Digital Banking Beyond Access: Institutional and Adoption Dynamics of FinTech in South and Southeast Asia

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ARTICLE INFO	ABSTRACT
	Digital banking and financial technology (FinTech) have become central to financial system modernization in emerging economies, yet their developmental impact depends on institutional design, sectoral integration, and user adoption. While several South Asian countries have embedded digital finance within coherent, sector-specific policy frameworks, Pakistan's experience remains uneven, with digital banking expansion showing limited linkage to productive economic activities. This study examines Pakistan's digital banking landscape from a comparative institutional perspective, using agriculture as a focal sector to assess how institutional coordination and adoption behavior shape FinTech outcomes. The study employs an exploratory mixed-methods approach, combining cross-country secondary indicators (2018–2024) from Pakistan, India, Bangladesh, and Malaysia with primary survey evidence from digital banking users in Pakistan. Rather than testing causal relationships, the analysis evaluates patterns of association between digital banking penetration, institutional coherence, and sectoral engagement, interpreted through Financial Intermediation Theory, the Technology Acceptance Model, and Innovation Diffusion Theory. Findings show that despite initiatives such as Raast and the Kissan Card, digital banking usage in Pakistan remains largely transactional and urban-centered, with limited integration into agricultural finance. Comparative evidence indicates that countries with stronger institutional alignment and sector-specific digital finance strategies achieve deeper productive engagement. Survey results further highlight behavioral constraints, including trust deficits, limited awareness, and gender-based access disparities in rural areas. The study concludes that FinTech-enabled digital banking is not inherently transformative; its effectiveness depends on institutional embedding, interoperability, and sustained user engagement to support inclusive and productivity-oriented development.

1. Introduction

The rapid expansion of financial technology (FinTech) and digital banking has coincided with significant changes in financial systems worldwide, reshaping how financial services are delivered, accessed, and regulated. What initially emerged as a supplementary innovation is increasingly positioned as a central component of contemporary financial ecosystems, particularly in developing and emerging economies. Digital financial services such as mobile payments, electronic wallets, and branchless banking are commonly linked to lower entry barriers to formal finance for households and small enterprises previously excluded from traditional banking

systems. As digital ecosystems mature, FinTech is increasingly viewed as a strategic enabler of sustainable development, with implications extending beyond the financial sector into productive economic activities, including agriculture (Khan & Ahmed, 2022).

Regional peers such as India, Bangladesh, and Malaysia exhibit contrasting institutional and regulatory approaches to digital financial development, offering useful benchmarks for evaluating Pakistan's digital banking trajectory within comparable developing-economy contexts (Somuncu, 2025; Rao et al., 2023). These countries represent differing stages of FinTech institutionalization rather than exhaustive regional coverage, with variations in regulatory coordination, governance capacity, and sectoral integration

shaping adoption outcomes (World Bank, 2023). Differences are evident not only in levels of technological uptake but also in the alignment between financial regulators, digital infrastructure agencies, and sector-specific ministries, particularly in agriculture and small-enterprise finance (Jena, 2025). Comparative analysis of these models enables clearer assessment of how institutional design influences digital finance outcomes and situates Pakistan's experience within a broader regional and policy context rather than in isolation (Somuncu, 2025).

Despite rapid expansion in digital financial services, Pakistan continues to lag behind comparable economies in translating FinTech growth into broad-based financial inclusion and productive economic use (SBP, 2023; World Bank, 2023). Digital banking adoption remains concentrated in urban areas, while rural uptake particularly among smallholder farmers remains limited (Malik & Sikarwar, 2025). Fragmented institutional coordination, uneven regulatory implementation, and weak linkages between financial authorities and sectoral agencies, especially in agriculture, are frequently identified as factors constraining the effectiveness of digital finance initiatives (Hussain et al., 2025; Somuncu, 2025). These challenges are especially significant given Pakistan's demographic structure, where a substantial proportion of the population resides in rural areas and relies directly or indirectly on agriculture for livelihoods (World Bank, 2023).

Agriculture remains central to Pakistan's economic and social structure, yet productivity growth has stagnated over time due to persistent structural constraints (FAO, 2022; World Bank, 2023). Limited access to formal credit, delayed subsidy disbursement, and enduring information asymmetries across agricultural value chains are widely associated with restricted investment capacity, heightened risk exposure, and weak responsiveness to market signals (Perveen et al., 2021; Chaiya et al., 2023). FinTech-enabled digital banking is frequently discussed as a mechanism with potential to ease some of these constraints by improving transparency, reducing transaction costs, and strengthening farmers' integration into formal financial systems when effectively embedded within agricultural finance frameworks (Kshetri, 2021; Hussain et al., 2025).

However, FinTech expansion does not inherently generate inclusive or productivity-enhancing outcomes. Evidence from developing economies suggests that adoption alone is insufficient where structural barriers such as low digital literacy, trust deficits, infrastructure gaps, and weak institutional support remain unresolved (Osahon, 2025). These constraints significantly limit FinTech's

transformative potential in rural and agriculture-dependent regions, where socioeconomic and behavioral factors interact with regulatory capacity (Kshetri, 2021; Jena, 2025). Consequently, empirical relationships between FinTech penetration and agricultural productivity should be interpreted within broader institutional, regulatory, and behavioral contexts rather than as purely technological effects (Rao et al., 2023).

Against this backdrop, this study examines the relationship between FinTech innovation, digital banking penetration, and agricultural productivity in Pakistan, using comparative evidence from India, Bangladesh, and Malaysia. Employing a mixed-methods approach, the study combines cross-country secondary data (2018–2024) with primary survey evidence from digital banking users in Pakistan. Guided by Financial Intermediation Theory, the Technology Acceptance Model, and Innovation Diffusion Theory, the analysis explores both institutional and behavioral mechanisms through which digital finance is statistically associated with agricultural productivity outcomes. Specifically, the study asks: how and under what institutional and behavioral conditions does FinTech-enabled digital banking to translate into measurable agricultural productivity gains in Pakistan, and how does this relationship compare with regional peers?

2. Contribution of the Study

Unlike existing narrative or access-focused studies, this paper advances an analytically structured and empirically tested examination of the FinTech–agriculture nexus in developing economies. Rather than treating FinTech adoption as a uniform productivity driver, the study demonstrates how institutional coherence and user-level adoption dynamics condition the strength and effectiveness of FinTech's relationship with agricultural outcomes. The paper makes three key contributions to the literature on FinTech, financial inclusion, and agricultural development.

First, it addresses a significant gap in existing research by empirically linking FinTech diffusion and digital banking penetration with sector-specific productivity outcomes rather than limiting analysis to general financial inclusion indicators. While prior studies have examined FinTech adoption or agricultural finance independently, systematic evidence connecting digital finance expansion with agricultural productivity, particularly in South Asia, remains limited. By demonstrating a statistically significant association between digital banking penetration and agricultural output per worker, this study advances understanding of FinTech's role in real-sector performance.

Second, the study contributes through a comparative institutional framework that contrasts Pakistan's FinTech ecosystem with India, Bangladesh, and Malaysia. By examining countries at different stages of FinTech maturity, the paper highlights how institutional coherence, regulatory coordination, and sectoral integration condition the effectiveness of digital finance in agriculture. This comparative approach moves beyond single-country analyses and provides transferable policy insights for developing economies with large rural populations.

Third, the study integrates macro-level cross-country indicators with micro-level behavioral evidence from primary survey data collected in Pakistan. This mixed-methods design bridges institutional conditions with user adoption dynamics, strengthening the connection between theory, empirical strategy, and findings. By jointly applying Financial Intermediation Theory, the Technology Acceptance Model, and Innovation Diffusion Theory, the paper provides a comprehensive explanation of how FinTech-enabled financial inclusion can translate under appropriate institutional and behavioral conditions into agricultural productivity gains.

Together, these contributions position the study as an analytically grounded and policy-relevant examination of FinTech-enabled agricultural transformation in developing economies.

3. Literature Review and Theoretical Framework

Theoretical Foundations of FinTech and Digital Banking

Digital finance represents an evolution of traditional financial intermediation, where technological innovation alters how financial services are produced, delivered, and accessed. Financial Intermediation Theory (FIT) emphasizes the role of financial institutions in reducing transaction costs and information asymmetries between savers and borrowers (Levine, 1997). In digital contexts, fintech platforms extend these functions by automating intermediation processes, lowering operational costs, and expanding outreach to underserved populations. Empirical

studies suggest that fintech-enabled intermediation is associated with improved efficiency, transparency, and allocation of financial resources, particularly in environments where conventional banking infrastructure is limited (Nguyen & Vo, 2023). The macro-institutional role of FIT and its key analytical variables are summarized in Table 1.

While institutional efficiency is a necessary condition, it does not alone ensure adoption or effective usage of digital financial services. The Technology Acceptance Model (TAM) provides a behavioral framework explaining individual adoption decisions through perceived usefulness and perceived ease of use (Davis, 1989). In digital banking environments, these perceptions are shaped by trust, security, usability, and digital literacy. Empirical evidence from South Asia indicates that concerns related to fraud, system reliability, and limited user familiarity significantly influence sustained usage of fintech services (Rahman et al., 2023). as reflected in the micro-level analytical mapping presented in Table 1.

Innovation Diffusion Theory (IDT) further situates fintech adoption within broader social, spatial, and institutional systems. According to Rogers (2003), the diffusion of innovations depends on communication channels, peer effects, and system readiness. In developing economies, diffusion processes are often uneven due to infrastructure gaps, regulatory fragmentation, and limited institutional coordination, particularly in rural regions (Hassan & Umar, 2022; Jabeen & Yousaf 2024). These factors contribute to spatially differentiated adoption outcomes despite expanding technological availability. The system-level role of IDT in explaining spatial adoption disparities is outlined in Table 1.

In this study, Financial Intermediation Theory informs macro-institutional analysis, the Technology Acceptance Model guides interpretation of survey-based adoption behavior, and Innovation Diffusion Theory explains observed spatial and sectoral variation.

Table 1: Theoretical Framework and Analytical Mapping

Theory	Analytical Level	Key Variables / Evidence	Role in Analysis
Financial Intermediation Theory	Macro	Digital penetration, agri credit, agri output	Explains efficiency and allocation mechanisms
Technology Acceptance Model	Micro	Trust, perceived usefulness, ease of use	Explains adoption and sustained usage
Innovation Diffusion Theory	System	Rural diffusion, peer effects, infrastructure	Explains uneven spatial adoption

FinTech and Financial Inclusion: Beyond Access

The empirical literature broadly recognizes FinTech as a potentially powerful driver of financial inclusion, particularly in contexts where traditional banking systems are costly, inaccessible, or inefficient. Digital financial services reduce transaction costs, expand geographic reach, and enable customized financial products, thereby improving access for underserved populations. Beck et al. (2022) demonstrate that FinTech adoption is associated with higher account ownership and transaction activity in low-income economies, supporting the view that digital finance can widen formal financial participation.

Nevertheless, recent studies caution against equating FinTech access with meaningful financial inclusion. Inclusion increasingly encompasses sustained usage, service quality, and economic impact rather than mere account ownership. Empirical evidence suggests that FinTech outcomes are highly conditional on user trust, financial literacy, and regulatory credibility. Rahman and Lee (2024) find that perceived security and usability significantly influence adoption decisions in South Asian economies, while Akhter et al. (2023) show that digital financial services enhance resilience among marginalized groups only when supported by targeted literacy and trust-building measures.

The literature therefore converges on the conclusion that FinTech functions as an enabling mechanism rather than an automatic solution. Without supportive institutional frameworks and consumer protection mechanisms, digital finance risks reinforcing existing inequalities instead of alleviating them. This conditional perspective is particularly relevant for developing economies, where structural constraints often limit the depth and quality of FinTech adoption.

Digital Finance and Agricultural Development

The relationship between digital finance and agricultural productivity has gained increasing scholarly attention as agriculture remains a primary source of employment and income in developing economies. Traditional agricultural finance systems are characterized by delayed payments, limited credit access, and high transaction costs, which constrain farmers' investment decisions and risk management capacity. FinTech-based interventions aim to address these challenges by digitizing payments, enabling data-driven credit scoring, and facilitating access to insurance and subsidy programs.

Empirical evidence indicates that digital payment systems can improve liquidity cycles and reduce leakage in agricultural subsidy delivery. FAO (2023) documents that digitized transfers enhance transparency and timeliness, allowing farmers to make more informed input-purchasing decisions. Studies from South Asia further suggest that mobile financial services can support wage payments, micro-insurance, and savings mechanisms for agricultural workers, thereby stabilizing rural incomes.

However, the literature also emphasizes that agriculture-specific FinTech outcomes depend on sectoral integration. Malik and Hussain (2023) argue that generic digital finance expansion often remains consumption-oriented unless explicitly aligned with agricultural value chains. Similarly, Hassan et al. (2023) find that weak interoperability and limited product customization constrain the scalability of digital agriculture initiatives. These findings underscore that FinTech's effectiveness in agriculture is contingent on deliberate policy design rather than generalized digital banking growth

Comparative Regional Evidence and Institutional Design

Comparative studies consistently highlight institutional coherence as a decisive factor in determining FinTech effectiveness. Cross-country analyses show that economies with centralized governance structures, interoperable payment systems, and coordinated regulatory frameworks achieve stronger inclusion and productivity outcomes than fragmented systems. Nguyen and Tran (2024) demonstrate that institutional alignment significantly amplifies the developmental impact of digital finance across emerging Asian economies.

Public private collaboration also emerges as a critical enabler of FinTech diffusion. Studies emphasize that trust, affordability, and regulatory clarity facilitate adoption, particularly in rural contexts. Conversely, fragmented governance structures characterized by overlapping mandates and weak coordination often undermine policy effectiveness and slow diffusion, even when technological infrastructure is available.

This body of literature suggests that FinTech outcomes are shaped less by the sophistication of technology and more by the quality of institutional design. As such, comparative institutional analysis provides a valuable lens for understanding divergent digital finance trajectories across countries.

Research Gap and Conceptual Positioning

Despite extensive research on FinTech and financial inclusion, several critical gaps remain. First, there is limited empirical work directly linking FinTech diffusion to sector-specific productivity outcomes, particularly in agriculture. Second, comparative cross-country analyses that explicitly account for institutional and policy variation remain scarce. Third, existing studies rarely integrate macro-level indicators with micro-level behavioral evidence to explain adoption dynamics in rural economies.

To address these gaps, this study adopts an integrated theoretical framework drawing on Financial Intermediation Theory, the Technology Acceptance Model, and Innovation Diffusion Theory. Financial Intermediation Theory explains how digital finance reduces transaction costs and information asymmetries, enhancing allocative efficiency. The Technology Acceptance Model emphasizes perceived usefulness and ease of use as key drivers of adoption, while Innovation Diffusion Theory highlights the role of social learning, communication channels, and system readiness.

Together, these frameworks suggest that FinTech-driven inclusion and productivity gains depend on behavioral acceptance and institutional readiness rather than technological availability alone. This integrated approach provides a coherent analytical foundation for examining the FinTech–agriculture nexus in Pakistan and its regional peers.

In sum, the literature confirms FinTech's potential to enhance inclusion and productivity but also reveals that outcomes vary widely across institutional contexts. Digital finance delivers measurable benefits only when supported by coordinated policy design, infrastructure readiness, and user trust. By combining comparative regional analysis with primary survey evidence, this study advances understanding of how FinTech can transition from a financial innovation to a driver of agricultural transformation in developing economies.

4. Materials and Methods

Research Design and Approach

This study employs a mixed-methods research design that integrates quantitative and qualitative approaches to examine the relationship between FinTech innovation, digital banking penetration, and agricultural productivity in South and Southeast Asia. The focus is on Pakistan, with comparative analysis drawn from India, Bangladesh, and Malaysia. The design combines secondary cross-country data (2018–2024) with primary survey evidence collected from individual digital banking users in Pakistan.

The research design is exploratory–descriptive, consistent with the study's objective of identifying relationships and contextual mechanisms rather than establishing strict causality. The quantitative dimension captures macro-level financial and agricultural indicators, while the qualitative dimension assesses user perceptions, adoption behavior, and institutional barriers. This triangulation is associated with both validity and contextual interpretation, aligning with standard practices in development economics and financial inclusion research (Yin, 2023). Digital banking penetration is used as the primary quantitative indicator, while the FinTech Integration Rating serves as a qualitative, descriptive proxy capturing institutional coordination, interoperability, and regulatory readiness, with the index serving as a composite proxy. The FinTech Integration Rating is not used for econometric estimation but to support comparative institutional interpretation.

Data Sources and Variables

Secondary Data

Secondary data were compiled from international and national institutional sources for the period 2018–2024, including the World Bank, State Bank of Pakistan, Reserve Bank of India, Bangladesh Bank, Bank Negara Malaysia, FAO, and IMF. All monetary variables were converted to constant 2020 USD, and population-adjusted indicators were used to ensure cross-country comparability.

To contextualize Pakistan's FinTech position relative to regional peers, **Table 2** presents cross-country indicators on digital banking penetration, agricultural dependence, and FinTech integration.

Table 2: Cross-Country Digital Banking and Agricultural Indicators (2018–2024)

Country	Digital Banking Users (Million)	Digital Penetration (%)	Agriculture GDP Share (%)	FinTech Integration Rating (1–5)
Pakistan	24	15	19	2
India	450	40	17	5
Bangladesh	60	35	12	4
Malaysia	10	40	7	5

Note: The FinTech Integration Rating is a composite descriptive indicator based on regulatory readiness, interoperability, and institutional coordination.

Primary Data Collection

Primary data were collected through a structured questionnaire survey conducted between January and March 2024 across Bahawalpur, Multan, Rahim Yar Khan, Karachi, and Faisalabad. A total of 214 respondents participated, consisting of registered users of Easypaisa, JazzCash, and Raast.

Sample Characteristics and Usage Profile

The demographic composition of the survey sample is summarized in **Table 3**. The sample reflects Pakistan's rural demographic structure, with 60 percent rural respondents and a substantial representation of agricultural livelihoods.

Table 3: Demographic Characteristics of Survey Respondents (n = 214)

Variable	Category	Percentage (%)
Gender	Male / Female	60 / 40
Location	Rural / Urban	60 / 40
Age Group	18–25 / 26–40 / 41–60	28 / 45 / 27
Occupation	Farmer / Laborer / Small Business / Student	33 / 21 / 29 / 17
Education Level	Primary / Secondary / Higher	26 / 34 / 40

Table 4 presents the descriptive statistics summarizing respondents' usage patterns, platform preferences, perceived benefits, and barriers related to digital financial services. The results indicate a relatively high level of engagement, with 28% of respondents using digital financial services on a daily basis and 36% on a weekly basis, suggesting regular usage among the majority of participants. However, 36% of respondents reported monthly or rare usage, reflecting

continued heterogeneity in adoption intensity. In terms of platform preference, banking applications emerged as the most widely used platform (42%), followed by mobile wallet services such as Easypaisa and JazzCash (37%). The Raast payment system accounted for 21% of usage, indicating moderate but growing adoption.

Regarding the primary purpose of use, bill payments (40%) and fund transfers (38%) were the dominant activities, whereas payments for agricultural inputs (17%) remained comparatively limited. This highlights the transactional nature of current digital finance usage and suggests potential for expansion into agriculture-related financial services. Respondents identified speed (52%) as the most significant perceived benefit, followed by security (25%) and convenience (23%), underscoring efficiency as the primary driver of adoption. Conversely, internet connectivity (32%) and lack of awareness (28%) were reported as the major barriers, while trust (19%) and cost (12%) were relatively less constraining.

Table 4: Digital Banking Usage Patterns and Barriers

Indicator	Category / Response	Percentage (%)
Frequency of Use	Daily / Weekly / Monthly / Rarely	28 / 36 / 18 / 18
Platform Used	Bank App / Easypaisa–JazzCash / Raast	42 / 37 / 21
Primary Use	Bill Payments / Transfers / Agricultural Inputs	40 / 38 / 17
Perceived Benefits	Speed / Security / Convenience	52 / 25 / 23
Key Barriers	Internet / Awareness / Trust / Cost	32 / 28 / 19 / 12

These patterns indicate that while access to digital banking is widespread, productive usage in agriculture remains limited.

Given data constraints and cross-country heterogeneity, all indicators are interpreted as proxies rather than precise measures of fintech depth or productivity outcomes. Cross-country comparisons emphasize relative positioning and institutional patterns rather than exact numerical equivalence.

Analytical Framework

The analysis was conducted in three stages:

Stage 1: Descriptive Statistics

Descriptive summaries (mean, percentage share, frequency distributions) were used to analyze digital banking usage, trust levels, and perceived barriers. Cross-tabulations compared adoption rates by gender, education, and location.

Stage 2: Cross-Country Comparative Analysis

To contextualize Pakistan's progress, digital penetration, agricultural productivity, and FinTech maturity were compared across India, Bangladesh, and Malaysia. Ratio analysis and visual comparisons (bar and scatter charts) illustrated structural disparities in inclusion and innovation.

Stage 3: Correlation and Regression Analysis

A quantitative test of the hypothesized FinTech–agriculture relationship was performed using correlation and simple regression analysis. The base model is expressed as:

Given the limited number of countries included in the comparative analysis, regression estimates are interpreted as statistically supported associations that highlight the strength and direction of the FinTech–agriculture relationship within the observed sample. Statistical significance ($p < 0.05$), consistent with comparable cross-country exploration studies, these estimates are interpreted as indicative relationships rather than causal effects is reported to indicate robustness within the sample rather than to imply universal causality.

$$AGRI\_OUTPUT_i = \alpha + \beta_1 DIGIPEN_i + \beta_2 AGRICREDIT_i + \epsilon_i \qquad \text{eq \#1}$$

Where:

$AGRI\_OUTPUT_i$ = Agricultural output per worker (USD),

$DIGIPEN_i$ = Digital banking penetration rate (% of adults),

$AGRICREDIT_i$ = Agricultural credit access (% of farmers with formal credit),

α = Constant, ϵ_i = Error term.

The model estimates the marginal effect of digital banking penetration on agricultural productivity, controlling formal credit access. Empirical findings show $\beta_1 > 0$ and statistically significant ($p < 0.05$), supporting the hypothesis that FinTech adoption is associated with sectoral productivity. The regression explains approximately 68% of variance in agricultural output ($R^2 = 0.68$), confirming a strong positive relationship.

Reliability and Validity

Instrument reliability was ensured through a pilot test involving fifteen respondents prior to the main survey. Cronbach's alpha for the multi-item Likert scales (covering trust, literacy, and usage) was 0.82, exceeding the 0.70 benchmark for internal consistency (Nunnally, 1978).

Construct validity was established by aligning survey dimensions with theoretical constructions from TAM and FIT (e.g., perceived ease of use, trust, accessibility). Triangulation between secondary and primary datasets further strengthened external validity, ensuring that findings reflected both individual-level and systemic realities.

Content validity was ensured through expert review by two faculty members of the Department of Economics, The Islamia University of Bahawalpur, who confirmed the instrument's relevance and coverage.

5. Results and Discussion

Results

Overview of Empirical Strategy

This section synthesizes evidence from macro-level cross-country indicators and micro-level survey data to assess how FinTech penetration translates into agricultural productivity outcomes. The analysis is structured around three dimensions: institutional context, empirical productivity linkages, and behavioral constraints, interpreted through Financial Intermediation Theory, the Technology Acceptance Model, and Innovation Diffusion Theory.

Cross-Country Patterns: Institutional Context Matters

Cross-country variation in FinTech outcomes reflects differences in institutional coordination rather than technology alone. Table 5 compares agricultural credit access and the extent to which digital channels support rural finance.

Table 5: Agricultural Credit Access and Digital Channels (2023)

Country	Farmers with Formal Credit (%)	Mobile / Online Credit Access (%)
Pakistan	33	6
India	68	24
Bangladesh	51	22
Malaysia	80	45

Pakistan's low level of digital agricultural credit access helps explain why FinTech expansion has not translated into comparable productivity gains.

FinTech Penetration and Agricultural Productivity

Table 6 presents the correlation matrix examining the relationships among digital FinTech penetration, agricultural output, and agricultural credit access. The results indicate a strong positive association between digital penetration and agricultural output (r = 0.82), suggesting that higher levels of FinTech usage are closely linked with improved agricultural productivity. This finding supports the argument that digital financial services can facilitate more efficient transactions, better access to inputs, and improved market participation in the agricultural sector.

The correlation between digital penetration and agricultural credit access (r = 0.74) is also positive and substantial, indicating that increased FinTech adoption is associated with improved access to agricultural credit. This relationship highlights the role of digital financial platforms in easing credit constraints faced by farmers through enhanced financial inclusion and reduced transaction costs.

Furthermore, agricultural credit access is strongly correlated with agricultural output (r = 0.79)**,** implying that improved availability of credit contributes significantly to higher agricultural production. Overall, the correlation matrix confirms that FinTech penetration, credit access, and agricultural productivity are closely interconnected. However, while these correlations indicate strong associations, they do not imply causality and therefore motivate further econometric analysis.

Table 6: Correlation Matrix (2024)

Variable	Digital Penetration	Agricultural Output	Agricultural Credit
Digital Penetration	1.00	0.82	0.74
Agricultural Output	0.82	1.00	0.79
Agricultural Credit Access	0.74	0.79	1.00

Table 7 presents the regression results examining the relationship between FinTech penetration and agricultural productivity, while controlling agricultural credit access. The estimated coefficient for digital penetration is positive and statistically significant ($\beta = 0.72$, $p = 0.002$), indicating that higher levels of digital banking penetration are associated with increased agricultural output. This suggests that digital financial services play an important role in enhancing productivity by facilitating transactions, improving access to markets, and reducing financial frictions.

Similarly, agricultural credit access exhibits a positive and statistically significant effect on agricultural productivity ($\beta = 0.43$, $p = 0.007$), highlighting the importance of credit availability in supporting input purchases and productive investment in the agricultural sector. The constant term is also statistically significant, reflecting baseline productivity effects independent of the explanatory variables.

The model explains a substantial proportion of variation in agricultural output, with an R^2 value of 0.68**,** indicating strong explanatory power. Overall, the results confirm that digital banking penetration is significantly associated with higher agricultural output, conditional access to agricultural credit, reinforcing the complementary role of FinTech and credit availability in agricultural development.

Table 7: Regression Results – FinTech Penetration and Agricultural Productivity

Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant	1.24	0.08	15.5	0.000
Digital Penetration	0.72	0.11	6.5	0.002
Agricultural Credit Access	0.43	0.09	4.7	0.007

$R^2 = 0.68$

Behavioral and Adoption Constraints in Pakistan

Despite the expansion of digital banking infrastructure in Pakistan, effective utilization within productive sectors remains limited due to behavioral, informational, and structural constraints. Evidence from the primary survey indicates that adoption is predominantly transactional rather than productive in nature. While a majority of respondents report regular use of digital banking platforms, engagement is concentrated in low-risk activities such as bill payments and peer-to-peer transfers, with comparatively limited use

for sector-specific purposes such as agricultural inputs, credit, or insurance.

Survey results reported in Tables 2 and 3 reveal pronounced rural–urban and usage-intensity disparities. Rural respondents, who constitute a substantial share of productive economic participants, exhibit lower engagement with advanced digital financial services. This pattern reflects not only infrastructure limitations but also gaps in awareness and familiarity with sector-relevant digital products. A significant proportion of respondents identified insufficient knowledge as a primary barrier, indicating that access alone does not translate into effective inclusion.

Trust-related concerns further constrain adoption. Respondents expressed apprehension regarding transaction security, dispute resolution mechanisms, and system reliability, particularly for larger or time-sensitive payments. Such concerns are more pronounced among users with volatile income streams, for whom perceived risk plays a critical role in financial decision making. Consistent with the Technology Acceptance Model, these trust deficits weaken perceived usefulness and discourage sustained engagement beyond basic transactions.

Gender disparities also emerge as an important constraint. Female respondents reported lower usage frequency and limited control over mobile devices, reinforcing existing inequalities in financial access. These patterns suggest that without targeted inclusion measures, digital banking expansion may inadvertently replicate preexisting socio-economic asymmetries Suri and Jack (2016).

Overall, the survey evidence highlights a disconnect between the availability of fintech services and their functional integration into productive economic activities. Behavioral barriers, particularly limited awareness, trust deficits, and gendered access constraints, continue to limit the depth of digital banking usage in Pakistan.

Interpreting the FinTech–Agriculture Nexus

The empirical findings suggest that digital banking penetration is associated with improved sectoral outcomes only when technological expansion is accompanied by institutional integration and sustained user adoption. Cross-country comparisons indicate that Pakistan's relatively shallow productive usage of digital finance reflects weak alignment between fintech platforms and sectoral policy frameworks rather than limited technological availability.

From a Financial Intermediation Theory perspective, fragmented institutional coordination constrains the efficiency gains typically associated with digital financial intermediation. Although platforms such as Raast and the Kissan Card have expanded digital access, their limited linkage with sectoral institutions, value chains, and service delivery mechanisms reduces incentives for users to transition from cash-based to digital transactions.

Comparative evidence highlights the role of institutional embedding in strengthening fintech outcomes. In India, digital payment platforms are integrated with subsidy disbursement systems, credit programs, and welfare transfers, creating repeated and low-risk interaction points for users. This institutional anchoring supports learning effects and reinforces trust, contributing to broader and more sustained adoption. Malaysia demonstrates a complementary model, where sector-specific digital finance is delivered through dedicated institutions such as Agrobank, facilitating targeted financial services aligned with sectoral needs.

Innovation Diffusion Theory helps explain why adoption patterns in Pakistan remain spatially and functionally uneven. Limited interoperability, weak coordination across agencies, and the absence of unified digital governance slow diffusion beyond urban and consumption-oriented use cases. Behavioral constraints identified in table 8 interact with these institutional weaknesses, further suppressing productive engagement.

Taken together, the findings underscore that fintech-driven transformation is not automatic. Digital banking is associated with improved outcomes only when embedded within coherent institutional frameworks and supported by user-centered implementation strategies. Pakistan's experience illustrates the risks of a fragmented approach, where technological expansion outpaces institutional readiness, limiting the potential developmental impact of fintech initiatives.

Table 8: Institutional Mediation of FinTech Outcomes

Country	FinTech Penetration	Institutional Coordination	Agricultural Productivity Outcome
Pakistan	Low–Moderate	Fragmented	Weak translation
India	High	Strong	High translation
Bangladesh	Moderate	Partial	Moderate translation
Malaysia	High	Strong	High translation

Comparative Policy Implications

Table 9 summarizes the key empirical findings of the study by highlighting the relationships between digital banking, institutional conditions, and agricultural productivity. The table shows a strong positive association between digital banking penetration and agricultural productivity, indicating that increased access to digital financial services is closely linked with improved agricultural performance. The results further demonstrate that institutional coherence significantly strengthens the developmental impact of FinTech, suggesting that coordinated regulatory and governance frameworks enhance effectiveness.

The table also reveals that, in Pakistan, FinTech adoption remains relatively shallow and is primarily oriented toward consumption-based activities rather than productive investment. Trust-related concerns, usability challenges, and limited digital connectivity emerge as major binding constraints, particularly in rural areas, restricting broader and more effective adoption. Cross-country comparisons reported in Table 9 indicate that countries with centralized FinTech governance structures outperform those with fragmented systems. Finally, the findings suggest that FinTech contributes to productivity gains only when it is embedded within agricultural value chains, rather than operating as a standalone financial access mechanism.

Table 9: Comparative Digital Finance and Agricultural Policy Models

Country	Core FinTech Model	Key Institutional Feature
India	UPI-based interoperability	Centralized digital governance
Bangladesh	bKash (PPP model)	Trust-based public–private partnership
Malaysia	Agrobank digital integration	Institutionalized agri-finance
Pakistan	Raast, Kissan Card	Fragmented implementation

6. Summary of Key Findings

The key findings of this study reveal a strong positive association between digital banking penetration and agricultural productivity, with a correlation coefficient of 0.82, indicating that expanded access to digital financial services is closely linked to improved agricultural outcomes. The results further show that institutional coherence plays a critical role in amplifying the developmental impact of FinTech, as countries with centralized and well-coordinated governance frameworks consistently outperform those characterized by fragmented regulatory systems. In the context of Pakistan, FinTech adoption remains relatively shallow and largely consumption-focused, limiting its contribution to productive investment in agriculture. Moreover, trust deficits, usability challenges, and inadequate digital connectivity emerge as binding constraints on rural adoption, restricting sustained and effective use of digital financial services. Importantly, the findings suggest that FinTech contributes to agricultural productivity only when it is embedded within agricultural value chains, rather than operating as a standalone financial access mechanism.

7. Conclusion

This study provides empirical evidence on the role of digital banking and FinTech in supporting agricultural productivity, with particular emphasis on institutional and structural conditions. The findings indicate a strong positive association between digital banking penetration and agricultural productivity, highlighting the potential of digital financial services to contribute to sectoral performance when effectively deployed. However, this relationship is not automatic and is significantly shaped by the broader institutional environment.

The results further demonstrate that institutional coherence plays a critical role in amplifying the developmental impact of FinTech. Countries with centralized and coordinated FinTech governance frameworks exhibit stronger performance outcomes compared to those characterized by fragmented regulatory systems. In the context of Pakistan, FinTech adoption remains relatively shallow and largely consumption-oriented, with limited integration into productive agricultural activities.

Moreover, trust deficits, usability challenges, and inadequate digital connectivity emerge as binding constraints on rural FinTech adoption. These barriers restrict sustained usage and limit the ability of digital financial services to support productivity-enhancing investments. The findings also suggest that FinTech contributes to agricultural productivity primarily when embedded within agricultural value chains, rather than through standalone financial access.

Overall, the study underscores that digital finance can serve as a catalyst for agricultural development only when supported by coherent institutions, reliable infrastructure, and sector-specific integration strategies.

8. Ethical Considerations

All participants were informed of the study's purpose and provided informed consent before participating. Data collection adhered to principles of confidentiality and voluntary participation. No personal identifiers were retained, and all responses were anonymized during analysis.

Ethical approval for this research was obtained from the Departmental Ethics Committee, The Islamia University of Bahawalpur (Approval No. IUB-ECON/2024/112). The study also complied with the SBP Data Protection Guidelines (2023) to ensure responsible handling of digital and financial information.

9. Limitations of the Study

The primary survey is not intended for statistical generalization but to contextualize macro-level patterns with user-level behavioral evidence. Despite the robustness of its mixed-methods approach, this study faces certain limitations:

1. **Temporal limitation:** Primary data were cross-sectional, constraining the ability to infer causality over time.
2. **Geographical scope:** While geographically diverse, the survey excluded remote northern and western districts due to connectivity constraints.
3. **Comparability of secondary data:** Variations in data definitions across institutions may introduce minor inconsistencies.
4. **Measurement constraint:** Self-reported behavioral indicators (e.g., trust, perceived risk) are subject to response bias.

Nonetheless, the combined use of institutional data, rigorous sampling, and theoretical alignment is associated with the study's credibility and provides a comprehensive lens for evaluating the FinTech–agriculture nexus in Pakistan and its regional peers.

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