

Effect of Digital Financial Inclusion on Access to Agricultural Finance Among Smallholder Farmers in Selected States in North-Central Nigeria

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Abstract

This study examined the effect of digital financial inclusion on access to agricultural finance among smallholder farmers in Benue, Kogi and Nasarawa States and the Federal Capital Territory, Nigeria. Kwara, Niger and Plateau States were excluded to maintain a manageable geographical scope. A cross-sectional survey design was adopted, and 440 questionnaires were administered, of which 387 valid responses were analysed. Data were collected using a structured questionnaire and analysed using Partial Least Squares Structural Equation Modelling in SmartPLS 4. The findings showed that FinTech-based credit access had a strong positive and significant effect on access to agricultural finance ($\beta = 0.924, p < 0.001$). Agent-banking accessibility ($\beta = 0.293, p < 0.001$) and digital payment usage ($\beta = 0.098, p < 0.001$) also had positive and significant effects. Digital financial literacy had a negative but significant effect ($\beta = -0.279, p < 0.001$), while mobile banking usage had a negative and insignificant effect ($\beta = -0.067, p = 0.069$). The study concluded that digital financial inclusion improves agricultural-finance access when it provides affordable, timely and suitable credit rather than connectivity and routine transactions alone. It recommended expanding farmer-oriented FinTech credit, strengthening rural agent-banking networks, using digital payment histories for credit assessment and aligning digital loan conditions with agricultural production cycles.

Keywords: *agricultural finance, agent banking, digital financial inclusion, FinTech credit, smallholder farmers.*

1.Introduction

Agriculture remains an important source of employment, income, food security and rural development in Nigeria. Smallholder farmers constitute a major component of the agricultural sector and contribute substantially to domestic food production. However, their productivity and livelihood sustainability are frequently constrained by inadequate access to affordable and timely agricultural finance (Adegbite, 2021; Mamman & Jimoh, 2025). Agricultural activities require sufficient funding to purchase improved seeds, fertilisers, machinery, agrochemicals and other productive inputs. When farmers cannot obtain financing at the appropriate time, their capacity to

expand production, adopt modern technologies and improve productivity becomes limited (Adedamola, 2024; Moses et al., 2025).

Digital financial inclusion plays a vital role in improving smallholder farmers' access to affordable and timely agricultural finance. Through mobile banking, agent banking, digital payment platforms and FinTech-based credit services, farmers can save, receive payments, obtain loans and purchase agricultural inputs without relying exclusively on conventional bank branches (Halilu, 2026a, 2026b; Ogunfolaju et al., 2025, 2026). It also reduces geographical and transaction barriers, creates digital transaction records for credit assessment and connects farmers with formal financial institutions. Consequently, effective digital financial inclusion can strengthen agricultural investment, productivity, income and livelihood sustainability among smallholder farmers (Abraham, 2018; Ibrahim et al., 2023, 2024; Mamman & Jimoh, 2025).

Existing empirical evidence on the contribution of financial inclusion to smallholder farmers presents mixed and inconclusive findings. Some studies suggest that access to formal financial services improves farmers' participation in the financial system, livelihood outcomes, ownership of productive assets and agricultural development (Abraham, 2018; Adegbite, 2021; Alabi et al., 2022). These findings imply that financial inclusion can reduce financing constraints and enable farmers to invest in agricultural production. Conversely, other evidence suggests that access to financial services does not automatically translate into adequate agricultural financing. The seasonal nature of agriculture, climate-related risks, insufficient collateral, high borrowing costs and unsuitable repayment conditions may continue to restrict farmers' access to credit, even where financial services are available (Abraham & Fonta, 2018; Halilu, 2026a). Thus, farmers may be financially connected through mobile phones, bank accounts or financial agents but remain excluded from productive agricultural credit. Therefore, the available evidence remains mixed: some studies identify potential benefits from financial access and digital-service adoption, while others highlight persistent barriers that prevent farmers from converting digital access into productive agricultural financing. This study addresses the evidence gap by examining the individual and combined effects of digital payment usage, mobile banking usage, agent-banking accessibility, digital financial literacy and FinTech-based credit access on agricultural-finance access among smallholder farmers in selected states in North-Central Nigeria. Accordingly, the objective of this study is to examine the effect of digital financial inclusion on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria. Specifically, the study assesses the effects of digital payment usage, mobile banking usage, agent-banking accessibility, digital financial literacy and FinTech-based credit access on smallholder farmers' access to adequate, affordable and timely agricultural finance.

2. Literature Review and Hypotheses Development

2.2.1 Digital Payment Usage and Access to Agricultural Finance

Digital payment usage involves sending and receiving money through mobile applications, electronic wallets, point-of-sale terminals, bank transfers and other electronic platforms. For smallholder farmers, digital payments can facilitate the receipt of proceeds from agricultural sales and the payment for inputs, labour and transportation. Regular digital transactions create electronic records of farmers' financial activities. These records may provide financial institutions and FinTech lenders with information about transaction frequency, cash flows and repayment capacity. Digital payment usage can therefore reduce information asymmetry and improve farmers' eligibility for formal or digitally delivered agricultural credit. It may also reduce the risks and costs

associated with cash-based transactions. Nevertheless, the contribution of digital payments depends on the reliability of networks, farmers' trust in electronic platforms, transaction charges and the willingness of lenders to use digital transaction histories in their credit decisions. Although financial access can improve the welfare and productive capacity of rural farmers, digital access does not necessarily guarantee adequate agricultural credit (Abraham, 2018; Halilu, 2026a). The following null hypothesis is formulated:

H₀₁: Digital payment usage has no significant effect on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria.

2.2.2 Mobile Banking Usage and Access to Agricultural Finance

Mobile banking usage refers to farmers' use of mobile phones and banking applications to check account balances, transfer funds, save money, repay loans and access other financial services. Mobile banking can reduce the need for farmers to travel long distances to conventional bank branches and can make financial transactions more convenient. Through mobile banking, farmers may receive loan information, submit applications, obtain disbursements and make repayments. Regular usage may also strengthen farmers' financial histories and relationships with formal financial institutions. Research on rural financial access and digital-service adoption suggests that mobile financial channels can reduce some of the geographical barriers experienced by rural farmers (Abraham, 2018; Ogunfolaju et al., 2025, 2026). However, low digital literacy, poor network coverage, security concerns and high data costs may restrict farmers' effective use of mobile banking. Accordingly, its effect on agricultural-finance access requires empirical examination.

H₀₂: Mobile banking usage has no significant effect on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria.

2.2.3 Agent-Banking Accessibility and Access to Agricultural Finance

Agent banking involves authorised individuals or businesses providing selected banking services on behalf of regulated financial institutions. Such services may include account opening, deposits, withdrawals, transfers, bill payments and, in some cases, support for loan applications. Agent banking can extend financial services to rural communities where establishing conventional bank branches may not be economically viable. Accessible agents may help farmers complete transactions, obtain financial information and resolve difficulties encountered when using digital platforms. Agent banking may consequently reduce distance, transportation costs and procedural barriers to formal financial services (Malik-Abdulmajeed, 2021). However, the presence of agents may not automatically improve agricultural-finance access if the agents mainly provide withdrawal and transfer services without facilitating savings, insurance or credit. Liquidity shortages, high charges and limited knowledge of agricultural financial products may also reduce their effectiveness.

H₀₃: Agent-banking accessibility has no significant effect on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria.

2.2.4 Digital Financial Literacy and Access to Agricultural Finance

Digital financial literacy represents the knowledge and ability required to understand, evaluate and safely use digitally delivered financial products. It includes the ability to operate mobile applications, compare credit products, calculate borrowing costs, protect personal information,

recognise fraud and understand repayment conditions. Financial literacy can assist farmers in selecting suitable financial products, preparing credit applications and making informed borrowing decisions. Farmers with sufficient knowledge may be better positioned to distinguish between productive and harmful debt and to avoid fraudulent digital lending platforms. Evidence from rural farming households in Kwara State highlights the importance of financial literacy in promoting meaningful financial inclusion (Falola et al., 2023). Limited digital financial literacy may prevent farmers from using available services or expose them to excessive borrowing, hidden charges and cyber fraud. Thus, the availability of digital platforms may have little effect on agricultural financing when farmers lack the knowledge and confidence required to use them.

H₀₄: Digital financial literacy has no significant effect on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria.

2.2.5 FinTech-Based Credit Access and Agricultural Finance

FinTech-based credit access refers to the availability and use of loans delivered through mobile applications, digital platforms and technology-enabled financial institutions. Such lenders may use transaction histories, mobile-phone usage and other alternative data to evaluate borrowers who lack conventional collateral or formal credit records.

FinTech credit can shorten application procedures, reduce documentation requirements and accelerate loan disbursement. These characteristics are important in agriculture because financing must frequently be obtained before planting or other time-sensitive production activities. Digital lending may therefore expand financing opportunities for farmers excluded from conventional bank credit (Halilu, 2026a, 2026b). Nevertheless, FinTech-based credit may involve high interest rates, short repayment periods and loan amounts that are insufficient for agricultural investment. These features may make some digital credit products unsuitable for farmers whose income depends on seasonal harvests. The effect of FinTech credit on agricultural-finance access must therefore be evaluated in terms of affordability, adequacy and timeliness rather than the mere availability of loans.

H₀₅: FinTech-based credit access has no significant effect on access to agricultural finance among smallholder farmers in selected states in North-Central Nigeria.

2.3 Theoretical Review

2.3.1 Financial Intermediation Theory

Financial Intermediation Theory explains how financial institutions mobilise funds from surplus economic units and channel them to individuals and businesses requiring finance. Financial intermediaries reduce transaction costs, address information asymmetry, assess borrowers' creditworthiness and facilitate the allocation of financial resources to productive activities.

The theory is relevant because smallholder farmers often experience information asymmetry and high transaction costs when seeking formal agricultural finance. Financial institutions may possess limited information about farmers' income, production capacity and repayment behaviour. Digital platforms can reduce this information gap by producing transaction histories and alternative data that support credit assessment. Mobile banking, agent banking and FinTech platforms may also reduce the cost of delivering financial services to geographically dispersed farmers. The theory therefore suggests that digital financial inclusion strengthens the intermediation process by linking farmers with financial institutions, reducing information and transaction barriers and facilitating

the transfer of funds to agricultural activities. However, the effectiveness of this process depends on the accessibility, affordability and suitability of digital financial products.

2.3.2 Technology Acceptance Model

The Technology Acceptance Model explains individuals' acceptance and use of technology through perceived usefulness and perceived ease of use. Farmers are more likely to adopt digital financial services when they believe that such services improve their financial transactions and are relatively easy to understand and operate.

The model is relevant because access to agricultural finance through digital channels depends partly on farmers' willingness and ability to use mobile banking, digital payments, agent banking and FinTech platforms. Even when digital services are available, farmers may not use them if they perceive the platforms as complicated, insecure or irrelevant to their needs. Digital financial literacy, trust and ease of access can therefore influence whether digital financial services produce meaningful agricultural-financing outcomes (Halilu, 2026a; Ogunfolaju et al., 2025, 2026).

Financial Intermediation Theory serves as the principal theory because the study focuses on how digital financial channels connect smallholder farmers with agricultural finance. The Technology Acceptance Model provides a supporting explanation of farmers' adoption and effective use of those channels.

Methodology

The study adopted a cross-sectional survey research design. The design is appropriate because it enabled the collection of quantitative data directly from farmers concerning their use of digital financial services and access to agricultural finance at a particular period. The population of the study comprised approximately 10.5 million smallholder farming households across North-Central Nigeria, covering Benue, Kogi, Kwara, Nasarawa, Niger and Plateau states and the Federal Capital Territory. The sample size was determined using the Yamane formula because the study adopted a finite population of 10,500,000 smallholder farming households in North-Central Nigeria. The formula is expressed as:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = required sample size;

N = population size; and

e = margin of error at 5%.

Substituting the population into the formula:

$$\begin{aligned} n &= \frac{10,500,000}{1 + 10,500,000(0.05)^2} \\ n &= \frac{10,500,000}{1 + 26,250} \\ n &= \frac{10,500,000}{26,251} = 399.98 \end{aligned}$$

The result was approximated to 400 respondents. To compensate for possible non-response, incomplete questionnaires and unusable responses, a 10% attrition allowance was added:

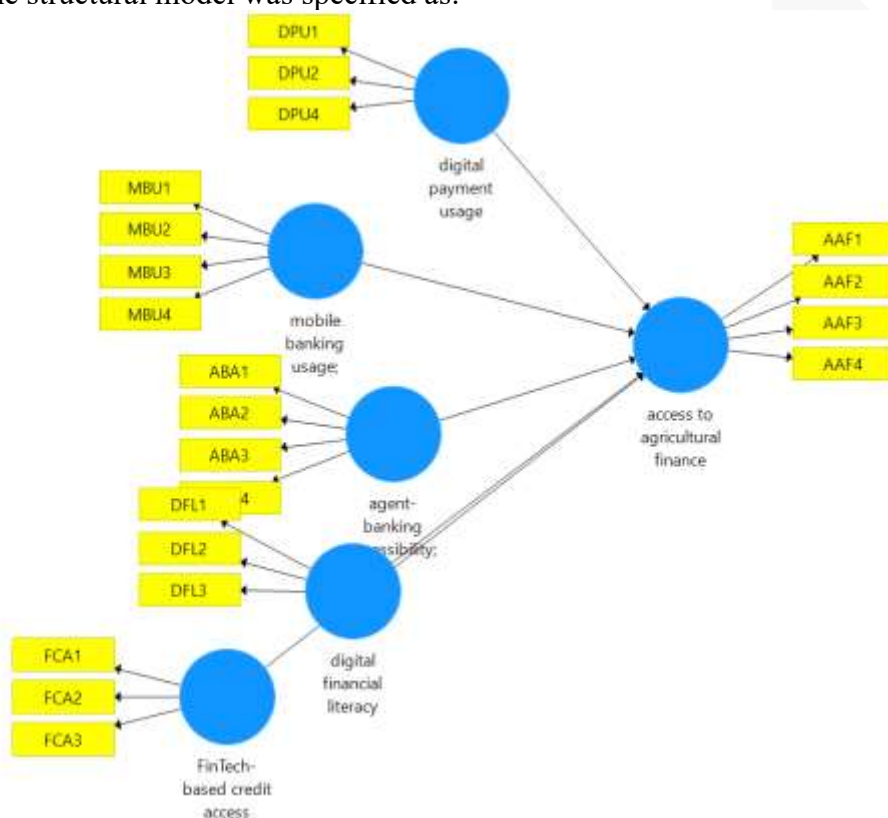
$$10\% \text{ of } 400 = 40$$

$$400 + 40 = 440$$

Benue, Kogi, Nasarawa and the FCT were selected because of their substantial smallholder-farming populations and varying access to digital financial services. Kwara, Niger and Plateau were excluded to maintain a manageable geographical scope and reduce data-collection costs. A total of 440 questionnaires were administered to obtain at least 400 valid responses. Primary data were collected from smallholder farmers using a structured questionnaire adapted from previous studies (Abraham, 2018; Adegbite, 2021; Halilu, 2026a, 2026b; Ogunfolaju, 2026; Ogunfolaju et al., 2025, 2026). The data were analysed using PLS-SEM in SmartPLS 4 to assess the measurement and structural models simultaneously.

Model Specification

The structural model was specified as:



Source: Smrtpls 2026

$$AAF = \beta_0 + \beta_1 DPU + \beta_2 MBU + \beta_3 ABA + \beta_4 DFL + \beta_5 FCA + \varepsilon$$

Where:

AAF= access to agricultural finance;
DPU= digital payment usage;
MBU= mobile banking usage;
ABA= agent-banking accessibility;
DFL= digital financial literacy;
FCA= FinTech-based credit access;
 β_0 = intercept;
 β_1 – β_5 = path coefficients; and
 ε = error term.

4. Results and Discussion

4.1 Questionnaire Administration and Response Rate

A total of 440 copies of the questionnaire were administered to smallholder farmers in the selected states in North-Central Nigeria. Of this number, 398 questionnaires were returned, while 11 were excluded because of incomplete responses and other data-quality problems. Consequently, 387 valid questionnaires were retained for the analysis, representing a valid response rate of 87.95%.

Table 4.1 Construct Reliability and Convergent Validity

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
FinTech-based credit access	0.901	0.908	0.939	0.838
access to agricultural finance	0.975	0.975	0.982	0.931
agent-banking accessibility;	0.911	0.933	0.938	0.792
digital financial literacy	0.961	0.963	0.975	0.928
digital payment usage	0.735	0.749	0.848	0.652
mobile banking usage;	0.948	0.952	0.962	0.865

Source Smart pls 2026

The results established satisfactory reliability and convergent validity. Cronbach's alpha (0.735–0.975), rho_A (0.749–0.975) and composite reliability (0.848–0.982) exceeded the minimum threshold of 0.70. Similarly, AVE values ranged from 0.652 to 0.931, exceeding the recommended value of 0.50. Thus, all constructs demonstrated adequate internal consistency and convergent validity. However, the high reliability values for access to agricultural finance and digital financial literacy suggest possible item redundancy.

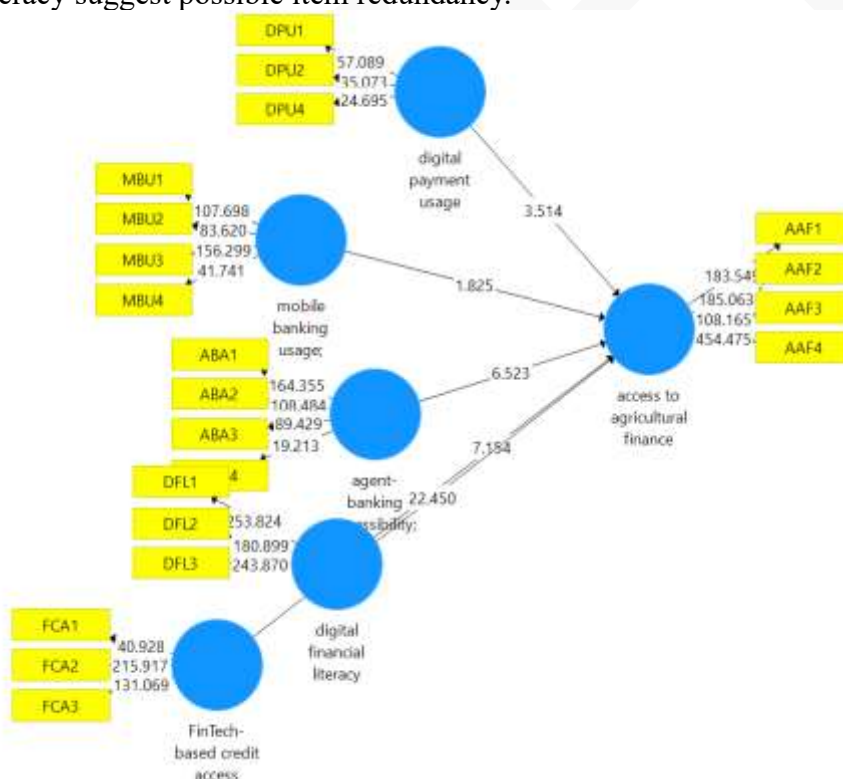


Table 4.2 Structural Model

FinTech-based credit access -> access to agricultural finance	0.924	0.927	0.041	22.450	0.000
agent-banking accessibility; -> access to agricultural finance	0.293	0.288	0.045	6.523	0.000
digital financial literacy -> access to agricultural finance	-0.279	-0.281	0.039	7.154	0.000
digital payment usage -> access to agricultural finance	0.098	0.101	0.028	3.514	0.000
mobile banking usage; -> access to agricultural finance	-0.067	-0.064	0.037	1.825	0.069

FinTech-based credit access had a strong positive and statistically significant effect on access to agricultural finance ($\beta = 0.924$, $t = 22.450$, $p < 0.001$). Thus, the relevant null hypothesis was rejected. This indicates that convenient applications, timely disbursement and access to digitally delivered loans substantially improve farmers' access to agricultural finance. This finding aligns with studies that emphasise the importance of financial access and digital innovation in supporting rural farmers and agricultural development (Abraham, 2018; Adegbite, 2021; Alabi et al., 2022). It is also consistent with the argument that FinTech can broaden farmers' participation in formal finance when digital products are accessible, affordable and adapted to agricultural needs (Halilu, 2026a, 2026b). The result supports Financial Intermediation Theory because FinTech platforms reduce transaction costs and information asymmetry between farmers and lenders.

Agent-banking accessibility also had a positive and significant effect ($\beta = 0.293$, $t = 6.523$, $p < 0.001$). The null hypothesis was rejected, suggesting that the proximity and availability of banking agents reduce geographical and transaction barriers to agricultural finance. The result aligns with Malik-Abdulmajeed (2021), who emphasised the relevance of agency banking to financial inclusion in rural North-Central Nigeria. It is also consistent with evidence that access to formal financial services can improve farmers' participation in the financial system and support their productive activities (Abraham, 2018; Adegbite, 2021). The finding supports Financial Intermediation Theory because agents operate as local financial intermediaries that reduce geographical and transaction barriers between rural farmers and financial institutions.

Digital financial literacy had a negative but statistically significant effect ($\beta = -0.279$, $t = 7.154$, $p < 0.001$). Therefore, the null hypothesis was rejected. The negative coefficient may indicate that financially knowledgeable farmers are more cautious about costly, insecure or unsuitable digital credit products. It could also represent a suppression effect caused by overlap among the predictors and should be interpreted alongside the inner VIF values.

Digital payment usage exerted a positive and significant effect on agricultural-finance access ($\beta = 0.098$, $t = 3.514$, $p < 0.001$). The null hypothesis was rejected. Although the effect was relatively small, using digital payment platforms may generate transaction records and strengthen farmers' visibility to formal and digital lenders. The finding also supports the relationship between financial innovation and agricultural development identified in prior literature (Alabi et al., 2022). From the perspective of Financial Intermediation Theory, digital transaction records reduce information asymmetry and assist lenders in assessing farmers who lack conventional financial statements or collateral.

Mobile banking usage had a negative but statistically insignificant effect ($\beta = -0.067$, $t = 1.825$, $p = 0.069$). The null hypothesis was therefore not rejected. This suggests that using mobile banking

mainly for transfers, balance enquiries and payments does not necessarily provide smallholder farmers with access to productive agricultural credit. The finding suggests that using mobile banking for transfers, payments, balance enquiries and savings does not automatically enable farmers to obtain agricultural credit. It provides a qualification to studies that emphasise growing adoption and utilisation of digital financial services among smallholder farmers (Ogunfolaju, 2026; Ogunfolaju et al., 2025, 2026). The result also supports Halilu's (2026a) argument that connectivity and digital-service usage are insufficient without appropriate credit products, institutional support, affordability and trust. Under the Technology Acceptance Model, farmers may perceive mobile banking as easy to use for routine transactions but not sufficiently useful for accessing agricultural loans.

5. Conclusion and Recommendations

The findings showed that FinTech-based credit access, agent-banking accessibility and digital payment usage had positive and statistically significant effects on access to agricultural finance. FinTech-based credit access emerged as the strongest predictor, demonstrating the importance of digitally delivered loans in reducing conventional credit barriers.

Digital financial literacy had a negative but significant effect, suggesting that knowledgeable farmers may avoid digital credit products considered expensive, risky or unsuitable for seasonal agricultural activities. Mobile banking usage had a negative but statistically insignificant effect, indicating that routine mobile transactions do not automatically provide access to agricultural credit. The study concludes that digital financial inclusion can improve agricultural-finance access when it extends beyond connectivity and routine transactions to provide affordable, adequate and timely credit. Its effectiveness depends on the availability of suitable financial products, accessible service channels and repayment arrangements aligned with agricultural production cycles. Based on the conclusion, the study recommends that

- i. Financial institutions should use farmers' digital payment histories as alternative credit information to assess creditworthiness and expand access to agricultural finance.
- ii. Banks should integrate agricultural loan applications, disbursements, tracking and repayment functions into mobile banking and USSD platforms because routine mobile banking usage did not significantly improve financing access.
- iii. Banks should expand agent networks in rural farming communities and equip agents to support agricultural loan applications, disbursements, insurance registration and repayments.
- iv. Agricultural extension agencies and financial institutions should provide practical financial education on loan costs, repayment terms, cybersecurity and product comparison. This should help farmers identify affordable and suitable digital credit products.
- v. FinTech companies should provide affordable and adequate agricultural loans with transparent charges and repayment schedules aligned with planting and harvesting cycles.

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