

Impact of digital transformation on financial inclusion and sustainable development goals : Evidence from major Indian states

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Abstract

India has demonstrated notable success in leveraging Digital Public Infrastructure (DPI) to advance financial inclusion and accelerate progress toward the Sustainable

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Development Goals (SDGs). This study examines the key determinants of DPI that influence policy outcomes across major Indian states. The findings indicate that states such as Kerala, Tamil Nadu, Karnataka, Gujarat, and Andhra Pradesh have been more effective in adopting and integrating DPI, thereby achieving stronger performance on SDG indicators. By situating India's experience within the broader discourse on digital financial inclusion and sustainable development, this paper highlights the transformative role of DPI in fostering inclusive growth.

Subject Classification: Q01, Q55, Q56.

Keywords: *Digital financial inclusion, Sustainable development goals, Digital public infrastructure, Mobile banking, Indian states.*

I. Introduction

Technology holds transformative potential for enhancing citizen welfare and reconfiguring governance structures. Digital Public Infrastructure (DPI) is conceptualized as an infrastructure-centric paradigm that employs technology to advance societal objectives through an ecosystem of technology, markets, and governance. Designed in the public interest, DPI fosters inclusive innovation by harnessing competitive private-sector capabilities within clearly defined regulatory frameworks. Over the past one and half decades, Government of India has implemented a series of policy initiatives aimed at fostering technological innovation and strengthening e-governance mechanisms to minimize systemic leakages in public service delivery. This strategic policy shift toward digital transformation, under the umbrella of the *Digital India* initiative, has positioned technology-driven governance as a central instrument for improving efficiency, transparency, and inclusivity in the financial ecosystem. Over the past one and a half decades, India has demonstrated how inclusive Digital Public Infrastructure (DPI)—comprising digital identity systems, digital payments, and consent-based data sharing—can be effectively harnessed to deliver public services, even in times of crisis such as the COVID-19 pandemic. By leveraging DPI, India has leapfrogged conventional trajectories of financial inclusion and socio-economic development, accomplishing within a decade progress that would typically require several decades. To date, India has generated approximately 1.389 billion Aadhaar enrolments, enabling over 10 million daily electronic Know Your Customer (e-KYC) transactions. More than 500 million individuals have gained access to formal banking services, of whom 55% are women and 66% reside in rural regions, thereby addressing

both gender and geographical inequities. The expansion of the Unified Payments Interface (UPI) further illustrates this transformation: in April 2024 alone, UPI facilitated over 13 billion transactions, amounting to a cumulative value of USD 230 billion. Equally significant has been the role of DPI in strengthening the delivery of welfare programs. The implementation of Direct Benefit Transfers (DBT) across a wide array of central government schemes has curtailed systemic leakages, enabling the government to achieve fiscal savings exceeding USD 41 billion. These savings were redirected to citizens through direct deposits, ensuring transparency and accountability. As a result, millions have been lifted out of poverty and gained enhanced access to education, healthcare, and sustainable livelihoods adhering to the Sustainable Development Goals set by UN. Thus, DPI's role as a catalyst for inclusive growth and dignified living has been redefined in the Indian context. This paper addresses the impact of digital transformation of major Indian states on financial inclusion and how these state outperform each other on Sustainable Development Goals through inter-state study.

Financial inclusion refers to a process that ensures ease of access, availability and usage of formal financial services to the those people who were excluded from such services, particularly the poor. Achieving financial inclusion is the top priority of policy makers towards setting the nation to inclusive growth trajectory. In the year 2014 the central government launched its flagship scheme – PM Jan Dhan Yojana towards this direction. Digital financial inclusion consists of the use of the cost-effective digital means like mobile banking to reach currently financially excluded and underserved populations with a range of formal financial services suited to their needs that can be delivered through sustainability and scalability.

The initiative of JAM – Jan Dhan-Aadhar-Mobile model helped to achieve digital financial inclusion at a rapid speed in India. Digital transformation fosters not only financial inclusion but also helps a nation to achieve the Sustainable Development Goals. India is actively engaging in technological innovations in building the required infrastructure. which includes a digital identification layer – Aadhar, Unified Payment Interfaces [UPI] and a data exchange layer for achieving digital financial inclusion. The combinations of these digital interventions in public services delivery have contributed immensely towards achieving several SDGs – SDG1, SDG2, SDG7, SDG8, SDG9 and SDG10 among Indian states Some of these initiatives also in promoting cost effective sustainable business practices in India which contributed positively to the business environment[18]. The

two back-to-back economic shocks emanated from the process of demonetization and the Covid-19 pandemic situations forcefully made Digital India a reality rather than a policy initiative. This paper addresses how India's digital transformation through Digital Public Infrastructure helped the nation to achieve faster progress in Sustainable Development Goals – SDG1, SDG2, SDG7, SDG8, SDG9 and SDG10 in line with the target laid down by UN. India has created a strong Digital Public Infrastructure which helped to use frugal solutions to help the poorest of the poor people who were digitally excluded through sustainability and scalability. This paper addresses the regional dynamics in India in the digital penetration and the inter-state analysis of progress of SDGs in India aligning with global commitment to SDGs.

II. Review of Literature

Financial inclusion significantly contributed to inclusive growth and capacity building to achieve several SDGs. It refers to Government's efforts to reach banking products and services to the poor people. Government of India defined it as the process that can facilitate easy access to banking services [1]. Diverse attributes of individuals like demographic factors contributes immensely to financial inclusion.[2]

Several previous studies [3, 4, 5, 6, 7, and 8] have used the World Bank Findex data to examine how digital financial services contribute to faster public delivery and promote transparent governance. For instance, Anson et al.[3] this database to study the pattern of accounts kept at post offices compared to banks. Their result indicated that post offices offer several cost-effective solutions that promote financial inclusion better than banks. Borg and Smith [4]studied this behavior in the Australian context. They found that the demographic features significantly contributed to the frequency of internet use, thereby enhancing digital financial inclusion. Additionally, non-demographic factors also influenced the internet use. The study [5,6] investigated the influence of technology on financial inclusion across a panel of 140 countries. Their findings suggest that FinTech and financial inclusion significantly reduces income inequality with the strongest impact observed in wealthier nations. Another study [7] found that individual attributes like age, per capita income and access to information technology influence the easy access to banking in Nigeria. Another study by Zins & Weill [8] using the Global Findex data, analyzed the factor that influenced financial inclusion in Africa. Their study

concluded that literacy rate, income and demographic factors are key variables positively affecting financial inclusion. Finally, the Global Findex report by the World Bank [9] based on a sample of 3000 adults across major Indian states explored the digital penetration in India across major Indian states. Fadun [10] identified five key pillars of financial inclusion – access, provision of enabled services to protect the dignity of individuals, facilitating equal access to financial services, creating a broad network of financial service providers and a vibrant society with the required skill set. Bongomin, Yourougou, and Munene [11] observed that digital financial inclusion can foster the capability to achieve Sustainable Development Goals (SDGs) Their study found that policies such as tax exemptions on digital financial innovations like mobile banking and internet banking can promote economic growth by enhancing financial inclusion. Income, education, age, gender, access to bank accounts, formal savings and credit can be potential drivers of financial inclusion due to non-linear relationship. [12] Between 2013 and March 2020, India's Direct Benefit Transfers [DBT] policies driven by digital financial inclusion resulted in the cumulative savings of \$24.4b . Indeed, this was achieved by eliminating duplicate beneficiaries, reducing considerably the transaction costs, expanding mobile banking and minimizing leakages in public service delivery[13] . While the COVID-19 pandemic has accelerated the global adoption of digital financial services, it has simultaneously posed significant challenges for several countries. Developing economies—particularly in Asia—have increasingly adopted and enhanced digital financial inclusion initiatives, which in turn contribute to poverty reduction and broader socio-economic development adhering to the Sustainable Development Goals set by UN[16]. While analyzing the components of Covid-19 that impacted economy from the developing country perspective, [17] found that the digital delivery system increased the efficiency of the dynamics of supply chain to confront the pandemic challenges that has disrupted the global supply chain.

III. Methodology

Gap Identification:

The study has identified the following gaps from the comprehensive review of literature.

1. Though there are cross national studies on how digital financial inclusion fostered nations to achieve SDGs there is lack of studies on cross state analysis in the Indian context.
2. A detailed study of India's Digital Public Infrastructure based on interstate analysis is imperative to study her progress in SDGs through regional dynamics which have not been captured by existing studies.

Research Objectives:

The study is undertaken with the following two broad objectives emanating from the gap identifications.

1. To probe the cross-state analysis of digital transformation in the Indian context that deepened financial inclusion and contributed significantly to the progress in SDGs
2. To investigate the major drivers of digital transformation that fostered financial inclusion and contributed significantly to the progress in SDGs.

Research Methodology

Sample:

The study has identified 16 major Indian states for the purpose of finding out the digital financial inclusion penetration in India. These states are identified based on the criteria of the percentage of state GDP to national GDP. These states contribute 82.12% of India's GDP.

Identification of Variables and Conceptual Framework:

The socioeconomic variables identified as follows.

- (1) **access to bank branches per 1 lac population:** It is expected that access to bank branches enhances the accessibility of banking services and would positively impact the financial inclusion.
- (2) **percentage of women's employment:** It is expected that women's employment ensures steady income to the family and saving capacity of the households can be strengthened which would then increase the financial inclusion of the people.

- (3) **internet subscribers – both for mobile and broadband Rural and**
- (4) **internet subscribers – both for mobile and broadband – Urban.** It is expected that the number of internet subscribers can have positive impact on the digital financial inclusion. Government's initiative of JAM – Jan Dhan-Aadhar-Mobile trinity enhanced the digital public infrastructure in recent times.

Multiple regression analysis is used to find out the significant of each independent variable. These independent variables have been regressed to show the significance of their individual contributions to the Sustainable Development Goals. The SDG India Index score [14] achieved by each identified state has been taken as dependent variable. This is shown in the following conceptual framework. [Figure 1]

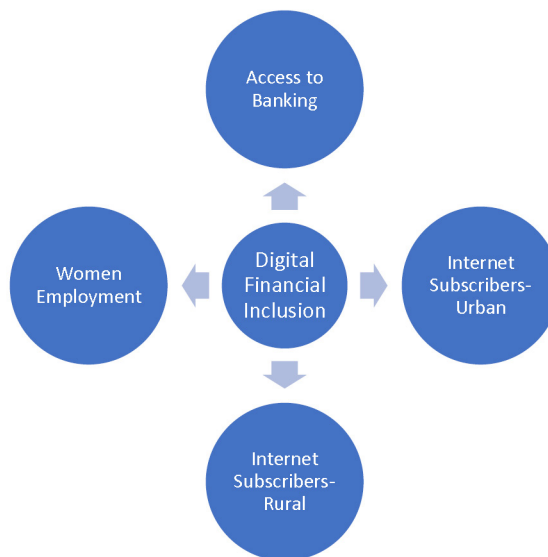


Figure 1
Conceptual Framework

Econometric Model:

The statistical tool of multiple regression has been used to develop the following econometric model

$$Y = \alpha + \beta_1 \text{access to banking} + \beta_2 \text{women's employment} + \beta_3 \text{number of internet users in rural areas} + \beta_4 \text{number of internet users in urban areas} + \mu$$

IV. Result & Discussion

The findings of the performance of the identified states are given the following table.

Table 1
Inter State Performance

States	Y*	X1**	X2***	X3****	X4*****
Andhra Pradesh	74	13.8	42.1	25.51	33.14
Assam	65	8.4	19	8.31	5.93
Bihar	57	6	12.6	30.53	17.86
Gujarat	74	11.9	30.8	13.67	31.64
Haryana	72	16.9	18.8	6.81	10.37
Karnataka	75	15.6	37	17.01	28.82
Kerala	79	18.5	25.8	10.75	15.79
Madhya Pradesh	67	8.5	26.8	19.75	28.97
Maharashtra	73	10.5	34.7	25.16	37.85
Odisha	66	11.5	25.7	12.36	6.91
Punjab	76	20.9	22.3	8.43	17.70
Rajasthan	67	9.8	17.4	20.02	22.48
Tamil Nadu	78	15.4	40.8	13.82	37.82
Telangana	74	14.6	45.1	13.10	22.49
West Bengal	70	9.5	20.2	16.65	16.35
Uttar Pradesh	67	7.6	15.5	42.25	50.11
India	71	11	25.4	285.94	457.21

Sources

Y*NITI Aayog SDG India Index 2024 values[14]

X1** Number of banks per one lac population X2*** % of women in jobs X3**** Internet Users – RURAL [in millions] X4***** Internet Users – URBAN [in millions] – RBI Handbook “Statistics on Indian Economy”[15]

The result [Table 1] shows the inter state variations. In a nutshell the Southern states like Kerala, Tamil Nadu, Andhra Pradesh, Karnataka and Telangana have done better performance compared to the rest of India.

Multiple R 0.932872 R² 0.87025

From the above regression output [Table 2] it is clear that number of banks, % of women Jobs and Internet Users in Urban areas show statistically

Table 2
Regression Result

Independent Variables	Coefficient	p-value
No of Banks	0.902848 (0.195596)	0.00745
% Of women Jobs	0.272982 (0.072596)	0.003153
Internet users-R	-0.116858 (0.1356040)	0.4072
Internet users-U	0.19890 (0.085565)	0.040247

significance while internet users in rural areas does not show statistical significance in the chosen sample. Further, the coefficient of variable – number of banks shows highest value indicating how access to banking helped in achieving financial inclusion, particularly after the implementation of Jan Dhan Yojana. The result [Table 2] shows Multiple R at 0.932872 and the R Square value at 0.87025 testing the goodness of fit of the model

As stated above the state of Kerala tops the SDG India state ranks and the state of Bihar ranks last in the chose 16 states in India. Punjab ranks first as far as access to bank is concerned with a total 20.9 branches per lac population followed by Kerala with 18.5 branches per one lac population. As far as women's employment share in total employment is concerned the states of AP, Telangana and Tamil Nadu were leading with 45.1%, 42.1% and 40.8% respectively. UP, Andhra Pradesh, Maharashtra and Tamil Nadu were leading in the internet users – both rural and urban taken together with 92.3million user, 63.01million users, 58.65 million users and 51.64 million users respectively. This clearly shows that these states are leading in Digital Financial Inclusion. When we analyse the Sustainable Development Goals India Index – 2024 developed by NITI Aayog, the state of Kerala tops the rank of the major Indian states with the SDG score of 75 following by the state of Tamil Nadu with the SDG score of 74 and then by Karnataka with the SDG score of 72 followed by the state of Maharashtra with the SDG score of 70 and the fifth rank is shared by the state of Gujarat and Telangana with the SDG score of 69. We run the multiple regression with SDG score as dependent variable and the independent variables identified are number of bank branches per 1 lac population, % of women in jobs, number of internet users – both mobile

bank and broad band users – both for rural and urban areas. Out of the four independent variables three – number of banks per 1 lac population, % of women in jobs and the internet users in urban areas show p values less than 0.05 showing that individually these variables show statistical significance. The result of the multiple regression output is given below.

V. Conclusions and Policy Recommendations

This paper addressed the issue of how India's advancement in Digital Public Infrastructure (DPI) became the new game changer in advancing the progress of sustainable development goals in the Indian context. The policy initiatives taken by the central government offers paradigm shift in the governance of several areas of public delivery system like Government's payments to different stakeholders like state government departments, schools, colleges, farmers, banks and financial institutions, public delivery of different welfare schemes implemented by both central and state governments. Digital India's advancement in digital financial inclusion has not only helped her to progress at a faster rate toward SDGs but also eliminated leakages in the public delivery system which is not a mean achievement in any scale. There are several factors that contributed to the regional dynamics of the SDG outcome for the identified states like human development dimensions like health, education and expected life apart from basic amenities, infrastructure etc. contributed. The state of Kerala outperformed other states due to its first mover advantage on human development indicators while states like Tamil Nadu, Karnataka and Andhra Pradesh also made remarkable progress on the SDG India State Rank Bihar, Odisha, Assam and Madhya Pradesh are low performing states. The robustness of the results has been checked with the SDG India Index 2024 where these states performed on similar trend. Effective implementation of Digital Public Infrastructure is vital in achieving better financial inclusion and better progress in sustainable development goals. The low performing states like Bihar, Assam, Odisha and Madhya Pradesh should focus more on e governance that can boost digital penetration and can curb leakages in the public delivery system. These states should also focus on improving human development indicators like education, health and expected life that can improve their progress on sustainable development goals. These states should focus on broad based growth trajectory.

Digital Public Infrastructure (DPI) represents a systemic approach to addressing multifaceted societal challenges that necessitate the coordinated

participation and innovation of both public and private actors. By integrating advanced technologies, effective governance mechanisms, and market dynamics, DPI enables nations to accelerate economic development in a manner that is both inclusive and competitive. Its application has already demonstrated significant progress in critical domains such as healthcare delivery, financial inclusion, human capital development, employment generation, and the enhancement of public services. Looking forward, DPI is poised to play a pivotal role in tackling pressing global challenges, including the pursuit of sustainable growth, the deepening of financial inclusion, the reduction of transaction costs, and the strategic harnessing of data for development. The impact of DPI can be further amplified through the responsible integration of emerging technologies, particularly artificial intelligence, which holds the potential to expand the scale and efficiency of interventions. Equally essential is the sustained emphasis on iterative development—building new DPI layers, fostering adoption, incorporating user feedback, and encouraging innovation within regulatory and ethical guardrails.

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