

Spatial Variations in Digitalization and its Impact on the Occupational Structure: Evidence from Rural India

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Digitalization has played a crucial role in transforming the world into a digital economy, restructuring the socio-economic fabric of the globe. Digitalization in rural India is vital for ensuring sustainable development and competing in the global economy. The paper has examined the degree of inequality in various indicators of digitalization across the rural counterparts of different Indian states. This study has attempted to make a comparative analysis of the extent of digitalization in major states of rural India by using the Composite Digitalization Index (CDI). Here, we have observed a wider disparity in the extent of digitalization in various parts of rural India. Moreover, this paper has also examined the impact of digitalization on occupational structure. The estimates suggested that digitalization has significantly affected the migration of labourers from agriculture to the non-agricultural sector, contributing to economic growth and sustainable development.

Keywords: digitalization, occupational structure, sustainable development, rural, agriculture, non-agriculture

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1. Introduction

Digitalization is the need of the hour worldwide as the global economy has made rapid advancements in the field of technology. Innovation and creativity are being promoted all around the world in every aspect of the economy. Digitalization leads to cost efficiency, reduces communication barriers, and enhances accountability and transparency by increasing potential resource allocation towards the production process, hence raising the welfare of the nation. The impact of digitalization on the world economy is extensive (Brynjolfsson & McAfee, 2014) in terms of socio-economic and cultural factors. Quality of life, per capita income, and efficiency in agricultural, industrial, and service sectors can touch new heights as the nation follows the path of automation. Digitalization has resulted in increase in efficiency and levels of output in various sectors of the economy (Suntsova, 2023). It acts as a catalyst in boosting the national income, job opportunities, efficiency, innovation, and creativity (Kaggwa, 2023).

Chen and Wellman (2004) has highlighted that the impact of digitalization hasn't been the same all around the world. This digital era has boosted the capital-intensive economies more, thus making the economic power concentrated among fewer nations. Especially the underdeveloped nations lag behind in terms of huge capital investment, lack of expertise in adopting advance technologies, and ease of doing business, hence get trapped in the conventional structure of a backward economy.

Therefore, it becomes very necessary for the underdeveloped nations, like India, to adopt technological advancement and enter the world of automation, which would pave the way towards sustainable development. With the advent of digitalization, Indian economy has faced a radical transformation in the process of operations, in all sectors of the economy, which in turn enhanced job creation, increased production efficiency, and overall development (Shukla and Bose, 2017). Clark (1941) pointed out that the rapid modernization of the economy has led to the shifting of occupational structure from agriculture to non-agricultural sectors, such as industry and service sectors. India's service sector has improved leaps and bounds after digitalization in terms of efficiency (Maiti and Kayal, 2017).

But the agricultural sector provides a huge pool of employment generation in India, especially in the rural counterparts, which comprises of vast disguised unemployment. Hence, labour mobility between the sectors becomes a highly desirable choice for policymakers in order to raise the economic growth of the nation.

2. Objectives

This study aims to highlight the regional disparity in digitalization across the rural parts of the various states. Moreover, we have tried to highlight on the degree of digitalization achieved by the rural sectors of the different states of India. Finally, we attempted to examine the impact of digitalization on occupational shift from agriculture to the non-agricultural sector in rural India. Hence, this paper tried to justify the need of digitalization for sustainable development.

3. Data and Methodology

An economy can be considered to be digitalized in terms of two aspects. Firstly, digitalization can be reflected in the availability and affordability of digital tools. Secondly, digitalization can be mirrored by the quality of human resources in terms of expertise in using digital tools. So, we have made an attempt to measure the extent of inequality in different indicators of digitalization across the rural parts of various states of India, using the Gini coefficient, calculated by applying the Rao-Approach method of Gini Index (Rao, 1969), which is mathematically expressed in the following equation (1):

$$G = \sum_{i=1}^{n-1} (P_i Q_{i+1} - P_{i+1} Q_i) \quad (1)$$

In the above equation, P_i is the cumulative population share, and Q_i is the cumulative share of the indicator of digitalization corresponding to the i th person or household when all persons or households are arranged in non-decreasing order.

To measure the extent of digitalization across the rural regions of various states, we have created a Composite Digitalization Index (CDI), undertaking the three indicators, such as the percentage of rural population who own a mobile phone, the percentage of rural households with internet facilities within household premises, and the digital expertise criteria. We have provided equal weightage to all three indicators.

For each of these three indicators, each of these three indicators, we have used the method of indexation as follows in the Human Development Index framed by UNDP, i.e.,

$$Indicator_i = \frac{(Actual\ Value_i - Minimum\ Value_i)}{(Maximum\ Value_i - Minimum\ Value_i)} \quad (2)$$

The average values of all indicators are considered to measure the CDI. Therefore,

$$Composite\ Digitalization\ Index(CDI) = \frac{\begin{array}{c} \%ge\ of\ population\ who\ own\ a\ mobile\ phone \\ + \\ \%ge\ of\ household\ with\ internet\ facilities \\ within\ household\ premises \\ + \\ digital\ expertise\ criteria \end{array}}{3} \quad (3)$$

The digital expertise criteria encompasses the percentage of rural households who made online purchase of goods, the percentage of the rural population comfortable in using online banking transactions, and the percentage of the rural population capable of complaining about cyber fraud in the online dedicated portal. In order to measure the digital expertise criteria, we have followed the above-mentioned process of indexation.

The study has used secondary level data for analysis, which has been obtained from the Annual report of Periodic Labour Force Survey (PLFS), 2023-24, and the 80th Round Report on Comprehensive Modular Survey on Telecom, 2024-25, published by the Ministry of Statistics and Programme Implementation (MoSPI) and National Sample Survey Organization (NSSO). For measuring infrastructural development, the study has used the reports published by the Ministry of Rural Development, 2022, Pradhan Mantri Gram Sadak Yojana (PMGSY) on Rural Connectivity Datasets. The data on microfinance has been acquired from the report of the Status of Microfinance in India, 2022-23 published by NABARD. The agricultural and non-agricultural wages has been obtained from the Indian Labour Journal, Labour Bureau, Government of India for the year 2023-24.

The study has considered rural sectors of fifteen major states of India, such as Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.

4. Model Specification

In this study, we have also tried to estimate the impact of digitalization on the changing occupational structure in the rural economy of India. For such purpose, we have constructed Occupational Transformation Index, defined as follows:

$$Occupational\ Transformation\ Index\ (OTI) = \frac{\%ge\ of\ people\ employed\ in\ the\ Non\ Agricultural\ Sector}{\%ge\ of\ people\ employed\ in\ the\ Agricultural\ Sector} \quad (4)$$

In order to analyze, the role of digitalization, we have considered the following models for stepwise regression analysis, as,

$$Model\ 1: OTI = \beta_0 + \beta_1 \cdot CID + \varepsilon_1 \quad (5)$$

$$Model\ 2: OTI = \beta_0 + \beta_1 \cdot CID + \beta_2 \cdot INFRA_DEV + \varepsilon_2 \quad (6)$$

$$Model\ 3: OTI = \beta_0 + \beta_1 \cdot CID + \beta_2 \cdot INFRA_DEV + \beta_3 \cdot MICROFINANCE + \varepsilon_3 \quad (7)$$

$$Model\ 4: OTI = \beta_0 + \beta_1 \cdot CID + \beta_2 \cdot INFRA_DEV + \beta_3 \cdot MICROFINANCE + \beta_4 \cdot WR_NonAgri_Agri + \varepsilon_4 \quad (8)$$

Where the other explanatory variables include,

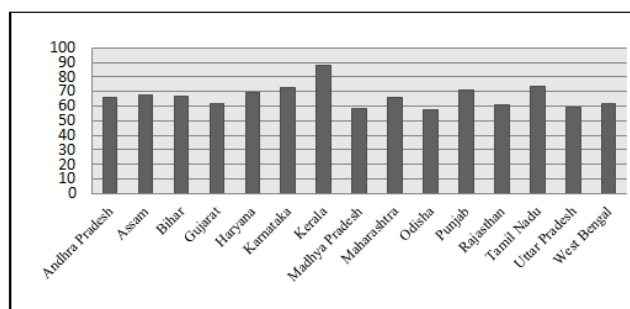
INFRA_DEV is the infrastructural development index represented by considering the log transformation of the total length of roads (km.) constructed for per 1000 rural population under the Pradhan Mantri Gram Sadak Yojana (PMGSY) highlighted in equation 6.

MICROFINANCE is measured using the log-transformation of per capita loans (Rs.) disbursed in rural regions of the states by the Self Help Groups (SHGs) through commercial banks, regional rural banks, and cooperative banks in rural regions of different states (Equation 7).

WR_NonAgri_Agri is the wage ratio between non-agricultural workers and agricultural workers included in equation 8.

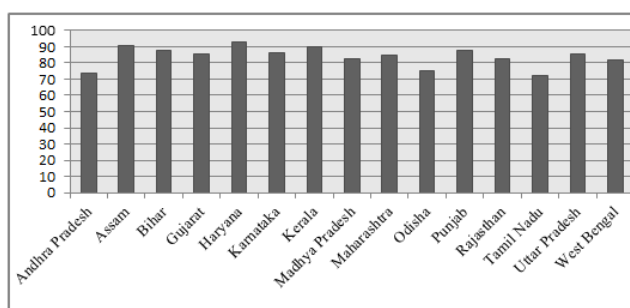
Estimates

Here in figure 1, we can observe a huge disparity among the intensity of digitalization in terms of the percentage of people using their own mobile phones across the rural areas of different states in India, ranging from about 50 percent to 90 percent. The rural Kerala encountered the highest percentage of population using their own mobile phones, whereas the rural parts of Odisha experienced the lowest figure.

Figure 1: Persons using their own mobile phones (%) in rural parts of Indian States

Source: Comprehensive Modular Survey on Telecom, 2025

Rural parts of Madhya Pradesh, Uttar Pradesh, West Bengal, and Rajasthan are the states where less than 60 percent of the rural population possesses a mobile phone for use. In Haryana, Kerala, Assam, and Punjab, about 90 percent of the rural households have access to internet facilities within their premises (Figure 2). People in rural counterparts of Andhra Pradesh and Tamil Nadu experience weaker accessibility to internet facilities within their household premises compared to other parts of the nation.

Figure 2: Households having internet access within premises in rural parts of Indian States (%)

Source: Comprehensive Modular Survey on Telecom, 2025

Moreover, we have attempted to assess the regional disparity in various indicators of digitalization across the different states of India. Here, we have found more or less equal distribution in terms of accessibility and affordability of digital equipment across the states, but the unevenness can be observed in the quality of human resources, expertise in handling the digital technologies.

Table 1: Inequality measured in terms of various indicators of Digitalization

Indicators of Digitalization	Gini Coefficient
Rural Population having own mobile phone as recorded in the last three months (%)	0.044
Rural household with internet facilities within household premises (%)	0.033
Rural household comfortable in online purchase of goods as recorded in the last 30 days (%)	0.223
Rural Population who practices online banking transactions (%)	0.230
Rural population able to complain about cyber fraud in the cybercrime reporting portal (%)	0.141

Source: Comprehensive Modular Survey on Telecom, 2025

More specifically, we have noticed that the maximum disparity across the states is found in the percentage of rural population using online banking transactions and online purchase of goods across the rural parts of different states.

Now, taking into consideration the aspect of availability of digital tools, combined with the other aspect of expertise in handling digital tools, the Composite Digitalization Index (CDI) has been calculated for the rural parts of the 15 major states of India represented in Table 2.

Moreover, we can observe that rural parts of Kerala, Haryana, Assam, and Karnataka recorded higher digitalization during the year 2024-25 compared to the other states. The rural counterparts of Odisha, West Bengal, Gujarat, Madhya Pradesh, Uttar Pradesh and Rajasthan have encountered a lower rate of digitalization in comparison to the national average.

Table 2: Composite Digitalization Index in Rural Areas of Indian States

States	CDI	States	CDI
Andhra Pradesh	0.467	Maharashtra	0.590
Assam	0.639	Odisha	0.227
Bihar	0.526	Punjab	0.596
Gujarat	0.285	Rajasthan	0.364
Haryana	0.663	Tamil Nadu	0.446
Karnataka	0.631	Uttar Pradesh	0.340
Kerala	0.933	West Bengal	0.260
Madhya Pradesh	0.305	All-India	0.429

Source: Authors' Calculation

Now, we have attempted to examine the impact of digitalization on the transformation of occupational structure (Table 3). Here, we have observed that the Composite Digitalization Index has significantly affected the changing occupational structure from agriculture to the non-agricultural sector.

Table 3: OLS Estimates reflecting the impact of Digitalization on Occupational Transformation

Factors	Model 1	Model 2	Model 3	Model 4
CDI	1.285** (0.02)	0.937* (0.07)	0.917* (0.09)	1.486** (0.03)
INFRA_DEV	-	0.100** (0.05)	0.102* (0.06)	0.134** (0.02)
Microfinance	-	-	0.009 (0.88)	0.092 (0.24)
WR_NonAgri_Agri	-	-	-	3.499 (0.11)
C	0.247 (0.37)	0.216 (0.37)	0.203 (0.65)	-3.784 (0.13)
R ²	0.33	0.52	0.52	0.63
F-Value	6.37** (0.02)	6.46*** (0.01)	3.97** (0.04)	4.27** (0.03)

Source: Authors' Calculation

[**Note:** ***Significant at 1 percent level; **Significant at 5 percent level; *Significant at 10 percent level]

In model 2, the study has considered infrastructural development measured by the length of roads constructed under Pradhan Mantri Gram Sadak Yojana (PMGSY), which reflected a positive and significant impact on the shift of employment from agriculture to the non-agricultural sector in rural India.

Additionally, the study has scrutinized the impact of microfinance in the shift of occupational structure in rural regions (Model 3). The role of microfinance is measured by the loans disbursed by the SHGs. It is found that there is a positive impact of microfinance loans in transferring labourers from the agricultural to the non-agricultural sector in rural India.

Finally, in model 4, the study has examined the influence of relative wage gap between non-agricultural and agricultural labourers, and it seems to have positive impact on the shift of labourers from the productive to relatively low productive sector.

In all four models, it can be remarkably noticed that digitalization has a positive impact on the migration of labourers from agriculture to the non-agricultural sector in rural India, which generates higher wages and boosts up the income of the rural population, thereby enhancing the labour mobility towards productive activities.

5. Conclusion

This study has quantified the extent of digitalization in rural parts of different states of India. Firstly, it has been observed that there exists a moderate disparity among the rural areas of the Indian states in terms of affordability and accessibility to digital tools. Though in terms of infrastructure built up for digitalization, rural India has performed quite well, ensuring more than 70 percent of the population having internet accessibility. This may be attributed to the launch of the Digital India Campaign in 2015, adopted by the Government of India. The government has also established Common Service Centers to access various public utility and essential services, medical, banking, and educational facilities in rural counterparts of the nation. On the contrary, people in rural regions of high income states like Kerala, Tamil Nadu, Karnataka, Haryana, and Punjab are able to have access to digital tools like mobile phones, compared to the lower-income states. It has been found that the regional disparity across the rural parts of the states is higher in terms of the quality of human resources in handling the digital tools. The paper has specifically found high inequality in online digital banking transactions that demotivates the potential of creating an inclusive business ecosystem, which ensures rural development (Ayyappan, Theres, 2025).

To be more particular in measuring the digitalization, in this study, we have constructed a Composite Digitalization Index (CDI), where we have taken into consideration both the aspects of availability of digital technologies and expertise in coping up with the new technology. Interestingly, we have observed here that there is wider dispersion in digitalization among the rural areas of various states of India. Maximum digitalization has been recorded by rural regions of Kerala, while rural parts of Odisha have encountered the lowest score.

Finally, we have empirically examined the impact of digitalization on change in the occupational structure in India.

In this study, we have noticed that there is a significant impact of digitalization on the transformation of occupational structure and mobility of labour witnessed from the agricultural to the non-agricultural sector in rural parts of India. The study also observed that infrastructural development through schemes like Pradhan Mantri Gram Sadak Yojana has a positive and significant impact on relocating labourers from the agricultural sector to the non-agricultural sector of the rural economy. Moreover, microfinance boosts up the diversification of employment in rural India. The higher wage-gap between the non-agricultural sectors in comparison to the agricultural sector, also boosts up the employment diversification in the rural economy. This positive transformation of labourers from the low productive to the productive sector in the rural economy contributes towards the economic growth of the nation.

This study aims to draw the attention of policymakers to frame the policies that generate awareness among the rural mass in adopting newer technologies, to strive in the age of automation. The government should therefore focus on ensuring a digital rural economy and make digital education as a part of the school curriculum. The Skill India Campaign, launched in 2015, should be more inclusive and should encompass digital literacy to channelize the development towards the rural sector of the nation. The Government can therefore increase the technological awareness by providing subsidies on digital equipment, hence making the digital infrastructure stronger, thus enhancing the scope of universal digital literacy and Viksit Bharat 2047 for the sake of sustainable development.

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