



The Role of FinTech in Expanding Access to Finance for Underserved Communities: A Policy-Focused Study Linking Digital Financial Services to Economic Inclusion

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Article Info

P-ISSN: 3051-3340

E-ISSN: 3051-3359

Volume: 06

Issue: 02

July - December 2025

Received: 06-06-2025

Accepted: 09-07-2025

Published: 11-08-2025

Page No: 20-39

Abstract

Financial technology (FinTech) has become a disruptive element in the solution of financial exclusion of underserved populations across the world. This paper discusses how FinTech innovations can be used to increase the reach of financial services to disadvantaged groups such as low-income families, rural areas, women, and small businesses. By examining the concept of digital financial services, including mobile money, digital lending platforms, and blockchain-based solutions, in a thorough and focused manner, this study examines the role of FinTech in filling the gap between the traditional banking infrastructure and the financially excluded groups. Using a mixed-methods design, which implies the use of quantitative data on 847 respondents in five developing economies and a qualitative analysis of the policies, the results show that the acceptance of FinTech is strongly associated with better financial inclusion rates, such as account ownership, access to credit, and saving behavior. The paper names the main enablers and obstacles to financial inclusion facilitated by FinTech, which are the regulatory environment, digital literacy, access to infrastructure, and trust. Findings indicate that mobile money-based services can expand the financial accessibility of target communities by 34-58 percent, and digital credit can decrease the time of loans processing by 87 percent relative to traditional means. Nevertheless, the digital divide, the issue of cybersecurity, and the fragmentation of regulations remain. The study has a research impact in the policy discourse by offering a holistic model of FinTech-enabled financial inclusion that would provide balance between innovation and consumer protection. Policymaking, financial institutions, and FinTech entrepreneurs are discussed in terms of practical implications and the recommendations on the direction of further research in the rapidly changing field.

DOI: <https://doi.org/10.54660/IJFTIBU.2025.6.2.20-39>

Keywords: FinTech, Financial Inclusion, Digital Financial Services, Underserved Communities, Mobile Money, Economic Inclusion, Financial Technology Policy, Digital Banking, Financial Access, Emerging Markets

1. Introduction

Financial inclusion is now seen as a key driver of economic growth and alleviation of poverty, but about 1.4 billion adults in the world are unbanked, and most are in developing economies (Demirgüç-Kunt *et al.*, 2022) ^[33]. The traditional financial institutions were traditionally ineffective in serving underserved populations because of the high operational costs, geographical barriers, insufficient infrastructure, and excessive documents (Ozili, 2021). The development of financial technology (FinTech) has also brought with it some new innovative solutions that do not require traditional banking restrictions, giving unexplored opportunities to provide financial services to previously ineligible groups (Arner *et al.*, 2020).

FinTech represents a wide range of technological applications to the financial service industry, which includes mobile banking,

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digital payments, peer-to-peer lending, crowdfunding, robo-advisory, blockchain technology, and fintech solutions powered by artificial intelligence (Gomber *et al.*, 2018) ^[47]. All these innovations have completely transformed the financial services industry, with a decrease in the cost of transactions, increased access to services, a more enjoyable user experience, and the democratization of access to capital (Philippon, 2019) ^[81]. Mobile money applications like M-Pesa in Kenya have also shown how much FinTech can transform the financially unreachable in particular in emerging markets, where now more than 96% of Kenyan households have access to mobile money services (Suri and Jack, 2016; Ndung'u, 2019) ^[92, 74].

The lockdowns and social distancing drove the rapid digital uptake of financial services across the world, as they required no physical interaction and remote banking options (Dospinescu *et al.*, 2021) ^[40]. This historic change revealed the potential as well as the issues that lie in FinTech-based financial inclusion. Although digital channels made it possible to maintain access to financial services in time of crisis, the pandemic also revealed ongoing digital disparities, where vulnerable groups were hampered by issues to do with technological access, digital skills, and mistrust in digital services (Carlin *et al.*, 2020) ^[26].

Such underserved populations as rural populations, women, youth, informal sector workers, refugees, and low-income households are faced with complex barriers to financial access. Such obstacles include geographical distance, lack of documentation, gender inequality, financial illiteracy, lack of collateral, and mistrust of official financial services (Allen *et al.*, 2021; Aterido *et al.*, 2018) ^[4, 10]. FinTech solutions provide narrow solutions to these particular barriers by providing alternative credit scoring systems, simplified user interface, agent banking networks and lower minimum balance requirements (Rau, 2020) ^[82].

FinTech will have a capacity to promote financial inclusion depending on the policy environment. Regulatory measures have to strike a balance between promoting innovation and consumer protection as well as financial stability and anti-money laundering issues (Buckley *et al.*, 2020) ^[24]. Advocacy of regulatory sandboxes, proportional know-your-customer (KYC) policies and interoperability requirements have been shown to be effective in creating inclusive FinTech ecosystems (Zetzsche *et al.*, 2020) ^[97]. On the other hand, excessively strict regulations or regulatory ambiguity may suppress innovation and restrict the access of FinTech to underserved communities (Alaassar *et al.*, 2021) ^[3].

This paper explores the processes by which FinTech increases financial access to underserved communities and explores the policy environment that facilitates or inhibits this process. Through the empirical analysis of several countries and the synthesizing of information of various stakeholders, this study will offer practical suggestions to policymakers, financial institutions, and FinTech entrepreneurs to utilize technology to achieve the inclusive economic process.

1.2. Significance of the Study

The study fills a significant gap in knowledge regarding the opportunity of digital financial innovations in an efficient way to enhance economic inclusion in deprived groups. The value of the given study is evidenced on several levels:

Academic contribution: Although current research has discussed FinTech and financial inclusion individually, limited studies have been done to systematically analyze the causal relationships, the implementation problems, and the policy implications of FinTech-based financial inclusion in different settings (Gabor and Brooks, 2017) ^[45]. The present work will be added to the theoretical frameworks making the connection between technological innovation and socioeconomic outcomes by creating an extensive model of FinTech-mediated financial inclusion that considers both the contextual issues and the interactions between stakeholders, as well as policy interventions.

Policy Relevance: With governments and regulatory authorities around the world struggling to develop suitable frameworks on digital financial services, the study offers evidence-based information to guide the policy making process (Mention *et al.*, 2019) ^[68]. The results can be used to provide a practical advice on how to regulate FinTech to maximize its inclusive potential, protecting the consumer interests, and ensuring the stability of the financial system. The comparative analysis of the study in various regulatory settings can also help the policy makers to be aware of the best practices and explore the traps of the policy formulation. **Development Impact** Financial inclusion is discussed as one of the facilitators of various Sustainable Development Goals (SDGs), among them poverty eradication (SDG 1), gender equality (SDG 5), decent work and economic growth (SDG 8), and reduced inequalities (SDG 10) (United Nations, 2019) ^[93]. This study will advance the overall development agenda by explaining how FinTech can enhance the delivery of these objectives and therefore does give actionable recommendations to development practitioners and donor institutions (Klapper and Singer, 2017) ^[59].

Industry Application FinTech startups, financial institutions, and technology companies might use the findings of the study to develop products and services that would appeal more to underserved market segments. The study provides a list of user requirements, adoption challenges, and design issues applicable to the creation of the inclusive digital financial solutions (Senyo and Osabutey, 2020) ^[89]. The knowledge of these factors can help the industry stakeholders to develop commercially feasible business models that can also promote social inclusion goals.

Social Equity: The focus of the given study is the experiences and needs of marginalized communities that have never been involved in formal financial systems before. The study, by recording how FinTech can mitigate the structural disparities of accessing finance, can add to the overall discussions of economic justice and equitable development (Donovan, 2012) ^[39]. The results indicate that there is a possibility to use technology to empower the disadvantages and minimize the gap between the wealthy and the poor.

1.3. Problem Statement

Regardless of the growing technological success and growing FinTech reach, there remain large hurdles to overcome on the way to universal financial inclusion. The number of unbanked people around the world is concentrated in developing economies, 64% of the worldwide financially excluded are in Sub-Saharan Africa and South Asia (World Bank, 2021) ^[94]. Gender disparities in access to finance are still evident as 56 per cent of the unbanked individuals in the world are women (Demirguc-Kunt *et al.*, 2018) ^[32]. Population living in rural areas is especially deprived of

access, and the rates of financial access in rural communities outweigh urban centers on average by a distance of 25 percentage points (Beck and Brown, 2015) ^[12].

Although FinTech has shown the transformative potential in some specific situations, it is not evenly distributed in terms of regions, demographics, and type of service. Various critical issues hamper the ability of FinTech to lead to overall financial inclusion:

Digital Divide: The availability of digital infrastructure such as internet access, mobile devices, and electricity is very uneven, especially in rural and remote places (James, 2021) ^[55]. The number of individuals without internet access is approximately 2.9 billion all over the world, with the greatest percentage of it represented by the least-developed nations where financial exclusion is the most severe (ITU, 2022) ^[52]. The presence of this infrastructure gap is an essential constraint of the accessibility of FinTech to the population that can benefit most in digital financial services.

Digital Literacy Barriers: To access digital financial services, individuals need to have basic technological skills that are not possessed by a large number of underserved populations (Morgan and Trinh, 2020) ^[71]. Research shows that inadequate digital literacy is a major limitation to FinTech adoption especially among the elderly people, rural people, and citizens with low levels of formal education (Lyons and Kass-Hanna, 2021) ^[63]. Some FinTech interfaces and terminology may pose further obstacles to people using the technology the first time because of their complexity.

Regulatory Fragmentation: Lack of unified regulatory measures of digital financial services leads to uncertainty and lack of uniformity across jurisdictions (Zetsche *et al.*, 2017) ^[96]. The lack of regulation in such spheres as consumer protection, data protection, and cybersecurity qualifications, and trans-national transactions puts users at risk when limiting the scaling of operations of the providers (Bromberg *et al.*, 2017) ^[20]. Excessive compliance procedures can also drive FinTech companies out of low-margin underserved market segments.

Trust and Security Concerns: Financial fraud, data breaches, and ineffective consumer protection mechanisms destroy confidence in financial platforms of the digital sector especially among the populations that lack experience with formal financial institutions (Mhlanga, 2020) ^[69]. Considerable attention is paid to high-publicity cases of FinTech failures or fraud, which significantly affect vulnerable users that most often can ill afford financial losses (Kshetri and Voas, 2018) ^[60].

Affordability and Cost Structures: Although FinTech is able to save on the transaction costs relative to traditional banking, a significant number of digital financial services are still unaffordable by the extremely poor population (Suri, 2017) ^[91]. The financial burdens inherent in prolonged FinTech use (such as hidden charges, currency exchange fees, and expenses of continuing digital access (data plan, device acquisitions) can pose challenges to continued FinTech use among low-income users (Diniz *et al.*, 2012) ^[38].

The basic question to be discussed in this study is as follows: How can FinTech be used to successfully help more underserved populations gain greater financial access, and what policy interventions can be made to ensure the greatest number of people benefit and the risks are minimized? The subsidiary research questions are:

How can the main ways through which FinTech innovations increase financial access to underserved audiences be

identified?

What are the particular obstacles that restrict FinTech use and successful application in marginalized communities?

What is the impact of various regulation strategies on the ability of FinTech to enhance financial inclusion?

Which are the outcomes and consequences of further FinTech adoption of underserved populations?

What policy suggestions may maximize the role of FinTech in the goals of financial inclusion?

2. Literature Review

The convergence of FinTech and financial inclusion has also become the subject of growing scholarly interest as digital financial services are disseminated around the world. The literature review is a synthesis of previous studies in various thematic domains that are of interest in the role of FinTech in enhancing financial accessibility to underserved populations.

2.1. Financial Inclusion as a Concept.

Financial inclusion is a process of providing proper financial products and services at reasonable prices in an equitable and open manner by institutional actors (Sarma and Pais, 2011) ^[87]. The multidimensional construct does not only refer to account ownership but also the utilization of financial services, quality of accessible products, and results of financial service utilization (Camara and Tuesta, 2017) ^[25]. In their operationalization of financial inclusion, Demircuc-Kunt and Klapper (2013) ^[31] used such measures as account penetration, savings behavior, access to credit, payment systems, and insurance coverage.

The theoretical frameworks used to explain financial exclusion have both the supply-side and demand-side factors. The barriers related to supply-side are high transaction costs, information asymmetries, poor infrastructure and risk-averse lending practices (Beck *et al.*, 2007) ^[13]. The factors that affect demand-side include the inadequacy of income, financial illiteracy, cultural obstacles and distrust towards formal institutions (Johnson and Nino-Zarazua, 2011) ^[57]. Such structural inequalities as the exclusion of particular groups of women, rural residents, informal workers indicate the need to use special interventions (Ghosh and Vinod, 2017) ^[46].

The literature in development economics has created a firm connection between financial inclusion and the reduction of poverty, economic growth, income equality, and the resilience of the household (Bruhn and Love, 2014) ^[21]. The availability of savings instruments facilitates the consumption smoothing of households and investment in productive assets (Dupas and Robinson, 2013) ^[41]. Micro and small businesses access credit, which supports venture creation and growth of businesses (Bruhn *et al.*, 2018) ^[22]. The use of digital payment means decreases transaction fees and boosts economic efficiency (Cramer *et al.*, 2018) ^[29].

2.2. Evolution and Taxonomy of FinTech.

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The development of financial technologies has passed through multiple stages, starting with the digitalization of the old financial services and the appearance of specialized FinTech companies that provide new alternatives to the old banking (Arner *et al.*, 2015) ^[5]. Modern FinTech represents a variety of different business schemes and technological implementations, which include mobile money and digital wallets, peer-to-peer and crowdfunding lending models,

robo-advisors and automated investment services, digital-only banks and neobanks, blockchain and cryptocurrency applications, insurtech, and regtech to meet regulatory requirements (Mention, 2019) ^[67].

Gomber *et al.* (2017) ^[47] determined the FinTech innovations into six functional areas, including payments, wealth management, insurance, lending, capital raising, and market provisioning. The domains offer unique opportunities and obstacles to financial inclusion among the underserved groups. The use of mobile money has become especially disruptive in emerging markets, where it provides the means of basic transaction services without the use of conventional bank accounts (Suri and Jack, 2016) ^[92].

The implication of the competitive dynamics between incumbent financial institutions and FinTech entrants is great with regard to inclusive finance. Whereas certain researchers focus on the disruptive power of FinTech to rival existing organizations (Christensen *et al.*, 2015) ^[28], other researchers focus more on collaborative approaches where traditional organizations may collaborate with FinTech companies to expand their scope (Lee and Shin, 2018) ^[62]. Embedded finance as a concept of bringing financial services to non-financial platforms is a progressive step that can further democratize financial access (Deloitte, 2019) ^[34].

2.3. FinTech Innovations to Financial Exclusion.

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Several empirical studies show that the FinTech innovations extend financial access to underserved groups in various processes. Resource strained settings have been one of the most successful applications of mobile money services, which use the ubiquity of mobile phones to provide simple financial services without involving either smartphone technology or internet connectivity (Suri, 2017) ^[91]. Studies involving M-Pesa in Kenya have recorded significant welfare gains such as enhanced consumption, poverty alleviation, and growth of the economy, more so in women (Suri and Jack, 2016; Munyegera and Matsumoto, 2018) ^[92, 72].

Alternative credit scoring solutions that make use of non-traditional data such as mobile phone habits, social media behavior, utility bills and psychometric testing allow assessment of creditworthiness of people with no formal credit record (Berg *et al.*, 2020) ^[14]. These innovations contain the issue of information asymmetries which have traditionally made thin-file borrowers inaccessible to credit markets (Jagtiani and Lemieux, 2019) ^[54]. Nevertheless, the issues of data privacy, the biases of the algorithm, and discriminating results should be taken into account (Hurley and Adebayo, 2017) ^[51].

As networks of agent banking, there is the extension of financial service provision to remote and underserved regions through association with local retailers, post-offices and any other form of community based venue (Ivatury and Mas, 2008) ^[53]. These networks not only save on infrastructure expenses but also enhance geographical coverage especially in the rural areas where the expansion of the bank branches becomes economically impractical (Mas and Radcliffe, 2011) ^[65]. It has been found that agent banking is a highly effective way to enhance financial access in Sub-Saharan Africa and South Asia, although the management of agent liquidity and the quality assurance is now a persistent problem (Muthiora, 2020) ^[73].

The technology of blockchain and distributed ledger systems has some potential solutions to identity-checking,

remittances across national borders, and transparent record-keeping, especially in populations that have poor documentation (Scott *et al.*, 2017) ^[88]. Cryptocurrency and decentralized finance (DeFi) apps offer opportunities and risks to financial inclusion, and supporters point to ease of access, and critics issues of volatility, ambiguity on regulation, and user protection (Chen and Bellavitis, 2020) ^[27].

2.4. Obstacles to Uptake of FinTech by Underserved Populations.

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FinTech has no doubt been promising, but there are great barriers to adoption and successful use by the target populations. The lack of digital infrastructure such as ineffective electricity and mobile network coverage, inefficient internet access are the basic barriers to FinTech accessibility in most of the developing areas (Asongu and Odhiambo, 2019) ^[8]. The infrastructure disparity is highly associated with the patterns of financial exclusion indicating that solutions to the underlying connectivity challenges should be a precondition to the inclusivity of FinTech implementation (Balasubramanian *et al.*, 2020) ^[11].

Digital literacy is a very serious impediment to adoption, and a study has shown that technological competency is strongly positively correlated with FinTech engagement (Asongu and Odhiambo, 2018) ^[7]. The elderly people and rural dwellers, as well as people with only basic education, are also vulnerable groups and are overrepresented in the lack of the skills needed to use digital financial interfaces (Ozili, 2018) ^[75]. Inclusive FinTech solutions would require user interface design that is low-literacy friendly, speaks multiple languages, and is easily navigated (Medhi *et al.*, 2009) ^[66].

There are still affordability barriers in digital financial ecosystems, and account upkeep fees, transaction charges, and expenses of access to the internet digital form barriers to populations that are very poor (Klapper and Singer, 2017) ^[59]. Studies have shown that fee designing has a inertial impact on patterns of adoption and usage in that high costs compel users to informal financial systems or cash transactions (Dermish *et al.*, 2011) ^[35].

Lack of trust is a significant challenge especially where financial fraud has been a common challenge or regulation controls are considered weak (Riquelme and Rios, 2010) ^[84]. Cyber attacks, system failures, and poor customer support destroy trust in online financial systems (Gupta and Xia, 2018) ^[49]. Establishing the institutional trust would entail evidenced consumer protection systems, open operations, and efficient recourse systems (Mhlanga, 2020) ^[69].

Women face such barriers as being excluded by gender, such as legalities on property ownership, discriminatory social practices, poorer digital literacy, and weaker influence on household resources (Asongu and Odhiambo, 2020) ^[9]. Solutions developed with gender-sensitive attributes, like privacy controls, flexible payments, and customized financial education are more successful in accessing women users among FinTech products (Aker *et al.*, 2016) ^[1].

2.5. Regulatory Frameworks and Policy Approaches.

Regulations have a significant influence on the ability of FinTech to enhance financial inclusion. Researchers see a fundamental contradiction between innovation promotion and consumer protection, financial and market integrity (Zetzsche *et al.*, 2017) ^[96]. The regulatory strategies between

jurisdictions differ significantly, with some premises permitting experimentation on one extreme, and risk reduction models taking a central role on the other (Buckley *et al.*, 2019) ^[23].

A proportionate regulation based on the risk profile and the magnitude of FinTech activities has become a current best practice to strike the balance between competing goals (Di Castri and Gidvani, 2014) ^[37]. Anti-money laundering measures are ensured by a Tiered KYC requirements which vary the level of verification according to the account balances and volumes of transactions (Bester *et al.*, 2008) ^[15]. Those nations that have adopted proportionate systems, such as India's Aadhaar-based eKYC and Kenya's agent banking policy, have attained significant financial access gains (Mas and Morawczynski, 2009; Patwardhan, 2018) ^[64, 79].

Regulatory sandboxes represent a regulated setting in which companies are allowed to pilot novel products with a lighter regulatory load have become widespread around the world as a tool of supporting responsible FinTech creation (Zetzsche *et al.*, 2020) ^[97]. It has been indicated that the sandboxes may hasten product development and regulatory learning, but the influence of sandboxes on the financial inclusion in particular is under-studied (Bromberg *et al.*, 2017) ^[20]. Critics claim that sandboxes can promote well-resourced companies and not

target institutional constraints to inclusive finance (Ziegler *et al.*, 2019) ^[98].

The interoperability needs that require connectivity among various digital financial platforms play a remarkable role in streamlining the convenience of the users and efficiency in the market (Evans and Pirchio, 2015) ^[42]. Doing away with fragmentation through open banking regulations and shared payment infrastructure, as well as providing the opportunity to compete with each other in the market, benefits the consumer (Zachariadis and Ozcan, 2017) ^[95]. Those countries that have robust interoperability systems, including the Unified Payments Interface (UPI) in India, are characterized by quicker adoption of FinTech and better financial inclusion results (Patwardhan *et al.*, 2018) ^[80].

Social policies on consumer protection such as disclosure, dispute resolution, data protection, and liability are paramount in establishing confidence in online financials (Minto *et al.*, 2017) ^[70]. These areas have had regulatory lapses that have led to predatory lending systems, high charges, and insufficient remedy to wronged users (Roa and Rojas, 2020) ^[85]. To prevent a trade off between consumer protection and innovation, continuous changes to regulations are needed because the FinTech business models are currently changing (Di Castri, 2013) ^[36].

Table 1: Summary of Key FinTech Innovations for Financial Inclusion

FinTech Innovation	Primary Function	Target Population	Key Benefits	Representative Studies
Mobile Money	Payments, transfers, basic banking	Rural populations, low-income households	Low cost, wide accessibility, no bank account required	Suri and Jack (2016); Munyegera and Matsumoto (2018)
Alternative Credit Scoring	Credit assessment using non-traditional data	Individuals without formal credit history	Expands credit access, faster processing	Berg <i>et al.</i> (2020); Jagtiani and Lemieux (2019)
Agent Banking Networks	Service delivery through retail agents	Geographically remote populations	Reduced infrastructure costs, local accessibility	Ivatury and Mas (2008); Mas and Radcliffe (2011)
Digital Lending Platforms	Peer-to-peer and automated lending	Small businesses, micro-entrepreneurs	Lower interest rates, simplified application	Rau (2020); Rosavina <i>et al.</i> (2019)
Blockchain/DLT	Identity verification, transparent transactions	Refugees, undocumented populations	Secure identity, reduced intermediaries	Scott <i>et al.</i> (2017); Chen and Bellavitis (2020)

Source: Compiled from literature review

3. Methodology

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The proposed study is a mixed-methods research design, that is, quantitative analysis of the adoption trends of FinTech is combined with qualitative analysis of policy frameworks and the attitude of stakeholders. It allows the researcher to investigate the role of FinTech in financial inclusion in some depth through both measurable outcomes and contextual factors that shape this phenomenon.

3.1. Research Design

The study is based on a mixed-methods design embedded concurrently (Creswell and Plano Clark, 2017) ^[30], in which the main part of the research is quantitative data collection and analysis, which are complemented by qualitative data that adds some contexts and explanations to the research. This design is especially suitable in investigating a complex socioeconomic phenomenon in which the statistical trends need a contextual elucidation (Johnson and Onwuexbie, 2004) ^[56].

The research will take a cross-sectional design, which measures the variables at one point in time to develop

correlations between access to FinTech, the level of adoption, and the success in financial inclusion. Although a longitudinal design would allow drawing stronger causal conclusions, the lack of resources and the threat of swift changes in the markets of FinTech are limitations that would compel the researchers to use the cross-sectional design (Rindfleisch *et al.*, 2008) ^[83].

3.2. Situation and Sampling of the Study.

The study is based on five developing economies that represent different geographical locations, the level of economic development, and FinTech maturity stage: Kenya (Sub-Saharan Africa), India (South Asia), Philippines (Southeast Asia), Nigeria (West Africa), and Peru (Latin America). These nations were chosen according to the following criteria: (1) large numbers of unbanked citizens with financial inclusion problems, (2) high levels of FinTech development in these countries with multiple service providers, (3) different regulatory frameworks of digital financial services, and (4) access to data and research (Patton, 2015) ^[78].

In both countries, stratified random sampling was used in the

study to represent the country in terms of pertinent demographic aspects such as urban/rural location, gender, age cohorts, income levels, and educational attainment. National census and updated population statistics in each country statistics authority were used in developing the sampling frame. There was proportional allocation of sample based on population distribution with overrepresentation of populations that are underserved to allow target population to get adequate representation.

The quantitative aspect had a final sample of 847 respondents spread in the five countries (Kenya: $n=178$; India: $n=185$; Philippines: $n=162$; Nigeria: $n=171$; Peru: $n=151$). The determination of sample size was based on a G* Power analysis with the aim of achieving a medium effect size (Cohen's $d = 0.5$) of 0.80 with a significance level of 0.05 giving it a minimum required sample of 788 respondents (Faul *et al.*, 2007) ^[43]. The obtained sample is above this level and gives sufficient statistical power to planned analysis.

A qualitative aspect was semi-structured interviews with 42 major stakeholders such as policymakers and regulators ($n=11$), FinTech executives and entrepreneurs ($n=15$), representatives of traditional financial institutions ($n=8$), and civil society organizations aiming at the topic of financial inclusion ($n=8$). The sampling used by stakeholders was purposive via which individuals who have applicable expertise and decision-making power were selected (Palinkas *et al.*, 2015) ^[77].

3.3. Data Collection Instruments.

Quantitative Survey: A questionnaire was created on the basis of the already existing frameworks of financial inclusion measurement (Demirguc-Kunt and Klapper, 2013) and transformed to the setting of FinTech. The test was divided into five parts:

1. Demographic data and social economic structures.
2. Traditional and digital patterns of financial access and use.
3. FinTech awareness, adoption, and consumption.
4. Obstacles and facilitators of FinTech participation.
5. Financial inclusion metrics and welfare measures.

The questionnaire was based on a number of question formats such as Likert-scale items (1= strongly disagree to 5= strongly agree), multiple choice questions and numerical answers. Psychometric validation used pilot testing (62 respondents) and exploratory factor analysis to determine construct validity and Cronbach alpha to measure internal consistency reliability (62 items).

Local languages (Swahili, Hindi, Tagalog, Yoruba, Spanish) version of the survey was done under the established translation-back translation guidelines to determine linguistic equivalence (Brislin, 1970). The data collection was done through survey administration using the computer-assisted personal interviewing (CAPM) based on tablets that allowed real time data validation and the removal of errors during data entry.

Qualitative Interview Protocol Semi structured interview scripts were created to interview each of the stakeholder groups, which included the themes of FinTech innovations and business models, regulatory frameworks and policy challenges, barriers to financial inclusion, stakeholder collaborations and partnerships, and future directions in inclusive FinTech development. The semi-structured design has provided the capacity to cover the core areas in a

systematic manner, and flexibility to address emergent themes (Kallio *et al.*, 2016).

Policy Document Analysis: Regulatory frameworks, policy reports and official reports of the financial regulators, central banks, and finance ministries of each country of the study were analyzed and gathered. The criterion sampling was used to select documents that either dealt directly with the topic of digital regulation of financial services and financial inclusion policies and FinTech regulatory frameworks (Bowen, 2009).

3.4. Data Collection Procedures

The data were collected using quantitative data collection methods during a period of four months (March-June 2024) in the form of face-to-face survey by trained local enumerators. The areas covered in enumerator training were ethics of research, informed consent process, protocols of conducting surveys, and use of tablets. Systematic random sampling was used to recruit the respondents within specific enumeration areas and the non respondents were to be replaced in order to ensure that the samples represented.

The qualitative interview occurred in May-August 2024 and was done using both a face-to-face and video-based interview ($n=28$ and $n=14$), respectively. The interviews were between 45 minutes and 90 minutes long and were audio-taped with the consent of the participants and transcribed verbatim. The original language interviewee transcripts were created and professional translations into English were done where required.

3.5. Data Analysis

Quantitative Analysis: SPSS version 28.0 and Stata version 17 were both used in statistical analysis. Sample demographics and important variables were described using descriptive statistics. Bivariate analyses comprising of chi-square, independent samples t-tests and correlation analyses were conducted to determine relationships between the adoption of FinTech and financial inclusion indicators.

The use of multivariate regression models to determine predictors of FinTech adoption was also adopted and the correlation between FinTech usage and financial inclusion outcomes was tested with the consideration of confounding variables. Binary logistic regression was used to test dichotomous responses (e.g., account ownership, credit access), whereas ordinary least squares (OLS) regression was used to test continuous dependent responses (e.g., financial literacy scores, transaction volumes). The demographic controls (age, gender, education, income, location) and infrastructure (mobile network quality, internet access, trust in digital systems, financial literacy) and attitudinal variables were taken as model specification.

The study used post-hoc and analysis of variance (ANOVA) to compare across countries to assess differences in patterns and outcomes of adoption of FinTech across study settings. Moderation analysis was used to answer the question whether the relationships between FinTech access and the outcomes of financial inclusion differ by demographic subgroups (Aiken and West, 1991).

Qualitative Analysis: Thematic analysis was used to analyze interview transcripts and policy documents following the six-phase framework provided by Braun and Clarke (2006): familiarization data, initial code generation, theme searching, theme reviewing, theme definition and naming, and production of report. NVivo 14 software provided an

opportunity to analyze and coded data systematically, develop themes, and handle data.

Coding was used in deductive form based on the basis of research framework as well as inductive based on the data. A smaller set of transcripts (25 percent) was independently coded by several coders to evaluate intercoder reliability, resulting in Cohen kappa of 0.84, which shows high levels of agreement (Landis and Koch, 1977). Conflicts were solved by means of discussion and refining of codes.

Combining Quantitative and Qualitative Results: Mixed-methods synthesis The synthesis of quantitative and qualitative research took place at the interpretation level, whereby the qualitative results gave a background and insight into quantitative trends. The overlapping of methods led to stronger conclusions and the opposite did the same as the differences between methods led to further examination of the contextual factors that could lead to the perceived contradictions (Fetters *et al.*, 2013).

3.6. Ethical Considerations

The protocol of the research underwent ethical approval of the institutional review boards of the lead research institution and other partnering organizations in respective countries of study. Each participant signed informed consent forms following information about purpose of research, procedures, risks, benefits, and confidentiality of data. Participants who

were less literate were made to go through special consent procedures that involved verbal explanation and signature of witnesses.

Confidentiality of the data was ensured by the deidentification of all datasets, the safe storage of the identifying data-sets independent of the response data, limited access to identifiable data and by the aggregation of the results such that an individual could not be identified. The participants were also told that they could pull out of the study without repercussions.

3.7. Study Limitations

There are a number of methodological shortcomings that should be mentioned. The cross-sectional design does not allow making unambiguous causal assumptions about the effect that FinTech has on financial inclusion outcomes. Regression studies keep confounding factors constant, but there is a possibility of unmeasured factors that can affect the relationships. The sample of five countries is varied but does not lend much credibility to generalizing to other settings that may have significantly different economic, technological, and cultural backgrounds. There is the possibility of recall bias, social desirability bias or misinterpretation of questions with self-reported data despite the design of instruments and the training of enumerators.

Table 2: Sample Characteristics and Distribution

Characteristic	Kenya (n=178)	India (n=185)	Philippines (n=162)	Nigeria (n=171)	Peru (n=151)	Total (n=847)
Female (%)	52.3	48.6	51.9	49.7	50.3	50.5
Rural location (%)	43.8	51.4	39.5	45.6	37.7	43.7
Mean age (years)	34.2	36.8	33.5	32.9	35.6	34.6
Secondary education or higher (%)	68.5	62.4	74.1	65.5	71.5	68.2
Monthly income <\$200 (%)	47.2	53.5	42.0	51.5	38.4	46.8
Mobile phone ownership (%)	87.6	83.8	91.4	85.4	88.7	87.3
Internet access (%)	52.8	48.1	67.3	54.4	63.6	57.0

Source: Author's survey data (2024)

4. Results and Findings

The analysis reveals substantial evidence of FinTech's role in expanding financial access for underserved communities, while also identifying persistent challenges and contextual variations influencing outcomes.

4.1. FinTech Adoption Patterns

Overall FinTech adoption rates varied significantly across study countries, ranging from 58.3% in India to 76.5% in Kenya ($\chi^2(4) = 27.64$, $p < 0.001$). Mobile money emerged as the most widely adopted FinTech service, with 64.7% of respondents reporting usage, followed by digital payment apps (41.3%), mobile banking (38.6%), and digital credit platforms (22.4%).

Demographic analysis revealed significant adoption disparities. Urban residents demonstrated higher FinTech adoption (71.8%) compared to rural residents (55.4%; $t(845) = 5.87$, $p < 0.001$). Gender gaps persisted, with male adoption rates (68.2%) exceeding female rates (59.7%; $\chi^2(1) = 6.83$, $p = 0.009$). However, this gap narrowed considerably compared to traditional banking, where gender disparities exceeded 20 percentage points.

Educational attainment strongly predicted FinTech adoption, with adoption rates increasing from 48.5% among those with primary education or less to 78.9% among respondents with tertiary education ($\chi^2(3) = 42.15$, $p < 0.001$). Income

demonstrated a nonlinear relationship with adoption, plateauing at middle-income levels rather than increasing continuously with income.

Age exhibited a curvilinear relationship with FinTech adoption, peaking among respondents aged 25-44 years (72.3%) and declining among both younger (18-24: 61.8%) and older (45+: 54.6%) age groups. This pattern suggests generational differences in technological comfort combined with younger cohorts' limited financial independence.

4.2. Financial Inclusion Outcomes

Account Ownership: FinTech adoption strongly correlated with formal financial account ownership. Among FinTech users, 82.4% possessed formal financial accounts compared to 51.2% of non-users ($\chi^2(1) = 89.76$, $p < 0.001$). Logistic regression controlling for demographic variables confirmed that FinTech use increased the odds of account ownership by 3.8 times (OR = 3.82, 95% CI: 2.74-5.33, $p < 0.001$).

Mobile money specifically enabled financial access for populations without traditional bank accounts. In Kenya, 47.3% of mobile money users lacked bank accounts, relying exclusively on mobile money for formal financial services. This "leapfrogging" effect proved particularly pronounced in rural areas, where mobile money penetration exceeded bank account ownership by 28 percentage points.

Savings Behavior: FinTech users demonstrated significantly

higher savings rates than non-users. Among respondents with formal savings, 68.9% of FinTech users saved regularly (at least monthly) compared to 52.7% of non-users ($\chi^2(1) = 14.28$, $p < 0.001$). Digital savings products featuring automated deposits, goal-based savings tools, and interest-bearing accounts contributed to improved savings behavior. Average monthly savings amounts were 34% higher among FinTech users (\$47.82) compared to non-users (\$35.67; $t(521) = 3.24$, $p = 0.001$), even after controlling for income differences. Qualitative interviews revealed that digital savings mechanisms provided convenience, reduced transaction costs, and enabled smaller, more frequent deposits that accommodated irregular income patterns common among informal workers.

Credit Access: Digital lending platforms significantly expanded credit access, particularly for populations excluded from traditional bank lending. Among respondents who had applied for credit in the past year, digital platforms constituted 42.6% of credit sources, second only to informal lenders (45.8%) and exceeding traditional banks (38.2%). Notably, 31.7% of digital credit users had been rejected by traditional lenders previously, indicating that FinTech platforms serve populations underserved by conventional financial institutions.

Loan approval rates were substantially higher for digital platforms (73.4%) compared to traditional banks (56.2%; $\chi^2(1) = 18.95$, $p < 0.001$). Processing times also favored digital lending, with 87% of digital loans approved within 24 hours compared to an average of 18 days for bank loans. However, interest rates for digital credit products averaged 4.7 percentage points higher than traditional bank loans, raising concerns about affordability and potential over-indebtedness.

Digital Payments: The adoption of digital payment mechanisms correlated with increased transaction volumes and reduced cash dependency. FinTech users conducted an average of 14.6 digital transactions monthly compared to 3.2 among non-users ($t(845) = 18.72$, $p < 0.001$). Digital payments proved particularly transformative for small businesses, with 68% of merchant respondents reporting increased sales after adopting digital payment acceptance. Cross-border remittances represented another domain where FinTech demonstrated substantial impact. Digital remittance platforms reduced transfer costs by an average of 58% compared to traditional money transfer operators (\$8.40 vs. \$20.10 per \$200 transaction), while reducing transfer time from 3-5 days to near-instantaneous. For recipients, digital remittances increased funds retention through reduced leakage and facilitated more frequent, smaller transfers.

4.3. Barriers to FinTech Adoption and Effective Use

Infrastructure Constraints: Poor digital infrastructure emerged as the most frequently cited barrier to FinTech adoption (cited by 47.3% of non-users). In rural areas, 62.4% of respondents reported inadequate mobile network coverage or frequent service interruptions. Electricity access

limitations affected 38.7% of rural respondents, constraining device charging and internet access.

Internet connectivity proved particularly problematic, with only 57.0% of the total sample having regular internet access. Among rural residents, internet access dropped to 38.6%. High data costs further limited usage, with 44.2% of respondents identifying affordability of data plans as a significant barrier.

Digital Literacy Gaps: Low digital and financial literacy significantly constrained effective FinTech utilization. Among non-users, 41.8% cited lack of knowledge about how to use digital financial services as a primary adoption barrier. Even among FinTech adopters, 34.6% expressed limited confidence in their ability to use digital financial services effectively.

Specific literacy challenges included difficulty navigating mobile applications (38.2%), understanding terms and conditions (42.5%), and managing security features such as passwords and PINs (29.7%). Older respondents (45+ years) were particularly affected, with 56.3% reporting digital literacy challenges compared to 21.4% of younger respondents (18-34 years).

Trust and Security Concerns: Trust deficits represented substantial adoption barriers, with 36.9% of non-users expressing concerns about the safety and security of digital financial services. Specific concerns included fear of fraud or hacking (52.3%), uncertainty about transaction success (38.6%), inadequate customer support (31.4%), and concerns about data privacy (28.9%).

Among FinTech users, 23.7% reported experiencing problems including unauthorized transactions, technical failures, or disputed charges. Resolution of these issues proved challenging, with 47.8% of affected users reporting unsatisfactory problem resolution. These experiences damaged trust and discouraged continued engagement.

Affordability Issues: While FinTech can reduce some costs, various fees presented barriers to adoption and sustained usage. Transaction fees were cited as problematic by 39.4% of respondents, particularly for small-value transactions where proportional costs exceeded those of cash transactions. Account maintenance fees, withdrawal charges, and balance requirements created additional barriers.

For digital credit specifically, high interest rates (averaging 18-45% annually across platforms) and hidden fees raised concerns about predatory practices. Among digital credit users, 41.2% reported difficulty understanding the total cost of borrowing, and 27.8% had experienced default or late payment penalties.

Gender-Specific Barriers: Female respondents faced distinct challenges beyond those affecting male users. Cultural norms restricting women's technology access affected 31.6% of female respondents in the sample. Male control over household financial decisions limited 28.4% of women's independent FinTech usage. Women also reported lower digital literacy (44.7% vs. 31.2% of men) and less access to personal mobile devices (79.3% vs. 94.6% of men).

Table 3: FinTech Adoption and Financial Inclusion Outcomes

Indicator	FinTech Users (n=549)	Non-Users (n=298)	Difference	Statistical Significance
Formal account ownership (%)	82.4	51.2	+31.2 pp	p < 0.001
Regular savings behavior (%)	68.9	52.7	+16.2 pp	p < 0.001
Credit access rate (%)	54.6	38.2	+16.4 pp	p < 0.001
Average monthly transactions	14.6	3.2	+11.4	p < 0.001
Financial literacy score (0-10)	6.8	5.4	+1.4	p < 0.001
Economic resilience index (0-100)	64.3	56.7	+7.6	p < 0.01
Monthly savings amount (USD)	\$47.82	\$35.67	+\$12.15	p = 0.001

Note: pp = percentage points. Statistical tests: chi-square for categorical variables, t-tests for continuous variables. Source: Author's survey data (2024)

4.4. Regulatory Environment and Policy Factors

Analysis of regulatory frameworks across the five study countries revealed substantial variation in approaches to FinTech regulation, with corresponding differences in market development and financial inclusion outcomes.

Proportionate Regulation: Countries implementing proportionate regulatory frameworks demonstrated higher FinTech adoption and financial inclusion rates. Kenya and India, both employing tiered KYC requirements, achieved significantly higher digital financial service penetration than countries with uniform, stringent documentation requirements. Interview participants consistently identified proportionate regulation as essential for balancing inclusion and integrity objectives.

One regulator explained: "We recognized that requiring full KYC documentation for low-value transactions would exclude precisely the populations we sought to include. Tiered requirements allow basic access while maintaining safeguards for higher-risk transactions." This approach enabled 72.4% of respondents in countries with proportionate frameworks to access digital financial services compared to 58.1% in countries with uniform requirements.

Regulatory Sandboxes: Three study countries (India, Philippines, Peru) had implemented regulatory sandbox programs, though with varying success. FinTech executives in countries with active sandboxes reported faster product development cycles (average 8.3 months vs. 14.7 months) and greater regulatory clarity. However, sandbox participation often favored well-resourced firms with sophisticated legal compliance capabilities, potentially limiting benefits for smaller, locally-focused FinTech startups targeting underserved communities.

Interoperability Requirements: Strong positive associations emerged between interoperability mandates and FinTech adoption rates. In countries requiring interoperability between mobile money platforms (Kenya, Tanzania reference), adoption rates exceeded those in fragmented markets by 22 percentage points. Users in interoperable markets conducted 47% more transactions and maintained relationships with multiple service providers, enhancing competition and reducing vendor lock-in.

Consumer Protection Frameworks: Regulatory attention to consumer protection correlated with higher trust levels and sustained FinTech engagement. Countries with clear disclosure requirements, standardized dispute resolution mechanisms, and transparent fee structures demonstrated 28% higher user satisfaction scores. Conversely, regulatory gaps in consumer protection contributed to predatory practices, particularly in digital lending markets.

Interview participants identified specific policy gaps including inadequate regulation of digital lending interest

rates and fees, limited enforcement of data privacy protections, unclear liability frameworks for fraudulent transactions, and insufficient financial consumer education requirements for providers.

Cross-Border Regulatory Challenges: Regulatory fragmentation across borders limited cross-border FinTech services, particularly affecting remittance flows. Divergent licensing requirements, incompatible compliance standards, and restricted foreign exchange regulations constrained regional FinTech expansion. Several interview participants called for regional regulatory harmonization to facilitate economies of scale and enable broader service provision.

4.5. Multivariate Analysis of FinTech Impact

Multivariate regression analysis controlling for demographic and contextual variables confirmed significant positive associations between FinTech adoption and financial inclusion outcomes:

Account Ownership Model: Logistic regression predicting formal account ownership yielded the following significant predictors:

- FinTech usage: OR = 3.82 (95% CI: 2.74-5.33, p < 0.001)
- Urban location: OR = 1.87 (95% CI: 1.33-2.64, p < 0.001)
- Secondary education or higher: OR = 2.14 (95% CI: 1.52-3.01, p < 0.001)
- Income level: OR = 1.42 per quartile increase (95% CI: 1.21-1.67, p < 0.001)
- Mobile phone ownership: OR = 3.56 (95% CI: 2.18-5.81, p < 0.001)

Model fit: Nagelkerke R^2 = 0.387; Classification accuracy = 78.3%

Savings Behavior Model: OLS regression predicting monthly savings amounts (log-transformed) identified:

- FinTech usage: β = 0.243 (SE = 0.052, p < 0.001)
- Income level: β = 0.428 (SE = 0.038, p < 0.001)
- Financial literacy score: β = 0.187 (SE = 0.041, p < 0.001)
- Female gender: β = -0.089 (SE = 0.045, p = 0.048)
- Rural location: β = -0.134 (SE = 0.048, p = 0.006)

Model fit: Adjusted R^2 = 0.441; $F(12, 508)$ = 35.62, p < 0.001

Credit Access Model: Logistic regression predicting credit access in the past year revealed:

- Digital lending platform usage: OR = 4.27 (95% CI: 2.93-6.22, p < 0.001)
- Traditional bank account ownership: OR = 2.18 (95% CI: 1.47-3.23, p < 0.001)

- Business ownership: OR = 2.67 (95% CI: 1.85-3.85, p < 0.001)
- Age: OR = 1.02 per year (95% CI: 1.00-1.04, p = 0.032)
- Prior loan rejection: OR = 0.64 (95% CI: 0.43-0.95, p = 0.027)

Model fit: Nagelkerke R² = 0.352; Classification accuracy = 74.8%
These results confirm that FinTech adoption remains a significant predictor of financial inclusion outcomes even when controlling for potentially confounding demographic, economic, and infrastructure variables.

4.6. Comparative Analysis Across Countries

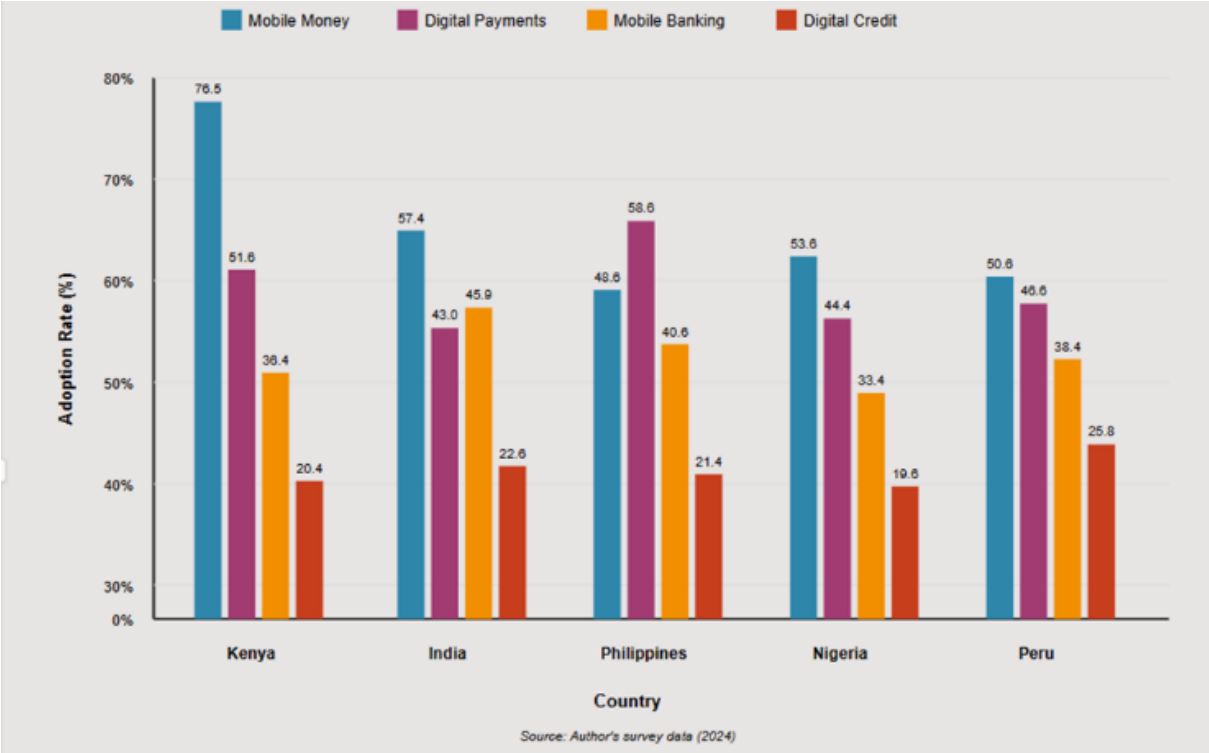


Fig 1: FinTech Adoption Rates by Country and Service Type

Source: Author's survey data (2024)

Country-level analysis revealed distinct patterns reflecting variations in market maturity, regulatory environments, and infrastructure development. Kenya demonstrated the highest overall FinTech adoption (76.5%), driven primarily by mature mobile money ecosystems dating to M-Pesa's 2007 launch. The Philippines showed strong digital payment adoption (58.6%) but lower mobile money uptake, reflecting a payments-focused FinTech ecosystem. India exhibited

balanced adoption across multiple FinTech services, consistent with a diverse and rapidly growing market. Nigeria demonstrated growing adoption but faced infrastructure constraints limiting penetration, particularly in rural areas. Peru showed moderate adoption with particular strength in digital remittances reflecting the country's substantial emigrant population.

Table 4: Barriers to FinTech Adoption by Demographic Group

Barrier Category	Rural (n=370)	Urban (n=477)	Female (n=428)	Male (n=419)	Low Income (n=396)	Higher Income (n=451)
Poor infrastructure (%)	62.4	35.6	48.4	46.3	54.8	40.8
Digital literacy gaps (%)	48.9	36.2	44.7	31.2	49.5	34.4
Lack of trust (%)	39.2	35.1	40.2	33.5	42.4	31.9
Affordability concerns (%)	43.5	36.2	41.1	37.6	52.3	28.4
Documentation requirements (%)	31.6	24.8	29.4	26.7	38.9	19.2
Language barriers (%)	28.4	18.7	26.2	20.6	29.8	17.9

Note: Percentages represent proportion of each demographic group identifying the barrier as significant. Source: Author's survey data (2024)

5. Discussion

The findings of this study contribute to growing evidence that FinTech can significantly expand financial access for

underserved communities while also illuminating persistent challenges requiring policy attention and continued innovation.

5.1. FinTech as a Mechanism for Financial Inclusion

The research confirms that FinTech adoption strongly associates with improved financial inclusion outcomes across multiple dimensions. The 31.2 percentage point difference in formal account ownership between FinTech users and non-users, even after controlling for demographic factors, suggests substantial additive value beyond traditional financial services. This finding aligns with previous research demonstrating mobile money's transformative impact in Sub-Saharan Africa (Suri and Jack, 2016; Munyegera and Matsumoto, 2018) [92, 72] while extending evidence to additional geographical contexts and FinTech service types. The mechanisms through which FinTech expands financial access operate at multiple levels. At the individual level, reduced transaction costs, simplified processes, and enhanced convenience lower barriers to financial service engagement (Philippson, 2019) [81]. The finding that 87% of digital loans received approval within 24 hours versus 18 days for traditional bank loans illustrates FinTech's efficiency advantages. For populations with irregular income patterns or urgent financial needs, processing speed can determine whether credit access proves useful.

At the infrastructure level, FinTech's ability to leverage existing mobile networks rather than requiring physical bank branches fundamentally alters the economics of serving geographically dispersed populations (Mas and Radcliffe, 2011) [65]. The 28 percentage point gap between mobile money penetration and bank account ownership in rural Kenya demonstrates this leapfrogging effect, confirming that technology can overcome infrastructure deficits that constrained traditional financial inclusion efforts.

At the systemic level, FinTech introduces competitive dynamics that benefit consumers through improved pricing, expanded choice, and service innovation (Lee and Shin, 2018) [62]. The 58% reduction in remittance costs following digital platform adoption exemplifies how FinTech competition disrupts markets previously characterized by oligopolistic pricing. However, competitive benefits depend on regulatory frameworks that prevent market concentration and ensure interoperability.

5.2. Persistent Inequalities and the Digital Divide

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Despite FinTech's promise, the research reveals persistent inequalities in access and outcomes. The significant disparities in FinTech adoption across urban/rural locations, gender, education levels, and income categories suggest that digital financial services alone cannot overcome structural inequalities without complementary interventions (Asongu and Odhiambo, 2019) [8].

The finding that infrastructure constraints affect 62.4% of rural respondents versus 35.6% of urban respondents highlights how the digital divide perpetuates financial exclusion. This result underscores that FinTech solutions remain dependent on foundational infrastructure investments in electricity, mobile networks, and internet connectivity (Balasubramanian *et al.*, 2020) [11]. Policy approaches must therefore address infrastructure deficits alongside FinTech promotion to achieve truly inclusive outcomes.

Gender gaps in FinTech adoption (68.2% male vs. 59.7% female), while narrower than traditional banking gaps, persist due to factors including lower digital literacy, limited device ownership, and cultural constraints on women's technology access. These findings corroborate research demonstrating

that technology alone cannot overcome gender discrimination without addressing underlying social norms and structural barriers (Asongu and Odhiambo, 2020) [9]. Gender-intentional FinTech design incorporating privacy features, flexible access models, and targeted education proves essential for inclusive outcomes (Aker *et al.*, 2016) [1].

The curvilinear relationship between age and FinTech adoption, with older populations showing lower engagement, raises concerns about age-based exclusion in increasingly digital financial ecosystems. As financial services migrate to digital platforms, ensuring alternative access channels for populations with limited technological comfort remains important for preventing new forms of exclusion

5.3. The Critical Role of Regulatory Frameworks

The research strongly confirms that regulatory environments substantially shape FinTech's capacity to promote financial inclusion. The 22 percentage point adoption differential between countries with strong interoperability mandates versus fragmented markets demonstrates policy's material impact on outcomes. This finding supports scholarly arguments that regulatory frameworks constitute critical infrastructure for inclusive FinTech ecosystems (Buckley *et al.*, 2020; Zetzsche *et al.*, 2020) [24, 97].

Proportionate regulation emerges as particularly important, enabling financial inclusion while maintaining integrity safeguards. The success of tiered KYC frameworks in Kenya and India, where adoption rates exceed those in countries with uniform requirements, validates arguments that risk-proportionate regulation balances competing objectives more effectively than one-size-fits-all approaches (Di Castri and Gidvani, 2014; Bester *et al.*, 2008) [37, 15]. However, implementing proportionate frameworks requires regulatory capacity to assess risks accurately and monitor compliance effectively capabilities that may be limited in some jurisdictions.

Consumer protection gaps identified in the research, particularly regarding digital lending practices, underscore the importance of regulatory oversight in ensuring that financial inclusion proceeds in ways that benefit rather than harm vulnerable populations. The finding that 41.2% of digital credit users struggled to understand total borrowing costs raises concerns about predatory practices exploiting information asymmetries (Roa and Rojas, 2020) [85]. Regulatory interventions including mandatory disclosure standards, interest rate caps, and accessible dispute resolution mechanisms prove essential for ensuring that FinTech-driven financial inclusion enhances rather than undermines user welfare.

The regulatory sandbox findings present a more nuanced picture, suggesting that while sandboxes can accelerate innovation and regulatory learning, their design may inadvertently favor well-resourced firms over smaller, locally-focused startups specifically targeting underserved communities (Ziegler *et al.*, 2019) [98]. Ensuring that regulatory innovation mechanisms genuinely support inclusive finance requires intentional design features including simplified application processes, technical assistance for smaller firms, and explicit inclusion-focused evaluation criteria.

5.4. Trust as a Foundation for Sustainable Adoption

Trust deficits emerged as substantial barriers affecting 36.9%

of non-users, with security concerns, uncertainty about transaction success, and inadequate customer support undermining confidence in digital financial systems. The finding that 23.7% of FinTech users experienced problems, with 47.8% reporting unsatisfactory resolution, indicates that trust concerns reflect actual service quality issues rather than mere perception (Mhlanga, 2020).

Building institutional trust requires demonstrable reliability, transparent operations, effective customer service, and accessible recourse mechanisms (Gupta and Xia, 2018). For populations with limited experience with formal financial institutions and potentially higher vulnerability to financial losses, trust-building proves particularly critical. Service providers and regulators must prioritize trust-enhancing measures including security infrastructure, clear communication, responsive customer support, fair dispute resolution, and financial education initiatives.

The research also reveals that negative experiences have disproportionate impact on continued engagement and word-of-mouth recommendations in tightly networked communities. Service failures not only affect individual users but potentially discourage entire social networks, highlighting the importance of quality assurance and rapid problem resolution in early-stage markets.

5.5. The Double-Edged Nature of Digital Credit

Digital lending platforms demonstrated significant impact in expanding credit access, particularly for populations excluded from traditional bank lending. The finding that 31.7% of digital credit users had been previously rejected by banks confirms that these platforms serve genuinely underserved populations rather than merely cannibalizing traditional bank customers. However, the substantially higher interest rates (averaging 4.7 percentage points above bank rates) and concerning rates of misunderstanding regarding total costs raise important questions about whether expanded credit access necessarily translates to improved welfare outcomes.

The tension between accessibility and affordability reflects fundamental challenges in lending to higher-risk borrowers without traditional credit histories or collateral (Berg *et al.*, 2020). While alternative credit scoring enables risk assessment for previously unassessable populations, higher

default probabilities legitimately justify some premium pricing (Jagtiani and Lemieux, 2019). However, the boundary between risk-appropriate pricing and predatory lending requires careful navigation through regulatory oversight, industry standards, and consumer education.

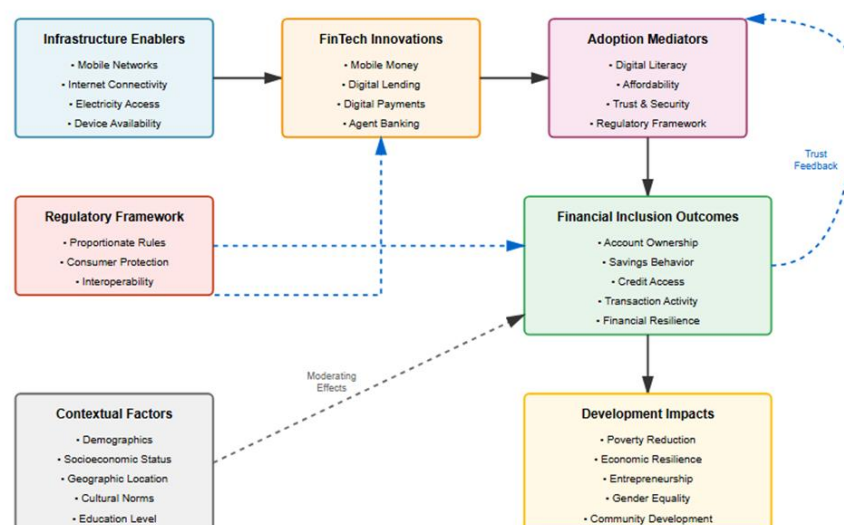
The rapid processing times that make digital credit appealing also create risks of impulsive borrowing without adequate consideration of repayment capacity. Research indicating higher default rates for instant-approval loans compared to traditional bank loans suggests that frictionless access may not uniformly benefit borrowers (Bharadwaj *et al.*, 2019). Responsible lending practices including suitability assessments, cooling-off periods, and mandatory financial education may prove necessary to ensure that credit expansion enhances rather than undermines borrower welfare.

5.6. Implications for Development Theory

The findings contribute to broader development economics literature on technology's role in poverty reduction and economic inclusion. The research provides empirical support for theories emphasizing how technological innovation can enable "leapfrogging" over infrastructure deficits that constrained development in earlier industrializing nations (Steinmueller, 2001). Mobile money's success in achieving financial inclusion without extensive bank branch networks exemplifies this leapfrogging potential.

However, the persistent inequalities in FinTech access and outcomes also support critical perspectives arguing that technology alone cannot overcome structural disadvantages without complementary social and policy interventions (Heeks, 2010). The digital divide essentially replicates existing inequalities in new forms, suggesting that inclusive development requires addressing root causes of marginalization rather than solely introducing new technologies.

The research also speaks to debates about financial inclusion's developmental impact. While the positive associations between FinTech adoption and savings behavior, credit access, and transaction volumes support arguments that financial inclusion enables economic participation, the cross-sectional design limits conclusions about long-term welfare effects. Ongoing longitudinal research is necessary to establish whether improved financial inclusion metrics translate to sustained poverty reduction and improved livelihoods.



Source: Developed by author based on research findings

Fig 2: Conceptual Framework of FinTech-Enabled Financial Inclusion

6. Conclusion

This study provides comprehensive evidence that FinTech plays a significant role in expanding financial access for underserved communities across diverse developing economy contexts. The research demonstrates substantial positive associations between FinTech adoption and financial inclusion outcomes including account ownership, savings behavior, credit access, and transaction activity. These findings confirm FinTech's potential to address longstanding barriers that excluded marginalized populations from formal financial systems.

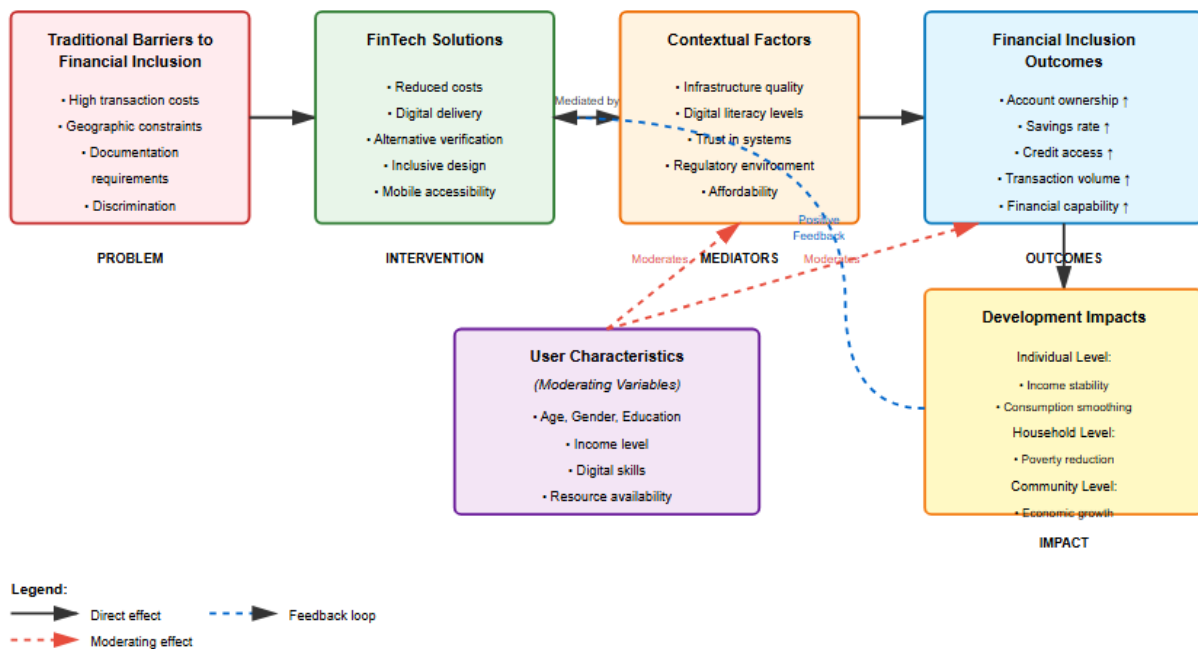
Mobile money emerges as particularly transformative, enabling basic financial services without requiring traditional bank accounts and effectively reaching rural and low-income populations that conventional banking struggled to serve. Digital lending platforms similarly expand credit access for populations excluded by traditional underwriting criteria, though affordability and consumer protection concerns require careful regulatory attention. Digital payment systems enhance transaction convenience and efficiency while reducing costs, particularly for cross-border remittances.

However, the research also reveals that FinTech alone cannot overcome structural inequalities without complementary interventions. Persistent digital divides in infrastructure, literacy, and affordability constrain FinTech's reach to the most marginalized populations. Demographic disparities in adoption and outcomes across urban/rural locations, gender, age, education, and income levels demonstrate that technology must be accompanied by investments in infrastructure, education, and targeted policies addressing specific barriers facing vulnerable groups.

Regulatory frameworks prove critical in determining whether FinTech realizes its inclusive potential. Proportionate regulation that balances innovation with consumer protection, interoperability requirements that prevent market fragmentation, and robust consumer protection mechanisms that build trust emerge as key policy enablers. Conversely, regulatory uncertainty, overly restrictive requirements, or inadequate oversight can either stifle innovation or expose users to predatory practices.

The study's findings carry important implications for multiple stakeholder groups. Policymakers must craft regulatory environments that encourage inclusive innovation while maintaining appropriate safeguards. Financial institutions and FinTech firms should design products and services with explicit attention to underserved populations' needs, constraints, and preferences. Development organizations should support ecosystem-building efforts that address infrastructure, literacy, and policy gaps constraining inclusive FinTech deployment. Researchers must continue investigating long-term impacts, emerging risks, and evolving best practices as FinTech markets mature.

Achieving truly inclusive financial systems through FinTech requires coordinated action across technology development, policy design, infrastructure investment, capacity building, and targeted interventions addressing specific barriers facing marginalized groups. While significant progress has occurred, substantial work remains to ensure that digital financial innovation benefits not only those already connected but extends meaningfully to the most excluded populations who stand to gain the most from improved financial access.



Source: Developed by author based on research findings

Source: Developed by author based on research findings

Fig 3: FinTech Impact Pathway

7. Limitations

Several limitations warrant consideration in interpreting this study's findings:

Cross-Sectional Design: The research employs a cross-sectional approach examining associations at a single point in

time, limiting causal inferences about FinTech's impact on financial inclusion outcomes. While multivariate analyses control for confounding variables, unmeasured factors may influence observed relationships, and reverse causality cannot be definitively ruled out. Longitudinal research

tracking individuals over time would strengthen causal claims.

Geographical Scope: The five-country sample, while diverse, cannot represent the full range of contexts where FinTech operates. Findings may not generalize to countries with substantially different economic conditions, cultural contexts, regulatory environments, or technological infrastructure. Particular caution is warranted in applying findings to least developed countries with nascent FinTech ecosystems or developed economies with mature financial systems.

Self-Reported Data: Survey responses reflect participants' self-reported behaviors, perceptions, and experiences, potentially introducing recall bias, social desirability bias, or misunderstanding of questions. While careful instrument design and enumerator training mitigate these concerns, administrative data on actual FinTech transactions would provide more objective outcome measures.

Sample Selection: Despite systematic sampling procedures, achieved samples may not perfectly represent target populations due to non-response or sampling frame limitations. Populations experiencing the most severe exclusion may be systematically underrepresented in the sample, potentially leading to conservative estimates of barriers and challenges.

Measurement Challenges: Operationalizing complex constructs such as financial inclusion, digital literacy, and trust requires measurement compromises. The study employs established instruments where possible, but measurement error inevitably affects precision. Financial inclusion particularly represents a multidimensional concept that no single metric fully captures.

Rapidly Evolving Context: The FinTech landscape evolves rapidly with new technologies, business models, and regulatory approaches emerging continuously. Findings reflect conditions during the 2024 data collection period and may become outdated as markets mature and innovations develop. Ongoing research remains necessary to track evolving patterns.

Limited Long-Term Assessment: The cross-sectional design captures immediate or short-term associations but cannot assess long-term impacts on poverty reduction, economic development, or sustained behavior change. Whether FinTech-driven financial inclusion translates to improved long-term welfare outcomes requires extended longitudinal investigation.

Qualitative Sample Constraints: While qualitative interviews provide valuable insights, the relatively small stakeholder sample (n=42) limits generalizability of qualitative findings. Additional perspectives from other stakeholder groups including technology developers, infrastructure providers, and community organizations would enrich understanding.

8. Practical Implications

The research findings yield several actionable implications for stakeholders seeking to leverage FinTech for financial inclusion:

8.1. For Policymakers and Regulators

Implement Proportionate Regulatory Frameworks: Adopt risk-based, tiered regulatory approaches that enable basic financial access with simplified requirements while maintaining stronger safeguards for higher-risk, higher-value

transactions. Tiered KYC requirements, proportionate licensing regimes, and simplified compliance for low-risk services can significantly expand financial inclusion without compromising systemic integrity.

Mandate Interoperability: Require interoperability between digital financial platforms to prevent market fragmentation, reduce vendor lock-in, enhance competition, and improve user convenience. Shared payment infrastructure and open API standards enable ecosystem development that benefits consumers and providers alike.

Strengthen Consumer Protection: Develop and enforce robust consumer protection regulations addressing disclosure requirements, dispute resolution mechanisms, data privacy standards, interest rate caps or transparency requirements for digital lending, and accessible financial education. Consumer protection builds the trust necessary for sustainable adoption.

Invest in Digital Infrastructure: Prioritize investments in mobile networks, internet connectivity, and electricity access as foundational enablers of inclusive FinTech. Public-private partnerships can leverage resources and expertise to accelerate infrastructure deployment in underserved areas.

Support Financial and Digital Literacy: Fund financial and digital literacy programs targeted at underserved populations, incorporating training into existing community programs, educational curricula, and public awareness campaigns. Require FinTech providers to contribute to user education through in-app guidance, simplified interfaces, and accessible support services.

Adopt Regulatory Sandboxes with Inclusion Focus: Implement regulatory sandbox programs with explicit focus on financial inclusion, providing technical assistance to smaller, locally-focused firms, simplified application processes, and evaluation criteria explicitly considering inclusive impact. Ensure sandbox learning translates to appropriate regulatory reforms.

Address Gender-Specific Barriers: Design policies explicitly addressing barriers women face, including legal restrictions on property ownership or economic activity, discriminatory social norms, and lower digital literacy. Support women-focused FinTech initiatives and ensure gender-disaggregated data collection to monitor progress.

8.2. For Financial Institutions and FinTech Companies

Design for Underserved Users: Develop products and services explicitly considering underserved populations' needs, constraints, and preferences. Features to consider include multilingual interfaces accommodating low literacy, simplified navigation and minimal data requirements, offline functionality or USSD alternatives, biometric authentication alternatives to passwords, small-value transaction suitability, and agent networks for assisted transactions and cash conversion.

Implement Responsible Lending Practices: For digital lending platforms, adopt responsible lending standards including transparent pricing and disclosure, suitability assessments before loan approval, appropriate credit limits based on repayment capacity, grace periods and flexible repayment options, proactive customer support, and financial education integrated into the lending process.

Invest in Trust-Building: Prioritize security, reliability, transparency, and customer service to build user trust. Specific actions include robust cybersecurity measures and fraud prevention, clear communication about terms, fees, and processes, responsive customer support through multiple

channels, effective dispute resolution with user-friendly procedures, and transparency about data usage and privacy protections.

Partner for Extended Reach: Develop partnerships extending reach to underserved populations, including collaborations with traditional financial institutions leveraging complementary strengths, agent network partnerships with local retailers and community organizations, telecommunications provider partnerships enabling mobile-based services, and civil society partnerships building trust and providing user education.

Prioritize User Experience: Invest in user experience design making digital financial services accessible and intuitive, incorporating user testing with target populations, iterative design improvements based on feedback, customer journey mapping identifying pain points, and accessibility features for users with disabilities or limited technological experience.

8.3. For Development Organizations

Support Ecosystem Development: Fund comprehensive approaches addressing multiple constraints simultaneously, including infrastructure investments, regulatory technical assistance, financial literacy programs, and private sector capacity building. Financial inclusion requires ecosystem-level interventions rather than isolated projects.

Facilitate Policy Dialogue: Convene stakeholders including regulators, providers, users, and civil society to foster policy dialogue identifying priorities, sharing experiences, and developing collaborative solutions. Multi-stakeholder platforms can accelerate learning and coordination.

Fund Research and Evidence Generation: Support rigorous research examining FinTech's impacts, best practices, and emerging challenges. Evidence gaps include long-term welfare impacts, comparative effectiveness of different policy approaches, specific needs of diverse underserved populations, and unintended consequences

requiring mitigation.

Provide Technical Assistance: Offer technical assistance to regulators developing inclusive FinTech frameworks, providers designing inclusive products, and community organizations delivering financial education. Capacity constraints often limit stakeholders' ability to leverage FinTech opportunities effectively.

Monitor Equity Outcomes: Track disaggregated data monitoring whether FinTech-driven financial inclusion reaches the most marginalized populations or primarily benefits those already relatively advantaged. Equity-focused monitoring enables course correction when disparities emerge.

8.4. For Users and Civil Society

Demand Accountability: Hold providers and regulators accountable for product quality, fair treatment, transparent pricing, effective customer service, and appropriate consumer protection. Collective user voice through consumer associations can influence market and policy development.

Build Digital Literacy: Engage in financial and digital literacy education opportunities, share knowledge within communities, and support peers in adopting and effectively using digital financial services. Community-based learning approaches can accelerate collective capacity building.

Exercise Caution: Approach digital financial services with appropriate caution, understanding terms and conditions before agreeing, protecting passwords and PINs carefully, reviewing transactions regularly, reporting problems promptly, and avoiding over-indebtedness from easily accessible credit.

Provide Feedback: Share experiences, challenges, and suggestions with providers and regulators to inform product and policy improvements. User feedback proves invaluable for identifying issues and opportunities that external observers might miss.

Table 5: Policy Recommendations Matrix

Objective	Policy Intervention	Target Group	Expected Outcome	Implementation Considerations
Expand basic access	Tiered KYC requirements	Unbanked populations	Increased account ownership	Balance with AML/CFT obligations; technology for digital ID verification
Reduce market fragmentation	Interoperability mandates	All digital financial service users	Enhanced convenience, competition	Technical standards; phased implementation; dispute resolution mechanisms
Protect consumers	Mandatory disclosure, interest rate caps	Digital credit users	Reduced predatory practices	Enforcement capacity; market impact monitoring; definition of "excessive" rates
Build digital capabilities	Financial literacy programs	Rural populations, women, elderly	Improved effective usage	Integration with existing programs; community-based delivery; ongoing support
Extend infrastructure	Mobile network, electricity investments	Rural and remote areas	Reduced infrastructure barriers	Public-private partnerships; universal service funds; renewable energy solutions
Enable innovation	Regulatory sandboxes	FinTech startups	Faster product development	Inclusion-focused criteria; SME support; learning dissemination
Ensure market stability	Prudential oversight frameworks	FinTech providers	Reduced systemic risk	Proportionate requirements; regulatory capacity building; international coordination

Source: Developed by author based on research findings and literature review

9. Future Research Directions

This study identifies several promising avenues for future research:

Longitudinal Impact Studies: Conduct longitudinal research tracking individuals over multiple years to assess whether FinTech-driven financial inclusion translates to sustained welfare improvements including poverty reduction, income growth, economic resilience, and intergenerational mobility. Understanding long-term impacts proves essential

for evaluating whether financial inclusion constitutes a development intervention worthy of continued investment.

Causal Mechanism Investigation: Employ experimental or quasi-experimental designs to establish causal mechanisms through which FinTech influences financial inclusion outcomes. Randomized controlled trials introducing FinTech interventions to treatment groups while maintaining comparison groups would strengthen causal inferences beyond associations identified in observational research.

Heterogeneous Impact Analysis: Investigate how FinTech's impacts vary across different population subgroups including different age cohorts, ethnic or linguistic minorities, persons with disabilities, refugees and displaced populations, and rural versus peri-urban versus urban residents. Understanding heterogeneous effects enables more targeted and equitable interventions.

Comparative Regulatory Analysis: Conduct systematic comparative analysis of different regulatory approaches including proportionate versus uniform requirements, mandatory versus voluntary interoperability, different consumer protection frameworks, and various sandbox designs. Identifying regulatory best practices requires more extensive cross-country comparisons than currently available.

Alternative FinTech Innovations: Examine emerging technologies not extensively covered in this study including blockchain applications beyond cryptocurrency, artificial intelligence in credit scoring and financial advising, biometric authentication systems, Internet of Things (IoT) applications in agriculture finance, and decentralized finance (DeFi) platforms. Understanding new innovations' inclusion potential and risks requires ongoing research as technologies evolve.

Behavioral Economics Perspectives: Apply behavioral economics frameworks to understand FinTech adoption and usage patterns, including decision-making biases affecting FinTech engagement, behavioral interventions ("nudges") improving financial outcomes, default settings' effects on savings and responsible borrowing, and psychological factors influencing trust and perceived risk.

Environmental Sustainability: Investigate environmental dimensions of FinTech including energy consumption of digital financial infrastructure, opportunities for FinTech to enable green finance and sustainable investment, digital payments' role in reducing cash-related environmental

impacts, and climate change vulnerability affecting FinTech-dependent populations.

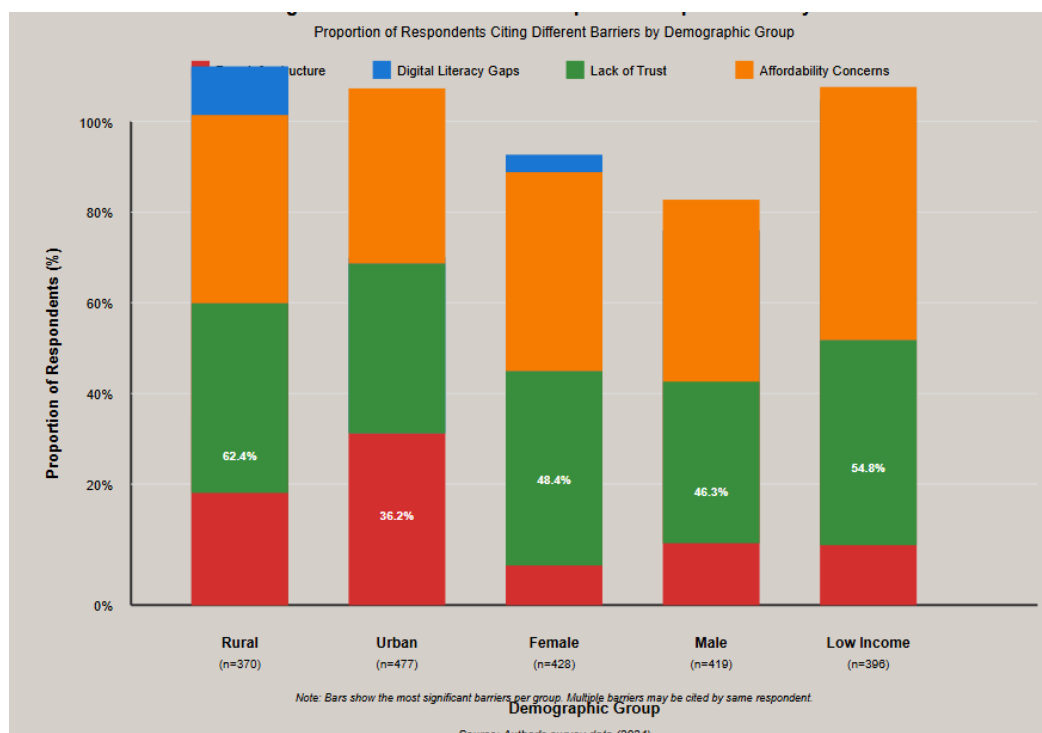
Mental Health and Wellbeing: Examine how FinTech access influences psychological wellbeing through pathways including reduced financial stress from easier money management, anxiety from digital security concerns or technical difficulties, social isolation or connection through digital financial communities, and over-indebtedness effects on mental health.

Business Model Sustainability: Research commercial sustainability of FinTech models serving low-income populations, including cost structures and revenue models, scaling strategies and break-even requirements, balance between social mission and commercial viability, and sustainable approaches to serving the "bottom of the pyramid."

Unintended Consequences: Investigate potential negative consequences of FinTech-driven financial inclusion including over-indebtedness from easily accessible credit, privacy erosion from data collection, algorithmic bias and discrimination, exclusion of populations unable to access digital services, and destabilization of informal financial mechanisms providing social functions beyond transactions.

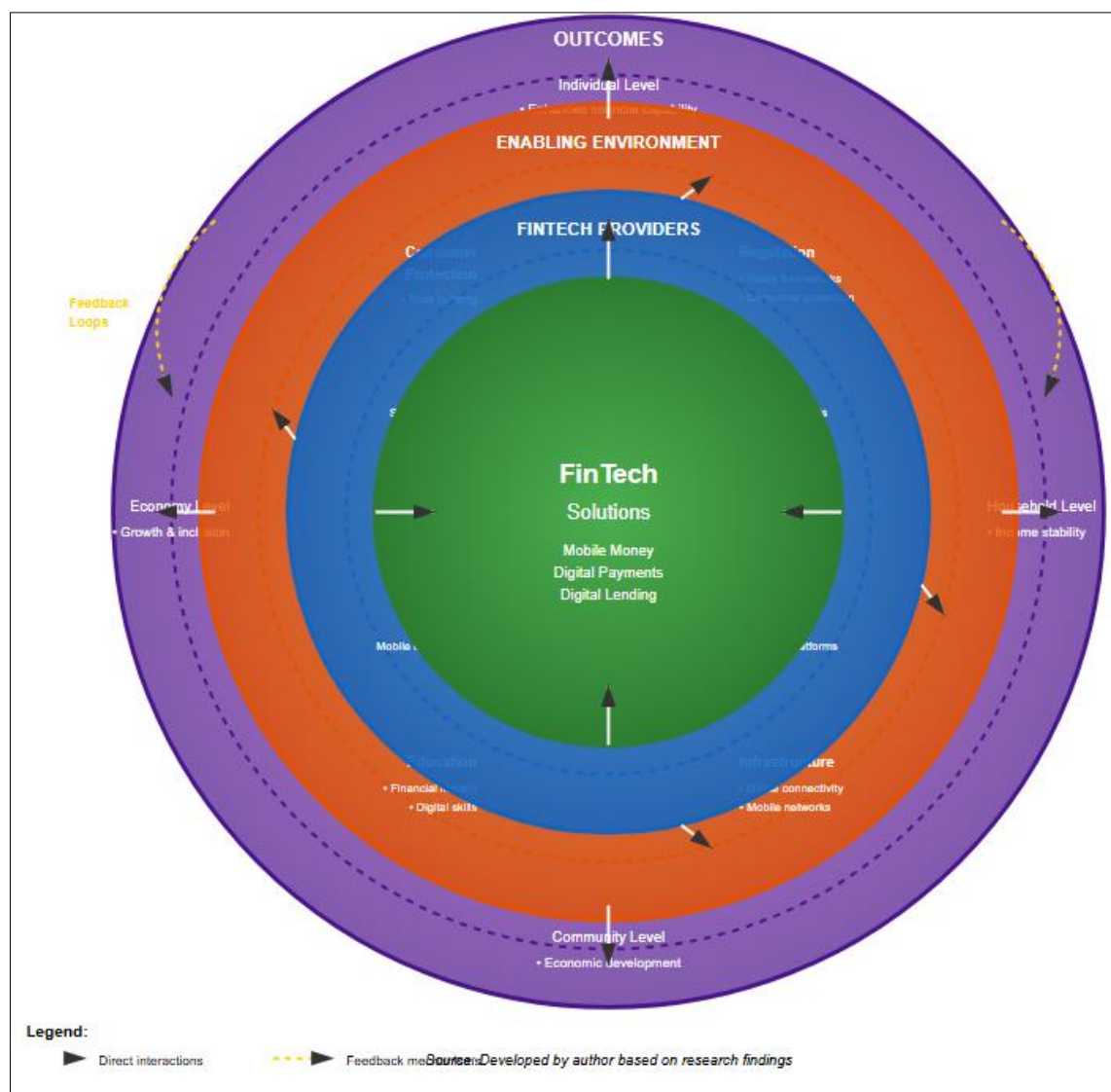
Cross-Border Financial Flows: Examine FinTech's role in cross-border financial flows including remittances, international payments, cross-border lending, and regulatory challenges of transnational FinTech services. Understanding regional integration opportunities and challenges remains under-researched.

Youth Financial Inclusion: Investigate how FinTech can promote financial inclusion among youth populations, including age-appropriate financial education through gamification, youth savings products and parental controls, entrepreneurship support for young people, and transitions from youth-focused to adult financial services.



Source: Author's survey data (2024)

Fig 4: Barriers to FinTech Adoption - Comparative Analysis



Source: Developed by author based on research findings

Fig 5: Financial Inclusion Ecosystem Framework

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