

The Role of Digital Financial Services in Enhancing Financial Inclusion Among Smallholder Farmers: A Case Study of Ndola District, Zambia

Chipo Ng'andu^{1*}; James Mutambo²

¹ School of Agriculture and Natural Resources, Mulungushi University, Kabwe, Zambia

² Office of the Dean, Mulungushi University, Kabwe, Zambia

Corresponding Author: Chipo Ng'andu*

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Abstract: Financial inclusion remains a critical challenge for smallholder farmers (SHFs) in Zambia despite rapid growth in Digital Financial Services (DFS). This study empirically investigates the role of DFS in enhancing financial inclusion among SHFs in Ndola District, Zambia, and identifies key drivers and barriers to adoption and usage. A cross-sectional mixed-methods design was employed, combining quantitative data from 200 SHFs with qualitative data from 4 Focus Group Discussions and 10 Key Informant Interviews. Quantitative data were analyzed using descriptive statistics and binary logistic regression, while qualitative data underwent thematic analysis. Results revealed 100% mobile money wallet ownership but only 34.5% bank account ownership, indicating a digital-first financial trajectory. The binary logistic regression model demonstrated excellent predictive performance (Nagelkerke $R^2 = 0.788$, classification accuracy = 92%). Agent location emerged as the single most powerful determinant of financial inclusion (OR = 425.41, $p < 0.001$), followed by gender (OR = 8.17, $p = 0.004$), age (OR = 1.063, $p = 0.044$), and occupation (OR = 0.055, $p < 0.001$). While DFS achieved near-universal adoption for basic transactions (100% for airtime and money transfers) and savings (86.5%), uptake of advanced products remained limited: digital loans (36.5%), digital insurance (0%). The study concludes that DFS plays a significant role in basic financial inclusion but faces structural barriers to deepening inclusion into productive finance. Policymakers and DFS providers must prioritize rural agent network expansion, gender-sensitive interventions, and farmer-centric product design aligned with agricultural cash flows.

Keywords: Digital Financial Services, Financial Inclusion, Smallholder Farmers, Mobile Money, Binary Logit Model, Zambia.

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I. INTRODUCTION

Financial inclusion—defined as access to useful and affordable financial products and services that meet household and business needs—is a critical enabler of poverty reduction and economic development (World Bank, 2022). In Sub-Saharan Africa, smallholder farmers (SHFs) constitute the majority of the rural poor, yet remain persistently excluded from formal financial systems. Zambia exemplifies this paradox: agriculture contributes 19.3% to national GDP and employs over 70% of the population, predominantly through smallholder farming, yet only 37.8% of rural adults had access to formal financial services as of 2015, compared to 69.7% in urban areas (FinScope, 2015).

The advent of Digital Financial Services (DFS)—particularly mobile money—has been heralded as a transformative solution to financial exclusion in developing economies. Mobile money has achieved remarkable penetration in Sub-Saharan Africa, with Zambia's mobile penetration rate exceeding 88% (ZICTA, 2023). Pioneering success stories, most notably Kenya's M-PESA, have demonstrated that DFS can enable financial resilience and facilitate agricultural development (Suri & Jack, 2016). In Zambia specifically, national-level surveys show mobile money account ownership rising from 14% in 2015 to 43% in 2020 (FinScope, 2020), yet research on the ground-level adoption, usage patterns, and impact among SHFs remains limited.

Despite the strategic national push for DFS and its documented potential, a significant disconnect persists between DFS access and meaningful usage among Zambian SHFs. Preliminary evidence suggests that while mobile money account ownership is increasing, usage remains shallow—dominated by person-to-person transfers rather than savings, credit, insurance, or structured agricultural payments (FSD Zambia, 2022). Furthermore, extant literature on DFS and financial inclusion in Zambia comprises primarily national-level surveys (FinScope) or studies from other regions, leaving specific agro-economic contexts under-researched.

This study addresses this gap by providing a localized, empirical investigation of DFS adoption and financial inclusion among SHFs in Ndola District, a key agricultural region at the interface of urban and rural economies. The study aims to: (1) assess the level of awareness, access, and usage patterns of DFS among SHFs; (2) identify key drivers and barriers influencing adoption and sustained use; and (3) provide evidence-based policy recommendations for designing more inclusive and farmer-centric digital financial products.

II. LITERATURE REVIEW

➤ *Global Evidence on DFS and Financial Inclusion*

A substantial body of empirical research employing logistic regression models has examined DFS adoption among SHFs across Sub-Saharan Africa. Masuka (2025) found that 94.4% of Zimbabwean smallholder farmers achieved basic financial inclusion, but only 25.6% accessed multiple financial services, with financial literacy emerging as the most significant determinant. Similarly, Ogunfolaju et al. (2026) investigated DFS usage determinants among 813 SHFs in Nigeria, finding that education positively influenced adoption while age, income, and household size negatively affected it. Notably, despite 97.4% mobile phone ownership and 72.4% internet-enabled phone ownership, adoption gaps persisted, underscoring the importance of digital literacy.

Research on the impact of DFS on agricultural outcomes provides compelling evidence of welfare gains. Kouandou (2025) found that mobile banking use is associated with approximately 10% higher agricultural productivity, 4% higher per capita food consumption expenditure, and 12% higher per capita non-food consumption expenditure among smallholder farmers in West Africa. Jack and Suri (2016) demonstrated that M-PESA access in Kenya increased per capita consumption and lifted approximately 2% of households out of poverty, primarily through enhanced financial resilience and remittance mechanisms.

However, global literature also highlights significant barriers. Gender remains a persistent constraint: women in low-income economies are 20% less likely than men to own a mobile money account and face disproportionate barriers including lack of ID, limited mobile phone ownership, and lower digital literacy (GSMA, 2023). Additionally, a usage gap persists whereby many accounts remain dormant or are used only for limited transactions rather than a

comprehensive suite of financial services (Karlan et al., 2016).

➤ *Zambian Context and DFS Ecosystem*

Zambia's financial inclusion trajectory has been remarkable. The FinScope Survey series shows national financial inclusion rising from 59% in 2015 to 69% in 2020. However, a rural-urban disparity persists: 80% of urban adults are banked compared to 62% of rural adults. Mobile money account ownership surged from 14% to 43% over the same period, indicating a digital-first financial inclusion pathway in rural areas (FinScope, 2020). The Bank of Zambia's National Financial Inclusion Strategy (2022-2026) explicitly identifies DFS as a key strategic pillar, targeting 85% financial inclusion by 2028.

Recent empirical research in Zambia corroborates the potential yet limitations of DFS. Chanda et al. (2026) assessed Mobile Financial Technology (MFT) adoption among 117 small-scale farmers across three provinces using binary logistic regression based on the UTAUT2 framework. Results showed that performance expectancy ($OR = 1.97, p < 0.001$), social influence ($OR = 2.48, p = 0.017$), and trust ($OR = 1.68, p = 0.002$) all significantly predicted MFT adoption, while financial literacy surprisingly showed no direct influence. A study by Mwalupaso et al. (2025) found that women's participation in Village Savings and Loan Associations (VSLAs) significantly boosted climate-smart agriculture adoption among 436 women smallholder farmers, with digital tools mediating 66% of this effect. These findings highlight the intersection of informal financial mechanisms, digital tools, and agricultural outcomes in the Zambian context.

III. METHODOLOGY

➤ *Study Area and Population*

This study was conducted in Ndola District, Copperbelt Province, Zambia. Ndola is the third-largest city and represents a unique agro-economic interface between urban and rural economies. The district has 40,000 registered smallholder farmers (17,367 males and 22,633 females) under the Zambia Integrated Agricultural Management Information System (ZIAMIS), distributed across 4 agricultural blocks and 17 agricultural camps (ZIAMIS, 2025). Ndola was selected purposively as a case study representing a high-potential agricultural zone with significant urban market access yet facing persistent financial inclusion challenges.

➤ *Research Design and Sampling*

A cross-sectional mixed-methods research design was employed. Quantitative data were collected from 200 SHFs selected through multi-stage sampling: Stage 1 involved purposive selection of 4 agricultural camps; Stage 2 involved simple random sampling of 200 farmers from camp registers (95% confidence level, 5% margin of error). Qualitative data comprised 4 Focus Group Discussions (FGDs) with mixed-gender farmer groups and 10 Key Informant Interviews (KIIs) with DFS agents (5), bank managers (2), agro-dealers (2), and extension officers (1).

➤ *Data Collection Instruments*

Quantitative data were collected using a structured questionnaire pre-tested and administered by trained enumerators. The instrument covered: (1) demographic and socio-economic characteristics; (2) farm characteristics; (3) mobile phone and DFS ownership and usage; (4) perceived impact of DFS; and (5) perceived barriers. Qualitative data were collected using semi-structured interview guides for KIIs and FGD guides for group discussions, exploring drivers, barriers, and contextual factors influencing DFS adoption.

➤ *Data Analysis*

Quantitative data were analyzed using SPSS version 16. Descriptive statistics (frequencies, percentages, means, ranges) were generated to characterize the study population and DFS usage patterns. For inferential analysis, a binary logistic regression model was employed to identify determinants of financial inclusion, specified as:

$$\ln(P_i / 1 - P_i) = \beta_0 + \beta_1(\text{Age}) + \beta_2(\text{Gender}) + \beta_3(\text{Education}) + \beta_4(\text{Occupation}) + \beta_5(\text{Farm Size}) + \beta_6(\text{Income}) + \beta_7(\text{Mobile Ownership}) + \beta_8(\text{Agent Location}) + \beta_9(\text{Reliability}) + \beta_{10}(\text{Confidence}) + \beta_{11}(\text{Time}) + \beta_{12}(\text{Distance to Financial Institution}) + \beta_{13}(\text{Perceived Usefulness}) + \varepsilon$$

where P_i represents the probability of financial inclusion (bank account ownership as proxy). The model was assessed for fit using the -2 Log-Likelihood statistic, Nagelkerke R^2 , and classification accuracy. Qualitative data underwent thematic analysis, with transcripts coded and organized by theme to triangulate and contextualize quantitative findings.

➤ *Ethical Considerations*

The study obtained ethical approval from Mulungushi University and adhered to principles of informed consent, confidentiality, and voluntary participation. All respondents provided verbal informed consent before data collection.

IV. RESULTS

➤ *Demographic Characteristics*

The sample was 58% male ($n=116$) and 42% female ($n=84$), with a mean age of 41.03 years (range: 18-76). Educational attainment was relatively high: 69.5% completed secondary school, 22.5% primary school, 7% tertiary education, and only 1% had no formal schooling. Primary occupation was predominantly mixed crop-livestock farming (53%), followed by crop farming only (42.5%), farming with petty trading (3.5%), and livestock only (1%).

➤ *Mobile Phone and Digital Financial Services Ownership*

Universal mobile phone ownership (100%, $n=200$) was achieved in the sample. Among phone types, 55.5% owned smartphones, 21% feature phones, 20% basic phones, and 3.5% owned multiple types. Remarkably, all 200 respondents (100%) possessed active mobile money wallets. In contrast, only 34.5% ($n=69$) owned bank accounts, indicating a strong preference for and reliance on digital financial channels over traditional banking.

➤ *DFS Usage Patterns*

DFS usage varied by service type. All respondents (100%) used mobile money for buying airtime, sending money to family/friends, and receiving money from family/friends. High proportions used mobile money for saving money (86.5%, $n=173$) and receiving crop payments (69.5%, $n=139$). Notably, 36.5% ($n=73$) had accessed digital loans, but no respondent reported using digital insurance products. Regarding savings mechanisms, 100% used mobile money wallets, 96.5% participated in savings groups (Chilimba), 79.5% kept cash at home, 19.5% used bank accounts, 3.5% purchased livestock as savings, and 6.5% did not regularly save.

➤ *Agent Accessibility and Reliability*

Agent location was highly accessible: 79.5% of frequently-used agents were located in respondents' villages, 17% at the nearest market/trading centre, and 3.5% in Ndola town. The average travel time to the most frequently used agent was 12 minutes (range: 3-30 minutes). In terms of agent reliability, 49.5% ($n=99$) rated agents as very reliable, 47% ($n=94$) as reliable, and only 3.5% ($n=7$) reported sometimes problematic service regarding cash/e-float availability.

➤ *Perceived Impact of DFS*

Perceived impact was assessed on a five-point Likert scale. Large proportions strongly agreed that mobile money made receiving crop payments easier and safer (86.5%), helped manage household expenses better (82.5%), and made obtaining financial help from family in emergencies easier (91.5%). Regarding access to credit for farming inputs, opinions were more divided: 43% agreed/strongly agreed, 48.5% remained neutral, and 8.5% disagreed. Overall, 86% strongly agreed that mobile money had improved household financial security.

➤ *Binary Logistic Regression Results*

The binary logistic regression model predicting financial inclusion (bank account ownership as a proxy) demonstrated excellent fit and predictive performance. The Nagelkerke R^2 was 0.788, indicating the model explained 78.8% of variance in financial inclusion. Overall classification accuracy was 92%. Four variables emerged as statistically significant predictors:

- **Agent Location** (distance to frequently used mobile money agent): This variable had the most dramatic effect ($OR = 425.41$, $p < 0.001$). Farmers with nearby agents had 425 times higher odds of financial inclusion than those without.
- **Gender** (Male = 1): Males had 8.17 times higher odds of financial inclusion than females ($OR = 8.169$, $p = 0.004$).
- **Age**: Older farmers had higher odds of inclusion ($OR = 1.063$, $p = 0.044$), with each additional year increasing inclusion odds by approximately 6.3%.
- **Occupation** (Main livelihood activity): Occupation had a strong negative effect ($OR = 0.055$, $p < 0.001$), with a one-

unit increase associated with a 94.5% decrease in inclusion odds.

Non-significant variables included education level, farm size, household income, time to agent, agent reliability, and confidence in using mobile phones.

➤ *Qualitative Findings*

Qualitative data from FGDs and KIIs identified several key themes enabling DFS adoption: (1) Trust in agents, particularly those embedded in communities and belonging to farmers' social networks; (2) Social influence from observing neighbors and group members successfully using DFS; (3) Convenience and time savings from accessing services locally rather than traveling to distant bank branches; and (4) Agent liquidity and reliability as critical factors determining regular usage.

- Barriers to deeper DFS engagement included: (1) Limited understanding of advanced products like digital loans and insurance, with many farmers unaware such services existed; (2) Concerns about digital security and fraud, with several farmers citing fear of losing money to scams; (3) Gender-related barriers, with women often requiring spousal permission to open wallets or access services; and (4) Agent liquidity challenges during peak agricultural seasons when transaction volumes surge.

V. DISCUSSION

➤ *The Digital-First Financial Inclusion Trajectory*

This study provides empirical evidence of a fundamental shift in financial inclusion pathways for rural Zambia. The juxtaposition of 100% mobile money ownership against only 34.5% bank account ownership reveals that smallholder farmers are achieving financial inclusion through digital channels rather than traditional banking. This pattern is consistent with national data showing mobile money account ownership (43%) now exceeds formal bank account penetration in rural areas (World Bank, 2023).

The universal adoption rate in Ndola—higher than national rural averages—reflects three converging factors: (1) Ndola's location in the Copperbelt province, which concentrates 19% of national Point-of-Sale terminals and financial infrastructure (Imani Development, 2025); (2) the strategic placement of agent networks within walking distance (mean 12 minutes), demonstrating successful last-mile connectivity; and (3) the proliferation of mobile money alternatives (MTN MoMo, Airtel Money, Zampost Money) providing competition and coverage.

➤ *Agent Proximity as the Dominant Determinant*

The finding that agent location emerged as the single most powerful predictor of financial inclusion (OR = 425.41) has profound implications. This effect size far exceeds typical predictors identified in the literature—education, income, age—suggesting that infrastructure trumps individual characteristics. Farmers with access to nearby agents have nearly 425 times higher odds of formal financial access than those without, regardless of education, income, or age.

This finding aligns with research from Kenya showing that distance to the nearest mobile money agent significantly influences adoption (Kirui et al., 2012). It also reinforces conclusions from Sub-Saharan African studies that agent network density is the primary mechanism through which DFS translates into financial inclusion (Ouma et al., 2017). The implication is clear: policymakers cannot rely on individual-level interventions (financial literacy, digital skills training) to drive inclusion without ensuring adequate infrastructure. The agent network is the necessary precondition.

➤ *Gender Disparity in Financial Inclusion*

The finding that males have 8.17 times higher odds of financial inclusion than females is consistent with documented gender gaps in DFS adoption globally. Women in low-income economies are 20% less likely to own a mobile money account and face compounded barriers: lower mobile phone ownership (often sharing devices with male household members), limited control over household finances, social norms restricting autonomous financial decision-making, and lower digital literacy (GSMA, 2020).

In the Zambian agricultural context, women constitute over 60% of smallholder farmers yet face a "double exclusion" from both financial markets and digital financial services. The study's finding that 96.5% of farmers participate in Chilimba savings groups—which are traditionally women-led—suggests that women have strong pre-existing financial behaviors and organizational capacity. The challenge is translating this into access to formal financial services and bank accounts. Digital financial services should theoretically bypass physical distance and gender-based discrimination inherent in traditional banking. However, the large gender gap suggests that without deliberate design for inclusion—such as female agents, women-focused marketing, and culturally-appropriate product design—DFS may perpetuate rather than overcome gender disparities.

➤ *The Gap Between Access and Transformative Usage*

While DFS achieved near-universal adoption for basic transactions and savings, the uptake of transformative financial services remained limited. Digital loans were accessed by only 36.5% of respondents, and no farmer reported using digital insurance. This pattern is consistent with global evidence that DFS usage follows a progression: universal adoption of basic services (payments, transfers) → high adoption of savings → emergent adoption of credit → minimal insurance adoption (Karlan et al., 2016).

This gap likely reflects several factors. First, borrowing requires credit assessments and repayment capacity evaluation, implying higher perceived risk. Second, agricultural finance requires products designed for lumpiness (large, infrequent sums for inputs and harvest) and seasonal cash flow patterns—features rarely embedded in generic digital lending platforms. Third, insurance remains an unfamiliar and often misunderstood financial product in rural areas, requiring both trust and financial sophistication to assess value. The absence of digital insurance is particularly

concerning given farmers' vulnerability to climate shocks and production risks.

➤ *The Convergence of Digital and Informal Financial Systems*

The near-universal participation in Chilimba savings groups (96.5%) alongside mobile money wallet ownership (100%) reveals the emergence of a hybrid financial system where informal and digital mechanisms are converging rather than competing. This finding challenges assumptions that formal or digital finance necessarily displaces informal mechanisms.

Chilimba provides social accountability, forced savings discipline, and trust that digital platforms must build through technology. Digital tools provide security, transparency, and convenience that informal groups struggle to offer. The convergence—where groups collect contributions via mobile money and maintain digital records—suggests an opportunity for structured interventions that link informal group mechanisms with formal financial institution products. This finding aligns with research showing that village savings groups linked to mobile banking can increase agricultural productivity and household resilience (Mwalupaso et al., 2025).

VI. IMPLICATIONS FOR POLICY AND PRACTICE

➤ *Policy Implications*

The findings have direct implications for Zambia's National Financial Inclusion Strategy (NFIS II, 2024-2028), which targets 85% financial inclusion by 2028 through expanding digital financial services. The study's evidence suggests that DFS expansion is necessary but insufficient; intentional focus on infrastructure (agent networks), gender inclusion, and product design is essential to translate access into meaningful financial inclusion.

First, policymakers must prioritize agent network expansion into underserved rural areas. Given the 425-fold impact of agent proximity on financial inclusion, every kilometer of distance matters. This requires coordinating mobile network operators, DFS providers, and government to establish sustainable agent ecosystems with adequate compensation, training, and liquidity management systems.

Second, gender-responsive financial inclusion policies are urgently needed. The 8.17-fold gender gap in bank account ownership suggests that generic financial inclusion programs will miss half the farming population. Specific interventions—female-focused digital literacy programs, recruitment of female agents, women-centered marketing—must be mainstreamed into national financial inclusion strategies.

Third, agricultural finance products must be deliberately designed for smallholder farmers' financial realities. This includes input financing products aligned with planting seasons, flexible repayment schedules matched to harvest cycles, and index-based crop insurance addressing

production risks. Current generic digital lending platforms rarely accommodate these features.

➤ *Practice Implications for DFS Providers*

For DFS providers, this research offers actionable insights. First, invest in real-time e-float and cash management systems enabling agents to request and receive liquidity replenishment efficiently. Agent liquidity constraints during peak agricultural seasons directly undermine trust and service reliability.

Second, develop farmer-centric product suites that address documented gaps. Digital loan products should offer flexible repayment terms aligned to agricultural cash flows. Savings products should enable goal-based saving (e.g., "savings for inputs"). Insurance products should be designed for index-based triggers (e.g., rainfall insurance triggered by below-normal precipitation), reducing transaction costs and information asymmetries.

Third, leverage the documented power of social influence by engaging community leaders, extension officers, and savings group leaders as trusted sources of information and adoption facilitators. The qualitative finding that trust in agents and social influence drive adoption suggests marketing strategies should emphasize community endorsement over mass media approaches.

➤ *Recommendations for Future Research*

This cross-sectional study identifies associations but cannot establish causality. Longitudinal research is urgently needed to assess the long-term causal impact of DFS adoption on agricultural productivity, household income, and economic resilience. Additionally, experimental or quasi-experimental designs (randomized controlled trials, difference-in-differences) could isolate the causal effects of specific interventions (e.g., agent network expansion, digital literacy training) on financial inclusion outcomes.

VII. CONCLUSION

Digital Financial Services have achieved remarkable penetration among smallholder farmers in Ndola District, Zambia, with 100% mobile money wallet ownership—substantially exceeding global and regional averages. This study provides empirical evidence that DFS is succeeding in bridging the financial inclusion gap for previously excluded rural populations. However, the stark contrast between universal mobile money adoption and limited bank account penetration (34.5%) reveals a new financial frontier: digital-first financial inclusion.

The analysis identified agent proximity as the overwhelmingly dominant determinant of financial inclusion (OR = 425.41), far outweighing individual characteristics like education or income. This finding has profound implications: infrastructure matters more than individual capacity. A farmer's decision to open a bank account or use formal financial services is primarily constrained by structural availability of services, not by lack of knowledge or inability.

However, persistent gender disparities (8.17-fold difference in inclusion between males and females) and limited uptake of advanced financial services (digital loans 36.5%, digital insurance 0%) indicate that while DFS has solved the "access problem," significant barriers to "meaningful inclusion" remain. The convergence of informal savings groups (96.5% participation) with digital financial services offers a promising pathway for leveraging existing community-based financial mechanisms to deepen formal financial inclusion.

As Zambia pursues its ambitious financial inclusion targets, this evidence suggests a need to balance expansion of digital financial services with deliberate focus on rural agent networks, gender-responsive design, and farmer-centric product innovation. The tools are in farmers' hands; what's needed now is intentionality in how they're designed and deployed.

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