

## Bridging Digital Divide: Challenges And Opportunities For Inclusive Technology Adoption In Rural Development

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### Abstract

The digital revolution is making a significant contribution to our country's development and economic growth, but a large section of the rural population still remains deprived of its benefits. This paper analyzes the many factors that contribute to the digital divide between rural and urban areas and identifies challenges and opportunities for Equitable Access to Technology. In this paper used case studies from India, Kenya, and Bangladesh, this research provides policy recommendations based on insights gained from the existing literature. The results show that physical connectivity has improved, but meaningful adoption remains limited due to barriers. The paper shows a strong emphasis on public-private partnerships, localized digital literacy programs, and sustainable business models adapted to rural contexts. In this paper a mixed method approach, secondary data analysis and empirical findings used. This study contributes deep understanding of the digital divide and offers insights for policymakers, practitioners, and researchers working towards inclusive and sustainable rural development.

**Keywords:** digital divide, rural development, inclusive technology, digital inclusion, SDGs.

### Introduction

Digital technology has become a fundamental driver of global progress in the 21<sup>st</sup> century. However, its benefits are not distributed equally, especially between the urban and rural population. The digital divide – the gap between those who have effective access to digital tools and those who do not – has resulted in a form of digital inequality that reflects and reinforces existing economic and social inequalities. Rural regions, which form the backbone of developing economies, often lack the basic digital infrastructure, reliable electricity, internet access and digital skills needed to fully participate in the digital age. As a result, rural citizens remain excluded from opportunities in education, finance, governance and entrepreneurship.

This paper explores how bridging the digital divide can serve as a catalyst for inclusive rural development and directly contribute to the SDG. It also presents a comparative analysis of successful initiatives –e choupal in India, M-Pesa in Kenya and Union Digital Hubs in Bangladesh – to demonstrate practical pathways to sustainable and inclusive digital adoption.

#### **The Digital Divide and Rural Development**

The digital divide is not only a technological issue but also a developmental challenge. Limited connectivity, lack of affordability, and insufficient digital literacy perpetuate socioeconomic exclusion. In rural areas, this gap prevents citizens from accessing government schemes, educational resources, and financial systems, thereby reinforcing cycles of poverty.

Inclusive digital transformation ensures that technology becomes an enabler of equality, empowerment, and participation. It allows rural citizens to access markets, receive online education, avail of e-governance services, and participate in the knowledge economy—core components of sustainable rural development.

## LITERATURE REVIEW

**(Linh and Huyen, 2025)** examine the hypothesis of digital payment services in Vietnam. They extend the Technology Acceptance Model (TAM) and the Trust Model with Theory of planned behavior (TPB). Using an approach based on quantitative survey and Structural equation model (SEM), the study evaluates how trust, ease of use, perceived usefulness, and behavioral intention influence adoption. The results show that trust and perceived behavioral control significantly influence digital payment adoption, while security concerns and lack of awareness remain obstacles. The study stresses the need to strengthen cyber security measures and financial education. It concludes that integrating beliefs and behavioral intention theories provides a deeper digital insight into payment approval in emerging markets.

**(Divi et al., 2024)** analyze the penetration of digital transactions in rural India, estimate its role in financial inclusion and economic participation. Using mixed methods, the approach, including statistical analysis and case studies, the study evaluates progress in the adoption of digital payments and the ongoing challenges faced by rural communities. The results show the initiatives taken by the government like UPI and Aadhaar Payment have significantly improved the availability of financial services, but barriers such as poor digital literacy, cyber security issues, and unreliable internet infrastructure prevent widespread adoption. The research highlights the need for strengthened digital education programs, strengthened financial security measures, and improved rural connectivity to ensure inclusive and sustainable digital financial growth. It concludes that closing these gaps is essential to achieve a large-scale rural financial inclusion.

**(Sravan et al., 2024)** explore a partially offline payment system using the Internet of Things to facilitate financial transactions in unconnected regions. Using a survey-based approach, the study examines existing offline and low connectivity systems. Payment solutions, analyzing their feasibility, security, and scalability in rural and remote areas. The results highlight that IoT payment systems can be improved. Financial inclusion is achieved by allowing digital transactions even in areas with interrupted internet access. However, challenges such as data security risks, hardware limitations, and integration with existing financial ecosystems remain. The study highlights the urgent need for adaptive regulatory frameworks, secure offline transaction protocols, and public-private partnerships to implement scalable offline digital payment models. It concludes that IoT-based payment systems can fill gaps in financial access, especially in digitally disconnected rural communities.

**Bhatnagar (2014)** analyzed the use of information and ICTs to help poor people in developing countries. It helps in ensuring accountability, transparency, and minimizing bribes in governmental activities. The rapid usage of mobile phones, e-Health services, smart cards, and other ICT facilities in India and other developing countries helps largely in empowering the poor and strengthening developmental initiatives in both government and nongovernmental sectors.

**Alam (2014)** surveyed the efficiency and effectiveness of Union Information Service Centers of Sylhet Sadar Upazila where people are exploiting the benefits of digital information services and ICT facilities in their daily lives. UISCs are working in the transformation of different types of information services and ICT facilities from the governmental level to the grass root level of the country.

## OBJECTIVES OF THE STUDY

- Identify the main challenges that prevent the adoption of inclusive technologies in rural areas.
- Explore the possibilities and potential of digital technology for rural transformation.

- Analyze and compare the models of E-choupal(india), M-Pesa (Kenya) and Union Digital Centers (Bangladesh).
- Link digital inclusion to the Sustainable Development Goals (SDGs).
- It proposes a hybrid model and policy recommendations for inclusive digital rural development.

## **METHODOLOGY**

The study follows a mixed-method research design, combining both quantitative and qualitative approaches. This design enables a comprehensive understanding of the factors influencing the digital divide and the opportunities for inclusive technology adoption in rural areas.

A comparative case study method has been used to analyze real-world examples from India, Kenya, and Bangladesh, where different strategies have been implemented to promote digital inclusion.

## **DATA COLLECTION**

The study is based on secondary data collected from reliable and authentic sources such as: Government reports (e.g., Ministry of Electronics and IT, NITI Aayog, World Bank, ITU) Scholarly journals, research articles, and case studies Reports from UNDP, World Economic Forum, and UNESCO National Sample Survey (NSSO) and Census data International databases like Internet World Stats and Digital 2025 reports.

## **COMPARATIVE CASE STUDY ANALYSIS**

### **Case Study 1: E – Choupal India**

e-Choupal's unique model created an important two-way multi-dimensional channel that could efficiently transport products and services into and out of rural India, recovering associated costs through agro-resource efficiency. This initiative now includes approximately 6,100 facilities covering more than 35,000 villages and serving more than 4 million farmers. E-Choupal's network is supported by ITC's sourcing teams, managing agents and flagship warehouses across India, enabling its food processing business to receive stocked identity goods even at short notice. ITC transformers are hand-picked, high-quality and reliable companies that guarantee hygienic processing and modern packaging. Strict quality control is exercised at every stage to preserve the natural taste, flavor and aroma of various agricultural products.

ITC's unique strength in this sector lies in the many backward linkages it has established with farmers. This network with the farming community has allowed ITC to create a very profitable supply system. ITC has made significant investments to bring Indian farmers online. Called 'e-Choupal', ITC's farmer empowerment plan revolves around providing Internet terminals in villages. Farmers used this technological infrastructure to access information online. The data that farmers have access to include weather, crop conditions, best agricultural practices, prevailing international prices and a host of other important information. E-Choupal is now the world's largest rural digital infrastructure. Launched in June 2000, "e-Choupal" has become the largest initiative among all Internet-based interventions in rural India. E-Choupal's services today reach more than 4 million farmers growing various crops – soybeans, coffee, wheat, rice, pulses, locusts – in more than 35,000 villages through 6,100 kiosks spread across 10 states (Madhya Pradesh, Haryana, Uttarakhand, Ranatak, Maharashtra and Tamil Nadu Maharashtra). The problems encountered in the creation and management of these "e-Choupals" services are mainly due to the inadequacy of the infrastructure, including power supply, telecommunication connectivity and bandwidth, in addition to the challenge of empowering new Internet users in remote and inaccessible areas of rural India. Some alternative and innovative solutions – some of them expensive – are used to overcome these challenges, for example. Power backup through batteries charged by solar panels, Upgrading BSNL exchanges with RNS kits, Installation of VSAT equipment, Mobile Choupals, local storage of static website content to deliver dynamic content more

effectively, 24x7 help desk, etc. Moving forward, the roadmap includes plans to integrate warehousing, handling and bulk transportation facilities to improve logistics efficiency. As a kisan company in India, ITC has taken care to involve farmers in the design and management of the entire e-Choupal initiative. The active participation of farmers in this rural initiative created a sense of ownership of the project among the farmers. They see 'e-Choupal' as the new age cooperative for all purposes. This enthusiastic response from farmers has encouraged ITC to plan to expand the 'e-Choupal' initiative to a total of 15 states across India in the coming years. On the anvil are projects aimed at channeling other services related to microcredit, health and education through the same "e-Choupal" infrastructure.

Another path-breaking initiative – the 'Choupal Pradarshan Khet', brings the benefits of agricultural best practices to small and marginal farmers. Backed by intensive research and knowledge, this initiative provides Agri-extension services which are qualitatively superior and involves pro-active handholding of farmers to ensure productivity gains. The services are customised to meet local conditions, ensure timely availability of farm inputs including credit, and provide a cluster of farmer schools for capturing indigenous knowledge.

### **CASE STUDY 2 : M-PESA (KENYA)**

M-Pesa, started by safaricom in 2007, is a leading mobile money service aimed at providing financial access to people without bank accounts. It allows users to send, receive, and store money using basic mobile phones, with low fees and high security. M-Pesa has changed Kenya's financial system, helping rural communities with credit and savings while supporting women's participation in the economy and reducing poverty. This note discusses the growth of M-Pesa, ways to serve homeless individuals in urban and rural Kenya, and the Central Bank of Kenya's role in ensuring M-Pesa's security and efficiency. It also addresses risks associated with the service and how they are managed. M-Pesa works differently from traditional banks as the money is kept in a trust account at the Commercial Bank of Africa, which Safaricom cannot control or use for lending. While mobile phones provide a reliable way to transfer money, the service contributes positively to the economy through rapid transactions. Legal protections are in place for the trust account, and the Central Bank oversees M-Pesa's compliance before its launch.

The Central Bank and Treasury are making legal and regulatory efforts to improve payment systems' security, efficiency, and effectiveness in the country. Key actions include reviewing the Central Bank of Kenya Act 2003 to add section 4A 1 (d) and drafting laws for the National Payment System, along with developing supervisory policies for payment systems. These efforts are compared to international standards set by the Bank for International Settlements (BIS). M-Pesa is a popular low-value transfer service that reaches both banked and unbanked people, mainly for transferring funds. Its customer base grew from 876,000 in October 2007 to 3.7 million by August 2008. During this time, transaction value jumped from Ksh 2.830 billion to Ksh 16.756 billion, though the average transaction value changed little, remaining around Ksh 2,951 in October 2007 and Ksh 2,642 in August 2008, averaging Ksh 2,916 across the service's operation period.

### **CASE STUDY 3: UNION DIGITAL CENTRES (BANGLADESH)**

Bangladesh's Union Digital Centres (UDCs) were launched in 2010 under the Digital Bangladesh Vision 2021. These centres act as rural ICT access points, offering over 100 services related to governance, education, health, and agriculture. Each UDC is operated by a male and female entrepreneur, promoting gender inclusion and local ownership. Citizens can access services like birth registration, passport applications, exam results, online payments, and e-health consultation.

Union Digital Centers (UDCs) in Bangladesh are grassroots information centers providing ICT services to rural areas to bridge the digital divide. They are an e-governance initiative offering various government and

private services, such as online birth registration and health information, which aim to improve socioeconomic conditions and empower rural communities. While they have shown positive impact and user satisfaction, key challenges remain, including issues with infrastructure, electricity, internet connectivity, and staff limitations.

## FINDINGS AND DISCUSSION

### Challenges

**Limited Access to Information-** Rural communities lack access to information on healthcare, education, and government services, hindering their ability to make informed decisions.

**Inadequate Digital Infrastructure-** Insufficient digital infrastructure, such as internet connectivity and mobile networks, limits access to digital services and opportunities.

**Digital Literacy Gap-** Limited digital literacy among rural populations hinders their ability to effectively utilize digital technologies and services.

**Economic Disparities-**The digital divide exacerbates economic disparities, as rural communities lack access to digital job opportunities and e-commerce platforms.

**Limited Access to Healthcare-**Telemedicine and online health services are inaccessible to rural communities, affecting their healthcare outcomes.

**Education Disparities-** Limited access to digital resources and online education platforms hinders students' ability to access quality education.

**Social Isolation-** The digital divide contributes to social isolation, as rural communities lack access to digital communication tools and social networks.

**Limited Access to Government Services-** Rural communities face difficulties in accessing government services, such as online portals and digital applications.

**Agricultural Development-** Limited access to digital technologies and information hinders agricultural development, affecting crop yields and productivity.

**Entrepreneurial Opportunities-** The digital divide limits entrepreneurial opportunities, as rural businesses lack access to digital markets and resources.

**Skill Development-** Limited access to digital skills training and development opportunities hinders rural communities' ability to participate in the digital economy.

**Rural Brain Drain-** The digital divide contributes to rural brain drain, as young and educated individuals seek better opportunities in urban areas.

**Inequitable Access to Services-** The digital divide perpetuates inequitable access to services, such as financial services, education, and healthcare.

## STRATEGIES FOR INCLUSIVE TECHNOLOGY ADOPTION

- Digital Literacy Programs
- Accessibility Features
- Affordable Pricing
- Community Engagement
- Partnerships and Collaborations
- Training and Capacity Building
- Content Localization

- Inclusive Design
- Digital Champions
- Feedback Mechanisms
- Inclusive Policy Frameworks

## CONNECTION WITH THE SUSTAINABLE DEVELOPMENT GOALS

Bridging the digital divide contributes directly to the achievement of multiple SDGs:

**SDG 1 – No Poverty** End poverty in all its forms. Digital finance (e.g., M-Pesa) enables savings, remittances, and micro-entrepreneurship, reducing vulnerability.

**SDG 4 – Quality Education** Ensure inclusive and equitable education.

Digital literacy and e-learning platforms improve rural access to quality education.

**SDG 5 – Gender Equality** Empower all women and girls. Both M-Pesa and UDCs promote women's empowerment through access to finance and ICT employment.

**SDG 8 – Decent Work and Economic Growth** Promote sustained economic growth. ICT-driven entrepreneurship and e-commerce generate new employment opportunities.

**SDG 9 – Industry, Innovation and Infrastructure** Build resilient infrastructure and promote innovation. Expansion of ICT networks and digital entrepreneurship drives local innovation.

**SDG 10 – Reduced Inequalities** Reduce inequality within and among countries. Digital tools bridge the urban–rural divide and promote social inclusion.

**SDG 16 – Peace, Justice and Strong Institutions** Promote effective, accountable institutions. UDCs enhance e-governance, transparency, and citizen trust.

**SDG 17 – Partnerships** for the Goals Strengthen implementation through partnerships. Combining private innovation (M-Pesa) with public governance (UDCs) exemplifies SDG 17's partnership principle.

## POLICY IMPLICATIONS AND RECOMMENDATIONS

- Invest in Rural Infrastructure
- Enhance Digital Literacy Programs
- Promote Gender-Sensitive Digital Policies
- Foster Public–Private Partnerships
- Ensure Data Protection and Trust
- Localize Digital Services

## LIMITATION OF THE STUDY

Reliance on secondary data may limit the scope for real-time observation. The study focuses on selected countries, so findings may not represent global patterns. Rapid technological changes could make some data quickly outdated.

## CONCLUSION

The study concludes that while the digital revolution has created transformative opportunities for development and economic growth, the benefits remain unevenly distributed across rural and urban populations. Despite progress in improving physical connectivity and infrastructure, the real challenge lies in ensuring meaningful and inclusive digital participation. The findings highlight that digital exclusion in rural areas is not merely a

technological gap but a multidimensional issue—rooted in socio-economic disparities, lack of localized content, inadequate digital literacy, and unsustainable policy implementation.

Case studies from India, Kenya, and Bangladesh demonstrate that successful digital inclusion depends on context-sensitive approaches combining technology with human capacity building. Public–private partnerships, community-driven digital literacy initiatives, and affordable access models emerge as key strategies for bridging the divide. The study recommends that governments and development agencies focus on empowerment through education, local entrepreneurship, and policy alignment with SDGs (especially Goals 4, 8, 9, and 10) to ensure equitable and sustainable technology adoption.

Ultimately, bridging the digital divide is not just about connecting people to the internet—it is about connecting them to opportunities, knowledge, and social empowerment, paving the way for inclusive rural transformation and long-term national progress.

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