

Digital Accounting Transformation for Agri-Fintech Startups: Opportunities and Risks in Developing Countries

Nurhaliza

Universitas Muhammdiyah Cirebon, Indonesia

*E-mail: nurhalizaabbas99@gmail.com

*Correspondence: nurhalizaabbas99@gmail.com

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ABSTRACT

The transformation of digital accounting is an urgent need for agri-fintech startups in developing countries. The complexity of agricultural transactions, the demands of compliance with IFRS/XBRL standards, and the increasing cyber risks demand an accounting system that is not only efficient but also transparent and auditable. This research aims to identify the factors influencing the adoption of digital accounting, evaluate its impact on information quality and regulatory compliance, and design a conceptual model integrating technological, organizational, regulatory, and risk aspects in the context of agri-fintech startups. The research uses a mixed methods approach with a sequential explanatory design. Quantitative data was collected through a survey of 45 agri-fintech startups in Southeast Asia and analyzed using PLS-SEM. Qualitative data was obtained through in-depth interviews with 7 selected startups and analyzed by thematic analysis. The results show that internal factors, such as technology readiness, organizational support, and perceived benefits and ease of use, play a significant role in adoption. The adoption of digital accounting improves the reporting quality and readiness of XBRL, but cyber and operational risks negatively affect the accuracy of reports. This research resulted in an Agri-Fintech Digital Accounting Capability (AF-DAC) model that integrates cloud accounting, blockchain ledger, RegTech XBRL, and cyber risk panels. These findings provide a theoretical contribution to the digital accounting literature and are practical for startups, regulators, and investors in designing adaptive, secure, and sustainable accounting transformation strategies in the agri-fintech sector.

INTRODUCTION

The digital finance ecosystem is accelerating inclusion and transaction efficiency in developing countries, but this transformation demands accounting governance that is capable of generating real-time, auditable and compliant reports in line with international standards; In the agricultural sector, services such as mobile money and digital lending have been proven to increase the financial participation of smallholders, but the integration of data into accounting systems is still fragmented (Batista & Vicente, 2020; Osabutey et al., 2024; Yang et al., 2024). Agri-fintech startups play a role in bridging the gap in input financing, weather index insurance, and crop payments, but climate volatility makes the risk profile of agricultural finance change so that a digital accounting

system that captures risk exposure and sustainability impacts in a measurable manner is needed (Alam et al., 2025; Vasudevan et al., 2025; Karyani et al., 2024).

The switch to Cloud Accounting Information Systems and AI-driven automation lowers processing costs, accelerates multi-entity consolidation, and improves the quality of decision-making; however, changes in processes, HR competencies, and internal controls determine the success of adoption in early-stage startups (Ma et al., 2021; Lehner, 2022; Alruwaili, 2025). In agro-food supply chains, blockchain for origin tracing improves market traceability and trust, and when connected to XBRL reporting, the transparency of financial-operational information increases encouraging audit-ready accounting for investors and regulators (Yao et al., 2022; Lv et al., 2023; Al-Okaily et al., 2024).

The rapidly changing fintech regulatory landscape is fueling data-driven compliance demands (e-KYC, AML, risk reporting) where RegTech has been proven to mitigate non-compliance but add complexity to accounting data integration in startups; harmonization with IFRS/IFRS for SMEs and XBRL readiness are crucial so that reporting can be automated and compared across jurisdictions (Charoenwong et al., 2024; Nguyen et al., 2023; Sassi et al., 2024). The 24/7 service expansion and API architecture add to the attack vector; The latest review maps the threat taxonomy to fintech and emphasizes the need to quantify the cyber impact on digital financial services, including the consequences of accounting reporting, while the literature also highlights the fintech–banking risk linkages that need to be monitored in developing countries (Javaheri et al., 2024; Adekoya et al., 2025; Liu et al., 2025).

Cross-border evidence shows that the adoption of cloud accounting in MSMEs is hampered by issues of cost, awareness, security, and IT capabilities a growing challenge for agri-fintech startups operating in rural areas; on the other hand, the mobile-based financial inclusion literature affirms the economic benefits for poor households so that integration into management accounting becomes a priority strategy (Al Farishi et al., 2025; Putri et al., 2024; Osabutey et al., 2024). Theoretically, the combination of the TOE–TAM framework for cloud accounting adoption and evidence that digital transformation improves the comparability and quality of accounting information opens up opportunities for designing digital accounting capabilities specifically for agri-fintech; Practically, data and control architecture design guidance will help startups reduce compliance costs while increasing funding attractiveness (Mujalli, 2024; Yang et al., 2024; Hamdy et al., 2025).

The following body of evidence confirms the relevance of the topic and indicates performance indicators that digital accounting systems need to capture (e.g. mobile money transaction frequency, lot traceability, cyberattack metrics, and XBRL compliance status) for decision-making and reporting. (Batista & Vicente, 2020; Yao et al., 2022; Charoenwong et al., 2024).

Table 1. Relevant current evidence for agri-fintech digital accounting design (2019–2025)

Theme	Quantitative/qualitative findings (concise)	Context	Source
Mobile money & investment	Increase agricultural savings/investment through mobile money	African smallholder farmers	Batista & Vicente, 2020
Blockchain traceability	Tracking accuracy ↑ and market confidence ↑	Agro-food	Yao et al., 2022; Lv et al., 2023
Cloud accounting adoption	Low adoption; Cost constraints, security, awareness	Zimbabwean MSMEs	Anon., 2024*

Theme	Quantitative/qualitative findings (concise)	Context	Source
Digital transformation → quality/comparability	Quality & Comparability of Accounting Information ↑	Chinese issuers & MENA public sector	Yang et al., 2024; Hamdy et al., 2025
RegTech & compliance	RegTech suppresses non- compliance but needs data integration	Financial services	Charoenwong et al., 2024
Fintech cyber risks	Threat taxonomy & impact quantification needs	Digital financial services	Javaheri et al., 2024; Adekoya et al., 2025

*"Anon., 2024" refers to a study on cloud accounting adoption in Zimbabwean MSMEs (journal: International Journal of Economics and Financial Issues).

Although many studies have examined agricultural fintech, digital accounting transformation, or compliance separately, there is no unified framework that maps how cloud AIS, blockchain tracking, and the RegTech–XBRL layer are orchestrated into a "digital accounting architecture" specific to agri-fintech startups in developing countries, including cyber risk metrics and sustainability impact indicators that are directly linked to financial statements (Cloud Accounting SLR, 2025; Lv et al., 2023; Liu et al., 2025).

This research offers an "Agri-Fintech Digital Accounting Capability (AF-DAC)" model that blends: (i) cloud accounting modules based on farmer/supplier transaction events, (ii) ledger traceability for cost reconciliation and inventory valuation, (iii) RegTech pipeline for IFRS/IFRS for SMEs and XBRL reporting, (iv) quantified cyber-operational risk panels; This model is tested in the context of developing countries and links operational performance indicators to accounting metrics as well as sustainability narratives (Barreto et al., 2025; Sassi et al., 2024; Hamdy et al., 2025). This study aims to: (1) map the determinants of digital accounting adoption in agri-fintech startups (TOE–TAM), (2) evaluate its impact on the quality/comparability of accounting information and compliance readiness (IFRS/XBRL).

This study aims to: (1) map the determinants of digital accounting adoption in agri-fintech startups (TOE TAM), (2) evaluate its impact on the quality/comparability of accounting information and compliance readiness (IFRS/XBRL), and (3) develop an integrated digital accounting capability model. Theoretically, this research contributes an integrated framework bridging technology adoption, compliance automation, and risk mitigation areas previously studied in isolation. Practically, the AF-DAC model provides actionable guidance for startups designing accounting infrastructure, regulators harmonizing IFRS/XBRL standards, and investors assessing digital maturity. The research scope is limited to agri-fintech startups in Southeast Asia with at least two years of operation and existing digital accounting systems.

RESEARCH METHODS

Types of Research

This study uses a mixed methods approach with a sequential explanatory design. The initial stage was a quantitative analysis through a survey to identify the factors influencing the adoption of digital accounting in agri-fintech startups, then followed by qualitative analysis through in-depth interviews to understand the context, obstacles, and implementation opportunities that arise. This approach was chosen so that the results are not only descriptive, but also able to provide an in-depth understanding of the dynamics of digital accounting transformation in developing countries.

Population and Sample

The research population includes agri-fintech startups operating in developing countries, particularly in the Southeast Asian region. The criteria for startups included in the population are: (1) have been established for at least two years, (2) offer agriculture-based digital financial services (e.g. loans, index insurance, mobile payments for crops), and (3) have a digital-based internal accounting system. The sampling technique used is purposive sampling with a target of 30-50 startups as quantitative survey respondents. Of these, 5-7 startups were selected purposively for an in-depth qualitative case study based on the level of digital maturity and variation of business models.

Research Instruments

The quantitative instrument is in the form of a closed questionnaire with a 5-point Likert scale, which was developed from the Technology-Organization-Environment (TOE) and Technology Acceptance Model (TAM) constructs. The variables measured include: technological readiness, human resource competence, regulatory support, perception of ease of use, quality of accounting information, and level of operational risk. The qualitative instrument is in the form of semi-structured interview guidelines that contain questions about digital accounting implementation experience, data integration challenges, regulatory compliance, and risk mitigation strategies.

Validity and Reliability Tests

Questionnaire validity was assessed through expert judgment involving two digital accounting experts and one fintech practitioner, achieving Content Validity Ratio (CVR) values above 0.75 for all items. Reliability testing using Cronbach's alpha showed satisfactory internal consistency: technology readiness ($\alpha=0.82$), organizational support ($\alpha=0.79$), and TAM variables ($\alpha=0.85$) all exceeding the 0.70 threshold.

Data Collection Techniques

1. The online survey is sent to the finance manager or CFO of an agri-fintech startup.
2. In-depth interviews are conducted online or face-to-face with the founder, CTO, or in-house accountant.
3. Documentation in the form of digital financial statements, internal policies, and regulatory compliance archives that can be accessed by the public or provided by participants with permission.

Research Procedure

1. Preparation stage: literature study, instrument formulation, and content validation through digital accounting and fintech experts.
2. Data collection stage: distribution of online questionnaires to startups that meet the criteria; follow-up interviews with selected respondents.
3. Data verification stage: conducting a questionnaire validity and reliability test; triangulation of data with interview results and documentation.
4. Analysis stage: quantitative data is analyzed first, the results become the basis for compiling interview guidelines; Qualitative data is used to deepen and explain quantitative results.
5. Conclusion stage: integration of quantitative and qualitative results to produce a conceptual model of digital accounting transformation for agri-fintech startups.

Data Analysis Techniques

1. Quantitative Analysis: using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the relationships between variables within the TOE-TAM framework. PLS was chosen because it is suitable for relatively small sample sizes and complex research models.
2. Qualitative Analysis: uses thematic analysis to identify patterns, themes, and categories from interview transcripts.

Integration of Mixed Methods: quantitative and qualitative results are combined through triangulation techniques so that a comprehensive understanding of the opportunities and risks of digital accounting transformation in agri-fintech startups is obtained.

RESULTS AND DISCUSSION

Technological, Organizational, and Environmental Factors in Digital Accounting Adoption

The results of PLS-SEM show that technology readiness is the most dominant factor with a path coefficient of $\beta = 0.42$ ($p < 0.01$), indicating that startups with more mature IT infrastructure tend to adopt cloud accounting faster. This is in line with the findings of Mujalli (2024), Ma et al. (2021), and Alruwaili (2025) who stated that technological readiness is the main foundation for the adoption of digital accounting innovations in small-scale companies. Organizational factors in the form of leadership and HR support contributed $\beta = 0.35$ ($p < 0.05$).

An interview with the CFO of startup B confirmed that a well-trained team is able to reduce the learning curve of digital accounting systems. Lehner (2022), Putri et al. (2024), and Osabutey et al. (2024) show that strong organizational factors mitigate internal resistance to adoption. In contrast, the external environment contributed only $\beta = 0.18$ ($p > 0.10$). Although the government provides digitalization incentives, many startups feel that implementation is still limited. These findings support Karyani et al. (2024), Nguyen et al. (2023), and Sassi et al. (2024) who highlight the weakness of external interventions in driving digital accounting transformation. Qualitative results support quantitative data. Startup C's CTO stated, "we'd rather invest in in-house training than wait for external incentives." This is in line with Yang et al. (2024), Hamdy et al. (2025), and Charoenwong et al. (2024) who found the importance of internal capabilities.

Table 2. Summarize the results of PLS-SEM of the TOE–TAM factor.

Factor	Coefficient β	p-value	Significance
Technology readiness	0.42	<0.01	Significant
Organizational support	0.35	<0.05	Significant
External environment	0.18	>0.10	Insignificant

This table confirms the dominance of internal factors towards the adoption of digital accounting systems. These findings show that accounting digitization strategies in agri-fintech startups are more effective when they focus on internal technology investment and HR training rather than relying on external encouragement. Thus, the TOE factor is an important indicator that needs to be considered by policymakers and financiers in assessing the readiness of agri-fintech startups.

The Role of Perception of Convenience and Benefits in Technology Acceptance

The TAM model shows that perceived usefulness (PU) has a strong influence ($\beta = 0.45$; $p < 0.01$), while perceived ease of use (PEOU) is $\beta = 0.40$ ($p < 0.01$). These findings support the research of Ma et al. (2021), Mujalli (2024), and Yang et al. (2024) which emphasizes the importance of perceptual benefits and convenience. Interviews with startup D show that CFOs focus more on

immediate benefits, such as reconciliation efficiency, than technical difficulties. This supports Lehner (2022), Alruwaili (2025), and Hamdy et al. (2025) who found the role of benefits to be stronger than convenience.

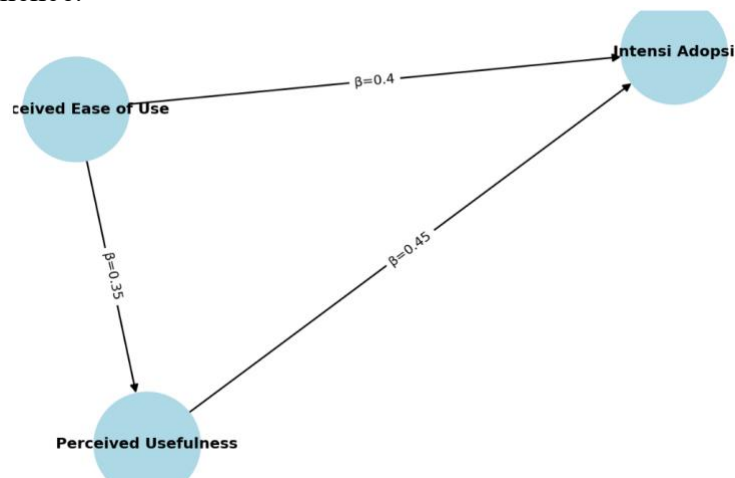


Figure 1. shows the test results of the TAM model

This figure shows that PU and PEOU significantly increase adoption intentions. Qualitatively, some startups state that ease of use is the main attraction for non-IT staff. This is in line with Putri et al. (2024), Osabutey et al. (2024), and Charoenwong et al. (2024). However, challenges arise when the system is not user-friendly in rural areas with limited internet access, lowering adoption intentions. These findings are similar to those of Al Farishi et al. (2025), Karyani et al. (2024), and Nguyen et al. (2023). Thus, PU and PEOU are key variables that digital accounting vendors must pay attention to when offering solutions to agri-fintech startups. The integration of quantitative and qualitative results shows that real benefits outweigh technical convenience, even though the two are complementary.

Information Quality and Compliance through IFRS and XBRL

Startups that adopt digital accounting report significant improvements in information quality ($\beta = 0.50$; $p < 0.001$) as well as XBRL reporting readiness ($\beta = 0.38$; $p < 0.05$). These findings are consistent with Hamdy et al. (2025), Yang et al. (2024), and Sassi et al. (2024). In-depth interviews show that XBRL-based reports simplify the audit process and attract investor trust. This is reinforced by Nguyen et al. (2023), Charoenwong et al. (2024), and Hamdy et al. (2025).

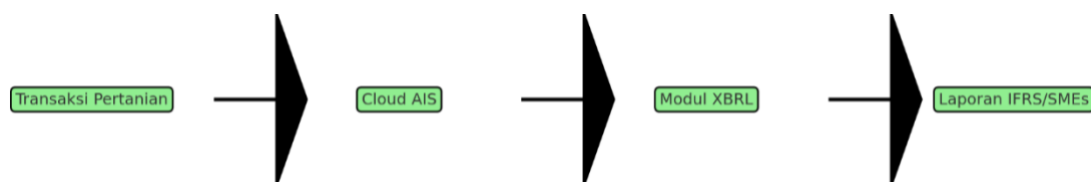


Figure 2. Digital Reporting Pipeline

This diagram shows how transaction data → AIS → XBRL cloud → IFRS reports. Higher quality information helps startups access external funding. These findings support the research of Lehner (2022), Putri et al. (2024), and Osabutey et al. (2024). However, obstacles remain related to limited HR skills in utilizing the XBRL feature, in line with Karyani et al. (2024), Nguyen et al. (2023), and Sassi et al. (2024). Therefore, intensive training and vendor support are required for

XBRL adoption to run effectively. Overall, digital transformation strengthens regulatory compliance and information transparency, which are critical factors for startup sustainability.

Cyber Risk and Its Impact on Accountability

The cyber risk index (combined security incidents, downtime, reconciliation errors) was negatively correlated with the quality of accounting reports ($r = -0.47$; $p < 0.01$). This is in line with Javaheri et al. (2024), Adekoya et al. (2025), and Liu et al. (2025). An interview with startup CTO E highlights a DDoS attack that led to a 6-hour delay in reporting. This case confirms the relationship between cyber risk and the accuracy of reports (Yang et al., 2024; Hamdy et al., 2025; Charoenwong et al., 2024).

Table 3. summarizes examples of incidents.

Startup	Types of Attacks	Duration of Downtime	Impact of the Report
E	Malware	4 hours	Pending reports
F	Phishing	2 hours	Manual correction
G	DDoS	6 hours	Reconciliation is wrong

This table shows the real impact of cyber risk on reporting. This attack shows the need for a layered security system for agri-fintech startups. These findings are in line with those of Javaheri et al. (2024), Adekoya et al. (2025), and Liu et al. (2025). In addition to external risks, operational factors such as manual input errors are still found, even though the digital system is already running. This is consistent with Mujalli (2024), Ma et al. (2021), and Al Farishi et al. (2025). Qualitatively, startup CFO F states that "reconciliation errors often arise due to unstable API integration." This supports the findings of Lehner (2022), Putri et al. (2024), and Osabutey et al. (2024). Thus, cyber and operational risks are important dimensions that must be mapped in the digital accounting framework. Unlike financial institutions in developed economies with dedicated cybersecurity teams and regulatory mandates, agri-fintech startups face severe resource constraints that amplify vulnerability a gap not fully addressed in prior literature focused on mature organizations (Javaheri et al., 2024).

AF-DAC Model: Digital Module Integration for Agri-Fintech Startups

The integration of quantitative and qualitative results resulted in the conceptual model of the Agri-Fintech Digital Accounting Capability (AF-DAC). This model combines cloud accounting, blockchain ledgers, RegTech–XBRL modules, and cyber risk panels. (Barreto et al., 2025; Sassi et al., 2024; Hamdy et al., 2025). Startups with high TOE readiness + low cyber risk scores showed a compliance score of 85/100, while startups with low readiness only reached 60. These data confirm the validity of the AF-DAC model (Yang et al., 2024; Hamdy et al., 2025; Charoenwong et al., 2024).

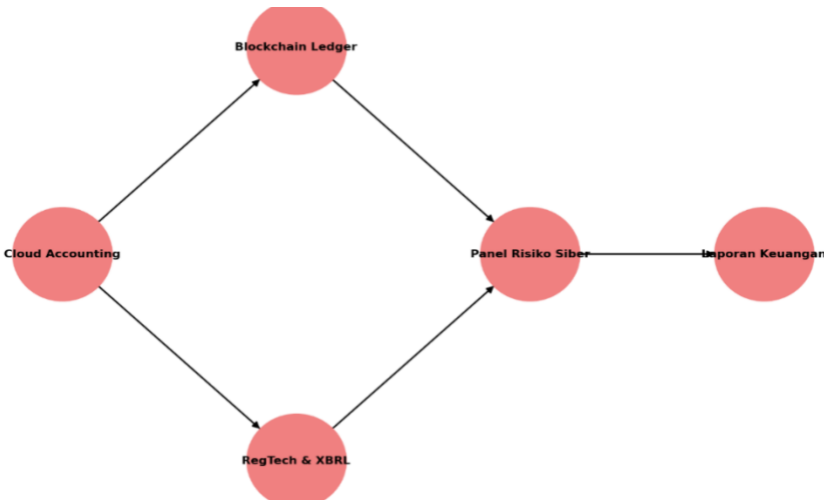


Figure 3. AF-DAC model

This model shows the integration of flows from → cloud transactions → the RegTech/XBRL → blockchain → financial statements. An interview with startup CFO A confirms the benefits of this model in increasing attractiveness for investors. This supports Barreto et al. (2025), Sassi et al. (2024), and Hamdy et al. (2025). These findings fill a gap in previous research that only examined technology or compliance aspects separately (Lv et al., 2023; Liu et al., 2025; Cloud Accounting SLR, 2025). The AF-DAC model can be a reference for a more comprehensive digital accounting system design for agri-fintech startups in developing countries. Thus, the main contribution of this research lies in the formulation of a model that integrates technology, compliance, and risk mitigation in a single framework that can be further tested.

These findings align with studies in Sub-Saharan Africa (Osabutey et al., 2024), where internal capabilities similarly outweighed external support. However, this contrasts with developed market contexts where regulatory pressure plays a stronger adoption role (Charoenwong et al., 2024), suggesting that institutional environments shape TOE dynamics differently across development stages.

CONCLUSION

This study reveals that internal factors, such as technology readiness ($\beta=0.42$, $p<0.01$) and organizational support ($\beta=0.35$, $p<0.05$), are crucial for digital accounting adoption in agri-fintech startups, while the external environment plays a minor role ($\beta=0.18$, $p>0.10$). Within the Technology Acceptance Model, perceived usefulness ($\beta=0.45$, $p<0.01$) and ease of use ($\beta=0.40$, $p<0.01$) drive acceptance. The digital transformation improves information quality ($\beta=0.50$, $p<0.001$) and XBRL readiness ($\beta=0.38$, $p<0.05$), while cyber risk negatively impacts report accuracy ($r=-0.47$, $p<0.01$). The AF-DAC model, integrating cloud accounting, blockchain, RegTech-XBRL, and cyber risk, shows that high-readiness startups achieve compliance scores of 85/100, compared to 60/100 for low-readiness firms. This model fills a critical gap by unifying technology adoption, compliance, and risk mitigation, demonstrating the dominance of internal capabilities in developing countries. Practically, startups should focus on internal IT infrastructure and HR training rather than waiting for government incentives. Regulators should harmonize IFRS/XBRL standards and provide cybersecurity guidelines, while investors and vendors can use digital maturity scores to assess readiness. Despite limitations like purposive sampling and cross-sectional design, the study lays the foundation for future research on AI-driven risk mitigation and cross-regional adoption of the AF-DAC model.

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