



Assessing Training-to-Employment Outcomes Across Indian States *Evidence from the Suryamitra Skill Development Programme*

Dhanraj Sharma¹, Ruchita Verma² & Prince³

ABSTRACT

The present study attempts to examine the attainments of the Suryamitra Skill Development Programme (SSDP) across Indian states from 2015-16 to 2024-25. This investigation involves focus on the growth, market share of trained candidate, and their subsequent placement. To achieve this objective, the data is collected from the National Institute of Solar Energy (NISE). Apart this, the various report of SSDP is used to collect the information about the trained and placed candidates. The collected data is analysed with the help of the descriptive statistics as well as BCG Matrix to determine variation in the efficiency of program across states. The findings reveals that significant regional differences exist as the states viz., Bihar, Rajasthan, Uttarakhand, and Tamil Nadu performed well in terms of trained and placed candidates, whereas, north-eastern and smaller union territories are lagged behind. The BCG classification reveals the presence of structural imbalances as the few states seeing sustainable growth. Despite the development of solar skill capacity across the various states of the country, the SSDP placement results remain unequal. Hence, the study emphasises the pertinent importance of targeted policy initiatives, strengthening industry alliances and stronger monitoring systems for ensuring fair and sustainable development in India's renewable energy skill ecosystem.

Keywords: Suryamitra Skill Development Program (SSDP), Employment, Training, Placement, Skill

INTRODUCTION

The Government of India (GOI) under the Ministry of New and Renewable Energy (MNRE) has launched the Suryamitra Skill Development Programme (SSDP) in the year 2015. The GOI took this initiative to develop the competent workforce to meet the increasing demand of the solar energy industry. The nodal agency to serve this initiative is the National Institute of Solar Energy (NISE), which seeks to inculcate skill by extending training to young people, women, and marginalized communities, particularly from rural areas. The dimensions on which the training is imparted include installation, operation, and maintenance of solar photovoltaic systems.

In practice, the SSDP is a residential training program of 600 hours that follows the Qualification Pack SCG/Q0101 and further compliance with the National Skill Qualification Framework (NSQF). Although no

rigorous eligibility criteria, yet any candidates with an ITI or Diploma are eligible to get training under program. However, as residency requirement has to be complied by the participants, the program promotes practical skills and entrepreneurship in the area of renewable energy, with boarding and housing available at the registered training institutions. On the completion of the program, the participants will get certification from the Skill Council for Green Jobs.

According the Statistics released by NISE, 2024, the number of candidates who had already been trained under this program is 57371 and a significant proportion finding employment in the solar energy sector. Considering the relevance of the SSDP, the present study is an attempt to evaluate its effectiveness with the investigation of state-specific statistics on the total number of individuals trained and their placement subsequent training between the years 2015-2024. It

¹ Department of Financial Administration, School of Management, Central University of Punjab.

² Department of Financial Administration, School of Management, Central University of Punjab. E-mail: ruchitaverma@cup.edu.in

³ Department of Financial Administration, School of Management, Central University of Punjab.

assesses the growth trends and market share of trained candidates under SSDP across different Indian states for the period under consideration. It also gauges the factors influence the employment rate and regional disparities if any to evaluate the placement opportunities for the trained candidates under SSDP.

The rest of the paper is organized as follows: The review of literature is dealt with first, followed by the research methodology applied. Next, the empirical analysis of results is presented and discussed. Finally, the paper concludes.

LITERATURE REVIEW

This section deals with the review of existing literature in context of solar energy in India. It emphasized the immense importance of extensive innovation in technology and its adoption along with its effective legislative framework to derive the maximum gain at regional as well state level. Sathish (2024) highlighted that despite continuously pushed by the changing policy frameworks, the discrepancies continue to obstruct the progress of solar energy in India both at institutional and regulatory level. Yadav et al. (2024) depicted that the major obstacle to expand the application of solar energy include the requirement of huge capital, technological innovation with adoption, and land-use restrictions. Research in India on photovoltaic potential, as renowned by Ghosh (2024), analysed the impact of long-lasting radiation patterns and uncertainty in the climate prediction on the capacity and reliability of forecasts. Shufian and Shaikh (2024) suggested that for the Indian conditions the rooftop solar-based residential systems is the optimum solution. Whereas, Sinha (2024) assessed and highlighted that the hybrid PV design of solar system can improve the reliability in various climatic locations.

Several studies depicted the mixed result on the employment gains from any formal technical training to the participant. These studies are conducted under different environment of controlled and quasi-experimental investigations which shown positive but inconsistent returns of training to the participants (Maitra and Mani, 2017; Chakravorty et al., 2024). On the other hand, a systematic evaluation of large Indian schemes has shown modest to limited placement outcomes in many contexts (Chakravorty and Bedi,

2019; Kumar et al., 2019). The existing research presented the immense importance of demand-side linkages, regional heterogeneity, and program quality are key drivers that drive significant outcome such program across various states. The studies documented that improvement in the infrastructure, bridging gap in the employer-engagement, urban-rural and social-group differences with the enhanced role of information assistance to increase with placement. (Agrawal, 2012; Banerjee, 2016; Gupta et al., 2023). The experimental research suggested that retention in program and placement can be significantly enhanced and matched with the supply and demand gap with the continuous small intervention (Chakravorty et al., 2024). Over time the methodological thread has extensively stretched with the application of indicators of growth rate, portfolio classification as well as market share indicators, to compare various units. Gunasekarage et al. (2020), García-Vidal et al. (2023), and Fu et al. (2022) applied the framework of growth-share and BCG matrix in the non-commercial and public sector undertakings to validate the aid in strategic prioritization with the application of these two-dimensional techniques in conjunction. In nutshell, all these studies supported the research in context of program meant for training and placement. However, the present study focuses on the analysis of SSDP with coverage of followings: (a) descriptive and longitudinal assessment of training and placement across states; (b) focus on removal of regional inequalities and placement outcomes; and (c) the use of growth rate and sharing style BCG matrix framework as a transparent and policy relevant tool.

METHODOLOGY

Research Design

In order to achieve the objective of the present study secondary data is majorly drawn from the official web site of SSDP and its associated training partners across various states has been used. Apart this, the additional information collected from the National Institute of Solar Energy (NISE) and Annual Reports of the SSDP is used to enhance the completeness and credibility of the dataset.

Data Scope and Coverage

The data is collected and analysis of the performance of the Suryamitra Skill Development Programme

(SSDP) over a period of 10 years is carried i.e. from the year 2015-16 to 2024-25. The study focuses are on two major central indicators, viz., the number of applicants trained under the SSDP; and their placement outcomes across the various states of India. As the placement, related information is available only until the year 2020-21. Hence, the second indicator is analysed till 2020-21 and acknowledged as methodological limitation of the study.

Analytical Techniques

The collected data is analysed with a set of quantitative methodologies employed to assess the performance of the SSDP. It include the determination of the variation in the participation and placement post participation in

the various states with the application of the descriptive statistics; calculation of the growth rate to evaluate the sequential movements in training of the participants under SSDP and their subsequent placement outcomes across the various states; determination of market share to know the relative contribution of each state to overall performance of the SSDP; and BCG Matrix analysis (Singh and Kumar, 2023; Patel and Rao, 2022; Sharma et al., 2024) is used to determine the relative positioning of the Indian states in terms of trained and placed.

RESULTS AND DISCUSSION

The longitudinal assessment as shown in the Table 1 depict the growth rate and market share of the

Table 1: Training Related Growth Rate and Market

	States	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
1	Andaman & Nicobar (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
2	Andhra Pradesh	N/A (0.0902)	0.6936 (0.0473)	-0.4698 (0.0258)	1.1991 (0.0390)	0.0517 (0.0390)	-0.5512 (0.0502)	-0.4521 (0.0453)	-0.5000 (0.0188)	-0.5000 (0.0412)	2.0000 (0.0000)
3	Arunachal Pradesh (NER)	N/A (0.0115)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0390)	N/A (0.0000)	N/A (0.0113)	-1.0000 (0.0000)	N/A (0.0000)	1.0000 (0.0000)
4	Assam (NER)	N/A (0.0115)	4.0333 (0.0180)	0.6689 (0.0309)	0.5873 (0.0336)	0.4025 (0.0336)	-0.7362 (0.0339)	-0.3919 (0.0340)	-0.6667 (0.0094)	1.0000 (0.0000)	-1.0000 (0.0204)
5	Bihar	N/A (0.0115)	12.4000 (0.0478)	-0.2861 (0.0351)	0.4634 (0.0353)	0.3524 (0.0353)	-0.6849 (0.0410)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	0.4000 (0.0191)
6	Chandigarh (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0071)	0.5517 (0.0076)	0.0000 (0.0076)	-1.0000 (0.0000)	N/A (0.0113)	0.0000 (0.0094)	-1.0000 (0.0000)	N/A (0.0000)
7	Chhattisgarh	N/A (0.0345)	3.1000 (0.0439)	0.1057 (0.0500)	-0.1176 (0.0302)	1.1611 (0.0302)	-0.7378 (0.0468)	-0.8627 (0.0106)	0.0714 (0.0094)	2.0000 (0.0137)	0.0000 (0.0191)
8	Dadra & Nagar Haveli Daman & Diu (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
9	Delhi (UT)	N/A (0.0192)	-1.0000 (0.0000)	N/A (0.0222)	0.1105 (0.0169)	0.1940 (0.0169)	-0.8750 (0.0069)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0124)	N/A (0.0000)
10	Goa	N/A (0.0115)	0.0000 (0.0036)	0.8000 (0.0066)	0.1111 (0.0050)	0.9500 (0.0050)	-0.7436 (0.0069)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
11	Gujarat	N/A (0.1140)	2.2121 (0.1135)	-0.6488 (0.0410)	0.6418 (0.0462)	0.5564 (0.0462)	-0.6951 (0.0598)	-0.7701 (0.0227)	0.4000 (0.0263)	-0.6429 (0.0412)	3.0000 (0.0000)
12	Haryana	N/A (0.0200)	1.3269 (0.0144)	2.0909 (0.0458)	0.0428 (0.0327)	0.2308 (0.0327)	-0.8208 (0.0197)	-0.3256 (0.0219)	0.0345 (0.0182)	-0.0167 (0.0137)	-1.0000 (0.0204)
13	Himachal Pradesh	N/A (0.0000)	N/A (0.0043)	2.8333 (0.0169)	0.0870 (0.0126)	-0.2000 (0.0126)	-0.7500 (0.0069)	0.0000 (0.0113)	0.0000 (0.0094)	0.0000 (0.0000)	-1.0000 (0.0000)
14	Jammu & Kashmir (UT)	N/A (0.0100)	-1.0000 (0.0000)	N/A (0.0073)	1.6333 (0.0133)	0.9367 (0.0133)	-0.5229 (0.0335)	-0.5890 (0.0227)	-0.0333 (0.0188)	4.6897 (0.1372)	0.0909 (0.1340)
15	Jharkhand	N/A (0.0000)	N/A (0.0181)	0.2171 (0.0227)	-0.0270 (0.0151)	0.4944 (0.0151)	-0.7770 (0.0138)	-0.5000 (0.0113)	0.0000 (0.0094)	0.0000 (0.0000)	-1.0000 (0.0191)
16	Karnataka	N/A (0.0345)	3.6667 (0.0500)	0.2214 (0.0628)	-0.3216 (0.0292)	0.0431 (0.0292)	-0.7824 (0.0181)	0.1392 (0.0340)	-0.3333 (0.0188)	1.0000 (0.0137)	0.5000 (0.0000)
17	Kerala	N/A (0.0219)	2.0877 (0.0209)	-0.3182 (0.0147)	0.1833 (0.0119)	0.6901 (0.0119)	-0.6250 (0.0206)	-0.3333 (0.0227)	0.5000 (0.0282)	-0.6667 (0.0133)	-1.0000 (0.0089)

	States	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
18	Ladakh (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0069)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	-1.0000 (0.0191)
19	Lakshadweep (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0037)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
20	Madhya Pradesh	N/A (0.1032)	0.8290 (0.0585)	0.2134 (0.0731)	0.9497 (0.0977)	0.3883 (0.0977)	-0.6689 (0.1226)	-0.6636 (0.0680)	2.3222 (0.1872)	-0.0468 (0.1766)	-0.0544 (0.1123)
21	Maharashtra	N/A (0.2533)	0.2561 (0.986)	-0.3233 (0.0687)	0.5740 (0.0741)	0.4439 (0.0741)	-0.8384 (0.0472)	0.1650 (0.0906)	-0.1250 (0.0657)	0.0000 (0.0274)	0.2857 (0.0147)
22	Manipur (NER)	N/A (0.0115)	0.0000 (0.0036)	0.0000 (0.0037)	1.0000 (0.0050)	-1.0000 (0.0050)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0137)	N/A (0.0191)
23	Meghalaya (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0069)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
24	Mizoram (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
25	Nagaland (NER)	N/A (0.0115)	-1.0000 (0.0000)	N/A (0.0037)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0094)	-1.0000 (0.0000)	N/A (0.0000)
26	Orissa	N/A (0.0000)	N/A (0.1107)	-0.7121 (0.0328)	1.1157 (0.0476)	-0.0988 (0.0476)	-0.6477 (0.0413)	-0.3333 (0.0453)	0.0000 (0.0376)	0.0000 (0.0000)	0.2500 (0.0000)
27	Pondicherry (UT)	N/A (0.0000)	N/A (0.0074)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0113)	-1.0000 (0.0000)	N/A (0.0000)	-1.0000 (0.0000)
28	Punjab	N/A (0.0115)	0.0667 (0.0038)	3.4063 (0.0173)	-0.1489 (0.0101)	-0.3000 (0.0101)	-0.6786 (0.0062)	4.5185 (0.0563)	-0.1946 (0.0376)	-0.0083 (0.0133)	-0.2605 (0.0377)
29	Rajasthan	N/A (0.0203)	9.9623 (0.0691)	0.0275 (0.0731)	0.2982 (0.0651)	0.4400 (0.0651)	-0.6855 (0.0804)	0.2479 (0.1654)	-0.0411 (0.1315)	0.8548 (0.0663)	-0.0449 (0.1627)
30	Sikkim (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	-1.0000 (0.0000)
31	Tamil Nadu	N/A (0.0468)	2.5738 (0.0519)	0.5413 (0.0823)	0.3571 (0.0766)	0.2412 (0.0766)	-0.7800 (0.0571)	-0.1566 (0.0793)	-0.1524 (0.0557)	0.6742 (0.0000)	-0.5134 (0.0498)
32	Telangana	N/A (0.0345)	2.0444 (0.0326)	1.1898 (0.0735)	0.5833 (0.0798)	0.4747 (0.0798)	-0.7102 (0.0931)	-0.7783 (0.0340)	-0.6667 (0.0094)	2.0000 (0.0412)	-0.3333 (0.0574)
33	Tripura (NER)	N/A (0.0230)	-1.0000 (0.0000)	N/A (0.0034)	1.1429 (0.0050)	-0.5000 (0.0050)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0137)	N/A (0.0000)
34	Uttar Pradesh	N/A (0.0710)	2.5892 (0.0790)	0.1973 (0.0973)	0.2126 (0.0809)	0.6639 (0.0809)	-0.6584 (0.1256)	-0.4069 (0.1227)	1.2154 (0.2254)	-0.4667 (0.3477)	0.9505 (0.2668)
35	Uttarakhand	N/A (0.0230)	4.1833 (0.0370)	-0.7492 (0.0096)	1.9615 (0.0194)	0.1385 (0.0194)	-0.6616 (0.0204)	-0.6629 (0.0113)	1.8667 (0.0269)	-0.6512 (0.0137)	1.8333 (0.0191)
36	West Bengal	N/A (0.0000)	N/A (0.0661)	0.0144 (0.0691)	1.3280 (0.1102)	0.1927 (0.1102)	-0.9042 (0.0344)	0.0000 (0.0566)	-0.2000 (0.0376)	0.0000 (0.0000)	-0.2500 (0.0000)

Source: Authors' compilation

Note: Values outside the brackets represent growth rate of number of trainees under SSDP and values inside the brackets represent market share in the that particular year.

participants trained under the SSDP from the year 2015-16 to 2024-25. It indicates that the extensive disparities exist in the growth rate of the training and market share of the among the various states (National Institute of Solar Energy, 2024). The states namely Bihar, Rajasthan, Uttarakhand and Telangana consistently exhibit the strong outcomes and therefore occupying the status of high performing states. It reflects that the vocational initiatives can yield significant gains as

and when supported by the institutional capacity and implementation of the sustained programme (Agrawal, 2012; Banerjee, 2016).

Training related Descriptive Analysis of the Growth Rate and Market Share

In case of Bihar, the growth rate is 12.40% in the year 2016-17 with the market share of 0.0478 and improvements are observed in the subsequent years.

It provides that the skills training program in the regions like Bihar often leads to progress in the employment outcomes (Chakravorty & Bedi, 2019). Similarly, Rajasthan exhibit an exceptional growth rate (market share) of 9.96 (0.0691) in the year 2016-17, highlighting its strong training mechanism which has to be aligned with the expansion of the renewable energy (Sathish, 2024; Singh & Kumar, 2023). Conversely, various other states viz., Kerala, Madhya Pradesh and Delhi shows the inconsistent or adverse growth rate. Such structural and regional constraints in the pattern of trends highlights the diverse degree of the vocational engagement and participation in the states of India (Kumar et al., 2019; Patel & Rao, 2022). At the same time, the Northeastern states and union territories namely Arunachal Pradesh, Nagaland and Lakshadweep documented either minimum or no skill training activity during the study period under consideration. Therefore, it validate the presence of low market shares of the renewable energy across various geographies (Sharma et al., 2024; Singh & Kumar, 2023).

Overall, the results shows that the development of the solar energy is concentrated within few leading states, while many others states remain lagged behind. The balancing of this disproportion require enhancement of vocational training landscapes, better flow of to create awareness and strengthening of regional targeting (Chakravorty et al., 2024; Agrawal, 2012). These findings stressed the immense importance of policy framework which is regionally balanced including the equal allocation of the resources among states and curriculum liked with the industry requirement to promote sustainable solar workforce development across India (Ghosh, 2024; Yadav et al., 2024; Shufian & Shaikh, 2024).

Concentration Analysis Related to the Training

The concentration indicators (CR2, CR5 and HHI) as shown in table 2 depict the variations in the training activities of SSDP across states over the period under consideration. From the year 2015-16 to 2017-18, the low concentration is observed as the CR2 falls to 0.1796 and HHI to 0.0581. However, from the year 2021-22 onward, concentration seem to increase suddenly, cresting in 2023-24 with CR2 is 0.5242, CR5 is 0.7690, and HHI is 0.1828. This shows that

Table 2: Training Concentration Analysis

Year	CR2	CR5	Average Market Share	HHI
2015-16	0.3672	0.6316	0.02778	0.1105
2016-17	0.2242	0.4709	0.02778	0.0692
2017-18	0.1796	0.3993	0.02778	0.0581
2018-19	0.2079	0.4452	0.02778	0.0629
2019-20	0.2003	0.4642	0.02778	0.0657
2020-21	0.2482	0.4815	0.02778	0.0686
2021-22	0.2881	0.5261	0.02778	0.0784
2022-23	0.4126	0.6656	0.02778	0.119
2023-24	0.5242	0.769	0.02778	0.1828
2024-25	0.4295	0.7332	0.02778	0.1387

Source: Authors' compilation

Note: HC: Highly concentrated, MC: Moderately concentrated, and LC: Low concentrated

few states are highly dominating other in terms of the training activities. These findings are consistent with the existing research of (Agrawal, 2012; Banerjee, 2016; Chakravorty & Bedi, 2019) in context of the regional disparities in infrastructure facility, readiness of the institutional and skill-industry linkages to drive vocational training participation across states. The increasing concentration after 2021-22 also reflects the gathering of renewable-energy related training in those states where the strong policy support is available (Singh & Kumar, 2023; Sharma et al., 2024; National Institute of Solar Energy, 2024). The results show that the access to information, placement opportunities and program design considerably influence training (Chakravorty et al., 2024; Gupta et al., 2023), which explain the reason of variation among states. No doubt the SSDP has scaled at national level yet trends toward moderate to high concentration indicates the growing regional variations, highlighting concerns that uneven training distribution reduce the inclusiveness and placement outcomes. (Kumar et al., 2019; Maitra & Mani, 2017; Patel & Rao, 2022).

Training-related Growth and Market BCG Analysis

The Figure 1 shows the BCG matrix which highlights significant differences among the performance of states in terms of training growth and market share of SSDP. Bihar and Uttarakhand, positioned as Stars, depict that only these two stated have both the high growth and strong market share. This reflect that the robust institutional capacity, active industry linkages, and effective implementation mechanisms is followed

Star Bihar; Uttarakhand	Cash Cow Assam, Haryana, Jharkhand, Ladakh, Punjab, Rajasthan, Tamil Nadu, Telangana
Question Mark Jammu and Kashmir, Maharashtra, Uttar Pradesh	Dog Kerala, Madhya Pradesh

Figure 1: Training Growth and Market BCG Analysis

Source: Authors' compilation

which is consistent with the earlier findings related with the vocational training ecosystems (Agrawal, 2012; Banerjee, 2016). In contrast, states viz., Assam, Haryana, Jharkhand, Ladakh, Punjab, Rajasthan, Tamil Nadu and Telangana are classified as Cash Cows. It depicts the high market share with lower growth rates. This may be attributable to their stable performance in the training activities but limited recent expansion because of recent trend of saturation or stable demand in the industry (Sharma et al., 2024; Singh & Kumar, 2023). In the Question Mark category states namely

Jammu & Kashmir, Maharashtra, and Uttar Pradesh comes it shows the high growth but low market share. This demonstrates the huge potential for expansion in future if supported by the improved infrastructure, and alignment with the requirement of industry (Chakravorty et al., 2024; Gupta et al., 2023). Dog category states are Kerala and Madhya Pradesh, which exhibit both low growth and low market share. It exhibits the immediate need for stringent strategic intervention to increase outreach, employer involvement as well as relevance of the skilled training (Kumar et al., 2019; Patel & Rao, 2022).

Placement-related Descriptive Analysis of the Growth Rate and Market Share

The Table 3 shows the placement related growth rate and market share of the various states and point out the uneven labour market absorption under the SSDP network. Although the states namely, Assam, Bihar, Gujarat, Haryana, Karnataka, Tamil Nadu, Telangana, and Uttar Pradesh recorded remarkably high placement

Table 3: Placement-related Growth and Market Share Analysis

S.No.	States	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
1	Andaman and Nicobar Islands (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
2	Andhra Pradesh	N/A (0.1567)	0.2488 (0.0581)	-0.3711 (0.0331)	-0.0062 (0.0298)	0.5438 (0.0283)	-0.2308 (0.0821)
3	Arunachal Pradesh (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
4	Assam (NER)	N/A (0.0107)	1.3571 (0.0075)	3.8182 (0.0327)	0.4843 (0.0440)	0.5212 (0.0412)	-0.8189 (0.0281)
5	Bihar	N/A (0.0015)	102.0000 (0.0467)	-0.2573 (0.0315)	0.7451 (0.0498)	0.4906 (0.0457)	-0.7161 (0.0488)
6	Chandigarh (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0086)	0.4762 (0.0116)	-0.2581 (0.0053)	-1.0000 (0.0000)
7	Chhattisgarh	N/A (0.0528)	2.3188 (0.0519)	0.2795 (0.0603)	-0.5119 (0.0267)	1.2797 (0.0374)	-0.7607 (0.0377)
8	Dadra and Nagar Haveli and Daman and Diu (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
9	Delhi (UT)	N/A (0.0115)	-1.0000 (0.0000)	N/A (0.0212)	0.3883 (0.0267)	-0.6224 (0.0062)	-0.5741 (0.0099)
10	Goa	N/A (0.0000)	N/A (0.0048)	0.6190 (0.0070)	0.2353 (0.0078)	0.9286 (0.0093)	-0.7160 (0.0099)
11	Gujarat	N/A (0.1246)	2.6871 (0.1363)	-0.5341 (0.0576)	0.1643 (0.0608)	0.5276 (0.0571)	-0.6807 (0.0687)
12	Haryana	N/A (0.0359)	0.8936 (0.0202)	2.0112 (0.0552)	-0.7761 (0.0112)	1.8333 (0.0195)	-0.8235 (0.0130)
13	Himachal Pradesh	N/A (0.0000)	N/A (0.0077)	1.0882 (0.0146)	-0.1972 (0.0106)	-0.6491 (0.0023)	-1.0000 (0.0000)

S.No.	States	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
14	Jammu and Kashmir (UT)	N/A (0.0015)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0162)	-0.8511 (0.0091)
15	Jharkhand	N/A (0.0000)	N/A (0.0107)	0.5745 (0.0152)	0.7027 (0.0235)	0.5317 (0.0221)	-0.8653 (0.0112)
16	Karnataka	N/A (0.0245)	2.7500 (0.0272)	1.7500 (0.0679)	-0.7879 (0.0131)	1.4714 (0.0199)	-0.7399 (0.0194)
17	Kerala	N/A (0.0237)	1.6452 (0.0186)	-0.3415 (0.0111)	0.9074 (0.0192)	0.5825 (0.0187)	-0.8834 (0.0082)
18	Ladakh (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
19	Lakshadweep (UT)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
20	Madhya Pradesh	N/A (0.0390)	2.5098 (0.0406)	1.0056 (0.0739)	0.5905 (0.1065)	0.6095 (0.1055)	-0.7617 (0.0946)
21	Maharashtra	N/A (0.2439)	0.2571 (0.0910)	-0.2319 (0.0634)	0.5649 (0.0899)	0.5083 (0.0834)	-0.8556 (0.0454)
22	Manipur (NER)	N/A (0.0054)	2.1429 (0.0050)	-0.0455 (0.0043)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)
23	Meghalaya (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
24	Mizoram (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
25	Nagaland (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
26	Orissa	N/A (0.0000)	N/A (0.1018)	-0.6147 (0.0356)	0.0347 (0.334)	-0.0503 (0.0195)	-0.3000 (0.0514)
27	Pondicherry (UT)	N/A (0.0000)	N/A (0.0043)	-1.0000 (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
28	Punjab	N/A (0.0000)	N/A (0.0068)	2.0000 (0.0185)	-0.1222 (0.0147)	-0.4684 (0.0048)	-0.4048 (0.0108)
29	Rajasthan	N/A (0.0283)	9.5676 (0.0887)	0.1407 (0.0918)	-0.0202 (0.0815)	0.6041 (0.0804)	-0.6163 (0.1162)
30	Sikkim (NER)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)	N/A (0.0000)
31	Tamil Nadu	N/A (0.0688)	1.2444 (0.0458)	0.5495 (0.0644)	0.4089 (0.0822)	0.7574 (0.0889)	-0.8387 (0.0540)
32	Telangana	N/A (0.0665)	1.2414 (0.0442)	0.9846 (0.0797)	0.1809 (0.0852)	0.6411 (0.0861)	-0.7013 (0.0968)
33	Tripura (NER)	N/A (0.0122)	-1.0000 (0.0000)	N/A (0.0033)	-1.0000 (0.0000)	N/A (0.0029)	-1.0000 (0.0000)
34	Uttar Pradesh	N/A (0.0696)	1.9780 (0.0615)	0.2952 (0.0723)	0.0313 (0.0675)	1.2017 (0.0915)	-0.6951 (0.1050)
35	Uttarakhand	N/A (0.0229)	5.0333 (0.0411)	-0.6740 (0.0121)	1.0678 (0.0227)	0.0738 (0.0150)	-0.4580 (0.0307)
36	West Bengal	N/A (0.0000)	N/A (0.0796)	-0.1111 (0.0642)	0.4038 (0.0817)	0.8470 (0.0928)	-0.8480 (0.0531)

Source: Authors' compilation

Note: Values outside the brackets represent the growth rate of the number of placed candidates who trained under SSDP, and the value inside the brackets represent market share in the national total of that particular year.

growth in some specific years yet these hikes are often followed by sharp declines. These findings are in-line outcome of the existing literature (Agrawal, 2012; Banerjee, 2016; Chakravorty & Bedi, 2019). Many UTs and several Northeastern states exhibits zero or very negligible market share. It shows the presence of continuous structural constraints such as lack of adequate training infrastructure, weak industry linkage, and less mobility of young trainees (Maitra & Mani, 2017; Gupta et al., 2023). On the other hand despite holding moderate market shares, some states like Andhra Pradesh, Delhi, Himachal Pradesh, Kerala, Maharashtra, and West Bengal show the frequent negative growth in many years. These repeated contractions pose severe challenges to convert trained candidates into employed candidate. At the same time, some states such as Chhattisgarh, Jharkhand, Madhya Pradesh, Rajasthan and Uttar Pradesh indicate positive but inconsistent gains. Overall, the results demonstrates that the performance of the SSDP in terms of placement is still at embryonic stage because of with distinct disparities across states. Hence, the emphasis should be on the strong industry partnerships, extensive placement opportunities and better alignment of training curriculum with demand from the renewable energy industry (Sharma et al., 2024; Singh & Kumar, 2023).

Concentration Analysis Related to the Placement

Table 4: Placement Concentration Analysis

Year	CR2	CR5	Average Market Share	HHI
2015-16	0.4006	0.6636	0.02778	0.1221
2016-17	0.2381	0.4974	0.02778	0.0727
2017-18	0.1715	0.3856	0.02778	0.0585
2018-19	0.1963	0.4455	0.02778	0.0651
2019-20	0.1983	0.4647	0.02778	0.0688
2020-21	0.2212	0.4946	0.02778	0.0711

Source: Authors' compilation

Note: HC: Highly concentrated, MC: Moderately concentrated, and LC: Low concentrated

The concentration analysis of the placement as shown in the table 4 indicate that the placement under SSDP is low to moderately concentrated with CR2 and CR5 values declining from 0.4006, 0.6636 in 2015-16 to 0.2212, 0.4946 in 2020-21. This shows that initially two to five states dominated placements yet their dominance gradually reduced as some other

states began towards placement. After 2016-17, the corresponding decline in the Herfindahl-Hirschman Index (HHI) is observed, which reflects a gradual shift towards more competitive and less monopolized placement outcomes. In the initial years despite positive movement, the concentration indices remain moderately high is a sign of concentrated placement in a few advanced states having institutional capacity and better employer linkages. These findings are similar to those observed in other national skill initiatives (Chakravorty & Bedi, 2019; Kumar et al., 2019). The mild rise in concentration in 2019-20 and 2020-21 is seen, where by the HHI increased from 0.0688 to 0.0711. It reflects momentary interruptions and uneven recovery during and post pandemic period and align with the evidence that placement outcomes are highly sensitive to external shocks as well as sectoral demand shifts if any (Gupta et al., 2023; Sharma et al., 2024).

Placement-related Growth and Market Share BCG Analysis

Star N/A	Cash Cow <i>Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Odisha, Punjab, Rajasthan, Telangana, Uttar Pradesh, West Bengal</i>
Question Mark N/A	Dog <i>Assam, Haryana, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu</i>

Figure 2: Placement Growth and Market BCG Analysis

Source: Authors' compilation

The Figure 2 shows the BCG matrix for placement outcome of the various states for the SSDP and provides that no state falls under the Star and Question Mark categories, indicate that not even a single state exhibit both high growths as well high market share or high growth as well as low market share. A significant number of states namely Andhra Pradesh, Bihar, Chhattisgarh, Delhi, Goa, Gujarat, Odisha, Punjab, Rajasthan, Telangana, Uttar Pradesh, and West Bengal fall into the category of Cash Cows, with relatively higher market shares but low growth rates in the placement outcome post training. No doubt, these states contribute towards national placement yet their outcomes fail to maintain the overall programme

stability. The Dog category comprises of Assam, Haryana, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, and Tamil Nadu. These states show both low placement growth as well as low market share and demonstrate the continuous deficit and low performance in context of placement outcomes. Overall, the BCG analysis of the placement highlights the need for early interventions particularly for the states in the Dog quadrant to sustain the performance states in the Cash Cow to strengthen the overall impact of the SSDP.

CONCLUSION

The longitudinal assessment of the SSDP from 2015-16 to 2024-25 highlights its immense contribution in strengthening India's renewable energy workforce. With more than 57,000 candidates trained till the year 2024, the programme has offered employment opportunities for the youth, women as well as rural communities through its structure curriculum. The results of the study reveals that the extensive disparities exist in both the growth rates and market share of the training and placement under SSDP. The States such as Bihar, Rajasthan, Uttarakhand, and Telangana consistently emerge as high performers with strong as well as sustained institutional support and implementation mechanisms. Conversely, the numerous North-Eastern states and Union Territories continue to exhibit limited participation due to persistent infrastructural constraints and weak local engagement. Overall, the findings indicate that no doubt the SSDP has made worthy hike in the development of solar linked technical capacity, yet the placement outcomes remain uneven across states. The application of growth rate analysis, market share assessment and the BCG matrix provide a organized framework to classify states into leading, lagging and emerging performers in terms of training and placement under SSDP.

The results of this study offer policy and managerial implications. The Policymakers can utilize these insights to make wise allocation of resources while prioritize the support for the lagging regions and stronger collaborations with the industry to improve employment. The findings also emphasize policy formulation in the light of the necessity of cohesion between training and employment outcomes to ensure long-term sustainability of skill initiatives under SSDP.

As the study majorly relies on secondary data, hence it may not fully capture variations in implementation across states on real time basis. Beside this, the analysis is limited to quantitative indicators such as growth rates and market share, whereas non consideration of the qualitative aspects like satisfaction of the participants, quality of training, local operational constraints etc may add significant in the field. Last but not the least, the comparative study of SSDP with other national skill development programmes at national or international level may further enhance the understanding about the unique strengths as well as weakness.

Acknowledgement

The authors would like to thank Indian Council of Social Science Research (ICSSR), Government of India for providing the financial support to conduct the research.

REFERENCES

- Agrawal, T. (2012). Vocational education and training in India: Challenges, status and labour market outcomes. *Journal of Vocational Education and Training*, 64(4), 453–474. <https://doi.org/10.1080/13636820.2012.727851>
- Banerjee, T. (2016). Impacts of vocational education and training on employment and wages in Indian manufacturing industries: Variation across social groups—Empirical evidence from the 68th round NSSO data. *The Indian Journal of Labour Economics*, 59(4), 489–509. <https://doi.org/10.1007/s41027-017-0074-3>
- Chakravorty, B., Arulampalam, W., Bhatiya, A., Imbert, C., and Rathelot, R. (2024). Can information about jobs improve the effectiveness of vocational training? Experimental evidence from India. *Journal of Development Economics*, 169, Article 103273. <https://doi.org/10.1016/j.jdeveco.2024.103273>
- Chakravorty, B., and Bedi, A. S. (2019). Skills training and employment outcomes in rural Bihar. *The Indian Journal of Labour Economics*, 62(2), 173–199. <https://doi.org/10.1007/s41027-019-00167-8>
- Fu, J., Tang, H., and Chen, Z. (2022). Research on commodity business value and customer value of e-commerce platforms: Based on consumer psychology and cognition. *Frontiers in Psychology*, 13, 985537. <https://doi.org/10.3389/fpsyg.2022.985537>
- García-Vidal, G., Sánchez-Rodríguez, A., Pérez-Campdesuñer, R., and Martínez-Vivar, R. (2023). Contribution margin and quantity matrix to analyze the product portfolio in the context of SMEs: Criticism of

- the BCG matrix and its alternatives. *Cogent Business and Management*, 10, 2233272. <https://doi.org/10.1080/23311975.2023.2233272>
- Gunasekarage, A., Luong, H., and Truong, T.T. (2020). Growth and market share matrix, CEO power, and firm performance. *Pacific-Basin Finance Journal*, 59, Article 101257. <https://doi.org/10.1016/j.pacfin.2019.101257>
 - Gupta, P., Datta, A., and Kothe, S. (2023). Developing employability skills in vulnerable youth: Designing logic-model framework and outcome evaluation using quasi-experiment. *World Development Sustainability*, 2, 100045. <https://doi.org/10.1016/j.wds.2023.100045>
 - Ghosh, S. (2024). Future photovoltaic potential in India: Navigating the impacts of climate and resource variability. *Environmental Research Letters*, 19(4). <https://doi.org/10.1088/1748-9326/ad8c68>
 - Kumar, R., Mandava, S., and Gopanapalli, V.S. (2019). Vocational training in India: Determinants of participation and effect on wages. *Empirical Research in Vocational Education and Training*. <https://doi.org/10.1186/s40461-019-0078-y>
 - Maitra, P., and Mani, S. (2017). Learning and earning: Evidence from a randomized evaluation in India. *Labour Economics*, 45, 116–130. <https://doi.org/10.1016/j.labeco.2016.11.007>
 - National Institute of Solar Energy (2024). Suryamitra Skill Development Programme (SSDP). <https://suryamitra.nise.res.in/>
 - Patel, S., and Rao, M. (2022). Growth and regional distribution of vocational skill programs: Evidence from India. *Journal of Sustainable Development Studies*, 15(3), 211–225. <https://doi.org/10.1016/j.jsds.2022.07.004>
 - Singh, R., and Kumar, P. (2023). Performance mapping of renewable energy training programs in India: A BCG matrix approach. *Renewable Energy Policy and Management*, 48(2), 101–112. <https://doi.org/10.1016/j.renpol.2023.101112>
 - Sathish, K. M. (2024). Scenario of solar energy and policies in India. *Clean Energy*, 8(5), 117–128. <https://doi.org/10.1093/ce/zkae057>
 - Sharma, A., Gupta, R., and Nair, K. (2024). Evaluating government skill initiatives using growth and market share metrics: Lessons from the energy sector. *International Journal of Development Research*, 42(1), 89–103. <https://doi.org/10.1016/j.ijdr.2024.01.007>
 - Shufian, A., and Shaikh, A.F. (2024). Integrated rooftop solar PV-based residential advanced systems for India: Design and optimisation. *Cleaner Engineering Systems*, 100150. <https://doi.org/10.1016/j.cles.2024.100150>
 - Sinha, M.K. (2024). Design and optimisation of hybrid solar PV energy systems for Indian contexts. *International Journal of Ambient Energy*. <https://doi.org/10.1080/01430750.2024.2402773>
 - Yadav, A.K., Kumar, A.K., and Sinha, S. (2024). A review of concentrated solar power status and challenges in India. *Solar Compass*, 100079. <https://doi.org/10.1016/j.solcom.2024.100079>