

Digital Connectivity and Rural Development in Tripura: Evidence from an Empirical Survey

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Abstract

Digital technologies have emerged as one of the most significant drivers of socio-economic transformation, particularly in rural areas where access to information, financial services, education, healthcare, and governance has historically been constrained. In India, flagship initiatives such as Digital India, BharatNet, Common Service Centres (CSCs), Unified Payments Interface (UPI), and Direct Benefit Transfer (DBT) have accelerated the process of digital inclusion by expanding internet connectivity and promoting digital public infrastructure. Despite these efforts, rural communities continue to experience disparities in digital access due to infrastructural limitations, inadequate digital literacy, affordability issues, and uneven network coverage. These challenges are more pronounced in geographically isolated and socio-culturally diverse states such as Tripura, where digital transformation has considerable potential to improve rural livelihoods and public service delivery.

The present study examines the extent of digital connectivity, the utilization of digital services, and their socio-economic implications among rural households in Tripura. A descriptive research design was adopted using primary data collected from 104 respondents selected through simple random sampling from selected rural communities across the state. Data were collected using a structured interview schedule and analysed through descriptive statistical techniques, including frequencies and percentages.

The findings indicate that digital technologies have become increasingly embedded in the daily lives of rural residents. Smartphones, social media platforms, online communication tools, and UPI-based payment systems are widely used for communication, financial transactions, information access, and interaction with government services. Digital connectivity has enhanced convenience, reduced transaction costs, improved access to banking and welfare schemes, and strengthened social communication. However, several challenges continue to impede inclusive digital development, including unreliable internet connectivity, low levels of digital literacy among older populations, concerns regarding cyber fraud and data security, and limited awareness of advanced digital services.

The study concludes that digital infrastructure alone is insufficient to achieve meaningful digital inclusion. Sustainable rural digital development requires simultaneous investments in reliable connectivity, digital literacy, cybersecurity awareness, localized digital support systems, and community-based capacity-building initiatives. The findings provide important policy insights for strengthening digital governance and promoting inclusive rural development in Tripura and other northeastern states of India.

Keywords: Digital Connectivity, Rural Development, Digital Inclusion, Digital India, Digital Literacy, Digital Governance, UPI, Rural Communities, Tripura.

1. Introduction

The twenty-first century has witnessed an unprecedented expansion of digital technologies, fundamentally transforming the way societies communicate, access information, conduct business, and interact with public institutions. The integration of digital technologies into economic and social systems has reshaped governance, education, healthcare, agriculture, banking, and commerce, making digital connectivity an essential component of sustainable development. The rapid diffusion of smartphones, affordable internet services, cloud computing, artificial intelligence, digital payment systems, and online public service delivery has significantly altered development paradigms worldwide. Increasingly, digital infrastructure is recognized as a critical public utility, comparable to transportation, electricity, and communication networks, underpinning inclusive economic growth and social well-being.

For developing countries such as India, digital transformation represents more than technological advancement; it serves as a strategic instrument for addressing long-standing developmental challenges. Rural populations often face barriers related to geographical isolation, inadequate infrastructure, limited access to financial institutions, and poor delivery of public services. Digital technologies offer opportunities to overcome many of these constraints by enabling faster communication, expanding access to markets, improving financial inclusion, strengthening public service delivery, and facilitating knowledge dissemination. Consequently, digital connectivity has become an integral element of national development strategies aimed at reducing regional disparities and fostering inclusive growth.

Recognizing the transformative potential of digital technologies, the Government of India launched the **Digital India Mission** in 2015 with the objective of transforming India into a digitally empowered society and knowledge economy. The programme seeks to improve digital infrastructure, expand internet connectivity, promote digital literacy, enhance e-governance, and facilitate universal access to digital public services. Complementary initiatives such as BharatNet, Common Service Centres (CSCs), Unified Payments Interface (UPI), Aadhaar-enabled services, Direct Benefit Transfer (DBT), DigiLocker, eNAM, Ayushman Bharat Digital Mission, and PMGDISHA (Pradhan Mantri Gramin Digital Saksharta Abhiyan) have substantially strengthened India's digital ecosystem. Collectively, these initiatives have contributed to expanding internet penetration, improving financial inclusion, enhancing transparency in governance, and reducing transaction costs for millions of citizens.

One of the most remarkable achievements of India's digital transformation has been the development of Digital Public Infrastructure (DPI), which has attracted global recognition for its scalability and inclusiveness. The integration of Aadhaar, Jan Dhan bank accounts, and mobile connectivity—popularly known as the JAM Trinity—has facilitated seamless delivery of government benefits and digital financial services. The widespread adoption of UPI has revolutionized digital payments, making India one of the

world's largest digital payment ecosystems. These developments have created new opportunities for rural populations by increasing access to banking services, online commerce, digital entrepreneurship, and government welfare programmes.

Nevertheless, the benefits of digital transformation are not uniformly distributed across geographical regions or socio-economic groups. The persistence of the **digital divide** remains a significant concern, particularly in rural and remote areas where inadequate internet connectivity, poor telecommunications infrastructure, affordability constraints, limited digital literacy, and socio-economic inequalities restrict effective utilization of digital services. While access to digital technologies has expanded considerably during the past decade, meaningful digital inclusion depends not only on physical access but also on individuals' capabilities to use digital technologies effectively, safely, and productively.

These challenges are particularly relevant in India's North Eastern Region, where difficult terrain, dispersed settlements, and infrastructural constraints continue to influence digital connectivity. Tripura, despite making considerable progress in digital governance and internet expansion, still experiences disparities in network quality, digital literacy, and access to advanced digital services across rural areas. Agriculture remains an important source of livelihood, while government welfare programmes, rural banking, self-help groups, and local entrepreneurship increasingly rely on digital platforms for service delivery and financial transactions. Consequently, digital connectivity has become a crucial determinant of rural socio-economic development within the state.

The COVID-19 pandemic further highlighted the indispensable role of digital technologies in maintaining economic and social continuity. Online education, telemedicine, digital banking, e-commerce, virtual communication, and electronic governance emerged as essential services during periods of restricted physical mobility. At the same time, the pandemic exposed existing inequalities in digital access, particularly among economically weaker households and geographically isolated rural communities

Beyond facilitating communication and financial transactions, digital technologies are increasingly transforming rural livelihoods. Farmers utilize mobile applications to access weather forecasts, market prices, agricultural advisories, and government schemes. Rural entrepreneurs leverage social media and digital marketplaces to expand business opportunities beyond local markets. Self-help groups increasingly adopt digital payment systems to enhance financial transparency and improve institutional efficiency. Government departments employ digital platforms to improve beneficiary identification, monitor programme implementation, and ensure timely delivery of welfare benefits.

However, successful digital transformation requires more than infrastructure expansion. Digital literacy, awareness, trust in online platforms, cybersecurity preparedness, affordability of devices, and institutional support are equally important determinants of effective digital adoption. Cyber fraud, misinformation, privacy concerns, and inadequate technical support remain significant barriers that discourage many rural residents from fully utilizing digital services. Moreover, elderly individuals, economically disadvantaged households, and marginalized social groups often experience greater difficulties in adapting to rapidly evolving digital environments. Therefore, understanding how rural communities perceive, access, and utilize digital services is essential for designing effective policies that promote equitable and sustainable digital development.

Against this background, the present study investigates the role of digital connectivity in shaping rural development in Tripura. Specifically, it examines the availability and utilization of digital services among

rural households, analyses their socio-economic implications, identifies major constraints affecting digital adoption, and proposes policy recommendations for enhancing inclusive digital development. By providing empirical evidence from rural communities in Tripura, the study contributes to the growing discourse on digital transformation and rural development, offering practical insights for policymakers, development practitioners, and researchers concerned with promoting equitable digital inclusion in India's rural landscape.

2. Literature Review

2.1 Digital Connectivity and Rural Development

Digital connectivity has emerged as one of the most significant drivers of socio-economic development by improving access to information, markets, financial services, education, healthcare, and public administration. In rural areas, digital technologies facilitate communication, enhance agricultural productivity, reduce transaction costs, and strengthen the delivery of government services. Consequently, digital infrastructure is increasingly viewed as an essential component of rural development rather than merely a technological facility.

Klerkx, Jakku, and Labarthe (2019) observed that digital technologies have transformed rural economies through precision agriculture, digital advisory services, market information systems, and improved knowledge dissemination. Their study emphasized that digital innovations contribute to enhanced productivity and sustainable resource management, although their effectiveness depends on farmers' access to infrastructure and digital competencies.

Similarly, Yaacoub and Alouini (2020) highlighted that universal digital connectivity remains one of the major developmental challenges because rural regions continue to experience inadequate communication infrastructure and poor network quality. The authors argued that reliable broadband infrastructure and affordable internet services are essential prerequisites for achieving inclusive rural development.

The OECD (2021) further emphasized that digital connectivity contributes significantly to productivity growth, innovation, employment generation, and efficient public service delivery. However, the organization noted that meaningful digital transformation requires simultaneous investments in digital infrastructure, human capital, institutional support, and digital governance.

2.2 Digital Divide and Digital Inclusion

The concept of the digital divide has evolved considerably over time. Initially, it referred primarily to disparities in access to computers and internet services. Contemporary research, however, recognizes that digital inequality also encompasses differences in digital literacy, affordability, quality of connectivity, technological capabilities, and the socio-economic outcomes derived from digital technology use.

Van Dijk (2020) argued that modern digital inequalities are increasingly determined by differences in digital skills rather than physical access alone. Individuals possessing higher educational attainment and stronger technological competencies are more likely to utilize digital technologies effectively for economic and social advancement.

Tewathia, Kamath, and Ilavarasan (2020) examined digital inequality in India and found that education, income, age, and place of residence significantly influence internet adoption and digital participation. Their

study concluded that expanding internet infrastructure alone cannot eliminate digital exclusion unless accompanied by improvements in digital literacy and socio-economic conditions.

Similarly, the World Bank (2021) emphasized that digital inclusion requires not only affordable internet access but also institutional support, digital education, and opportunities that enable citizens to convert digital access into meaningful developmental outcomes. These findings indicate that digital inclusion should be understood as a multidimensional development process integrating infrastructure, knowledge, and institutional capacity.

2.3 Digital India and Rural Transformation

India has undertaken one of the world's largest digital transformation programmes through the Digital India Mission, launched in 2015. The programme seeks to provide digital infrastructure as a public utility, improve governance through digital platforms, and promote digital empowerment among citizens. Supporting initiatives such as BharatNet, Common Service Centres (CSCs), Aadhaar-enabled services, Unified Payments Interface (UPI), Direct Benefit Transfer (DBT), and DigiLocker have significantly expanded the country's digital ecosystem.

The Ministry of Electronics and Information Technology (MeitY, 2021) reported substantial improvements in rural digital infrastructure through the expansion of broadband connectivity and digital public services. The increasing availability of Common Service Centres has facilitated access to banking services, government documentation, online applications, and various welfare schemes at the village level. The National Payments Corporation of India (NPCI, 2021) documented remarkable growth in digital payment transactions following the widespread adoption of UPI. The simplicity, interoperability, and low transaction costs associated with UPI have encouraged greater participation in digital financial systems, particularly among younger populations.

Despite these achievements, studies continue to report disparities in broadband availability, digital literacy, and awareness regarding online services, particularly in geographically remote rural regions.

2.4 Digital Literacy and Digital Financial Inclusion

Digital literacy has emerged as one of the most important determinants of successful digital transformation. UNESCO (2018) defines digital literacy as the ability to access, evaluate, create, communicate, and utilize digital information effectively and responsibly. Digital literacy enables individuals to participate productively in education, employment, entrepreneurship, governance, and financial services.

Sharma and Singh (2021) reported that digital literacy significantly enhances the utilization of e-governance services, digital banking, online education, and mobile-based applications among rural populations. Their study further observed that educational attainment positively influences digital confidence and technology adoption.

The expansion of digital payment systems has substantially strengthened financial inclusion in rural India. According to the Reserve Bank of India (2021), digital payment platforms such as UPI, mobile banking, Aadhaar Enabled Payment Systems (AePS), and RuPay have significantly improved accessibility to formal financial services. However, cybersecurity concerns, online fraud, and inadequate digital awareness continue to influence users' confidence in digital transactions.

These findings suggest that improving digital literacy and financial awareness is equally important as expanding digital infrastructure for achieving inclusive digital development.

2.5 Digital Technologies and Rural Livelihoods

Digital technologies increasingly contribute to rural livelihoods by improving agricultural information systems, market access, entrepreneurship, communication, and access to public services. Smartphones and internet-based platforms enable rural households to obtain weather forecasts, agricultural advisories, market prices, online training, and government information.

Lioutas and Charatsari (2020) argued that responsible digital transformation in agriculture requires balanced investments in technological infrastructure, institutional support, and farmers' capabilities. Digital innovations create opportunities for improving agricultural productivity, but unequal access to technology may also widen existing socio-economic disparities.

FAO (2019) similarly emphasized that digital technologies support sustainable rural development by improving agricultural productivity, strengthening market integration, enhancing resource efficiency, and facilitating climate-resilient farming practices. However, the successful adoption of digital technologies depends on infrastructure availability, affordability, and users' digital competencies.

Overall, the literature demonstrates that digital technologies contribute significantly to improving rural livelihoods by expanding economic opportunities, strengthening governance, enhancing communication, and facilitating access to information.

3. Research Gap, Objectives and Conceptual Framework

3.1 Research Gap

The rapid advancement of digital technologies has generated a substantial body of literature on digital governance, digital financial inclusion, e-governance, and rural digital transformation in India. Numerous studies have examined the role of flagship initiatives such as Digital India, BharatNet, Common Service Centres (CSCs), Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA), Unified Payments Interface (UPI), and Aadhaar-enabled public service delivery in promoting digital inclusion and improving governance outcomes. These studies collectively suggest that digital technologies have enhanced transparency, efficiency, financial inclusion, and accessibility of public services, thereby contributing to socio-economic development in rural India.

Despite these contributions, several important research gaps remain.

First, **most existing studies focus on a single dimension of digital transformation**, such as digital payments, e-governance, internet accessibility, Common Service Centres, or digital literacy. Very few studies adopt an integrated approach that simultaneously examines digital connectivity, digital service utilization, digital literacy, socio-economic outcomes, and the challenges associated with digital adoption among rural households.

Second, **the majority of empirical studies have concentrated on larger states or urban and peri-urban settings**, while the North Eastern Region of India has received comparatively limited scholarly attention. Although the region presents unique geographical, infrastructural, socio-cultural, and economic characteristics that significantly influence digital adoption, systematic empirical evidence remains inadequate.

Third, **research specifically focusing on Tripura remains scarce**. Existing studies conducted in the state largely examine isolated issues such as digital payment systems, Common Service Centres, or selected e-governance services. Comprehensive empirical investigations that evaluate how digital connectivity influences multiple aspects of rural life—including communication, financial inclusion, education, access to government services, livelihood opportunities, and overall socio-economic development—are limited.

Fourth, **cybersecurity awareness and digital trust remain underexplored dimensions** in rural digital transformation studies. With the rapid expansion of online banking, UPI transactions, digital documentation, and e-commerce, rural users increasingly face cyber threats including phishing, fake calls, OTP fraud, identity theft, and financial scams. However, empirical evidence regarding rural citizens' awareness of cybersecurity risks and their preparedness to address such threats remains limited.

Furthermore, many previous studies primarily rely on secondary data, administrative statistics, or programme evaluations, with relatively fewer investigations based on household-level primary data collected directly from rural communities. Such primary evidence is particularly important for understanding citizens' lived experiences, behavioural patterns, perceptions, and challenges associated with digital technologies.

Against this backdrop, the present study attempts to bridge these research gaps by undertaking a comprehensive empirical assessment of digital connectivity and its implications for rural development in Tripura. Unlike previous studies, this research simultaneously examines the availability of digital infrastructure, patterns of digital service utilization, socio-economic impacts, user perceptions, and barriers affecting digital inclusion using primary data collected from rural households. By integrating these dimensions within a single analytical framework, the study contributes to the emerging literature on digital transformation, digital inclusion, and rural development in India's North Eastern Region.

3.2 Research Objectives

The present study seeks to examine the role of digital connectivity in promoting rural development in Tripura through an empirical assessment of digital service utilization and its socio-economic implications.

General Objective

To examine the contribution of digital connectivity to rural development in Tripura through an empirical assessment of digital service utilization, digital inclusion, and associated challenges among rural households.

Specific Objectives

1. **To examine the availability and accessibility of digital infrastructure and internet connectivity among rural households in Tripura.**
2. **To analyse the pattern of utilization of digital services for communication, financial transactions, education, information access, and government service delivery.**
3. **To assess the impact of digital connectivity on the socio-economic well-being of rural communities with particular reference to communication, financial inclusion, access to public services, education, and livelihood opportunities.**

4. To identify the major constraints affecting digital inclusion, including infrastructural limitations, digital literacy, cybersecurity concerns, affordability, and user awareness.
5. To suggest appropriate policy measures for strengthening digital connectivity and promoting inclusive rural digital development in Tripura.

3.3 Research Questions

The study is guided by the following research questions:

1. What digital infrastructure and digital services are available to rural households in Tripura?
2. Which digital services are most frequently utilized by rural residents?
3. How has digital connectivity influenced communication, financial transactions, education, governance, and livelihood opportunities in rural communities?
4. What socio-economic and technological factors influence the adoption of digital services among rural households?
5. What are the major barriers limiting effective digital inclusion in rural Tripura?
6. What policy interventions can strengthen digital connectivity and promote sustainable rural development?

3.4 Conceptual Framework

The conceptual framework of the present study is based on the premise that **digital connectivity functions as an enabling factor for rural development**. The framework assumes that the availability of digital infrastructure facilitates access to digital services, while digital literacy and socio-economic characteristics determine the extent to which rural households utilize these services. Effective utilization of digital technologies subsequently contributes to improved communication, financial inclusion, governance, education, healthcare, agricultural information dissemination, and livelihood opportunities, ultimately leading to enhanced rural development outcomes.

However, the relationship between digital connectivity and rural development is mediated by several intervening factors, including digital literacy, affordability, network quality, cybersecurity awareness, institutional support, and socio-economic conditions. These factors may either facilitate or constrain the realization of digital development outcomes.

Accordingly, the conceptual framework comprises five interrelated components:

(i) Digital Infrastructure

The component includes: Internet connectivity, Mobile network availability, Smartphone ownership, Broadband access, Availability of digital devices

Digital infrastructure provides the foundation upon which digital services become accessible to rural households.

(ii) Enabling Factors

These variables influence the effective utilization of digital technologies are:

- Digital literacy, Educational attainment, Household income, Age, Awareness of digital services, Institutional support, Availability of Common Service Centres, Government digital initiatives

These factors determine users' capability and willingness to adopt digital technologies.

(iii) Digital Service Utilization

This component captures the actual use of digital technologies, including:

- Social media, UPI payments, Mobile banking, Internet browsing, Online education, Telemedicine, e-Governance services, Online documentation, Digital communication, Agricultural information services

(iv) Challenges and Constraints

Several barriers may reduce the effectiveness of digital connectivity.

These include: Poor network connectivity, Slow internet speed, Lack of digital literacy, Cyber fraud, Fake calls and phishing, OTP fraud, High internet costs, Limited awareness, Device affordability, Technical problems

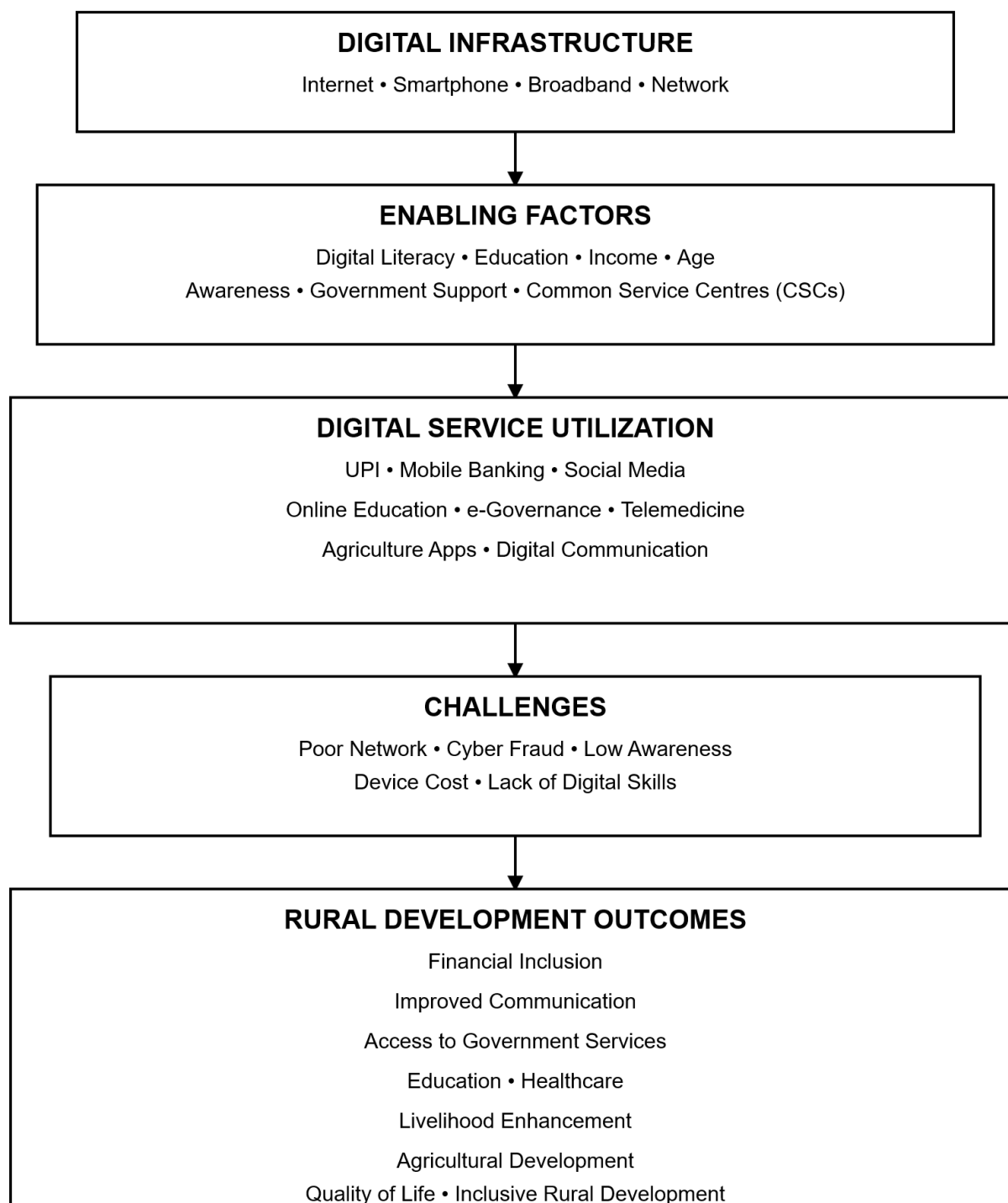
(v) Rural Development Outcomes

Successful utilization of digital services contributes to multiple development outcomes.

These include:

- Improved communication, financial inclusion, better access to government welfare schemes, enhanced educational opportunities, Improved healthcare access, Increased agricultural productivity, Expansion of rural entrepreneurship, Greater social inclusion, Improved quality of life, Sustainable rural development

Figure 1. Conceptual Framework of the Study



Theoretical Underpinning

The conceptual framework draws upon three complementary theoretical perspectives:

1. **Digital Divide Theory (van Dijk, 2020)**: explains inequalities in access, skills, and outcomes associated with digital technologies.
2. **Technology Acceptance Model (TAM) (Davis, 1989)**: posits that perceived usefulness and perceived ease of use influence individuals' adoption of digital technologies.

3. **Capability Approach (Sen, 1999):** emphasizes that development depends not merely on access to resources but on individuals' capabilities to convert those resources into meaningful improvements in well-being.

Integrating these perspectives provides a comprehensive analytical basis for examining how digital connectivity influences rural development. It recognizes that infrastructure alone is insufficient; meaningful development occurs when rural households possess the knowledge, skills, institutional support, and confidence to use digital technologies effectively. Consequently, the framework guides the empirical analysis by linking digital infrastructure and enabling conditions to digital service utilization and, ultimately, to broader socio-economic outcomes in rural Tripura.

4. Research Methodology

4.1 Research Design

The present study adopted a descriptive and analytical cross-sectional research design to examine the contribution of digital connectivity to rural development in Tripura. A cross-sectional survey design was considered appropriate because it enables the collection of primary data from respondents at a single point in time and facilitates the analysis of existing patterns of digital infrastructure, digital service utilization, financial inclusion, cybersecurity awareness, and perceived developmental outcomes. The study integrates descriptive and inferential statistical techniques to provide a comprehensive understanding of digital connectivity and its implications for rural development.

4.2 Study Area

The present study was conducted in **Hezamara Rural Development (R.D.) Block of West Tripura District**, Tripura. Four villages were purposively selected for the present study because they represent varying levels of digital connectivity and socio-economic characteristics within the block. These villages include: **Barkathal, Chandpur, Paschim Tamakari, Purba Noagaon**

According to the records of Hezamara R.D. Block, these four villages together have a population of **10,413** persons and provide an appropriate representation of rural communities within the study area.

The selection of these villages enabled the researcher to examine digital connectivity and service utilization among households with different socio-economic backgrounds and varying levels of access to digital infrastructure.

4.3 Sampling Technique

The study employed Simple Random Sampling (SRS) to select respondents from the four selected villages.

Initially, the villages were selected purposively considering their accessibility and representation of different socio-economic conditions within the block. Subsequently, households within each village were selected through simple random sampling to ensure that every eligible household had an equal probability of being included in the study.

The use of random sampling minimized selection bias and enhanced the representativeness of the sample.

4.4 Sampling Design and Sample Size

A multistage sampling technique was adopted for selecting respondents. In the first stage, Hezamara R.D. Block was selected purposively. In the second stage, four villages were selected based on their accessibility and representation of rural socio-economic conditions. In the final stage, respondents were selected using Simple Random Sampling (SRS).

A total of 104 respondents participated in the survey.

Table 1. Distribution of Sample Respondents

Village	Number of Respondents
Barkathal	26
Chandpur	26
Paschim Tamakari	26
Purba Noagaon	26
Total	104

Source: Field Survey (2022).

4.5 Sources of Data

The study is based on both **primary and secondary data**.

Primary Data: collected directly from respondents through a structured interview schedule (face-to-face household interviews) covering:	Secondary Data collected from
• Availability of digital infrastructure • Smartphone ownership • Internet connectivity • Digital payment practices • Online banking • Government digital services • Social media usage • Digital literacy • Cybersecurity awareness • Benefits and challenges of digital technologies	• Hezamara R.D. Block Office • Census of India • Ministry of Electronics and Information Technology (MeitY) • Reserve Bank of India • Digital India Reports • BharatNet Reports • Government publications • Books • Journals • Research articles • FAO • OECD • World Bank

4.6 Research Instrument

A structured interview schedule was developed after reviewing relevant literature and consulting experts in rural development and digital governance.

The schedule comprised four sections:

- **Section I:** Socio-economic profile
- **Section II:** Digital infrastructure
- **Section III:** Utilization of digital services
- **Section IV:** Perceived benefits and challenges

The instrument consisted primarily of close-ended questions with a few multiple-response items to facilitate quantitative analysis.

4.7 Variables Used in the Study

The variables were classified into four major dimensions.

Dimension	Variables
Socio-economic Characteristics	Age, Gender, Education, Occupation, Income
Digital Connectivity	Network availability, Smartphone ownership, Internet access, Digital infrastructure
Digital Service Utilization	UPI, Mobile Banking, Social Media, Online Education, Digital Communication
Perceived Rural Development Outcomes	Financial inclusion, Education, Communication, Government services, Overall perception, Satisfaction

4.8 Statistical Techniques Used

The collected data were analysed using Microsoft Excel and IBM SPSS Statistics (Version 16). Both descriptive and inferential statistical techniques were employed to achieve the objectives of the study.

4.8.1 Descriptive Statistics

Descriptive statistics were used to summarize the characteristics of respondents and their digital behaviour. Frequency distributions and percentages were calculated for categorical variables such as age, gender, educational qualification, digital payment methods, internet availability, and awareness of digital services.

4.8.2 Cross-tabulation

Cross-tabulation was employed to compare the distribution of digital service utilization across different socio-economic categories. In particular, the relationship between educational qualification and preferred digital payment method was examined to understand the influence of education on digital financial behaviour.

4.8.3 Chi-square Test of Association

The Pearson Chi-square (χ^2) test was used to examine the statistical association between categorical variables. The study specifically tested the relationship between respondents' educational qualification and their preferred digital payment method.

The Chi-square statistic is expressed as:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where:

- O = Observed frequency
- E = Expected frequency

The significance level was fixed at 5 per cent ($p < 0.05$).

4.8.4 Mean and Standard Deviation

Mean scores and standard deviations were computed for the ordinal perception variables after assigning appropriate numerical codes to the response categories. These descriptive measures were used to compare respondents' perceptions regarding the usefulness of digital services, satisfaction with digital infrastructure, and the contribution of digital connectivity to rural development.

5. Results and Discussion

The findings are presented under six broad themes: (i) socio-economic characteristics of respondents, (ii) digital infrastructure and connectivity, (iii) digital service utilization, (iv) adoption of digital financial services, (v) cybersecurity awareness, and (vi) perceived impact and challenges of digital connectivity. The discussion integrates empirical findings with existing literature to explain the role of digital technologies in rural development.

5.1 Socio-economic Profile of Respondents

The socio-economic profile of respondents provides the background for understanding patterns of digital adoption. Age, education, occupation, and household income influence the extent to which rural households can access and utilize digital technologies.

Table 1. Socio-economic Characteristics of Respondents (N = 104)

Variable	Category	Frequency	Percentage
Age	18–25 years	71	68.3
	26–35 years	24	23.1
	36–45 years	1	1.0
	Missing	8	7.7

Gender	Male	51	49.0
	Female	52	50.0
	Data entry error*	1	1.0
Education	Secondary	1	1.0
	Higher Secondary	29	27.9
	Graduate & Above	74	71.2
Occupation	Student	65	62.5
	Business	18	17.3
	Farmer	9	8.7
	Government Employee	5	4.8
	Others	7	6.7
Monthly Income	Below ₹10,000	44	42.3
	₹10,000–20,000	46	44.2
	₹20,000–40,000	9	8.7
	Above ₹40,000	5	4.8

Source: Field Survey, 2022.

Discussion

The respondents were predominantly young and educated. More than two-thirds (68.3%) belonged to the 18–25-year age group, while 71.2% possessed graduate-level education or above. Students constituted the largest occupational group (62.5%), indicating that younger and educated individuals are the primary users of digital technologies in the study area. Household incomes were modest, with nearly 86.5% of respondents earning less than ₹20,000 per month. These findings suggest that educational attainment rather than income may be the principal factor facilitating digital participation.

5.2 Digital Infrastructure and Accessibility

Reliable digital infrastructure is the foundation for successful digital transformation.

Table 2. Digital Infrastructure and Accessibility

Indicator	Category	Frequency	Percentage
Network Availability	Yes	59	56.7
	Partially	30	28.8
	No	15	14.4
Digital Services Available in Village	Social Media	37	35.6
	YouTube	37	35.6
	All Services	25	24.0
	UPI only	5	4.8

Family Access to Digital Services	Yes	54	51.9
	Only Few Members	45	43.3
	Only Respondent	5	4.8
Awareness of Digital Services	Aware	55	52.9
	Moderately Aware	31	29.8
	Highly Aware	14	13.5
	Not Aware	4	3.8

Source: Field Survey, 2022.

Discussion

The survey reveals that more than half of the respondents (56.7%) reported satisfactory network availability, while 43.2% experienced partial or poor connectivity. Although access to smartphones and internet-based services has become widespread, network instability remains a major concern. The findings indicate that digital infrastructure has expanded considerably under government initiatives, but quality of service continues to constrain effective digital participation.

5.3 Digital Service Utilization and Financial Inclusion

Digital service utilization reflects the extent to which respondents integrate technology into their daily lives.

Table 3. Digital Service Utilization and Digital Payment Behaviour

Indicator	Category	Frequency	Percentage
Preferred Digital Payment Method	UPI	81	77.9
	Mobile Banking	11	10.6
	ATM	10	9.6
	None	2	1.9
Perceived Usefulness of Digital Services	Very Useful	32	30.8
	Useful	70	67.3
	Less Useful	2	1.9
Digital Services Improve Rural Life	Highly Agree	19	18.3
	Agree	65	62.5
	Neutral	20	19.2

Source: Field Survey, 2022.

Discussion

UPI emerged as the dominant digital payment platform, being used by nearly four-fifths (77.9%) of respondents. This finding reflects the increasing acceptance of digital financial services in rural Tripura. In addition, 98.1% of respondents considered digital services useful or very useful in their daily lives, while more than four-fifths agreed that digital technologies contribute positively to rural development. These findings demonstrate growing confidence in digital technologies and indicate that rural households increasingly perceive digital connectivity as beneficial for communication, financial transactions, education, and access to public services.

5.4 Perceived Impact of Digital Connectivity

Respondents were asked to evaluate the overall contribution of digital technologies to rural development.

Table 4. Perceived Impact of Digital Connectivity

Response	Frequency	Percentage
Very Positive	15	14.4
Positive	54	51.9
Neutral	32	30.8
Negative	3	2.9

Source: Field Survey, 2022.

Discussion

A substantial majority (66.3%) perceived the impact of digital services on rural life as either positive or very positive. Only 2.9% expressed negative opinions. These findings suggest that digital connectivity has contributed significantly to improving communication, information access, educational opportunities, and financial inclusion. The positive perception of digital services indicates that government initiatives have successfully expanded digital participation among rural households.

5.5 Challenges Affecting Digital Adoption

Although respondents acknowledged the benefits of digital technologies, several constraints continue to hinder effective digital utilization.

Table 5. Satisfaction with Digital Facilities

Level of Satisfaction	Frequency	Percentage
Very Satisfied	5	4.8
Satisfied	44	42.3
Neutral	42	40.4
Not Satisfied	13	12.5

Source: Field Survey, 2022.

Discussion

The level of satisfaction indicates that while digital facilities are generally viewed positively, improvements remain necessary. Nearly half of the respondents expressed satisfaction with existing facilities; however, a considerable proportion remained neutral or dissatisfied. Responses elsewhere in the questionnaire suggest that unreliable network connectivity, limited digital literacy, cybersecurity concerns, and affordability continue to affect digital adoption. Addressing these challenges is essential for ensuring equitable access to digital opportunities.

5.6 Association between Educational Qualification and Digital Payment Adoption

To examine whether educational attainment influences the adoption of digital payment methods, a Pearson Chi-square test of independence was performed using respondents' educational qualification and their preferred digital payment method.

Table 6. Association between Educational Qualification and Preferred Digital Payment Method

Educational Qualification	UPI	Mobile Banking	ATM	Total
Graduate and Above	64	6	3	73

Higher Secondary	16	4	7	27
Secondary	0	1	0	1
Total	80	11	10	101*

Source: Field Survey, 2022.

*Three respondents did not provide a valid response for this question.

Chi-square Test: $\chi^2 = 20.53$, $df = 4$, $p < 0.001$

The Chi-square test reveals a statistically significant association between educational qualification and the preferred digital payment method ($\chi^2 = 20.53$, $df = 4$, $p < 0.001$). Respondents possessing graduate-level education overwhelmingly preferred **UPI** as their primary digital payment mode, whereas respondents with lower educational attainment were relatively more likely to rely on ATM cards or mobile banking. The findings indicate that educational attainment plays an important role in promoting digital financial inclusion by increasing confidence in digital payment technologies.

5.7 Cyber Fraud and Security Awareness

The expansion of digital financial services has also increased exposure to cybersecurity risks. Respondents were asked to identify the most common type of digital fraud encountered while using digital platforms.

Table 7. Common Cybersecurity Risks Reported by Respondents (N = 104)

Type of Fraud	Frequency	Percentage
Fake calls/SMS	66	63.5
OTP fraud	31	29.8
Social media hacking	7	6.7

Source: Field Survey (2022).

The results indicate that **fake calls and fraudulent SMS messages** are the most common cyber threats, reported by **63.5%** of respondents. OTP-related fraud accounted for **29.8%**, while **6.7%** reported social media hacking. These findings suggest that although digital financial services have become widely accepted, rural users remain vulnerable to phishing, fraudulent calls, and OTP scams. The results highlight the need for continuous cybersecurity awareness programmes and digital safety campaigns.

5.8 Perceived Impact of Digital Connectivity on Rural Development

Respondents were asked to assess the overall impact of digital services on rural development.

Table 8. Overall Perceived Impact of Digital Services (N = 104)

Perception	Frequency	Percentage
Very Positive	15	14.4
Positive	54	51.9
Neutral	32	30.8
Negative	3	2.9

Source: Field Survey (2022).

The findings reveal that **66.3%** of respondents perceived the impact of digital services on rural development as either **positive** or **very positive**, whereas only **2.9%** expressed a negative opinion. The widespread positive perception suggests that digital connectivity has enhanced communication, access to information, digital financial services, educational opportunities, and access to government programmes. Nevertheless, nearly one-third of respondents maintained a neutral opinion, indicating that the developmental benefits are not yet equally experienced by all rural households.

5.9 Satisfaction with Digital Facilities and Challenges in Digital Adoption

Respondents were also asked to evaluate their satisfaction with the existing digital facilities available in their locality.

Table 9. Satisfaction with Existing Digital Facilities (N = 104)

Satisfaction Level	Frequency	Percentage
Very Satisfied	5	4.8
Satisfied	44	42.3
Neutral	42	40.4
Not Satisfied	13	12.5

Source: Field Survey (2022).

The results indicate that nearly half of the respondents (**47.1%**) were satisfied or very satisfied with the available digital facilities. However, **52.9%** were either neutral or dissatisfied, suggesting that improvements in infrastructure remain necessary. Responses to other survey questions indicate that the principal constraints include unreliable network connectivity, internet interruptions, affordability concerns, and cybersecurity risks. These challenges continue to limit the effective utilization of digital services despite increasing digital penetration.

5.10 Integrated Discussion and Key Findings

To complement the descriptive findings, inferential statistical analyses were undertaken.

The **Chi-square test** demonstrated a significant association between educational qualification and digital payment adoption, indicating that respondents with higher educational attainment are more likely to adopt UPI-based digital payment systems. This finding is consistent with the argument that education improves digital literacy and confidence in using financial technologies.

Overall, the empirical findings demonstrate that digital connectivity has substantially improved communication, digital financial inclusion, educational access, and public service delivery among rural households in the study area. However, persistent challenges related to network quality, cybersecurity, and digital awareness continue to constrain the full realization of inclusive digital development. These findings underscore the importance of complementing investments in digital infrastructure with digital literacy programmes, cybersecurity awareness initiatives, and reliable broadband services to ensure equitable and sustainable rural digital transformation.

6. Major Findings, Policy Implications and Conclusion

6.1 Major Findings

The present study examined the status of digital connectivity, utilization of digital services, and their contribution to rural development among 104 respondents from four villages of Hezamara R.D. Block, West Tripura District. The empirical findings indicate that digital technologies have become an integral part of rural life, particularly in communication, digital financial services, education, and access to information. However, the extent of digital utilization varies according to educational attainment, digital awareness, and the availability of reliable digital infrastructure.

The socio-economic profile reveals that the respondents were predominantly young and educated. More than two-thirds (68.3%) belonged to the 18–25 years age group, while 71.2% possessed graduate-level education or above. This demographic composition indicates that younger and better-educated individuals are more likely to engage with digital technologies and online services. The findings suggest that education plays an important role in promoting digital literacy and digital participation.

The study further indicates that digital infrastructure has expanded considerably in the study area. More than half of the respondents (56.7%) reported satisfactory network availability, although 43.3% experienced either partial or poor connectivity. This finding demonstrates that while digital infrastructure has improved under national digital initiatives, the quality and consistency of network services remain important challenges affecting rural users.

With regard to digital service utilization, UPI emerged as the dominant digital payment method, used by nearly four-fifths of the respondents. The statistical analysis further confirmed a significant association between educational qualification and preferred digital payment method ($\chi^2 = 20.53, p < 0.001$), indicating that respondents with higher educational attainment were significantly more likely to adopt UPI-based transactions than those with lower educational qualifications.

The study also identified cybersecurity as an emerging concern. Fake calls and fraudulent SMS messages were reported as the most common cyber threats, followed by OTP-related fraud and social media account misuse. These findings indicate that although digital financial services have become widely accepted, users continue to face risks associated with cybercrime, highlighting the need for stronger digital safety awareness.

Respondents generally perceived digital connectivity positively. Approximately two-thirds (66.3%) believed that digital services have had a positive or very positive impact on rural development. Improvements in communication, access to information, digital financial transactions, educational opportunities, and government services were identified as the principal benefits associated with digital technologies.

Overall, the findings demonstrate that digital connectivity has made a positive contribution to rural development in the study area. Nevertheless, uneven network quality, cybersecurity concerns, and variations in digital awareness continue to constrain the full realization of inclusive digital development.

6.2 Policy Implications

The findings provide several policy implications for strengthening digital connectivity and promoting inclusive rural development in Tripura.

First, improving the quality and reliability of digital infrastructure should remain a priority. Although internet connectivity has expanded considerably, many respondents continue to experience unstable network services. Strengthening broadband connectivity and improving mobile network coverage under BharatNet and related initiatives would enhance the effectiveness of digital service delivery.

Second, digital literacy programmes should be strengthened through schools, Common Service Centres (CSCs), Panchayati Raj Institutions, Self-Help Groups, and community organizations. Particular attention should be given to women, elderly persons, and economically weaker households to ensure equitable participation in the digital economy.

Third, cybersecurity awareness should become an integral component of rural digital development programmes. Regular awareness campaigns focusing on safe digital transactions, OTP protection, fraud prevention, password management, and grievance reporting mechanisms would help build public confidence in digital financial services.

Fourth, Common Service Centres should be further strengthened as village-level digital facilitation centres. In addition to delivering government services, CSCs can play an important role in promoting digital literacy, facilitating online applications, supporting telemedicine, and improving access to digital financial services.

Finally, digital development policies should adopt an integrated approach combining infrastructure development, digital literacy, affordability, cybersecurity, and institutional support. Such an approach would enable digital connectivity to contribute more effectively to sustainable and inclusive rural development.

6.3 Conclusion

Digital connectivity has become an increasingly important driver of rural development by improving access to communication, information, financial services, education, and government programmes. The present study demonstrates that digital technologies have become widely integrated into the daily lives of rural households in the selected villages of Hezamara R.D. Block, West Tripura District.

The empirical evidence indicates that educational attainment significantly influences digital payment adoption, while positive perceptions regarding digital connectivity are associated with higher levels of satisfaction with available digital facilities. Respondents generally recognized the contribution of digital technologies to communication, financial inclusion, educational access, and public service delivery. However, persistent challenges such as inadequate network quality, cybersecurity risks, and uneven digital awareness continue to influence the extent of digital inclusion.

The findings also provide empirical support for the theoretical framework adopted in this study. Consistent with the Digital Divide Theory (van Dijk, 2020), disparities in network availability, digital literacy, and educational attainment continue to shape the adoption and utilization of digital technologies in rural areas. The widespread use of UPI and the positive perception of digital services indicate that respondents increasingly perceive digital technologies as useful and beneficial, thereby supporting the Technology Acceptance Model (Davis, 1989), which emphasizes perceived usefulness as a key determinant of technology adoption. Furthermore, the results align with Sen's (1999) Capability Approach by demonstrating that digital infrastructure contributes to rural development only when individuals possess

the knowledge, skills, and institutional support necessary to transform digital access into meaningful socio-economic opportunities.

The study concludes that expanding digital infrastructure alone is insufficient to achieve inclusive rural development. Sustainable digital transformation requires complementary investments in reliable broadband connectivity, digital literacy, cybersecurity awareness, institutional support, and community participation. By addressing these dimensions simultaneously, digital connectivity can become a more effective instrument for improving livelihoods, strengthening governance, and promoting inclusive rural development in Tripura.

Although the study is limited to 104 respondents from four villages of Hezamara R.D. Block, it provides valuable empirical evidence on the role of digital connectivity in rural development. Future studies may extend the analysis to other districts of Tripura and the wider North Eastern Region using larger samples and more advanced multivariate techniques to deepen understanding of the long-term developmental impacts of digital transformation.

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