while also tying their financial actions into the circular economy.
- **Advancing Innovations in Technology:** The use of mobile banking by Generation Z promotes the development of new technologies, particularly those that aid in the circular economy. Financial services are progressively incorporating innovations that help improve circular economy principles, including blockchain for transparent supply chains or AI for resource optimization.

In conclusion, mobile banking not only makes financial transactions easier, but it also fits in nicely with the principles of a circular economy and the ideals of Generation Z. Mobile banking may contribute to a more sustainable future by encouraging circular business models, cutting waste, and encouraging sustainable spending.

CONCLUSION: GENERATION Z, MOBILE BANKING AND THE CIRCULAR ECONOMY

The convergence of mobile banking, circular economy principles, and Generation Z offers a revolutionary and dynamic opportunity for achieving financial and environmental sustainability. Here's a summary of how these components work together and affect one another:

- **Engagement and Empowerment:** Generation Z is given strong tools via mobile banking systems to handle their finances more sustainably and successfully. Because they are digitally literate, members of this population can use these technologies to:
  - **Boost Financial Literacy:** Mobile banking applications include tools to assist users in managing budgets, keeping track of expenses, and making wise financial decisions. These tools can help users become more responsible consumers who follow the circular economy's tenets.
  - **Embrace Eco-Friendly Financial Products:** The availability of green financial services and goods, such as prizes for eco-friendliness and investments in sustainable businesses, may encourage the circular economy and accord with the ideals of Generation Z.
- **Encouraging the Circular Economy Methods:** Circular economy models may be actively supported by mobile banking through:
  - **Encouraging Sustainable Behaviours:** Generation Z is encouraged to develop sustainable habits via features like integration with recycling programs and rewards for eco-friendly acts.
  - **Encouraging Circular Economy Initiatives:** Mobile banking systems may help with transactions that encourage sustainable consumption, recycling, and reuse, which directly supports the objectives of the circular economy.
- **Obstacles and Difficulties**
  - **The Digital Divide:** Not every member of Generation Z may have equal access to mobile banking technology, which might restrict these tools' ability to encourage circular economy behaviours on a larger scale.
  - **Security and Privacy:** Maintaining user confidence and making sure mobile banking can efficiently support sustainable habits without jeopardizing user data require strong security measures.
- **Opportunities for Synergy:** Circular economy principles and mobile banking have a lot of room to work together:
  - **Integration with Sustainable Models:** In order to promote cooperative consumption, product lifecycle management, and sustainability education, mobile banking may be connected with models of the circular economy.
  - **Advocacy and Awareness:** By informing users on the fundamentals of the circular economy and promoting a wider adoption of sustainable practices, mobile banking platforms may help raise awareness of these issues.

Mobile banking has a substantial but complex effect on how Generation Z engages with the circular economy. Mobile banking may help support circular economy models, encourage sustainable practices, and improve financial management. However, a number of variables, including broad acceptance, usability, and the incorporation of sustainable elements into financial systems, will determine how effective it is. Aligning mobile banking services with circular

economy objectives presents a promising chance to influence Generation Z's economic and environmental results.

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Unified Payment Interface (UPI): Transforming Digital Payments and Revolutionizing Financial Transactions

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Abstract

The Indian banking sector has led to a shift from paper mode to virtual mode. A unified payment interface is also one of the major transformations in the financial sector which is launched to facilitate digital payments. UPI is a revamped, amazing, and cost-effective breakthrough enabling digital payment services to all. A unified payment interface is a potentially innovative way of doing virtual transactions using a virtual payment address by the NPCI (National Payment Corporation of India (NPCI) to achieve a paperless and cashless economy. Thus it is needed to assess for Unified payment interface's potential to put in/contribute to the growth achievement of the digital economy in the Indian Banking sector. This research is focused on understanding the Unified Payment Interface's (UPI) growth and its progression in the Indian banking sector over the last few months. Explored secondary data has been used to carry out this study by applying the data analysis technique.Remarkable growth has been seen in the Unified Payment Interface in the last updated data over the government's official website – Reserve Bank of India and different articles published, where the result finds that the data that private sector banks are leading the way in UPI adoption and usage, like it is driven by better technology, customer incentives, and focus on digital innovation. Public sector banks, while holding significant market shares, may need to focus more on enhancing their digital infrastructure and customer experiences to compete more effectively with their private counterparts in the UPI space.

Keywords: *Unified Payment Interface (UPI), Digital Payments, Financial Inclusion, Fintech, Digital Transformation*

INTRODUCTION

The unified Payment Interface (UPI) has emerged as a pivotal force in the evolution of digital payments and financial transactions in India. Launched in 2016 by the National Payments Corporation in India (NPCI), UPI represents a significant shift in how money is transferred, payments are processed, and financial services are accessed. By facilitating seamless, real-time interbank transactions through a user-friendly interface on smartphones, UPI has not only promoted financial inclusion but also transformed the broader payment ecosystem in the country (Mohapatra, 2017).

The push towards digital payments in India gained momentum with the government's demonetization drive in 2016, which aimed to reduce cash dependency and promote digital payment methods. UPI was introduced at a crucial time, providing an efficient alternative to traditional banking methods. Its unique ability to enable peer-to-peer and person-to-merchant transactions without requiring extensive bank details has led to its rapid adoption. Halder et al.

(2018) highlight that UPI's capability to handle various banking transactions as fund transfers, bill payments, and online purchases – via a single mobile app has significantly improved transaction speed and user convenience.

Several factors have driven the swift adoption of UPI. The system's simplicity and ease of use have made it accessible to a wide range of users, including those who were previously unbanked or underbanked. By allowing the linkage of multiple banking apps, and streamlining the payment process (Ali, 2018). Additionally, the use of a Virtual Payment Address(VPA) instead of sharing sensitive bank details has enhanced transaction security and privacy, boosting user confidence in digital payments (Mahesh et al., 2021).

The growth of UPI has been further accelerated by the widespread availability of smartphones and affordable internet services across India. The expansion of 4G networks has enabled people in rural and remote areas to access UPI services, thereby bridging the digital divide and promoting financial inclusion. Vasantha Kumar and Sowbarnika (2019) note that UPI's integration with popular mobile wallets and payment apps like PhonePe, Google Pay, and Paytm has further extended its reach, making it easier for users to conduct a wide range of transactions with just a few taps. This convenience has been a key factor in UPI's popularity, especially among younger, tech-savvy consumers.

In addition to its user-friendly interface, UPI is recognized for its robust security Features, including two-factor authentication and end-to-end encryption. These security measures have been crucial in building trust among users, particularly in a country where digital security concerns are significant. Das and Das (2020), report that UPI's security protocols have effectively reduced fraud and unauthorized transactions, encouraging more users to shift from cash to digital payments. The Reserve Bank of India (RBI) plays a crucial role in ensuring that these security measures are consistently implemented, keeping the system secure against evolving cyber threats.

Another important aspect of UPI's success is its contribution to promoting a cashless economy. By enabling instant, real-time payments, UPI has reduced the reliance on physical cash, especially in urban areas with well-developed digital payment infrastructure. The ability to make secure payments for everyday needs such as groceries, utility bills, and transportation – has made UPI an integral part of daily life for millions of Indians. Ranjith (2021) suggests that this shift towards a cashless economy has not only streamlined financial transactions but also enhanced transparency, reducing opportunities for corruption and tax evasion.

The impact of UPI extends beyond individual users to the broader financial ecosystem. For businesses, particularly small and medium enterprises (SMEs), UPI offers an affordable and efficient payment solution that simplifies financial transactions and reduces costs. The system's interoperability, which allows transactions across different banks and payment platforms, has improved business operations and cash flow management. Venkatesh et al., (2020) point out that UPI has been especially beneficial for merchants in remote areas, enabling them to accept digital payments and expand their customer base.

Furthermore, UPI has played a crucial role in driving innovation within the fintech sector. Its open architecture has encouraged the development of various fintech applications that provide diverse financial services, ranging from lending and insurance to investment and wealth management. This diversification of financial products has spurred competition in the financial services industry, resulting in better services and lower costs for consumers Jayaram Narayan

(2021), As UPI continues to evolve, it is expected to further accelerate the digital transformation of India's financial sector, paving the way for innovations and business models.

In conclusion, the Unified Payment Interface (UPI) has significantly transformed digital payments and financial transactions in India. By providing a secure, convenient, and accessible payment solution, UPI has played a critical role in driving the country's shift towards a digital economy. Its widespread adoption has not only enhanced financial inclusion but also contributed to broader economic empowerment. As UPI continues to grow and innovate, it is set to remain at the forefront of India's digital financial revolution, shaping the future of payments for years to come.

LITERATURE REVIEW

Somanjoli Mohapatra's (2017) study titled "Impact of Unified Payment Interface System on Customer Satisfaction and Role of National Payment Corporation of India in Promoting Digital Transactions," and colleagues examined how customers felt about different UPI features and established a link between those features and customer satisfaction. They made an effort to pinpoint the main issues clients were having with access to UPI services. They discovered responders' Customer happiness and UPI service dimensions are tightly connected. The majority of responders concur that Two of the biggest issues with UPI services are their complexity and lack of e-literacy. This study attempts to determine the link between UPI service elements and customer perceptions as well as the consumers' perceptions of UPI services.

Ali (2018): The primary objective of the study article was to examine the degree of awareness about the ideas utilized in financial technology and to examine how demographics affect knowledge levels. The responders who studied Islamic finance and banking were given the questionnaire. The awareness and knowledge levels of fintech were assessed using descriptive statistics, and the influence of demographics on awareness and knowledge was examined using multiple regression analysis. The results show that most students, particularly those of older age, are not very knowledgeable in financial technology or its sub-segment.

Halder et al. (2018), this study investigates young urban Bangalore residents' understanding of and use of the Unified Payments Interface (UPI). It focuses on comprehending consumer viewpoints about the government's BHIM app and the current bank-based UPI applications. Through a comparison of different apps, the study pinpoints areas for development as well as possible client concerns. By examining information from a poll with 250 participants, it seeks to make recommendations about how to get around these obstacles and promote the widespread use of UPI. As a result, the shift to a cashless economy will go more smoothly and UPI apps will be more innovative and technologically efficient.

Vasanthakumar & Sowbarnika (2019): The National Payments Corporation of India (NPCI) has launched the Unified Payments Interface (UPI), a digital payment architecture that uses mobile phones as the primary device and sophisticated digital payment features. 103 people are polled for this study. This study aims to determine consumer preferences, their degree of satisfaction with the UPI system, and the challenges they encounter while utilizing the scheme for the intended purpose. Based on how satisfied they are with the services they receive, customers are divided into several groups. Based on all the parameters, it can be deduced that the significant value is less than 0.05, indicating a substantial difference between the clusters.

Venkata et al. (2020): The understanding and views of people in a variety of age groups and professions on the use of UPI services were examined in the study "Role of Unified Payment Interface in Digital Banking Services – An Empirical Study on User Perceptions." They determined that different vocations users had different opinions about utilizing UPI banking services and that UPI services were superior to traditional banking services.

Das & Das (2020), the empirical study on the Pattern, Perception, and Adoption of Fintech Services is examined, with particular reference to the Hojai district of Assam. The paper primarily looks at relationships between various demographic profiles regarding adoption, how bank customers perceive Fintech services, and the problems that users encounter when using such services. It also notes the gender gap that is observed when using Fintech services, the growing use of digital payments, and the main barriers faced by consumers: low security and lack of technical know-how. Furthermore, the research found that the cash-driven economy is changing to a cashless one, that the adoption of fintech services would rise in tandem with awareness, and that fintech will result in financial inclusion.

Mahesh A. et al. (2021), the concerned study looks at how UPI or the Unified Payments Interface has become a major force behind digital payments in India. Following demonetization and the government's insistence on a digital economy, the NPCI launched UPI to meet the need for an affordable and user-friendly digital payment system. The study examines how the widespread use of smartphones and internet access has accelerated the adoption of UPI with a special emphasis on retail transactions. A SWOT analysis of UPI's advantages, disadvantages, opportunities, and threats is used in this study to determine how well-suited it is to help India become a cashless and paperless society. This study adds to our understanding of UPI's place in the digital payment system by indicating possible development areas and points of interest for future research.

Ranjith (2021), the concerned study looked at the general idea of digital payments as well as its style of operation. All of the study's foundation came from secondary sources. According to the report demonetization greatly benefited customers, but security concerns prevented them from using digital services. More individuals will adopt these practices if these challenges are addressed and greater awareness is raised in various contexts.

Jayaram Narayan (2021): In his paper "A Study on Growth of UPI Apps in India After COVID Outbreak," attempted to examine the UPI idea, as well as the effects and expansion of UPI as a result of the COVID-19 pandemic and the difficulties that UPI Apps experienced. They discovered that the expansion of UPI applications in India beyond 2020, their role in the country's digital transformation, the emergence of several fintech firms and start-ups, and the payment system's ability to process two billion transactions monthly are all extraordinary developments in the field of digital payments. Their research showed that the use of digital payment applications will lead to a rise in economic openness. This will boost the nation's credibility and encourage further investment.

RESEARCH GAP

Despite the budding body of literature on the Unified Payment Interface(UPI) and its transformative role in India's digital payment landscape, key areas remain underexplored. Studies by et al. (2021) and Singh & Kumar (2020) have predominantly focused on the adoption drivers, user

satisfaction, and the economic impact of UPI's role in enhancing financial inclusion and reducing transaction costs. The existing literature largely fails to analyse how UPI can balance its rapid growth with ensuring financial inclusivity in different public and private sector banks of India. This research paper aims to fill the gap by examining the long-term growth of UPI in Indian banks and contribute to a more nuanced understanding of UPI's transformative impact on India's digital payment ecosystem and its potential for broader financial inclusion.

RESEARCH METHODOLOGY

The research methodology adopts a mixed methods approach to comprehensively analyze the growth of UPI. The study is based on secondary data sources collected from different journals, articles, and sites of the Reserve Bank of India. Ten different Indian banks including five public and five private sector banks have been chosen based on the highest gross assets of banks.

RESEARCH DESIGN

This research adopts a descriptive design to explore the transformative impact of the Unified Payment Interface (UPI) on digital payments and financial transactions in India. The study relies on Secondary data to analyze the adoption, growth, and overall impact of UPI on the Indian financial ecosystem. By systematically reviewing existing literature and statistical data, the research aims to provide a comprehensive understanding of the growth of UPI's role in revolutionizing digital payments.

DATA ANALYSIS TECHNIQUES

Descriptive Analysis

Descriptive statistics will be used to analyze the collected data, providing a clear picture of UPI's growth and its impact on digital payments including UPI transaction value which analyses the increase in transaction volumes and values over the years, Adoption rates of different public and private sector banks, merchants and users towards UPI since its launch, comparison of UPI's market shares with other digital payment system.

Comparative Analysis

Comparative analysis will be conducted to evaluate UPI's performance against other digital payment methods like NEFT, IMPS, and Mobile wallets including Comparing speed, cost, and convenience of transactions as performance metrics, and reviewing studies and reports on user satisfaction and challenges faced with UPI. Analyzing the frequency and nature of security issues or frauds associated with UPI compared to other systems.

Trend Analysis

Trend Analysis will focus on identifying patterns and shifts in UPI usage over time including evaluating the year-on-year growth in transaction volume and value, assessing the impact of technological developments like 4G/5G, smartphone penetration, and app enhancements on UPI adoption, and understanding the role of policy changes and regulations on UPI's growth trajectory.

SWOT Analysis

SWOT analysis will be conducted to assess UPI's strengths, weaknesses, opportunities, and threats helping to understand strengths as user-friendly interface, interoperability, and low transaction

gaps. Weakness for security concerns, technical glitches, and user education gaps. Opportunities an expansion in the rural areas, integration with the global payment systems, and enhancement of security features. Threats due to competition from other digital payment systems, regulatory challenges, and cyber threats.

- **Strengths**
  - **Ease of Use:** UPI offers a seamless, user-friendly interface that allows instant money transfers, which has been widely recognized as a major strength Dahiya & Kumar, (2020).
  - **Interoperability:** It facilitates transactions across multiple banks and payment platforms, enhancing its utility and adoption Gopalkrishnan & Lamba, (2021).
  - **Low Transaction Costs:** UPI provides a cost-effective payment solution, especially beneficial for small businesses and consumers NPCI, 2021.
- **Weaknesses**
  - **Dependence on Internet Connectivity:** UPI transactions require stable internet, limiting its reach in rural areas with poor connectivity Kumar & Sharma, (2019).
  - **Cybersecurity Concerns:** Despite strong security measures, UPI's vulnerable to phishing and other cyber threats Mishra & Tripathi (2020).
- **Opportunities**
  - **Expansion into Rural Markets:** There is significant potential to increase UPI adoption in rural areas by improving digital infrastructure Sharma & Singh (2022).
  - **Global Expansion:** UPI can be adapted for use in other countries, offering opportunities for international growth Mehta (2021).
- **Threats**
  - **Intense Competition:** UPI faces competition from other digital payment platforms, which could impact its market share Rao & Venkatesh, (2020).
  - **Regulatory Risks:** Changes in government regulations could pose challenges to UPI's continued growth Choudhary (2021).

STATISTICAL DATA INTERPRETATION OF ENTITY UPI TRANSACTIONS OF PUBLIC AND PRIVATE BANKS

The statistical data has been interpreted with the help of Secondary data sources by using the Reserve Bank of India site, articles, and news for the top ten Public and Private sector banks selected based on the highest gross assets of the different Indian banks for the last three months.

Public Banks

UPI-Entity-wise Transactions Data for April 2024					
S. No.	*Entity Name*	*As a Remitter*		*As a Beneficiary*	
		Volume (in lakh)	*Volume (in cr)*	*Volume (in lakh)*	*Volume (in cr)*
1.	State Bank of India	33,698.57	5,22,071.80	14,972.55	3,85,283.07
2.	Bank of Baroda	8,146.45	1,14,756.04	3,704.55	90,980.42
3.	Punjab National Bank	6,896.84	1,02,536.63	3,072.16	80,627.60
4.	Union Bank of India	7,797.25	1,09,553.23	3,422.15	88,615.69
5.	Central Bank of India	1,712.71	28,159.30	902.16	23,413.10

Source: RBI

UPI-Entity-wise Transactions Data for May 2024					
S. No.	Entity Name	As a Remitter		As a Beneficiary	
		Volume (in lakh)	Volume (in cr)	Volume (in lakh)	Volume (in cr)
1.	State Bank of India	35,627.34	5,43,715.79	15,860.76	3,99,501.88
2.	Bank of Baroda	1,18,508.49	8,637.13	3,977.52	94,309.84
3.	Punjab National Bank	7,353.82	1,06,501.21	3,243.85	83,474.23
4.	Union Bank of India	8,280.58	1,14,063.33	3,575.01	91,769.57
5.	Central Bank of India	1,800.35	28,967.34	935.93	23,938.88

Source: RBI

UPI-Entity-wise Transactions Data for June 2024					
S. No.	Entity Name	As a Remitter		As a Beneficiary	
		Volume (in lakh)	Volume (in cr)	Volume (in lakh)	Volume (in cr)
1.	State Bank of India	35445.41	534730.93	15477.34	390411.27
2.	Bank of Baroda	8544.18	115992.56	3992.49	92848.52
3.	Punjab National Bank	7329.60	103495.37	3226.19	80735.70
4.	Union Bank of India	8179.74	111528.71	3536.48	89415.65
5.	Central Bank of India	1760.11	28219.13	914.21	23331.40

Source: RBI

The above table presents a detailed breakdown of UPI transaction volumes and values for five, major banks in India bank of India(SBI), Bank of Baroda (BOB), Punjab National Bank(PNB), Union Bank of India (UBI), and Central Bank of India(CBI)- for April, May, and June of the year 2024. The data is segregated into two categories: transactions as a remitter and transactions as a beneficiary. The results highlight significant trends and implications for the banking sector, financial services, and the overall adoption of UPI.

Private Banks

UPI-Entity-wise Transactions Data for April 2024					
S. No.	Entity Name	As a Remitter		As a Beneficiary	
		Volume (in lakh)	Volume (in cr.)	Volume (in lakh)	Volume (in cr.)
1.	ICICI	5,900.21	1,18,308.19	6,042.19	1,55,724.28
2.	HDFC	11,336.36	2,15,518.20	6,171.71	2,10,570.07
3.	Kotak Mahindra Bank	6,656.07	73,006.43	2,770.54	62,250.06
4.	Axis Bank	6,111.40	1,08,995.23	12,493.35	1,70,072.17
5.	Indusland Bank	1,404.58	22,137.39	1,223.42	22,256.14

Source: RBI

UPI-Entity-wise Transactions Data for May 2024					
S. No.	Entity Name	As a Remitter		As a Beneficiary	
		Volume (in lakh)	Volume (in cr)	Volume (in lakh)	Volume (in cr)
1.	ICICI	6,187.61	1,24,793.81	6,310.85	1,65,519.69
2.	HDFC	2,26,310.87	11,882.41	6,451.80	2,17,692.64
3.	Kotak Mahindra Bank	7,003.08	75,477.38	2,836.62	63,948.70
4.	Axis Bank	1,12,446.68	6,297.09	12,913.40	1,77,733.00
5.	Indusland Bank	22,721.03	1,475.99	1,267.47	22,940.12

Source: RBI

UPI-Entity-wise Transactions Data for June 2024					
S. No.	*Entity Name*	*As a Remitter*		*As a Beneficiary*	
		Volume (in lakh)	*Volume (in cr)*	*Volume (in lakh)*	*Volume (in cr)*
1.	ICICI	6119.26	125260.91	6215.45	167897.59
2.	HDFC	11669.89	221776.77	6459.25	212196.81
3.	Kotak Mahindra Bank	6707.33	72936.98	2733.62	60962.05
4.	Axis Bank	6340.76	111330.24	12796.18	173997.24
5.	Indusind Bank	1451.79	21976.39	1229.72	21871.65

Source: RBI

RESULTS FINALIZED OF TREND ANALYSIS ON UNIFIED PAYMENT INTERFACE

Year	*Key Trends*	*Data Points*	*References*
2017	Initial Adoption	92.8 million transactions	NPCI, 2023
2018	Rapid growth in transaction volume	1 billion transactions	RBI, 2023
2019	Expansion Across rural areas	Increased usage in tier 2 and tier 3 cities	Kumar & Mukherjee, 2023
2020	Boost during covid-19 pandemic	22 billion transactions	NPCI, 2023
2021	Introduction of UPI 2.0	Added features like overdraft accounts and auto-pay	Soni & Rao, 2022
2022	Integration with digital wallets and banking apps	Over 40% of UPI transactions through third-party apps	RBI, 2023
2023	International Expansion Begins	Over 46 billion transactions initiatives for cross-border	NPCI, 2023
2024	Emerging Competition	Increased competition from other payment systems	Bansal & Gupta, 2021

DISCUSSION/RESULTS/INTERPRETATION OF DATA

The UPI transaction data for April, May, and June 2024 provides a clear lens through which to compare the performance of public and private sector banks in India. Both sectors play critical roles in the UPI ecosystem, but there are discernible differences in their engagement and strategic focus.

As a remitter, SBI holds a dominant position, reflecting its extensive customer base and widespread use of UPI for initiating payments. This indicates a strong inflow of funds into accounts of SBI, suggesting that many users SBI as their receiving bank for UPI transactions. The data also indicates that SBI is a preferred bank for both sending and receiving payments, reinforcing its central role in the digital payments area in India. The BOB shows substantial engagement by its customers in initiating UPI payments or transactions where the volume and value on the beneficiary side indicate a healthy inflow of funds into BOB accounts. The BOB's performance highlights its growing presence in the UPI space. The bank's robust remitter volume suggests that its customers actively use UPI for outgoing payments, while the beneficiary data includes that BOB is also a popular choice for receiving funds. The bank's performance reflects its strategic

efforts to enhance its digital payment services and increase its footprint in the UPI ecosystem. The data of Punjab National Bank's engagement in UPI transactions on the remitter side shows bank's performance as a beneficiary indicates a significant inflow of funds, although slightly lower than its remitter transactions. Punjab National Bank's data reveals balanced participation in UPI transactions, both as a remitter and as a beneficiary. The substantial transaction values suggest that PNB is effectively leveraging its customer base to drive UPI adoption. The slightly lower volume as a beneficiary compared to its remitter volume might indicate a need for PNB to focus on attracting more inflow transactions. The volumes of UPI's show a strong position in facilitating UPI payments. This shows that UPI is also a popular choice for receiving funds through UPI. Union Bank of India's performance highlights its active participation in the UPI ecosystem. The relatively balanced volumes between remitter and beneficiary transactions indicate that UPI customers are equally engaged in sending and receiving payments. The data suggests that UPI services are well-received, and the bank is effectively catering to its customers' digital payment needs. CBI banks' volume is comparatively lower than the other banks in the dataset. The beneficiary volume is also relatively lower, reflecting a smaller scale of operations. Central Banks of India data indicate that it has a more modest presence in the UPI ecosystem compared to the larger banks. The lower transaction volumes and values suggest that while CBI is active in the UPI space, it may face challenges in scaling its digital payment services to match those of its larger counterparts. The bank may need to invest in digital infrastructure and marketing to boost its UPI adoption and increase transaction volumes.

In the private sector banks, ICICI Bank indicates a strong presence in initiating UPI transactions. The slightly higher volume as a beneficiary suggests that ICICI is also a favored bank for receiving payments. ICICI bank's data reflects its balanced performance in the UPI space, with substantial transaction volumes on both remitter and beneficiary sides. The bank's nearly equal participation in sending and receiving payments indicates a well-rounded approach to UPI services, making it a key player in the digital payments ecosystem. HDFC bank's data demonstrates the dominant role in facilitating UPI payments where HDFC bank's large transaction volume and value, particularly as a remitter, underline its leadership in the UPI world. The high volume suggests that HDFC customers heavily rely on the bank for initiating payments. While the beneficiary volume is slightly lower, the overall high transaction values on both sides confirm HDFC's critical role in transactions. Kotak Mahindra Bank I performing moderating engagement in initiating UPI transactions. Kotak Mahindra shows a significant gap between its remitter beneficiary volumes, with a higher emphasis on initiating payments. The lower beneficiary volumes suggest that Kotak is less frequently chosen as a receiving bank, potentially indicating a need to enhance its attractiveness as a UPI destination for funds. Axis Bank's data results in a unique position where its beneficiary transactions significantly outnumber its remitter transactions. This suggests that Axis Bank is highly favored as a receiving bank for UPI payments, possibly due to its strong digital infrastructure or customer incentives. The large beneficiary volume highlights Axis Bank's role as a central player in the inflow of digital payments. IndusInd Bank's lower transaction volumes compared to the other banks suggest a more modest presence in the UPI ecosystem. However, the close balance between its remitter and beneficiary transactions indicates a stable performance in both sending and receiving payments. The similar transaction values on both sides reflect consistent, if smaller, participation in UPI activities.

CONCLUSION/FINDINGS

The data underscore the significant role of UPI in transforming the financial transaction in India. The high volumes and values of transactions processed by the different public and private sector banks highlight the widespread adoption and integration of UPI into the daily financial activities of consumers and businesses alike. The results emphasize the need for continued innovation and investment in digital payment infrastructure to support the ongoing growth and development of UPI as a critical component of India's financial ecosystem. The private sector banks, particularly HDFC Bank and ICICI Bank, exhibit robust participation in UPI transactions. HDFC Bank leads with the highest remitter volume, showcasing its dominance in initiating payments, which suggests that its customers are heavily reliant on UPI for transactions. ICICI Bank shows a balanced performance with significant volumes as both a remitter and beneficiary, indicating its widespread use for sending and receiving payment. Axis Bank stands out for its substantial beneficiary transactions, suggesting digital infrastructure or customer incentives. Kotak Mahindra Bank, while showing strong remitter activity, has lower beneficiary volumes, indicating that while it is heavily used for sending payments, it is less chosen as a receiving bank. Indusland Bnak, though smaller in scale, shows consistent activity with closely matched remitter and beneficiary volumes, reflecting stable, albeit modest, engagement in the UPI ecosystem.

On the other hand, public sector banks such as the State Bank of India(SBI), Bank of Baroda (BOB), and Punjab National Bank (PNB) also demonstrate strong engagement in UPI transactions, particularly as a remitter. Sbi, in particular, shows the highest remitter volume among public sector banks indicating its large customer base preference for using UPI to initiate transactions, however, these banks generally show lower beneficiary volumes compared to their private sector counterparts, suggesting that while they are crucial for initiating payments, they might not be as frequently selected as receiving banks. This can be due to differences in digital; infrastructure, customer service, or incentives offered by the private sector. when comparing the two sectors, private sector banks generally appear to be outperforming public sector banks in terms of UPI transaction volumes. Especially as beneficiaries. The private banks' more balanced approach between remitter and beneficiary roles, coupled with their substantial transaction values, points to a more aggressive and customer-friendly digital payments strategy. In contrast, public sector banks, while performing well as remitters, may need to enhance their digital offerings and customer engagement to increase their attractiveness as beneficiary banks in UPI transactions.

Overall, the data suggest that private sector banks are leading the way in UPI adoption and usage, driven by better technology, customer incentives, and a focus on digital innovation. Public sector banks, while holding significant market shares, may need to focus more on enhancing their digital infrastructure and customer experiences to compete more effectively with their private counterparts in the UPI space.

LIMITATIONS AND FUTURE SCOPE

This research methodology, centered on the analysis of Secondary data, is designed to provide a thorough examination of UPI's impact on digital payments and financial transactions in India. While secondary data offers valuable insights, it also comes with certain limitations which include the study is dependent on the accuracy and reliability of the secondary data sources. Time lag has been seen as previous data might not be fully captured in the available data. The study does not

include primary data collection, which could limit the exploration of user-specific experiences and perceptions that can be used and followed for research in future papers.

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Green Finance and AI: Reviewing Studies, Challenges and Strategic Pathways for Sustainability

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Abstract

Artificial intelligence (AI) in sustainable finance has the potential to greatly enhance the resilience and environmental consciousness of the financial system. It is becoming more and more obvious that action is required as the globe struggles to address the serious issues of resource depletion, environmental degradation, and climate change. Extreme weather, an increase in sea level, and a decline in biodiversity are all consequences of climate change, which is caused by an increase in greenhouse gas emissions. These problems are made worse by resource depletion, which includes the exploitation of vital natural resources. Ecosystems and human health are further threatened by environmental degradation, such as pollution and deforestation. Global collaboration, financial support for long-term fixes, and a dedication to lessening our environmental impact are all necessary to tackle these interrelated problems. It's becoming more and more clear that a more sustainable approach to financing is required. The development of artificial intelligence (AI) has made it possible to use this potent instrument to significantly influence the creation of a more sustainable financial environment.

This study looks into how AI techniques affect sustainable finance with an emphasis on creating a more environmentally friendly future. Our goal to examine the current landscape of sustainable finance and identify existing challenges and opportunities & explore case studies and best practices illustrating the implementation of AI-powered solutions in sustainable finance

Keywords: *Artificial Intelligence, Sustainability, Sustainable Finance, Environment, Greener Future, AI Strategies, Green Finance*

INTRODUCTION

Sustainable finance encompasses financial activities that integrate environmental, social, and governance (ESG) criteria into investment decisions. While sustainable finance has gained traction in recent years, challenges persist in effectively channelling capital towards environmentally beneficial projects. Traditional banking models often lack the agility and precision needed to navigate complex environmental risks and opportunities. AI, with its capacity for data analysis, pattern recognition, and predictive modelling, offers unprecedented potential to address these challenges.

By leveraging AI technologies, banks can enhance their ability to assess and mitigate environmental risks, identify sustainable investment opportunities, and optimize resource allocation. Moreover, AI-powered solutions can enable banks to develop innovative financial

products tailored to the needs of environmentally conscious consumers and businesses. Through this research, we seek to explore the specific ways in which AI can transform banking practices to advance sustainability objectives.

The primary goal of the existing financial system has been to maximize short-term profits, frequently at the price of long-term social and environmental concerns. As a result, financial gains have taken precedence over sustainability, which has made environmental problems worse. By offering data-driven insights, streamlining decision-making, and facilitating more open and responsible financial processes, artificial intelligence (AI) has the potential to fundamentally change this paradigm.

RESEARCH METHODOLOGY

Describes the methodology used to evaluate the authors' contributions to the field of green finance, whereas Section describes the search procedure used to find and choose pertinent research articles.

OBJECTIVES

To assess the efficiency of AI-driven tactics in advancing environmentally, socially, and governance (ESG) objectives and sustainable financial practices.

LITERATURE REVIEW

The literature on sustainable finance highlights the growing importance of integrating environment, social and governance factors into investment decision-making processes. Studies have identified barriers such as data limitations, regulatory uncertainties, and a lack of standardized metrics for measuring sustainability performance. However, recent advancements in AI offer promising solutions to address these challenges.

Research in AI applications for sustainable finance has demonstrated the potential for machine learning algorithms to analyse vast datasets and extract actionable insights. These insights can inform investment strategies, risk management practices, and product development initiatives. Moreover, AI-driven tools such as natural language processing (NLP) and sentiment analysis can provide valuable insights into market trends and stakeholder preferences.

Aracil (January 2021): Since the turn of the century, there has been an abundance of literature on sustainable banking. This background makes it necessary to comprehend and classify a growingly diverse corpus of literature on sustainable banking. Their review results in an integrative framework that offers a thorough understanding of the nine clusters or theme areas found in sustainable banking literature, which are categorized into three domains: business-case, sustainable products, and ethical foundations. The framework identifies the main gaps in research, maps out the main areas of interest, and incorporates the extensive literature on sustainable banking. Ultimately, the study of the literature shows how the instrumental and ethical approaches to sustainable banking are gradually coming together. This convergence draws attention to how important it is to have a robust public discussion about banks' contributions to sustainability as well as the financial justifications for adopting sustainable practices.

Yalamati (December 2023): This study investigates how cutting-edge artificial intelligence (AI) methods can revolutionize emerging countries by accelerating the digitization of financial institutions. There's an increasing need to use AI technologies to improve traditional banking structures as these sectors see significant technology improvements. The study looks into the

complex effects of AI on a range of banking operations aspects, such as risk management, fraud detection, client interactions, and overall operational efficiency. The research intends to offer insights into the potential, difficulties, and strategic considerations for financial institutions aiming to embrace digital transformation through a thorough analysis of AI-driven strategies and implementations in emerging market environment. The results of this study add to the larger conversation on how AI is changing financial ecosystems, especially in areas with rapid economic and technological development.

Karim (October 2021): The global spread of COVID-19 has forced the financial industry, among others, to adjust to unforeseen difficulties. In order to achieve this, this study looks at how sustainable banking laws in Pakistan affected bank-specific traits both before and after the COVID-19 pandemic between 2006 and 2020. Furthermore, the moderating effect of financial stability on sustainable banking rules is tested. The system-Generalized Method of Moments, a dynamic estimator, is employed to examine the data's endogenous character. Results indicate that while leverage ratios are adversely correlated with profitability and market return, capital adequacy, deposit, and loan ratios are positive. Overall, the results show that sustainable banking laws have a significant impact on the features unique to each bank. Significant gains have been made by Pakistani banks in terms of profitabilities, market returns, capital adequacy, and deposit ratios both before and during the epidemic, according to the year-wise averages of the variables

Yalamati (Sep 2023): This study examines how Artificial Intelligence (AI) is changing the digital banking industry, with a particular emphasis on how AI affects client acquisition, retention, and engagement in general. Financial institutions are using artificial intelligence (AI) more and more to transform their digital banking services in this age of rapid technological innovation. The study explores the various ways that AI improves customer acquisition procedures through the prediction of user preferences, personalization of interactions, and streamlined onboarding. The study also looks at how predictive modeling and AI-driven data support strong client retention strategies by creating personalized financial solutions and proactive interaction that build long-term connections. The results underscore the possibility AI to improve digital banking by delivering a smooth, customized, and flexible client experience, eventually changing the financial services industry

Ochuba (March 2024): Artificial Intelligence (AI) integration into financial markets is becoming more and more important, especially in emerging economies where efficiency and accessibility continue to be major obstacles. This abstract examines how artificial intelligence (AI) technologies are changing the way financial markets grow, with an emphasis on improving accessibility and efficiency in developing nations.AI makes predictive modelling, comprehensive risk management, and task automation easier, which streamlines processes and lowers costs. In addition, AI-powered solutions democratize the financial services industry by providing tailored guidance and advancing financial inclusion programs. In order to ensure the sustainable development of financial markets in emerging economies, the abstract highlights the necessity for legislators to create favourable regulatory frameworks and calls on stakeholders to adopt AI technologies.

Parne (2021): Any country's economy is based on its financial services sector. Billions of financial transactions occur every day, and all of this data is recorded and can be viewed as a data gold mine for numerous firms. This volume of data is too vast for human intelligence to

sift through and find anything worthwhile. For this reason, banks are using artificial intelligence to develop new algorithms that have the potential to alter the way that financial transactions are conducted. Artificial Intelligence has a relatively short time to finish the assignment. Artificial intelligence can be used to spot potential attacks, scams, and any other irregularities that could be harmful to the organization. The function of machine learning and artificial intelligence in the banking industry is covered in this essay.

Truby (May 2020): Legislators have so far failed to convert the emerging global consensus on the fundamentals of AI governance into laws governing the financial industry. A public and regulatory backlash would result in overregulation, which might impede the advancement of this potentially helpful technology, once unregulated AI software causes significant economic harm. With countless potential advantages, including better financial services and increased regulatory compliance, artificial intelligence is having a significant impact on the financial industry. This paper makes the case that promoting a proactive regulatory approach before any financial harm occurs is the best way to foster a sustainable future for AI innovation in the financial sector. This proactive strategy ought to put into effect reasonable regulations that represent jurisdiction-specific guidelines in accordance with carefully interpreted international norms.

Agarwal (2024): A revolution known as Fintech, or financial services, has been triggered by the rapid progress of Artificial Intelligence (AI) technology. The study examines the industry's adoption of AI, its primary drivers and obstacles, and the consequences for both established financial institutions and up-and-coming Fintech firms. It does this by examining previous research and case studies. The study examines the industry's adoption of AI, its primary drivers and obstacles, and the consequences for both established financial institutions and up-and-coming Fintech firms. It does this by examining previous research and case studies. Additionally, the paper addresses how ethical issues and legal frameworks will influence how artificial intelligence (AI) is used in banking and other financial services in the future. It emphasizes the significance of striking a balance between innovation, consumer protection, and systemic stability. It also looks at how traditional banks have responded strategically, including joint ventures with Fintech companies, investments in AI R&D, and organizational reorganizations in response to the shifting market. This review study paper offers insightful information about the Fintech revolution powered by AI technology, emphasizing how it might upend established banking and financial services while posing opportunities and challenges for industry participants. Financial institutions may use AI to drive innovation, improve client experiences, and stay competitive in the digital age by being aware of the ramifications of adopting AI and taking proactive measures to solve ethical, strategic, and legal issues.

Qudah (June 2023): The results of this study allow us to suggest future lines of inquiry that might be helpful in considering the profound influence that technology will have on the development of Islamic finance and financial technology. Financial Inclusion and Corporate Governance in Islamic Fintech is the first trend displayed in the survey, which found four major research themes. Information technology and upcoming Islamic financial services are the main topics of the second trend. Fintech is revolutionizing the Islamic finance industry, and this is the third trend to watch. Islamic finance, a rising force in the digital era, is the subject of the fourth trend. With a focus on financial technology and Islamic finance, this study offers a thorough examination of current research trends and suggests areas for further investigation.

Aziz, issue 1 (2023): This study explores the various uses of AI in the banking industry for managing, preventing, and identifying fraudulent activity. Real-time detection capabilities of traditional rule-based fraud detection systems are frequently lacking. Additionally, natural language processing (NLP) can be used to improve Know Your consumer (KYC) procedures by using artificial intelligence (AI) to analyse textual data from several sources and verify the legitimacy of the consumer. The study also emphasizes how crucial it is to have user-friendly interfaces, such as chatbots driven by AI, for prompt reporting of suspicious activity and to incorporate advanced biometric verifications, such as voice and facial recognition. By examining transaction locations and user interaction patterns, respectively, geospatial analysis and behavioral biometrics enhance security even more. The versatility of artificial intelligence is a key benefit.

Devan (August 2023): This paper investigates the effects of artificial intelligence (AI) on banking in great detail, covering important areas including credit evaluation, operational efficiency, fraud detection, personalized banking experiences, customer service, predictive analysis, and regulatory compliance. Instantaneous support and personalized recommendations are provided by AI-powered chatbots and virtual assistants, which have completely transformed client engagement. In addition, artificial intelligence algorithms have strengthened security frameworks by promptly detecting fraudulent activity and reducing risks associated with credit evaluations and loan approvals. Artificial Intelligence (AI)-driven automation has greatly increased operational efficiency, and predictive analytics has enabled banks to implement data-centric strategies in the financial domain. By carefully monitoring transactions and guaranteeing compliance with regulatory norms, AI systems have also made regulatory compliance easier.

Qin (February 2023): We lead the field in this study by concentrating our investigation and analysis on the relationship between artificial intelligence and economic growth. In particular, we use a two-phase process. A qualitative content analysis of clusters derived from the bibliographic coupling method is carried out in the second stage, providing different viewpoints on the content orientations of recently disseminated themes in the field of AI&ED. However, the content analysis shows that the five aspects of intelligent decision-making labor and capital, Industry 4.0, social governance, and innovation are the focus of the majority of study. The findings give academics a forward-looking framework for understanding the state of the field of AI and education now and any prospective knowledge gaps.

Shershneva (2019): This article focuses on the examination of environmentally conscious banking practices, also known as "green" banking, both domestically and internationally. In order to establish a sustainable economy, the paper expands on the premise regarding the significance of commercial banks making greener financial decisions. Taking into account the views of various researchers, the author concludes that environmentally responsible banking is a strategically significant format of bank activity that ensures the synergy of four effects: boosting banks' economic efficiency, shaping their social image, minimizing their negative effects on the ecosystem, and creating future social benefits.

Dung Minh Nguyen (July 2021): According to these results, satisfaction, trust, and perceived utility all had an impact on the respondents' intentions to keep using the banks' chatbot services; trust had the largest impact. The findings also show that, in various ways, the three drivers of continuance intention were significantly impacted by information quality, system quality, service quality, and proof of expectations. By offering a more thorough perspective to comprehend the

attitudes and responses of chatbot users at the post-adoption period, our study adds to the body of literature. As a foundation for long-term and sustainable development strategies in the present digital era, the study's results also provide financial service providers with a number of important recommendations on how to increase their customers' intents to keep using chatbot services.

Al-Sartawi (March 2022): The papers in this Special Issue cover a wide range of topics, including ESG investment, sustainable development, and the use of artificial intelligence to support creditors, investors, and company management in making the best choices possible to guarantee long-term financial sustainability. In this particular situation, one may argue that it is imperative to take into account the pros and downsides of using AI to solve sustainability-related problems. This Editorial presents new insights from the literature on the significance of AI applications and models, for sustainable investments, and comprehending the value of AI beyond a problem-solving tool, in addition to summarizing the articles in this Issue.

Veerla (January 2021): The development of professional finance applications has been made possible by the numerous advancements in artificial intelligence (AI) over the past several years, which might potentially upend the finance sector. As a result, it is expected that AI will be able to outperform humans in terms of performance as well as completely or partially replace human capital. Numerous programs are available to businesses worldwide. With the help of cutting-edge digital technologies, the banking industry is prepared to step up the execution of its plan and provide its clients with quick and safe transaction processing. The evolution, adoption, use, and prospects for leverage in the future were all evaluated in this study. AI will help the banking industry in India execute its strategy with success.

Oyewole (January 2024): In order to redefine financial processes in accordance with Environmental, Social, and Governance (ESG) standards, this study examines the revolutionary integration of Artificial Intelligence (AI) into sustainable finance. According to research, AI tools like the Financial Maximally Filtered Graph (FMFG) algorithm greatly enhance the processing and analysis of large datasets, making it easier to make sustainable investment decisions. The application of AI in sustainable finance is not without its technological, legal, and ethical obstacles, though. Strategic proposals for overcoming these obstacles are put out in the report, with a focus on industry best practices, the creation of strong policy frameworks, and a methodical approach to AI integration. In order to create a more robust and sustainable financial system, the conclusion highlights the potential of AI in advancing sustainable finance and provides stakeholders with guidance on navigating the intricacies of this integration.

Filgueiras (March 2024): Through a study, this research seeks to assess how customers view the advantages that Sustainability 4.0 brings to the banking industry. A formalized survey comprising fifty-five components categorised into economic, social, and environmental domains was created. Ninety surveys in all were gathered. The goal of using descriptive statistics and Kendall's coefficient of agreement was to gauge how much bank customers' replies agreed or disagreed. The findings showed that consumers had a generally high degree of agreement and a positive assessment of the connection between sustainable practices and economic, social, and environmental issues. The economic and environmental benefits, like shorter wait times and more effective use of digital resources, received the highest ratings. This raises questions regarding the effects of technology on banking positions and the availability of financial services for particular demographics, such the elderly. The study concludes that by concentrating on customer

perception, it provides a comprehensive understanding of the consequences of sustainability 4.0, surpassing the scope of typical evaluations that concentrate on enterprises.

CONCLUSION

Using artificial intelligence (AI) to sustainable finance is a revolutionary way to solve the world's environmental and social problems. The substantial progress and promise of AI-driven tactics in improving sustainable financial practices have been brought to light by this review. We have discovered important trends, approaches, and effective case studies that highlight the effectiveness of AI in advancing environmental, social, and governance (ESG) objectives by examining recent research. The use of AI in sustainable finance is not without difficulties, despite the encouraging results. To fully reap the benefits of AI technology, concerns including algorithmic bias, data privacy, and the requirement for strong legal frameworks must be addressed. Additionally, the cooperation of all parties involved—financial institutions, IT companies, and legislators—is essential for developing an environment that promotes

Future studies should concentrate on resolving these issues and investigating fresh AI uses that have the potential to significantly advance sustainability in the financial sector. We can contribute to the global efforts to achieve sustainability and resilience by utilizing AI's skills to create a more environmentally friendly and sustainable financial future.

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The Idea of Circular Economy and the Promise of Industry 5.0

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Abstract

The study is conceptual in nature and aims at indulging in the diverse yet connected concepts of Industry 5.0 and Circular Economy. Industry 5.0 is an emerging concept that builds upon the principles of Industry 4.0, integrating human-centric approaches, sustainability, and resilience into industrial processes. While Industry 4.0 primarily focused on automation, smart technologies, and the Internet of Things (IoT), Industry 5.0 emphasizes the collaboration between humans and machines, aiming for more personalized, sustainable, and resilient manufacturing systems. Industry 5.0 represents a significant evolution in industrial practices, emphasizing human-centric, sustainable, and resilient approaches to manufacturing. While it offers substantial benefits in terms of customization, efficiency, and environmental sustainability, its implementation requires careful consideration of ethical, economic, and social challenges. As industries continue to evolve, the successful integration of human and machine capabilities will be crucial in realizing the full potential of Industry 5.0 & the realization of the circular economy.

Keywords: *Circular Economy, Industry 5.0, ICT Innovations, Sustainable Development*

INTRODUCTION

Industry 5.0, with its focus on human-machine collaboration, holds immense potential for advancing the circular economy. ICT innovations such as IoT, AI, big data analytics, and block chain are instrumental in driving sustainable industrial practices, optimizing resource use, and promoting a regenerative economic model. By addressing the challenges and leveraging the opportunities presented by ICT, businesses can transition towards more sustainable and resilient operations, contributing to a more circular and sustainable future. That's the promise of Industry 5.0 in making Circular Economy a path breaking reality enabling life altering approaches on our planet in foreseeable future.

OBJECTIVE

The study is conceptual in nature and aims at understanding the idea of Circular Economy in decent depth and how Industry 5.0 proposedly aims at achieving the same. The paper proposes that since Industry 5.0 is based on latest technologies incorporating Artificial Intelligence and Machine Learning etc., it can optimize the usage of resources in order to minimize wastage and promote sustainability. This paper also provides an overview of the circular economy, its core principles, benefits, and challenges, and discusses its application in various industries.

WHAT IS CIRCULAR ECONOMY?

The term Circular Economy was coined by Pearce and turner in 1990 in their work "Economics of Natural resources and Environment" where it was posited that the current economy system is

threatening the environment by converting it in a waste reservoir as production and manufacturing activities are continuously producing waste and pollution. Since products are used through their life cycle till they have accomplished their duty are replaced by newer products in the market with better features deeming them to be obsolete.

In the said premise the philosophy of Circular Economy rests on the pillars of "**7Rs**" called **Redesign**, **Refuse**, **Reduce**, **Reuse**, **Repurpose**, **Recycle** & **Retrieve**. The idea of Circular Economy revolves around the intent where lifecycle of the product doesn't end in a landfill rather enters a new circle of life where it finds a new purpose and use.

Circular Economy: A Paradigm Shift towards Sustainable Development

The circular economy (CE) represents a transformative approach to sustainable development, emphasizing resource efficiency, waste reduction, and regenerative processes. Here we put forth the principles, benefits, and challenges of the circular economy, examining its implementation across various sectors and highlighting innovative practices and policies that support this paradigm shift.

The linear economy, characterized by a **'take-make-dispose'** model, has led to significant environmental degradation and resource depletion. In contrast, the circular economy offers a restorative and regenerative approach, aiming to close the loop of product lifecycles through greater resource efficiency and waste minimization.

Core Principles of the Circular Economy

The circular economy is underpinned by several key principles:

1. **Design for Longevity and Reuse -** Products are designed to last longer, be easily repaired, and eventually repurposed or recycled. This reduces the need for virgin materials and minimizes waste.
2. **Closed-loop Systems -** Materials and products are kept in circulation for as long as possible. Waste from one process is used as an input for another, creating a closed-loop system that mimics natural ecosystems.
3. **Renewable Energy Sources -** The circular economy emphasizes the use of renewable energy sources to power industrial processes, reducing reliance on fossil fuels and lowering greenhouse gas emissions.
4. **Resource Efficiency and Waste Minimization -** Efficient use of resources is prioritized, and waste is minimized through practices such as recycling, composting, and the use of biodegradable materials.

Benefits of the Circular Economy

Adopting a circular economy offers numerous **environmental**, **economic**, and **social** benefits:

Environmental Benefits

- **Reduced Resource Consumption:** By keeping materials in use for longer, the demand for virgin resources is reduced, alleviating pressure on natural ecosystems.
- **Lower Greenhouse Gas Emissions:** Circular practices such as recycling and the use of renewable energy help reduce carbon footprints and combat climate change.

- **Decreased Pollution:** Reducing waste generation and promoting recycling and reuse lead to lower levels of pollution in air, water, and soil.

Economic Benefits

- **Cost Savings:** Businesses can achieve significant cost savings through resource efficiency, reduced waste disposal fees, and the reuse of materials.
- **Job Creation:** The circular economy can create new job opportunities in areas such as recycling, remanufacturing, and sustainable product design.
- **Innovation and Competitiveness:** Companies that adopt circular practices can gain a competitive edge by offering sustainable products and services, appealing to environmentally conscious consumers.

Social Benefits

- **Enhanced Quality of Life:** Sustainable practices contribute to cleaner environments, healthier communities, and improved overall quality of life.
- **Equity and Inclusion:** Circular economy initiatives can promote social equity by providing access to affordable goods and services and creating employment opportunities in underserved communities.

Challenges and Barriers to Implementation

Despite its numerous benefits, the transition to a circular economy faces several challenges:

Economic and Financial Barriers

- **Initial Investment Costs:** Transitioning to circular business models often requires significant upfront investments in new technologies, infrastructure, and training.
- **Market Demand:** Consumer demand for circular products and services may be limited, hindering widespread adoption.

Regulatory and Policy Barriers

- **Lack of Standardization:** The absence of standardized definitions, metrics, and regulations for circular economy practices can create confusion and inconsistency.
- **Inadequate Policy Support:** Insufficient government policies and incentives to promote circular practices can slow down the transition process.

Cultural and Behavioral Barriers

- **Resistance to Change:** Businesses and consumers may resist changing established practices and behaviors, preferring familiar linear models.
- **Awareness and Education:** Limited awareness and understanding of the circular economy among stakeholders can hinder its adoption and implementation.

Innovative Practices and Policies

Several innovative practices and policies have emerged to support the circular economy:

- **Extended Producer Responsibility (EPR):** EPR policies hold producers accountable for the entire lifecycle of their products, including end-of-life management. This incentivizes companies to design products that are easier to reuse, recycle, and dispose of responsibly.

- **Product-as-a-Service (PaaS):** PaaS models shift the focus from selling products to offering services. Companies retain ownership of products and provide them as services, taking responsibility for maintenance, upgrades, and end-of-life disposal.
- **Industrial Symbiosis:** Industrial symbiosis involves the collaboration between different industries to use each other's waste as a resource. This approach promotes resource efficiency and reduces waste by creating interconnected systems where one industry's by-products serve as another's raw materials.
- **Circular Supply Chains:** Circular supply chains prioritize the use of sustainable materials, promote recycling and reuse, and minimize waste throughout the entire supply chain. Companies are increasingly adopting circular supply chain practices to enhance resource efficiency and reduce environmental impact.
- **Government Policies and Incentives:** Governments play a crucial role in promoting the circular economy through policies and incentives. Examples include tax breaks for companies that adopt circular practices, grants for research and development of sustainable technologies, and regulations that mandate recycling and waste reduction.

The circular economy offers a transformative approach to sustainable development, emphasizing resource efficiency, waste reduction, and regenerative processes. While the transition to a circular economy presents challenges, the benefits far outweigh the barriers. By adopting innovative practices and policies, businesses, governments, and individuals can contribute to a more sustainable and resilient future. Embracing the principles of the circular economy is not only essential for environmental sustainability but also offers significant economic and social benefits, paving the way for a more sustainable and equitable world.

A BRIEF HISTORY ON THE EVOLUTION OF INDUSTRY 1.0 TO 4.0

The Industrial Revolution was first used by Arnold Toynbee for the economic development of Britain in 1760. The period of time is just an indicator of when it took place but it mainly points at the economic transformation that happens as an outcome. The primary aspects of an industrial revolution are **technological**, **cultural** and **socioeconomic**.

- **Industry 1.0 – Mechanization:** Industry 1.0 was characterized by mechanical production that used steam and water. It laid the foundation for future factories, mass production by shaping modern manufacturing. The transition from manual labor to mechanized processes increased production capacity and standardized output. The first mechanical Loom was the highlight of Industry 1.0.
- **Industry 2.0 – Electricity:** Electricity was used for the second industrial revolution bringing forth Industry 2.0 by characterized by widespread usage of electrification and assembly lines in 1800s. Electricity enabled the development of large scale manufacturing operations leading to economies of scale and production of goods on a mass scale. The first assembly line was the highlight of Industry 2.0.
- **Industry 3.0 – Automation:** Automation and computerization was the result of the third industrial revolution which was brought about by the advancement in electronics and the advent of IT in the late 1900s. The advent of automation technologies reduced human error and increased production speed enabling greater precision and consistency in manufacturing. The first programmable logic controller and robotics were the highlight of Industry 3.0.

- **Industry 4.0 – Digitalization:** The introduction of digital technologies revolutionized production systems, enabling data driven decision-making and the optimization of operational efficiency. Digitalization created smart and interconnected factories.
  The salient features of Industry 4.0 are IoT, Robotics, Big Data and loud Computing

WHAT IS INDUSTRY 5.0?

Industry 5.0 represents the next wave of industrial revolution, characterized by a harmonious collaboration between humans and advanced technologies. This review paper explores the pivotal role of Information and Communication Technology (ICT) in fostering a circular economy within the framework of Industry 5.0. It delves into how ICT innovations can drive sustainable industrial practices, enhance resource efficiency, and promote a regenerative economic model.

The advent of Industry 5.0 marks a significant shift from the automation-centric Industry 4.0, emphasizing the synergy between humans and machines. This paradigm shift is particularly relevant to the circular economy, an economic system aimed at eliminating waste and the continual use of resources. ICT plays a crucial role in facilitating this transition by enabling smarter, more efficient processes and fostering sustainable practices.

ICT in Industry 5.0

ICT encompasses a wide range of technologies, including the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and blockchain. These technologies collectively form the backbone of Industry 5.0, enabling real-time data exchange, advanced analytics, and seamless integration between human workers and automated systems.

1. **IoT and Smart Manufacturing:** The IoT connects devices and systems, allowing for real-time monitoring and control of industrial processes. In a circular economy, IoT facilitates the tracking of materials and products throughout their lifecycle. This ensures optimal resource use, minimizes waste, and enables the implementation of predictive maintenance strategies. Smart sensors can monitor equipment health, predict failures, and trigger maintenance activities before breakdowns occur, thus extending the lifespan of machinery and reducing waste.
2. **Artificial Intelligence and Machine Learning:** AI and machine learning algorithms analyze vast amounts of data to optimize production processes, enhance decision-making, and predict future trends. In the context of a circular economy, AI can identify patterns and inefficiencies in resource usage, suggest improvements, and enable more sustainable production practices. For example, AI can optimize supply chain logistics, reducing transportation emissions and ensuring materials are sourced and used efficiently.
3. **Big Data Analytics:** Big data analytics provides insights into various aspects of the production process, from raw material procurement to product distribution. By analyzing data from multiple sources, companies can identify opportunities for resource optimization and waste reduction. In a circular economy, big data analytics can track the flow of materials, assess the environmental impact of different processes, and support the development of closed-loop systems where waste is repurposed as input for new production.
4. **Blockchain Technology:** Blockchain ensures transparency and traceability in supply chains, which is essential for a circular economy. By recording every transaction and movement of goods on an immutable ledger, blockchain enables companies to verify the origin,

composition, and sustainability of materials. This fosters trust among stakeholders and ensures compliance with environmental regulations. Additionally, blockchain can facilitate the creation of decentralized marketplaces for recycling and reusing materials, promoting circular business models.

ICT-Driven Circular Economy Models

Several ICT-driven models exemplify how Industry 5.0 can support a circular economy:

1. **Product-as-a-Service (PaaS):** PaaS shifts the focus from selling products to providing services. Companies retain ownership of products and offer them as services, taking responsibility for maintenance, upgrades, and end-of-life disposal. ICT enables this model by facilitating remote monitoring, predictive maintenance, and efficient logistics. Customers benefit from access to the latest technology without the burden of ownership, while companies achieve better resource utilization and reduced waste.
2. **Industrial Symbiosis:** Industrial symbiosis involves the collaboration between different industries to use each other's waste as a resource. ICT plays a crucial role in identifying potential synergies, facilitating communication between partners, and optimizing the exchange of materials. For instance, a chemical plant's waste heat can be used to power a neighboring factory, reducing energy consumption and minimizing environmental impact.
3. **Reverse Logistics:** Reverse logistics focuses on the return and recycling of products after their use. ICT enables efficient reverse logistics by providing real-time information on product locations, conditions, and availability for recycling. This ensures that end-of-life products are collected, sorted, and processed in an environmentally friendly manner, closing the loop in the circular economy.

Challenges and Opportunities

While the integration of ICT in Industry 5.0 offers numerous benefits, it also presents challenges that need to be addressed:

1. **Data Security and Privacy:** The increased connectivity and data exchange in Industry 5.0 raise concerns about data security and privacy. Ensuring robust cyber security measures and protecting sensitive information are critical for gaining trust and ensuring the smooth functioning of ICT systems.
2. **Interoperability:** The seamless integration of diverse ICT systems and devices is essential for realizing the full potential of Industry 5.0. Developing standards and protocols that ensure interoperability between different technologies and platforms is crucial for enabling efficient communication and data exchange.
3. **Skilled Workforce:** The successful implementation of ICT-driven circular economy models requires a workforce with the necessary skills and expertise. Investing in education and training programs to equip workers with knowledge of advanced technologies and sustainable practices is essential for achieving Industry 5.0 objectives.

EXCERPTS FROM RBI REPORT- 2024

Since the whole world is under the spell of digital transformation, technological innovations and upheavals, the story is very much in line for India as well. Digitalization has particularly

enhanced the efficiency of the payments sector since the country was hit by the pandemic in 2020. It has come a long way since then.

The Annual RBI report – 2024, provided insights into the performance of payments sector in India emphasizing that the growth rate of total digital payments has decreased this year compared to 2022-2023.

The report also posits RBI's agenda for the coming year which focuses *on adapting the financial sectors to the latest technological developments*. This includes the need for **regulation and expansion** of the skyrocketing fintech industry in India.

The RBI stated "Risk management being integral to the working of central banks, the Reserve Bank is exploring possible applications of artificial intelligence(AI) to manage complete life cycle of risk management."

SUSTAINABLE DEVELOPMENT GOALS (SDGS) & THE CIRCULAR ECONOMY

The Sustainable Development Goals (SDGs), adopted by the United Nations in 2015, provide a comprehensive framework for global development, aiming to address critical issues such as poverty, inequality, climate change, and environmental degradation by 2030. The circular economy (CE) offers a systemic approach to achieving these goals by promoting sustainable resource management, waste reduction, and the regeneration of natural systems. This paper explores the interconnectedness of the SDGs and the circular economy, highlighting how the principles of circularity can drive progress towards sustainable development.

The 17 SDGs encompass a broad spectrum of development challenges, from eradicating poverty and hunger to ensuring clean water, affordable energy, and sustainable cities. At their core, these goals recognize the need for a balanced approach that integrates economic, social, and environmental sustainability. The circular economy aligns closely with this vision, advocating for the redesign of production and consumption systems to maintain the value of resources, minimize waste, and foster economic and social well-being. This paper examines how the principles and practices of the circular economy can contribute to achieving the SDGs.

- **SDG 1: No Poverty –** The circular economy can play a pivotal role in poverty reduction by creating new economic opportunities and promoting inclusive growth. Circular business models such as recycling, remanufacturing, and sharing economies generate jobs and income, particularly in underserved communities. For instance, waste collection and recycling initiatives can provide livelihoods for low-income individuals, helping lift them out of poverty.
- **SDG 2: Zero Hunger –** Sustainable agricultural practices, a key component of the circular economy, can enhance food security and reduce hunger. By optimizing resource use, minimizing waste, and promoting the recycling of organic materials, circular agriculture ensures more efficient food production. Composting organic waste into fertilizer, for example, can improve soil health and increase crop yields, supporting efforts to achieve zero hunger.
- **SDG 3: Good Health and Well-being –** The reduction of pollution and waste through circular economy practices directly contributes to better health outcomes. Minimizing the use of hazardous materials and promoting the safe disposal and recycling of waste can reduce environmental contaminants that harm human health. Additionally, sustainable product design that considers the entire lifecycle of a product can ensure safer, healthier environments for communities.

- **SDG 6: Clean Water and Sanitation –** Water management is a critical aspect of the circular economy. By promoting water recycling and efficient use, circular practices can help achieve clean water and sanitation for all. Technologies for wastewater treatment and reuse, as well as the reduction of water-intensive processes in manufacturing, contribute to sustainable water management and the prevention of water scarcity.
- **SDG 7: Affordable and Clean Energy –** The circular economy supports the transition to renewable energy sources, which is essential for achieving affordable and clean energy. By designing systems that prioritize energy efficiency and incorporate renewable energy technologies, the circular economy reduces reliance on fossil fuels and lowers greenhouse gas emissions. Energy recovery from waste materials, such as biogas production from organic waste, further supports clean energy goals.
- **SDG 8: Decent Work and Economic Growth –** The circular economy fosters innovation and entrepreneurship, creating new markets and job opportunities. By shifting towards sustainable business models, companies can drive economic growth while ensuring decent work conditions. The focus on resource efficiency and waste minimization leads to more resilient and competitive industries, supporting long-term economic stability and inclusive growth.
- **SDG 9: Industry, Innovation, and Infrastructure –** The principles of the circular economy promote the development of sustainable industries and infrastructure. By encouraging innovation in product design, manufacturing processes, and business models, the circular economy supports the creation of resilient and sustainable industrial systems. Investment in research and development of circular technologies further drives progress towards sustainable industrialization and infrastructure development.
- **SDG 11: Sustainable Cities and Communities –** Urban areas can benefit significantly from circular economy practices. By implementing sustainable waste management systems, promoting the reuse and recycling of materials, and supporting circular construction practices, cities can become more sustainable and resilient. Circular economy initiatives, such as community repair workshops and sharing platforms, also enhance social cohesion and community well-being.
- **SDG 12: Responsible Consumption and Production –** SDG 12 is at the heart of the circular economy, which aims to redefine consumption and production patterns to be more sustainable. By promoting the use of sustainable materials, extending product lifecycles, and reducing waste through recycling and remanufacturing, the circular economy directly contributes to responsible consumption and production. Consumer education and awareness are also crucial in driving demand for sustainable products and practices.
- **SDG 13: Climate Action –** The circular economy is a powerful tool for mitigating climate change. By reducing waste, optimizing resource use, and promoting renewable energy, circular practices lower greenhouse gas emissions and decrease the carbon footprint of production and consumption systems. Circular economy strategies, such as carbon capture and utilization and the development of low-carbon materials, support global efforts to combat climate change.
- **SDG 14: Life Below Water and SDG 15:** Life on Land-The circular economy helps protect marine and terrestrial ecosystems by reducing pollution and promoting the sustainable

management of natural resources. By minimizing plastic waste and promoting recycling, the circular economy reduces the amount of waste that ends up in oceans and landfills, protecting wildlife and natural habitats. Sustainable land use practices, such as agroforestry and regenerative agriculture, further support the preservation of biodiversity and ecosystem health.

- **SDG 17: Partnerships for the Goals –** Achieving the SDGs require strong partnerships and collaboration across sectors and borders. The circular economy encourages multi-stakeholder engagement, bringing together governments, businesses, academia, and civil society to develop and implement sustainable solutions. Collaborative platforms and networks can drive the exchange of knowledge, best practices, and resources, accelerating the transition to a circular economy and the achievement of the SDGs.

INDUSTRY 5.0 & THE CIRCULAR ECONOMY: A SYNERGISTIC PATH TO SUSTAINABILITY

Industry 5.0 represents the next evolution in industrialization, characterized by the seamless integration of human creativity and machine efficiency. This review explores the potential of Industry 5.0 in achieving the goals of the circular economy. It highlights how advanced technologies and human-centered approaches can drive sustainability, resource efficiency, and waste reduction, paving the way for a more resilient and regenerative economic model.

As the world grapples with environmental degradation and resource scarcity, the circular economy has emerged as a crucial framework for sustainable development. It emphasizes reducing waste, reusing products, and recycling materials to create closed-loop systems. Industry 5.0, with its focus on human-machine collaboration and advanced technologies, offers innovative solutions to accelerate the transition to a circular economy. This paper examines the effectiveness of Industry 5.0 in achieving circular economy goals, exploring the roles of technologies such as artificial intelligence (AI), the Internet of Things (IoT), robotics, and blockchain.

Human-Centric Innovation

Unlike Industry 4.0, which focuses on automation and smart manufacturing, Industry 5.0 places a strong emphasis on human-centric innovation. By leveraging human creativity and machine intelligence, Industry 5.0 fosters sustainable practices that align with the principles of the circular economy. Key aspects of this **human-machine collaboration** include:

Enhanced Design and Production

- **Sustainable Product Design:** Industry 5.0 enables designers to create products with longer life spans, easier repairability, and better recyclability. AI-powered design tools can optimize material usage, minimize waste, and enhance product durability.
- **Additive Manufacturing:** 3D printing technology allows for on-demand production, reducing the need for excess inventory and minimizing material waste. It also enables the use of recycled materials in the manufacturing process.

Smart Manufacturing and Resource Efficiency

- **IoT and Real-Time Monitoring:** IoT devices can monitor and optimize resource consumption in real-time, ensuring efficient use of materials and energy. This reduces waste and enhances the sustainability of production processes.

- **Predictive Maintenance:** AI-driven predictive maintenance can extend the lifespan of machinery and equipment by identifying potential failures before they occur. This minimizes downtime, reduces the need for replacement parts, and decreases waste.

Robotics and Automation

- **Collaborative Robots (Cobots):** Cobots work alongside human workers, enhancing productivity and precision. They can be programmed to handle repetitive tasks, allowing humans to focus on more creative and complex activities, including sustainable innovations.
- **Automated Sorting and Recycling:** Robotics and AI can improve the efficiency and accuracy of sorting recyclable materials, reducing contamination and increasing the quality of recycled outputs.

Technological Innovations Driving Circular Practices

Industry 5.0 leverages several advanced technologies that are instrumental in achieving the goals of the circular economy:

Artificial Intelligence and Big Data

- **Resource Optimization:** AI algorithms analyze vast amounts of data to identify inefficiencies in resource use and suggest improvements. This can lead to more sustainable production practices and better resource allocation.
- **Demand Forecasting:** AI can predict consumer demand more accurately, reducing overproduction and excess inventory. This aligns production with actual market needs, minimizing waste.

Blockchain Technology

- **Supply Chain Transparency:** Blockchain provides a secure and transparent way to track the lifecycle of products and materials. This ensures accountability and traceability, enabling companies to verify the sustainability of their supply chains.
- **Circular Supply Networks:** Blockchain can facilitate the creation of decentralized marketplaces for recycled and refurbished products, promoting the reuse of materials and reducing waste.

Internet of Things (IoT)

- **Circular Asset Management:** IoT devices can track the condition and location of products throughout their lifecycle, enabling efficient reverse logistics and end-of-life management. This supports the circular economy by ensuring products are reused, refurbished, or recycled.
- **Energy Efficiency:** IoT sensors can optimize energy use in manufacturing processes, reducing carbon footprints and supporting renewable energy integration.

Case Studies and Applications

Several industries have successfully integrated Industry 5.0 technologies to advance their circular economy initiatives:

1. **Automotive Industry**
   - **Remanufacturing and Refurbishment:** Companies like Renault and BMW use AI and robotics to remanufacture and refurbish automotive parts, extending their lifespan and reducing waste.

- **Shared Mobility Solutions:** IoT and blockchain enable the development of car-sharing and ride-hailing platforms, promoting the efficient use of vehicles and reducing the need for new car production.

2. **Consumer Electronics**
   - **E-Waste Management:** Companies like HP and Dell use AI and robotics to automate the recycling of electronic waste. This increases the recovery of valuable materials and reduces the environmental impact of e-waste.
   - **Product-as-a-Service Models:** By offering electronics as a service, companies retain ownership and responsibility for their products, ensuring they are maintained, upgraded, and recycled effectively.
3. **Textile and Fashion Industry**
   - **Sustainable Fashion:** Brands like Patagonia and H&M use IoT and blockchain to track the sustainability of their supply chains, ensuring materials are sourced responsibly and products are recycled at end-of-life.
   - **Circular Fashion Platforms:** Platforms like The RealReal and Rent the Runway use AI and IoT to manage the rental and resale of clothing, promoting reuse and reducing textile waste.

Challenges and Future Directions

While Industry 5.0 holds great potential for advancing the circular economy, several challenges must be addressed:

1. **Technological Integration –** Ensuring interoperability between different technologies and systems is crucial for seamless implementation. Standardized protocols and collaborative frameworks can facilitate this integration.
2. **Data Privacy and Security –** The increased use of data-driven technologies raises concerns about data privacy and security. Robust cybersecurity measures and data governance policies are essential to protect sensitive information.
3. **Skills and Workforce Development –** The transition to Industry 5.0 requires a workforce with advanced technical skills. Investment in education and training programs is necessary to equip workers with the knowledge needed to leverage new technologies.
4. **Regulatory and Policy Support –** Governments play a critical role in promoting the circular economy through supportive policies and regulations. Incentives for sustainable practices, tax breaks for circular business models, and regulations mandating recycling and waste reduction can drive industry-wide adoption.

CONCLUSION

Industry 5.0 offers a transformative approach to achieving the goals of the circular economy. By integrating advanced technologies with human-centric innovation, it fosters sustainable practices that enhance resource efficiency, reduce waste, and promote regenerative economic models. While challenges remain, the potential benefits of Industry 5.0 in advancing the circular economy are immense. Collaborative efforts between businesses, governments, and individuals are essential to realize this vision, paving the way for a more sustainable and resilient future.

The main difference between factories in 2030 and factories today will not only be physical but behavioral. Human and machine capabilities will grow together, and there will be a synergy of

digital reporting and a fully-automated production process. This kind of technology can expand into other industries that have a production-line setup like mining, airports and shipping ports.

The circular economy represents a transformative approach to sustainable development, offering a viable alternative to the traditional linear economy. By focusing on the efficient use of resources, minimizing waste, and regenerating natural systems, the circular economy has the potential to drive economic growth, reduce environmental impacts, and enhance social well-being. Collaborative efforts among businesses, governments, and consumers will be essential in achieving a successful transition to a circular economy.

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Aligning Circular Economy Goals with the Freemium Model in Digital Services

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Abstract

A circular economy may be crucial to achieving the current era's urgent requirement to minimise resource consumption in providing competitive goods and services to specific customers while protecting the environment. The circular economy, which involves exchanging materials and products through various processes such as repair, reuse, refurbishing, remanufacturing, recycling, and composting, is not limited to physical goods alone. Additionally, it has a plethora of uses in the realm of digital freemium services. These days, freemium services are vital in helping companies and sectors to improve, adapt, and expand circular practices through resource optimization through digital tools, product life extension, sharing economy platforms, circular supply chains etc.

Keywords: *Digital Economy (DE), Circular Economy (CE), Freemium Model*

INTRODUCTION

The technologies that support the fourth industrial revolution, such as the Internet of Things, 3-D printing, augmented reality, virtual reality, big data, and associated analysis, are thought to have disruptive consequences these days [1]. Since the 1960s, when commercial mainframe computers were first introduced, computerization has been the primary source of the digitization process [2]. The introduction of personal computers in the mid-1980s allowed for the development of digital design tools and computerized production. The increasing prevalence of global positioning, the Internet, and portable computers may be attributed to advancements in digital information and communication technologies (ICTs), as well as other factors including cost savings. Nowadays, the Internet is the center of the digital economy (DE) [2]. There is a bright future ahead for improving the productivity and global connection of consumers, firms, workers, and peripheral industries thanks to the platforms and technology that underpin DE. Additionally, they provide powerful new tools for promoting innovation in ancillary fields [2]. As such, DE is based on a new class of digital ICTs, digitalized knowledge, and Internet-related information [3], which embrace and change all aspects of social and economic life in the global economy. Another important aspect of digital services is the freemium services based on the freemium model. The freemium model is a business strategy where basic services or items are provided for free, but more advanced features or premium services are paid for. This technique aims to attract a significant user base and convert a portion of them into paying customers using the free version. The efficiency and ability to provide digital services freely at least the basic version for trial help customers to test a product before actual purchase helping in more informed and rational decisions while buying the services.

A sustainable economic model that prioritizes waste minimization and resource efficiency is the circular economy. It emphasizes how important it is to create a closed-loop system that minimizes its detrimental impacts on the environment by recycling, repurposing, minimizing wastage and renewing products and resources. Digital technology can also encourage CE in businesses [4,5, 6]. IoT, for instance, enables businesses to track resources [7], recycle waste materials [5], and remotely monitor the location, condition, and use of items in real-time [8,9]. The utilization of digital data may greatly boost the efficiency of sales, storage, and the delivery of economic activities across a variety of sectors, technologies, equipment, commodities, and services [10]. This is based on using the results of massively parallel processing and process analysis in DE. The abrupt COVID-19 pandemic halted social and economic activity and seriously damaged the world economy [11]. DE has been seen as a major driver of economic growth, contributing to the rise of new markets and business models such as telecommuting, telemedicine, and online learning, as well as the acceleration of the digital transformation of traditional enterprises [12]. As a matter of fact, CE is crucial to the advancement of sustainable development [13].

Furthermore, the digital revolution and the growing requirement for sustainability mean that CE has to employ more people with new talents in order to support development [14]. Digital technology offers a great deal of potential to improve CE development at this time, according to studies [1, 3,4,7]. The subject of study on the combination of digital technology and CE is still young, but it is expanding rapidly [3]. While a great deal of research has been done in each of these two domains individually, very little has been done to examine the combination of CE and DE. Consequently, this work aims to investigate the integration of trends and breakthroughs in CE and freemium services of DE research while providing a summary for more research.

To address this gap, the research questions are formulated to address this gap. These are as follows:

- **RQ-1:** How can digitally advanced freemium services help to attain circular economy goals?
- **RQ-2:** How can business model innovation help various digital services achieve CE evaluative indicators?

RESEARCH OBJECTIVE

- To evaluate how freemium services contribute to the achievement of circular economy objectives.
- How can different digital services accomplish the Circular Economy evaluation indicators with the aid of business model innovation?

LITERATURE REVIEW

Every step of the product lifecycle—that is, design, usage, and end-of-life—benefits from the use of the Internet, IoT, cloud computing, big data, and AI. We argued that, if the environmental and economic costs of DTs are evaluated and balanced with benefits, DTs have the potential to enable radical improvements to the CE model by addressing the three performance objectives of CE: closing the loop, increasing resource efficiency, and extending product lifespan [15].

The amount of research on how a digital circular economy affects sustainability is increasing and the number of publications has been rising steadily. Even though the majority of publications fall under the category of empirical research, the influence that they identify is rarely tested or

quantified and typically originates from anecdotal evidence or cited literature. Most articles focus on one digital technology or a mix of two, such as using massive amounts of data collected from Internet of Things devices. Digital technologies such as big data, sophisticated analytics, and the Internet of Things have received the greatest attention when it comes to a circular economy. Blockchain, internet platforms, 3D printing, and additive manufacturing come next. Virtual/augmented reality, cloud computing, cyber-physical systems, and sophisticated robots are some other digital technologies that are frequently included in the publications that are being assessed. The manufacturing sector—which encompasses the textile and garment, automotive, aerospace, waste management, and electronic equipment industries—is the one where the technology is most frequently used. The research by [16, 17, 18, 19, 20], which evaluates the real environmental and/or social effect of various circular economy methods made possible by Industry 4.0 technology, are a few noteworthy outliers which show how the digital services can significantly contribute in efficiently attaining circular economy goals.

RESEARCH METHODOLOGY

For the cases of Paytm, Policybazaar.com, Matrimony.com, JioSaavn.com, and Naukri.com, a qualitative research methodology is most appropriate, given the need to explore the complex and contextual application of circular economy principles within these digital platforms. The research methodology and data collection methods would focus on gathering in-depth, nuanced insights that allow for a comprehensive understanding of how these companies align with or contribute to the circular economy. A multiple case study research design is used here that allows for the in-depth exploration and comparison of each platform's alignment with the principles of the circular economy, while also considering the unique context and operations of each online platform. The research would adopt an interpretive approach, seeking to understand the subjective meanings and interpretations of circular economy practices as implemented by these companies. Thematic analysis would be employed to analyze the qualitative data, allowing the researcher to identify key themes and patterns related to circular economy practices across the different platforms. This could include themes such as resource efficiency, product-as-a-service models, sustainability initiatives, and consumer engagement. Themes identified in individual cases would be synthesized across all cases to draw broader conclusions about the application of circular economy principles in the digital economy.

The combination of qualitative research methodology and diverse data collection methods is used to gain a comprehensive approach to understanding how Paytm, Policybazaar.com, Matrimony.com, JioSaavn.com, and Naukri.com align with circular economy principles. Here secondary data sources are used to provide context and enable cross-case comparisons. This methodology is well-suited to uncovering the complexities and nuances of implementing circular economy practices in the digital economy.

DATA COLLECTION

Both primary and secondary data are used in the research. Here primary data is collected from Observations of user behaviour and interactions with the platform to understand how they engage with the services offered and how these interactions align with circular economy principles and secondary data is Collected from document analysis like Corporate Reports and Sustainability Disclosures, company reports, sustainability disclosures, press releases, and other

official documents to understand the stated commitment to circular economy principles, specific initiatives undertaken, and the outcomes of these efforts. The website and social media content were also examined the content on the companies' websites and social media platforms to identify how they communicated their sustainability efforts to users and the broader public.



Source: sciencedirect.com

COMBINING THE CIRCULAR ECONOMY WITH THE FREEMIUM MODEL

Combining the Circular Economy with the Freemium Model involves integrating sustainability principles into a business strategy that offers basic services for free while charging for premium features. Here's how these two concepts can be intertwined:

1. **Sustainable Product Design:** In a circular economy, products are designed to be durable, repairable, and upgradable. Companies that employ the freemium business model can charge for additional services such as enhanced durability, customizable features, or modular upgrades, all while offering their core, reliable product at no cost. This aligns with the circular economy's emphasis on lifespan and resource efficiency.
2. **Resource Efficiency of Services:** Migrating concepts from the circular economy into software or digital services based on the freemium model may involve using renewable energy sources, making the best use of data, or using less energy. Companies may charge for enhanced services that make users' experiences more enjoyable without compromising sustainability, but they may also offer a basic, energy-efficient version of the service for free.

3. **Recycling and Upcycling in Product Offerings:** Companies may implement a circular approach by pricing for goods with higher-quality materials or more functionality and giving away free things made of recycled or repurposed resources. This would promote the use of environmentally friendly materials and keep revenue from luxury goods coming in.
4. **Customer Education and Engagement:** Companies may use the freemium model to communicate with a lot of individuals. Businesses may promote circular economy ideas by giving away free teaching materials or information about eco-friendly operations. Those who would then like additional in-depth knowledge or customized guidance on applying circular economy principles to their own lives or businesses may receive premium content or services.
5. **Encouraging Sustainable Behavior:** A freemium business model can encourage consumers to adopt sustainable habits by offering free services or products that support trash reduction, recycling, or other circular economy ideas. Premium features include things like exclusive eco-friendly merchandise or rewards for sustainable behaviour.

Table 1: Comparison of All 5 Companies Based on Circular Economy Goals

Factors	*Policybazaar.com*	*Naukri.com*	*Paytm*	*Matrimony.com*	*JioSaavn*
1. Digital Product Design and Longevity	Digital operations reduce physical resources, promoting long-term customer engagement with renewals and support.	The digital platform encourages repeated use through job applications and career management, reducing waste in job search processes.	Offers long-term use of digital wallets, payments, and financial services, encouraging repeated use.	Facilitates long-term relationships and ongoing communication, reducing redundancy in matchmaking.	Provides continuous music streaming, encouraging user retention and long-term engagement without physical media.
2. Resource Efficiency	Paperless processes and energy-efficient data centers minimize resource use and carbon footprint.	Paperless job search and recruitment processes reduce the consumption of physical resources.	Digital payments reduce the need for physical cash and receipts, with a focus on energy-efficient operations.	Digital matchmaking reduces the need for physical documents, and energy-efficient operations minimize the environmental impact.	Digital music delivery eliminates the need for CDs or physical copies, with potential focus on energy-efficient streaming.
3. Product as a Service (PaaS)	Subscription-based services like insurance renewals foster ongoing relationships and reduce the waste of one-time services.	Offers continuous access to job postings, career tools, and services, promoting ongoing use rather than one-time transactions.	Provides subscription-based financial services and memberships, encouraging continuous use.	Subscription models for premium matchmaking services promote continuous customer engagement, reducing waste associated with one-time matches.	Offers freemium and subscription models for music streaming, promoting continuous use rather than single purchases.

Factors	*Policybazaar.com*	*Naukri.com*	*Paytm*	*Matrimony.com*	*JioSaavn*
4. Consumer Empowerment	Educates consumers on sustainable financial products, encouraging informed decisions.	Provides resources for informed career decisions, empowering users to make sustainable career choices.	Promotes digital literacy and financial education, empowering consumers to manage their finances sustainably.	Educates users on the importance of long-term relationships, supporting sustainable choices in personal life.	Empowers users with information about music, encouraging sustainable consumption through digital platforms.
5. Data-Driven Optimization	Uses data analytics to match customers with suitable insurance products, minimizing waste.	Utilizes data to optimize job matching, reducing inefficiencies and redundancies in the job market.	Data-driven services optimize financial transactions and customer interactions, minimizing resource use.	Employs data analytics to improve match quality and reduce resource wastage in the matchmaking process.	Uses data to optimize music recommendations and streaming quality, reducing resource wastage and enhancing user experience.
6. Collaboration	Partners with green insurers and promotes sustainable insurance products, contributing to a circular economy.	Could partner with companies that focus on sustainable employment practices and green jobs.	Collaborates with eco-friendly businesses and promotes digital services that reduce physical resource use.	Partners with organizations promoting sustainable relationships, contributing to social sustainability.	Collaborates with artists and platforms that emphasize sustainable music production and distribution, aligning with circular economy goals.
7. End-of-Life Management	Securely manages and disposes of customer data, ensuring compliance and resource management.	Properly handles and disposes of personal data after job seekers' accounts are no longer active, aligning with responsible data management practices.	Secure data management practices ensure that customer information is responsibly handled at the end of its life cycle.	Ensures secure disposal of personal data after the completion of matchmaking services, maintaining responsible data management.	Implements secure data management and disposal practices, ensuring that user data is handled responsibly after the end of its lifecycle.

CASE-1: POLICYBAZAAR.COM

Policybazaar.com, an online insurance aggregator and financial services platform, primarily operates in the digital economy by providing a marketplace for insurance products and financial services. While it might not be directly involved in traditional physical goods, several aspects of its business model can be aligned with the principles of a circular economy, especially when considering the broader definition of circularity in digital services and sustainable business practices.

Digital Product Design and Service Longevity

- **Sustainability in Operations:** Policybazaar.com operates digitally, which inherently reduces the need for physical resources like paper, office space, and physical infrastructure. By moving

the insurance buying process online, they reduce the environmental footprint associated with traditional insurance methods.

- **Long-Term Value:** The platform is designed to offer services that customers can use repeatedly over time, such as renewing policies, comparing new products, or accessing customer support. This focus on long-term relationships aligns with the circular economy's emphasis on longevity and reducing waste.

Resource Efficiency and Reduced Environmental Impact

- **Paperless Processes:** By digitizing insurance documentation, claims processes, and customer service, Policybazaar.com helps to reduce the consumption of paper and other physical resources. This reduction in resource use is a key aspect of the circular economy.
- **Energy Efficiency:** As a digital platform, Policybazaar.com can focus on improving the energy efficiency of its data centers, adopting renewable energy sources, and optimizing server use to minimize its carbon footprint.

Product as a Service (PaaS)

- **Subscription Models:** The financial services offered by Policybazaar.com can be seen as a form of "service-based" product offering. Instead of customers buying one-time services, they engage in ongoing relationships, such as annual insurance renewals or continuous financial advice. This shift from ownership to service is a hallmark of the circular economy.
- **Customized Solutions:** Policybazaar.com offers personalized and flexible insurance products that can adapt to changing customer needs. This flexibility reduces the likelihood of "wasted" products and ensures that customers get exactly what they need, promoting efficient resource use.

Consumer Empowerment and Behavior Change:

- **Education and Awareness:** Policybazaar.com provides extensive resources and tools to educate consumers about different insurance products and financial services. By empowering consumers with knowledge, they encourage more informed and sustainable financial decisions.
- **Incentivizing Sustainable Choices:** The platform could promote products that have a lower environmental impact, such as paperless insurance or green investment options. Encouraging customers to choose these products can drive broader adoption of sustainable practices.

Circular Supply Chains in Digital Services

- **Data-Driven Optimization:** Policybazaar.com uses data analytics to optimize the matching of customers with the right insurance products. This efficient allocation of resources is similar to circular economy principles where waste is minimized through precise demand forecasting and resource management.

Collaboration and Partnerships

- **Partnering with Green Insurers:** Policybazaar.com could collaborate with insurance companies that offer environmentally friendly products or invest in sustainable practices. This would align with the circular economy by promoting products that contribute to environmental sustainability.

- **Industry-Wide Initiatives:** Policybazaar.com could participate in or lead initiatives aimed at making the entire insurance industry more sustainable, such as promoting digital policies or reducing the carbon footprint of insurance operations.

End-of-Life and Waste Management in Digital Products

- **Secure Data Management:** Proper handling of customer data at the end of its life cycle (e.g., after policy expiration or account closure) aligns with circular principles of responsible resource management. Ensuring that data is securely deleted or repurposed in compliance with privacy regulations is crucial.

CASE-2: MATRIMONY.COM

Matrimony.com, an online matchmaking and matrimonial service, connects individuals seeking marriage partners. While its operations are primarily digital, several aspects of its business model can align with the principles of a circular economy, focusing on sustainability and efficient resource use.

Digital Product Design and Service Longevity

- **Sustainability in Operations:** Matrimony.com operates entirely online, reducing the need for physical resources such as paper, physical matchmaking offices, and related infrastructure. By facilitating the matchmaking process digitally, they contribute to minimizing environmental impacts associated with traditional matchmaking services.
- **Long-Term Value:** Matrimony.com provides a service that users can engage with over time until they find a match. This focus on creating long-lasting relationships aligns with the circular economy's emphasis on durability and reducing waste, ensuring that the platform remains relevant and useful over a longer period.

Resource Efficiency and Reduced Environmental Impact

- **Paperless Processes:** The platform's digital nature eliminates the need for physical matchmaking catalogs, brochures, and forms, significantly reducing paper consumption. This digital approach contributes to the circular economy by minimizing the use of physical resources.
- **Energy Efficiency:** As a digital platform, Matrimony.com can optimize its data centers and IT infrastructure for energy efficiency, potentially adopting renewable energy sources to reduce its carbon footprint. Efficient server use and data management practices also contribute to reduced environmental impact.

Product as a Service (PaaS)

- **Subscription Models:** Matrimony.com operates on a subscription model where users pay for ongoing access to matchmaking services. This shift from a one-time service to an ongoing relationship reflects the circular economy's focus on service-based models rather than ownership, ensuring continuous value for users.
- **Customized Solutions:** The platform offers personalized matchmaking services tailored to users' specific preferences, reducing the likelihood of mismatches and ensuring that resources (e.g., time and effort) are used efficiently. This customization aligns with circular economy principles by optimizing resource use and minimizing waste.

Consumer Empowerment and Behavior Change

- **Education and Awareness:** Matrimony.com provides resources and tools to educate users about the matchmaking process, empowering them to make informed choices. This aligns with the circular economy's goal of encouraging sustainable consumer behavior by promoting thoughtful and informed decisions.
- **Incentivizing Sustainable Choices:** Matrimony.com could promote matchmaking options that align with social sustainability, such as encouraging users to consider shared values related to sustainability or social responsibility. This would help drive broader adoption of sustainable practices in personal relationships.

Circular Supply Chains in Digital Services

- **Data-Driven Optimization:** Matrimony.com uses algorithms and data analytics to efficiently match users with compatible partners. This precise matching process minimizes the "waste" of time and effort, similar to how circular supply chains optimize resource use.
- **Reducing Redundancy:** By optimizing the matchmaking process, Matrimony.com reduces redundant interactions and unnecessary resource use, aligning with circular economy principles that focus on efficiency and minimizing waste.

Collaboration and Partnerships

- **Partnering with Sustainable Organizations:** Matrimony.com could collaborate with organizations that promote sustainable living or social causes, integrating these values into their matchmaking process. For example, partnerships with eco-friendly event planners for weddings could promote sustainable practices.
- **Industry-Wide Initiatives:** The platform could participate in or lead initiatives aimed at making the entire matchmaking industry more sustainable, such as promoting digital events, reducing the carbon footprint of weddings, or encouraging socially responsible matchmaking practices.

End-of-Life and Waste Management in Digital Products

- **Secure Data Management:** Matrimony.com must ensure proper handling of user data at the end of its life cycle, such as when a user finds a match and closes their account. Securely deleting or anonymizing data aligns with circular economy principles by responsibly managing resources and ensuring privacy.
- **Account Closure and Reuse:** For users who are no longer active or have found a match, the platform could offer options for repurposing profiles (e.g., for future networking or community engagement) in a way that aligns with users' privacy and consent, contributing to the circularity of digital identities.

CASE-3: PAYTM

Paytm, a leading digital payment platform in India, provides various financial services, including mobile payments, banking, insurance, and e-commerce. Although primarily a digital service, Paytm's operations can align with the principles of the circular economy, particularly through sustainable practices, resource efficiency, and service-based models.

Digital Product Design and Service Longevity

- **Sustainability in Operations:** Paytm operates as a digital platform, significantly reducing the need for physical cash, paper receipts, and other traditional financial instruments. By moving transactions online, Paytm helps to reduce the environmental impact associated with physical banking and payment processes.
- **Long-Term Value:** Paytm's services, such as mobile wallets, savings accounts, and investment options, are designed for continuous use, providing users with long-term value. This aligns with the circular economy's focus on durability and reducing the need for resource-intensive alternatives.

Resource Efficiency and Reduced Environmental Impact

- **Paperless Transactions:** Paytm's digital services eliminate the need for paper-based processes, such as bills, invoices, and payment receipts. This reduction in paper usage directly contributes to resource efficiency, a core principle of the circular economy.
- **Energy Efficiency:** Paytm can focus on optimizing its data centers for energy efficiency and adopting renewable energy sources to power its operations. By minimizing the energy consumption associated with digital transactions, Paytm supports the circular economy's emphasis on reducing environmental impact.

Product as a Service (PaaS)

- **Subscription and Transaction-Based Models:** Paytm operates on a service model where users pay for transactions, premium services, or subscriptions rather than owning physical financial products. This service-based approach aligns with the circular economy's focus on shifting from ownership to access, thereby reducing the need for physical resources.
- **Customized Financial Solutions:** Paytm offers personalized financial services, such as tailored investment options or savings plans, that meet the specific needs of users. By providing customized solutions, Paytm ensures efficient use of financial resources, minimizing waste and optimizing value for users.

Consumer Empowerment and Behavior Change:

- **Education and Awareness:** Paytm provides users with tools and resources to understand and manage their finances better, encouraging responsible financial behavior. This empowerment aligns with the circular economy's goal of promoting sustainable consumer practices.
- **Incentivizing Sustainable Choices:** Paytm can incentivize users to make sustainable choices by offering rewards for eco-friendly purchases or promoting digital over physical transactions. This approach encourages users to adopt behaviors that align with the principles of the circular economy.

Circular Supply Chains in Digital Services

- **Data-Driven Optimization:** Paytm uses data analytics to optimize financial transactions, reducing inefficiencies and ensuring that resources are used effectively. This data-driven approach is similar to circular supply chains, where precise management of resources minimizes waste.

- **Integration of Services:** By integrating various financial services on a single platform, Paytm reduces the need for multiple financial products and services, streamlining user experience and resource use. This integration aligns with the circular economy's focus on reducing redundancy and maximizing efficiency.

Collaboration and Partnerships

- **Partnering with Sustainable Businesses:** Paytm could collaborate with businesses that promote sustainability, such as offering cashback or discounts for purchasing eco-friendly products or services. These partnerships would encourage users to support circular economy practices.
- **Industry-Wide Initiatives:** Paytm could participate in initiatives aimed at making the financial services industry more sustainable, such as promoting digital financial inclusion, reducing the carbon footprint of financial transactions, or supporting green investments.

End-of-Life and Waste Management in Digital Products:

- **Secure Data Management:** Paytm must ensure the secure handling and deletion of user data at the end of its life cycle, such as when users close accounts or stop using certain services. Responsible data management is crucial for aligning with circular economy principles by reducing digital waste and ensuring privacy.
- **Repurposing and Reusing Data:** Paytm can explore ways to repurpose user data (with consent) for improving services or developing new financial products. This approach aligns with the circular economy's emphasis on maximizing the value of resources throughout their lifecycle.

CASE-4: NAUKRI.COM

Circular Economy in Naukri.com can be understood by exploring how the job portal can incorporate sustainability and resource efficiency into its operations, services, and user engagement. Here's a breakdown of how Naukri.com could align with circular economy principles:

Resource Efficiency in Operations

- **Digital Platform Optimization:** Naukri.com can enhance the efficiency of its digital infrastructure, ensuring that its servers, data centres, and network operations are optimized for minimal energy consumption. By adopting cloud computing solutions powered by renewable energy sources, the platform can reduce its carbon footprint.
- **Sustainable Talent Management:** The platform can promote resource efficiency by encouraging companies to hire locally, reducing the need for employee relocation and minimizing environmental impact. This also supports the local economy, aligning with circular economy principles.

Product Life Extension through Services

- **Career Development Tools:** Naukri.com can offer career counseling, skill assessment tools, and training programs that extend the career lifecycle of employees. By helping individuals upgrade their skills, the platform contributes to the employability and longevity of the workforce, reducing the need for constant churn in hiring.

- **Job Recycling and Redeployment:** The platform can facilitate the redeployment of employees within organizations, helping companies reassign staff to new roles instead of letting them go, thus reducing job redundancy and promoting job sustainability.

Waste Reduction through Digital Transformation

- **Paperless Recruitment Processes:** Naukri.com can continue to advance paperless recruitment by promoting digital resumes, virtual interviews, and online job applications, significantly reducing the need for physical paperwork and associated waste.
- **Eliminating Job Market Inefficiencies:** By providing data-driven insights and matching algorithms, the platform can reduce mismatches in the job market, ensuring that employers and job seekers find the best fit more quickly and efficiently, thereby reducing the time and resources spent on recruitment processes.

Recycling and Material Recovery

- **E-Recruitment Tools:** Naukri.com can offer tools that support the recycling of professional skills and knowledge. For instance, creating platforms where experienced professionals can share knowledge, mentor others, or retrain in new areas can help recycle intellectual capital within industries.
- **Second-Life Employment Opportunities:** The platform can support circular economy initiatives by promoting "second-life" job opportunities for retired professionals, enabling them to re-enter the workforce in new capacities, thus keeping valuable experience and expertise in circulation.

Consumer Engagement and Education

- **Promoting Green Jobs:** Naukri.com can play a significant role in promoting and educating job seekers and employers about green jobs and careers in sustainable industries. This can be done through dedicated sections on the platform, webinars, and partnerships with organizations focused on sustainability.
- **Sustainability Certification Programs:** The platform can offer courses and certifications in sustainability-related skills, helping job seekers prepare for roles in companies that are committed to circular economy principles.

Monetization through Circular Economy Initiatives

- **Premium Sustainability Features:** Naukri.com can offer premium services such as advanced analytics on job market trends related to the circular economy, helping businesses identify and recruit talent that aligns with their sustainability goals.
- **Partnerships with Sustainable Employers:** The platform can create partnerships with companies that are leaders in the circular economy, offering them tailored recruitment solutions that highlight their commitment to sustainability and attract like-minded candidates.

Data-Driven Sustainability Insights

- **Sustainability Reporting:** Naukri.com can offer insights into the job market's sustainability trends, such as the growth of green jobs or the demand for skills related to the circular economy. This data can help businesses make informed decisions about their recruitment strategies.

- **Personalized Career Paths:** The platform can provide users with personalized recommendations for career paths that are aligned with circular economy principles, encouraging job seekers to pursue roles in sustainable industries.

CASE-5: JIOSAAVN

JioSaavn is a digital music streaming service offering millions of songs and podcasts to users. While JioSaavn operates in the digital space, there are several ways its business model can align with the principles of a circular economy, focusing on sustainability, resource efficiency, and maximizing value throughout the service lifecycle.

Digital Product Design and Service Longevity

- **Sustainability in Operations:** JioSaavn operates entirely online, reducing the need for physical media like CDs, vinyl records, and tapes, which are resource-intensive to produce and dispose of. By offering music digitally, JioSaavn helps reduce the environmental impact associated with the production, distribution, and disposal of physical music formats.
- **Long-Term Value:** JioSaavn provides continuous access to music and podcasts, creating long-term value for users. Unlike physical media that can wear out or become obsolete, digital music remains accessible as long as the service is operational, aligning with the circular economy's focus on durability and reducing waste.

Resource Efficiency and Reduced Environmental Impact

- **Paperless and Physical Media-Free:** By streaming music and podcasts, JioSaavn eliminates the need for physical materials, such as CDs, packaging, and shipping, significantly reducing resource consumption and waste. This digital delivery method supports the circular economy by minimizing the use of physical resources.
- **Energy Efficiency:** JioSaavn can optimize its data centers and content delivery networks (CDNs) to be more energy-efficient, potentially adopting renewable energy sources to power its operations. Efficient streaming and data management practices contribute to reducing the carbon footprint of the platform.

Product as a Service (PaaS)

- **Subscription-Based Model:** JioSaavn operates on a subscription model, where users pay for ongoing access to music and podcasts rather than owning individual songs or albums. This service-based model aligns with the circular economy's focus on access over ownership, reducing the need for resource-intensive physical products.
- **Customized Listening Experience:** JioSaavn offers personalized playlists, recommendations, and curated content based on user preferences. By tailoring the listening experience, the platform ensures that users get maximum value from the service, which aligns with the circular economy's emphasis on efficient resource use.

Consumer Empowerment and Behavior Change:

- **Education and Awareness:** JioSaavn could educate users on the environmental benefits of digital music streaming compared to physical media. By promoting the sustainability of streaming, JioSaavn encourages users to adopt eco-friendly listening habits, aligning with the circular economy's goal of promoting sustainable consumer behavior.

- **Incentivizing Sustainable Choices:** JioSaavn could offer rewards or discounts for users who engage in eco-friendly activities, such as promoting "green" playlists featuring artists who support environmental causes. This could incentivize users to make choices that align with the principles of the circular economy.

Circular Supply Chains in Digital Services

- **Data-Driven Optimization:** JioSaavn uses data analytics to optimize content delivery, ensuring efficient use of bandwidth and server resources. This data-driven approach helps minimize waste in the digital supply chain, similar to how circular supply chains optimize resource use.
- **Integration of Services:** JioSaavn's integration with other digital platforms (e.g., smart speakers, mobile apps) reduces the need for multiple subscriptions or devices, streamlining the user experience and minimizing resource use. This integration aligns with the circular economy's focus on reducing redundancy and maximizing efficiency.

Collaboration and Partnerships

- **Partnering with Sustainable Artists:** JioSaavn could collaborate with artists and labels that promote sustainability or produce music with minimal environmental impact. By featuring these artists, JioSaavn supports the circular economy by encouraging content that aligns with eco-friendly values.
- **Industry-Wide Initiatives:** JioSaavn could participate in or lead initiatives aimed at making the music streaming industry more sustainable, such as reducing the carbon footprint of streaming services, promoting digital-only releases, or supporting green music festivals.

End-of-Life and Waste Management in Digital Products

- **Secure Data Management:** JioSaavn must ensure responsible handling of user data, including secure deletion or anonymization when users close their accounts or stop using the service. This aligns with circular economy principles by managing digital resources responsibly and reducing data waste.
- **Repurposing and Reusing Content:** JioSaavn can explore ways to repurpose content, such as creating remixes, mashups, or curated playlists that give old content new life. This practice aligns with the circular economy's emphasis on maximizing the value of resources throughout their lifecycle.

CONCLUSION

In summary, while all 5 companies operate in the digital space, they can align with the goals of a circular economy by focusing on sustainable operations, resource efficiency, long-term customer relationships, and promoting environmentally friendly financial products. The adoption of these practices can help reduce the environmental impact of the financial services sector and contribute to a more circular and sustainable economy.

Industry 4.0's new technologies and innovations have been used in a variety of circular product designs, including long-life, lease-or service-oriented, manufacturing-reuse- and material-recycling designs. Based on our findings, we created a framework that explains many aspects of CE. According to this framework, digital technology plays an important part in contributing to CE at every stage of the product lifecycle, from design to consumption and end-of-life to

freemium services. Lastly, if the environmental and economic costs of digital technology are assessed and balanced against the benefits, it has the potential to enable radical improvements to the CE model by addressing CE's three performance objectives: closing the loop, optimizing resource efficiency, and increasing product lifespan.

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Technology-led Circular Economy: Reviewing the Scope of Mobile Financial Services

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Abstract

The access and use of financial services on mobile and portable devices increasing popularity in recent years, especially amongst people who have not been a part of the formal financial system. In addition to providing the ease of inclusion, such technology-led financial initiatives have also opened opportunities to contribute towards India's transition to a more sustainable and circular economy. It is in this context that the present review provides an extensive discussion of the opportunities and challenges embedded in the adoption of mobile financial services (MFSs). The paper also delves into the scope of leveraging technology through fintech-based integration to strengthen the country's transition to a fully circular economy. The paper ends with outlining future research directions in this evolving domain.

Keywords: *Mobile Financial Services, Digital and Financial Inclusion, Fintech-based-MFS, Circular Economy*

INTRODUCTION

Mobile financial services (MFS)[*] have rapidly emerged as a critical segment of India's financial ecosystem, especially in the context of the country's push toward digital and financial inclusion. The Ericsson Report (2024) projects a growth of 80% and an increase of 114% in usage volume for Africa in next five years. These figures combined with the large-scale adoption of smartphones and government's Digital India initiative present a promising and expanding reach of financial services to previously under-served section of India's population.

The access and use of financial services on mobile and portable devices, especially in terms of mobile money transfers and digital wallet transactions, has gained increasing popularity. With rapid technological advancements, MFS programs or apps have paved a way for unbanked or under-banked people in low-income nations to get access to a formal financial system. As posited by Shaikh & Karjaluoto (2015), MFSs and related technologies are seen as a simple, convenient, and excellent way for people in remote rural locations to get financial services at a lower cost when traditional banking is not available or affordable. The biggest leap and use of this was during Covid-19 pandemic that saw MFS fulfilling the gap of the need of anywhere, anytime banking (Liu et al., 2019).

Further, recent studies (e.g. Ozili, 2021) have analyzed the role of financial institutions, particularly banks, in transitioning towards a circular economy[**] and found various benefits that

[*] Mobile financial services (MFSs) are a set of financial functions that can be performed or accessed via mobile devices such as phones and tablets (Dass & Pal, 2011).

[**] Circular economy can be defined as "a model that emphasizes the continuous use of resources through practices like recycling, reuse, and repair, aiming to minimize waste and environmental impact" (Cassano, 2020).

can be reaped through such changeover. These benefits may come in the form of opportunities in loan diversification, promotion of responsible and sustainable banking, increased lending to circular clients and the recycling sector which means more profit for banks, and improved perception about banks.

It is primarily in this context that the present paper provides an extensive review of the opportunities and challenges that arise in adopting mobile financial services. With renewed focus and attention on sustainable growth, a clear and detailed understanding of MFSs would be useful in formulating focused actionable plans for India's smooth transition towards a cashless circular economy.

OPPORTUNITIES IN MFS ADOPTION

The adoption of MFS does bring in a large bouquet of opportunities along with it for an emerging nation like India which has large swathes of land that are still in the phase of preliminary urbanisation process and are yet to be exposed to modern day one click orientation based financial services. The ensuing section discuss various opportunities that can be reaped through the adoption of MFS, thus reflecting its potential as a dynamic and powerful tool for faster convergence towards a cashless circular economy.

- **Financial Inclusion:** One of the most significant opportunities presented by mobile financial services in India is the potential for enhanced financial inclusion. MFS has the ability to reach remote and underserved populations, providing them with access to banking services such as savings accounts, credit, insurance, and payments. The success of mobile payment platforms like Paytm, PhonePe, and the government's Unified Payments Interface (UPI) highlights the growing penetration of MFS in India (Gupta & Arora, 2020). These platforms have played a critical role in bringing millions of previously unbanked individuals into the formal financial system. MFS provides an unprecedented opportunity to extend financial services to unbanked and underbanked populations. This can lead to increased economic participation and improved living standards (Demirgüç-Kunt et al., 2020).
- **Economic Empowerment:** The expansion of mobile financial services can have a positive impact on economic growth and development. By facilitating easier access to credit, savings, and insurance products, MFS can empower individuals and small businesses to invest, grow, and manage risks more effectively. This, in turn, can stimulate local economies and contribute to broader economic development goals (World Bank, 2019). Mobile financial services can drive economic empowerment by facilitating easier access to multiple financial services on a single platform for small businesses and entrepreneurs. This is particularly important in India, where small and medium-sized enterprises (SMEs) are a major contributor to economic growth but often struggle to secure financing through traditional channels. By leveraging MFS, these businesses can access microloans and other financial products that enable them to expand and innovate (Kumar & Vashisht, 2021).
- **Government Initiatives and Policy Support:** The Indian government has been proactive in promoting digital payments and mobile financial services as part of its broader financial inclusion strategy. Initiatives like the Pradhan Mantri Jan Dhan Yojana (PMJDY) and the Aadhaar-enabled Payment System (AePS) have significantly boosted the adoption of MFS. The government's push for a cashless economy, particularly in the wake of demonetization in 2016, has further accelerated the growth of mobile payments and digital financial services (Rastogi & Tripathi, 2019).

- **Innovation and Technology Transforming into Product Diversification:** The MFS sector is a hotbed for innovation, with providers developing new products and services tailored to the needs of diverse customer segments. From mobile wallets and peer-to-peer transfers to microloans and insurance products, MFS is expanding the range of financial services available to consumers. This innovation is also driving competition, leading to better services and lower costs for users (GSMA, 2021). India's MFS landscape is characterized by rapid innovation and the adoption of new technologies. The development of the UPI system, which allows instant real-time payments, has been a game-changer in the Indian payments ecosystem. The integration of MFS with other emerging technologies such as artificial intelligence (AI) and blockchain holds the potential to further enhance the efficiency, security, and user experience of these services (Agarwal & Malik, 2021). Moreover, fintech startups in India are continually exploring new business models and partnerships to reach underserved markets.
- **Data Analytics and Customer Insights:** The data generated from the use of mobile financial services can be leveraged to understand the preferences, attitude and behaviour of people towards these services. The insights drawn thereof can be used to subsequently develop personalized financial products, enhance customer experience, and improve risk management. Additionally, the use of data analytics can help providers identify and address gaps in service delivery, leading to more efficient and targeted offerings (CGAP, 2018).
- **Partnerships and Collaborations:** The MFS ecosystem offers ample opportunities for partnerships and collaborations among various stakeholders, including financial institutions, telecom operators, fintech companies, and governments. Such collaborations can lead to the development of more comprehensive and integrated financial services, enhancing the overall value proposition for consumers. For example, partnerships between banks and mobile network operators (MNOs) have been instrumental in expanding the reach of MFS in many markets (Demirgüç-Kunt et al., 2020).
- **Social Impact:** Mobile financial services can have a profound social impact by enabling better access to financial resources for marginalized groups. For instance, MFS can help women gain more control over their finances, thereby contributing to gender equality and empowerment. Additionally, the ability to send and receive remittances through mobile platforms can have a positive impact on rural households, improving their economic resilience and overall quality of life (Chaudhuri, 2019).

CHALLENGES IN THE ADOPTION OF MFS

Despite the opportunities discussed in the aforesaid section, there exist various challenges that present hurdles in the adoption of MFS. The brief account of these challenges is provided below.

- **Regulatory Hurdles:** Though the regulatory landscape in India for mobile financial services has evolved rapidly over time, it continues to face challenges posed by various facets of the operational framework at place in the country's economic environment. In this regard, several regulations aimed at ensuring the safety and integrity of mobile financial transactions have been implemented by the Reserve Bank of India. However, the frequent changes and complexities in regulatory frameworks can create uncertainty for service providers. For instance, the stringent KYC requirements, while essential for preventing fraud, have often been cited as barriers to customer onboarding, particularly among the rural population (Singh & Pathak, 2020).

- **Security and Privacy:** Security remains a major concern in the MFS segment in India. Despite advancements in technology, the threat of frequent cyber-attacks, phishing, and identity theft looms large on the vast population using MFS. The large-scale adoption of mobile financial services has made it a lucrative target for cybercriminals. Additionally, there are also serious concerns about the privacy of user data, especially because of the inadequate data protection frameworks in place (Agarwal & Malik, 2021). The lack of robust cybersecurity measures in rural and semi-urban areas further increases these risks in India.
- **Digital Literacy and Awareness:** A significant challenge to the adoption of mobile financial services in India is the low level of digital literacy. Many potential users, particularly in rural areas, are not familiar with digital financial tools, which limits their ability to utilize these services effectively. Studies have shown that a lack of understanding of digital transactions can lead to distrust and hesitancy in using MFS, thereby hindering financial inclusion efforts (Chaudhuri, 2019). Additionally, gender disparities in digital literacy further compound this challenge, with women being less likely to use MFS compared to men (Singh & Kaur, 2021).
- **Infrastructure Deficiencies:** Infrastructure limitations, including poor mobile network coverage and unreliable internet connectivity, pose significant barriers to the widespread adoption of MFS in India. Despite the rapid expansion of mobile networks, many rural areas still suffer from inadequate connectivity, which affects the consistency and reliability of mobile financial transactions. Moreover, the limited availability of affordable smartphones further restricts access to MFS (Das & Das, 2020).
- **Cost of Services:** The cost associated with mobile financial transactions can be a deterrent for low-income users. While some services are offered at minimal cost, others involve transaction fees that may be unaffordable for economically disadvantaged populations. This is particularly challenging in a country like India, where price sensitivity is high, and a large portion of the population lives below the poverty line (Rastogi & Tripathi, 2019).

CONCLUSION AND WAY FORWARD: THE PROMISING INTEGRATION OF FINTECH-BASED-MFS

The present paper provides a holistic understanding of mobile financial services by highlighting promising opportunities as well as significant challenges that need due consideration to effectively utilize the potential of MFS in shaping the future of financial inclusion and economic development in India. The review suggests a forward approach towards making MFS ecosystem more robust and dynamic by integrating it with the application of high-end contemporary financial technology (fintech) products.

In addition to enhancing the capability of MFS, the fintech integration can perform a pivotal role in supporting and scaling the circular economy initiatives in numerous ways. *First*, fintech can facilitate access to finance for circular businesses and projects. Traditional financing mechanisms often fail to support circular business models due to the perceived risks and the long payback periods associated with these initiatives. Fintech, through innovations such as peer-to-peer lending, crowdfunding, and blockchain-based finance, can offer alternative sources of funding that are more aligned with the needs of circular economy businesses (Naucler & Enkvist, 2020). These platforms enable small and medium-sized enterprises (SMEs) to access capital for circular projects that might otherwise be overlooked by traditional financial institutions.

Second, transparency and traceability are critical components of the circular economy, where the ability to track the lifecycle of products and materials is essential for ensuring sustainable practices. Fintech, particularly through blockchain technology, can enhance transparency in supply chains by providing immutable records of transactions and material flows. This capability allows businesses and consumers to verify the origin, composition, and history of products, thereby supporting circular practices such as recycling and responsible sourcing (Zhang et al., 2021). For example, blockchain can be used to certify the recycled content in products or to track the provenance of raw materials, ensuring that they meet sustainability criteria.

Third, fintech-based-MFS may turn out to be instrumental in enabling new business models that align with the principles of the circular economy. This can be in the line of developing models that encourage manufacturers to design durable products that can be repaired, upgraded, or recycled, thus promoting resource efficiency and reducing waste (Ellen MacArthur Foundation, 2019). The integration would also facilitate seamless transactions and payments between users, thereby reducing the need for ownership and encouraging the sharing of resources.

Fourth, technology led digital integration of financial services through fintech provides an inbuilt advantage of promoting sustainable consumption patterns. Digital payment platforms, for instance, can be integrated with tools that provide consumers with information about the environmental impact of their purchases, thereby encouraging them to make more sustainable choices. Moreover, fintech solutions such as green bonds and impact investing platforms allow consumers to direct their investments towards businesses and projects that contribute to the circular economy (Gimpel et al., 2018). In sum, it can be said that these tools not only empower consumers to make informed decisions but also drive demand for circular products and services.

FUTURE RESEARCH DIRECTIONS

The literature on MFS, fintech, and circular economy highlights the potential of integrating these domains for larger benefit. However, a careful assessment of the implications as well as an understanding of regulatory, technological, and social aspects of such integration need to be fulfilled beforehand. To begin with, future research may be undertaken to explore new applications of fintech-based-MFS in the circular economy. For example, the potential of artificial intelligence (AI) and machine learning to optimize circular business models and supply chains remains underexplored. Additionally, as suggested by Zhang et al. (2021), it would be worthwhile if research in future focus on the ways in which fintech and other technology-based platforms for financial services can support the scaling of circular economy initiatives, especially in respect of developing countries like India, where the challenges of financing, transparency, and technology adoption are particularly acute.

Another area for future research is the empirical assessment of the impact of MFSs on circular economy outcomes. While theoretical frameworks suggest that digital transition can drive circular practices, there is a need for more empirical studies to quantify this impact and to identify the conditions under which such tech-led solutions are most effective. Such research could provide valuable insights for policymakers and practitioners looking to leverage mobile financial services for sustainability.

Lastly, as mobile financial services and fintech solutions continue to evolve, it is important to address ethical and equity concerns related to their role in the circular economy. Research could explore how such solutions can be designed to ensure inclusivity, particularly for marginalized

communities that may be excluded from traditional financial systems. Brennan & Tennant (2021) too have emphasized the need to critically examine the ethical implications of data collection and usage in fintech applications so as to ensure the proper and responsible use of these technologies in future.

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The Confluence of Corporate Governance and Artificial Intelligence: Uncovering a New Era Through Bibliometric Analysis

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Abstract

The purpose of this study is to provide a comprehensive bibliometric analysis of research on the interrelationship of artificial intelligence (AI) and corporate governance, map the intellectual landscape, identify key contributors, and identify emerging trends and gaps in the highlighted literature.The study analyses 1,673 English-language documents published between 2010 and 2024, sourced from the Scopus database. Using the Biblioshiny in R package software, conducted various bibliometric analyses, including publication trends, author productivity, co-authorship networks, etc. Analysis shows that there has been a significant increase in publications since 2016, reaching a peak of 556 articles in 2023. The United Kingdom, the United States and Italy have emerged as the main contributors, with institutions such as Swansea University, Delft University of Technology and the University of St. Gallen. Lead authors such as Dwivedi YK, Kumar S and Kraus S have significantly framed the discussion. Analysis highlights focus areas including the decision-making process, ethical implications, risk management, and stakeholder engagement. This study provides the bibliometric analysis of corporate governance and AI nexus, providing a holistic view of the research environment. It identifies influential works, collaboration models, and new topics. It provides valuable information for researchers, policy makers, about the transformative capabilities of AI, and corporate governance issues. The findings help identify research gaps and future direction.

Keywords: *Artificial Intelligence, Corporate Governance, Bibliometric Analysis, Research Trends, Ethical AI, Decision-Making, Risk Management*

INTRODUCTION

In the rapidly evolving landscape of modern business, corporate governance stands as a critical structure that underpins the stability, accountability and sustainable growth of organisations around the world. This system of rules, practices and procedures is about reassuring stakeholders, ensuring regulation requirements and overcoming the complex web of ethical considerations involved in business management. As the global market becomes connected and stakeholder expectations evolve, the importance of a powerful corporate governance system is increasingly evident. In parallel, the rise of Artificial Intelligence (AI) promises to revolutionise decision-making, operational efficiencies and strategic planning, emerging as a transformative force in almost all economies. The capabilities of AI for rapid data analysis, model identification and modelling prediction provide unprecedented opportunities for businesses to achieve optimization

of understanding, performance and innovation. The interaction of these two important areas - business control and AI - is a series of huge opportunities and complexity. Given that AI methods are quickly integrated into the governance structure, they promise to improve the monitoring of the board of directors by analysing data in real-time, improve risk management using predictive models, well-organized compliance processes using automated monitoring systems, making more information and services more informed and promptly decisions at all levels of corporate leadership. This merger is not only a technological renewal of existing practices, but also a change in paradigm, which can rethink the nature of corporate governance. It introduces new capabilities in transparency, responsibility and strategic foresight, as well as changes in data privacy, algorithms, changes in the role of human decisions in organizational leadership and the ethical consequences. As companies progress in this new field, the integration of artificial intelligence into the practice of business administration offers an interesting opportunity to increase efficiency and efficiency and also presents complex problems for which a new solution is also cautious.

OBJECTIVES OF THE STUDY

The objectives of this study are to map the intellectual landscape of AI applications in corporate governance by identifying key research topics, trends, and gaps. Analyze changes in research directions over time, notable influential authors, publications, and organizations. Also to highlight potential research groups and collaborations.

LITERATURE REVIEW

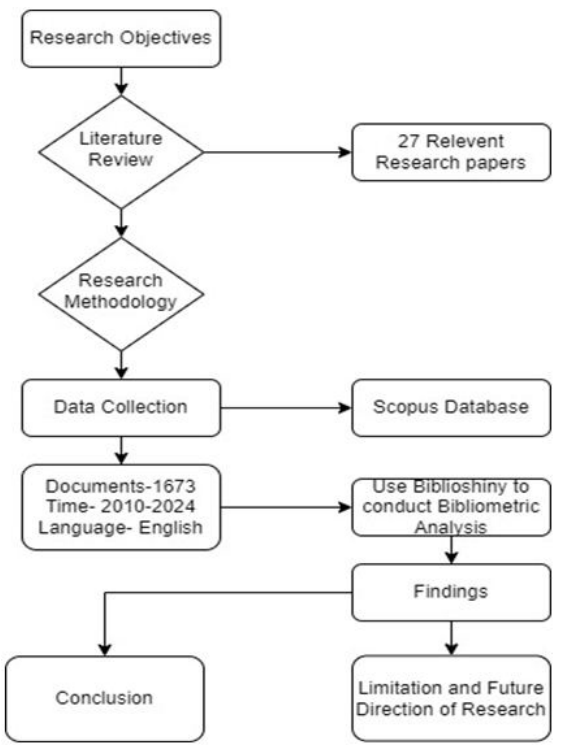
The interaction between artificial intelligence (AI) and corporate governance is increasingly explored and has significant implications on decision-making, transparency, and operational capabilities. Fahlevi et al. (2023) Although technical and regulatory issues remain, we emphasize how to transform corporate governance by leveraging blockchain, big data, AI transparency, and reducing information asymmetry. Kalkan (2024) further outlines AI's potential to determine and optimize operational capabilities, but warns of ethical concerns such as data privacy and algorithm bias. Similarly, Naili and Purwono (2024) identify both opportunities and issues with accountability and legal issues related to data privacy. Hilb (2020) discusses the desirability and feasibility of automating board-level decision-making with AI. McBride et al. (2022) examines the role of AI in promoting social responsibilities and sustainability in companies, believing that AI can act as a catalyst for management reform if legal and ethical rules are integrated. Hickman and Petrin (2021) emphasize the potential impact on corporate governance despite practical application issues, and discusses the EU's ethical recommendation for trustworthy AI. Kaya (2022) verifies the role of AI in corporate conference rooms and offers the possibility of AI supporting or replacing human decisions, while Tokmakov (2019) addresses blockchain problem with AI and digital methods such as blockchain. Abhilash et al. (2023) and Singhania et al. (2023). (2022) present a literature review of corporate governance research that reflects the emerging landscape and highlights key research topics. Alili (2024) and Bracarense et al. (2022) provide a literature review of the role of AI in corporate governance and sustainability, respectively, identify research gaps and suggest a future research agenda. Ali et al. (2023) and Sharma (2024) consider in depth the ethical problems of AI and the need for multilevel management. Finally, Dignam (2020) and Volosova and Matiukhina (2020) discuss the role of AI in decision making under uncertainty, stressing the importance of management capabilities and innovative models. In other

words, these researches emphasize the transformative potential of AI in corporate management, and emphasize the need for ethical considerations, legal evidence, and continuous research to solve new problems.

METHODOLOGY

The research methodology for this bibliometric study on AI and corporate governance employs a systematic approach using the Scopus database. The dataset comprises 1,673 English-language documents published between 2010 and 2024, including articles, conference papers, and editorial reviews. After thorough data cleaning and preparation to ensure consistency and accuracy, the analysis will be conducted using the Biblioshiny R package. This tool will facilitate various bibliometric analyses, including publication trends, author productivity, co-authorship networks, etc. The methodology aims to provide a comprehensive overview of the field's evolution, identify key contributors and emerging themes, and highlight potential research gaps.

RESEARCH FRAMEWORK



Source: Author's work

RESULTS AND DISCUSSION

Emerging AI Technologies in Corporate Governance

Table 1: Annual Scientific Production

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Articles	6	10	6	11	14	18	37	38	51	97	165	250	363	556	51

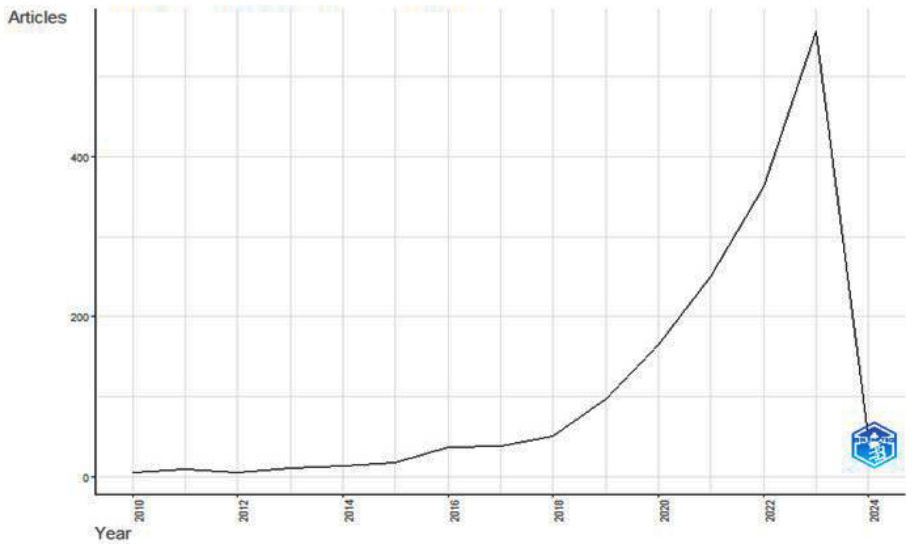


Figure 1: Annual Scientific Production

Annual scientific production data indicates that the number of articles published has increased rapidly in the past few years. From six articles in 2010 to 2015, the output has gradually increased. Since 2015, the growth has become more prominent, and there was a big rebound in 2016. It continued immediately, reaching an impressive peak of 556 articles in 2023. Notably, despite partial data, the number of articles in 2024 is already 51. This trend emphasizes academic and substantive interest in the intersection of AI and corporate governance. This affects corporate practices and verification mechanisms.

Table 2: Average Citation Per Year

Year	*Mean TC Per Art*	*N*	*Mean TC Per Year*	*Citable Years*
2010	108.17	6	7.21	15
2011	160.8	10	11.49	14
2012	97.83	6	7.53	13
2013	72.45	11	6.04	12
2014	162.64	14	14.79	11
2015	89.89	18	8.99	10
2016	79.92	37	8.88	9
2017	88.76	38	11.1	8
2018	71.41	51	10.2	7
2019	65.77	97	10.96	6
2020	45.95	165	9.19	5
2021	37.49	250	9.37	4
2022	17.51	363	5.84	3
2023	5.23	556	2.62	2
2024	0.49	51	0.49	1

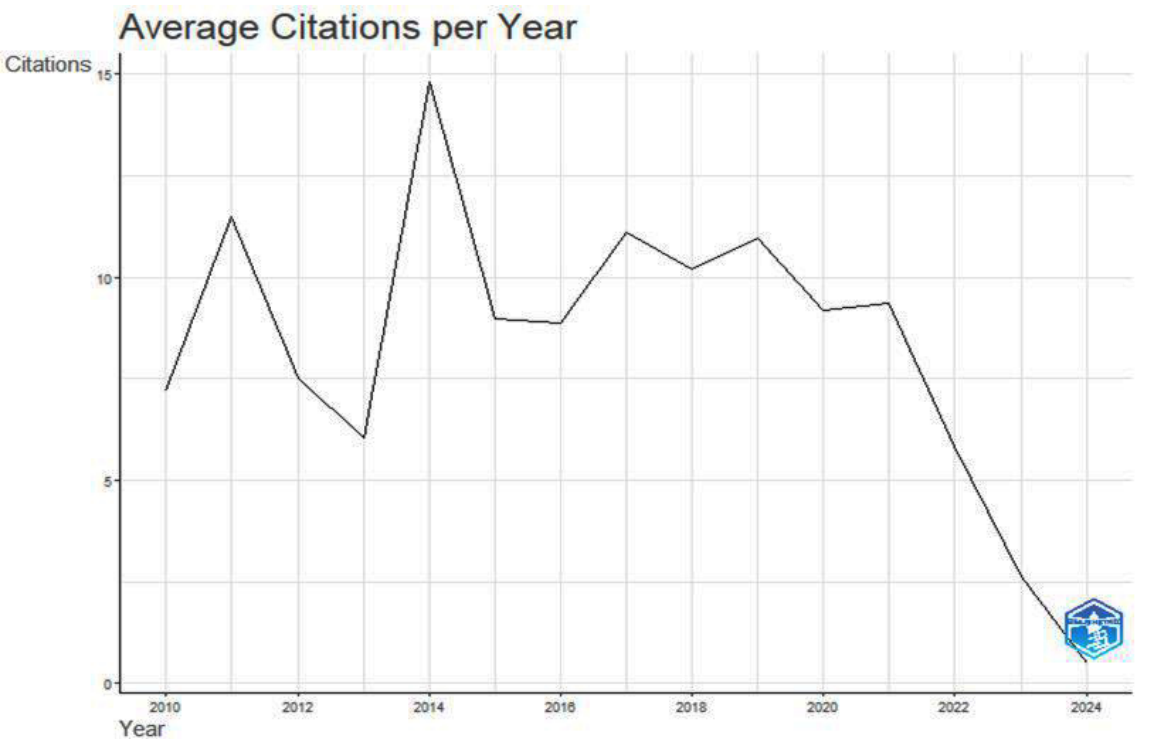


Figure 2: Average Citation Per Year

Initially, articles published in 2010 received a substantial average value of 7.21 citations per year, and108.17 citations per 15 years. The pace of bidding generally increased until 2014, reaching an impressive peak of 162.64 total citations per article with an average of 14.79 citations per year. After this peak, despite the increase in the number of published articles, there is a tendency for average citations per year to decrease. By 2023, the average number of citations per year had dropped significantly to 2.62, while the number of studies increases rapidly, the average impact, as measured by citations, may be decreasing, perhaps more than in recent years.

Table 3: Most Relevant Sources

Sources	*Articles*
Technological Forecasting and Social Change	64
Journal of Business Research	51
Journal of Risk and Financial Management	51
Journal of Cleaner Production	42
Cogent Business and Management	32
Humanities and Social Sciences Communications	25
International Journal of Information Management	23
Journal of Innovation and Knowledge	23
Administrative Sciences	22
Journal of Business Ethics	22

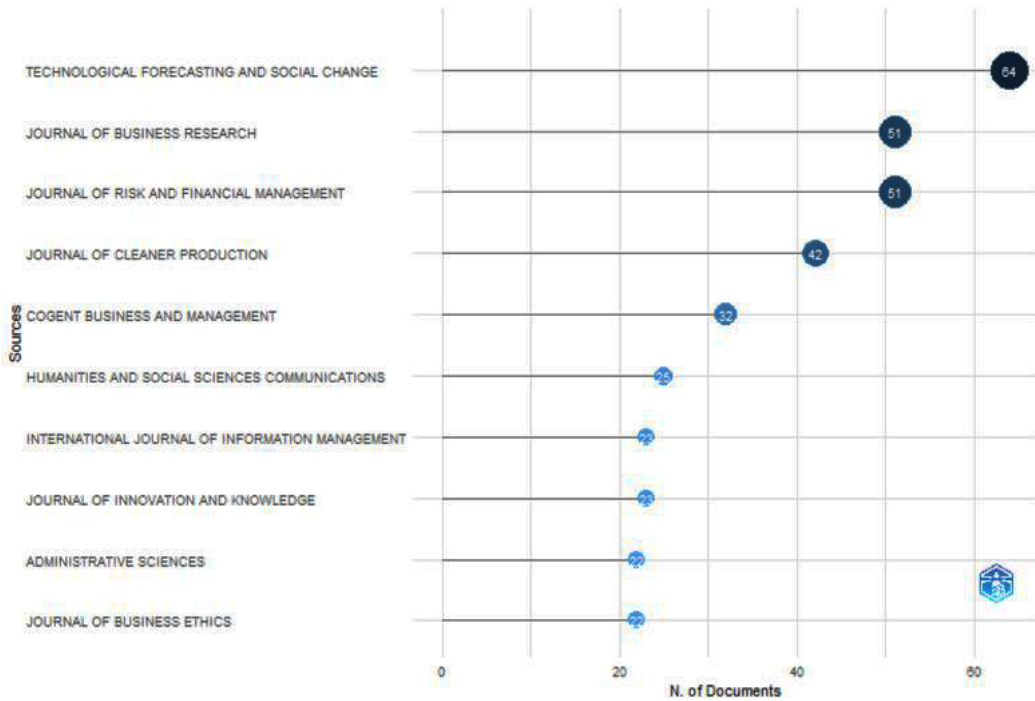


Figure 3: Most Relevant Sources

This analysis highlights several core journals that make significant contributions to this field. At the front edge of the list is "Technological Forecasting and Social Change", which has 64 articles. The "Journal of Business Research" and the "Journal of Risk and Financial Management", each with 51 articles. The "Journal of Cleaner Production" follows next with 42 articles. Other well-known sources include the "Cogent Business and Management" (32 articles) and "Humanities and Social Sciences Communications" (25 articles), reflecting a wide interdisciplinary interest. In addition, the "International Journal of Information Management" and "The Journal of Innovation and Knowledge", each contain 23 articles.

Table 4: Core Sources by Bradford's Law

Source	*Rank*	*Freq.*	*Cum. Freq.*	*Zone*
Technological forecasting and social change	1	64	64	Zone 1
Journal of Business Research	2	51	115	Zone 1
Journal of risk and financial management	3	51	166	Zone 1
Journal of Cleaner Production	4	42	208	Zone 1
Cogent business and management	5	32	240	Zone 1
Humanities and social sciences communications	6	25	265	Zone 1
International journal of information management	7	23	288	Zone 1
Journal of innovation and knowledge	8	23	311	Zone 1
Administrative sciences	9	22	333	Zone 1
Journal of Business Ethics	10	22	355	Zone 1

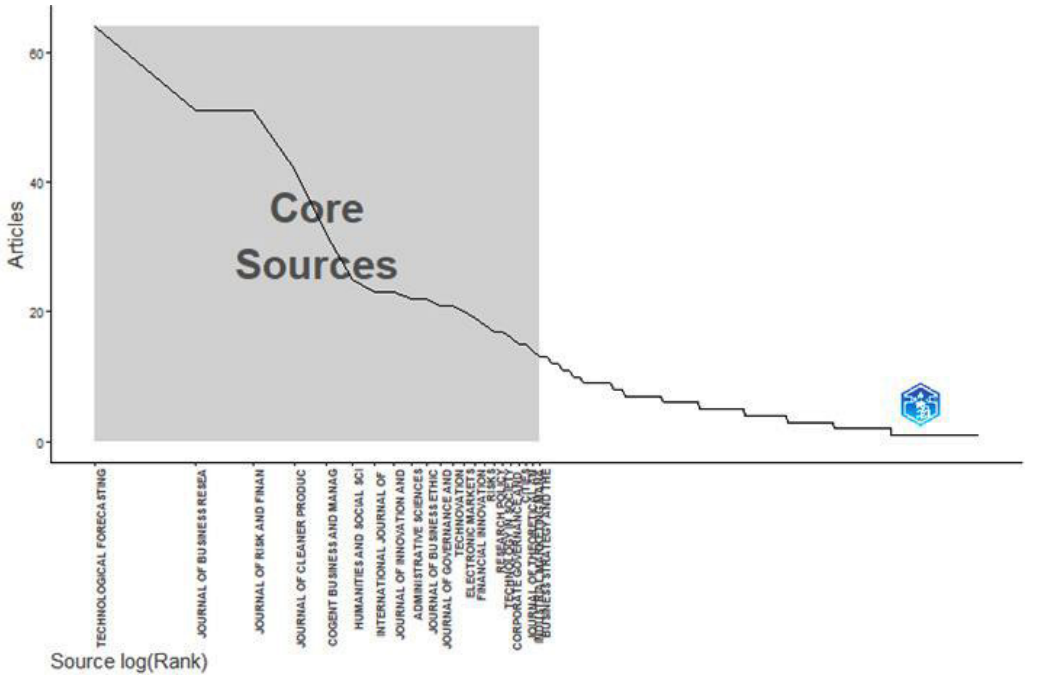


Figure 4: Core Sources by Bradford's Law

According to Bradford's Law, the main sources that contribute greatly to research on artificial intelligence and corporate governance are mainly focused on Zone 1. "Journal of Business Research" and "Journal of Risk and Financial Management", which indicated an article 51 that each explained its significant influence in this research area. 42 articles are included in the "Journal of Cleaner Production" and 32 articles in "Cogent Business and Management". Zone 1 (25 articles), "International Journal of Information Management" (23 articles), "Innovation and Knowledge" (23 articles), and "International Journal of Information Management" (23 articles). Similarly other Journals, details are given in the above table.

Table 5: Sources' Local Impact by H Index

Element	*h_index*	*g_index*	*m_index*	*TC*	*NP*	*PY_start*
Technological Forecasting and Social Change	27	55	1.8	3033	64	2010
Journal of Business Research	23	42	3.28571429	1805	51	2018
Journal of Cleaner Production	21	42	1.4	2068	42	2010
International Journal of Information Management	19	23	1.9	4691	23	2015
Journal of Business Ethics	12	22	1.71428571	618	22	2018
Journal of Risk and Financial Management	12	16	2	355	51	2019
Journal of Innovation and Knowledge	11	21	1.22222222	457	23	2016
Accounting, Auditing and Accountability Journal	10	11	0.71428571	506	11	2011
Cities	10	15	1.42857143	779	15	2018
Research Policy	10	17	0.90909091	2622	17	2014

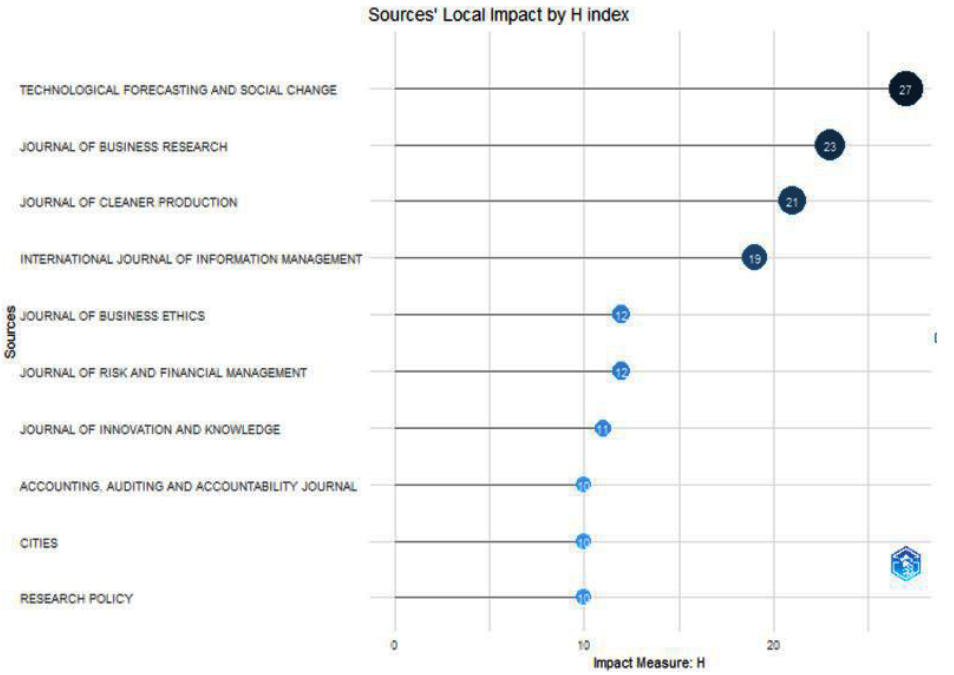


Figure 5: Sources' Local Impact by H Index

Analysis shows that "Technological Forecasting and Social Change" is the most influential journal in the field of AI and corporate governance, with an h-index of 27 and citations of 3033. Other important sources include "Journal Business Research " (h-index 23) and "Journal of Cleaner Production" (h-index 21). "International Journal of Information Management" is the most outstanding with a common citation (4691) and an h-index of 19.

Table 6: Sources' Production Over Time

Year	*Technological Forecasting and Social Change*	*Journal of Business Research*	*Journal of Risk and Financial Management*	*Journal of Cleaner Production*	*Cogent Business and Management*
2010	1	0	0	1	0
2011	1	0	0	1	0
2012	1	0	0	1	0
2013	1	0	0	2	0
2014	1	0	0	2	0
2015	1	0	0	2	0
2016	1	0	0	2	0
2017	1	0	0	3	1
2018	3	1	0	7	1
2019	13	1	4	10	1
2020	16	6	12	16	2
2021	28	15	22	23	6

Year	*Technological Forecasting and Social Change*	*Journal of Business Research*	*Journal of Risk and Financial Management*	*Journal of Cleaner Production*	*Cogent Business and Management*
2022	39	32	36	28	12
2023	59	48	51	40	32
2024	64	51	51	42	32

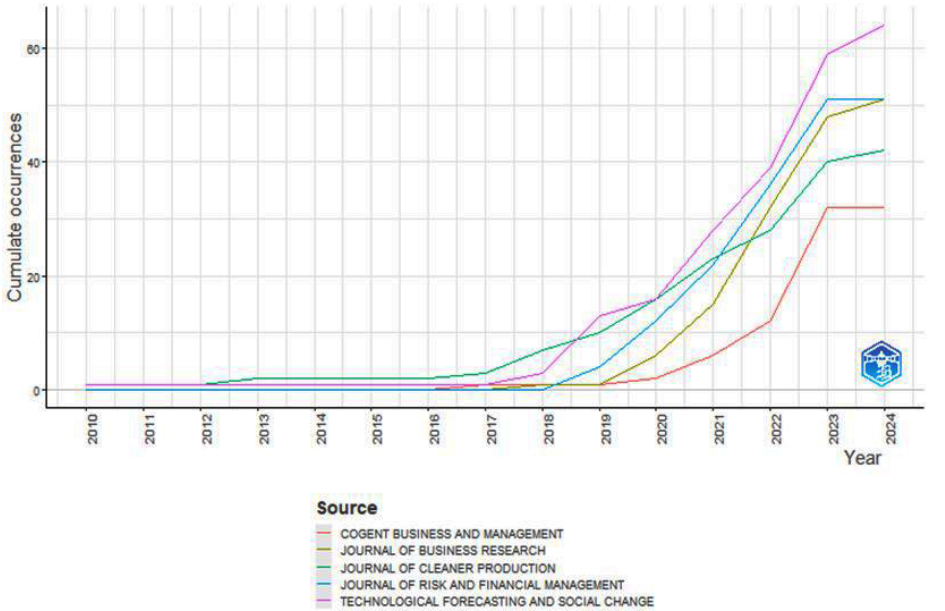


Figure 6: Sources' Production Over Time

"Technological Forecasting and Social Change" began with stable but minimal results from 2010 to 2017 and then grew rapidly, reaching 64 papers in 2024. The Journal of Business Research has also shown a similar trend, growing significantly from 2020 to 51 papers by 2024. Similarly, the progress of some journals has been shown in the above analysis.

Table 7: Most Relevant Author

Authors	*Articles*	*Articles Fractionalized*
DWIVEDI YK	19	3.05024947
KUMAR S	13	3.11666667
KRAUS S	10	1.89703196
VALASKOVA K	9	2.85
JANSSEN M	8	1.98274625
PARIDA V	8	2.06666667
RANA NP	8	0.95739232
CHATTERJEE S	6	1.5
CHAUDHURI R	6	1.5
CHEN Y	6	1.16785714

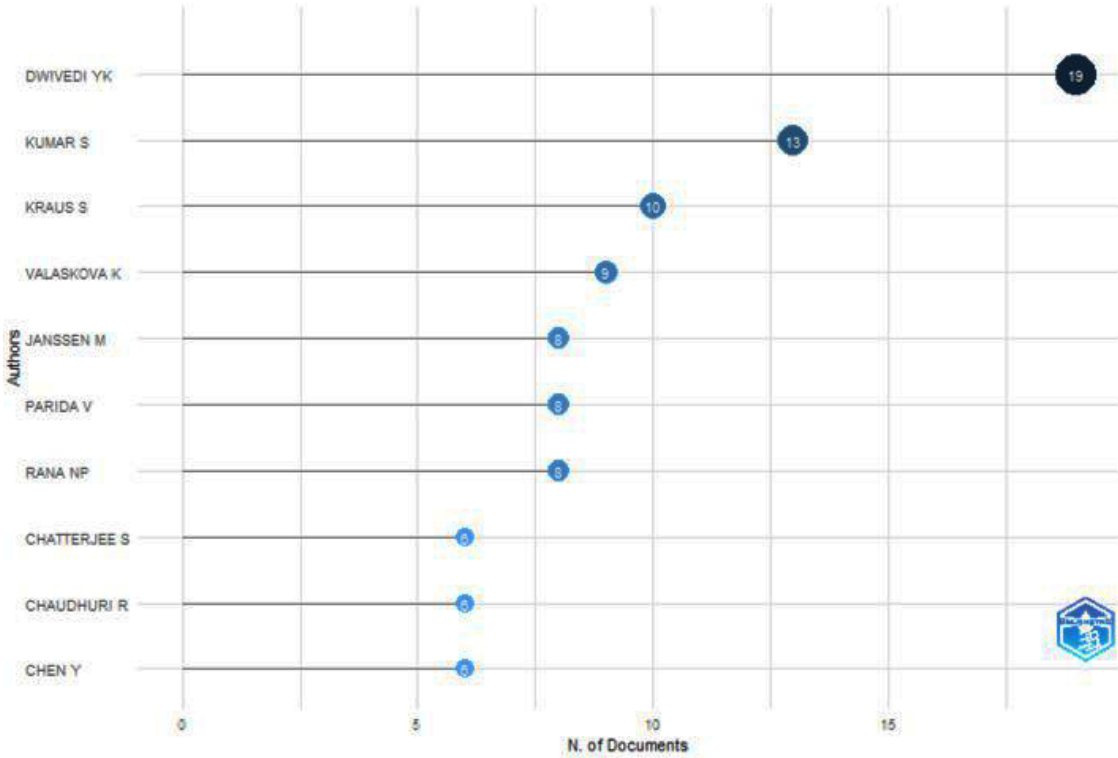


Figure 7: Most Relevant Author

Dwivedi YK is one of the most powerful authors in the field of artificial intelligence and corporate government, with 19 articles and a fractional count of 3.05, the main contributor indicating a substantial contribution. Kumar S is in second place with 13 articles and the highest fractional count of 3.12. Kraus S wrote 10 articles with a fractional count of 1.90.

Table 8: Author Productivity through Lotka's Law

Documents Written	*N. of Authors*	*Proportion of Authors*
1	4616	0.89683311
2	377	0.07324655
3	92	0.01787449
4	33	0.0064115
5	12	0.00233146
6	10	0.00194288
8	3	0.00058286
9	1	0.00019429
10	1	0.00019429
13	1	0.00019429
19	1	0.00019429

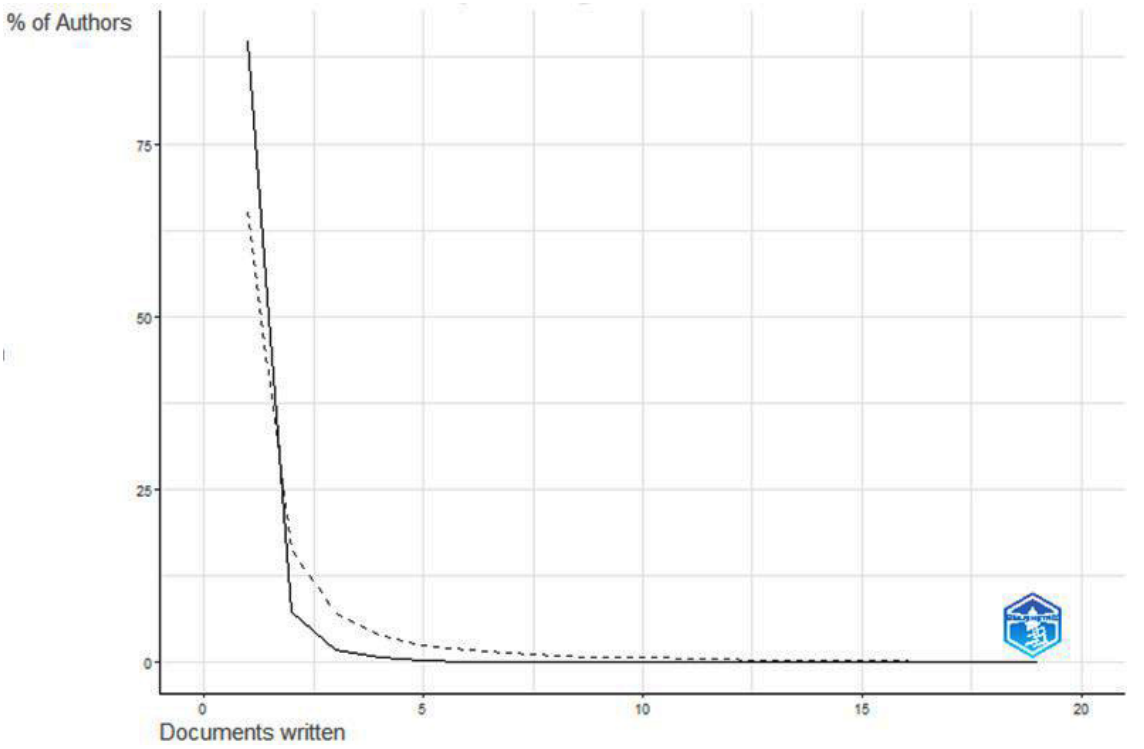


Figure 8: Author Productivity through Lotka's Law

Most authors (89.68%) wrote only one document which sometimes represents the most important basis for those who contribute. A small number of authors, 7.32%, wrote two documents. With the increase in the number of publications, the number of authors decreased significantly, only 1.79% of authors wrote three documents, and this trend continues quickly. A very small number of authors who wrote from 4 to 19 documents. This distribution indicates small number of authors are responsible for a large part of the research results from this field.

Table 9: Author's Local Impact by H Index

Element	*h_index*	*g_index*	*m_index*	*TC*	*NP*	*PY_start*
DWIVEDI YK	17	19	2.42857143	4008	19	2018
KUMAR S	10	13	2	348	13	2020
KRAUS S	9	10	1	980	10	2016
JANSSEN M	8	8	1.33333333	2148	8	2019
RANA NP	8	8	1.14285714	2708	8	2018
DE REUVER M	6	6	1	303	6	2019
DUBEY R	6	6	1.5	1289	6	2021
HUGHES L	6	6	1	2697	6	2019
KAR AK	6	6	1	1862	6	2019
PARIDA V	6	8	1.5	511	8	2021

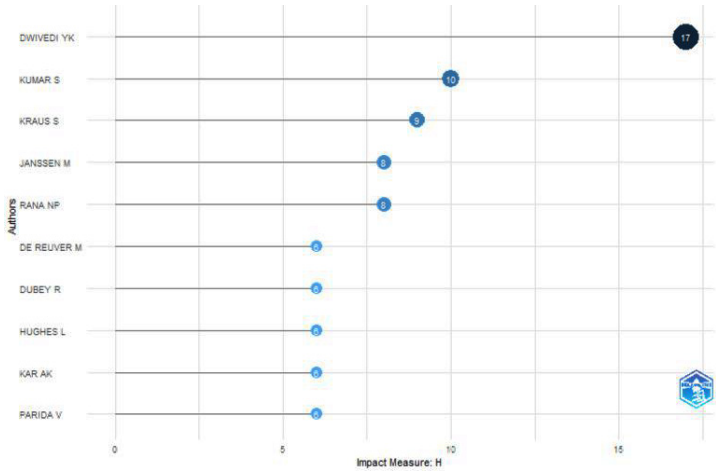


Figure 9: Author's Local Impact by H Index

Author's Local impact by the h-index reflect the influences of the most important authors in this fields. Dwivedi YK tops the list with an impressive h-index of 17 that shows significant citations in 19 articles and an overall citation count (TC) of 4008 since 2018. Kumar S ranks second with an h-index of 10 and 348 citations in 13 articles that have a substantial individual impact in a relatively short period of time since 2020.

Table 10: Most Relevant Affiliation

Affiliation	*Articles*	*Affiliation*	*Articles*
Swansea University	43	University of Turin	25
Delft University of Technology	40	University of Reading	23
University of St. Gallen	40	Queensland University of Technology	22
Politecnico Di Milano	38	The University of Manchester	20
University of Oxford	26	Utrecht University	20

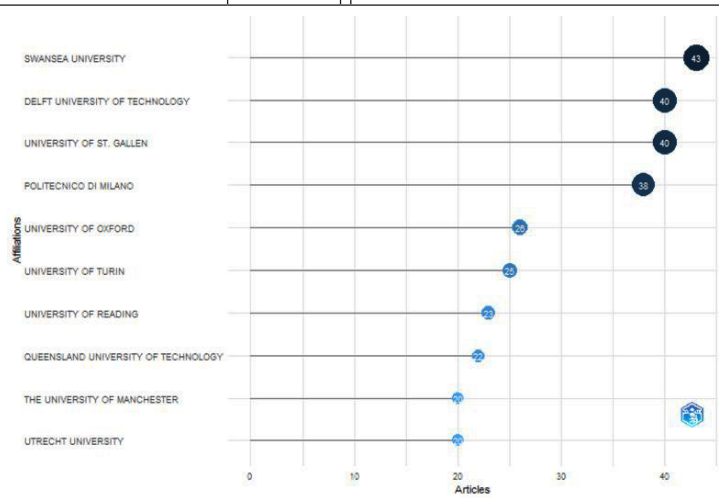


Figure 10: Most Relevant Affiliation

Several prominent institutions are highlighted in the analysis. Swansea University emerges as the most attentive with 43 articles, indicating a strong research output in the field. Delft University of Technology and the University of St. Gallen are in second place with 40 articles each, underlining its significant contribution to the field. The contribution of the remaining universities is described in the above analysis.

Table 11: Corresponding Author's Countries

Country	*Articles*	*SCP*	*MCP*	*Freq.*	*MCP_Ratio*
United kingdom	213	97	116	0.1273162	0.54460094
Italy	126	64	62	0.07531381	0.49206349
Germany	85	49	36	0.05080693	0.42352941
USA	75	35	40	0.04482965	0.53333333
China	71	30	41	0.04243873	0.57746479
Netherlands	64	37	27	0.03825463	0.421875
Australia	53	27	26	0.03167962	0.49056604
Sweden	50	17	33	0.02988643	0.66
Spain	49	40	9	0.0292887	0.18367347

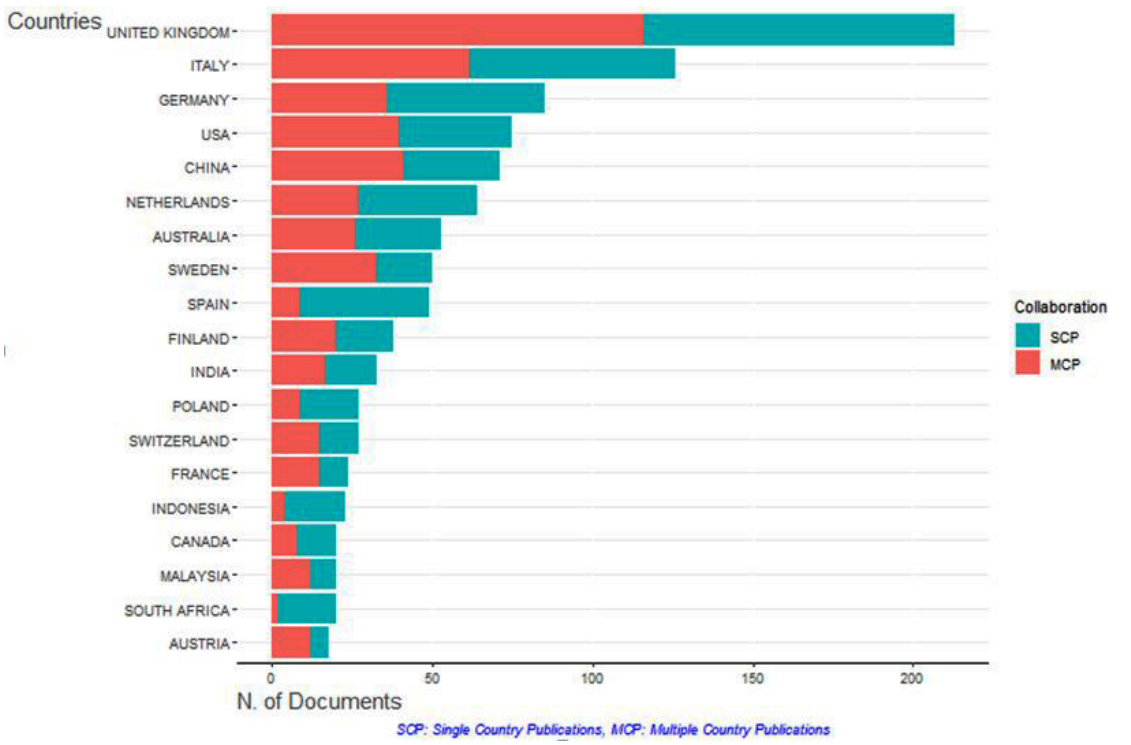


Figure 11: Corresponding Author's Countries

The author profiles provide information on the geographical distribution of authors, and research contributions in the field. The UK is first with 213 articles and shows a significant presence as an author interested in the field. Italy and Germany are also surprising, with 126

and 85 articles respectively, indicating a substantial contribution to the research environment. The United States and China also play a major role, presenting 75 and 71 articles respectively. Other countries such as the Netherlands, Australia, Sweden and Spain also showed significant participation, and each presented 49 to 64 articles.

Table 12: Country Scientific Production

S. No.	*Region*	*Freq..*	*S. No.*	*Region*	*Freq.*	*S. No.*	*Region*	*Freq.*
1	Uk	825	33	Belgium	42	65	Morocco	8
2	Italy	422	34	Greece	40	66	Serbia	8
3	Usa	387	35	Iran	40	67	Albania	7
4	Germany	313	36	Nigeria	39	68	Chile	7
5	Australia	248	37	Ireland	38	69	Liechtenstein	7
6	India	243	38	Lithuania	38	70	Sri lanka	7
7	China	235	39	Singapore	38	71	Ethiopia	6
8	Netherlands	226	40	Thailand	38	72	Latvia	6
9	Spain	185	41	Saudi Arabia	37	73	Uganda	6
10	France	133	42	Colombia	27	74	Argentina	5
11	Finland	132	43	New Zealand	23	75	Tunisia	5
12	Sweden	130	44	Egypt	19	76	Cameroon	4
13	Ukraine	127	45	Qatar	19	77	Mexico	4
14	Indonesia	125	46	Hungary	18	78	Uzbekistan	4
15	Malaysia	122	47	Cyprus	17	79	Montenegro	3
16	Switzerland	107	48	Croatia	15	80	Azerbaijan	2
17	Brazil	89	49	Slovenia	14	81	Fiji	2
18	Poland	85	50	Iraq	13	82	Georgia	2
19	Slovakia	85	51	Lebanon	13	83	Malta	2
20	South africa	83	52	Bahrain	12	84	Moldova	2
21	Portugal	77	53	Japan	11	85	North Macedonia	2
22	Czech Republic	74	54	Peru	11	86	Tanzania	2
23	Canada	73	55	Kazakhstan	10	87	Afghanistan	1
24	Austria	72	56	Kuwait	10	88	Algeria	1
25	Denmark	69	57	Luxembourg	10	89	Kenya	1
26	Jordan	68	58	Oman	10	90	Kyrgyzstan	1
27	Pakistan	55	59	Bangladesh	9	91	Mozambique	1
28	Norway	48	60	Bulgaria	9	92	Philippines	1
29	Romania	48	61	Israel	9	93	Uruguay	1
30	Turkey	47	62	Ecuador	8	94	Venezuela	1
31	South korea	45	63	Estonia	8	95	Yemen	1
32	United Arab Emirates	43	64	Ghana	8			

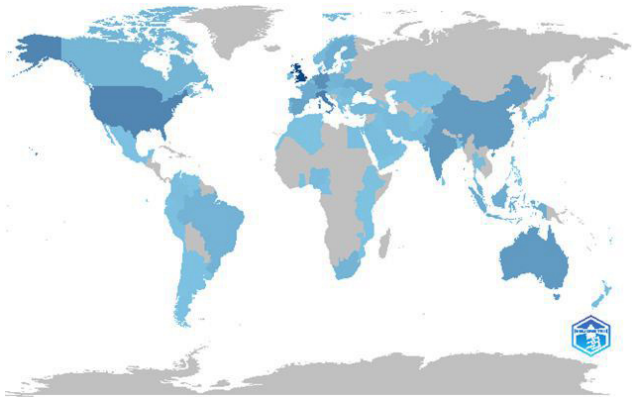


Figure 12: Country Scientific Production

By country, the number of scientific output emphasizes the different levels of research output in this field. The United Kingdom leads with 825 articles, followed by 422 articles of Italy, and the USA is third at 387 articles. Germany, Australia and India also have substantial contributions with 313, 248 and 243 articles. Details of the remaining countries are given in the table above.

Table 13: Most Cited Country

Country	*TC*	*Average Article Citations*	*Country*	*TC*	*Average Article Citations*
United Kingdom	12014	56.4	Australia	1630	30.8
Usa	4717	62.9	Finland	1224	32.2
Italy	4413	35	Sweden	1190	23.8
Netherlands	1898	29.7	China	1177	16.6
Germany	1875	22.1	France	1096	45.7

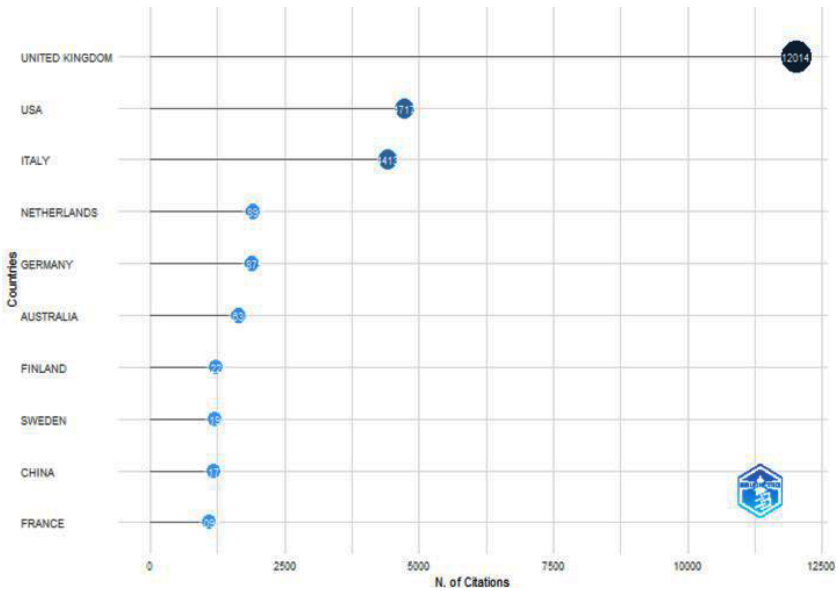


Figure 13: Most Cited Country

In the field of research on Artificial Intelligence and Corporate Governance, the UK ranks first with a total of 12,014 citations per article, averaging 56.4 citations per article, indicating its significant impact. The United States ranks second with 4717 citations and an average of 62.9 for each of the articles. This reflects its strong promotion of this interdisciplinary field. Italy, the Netherlands and Germany have made a notable contribution, each with appropriate citations and average impact of articles, and is active in the research of this field.

Table 14: Most Globally Cited Documents

Paper	*DOI*	*Total Citations*	*TC per Year*	*Normalized TC*
Foss Nj, 2017, J Manage	10.1177/0149206316675927	1192	149	13.428995
Gretzel U, 2015, Electron Mark	10.1007/s12525-015-0196-8	1025	102.5	11.4029666
Gawer A, 2014, Res Policy	10.1016/j.respol.2014.03.006	994	90.3636364	6.11155029
Dwivedi Yk, 2021, Int J Inf Manage	10.1016/j.ijinfomgt.2019.08.002	913	228.25	24.3544601
Bélanger F, 2011, Mis Quart Manage Inf Syst	10.2307/41409971	898	64.1428571	5.58457711
Nambisan S, 2019, Res Policy	10.1016/j.respol.2019.03.018	880	146.666667	13.3793103
Hashem Iat, 2016, Int J Inf Manage	10.1016/j.ijinfomgt.2016.05.002	745	82.7777778	9.32194792
Dwivedi Yk, 2020, Int J Inf Manage	10.1016/j.ijinfomgt.2020.102211	559	111.8	12.1666007
Hanelt A, 2021, J Manage Stud	10.1111/joms.12639	554	138.5	14.7780623
Dwivedi Yk, 2022, Int J Inf Manage	10.1016/j.ijinfomgt.2022.102542	527	175.666667	30.0929684

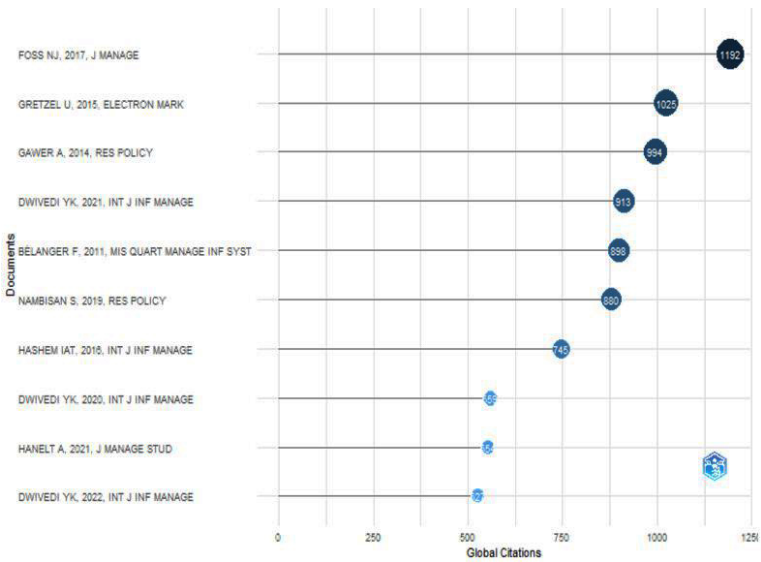


Figure 14: Most Globally Cited Documents

These documents, cited globally, are fundamental contributions beyond artificial intelligence and corporate governance. The "International Information Management Journal" was directed by DWINEI YK, which was particularly functional in 2022 and 2021, and these papers are the most cited, with publications of 527 and 30.09 citations. Other notable papers include research by Foss NJ in 2017 and a total of 1192 citations.

Table 15: Author Collaboration Network

No.	*Node*	*Cluster*	*Betweenness*	*Closeness*	*Page Rank*
1	Chen Y	1	96	0.00552486	0.02737134
2	Zhang J	1	0	0.00469484	0.02218708
3	Kumar A	1	0	0.00406504	0.01055426
4	Liu Y	1	34	0.00471698	0.0246453
5	Dhir A	2	196	0.00763359	0.01265455
6	Ferraris A	2	216	0.00900901	0.01707786
7	Bresciani S	2	234	0.01075269	0.01434397
8	Kumar S	3	35.5333333	0.00917431	0.02023295
9	Gupta S	3	0	0.00699301	0.00548232
10	Lim Wm	3	0	0.00884956	0.01374388
11	Dwivedi Yk	4	4.80173345	0.01136364	0.05053968
12	Kraus S	4	156.455462	0.01234568	0.04016477
13	Janssen M	4	3.01113953	0.01136364	0.03238121
14	Rana Np	4	0	0.01123596	0.03435073
15	Dubey R	4	2.72780619	0.01136364	0.02982516
16	Hughes L	4	3.09809605	0.01136364	0.0404647
17	Kar Ak	4	14.6952381	0.01149425	0.03304062
18	Mariani M	4	266.058824	0.01298701	0.02576669
19	Raman R	4	3.16476272	0.01136364	0.04129685
20	Stahl Bc	4	0	0.01123596	0.01747138
21	Baabdullah Am	4	2.72780619	0.01136364	0.02982516
22	Buhalis D	4	2.63432793	0.01136364	0.02745237
23	Duan Y	4	0	0.01123596	0.02714005
24	Jones P	4	0	0.01123596	0.02523301
25	Kumar V	4	0	0.00884956	0.01003723
26	Mardani A	4	0	0.01123596	0.01747138
27	Mogaji E	4	0	0.01123596	0.02398544
28	Pandey N	4	17.7581375	0.01162791	0.02928805
29	Parida V	5	182	0.00653595	0.03994722
30	Wincent J	5	0	0.00537634	0.02918949
31	Palmié M	5	0	0.00537634	0.02033057
32	Chatterjee S	6	3.66666667	0.00980392	0.01922285
33	Chaudhuri R	6	3.66666667	0.00980392	0.01922285
34	Mikalef P	6	0	0.00884956	0.00846686
35	Dabić M	7	0	0.00877193	0.00746296
36	Ferreira Jj	7	0	0.00877193	0.00927208
37	Chen L	8	0	1	0.02380952

No.	*Node*	*Cluster*	*Betweenness*	*Closeness*	*Page Rank*
38	Li S	8	0	1	0.02380952
39	Valaskova K	9	0	0.33333333	0.02870107
40	Kliestik T	9	0	0.33333333	0.02215583
41	Durana P	9	0	0.33333333	0.02215583
42	Kovacova M	9	0	0.33333333	0.02222537

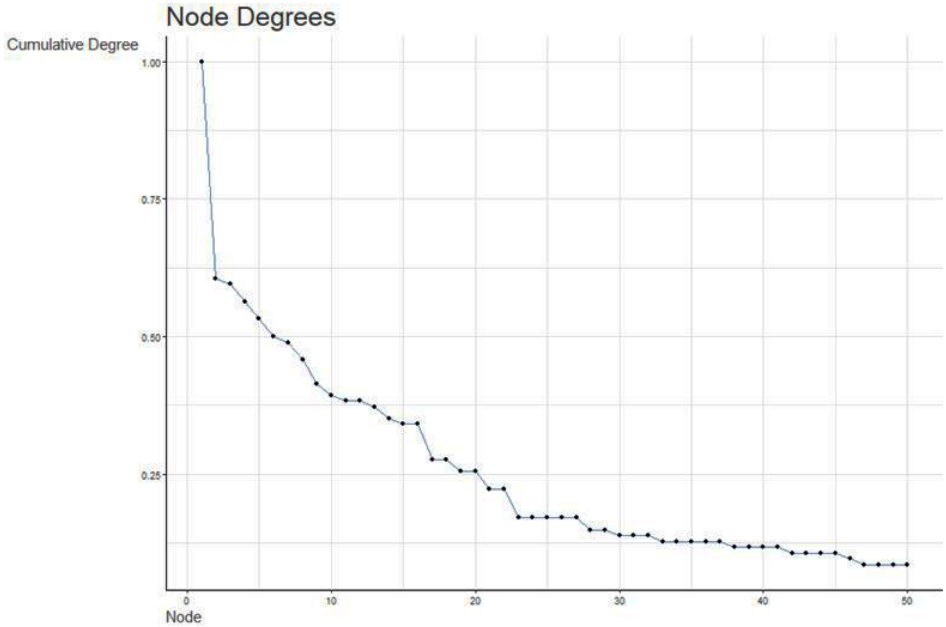


Figure 15

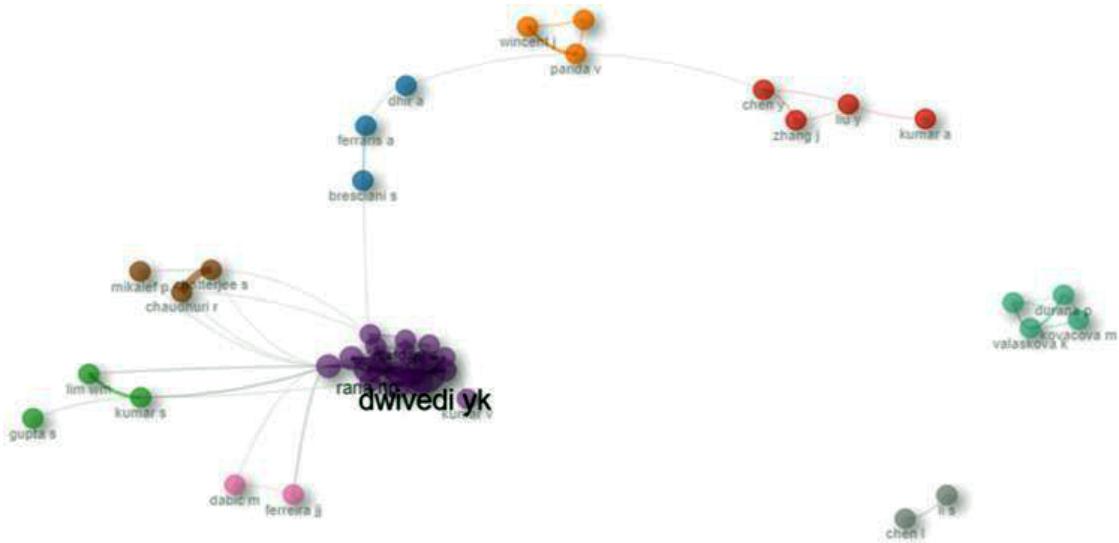


Figure 16: Author Collaboration Network

Author collaboration network analysis reveals different types of clusters. In particular, Dwivedi YK and Kraus S appear as the central characters of cluster 4 with significant betweenness centrality (4.80 and 156.46). This cluster includes other influential authors such as Janssen M and Rana NP, who contribute to the integrated network structure. Cluster 5 has a high paging centrality (0.0399) and a medium beach ness centrality (182), suggesting a powerful influence and effective communication within this subgroup. Cluster 8 is characterized by authors such as Chen L and Li S.



Figure 17: Collaboration World Map

This Figure 17 shows that Australia has the highest frequency of collaboration with Canada, China and India (10 times with each), followed by significant interactions with France (14) and the Netherlands (12). Germany collaborates most frequently with France (15), the Netherlands (16) and Switzerland (13). France has substantial collaboration with Denmark (8) and Switzerland (9). The data indicate a strong international partnership of research, particularly among Western countries, and highlight significant research exchanges, including countries such as China, India and Brazil.

COMPANIES EMBRACING AI

1. **JP Morgan Chase: COiN Platform –** JP Morgan Chase developed the Contract Intelligence (COiN) platform, which uses machine learning to analyze legal documents. In a pilot program, COiN reviewed 12,000 annual commercial credit agreements in seconds, a task that would typically take around 360,000 hours of human labour (Marr, 2018).
2. **Deloitte: Omnia Platform –** Deloitte's Omnia AI platform integrates various AI technologies to enhance audit processes. It uses natural language processing and machine learning to analyze vast amounts of structured and unstructured data, improving audit quality, efficiency, and risk assessment capabilities (Deloitte, 2021).
3. **HSBC: AI for Compliance –** HSBC implemented AI systems to enhance its anti-money laundering (AML) and know-your-customer (KYC) processes. This implementation has

reportedly reduced false positives by 20%, allowing the bank to focus on genuine risks more effectively (Finextra, 2019).

4. **ING: Predictive Analytics –** ING uses AI-powered predictive analytics to improve risk assessment and decision-making. Their system analyses historical data and market trends to predict potential credit risks and customer behaviour, leading to more accurate risk profiling (ING, 2020).
5. **AXA: AI in Claims Processing –** AXA implemented an AI system called Fizzy for flight delay insurance claims. The system automatically processes claims and initiates payouts when flight delays are detected, without requiring manual claims submission (AXA, 2018).
6. **EquBot: AI-Powered Investment Funds –** EquBot launched the AI Powered Equity ETF (AIEQ), which uses IBM's Watson AI to analyze and select stocks. The AI system processes millions of data points to make investment decisions, aiming to outperform traditional human-managed funds (ETF.com, 2021).
7. **PwC: Halo Platform –** PwC's Halo platform uses AI and data analytics to enhance auditing processes. It can analyze 100% of transactions, identifying anomalies and patterns that human auditors might miss (PwC, 2021).
8. **IBM Watson: Risk and Compliance –** IBM Watson for Regulatory Compliance uses natural language processing and machine learning to help organizations navigate complex regulatory environments. It has been adopted by various financial institutions to enhance their governance and compliance processes (IBM, 2021).

All are multinational corporations headquartered in Western countries, primarily the United States and the United Kingdom, with global operations that may include a significant presence in India While the adoption of AI in corporate governance is still evolving in India, there are some example of an Indian company adopting AI for corporate governance:

Tata Consultancy Services (TCS): ignio™ Platform Country: India

Tata Consultancy Services, an Indian multinational information technology services and consulting company headquartered in Mumbai, has developed and implemented an AI platform called ignio™. This cognitive automation solution is designed to enhance various aspects of corporate operations, including governance and compliance.TCS has not only implemented ignio™ within its operations but has also deployed it for various global clients, improving their corporate governance and operational efficiency (TCS, 2021).

Tech Mahindra: GAiA Platform Country: India

Tech Mahindra, an Indian multinational technology company, has developed GAiA, an AI and machine learning platform. While not exclusively focused on corporate governance, GAiA has applications that can enhance decision-making processes and risk management, which are crucial aspects of corporate governance (Tech Mahindra, 2022).

It's important to note that while these are examples of Indian companies developing AI solutions that can be applied to corporate governance, the specific use cases for corporate governance in Indian companies are not as extensively documented as those in Western counterparts. The adoption of AI in corporate governance is an evolving field in India, with many companies still in the early stages of implementation.

BENEFITS AND CHALLENGES OF AI IN CORPORATE GOVERNANCE

Artificial Intelligence (AI) has great potential to revolutionize the practice of corporate governance. From a benefits perspective, AI can analyze a huge dataset and identify complex models that may be overlooked by human analysts, to improve efficiency and accuracy. In addition, AI can increase transparency and responsibilities for a strong audit system that continuously controls activities, detects violations, provides regulations and national policies, and increases trust among stakeholders. However, the integration of AI into corporate governance is not a problem. The fear of data privacy and fear of AI handling systems should be taken into account, as the ethical practice of AI development, and powerful security measures. It may require a huge investment in technical infrastructure and data management systems.

CONCLUSION

The analysis has found a significant increase in publications in 2023, and demonstrates the growth of the research environment at the intersection of Artificial Intelligence (AI) and Corporate Governance. We particularly highlight the growth of countries such as the UK. The United States and Italy are focusing on influential institutions and authors, focusing on key areas such as decision-making, ethical consequences and risk management. This study emphasizes the transformative role of AI in management practice, provides valuable information to researchers, politicians and business leaders, and identifies gaps and future interests.Despite the intensive study of individual methods, such as AI, digital platforms and metadata, there is a significant gap in the integration of these different technological influences into a consistent structure applicable to different sectors. Various articles are focus on specific methods, but these methods are limited by the search for interrelationships in the context of the organization, as well as by the rules and management of the whole company. In addition, some studies provide future research programs, but they do not support the actual implementation of these results, especially to face the complexities and problems created by new technologies.The conclusion is that the use of AI requires appropriate management structures, internal collaboration, development and mitigation of ethical risks of AI. Progressive research and actual implementation are essential to the navigation of the complex relationship between new methods and corporate governance.

LIMITATIONS AND FURTHER DIRECTIONS OF THE STUDY

There are some restrictions on this analysis. the data was derived from the Scopus database and has taken only English language documents. if any researcher takes another database with many more languages. the findings may be different. The time frame of 2010-2024 may ignore past works and recent progress. in addition, if using software other than Biblioshiny tabulations and visualisation may be different. this methodology is quantitative. further research is needed for a general understanding of AI in corporate governance with the inclusion of a qualitative nature in, a different time frame.

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Leveraging Advanced Analytics and Machine Learning Techniques for Competitive Advantage in Laptop's Market Pricing Using R

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Abstract

Any IT professional, consumer, manufacturer or retailer must be aware of how laptop pricing dynamics are changing in computer industry at a phenomenal pace. We utilize advanced analytics and machine learning methods, specifically K-means clustering for market segmentation and Random Forest regression to estimate key factors in price fixation. This research attempts to analyze the changes in the prices of laptops over time and its impact on market strategies and consumer decisions. We utilize advanced analytics and machine learning methods specially K-means clustering in market segmentation and Random Forest regression to estimate main factors in price fixation for laptops. To achieve the objectives, we clean and normalize data using a high-performance model from the Kaggle dataset. We train the random forest model with 500 trees and predictor variables (RAM and SSD storage) to show how well this model captures price variability. K-means clustering for market segmentation gives four unique clusters in the form of processor brand, RAM type, graphics card capacity and display size. Paired T-tests support the view that laptop prices have reduced dramatically across the years.

Important insight gained in this research are in line with Porter's strategies for competitive analysis, Brynjolfsson and McAfee's ideas of technological progress and Kotler's principles of marketing. All these relevant theories and analyses contribute to businesses formulating with better strategies so that consumers can take prudent decisions to purchase cheap laptops. This study will help those willing to increase their market value with competitive advantage amidst a changing market diversified customer base for a laptop market. In coming times, the time series and multivariate analysis category will require future studies to better acquaint with the consumption behavior and market trends.

Keywords: *Advance Data Analytics, Machine Learning, K-means Clustering, Random Forest Regression, Laptop Market Pricing, R Programming Language*

INTRODUCTION

Being a part of inconsistent, ever-changing Tech industry working professionals, it becomes quite essential for consumers, manufacturers and retailers to understand the dynamics of laptop's pricing. Hence this study is highlighting the differences between the old and new laptop prices over time with particular emphasis on detecting significant patterns that would influence strategies at marketplace and consumer decisions.

This research paper will explore the concept of advanced data analytics techniques and tools with relation to price, laptop specifications and market segmentation using the Random Forest and K-means clustering technique respectively. In turn, it helps in devising better business strategies

and right consumer purchasing pattern of laptops. To achieve above-mentioned objectives, it takes better insights from technological progress postulated by Brynjolfsson and McAfee[1], real source of inspiration from Kotler's marketing management principles[2] and competitive analysis strategies devised by Porter [3]. In conclusion, this methodological synthesis of pricing analysis and market segmentation provides a critical view of the market landscape an invaluable resource for any stakeholder who longs for an increased competitive advantage with a wider consumer base.

DATA CLEANING AND PRE-PROCESSING

- **Language used:** R
- **Libraries used:** tidyverse, caret, randomForest, dplyr, factoextra
- **Data source:** The primary data set used for the report contains information sourced from https://www.kaggle.com/datasets/kuchhbhi/2022-march-laptop-data with a usability score of 10 [4].

– The analysis seeks to bring to the fore the differences between the old and new prices of laptops over time for a given set of data, with particular emphasis on detecting significant patterns that would influence strategies in the marketplace and consumer decisions.

– For Price analysis, Filter function is used to remove rows with the missing values in 'latest price' and 'old price'.

```
# Clean data - remove rows where any price is missing
laptops <- laptops %>%
  filter(!is.na(latest_price) & !is.na(old_price))
```

– Additionally, analysis seeks to dig out specific laptop features' that can influence in price of laptops using Random Forest;

Categorical variables have been converted into factors. It is crucial for random forest algorithm to interpret categorical data correctly.

```
# Convert all categorical variables to factors
categorical_vars <- c("processor_brand", "processor_gnrtn", "os", "os_bit", "warranty", "Touchscreen", "msoffice")
laptops_selected[categorical_vars] <- lapply(laptops_selected[categorical_vars], as.factor)
```

To make sure dataset is clean for modelling, rows with missing values have been removed using Naomi() function

```
# Handle any NA values
laptops_selected <- na.omit(laptops_selected)
```

Setting Up the Random Forest Model

Develop a Random Forest model using 500 trees, with the latest price as the target variable and all other selected variables as predictors.

The model is initialized with a random seed for reproducibility: set.seed(123). VarImpPlot() is a feature plotting feature importance, where one can view specifications posing greater impact on price.

```
# Training the Random Forest model
set.seed(123) # for reproducibility
rf_model <- randomForest(latest_price ~ ., data = laptops_selected, ntree = 500, importance = TRUE)

# Summary of the model
print(rf_model)

# Plotting feature importance
importance <- importance(rf_model)
varImpPlot(rf_model, type = 1, main = "Importance of Features in Predicting Laptop Prices")
```

- Lastly in analysis, the importance of segmentation is going to correlate the product offering with the customer interest which would enhance the marketing strategies for the highly competitive and dynamic laptop industry.
- For Market Segmentation, we make use of K means Clustering.

For clustering, only relevant features are selected, processor_brand, ram_type, graphic_card_gb, and display_size. Also, rows having missing values were removed using 'drop_na()'

```
# Select relevant features and remove any rows with NA values
laptops_selected <- laptops %>%
  select(processor_brand, ram_type, graphic_card_gb, display_size) %>%
  drop_na()
```

Categorical variables have been converted to numeric using one hot encoding and it has been done to avoid the ambiguity at factor levels.

```
# Convert all categorical columns to numeric using one-hot encoding
# This avoids the ambiguity of numeric conversion of factor levels
laptops_processed <- laptops_selected %>%
  mutate(across(where(is.character), as.factor)) %>%
  mutate(across(where(is.factor), as.integer))
```

The data was also normalized using scale() function to make sure all features are contributing equally to the clustering process.

```
# Double check if all columns are indeed numeric
if (!all(sapply(laptops_processed, is.numeric))) {
  print("Error: All columns must be numeric after processing.")
} else {
  print("All columns are now numeric. Proceeding with scaling and clustering.")
```

Using the Elbow Method, the optimal number of clusters is found. For various cluster numbers, we find the total within-cluster sum of squares and it was calculated for a different number of clusters(1:10). Elbow plot is generated for visualizing optimal number of clusters.

```
# Determine the optimal number of clusters using the Elbow method
set.seed(123)  # For reproducibility
wss <- map_dbl(1:10, ~kmeans(laptops_normalized, .x, nstart = 25)$tot.withinss)

# Plot the Elbow Curve to find the optimal number of clusters
elbow_plot <- qplot(1:10, wss, geom = "line") +
  ggtitle("Elbow Method for Determining Optimal K") +
  xlab("Number of Clusters K") +
  ylab("Total Within-Cluster Sum of Squares")
print(elbow_plot)
```

Further, four (4) number of optimal clusters are chosen and K-means cluster is performed and these clusters are visualized using fviz_cluster()

```
# Perform K-means clustering with the chosen number of clusters
optimal_clusters <- 4  # Assuming 4 is chosen based on the elbow plot
kmeans_result <- kmeans(laptops_normalized, centers = optimal_clusters, nstart = 25)

# Visualizing the clusters
fviz_cluster(kmeans_result, data = laptops_normalized, geom = "point") +
  ggtitle("Laptop Market Segmentation") +
  theme_minimal()
```

DETAILED ANALYSIS & MODELING SHOWING RESULTS TO COMPARE THE OLD PRICE VS LATEST PRICE

To make the above comparisons, scatter plot is used as it is easy to spot deviations from the expected trends, also line plot has been deployed to help check progression of prices over given

dataset additionally helping to track volatility of laptop prices. T-Test is used to cross check and statistically ascertain whether there is a significant difference between the new and old prices. This methodology is selected because it would be appropriate for comparing two related samples to infer if their mean differences are statistically significant to each other.

Analysis of Visual Output Scatter Plot (Old vs. New Prices)

- **Explanation:** The data clusters along the y = x line (dashed red line) indicate that previous laptop prices tended to compare very similarly to present pricing. While the number of points below this line is quite large, this obviously reflects that current prices are low from previous prices.
- **Visual Conclusion:** Laptop prices are decreasing and many are below the line of equality.

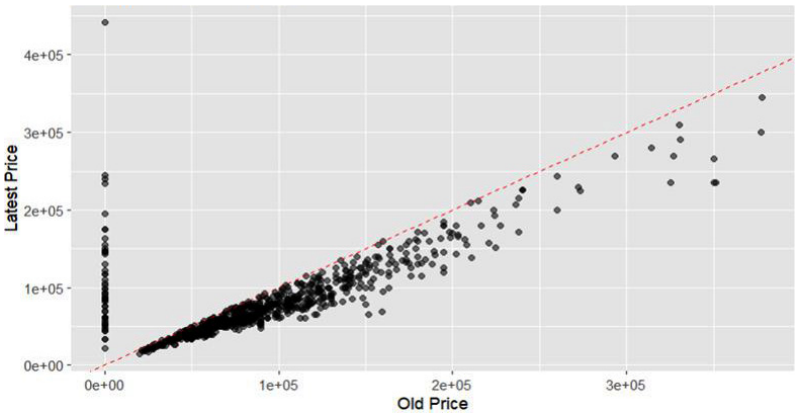


Figure 1: Analysis of Visual Output Scatter Plot (Old vs. New Prices)

Line Graph – Price Changes Over Data Set

- **Explanation:** This chart shows the spread of prices between the range from the high to low in the dataset. There seems to be some price variability; however, there is an easily identifiable pattern that recent prices (in red) systematically tend to undercut prior prices (in blue) by the formation of overlapping lines.
- **Visual Conclusion:** The price fluctuations are pretty variable and often have a tendency for the most recent prices to be below the old prices in many instances.

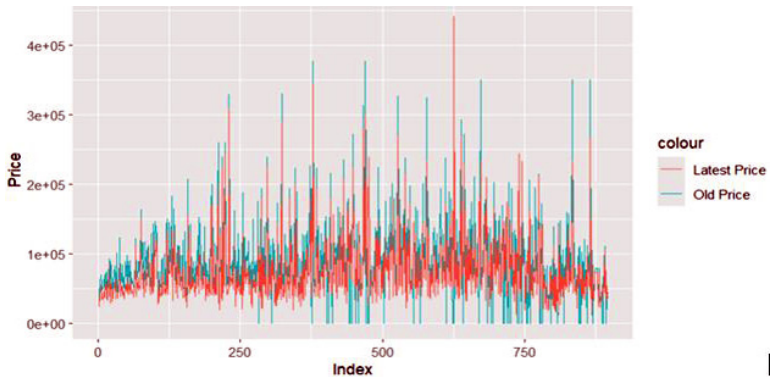


Figure 2: Line Graph – Price Changes Over Data Set

Analysis of Statistical Output (Paired T-Test Results)

```
> t_test_results

        Paired t-test

data:  laptops$latest_price and laptops$old_price
t = -9.4933, df = 895, p-value < 2.2e-16
alternative hypothesis: true mean difference is not equal to 0
95 percent confidence interval:
 -14268.81  -9379.78
sample estimates:
mean difference
      -11824.29
```

Figure 3: Analysis of Statistical Output using Paired T-Test Results

From the results of the paired sample T-Test with the t-value equal to –9.4933, it can be seen that statistically significant decrease in new laptop prices compared to the old prices. The test environment is robust since it has 895 degrees of freedom. The confidence interval ranging from –14268.81 to –9379.78, this result verifies that the mean reduction in price is substantial and is not going by pure random error. The mean difference (–11824.29) shows clear average decrease in prices of laptops.

Future Implications of the above Analysis

- **For business:** Insights can be utilised to tweak price and inventory strategies based on a more market-friendly perspective.
- **For customers:** The data provides a basis for making informed choices as to what product they must purchase, especially if it is to take advantage of the price discount.

SELECTION OF FEATURES TO DETERMINE LAPTOP PRICES USING RANDOM FOREST

Validation Summary of Configuration Models for Random Forests: The target variable latest price takes continuous values hence the appropriate type of model is regression which in this case Random forest is selected.

Performance Metrics

```
                Type of random forest: regression
                      Number of trees: 500
No. of variables tried at each split: 4

          Mean of squared residuals: 559023121
                    % Var explained: 74.24
```

Figure 4: Feature's Selection to Determine Laptop Prices using Random Forest

- **Number of Trees:** In that aspect, 500 trees seem to be a good number that will give some good trade-off between computational speed and performance. Generally, the more the number of trees, the better the model accuracy and stability.
- **Variables tried at each Split:** Normally, it would be good to try four variables at each split. This setting adds more randomness to the model-building process, in fact helping to reduce the variance in the predictions that the model makes. The mean squared residuals come out quite high which could possibly imply price variability for laptops that present a difficulty in trying to capture using the given features. However, the range of prices of laptops sets into

context what defines a high or low mean squared residual. Interpretation of Variance, 74% explained variance for the model is quite high and it suggests that the model explains a lot of variation in the factors influencing laptop prices.

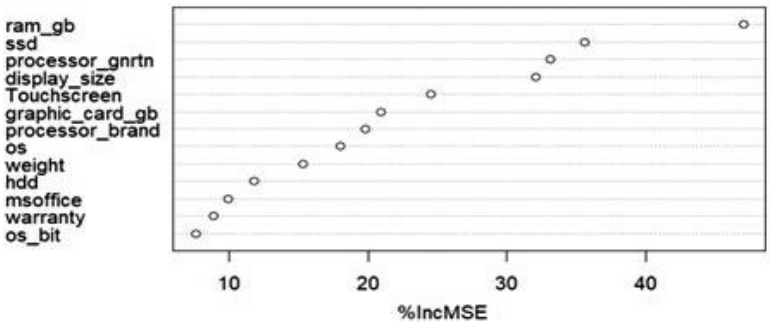


Figure 5: Important Product's Features to Influence in Predicting Laptop Prices

Important Observations for Product Features:

(a) Plot Interpretation: In this plot of percentage increase in Mean Squared Error (%IncMSE) by taking out of a variable, we are able to observe how the different variables come into action while predicting the laptop prices.

(b) Most Important Predictors: Most important predictors are RAM (ram_gb) and SSD storage (ssd), which makes perfect sense as these two will be the most impactful parts in regard to the price and performance of a laptop. Specifications like os_bit and warranty, it probably has lesser impact on the price.

Implications

1. For business: Understanding the importance of features helps to set a competitive price for laptops and aligning product features as per the customer needs.
2. For customers: Analysis easily establishes which features are premium so they can make more cost-effective choices.

MARKET SEGMENTATION USING K MEANS CLUSTERING

Elbow Curve to find the Optimal Number of Clusters

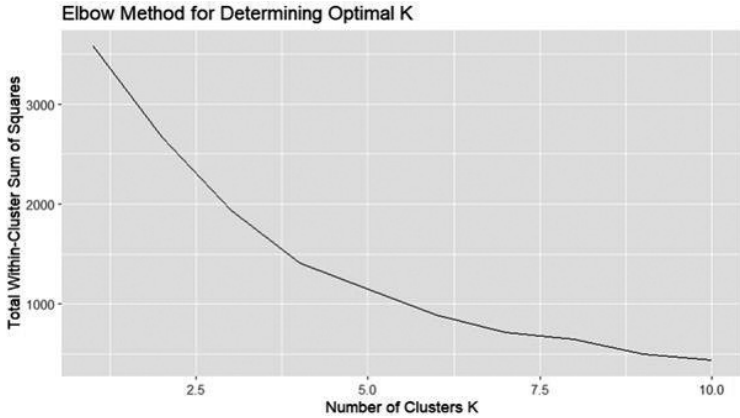


Figure 6: K-means Clustering with the Chosen Number of Clusters

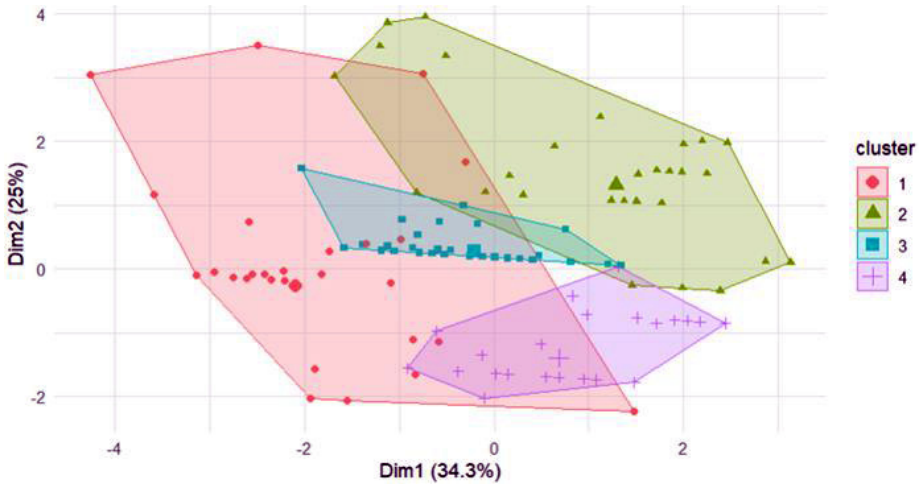


Figure 7: Laptop Market Segmentation

Cluster Centroids

	processor_brand	ram_type	graphic_card_gb	display_size
1	0.1922845	2.6308449	-0.2522774	-0.892174471
2	0.4567659	-0.3939162	1.8799966	0.483520927
3	0.5189516	-0.3311256	-0.4488809	0.004267545
4	-1.5957427	-0.3307140	-0.1111377	0.123320549

Figure 8: Cluster Centroids of Various Components of Computers

Interpretation of the Plot Clusters with Detailed and Output

Cluster 1 (Red Hexagons)

Cluster Centroid:

- `processor_brand`: 0.1922845
- `ram_type`: 2.6308449
- `graphic_card_gb`: -0.2522774
- `display_size`: -0.892174471

Figure 9: Red Hexagons Cluster Centroid Details

- **Processor Brand**: The slightly positive value of the Processor Brand cluster in this analysis indicates variety among the brands, with some being slightly biased toward better-known ones.
- **RAM Type**: The cluster mainly contains laptops with more advanced or modern types of RAM since the RAM type feature has a high positive value.
- **GB Graphic Card**: The rather negative value indicates that the laptops in this cluster would probably be having graphic cards less powerful as compared to laptops in other clusters.
- **Size of Display**: A negative value bodes well not at all. This signifies that on average, laptops from this cluster have a smaller display size.

Interpretation: This clustering most probably represents mid-range laptops with newer types of RAMS. They put relatively less emphasis on powerful graphics cards and smaller displays

compared to others. Business users or students requiring relatively high, reliable performance every day, but not needing high-end graphics capabilities in their typical tasks, might be possible target audiences for the designs.

Cluster 2 (Green Triangles)
Cluster Centroid:

- `processor_brand`: 0.4567659
- `ram_type`: -0.3939162
- `graphic_card_gb`: 1.8799966
- `display_size`: 0.483520927

Figure 10: Green Triangles Cluster Centroid Details

- **Processor Brand:** The more positive the value, the more likely people like specific - perhaps more expensive – processor brands.
- **RAM Type:** The negative value of the variable is indicative of this cluster containing laptops that belong to older and more affordable types of RAM.
- **Graphic Card GB:** This is a high positive value shows that all these laptops have pretty good graphic cards.
- **Display Size:** Laptops have display sizes larger than that of the Chromebook because the value is positive.

Interpretation: This cluster most likely consists of high-performance laptops with strong graphics cards, larger displays, and old types of RAM. Such laptops would be in the form of workstations or those gaming-oriented in nature. These are surely pretty good selections for users who require a lot more processing power and larger screens for graphic design, gaming, or even video editing.

Cluster 3 (Blue Squares)
Cluster Centroid:

- `processor_brand`: 0.5189516
- `ram_type`: -0.3311256
- `graphic_card_gb`: -0.4488809
- `display_size`: 0.004267545

Figure 11: Blue Square Cluster Centroid Details

Features

- **Brand of Processor:** The clusters that are scored with a large positive value show the strong affinity to certain high-end processor brands.
- **RAM Type:** We include some of the oldest and sometimes even cheapest RAM types if the scoop of the RAM type is in negative value.
- **Graphics Card GB:** If this number is lower, it means your graphics card is basic or weaker.
- **Display Size:** A value close to zero represents a screen size distribution where there is no clear trend either towards smaller or larger.

Interpretations: Analysing this cluster, it seems to gather laptops with older types of RAM and weaker graphic cards that put very high priority on the brand of the processor. Such laptops, available among many general-purpose models, can be potentially interesting for customers with higher priorities for processing speed over great graphic performance.

Cluster 4 (Purple Pluses)
Cluster Centroid:

- `processor_brand`: -1.5957427
- `ram_type`: -0.3307140
- `graphic_card_gb`: -0.1111377
- `display_size`: 0.123320549

Figure 12: Purple Pluses Cluster Centroid Details

Features

- **Processor Brand**: Strong -ve value shows a trend increasing with processor brands that are less-known or entry-level.
- **RAM Type**: Older or less expensive types of RAM may be included if the RAM type value is subtracted.
- **Graphic Card GB**: Slightly poor graphics cards are represented with a negative value.
- **Screen Size**: Slightly positive score means that there is a slight inclination for a bigger screen size.

Interpretation: This cluster most likely originates from budget laptops that are not associated with big names in processors, old models of RAM, and weak graphics cards. These are the kinds of notebooks that budget buyers end up with after realizing what they actually want is something that is fundamentally all-purpose and does not quite require a unit packed with top-of-the-line specifications.

Implications

1. **For Business:** Organizations can design their marketing initiatives based on the derived clusters toward specific groups. An example is it could target gamers and graphic designers (from cluster 2) for high performance laptops and less disposable income consumers for low-cost laptops in this case.
2. **For Customers:** Making Informed Decisions: Customers can make better choices during the purchase as they are knowledgeable about the value that can be availed relative to the needs. For example, a customer looking for high performance will be concentrating on Cluster 2.

CONCLUSION

In conclusion, this research underscores the critical insights gained by analyzing laptop pricing dynamics in the tech industry. The study utilized advanced data analytics techniques like Random Forest for feature importance and K-means clustering with R for market segmentation, revealing significant trends and patterns towards competitive advantages in Laptop pricing. It is evident from the findings that laptop prices have decreased over time, with RAM and SSD storage identified as pivotal factors influencing price variations. Statistical analyses further validated

these observations, emphasizing substantial decreases in newer laptop prices compared to older models.

These insights are invaluable for stakeholders in shaping competitive strategies and enhancing consumer decision-making processes. Businesses can leverage the findings to optimize pricing strategies, innovate product development, manage inventory effectively and personalize marketing efforts. Moreover, the study sets a foundation for future research avenues, including time-series and multivariate analyses, to deepen our understanding of consumer behavior and market dynamics in the evolving tech landscape. Finally, this research contributes a comprehensive framework for navigating the complexities of the laptop market, fostering informed decisions that align with both business objectives and consumer preferences in a rapidly changing technological environment.

FUTURE APPLICATIONS OF THE RESEARCH

In this line, future research can be enhanced by incorporating time-series and multivariate analysis for the analysis of consumer behaviour. To achieve competitive advantages in Laptop world pricing, five significant care should be taken of regarding customer decision-making and business strategy:

1. **Personalized Marketing Strategies:** With the knowledge obtained through meaningful market segmentation and main price drivers, a business can establish far more personalized marketing campaigns to increase customer satisfaction and conversation rates.
2. **Dynamic Pricing Models:** One can develop dynamic pricing models, modifying the inbuilt analysis methods used in this research study and change their laptop prices in real-time concerning feature importance, competitor pricing and market demand to sustain competitive advantage in market.
3. **Product Development and Innovations:** This would bring wider market acceptance and increase profitability by focusing on the most wanted features, such as RAM and SSD storage.
4. **Inventory Management:** This would further enable retailers to inventory management by using the older insights from market segmentation and pricing trends. Knowing which laptop models were likely to see price reductions, businesses would be better able to manage stock levels to avoid overstocking previous models and making way for new inventory before market demand picks up.
5. **Consumer Decision Support Tools:** These are consumer-oriented tools that assist buyers in very informed choices, assuring value for money by choosing a laptop most appropriate to their needs based on financial situation with such support tools.

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GURUGRAM UNIVERSITY

(A State Govt. University Established Under Haryana Act 17 Of 2017)

GURUGRAM UNIVERSITY BUSINESS REVIEW (GUBR)

ISSN: 2582-9718 (Online)

GUBR is an internationally recognized bi-annual peer-reviewed journal, featuring releases in both June and December annually. The journal seeks to promote high quality original research with a view to generate new knowledge and disseminate the same among academicians, practitioners and policy makers. It aims at creation of new intellectual capital by bridging the knowledge gaps in some of the frontier areas of research related to business issues. Papers with trans-disciplinary perspectives are encouraged. In addition, you may also submit Case Study, Book Review, and Perspective on various facets of business and management.

CALL FOR PAPERS (Volume 5, Issue 1)

Gurugram University Business Review (GUBR) seeks original and innovative theoretical, methodological and empirical research related to various facets of business in a global context. Papers with trans-disciplinary perspective are encouraged. Contributions in diverse fields of management and business in a global context covering (but not limited to) the following disciplines are invited:

- Economics and Economic Environment
- Business Strategies Post-Covid period
- AI & ML in Business
- Business Analytics
- Economics and Business Economics
- International Trade, Investment and Business
- Corporate Governance
- Technology Management
- Knowledge Economy and Knowledge Based Development
- International Strategic Management
- International Marketing
- International Finance
- Strategic Applications of Information Technology
- Human Resource Management

In addition you may also submit Case Study, Book Review, and Perspective on various facets of business and management.

MANUSCRIPT SUBMISSION & REVIEW PROCESS

All papers submitted to GUBR will go through a double blind review process as per the standard procedures of well-known referred journals. Only those papers/articles/case studies, which are complete in all respects and are duly formatted, will be considered for publication. GUBR follows the APA style for citation and referencing. It is the author's responsibility to obtain permission of

copyright issues wherever required. The editorial team has the right to modify or edit the work in order to match the standard and style requirement of the journal. The papers can be sent to: *editor.gubr@gmail.com* latest by May 15, 2025.

GUIDELINES FOR AUTHORS

A. Typescript Guidelines

1. The original typescript should be submitted electronically in A4 size format, with a word count of 4000–6000 (including figures and tables).
2. Typescript should have double line spacing at the time of submission.
3. A final paper which would exceed 6000 words or occupy more than 15 pages of the Journal may be returned for abridgement.
4. The text of the paper should include title, abstract, keywords, text, references & notes, tables, figure captions, figures, but not the names of authors, their biographical notes or any acknowledgements. Author needs to submit a separate file containing the title of the paper, plus the names affiliation and complete addresses, e-mail and contact number of author(s), and an abstract, keywords, and any acknowledgements.
5. Author(s) name(s) is/are not to be included in the document/file properties.
6. All papers must be written in English. If English is not your first language, please ask an English-speaking colleague/expert to proofread your paper.

B. Title, Abstract, Keywords, Addresses, Biographical Notes

1. Title: as short as possible.
2. Authors Affiliation Details and Address: Author Name and Position, department, name of institution, full postal address and email address for each author.
3. Abstract: approximately 150 maximum
4. Keywords: 5–7 words or phrases.
5. Biographical notes: approximately 100 words per author, maximum 150.

C. References and Notes

1. GUBR uses the APA (name and date) short reference system for citations in the text with a detailed alphabetical list at the end of the paper. For example ‘Large (2010) suggests…’ or ‘Liang and Zeger (1986) found that…’
2. Footnotes, if any, should be short, succinct notes making a specific point, may be placed in number order following the alphabetical list of references.
3. References should be made only to works that are published, accepted for publication (not merely ‘submitted’), or available through libraries or institutions. Any other source should be qualified by a note regarding availability.
4. References should be mentioned only for those scholars whose name is mentioned in the paper.

D. Ethical Guidelines for Authors

1. **Content:** All authors must declare they have read and agreed to the content of thesubmitted manuscript.
2. **Ethics:** Manuscripts may be rejected by the editorial office if it is felt that the work wasnot carried out within an ethical framework.

3. **Plagiarism:** Plagiarism in any form constitutes a serious violation of the most basic principles of scholar writing and cannot be tolerated. Examples of plagiarism include:
   (a) Word-for-word copying of portions of another's writing without enclosing the copied passage in quotation marks and acknowledging the source in the appropriate scholarly convention.
   (b) The use of a particularly unique term or concept that one has come across in reading without acknowledging the author or source.
   (c) The paraphrasing or abbreviated restatement of someone else's ideas without acknowledging that another person's text has been the basis for the paraphrasing.
   (d) False citation: material should not be attributed to a source from which it has not been obtained.
   (e) False data: data that has been fabricated or altered in a laboratory or experiment; although not literally plagiarism, this is clearly a form of academic fraud.
   (f) Unacknowledged multiple submission of a paper for several purposes without prior approval from the parties involved.
   (g) Unacknowledged multiple authors or collaboration: the contributions of each author or collaborator should be made clear.
   (h) Self-plagiarism/double submission: the submission of the same or a very similar paper to two or more publications at the same time.

E. Manuscript Guidelines

1. Fonts
   - Font Type: Times New Roman Font Size (Text): 12
   - Font Size (Tables and Figures): 12
2. Paragraph
   - Alignment: Left
   - Outline Level: Body Text
   - Indentation: Left: 0
   - Right: 0
   - Spacing: Before: 0 After: 0
   - Line Spacing: Double
3. Page Setup Margins
   - Top: 2.5 cm
   - Bottom: 2.5 cm
   - Left: 1.5 cm
   - Right: 1.5 cm
   - Gutter: 0
   - Paper Size: Letter
4. Structure of Paper
   - Abstract with Key words
   - Introduction
   - Literature Review
   - Research Method

- Analysis and Discussion
- Conclusion
- Limitations of the Study
- Scope for Further Research References

5. Word Count
   - Article/Research Paper/Case Study: 6000 words maximum

F. Address for Correspondence:

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The Editors



Prof. (Dr.) Amarjeet Kaur Malhotra is a self-acclaimed corporate trainer; an accomplished academician; an exemplary leader and an action-oriented self-motivated individual; Dr. Amarjeet has more than three decades of experience in education and food industry. She is currently working as professor of Accounting; Dean, Faculty of Commerce & Management, Dean-Students' Welfare and Director, Centre of Excellence for Gender Studies at Gurugram University, Gurugram, India. She is a Certified Management Accountant (CMA) from the Institute of Management Accountants (IMA), USA. She has dual master's degree: an MBA from The University of the West of the Scotland (UWS), UK and M.Com from MD University, India. She has traveled extensively and had taught at two prestigious Universities of USA, viz., College of Business (AACSB accredited) at Valparaiso University, Indiana and North Dakota State University, North Dakota. She is a visiting professor at IIM, Sambalpur, Odisha, India. She has 11 books (authored or edited) and 62 research papers to her credit; about half of these papers are published in Emerald, Sage, Inderscience and ABDC listed journals. She has been conferred with many awards in recognition to her contribution in the academia. She is a very dedicated person, who loves and admires nature and enjoys yoga and travelling.



Prof. Niclas Erhardt joined Valparaiso University as dean of the College of Business in 2020. In this role, he is responsible for the strategic leadership, coordination, and guidance of the College. Dean Erhardt previously served as associate dean and interim dean of the Maine Business School at the University of Maine. Dean Erhardt has 18 years of higher education experience and has taught at the University of Maine, Providence College, and Rutgers University. Dean Erhardt is widely published and has authored numerous journal articles including work featured in Journal of Management, Corporate Governance, International Small Business Journal, International Journal of Contemporary Hospitality Management, and International Journal of Human Resource Management. His expertise includes human resource management, organizational design, workplace diversity, sustainability and creativity. Dean Erhardt believes in the importance of integrating teaching, research, and applied learning to deliver transformative education. He has spent his career strengthening and connecting students, faculty, alumni and the business community.



Dr. Surabhi Goyal is Associate Professor & Chairperson at Department of Management and Coordinator for Unnat Bharat Abhiyan at Gurugram University, Gurugram, India. She is a keen learner, passionate mentor, learned academician and a harmonious team worker. Dr. Goyal is a management graduate from Institute of Management Studies & Research, M.D. University, India, UGC-NET (JRF), M. Phil from C.D.L University, India and Ph.D. from GGSIPU, New Delhi. A continual learner and with an experience of around 17 years in teaching and research, she published a book and 22 papers in various national and international journals, conference proceedings. Three research scholars also got their Ph.D. degrees awarded under her guidance. She polished her teaching skills and knowledge by participating in various FDPs organised by IIM, Central and State Universities, Online refresher courses and certifications by Swayam, UGC, All India Management Association (AIMA) and many eminent private institutes in India. She has conducted several MDPs and FDPs of national repute in the area of Accounts and Finance. Her areas of interest are Corporate Finance, Personal Finance, Investment Banking, Income Tax, Accountancy, Intellectual Property Rights and Banking & Insurance.



Dr. Tabassum Ahmed has an experience of more than 12 years in various fields like academics, aviation, BPO and banking, with well-known organisations like JERC Jaipur, Genpact, IndiGo Airlines and SBI. She joined State Bank of India as a Probationary Officer in 2012 and holds an excellent track record of more than nine years in the banking sector. She is an engineering graduate and holds a Ph.D degree in Management. She has qualified UGC-NET and has been awarded a JRF in management in the year 2019. Her areas of interest include Human Resource Management and Marketing in general and Organisational Behaviour and Customer Relationship Management in particular. In a short span of her academic career of two years, she has published a book, filed a patent, convened an International Conference and has published several research papers. She is a keen learner who believes that acquiring knowledge and gaining wisdom is a never ending process in life.

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ISBN: 978-93-92877-77-3

MRP ₹999
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