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Digital transformation as a pathway to competitiveness of agrifood small and medium enterprises in Uganda

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Abstract

Digital transformation is widely promoted as a route to productivity and competitiveness, yet its multidimensional effects on agrifood SMEs in low- and middle-income contexts remain underexplored. This study examines how digital technology adoption, digital process transformation, digital business model innovation, and digital customer engagement influence the competitiveness of agrifood SMEs in Uganda. The study adopts a quantitative cross-sectional design grounded in dynamic capabilities theory. Data were collected from 318 agrifood SMEs across eight districts in Eastern Uganda using structured questionnaires and stratified random sampling, and analyzed using correlation and hierarchical regression, controlling for firm age and size. All four dimensions of digital transformation significantly and positively predict SME competitiveness. Digital process transformation and technology adoption strongly influence operational efficiency, while business model innovation and customer engagement enhance market positioning. Digital transformation explains substantially more variance in competitiveness than firm age or size. Managers should pursue integrated digital strategies spanning technology, processes, business models, and customer engagement rather than isolated tools; policymakers should invest in digital infrastructure and capacity building. The study conceptualizes digital transformation as a multidimensional dynamic capability and empirically links it to SME competitiveness in an underexplored agrifood context, extending dynamic capabilities theory to resource-constrained settings.

1. Background

Competitiveness of agrifood SMEs is a strategic necessity for sustainable economic transformation, particularly in agrarian economies where food systems underpin employment, income generation, and export performance (Food and Agriculture Organization of the United Nations [FAO], 2023). Globally, agrifood systems employ over one billion people and are expected to feed a projected population of 9.7 billion by 2050 (FAO, 2022). Yet, these systems face mounting pressures including climate variability, supply chain disruptions, volatile commodity prices, and rising consumer demand for quality, traceability, and sustainability. Strengthening their competitiveness enhances productivity, market integration, resilience, and long-term value creation within agricultural value chains. Competitiveness refers to the ability of a firm to produce goods and services that meet market requirements in terms of quality, cost, reliability, and innovation while sustaining or improving profitability and market share over time (Barney, 1991; OECD, 2023). SME competitiveness is defined as an agrifood SME's capability to achieve and sustain strong market position and performance by (i) securing and expanding market linkages, (ii) generating and reinvesting surplus, (iii) operating efficiently, and (iv) adapting through innovation while meeting quality and regulatory/buyer requirements. This definition is consistent with recent agrifood digital transformation syntheses that frame competitiveness as a composite of efficiency, market connectivity, and resilience in value chains, and emphasize that digital approaches strengthen market links, improve financial access, and support data-driven decision-making capabilities that underpin long-run competitiveness and sustainability (Schroeder et al., 2021). Resultantly, we dimensionalise SME competitiveness as a five-dimensional construct because agrifood firms must compete simultaneously

on market reach, financial resilience, operational efficiency, innovation, and compliance/quality (Benavides-Espinosa et al., 2024). Market access captures reach and retention of buyers, sales-channel diversification, and ability to transact reliably. In Uganda and similar contexts, digital platforms and ag-ecommerce are described as important channels for market access, with market development framed explicitly as market access, diversification, and value addition. (Schroeder et al., 2021). Profitability captures value capture and financial resilience (margin protection, sales growth, and cash-flow adequacy). Productivity captures output (or sales) generated per unit of labor and time, reflecting cost competitiveness and delivery reliability. Innovation captures introduction of new/improved products and processes that enable differentiation and adaptation. Quality/standards capture compliance and consistency (e.g., certifications, traceability, rejection rates), which gate access to higher-value markets.

In Uganda, agriculture remains the backbone of the economy, employing about 68% of the labor force and contributing roughly 24% to GDP (UBOS, 2023). Agrifood SMEs account for over 75% of agro-based enterprises and more than 80% of private sector employment (MTIC, 2022). These enterprises operate across key value chains including maize, coffee, rice, dairy, and horticulture. Despite their numerical dominance and economic importance, Uganda's agrifood SMEs exhibit low levels of productivity, limited value addition, weak export orientation, and high post-harvest losses (FAO, 2022; NPA, 2023). Notably, only about 12% of Uganda's agricultural exports are processed products, compared to 60–80% in many middle-income economies (World Bank, 2022). This structural constraint reflects limited technological upgrading and weak competitiveness within agrifood value chains.

From a theoretical perspective, dynamic capabilities theory affirms that DT bundles translate into sustained competitiveness through sensing market shifts (price/quality requirements), seizing opportunities (new channels and products), and reconfiguring operations (process redesign and coordination). For instance, DT bundles often include digital payments and data trails that improve cash-flow management and access to finance. DT bundles strengthen three DC microfoundations. Sensing improves when SMEs use digital tools for market intelligence, buyer discovery, and standards awareness; Uganda evidence on platform participation underscores market development channels such as market access and diversification that are consistent with strengthened sensing routines. Seizing improves when SMEs mobilize resources to exploit opportunities most visibly through digital finance and digitally supported investment decisions; however, African firm evidence suggests that performance gains from digital finance can be stronger when paired with traditional finance access, indicating that seizing routines frequently rely on complementary financial resources (Ayyagari et al., 2017). Reconfiguring improves when SMEs redesign workflows and partner interfaces, using digital records and supply-chain tools to coordinate operations, manage quality, and meet delivery requirements; empirical supply-chain digitalization evidence links such reconfiguration to performance gains in agrifood industries.

The postulations of dynamic capabilities theory resonate with recent empirical research indicating that digital transformation is positively associated with firm competitiveness through improved market access and stronger financial performance, with frequent spillovers to productivity and innovation

(Ferreira et al., 2019). However, these gains are typically conditional, being stronger when DT is deployed as complementary bundles and when digitally enabled finance reinforces (rather than replaces) traditional finance within a supportive enabling environment (Konte & Tetteh, 2023; Schroeder et al., 2021). Although agrifood SMEs are recognized as critical to Uganda's economy, most digital transformation (DT) studies focus on farmers or ecosystems rather than SMEs themselves. This leaves a gap in understanding how DT adoption by individual SMEs affects their competitiveness (market access, productivity, innovation, etc.). This study fills that gap by analyzing firm-level survey data from Eastern Uganda to directly assess SME DT and competitiveness. Many existing studies measure DT as isolated technologies (e.g. mobile money or e-commerce alone). This single-tool focus neglects the strategic, multi-technology nature of DT bundles in practice. The study contributes theoretically by treating digital transformation as a strategic capability that directly reconfigures firm resources to enhance competitiveness. The authors provide more specific guidance regarding how to reconfigure the organization in digital transformation. The paper uses a novel context for digital transformation and complements the very few studies available using dynamic capabilities to understand digital transformation. It demonstrates that a bundle of digital strategies can independently drive multi-dimensional outcomes, from productivity and profitability to market access and innovation, extending Teece's notion of dynamic capability to agrifood SMEs. This application is novel because the agrifood context and Eastern Uganda setting have been largely unexplored in DCT research, thus enriching theory with new empirical evidence of how sensing-seizing-reconfiguring routines operate without intermediate mechanisms. Practically, the findings yield actionable insights for policymakers and development actors: coordinating digital tools (e.g. mobile finance, precision farming devices, e-markets) can boost agricultural productivity and broaden market reach. The research advances academic understanding by framing digitalization as a proactive dynamic capability in agribusiness, and provides Eastern Uganda's stakeholders with evidence-backed strategies to enhance SME competitiveness.

2. Theory and Hypotheses Development

2.1 Theoretical review

Dynamic Capabilities Theory (DCT), advanced by Teece and colleagues in the late 1990s, explains how firms achieve and sustain competitiveness in turbulent environments by continuously renewing their resource base (Teece, Pisano, & Shuen, 1997; Teece, 2007). The theory conceptualizes dynamic capabilities as higher-order organizational capacities that enable firms to integrate, build, and reconfigure internal and external competences in response to rapid market change. Teece (2007) categorizes these capabilities into three interrelated processes: sensing, seizing, and transforming (reconfiguring). Sensing refers to a firm's ability to scan, interpret, and anticipate technological shifts, market opportunities, and evolving customer needs. Seizing involves mobilizing and allocating resources to capitalize on identified opportunities through new products, processes, or business models. Transforming entails the continuous renewal and reconfiguration of organizational structures, routines, and assets to align with strategic change. Collectively, these processes enhance strategic agility and

enable firms to achieve competitive renewal. Within the context of digital transformation, DCT provides a robust explanatory lens by positioning digital transformation as an outcome of effective sensing, seizing, and transforming capabilities. Firms that detect emerging digital opportunities, invest in appropriate technologies, and reconfigure their processes accordingly are more likely to achieve superior performance. Thus, dynamic capabilities act as the underlying mechanism through which digital transformation translates into competitiveness, as they enable firms to adapt swiftly, innovate effectively, and sustain advantage in dynamic environments (Teece et al., 1997; Teece, 2007).

2.2 Empirical review and hypotheses

Digital technology adoption

Empirical studies show that the adoption of digital technologies such as cloud computing, e-commerce systems, data analytics, and enterprise platforms significantly strengthens SME competitiveness. Firms that invest in digital infrastructure report improved productivity, enhanced information processing capability, and faster strategic decision-making (Bharadwaj et al., 2013). Evidence further indicates that digital tools enable SMEs to reduce operational costs, overcome geographic limitations, and access wider markets, thereby improving profitability and market performance (Vial, 2019). In competitive environments, early and strategic adoption of digital technologies allows SMEs to compete effectively with larger firms by increasing operational flexibility and innovation capacity. Hence, we hypothesise

H1: Digital technology adoption significantly enhances SME competitiveness.

Digital process transformation

The digitalization of internal processes has also been empirically linked to improved competitive outcomes. Research shows that automating workflows, integrating supply chain systems, and digitizing financial and administrative operations enhance efficiency and reduce errors (Li et al., 2018). SMEs that transform their processes digitally experience shorter production cycles, improved service quality, and better coordination across departments. These improvements strengthen cost leadership and responsiveness to customer needs. Empirical findings consistently suggest that digitally integrated processes enhance organizational agility, which is a critical determinant of competitiveness in dynamic markets. Hence, we hypothesise

H2: Digital process transformation significantly enhances SME competitiveness.

Digital business model innovation

Studies further demonstrate that digital transformation enables SMEs to redesign their business models, thereby improving competitive positioning. Through digital platforms, online marketplaces, and subscription-based services, SMEs can create new value propositions and revenue streams (Verhoef et al., 2021). Empirical evidence shows that digitally enabled business model innovation enhances market expansion, differentiation, and strategic flexibility. SMEs leveraging digital ecosystems are better able to

collaborate, co-create value, and respond to changing consumer preferences, which strengthens long-term competitiveness (Vial, 2019). Hence, we hypothesise;

H3: Digital business model innovation significantly enhances SME competitiveness.

Digital customer engagement

Digital customer engagement has also emerged as a significant predictor of SME competitiveness. Research indicates that SMEs using social media platforms, CRM systems, and digital communication channels improve customer interaction, satisfaction, and loyalty (Vial, 2019). Digital engagement provides real-time market feedback and enhances personalization, allowing firms to tailor products and services more effectively. Empirical findings show that strong digital presence increases brand visibility, customer retention, and sales growth, thereby improving competitive advantage. Hence, we hypothesise;

H4: Digital customer engagement significantly enhances SME competitiveness.

3. Methods

3.1 Population and sample

The population comprised approximately 10,500 registered agrifood SMEs in eight Eastern Uganda districts, Mbale, Jinja, Soroti, Kumi, Pallisa, Kapchorwa, Bukedea, and Butaleja, chosen for their strong agricultural base and value-chain diversity (maize, rice, coffee, dairy, horticulture) (UBOS, 2023). The study targeted SMEs with at least three years of operation and 5–100 employees, consistent with Uganda's SME classification (MTIC, 2022). A sample of 384 was determined using Cochran's (1977) formula (95% confidence, 5% margin of error) and proportionately allocated across districts using stratified random sampling by value-chain segment, followed by simple random sampling within strata. Data were collected via structured questionnaires from owner-managers or the senior manager most knowledgeable about digital practices and performance. Of 384 questionnaires distributed, 332 were returned; after screening, 318 valid responses were retained (82.8% response rate). Sampled SMEs were 64% small (5–49 employees) and 36% medium (50–100); 44% were in production, 33% processing, and 23% marketing. Firm age ranged from 3–35 years (mean 8.1 years).

3.2 Measurement and validation

Digital transformation was measured across four dimensions, technology adoption, process transformation, business model innovation, and customer engagement, adapted from established scales (Bharadwaj et al., 2013; Vial, 2019; Verhoef et al., 2021; Li et al., 2018). SME competitiveness was measured across market access, productivity, profitability, innovation, and quality/standards compliance, adapted from the competitiveness literature (Barney, 1991; OECD, 2023; Benavides-Espinosa et al., 2024). All items used a five-point Likert scale; firm age, size, value-chain category, and district served as controls.

Confirmatory factor analysis confirmed construct validity: Average Variance Extracted and Composite Reliability exceeded 0.50 and 0.70 respectively, with factor loadings above 0.50 (Hair et al., 2010; Hair et al., 2021), and Cronbach's alphas exceeded 0.70 for all constructs (Table 1). Discriminant validity was confirmed via the Fornell-Larcker criterion and the Heterotrait-Monotrait ratio. Harman's single-factor test indicated no common method bias concern (Podsakoff et al., 2012), and a 30-SME pilot test refined item wording for contextual relevance.

Table 1
Instruments' validity and reliability

Constructs	**Code**	**Factor Loading**	**Cronbach α**	**AVE**	**CR**
Digital transformation			.82	.54	.78
Digital Technology Adoption (DTA)	DTA				
	DTA 1	.72			
	DTA 2	.76			
	DTA 3	.70			
Digital Business Model Innovation (DBMI)	DBMI				
	DBMI 1	.73			
	DBMI 2	.78			
	DBMI 3	.75			
Digital Process Transformation (DPT)	DPT				
	DPT 1	.68			
	DPT 2	.71			
	DPT 3	.74			
Digital Customer Engagement (DCE)	DCE				
	DCE 1	.77			
	DCE 2	.81			
	DCE 3	.79			
Competitiveness (C)	C	.77	.71	.66	.73
	C 1	.67			
	C 2	.73			
	C 3	.76			
Source: Primary data (2025)					

4. Findings

4.1 Correlations

To assess the relationships between the study variables, a Pearson correlation analysis was conducted, and the results are summarized in Table 2. The analysis focused on examining the strength and significance of associations between firm size, firm age, digital transformation dimensions, and SME competitiveness.

The results indicate that digital technology adoption has a significant positive correlation with SME competitiveness ($r = 0.71$, $p < 0.01$). This suggests that agrifood SMEs that adopt digital tools such as mobile payments, digital record-keeping, and online platforms tend to experience improved market access, productivity, profitability, innovation, and compliance with quality standards. Similarly, digital process transformation is strongly and positively correlated with SME competitiveness ($r = 0.74$, $p < 0.01$), indicating that SMEs that digitize and integrate their internal operations and supply chain activities demonstrate higher levels of competitive performance.

Digital business model innovation also shows a significant positive relationship with SME competitiveness ($r = 0.77$, $p < 0.01$). This implies that SMEs leveraging digital technologies to introduce new products, services, or revenue streams are better positioned to compete in dynamic agrifood markets. Furthermore, digital customer engagement exhibits the strongest positive correlation with SME competitiveness ($r = 0.80$, $p < 0.01$), suggesting that firms that actively interact with customers through digital channels enhance their market visibility, customer loyalty, and overall performance.

The results further reveal that the digital transformation dimensions are significantly correlated with each other. For example, digital technology adoption is positively associated with digital process transformation ($r = 0.69$, $p < 0.01$), digital business model innovation ($r = 0.65$, $p < 0.01$), and digital customer engagement ($r = 0.72$, $p < 0.01$). This indicates that SMEs that adopt digital tools are more likely to integrate digital processes and innovate their business models, reflecting the complementary nature of digital transformation strategies.

Regarding the control variables, firm size demonstrates a moderate positive correlation with SME competitiveness ($r = 0.46$, $p < 0.01$), indicating that larger SMEs, which generally possess more resources and managerial capacity, tend to exhibit stronger competitive performance. Firm age also shows a significant positive correlation with SME competitiveness ($r = 0.52$, $p < 0.01$), suggesting that more established SMEs benefit from accumulated experience, networks, and operational capabilities that enhance competitiveness.

Table 2
Correlations

Variable	Mean	SD	1	2	3	4	5	6
1. Size	3.21	0.39	1					
2. Age	3.49	0.35	.29**	1				
3. DTA	3.35	0.32	.31**	.36**	1			
4. DBMI	3.28	0.41	.30**	.35**	.65**	1		
5. DPT	3.42	0.38	.33**	.38**	.69**	.68**	1	
6. DCE	3.51	0.44	.28**	.37**	.72**	.74**	.70**	1
7. Competitiveness	3.40	0.43	.46**	.52**	.71**	.77**	.74**	.80**

*Note: N = 318. All correlations are significant at **p < 0.01 (two-tailed). DTA = digital technology adoption; DBMI = digital business model innovation; DPT = digital process transformation; DCE = digital customer engagement.*

Source: Primary data (2025)

4.2 Regression results

The hierarchical regression results, presented in Table 3, show that the dimensions of digital transformation significantly contribute to SME competitiveness when controlling for firm age and firm size. The analysis was conducted in three models to examine the incremental explanatory power of digital transformation variables.

In Model 1, only the control variables, firm age and firm size, were included in the regression model. Firm age had a positive and significant relationship with SME competitiveness ($\beta = 0.42$, $p < 0.01$), suggesting that older firms tend to exhibit higher competitiveness. Firm size also showed a positive and significant relationship ($\beta = 0.34$, $p < 0.01$), indicating that larger SMEs may benefit from greater resource capacity. This initial model explained 37% of the variance in SME competitiveness ($R^2 = 0.37$, $F = 94.41$, $p < 0.01$).

In Model 2, the core digital transformation dimensions digital technology adoption and digital process transformation were introduced into the regression model. The inclusion of these variables significantly improved the explanatory power of the model ($\Delta R^2 = 0.32$, $p < 0.01$), raising the explained variance to 70% ($R^2 = 0.70$). Digital technology adoption had a positive and significant effect on SME competitiveness ($\beta = 0.31$, $p < 0.01$), supporting H1 and indicating that SMEs leveraging digital tools experience improved competitive outcomes. Digital process transformation also had a positive and significant effect ($\beta = 0.39$, $p < 0.01$), supporting H2 and suggesting that digital integration of internal processes enhances operational efficiency and market performance. Firm age ($\beta = 0.21$, $p < 0.01$) and firm size ($\beta = 0.17$, $p < 0.01$) remained positive and significant, although their effects declined once digital transformation was accounted for.

In Model 3, digital business model innovation and digital customer engagement were added to the regression model. The addition of these variables further increased the model's explanatory power ($\Delta R^2 = 0.10$, $p < 0.01$), with the full model explaining 80% of the variance in SME competitiveness ($R^2 = 0.80$, $F = 209.41$, $p < 0.01$). Digital business model innovation had a positive and significant coefficient ($\beta = 0.25$, $p < 0.01$), supporting H3 and demonstrating that digitally enabled value creation strategies significantly enhance SME competitiveness. Digital customer engagement exhibited the largest effect in the model ($\beta = 0.33$, $p < 0.01$), supporting H4 and indicating that active digital interaction with customers strengthens market positioning and performance outcomes. Digital technology adoption ($\beta = 0.09$, $p < 0.05$) and digital process transformation ($\beta = 0.16$, $p < 0.01$) remained significant, though their coefficients were smaller once all four dimensions were entered, consistent with the strong intercorrelations among the digital transformation dimensions. Firm age ($\beta = 0.17$, $p < 0.01$) and firm size ($\beta = 0.16$, $p < 0.01$) remained positive and significant. Together, the four digital transformation dimensions explained an additional 42% of the variance beyond the control variables ($\Delta R^2 = 0.32 + 0.10$), compared with 37% for firm age and size.

Table 3
Regression findings

Variable	Model 1	Model 2	Model 3
Age	.42**	.21**	.17**
Size	.34**	.17**	.16**
DTA		.31**	.09*
DPT		.39**	.16**
DBMI			.25**
DCE			.33**
R^2	.37	.70	.80
Adjusted R^2	.37	.69	.80
ΔR^2	.37**	.32**	.10**
F	94.41**	180.80**	209.41**

*Note: N = 318. Standardized coefficients (β) are reported. *p < 0.05, **p < 0.01. Dependent variable: SME Competitiveness. DTA = digital technology adoption; DPT = digital process transformation; DBMI = digital business model innovation; DCE = digital customer engagement.*

Source: Primary data (2025)

5. Discussion

This study examined how digital transformation, technology adoption, process transformation, business model innovation, and customer engagement, shapes SME competitiveness in Uganda's agrifood sector,

extending research largely concentrated on developed economies (Bharadwaj et al., 2013; Vial, 2019) to a resource-constrained emerging-market setting.

Digital technology adoption significantly enhanced competitiveness, consistent with digital business strategy literature linking digital tools to improved information processing and operational efficiency (Bharadwaj et al., 2013); in Uganda's infrastructure-constrained context, such tools reduce transaction costs and expand market access. Digital process transformation also significantly contributed to competitiveness, supporting the dynamic capabilities view that reconfiguring internal processes builds advantage (Teece, 2007); in agrifood value chains where delays erode profitability, digitally integrated processes enhance reliability and cost-effectiveness.

Digital business model innovation significantly predicted competitiveness, reinforcing the argument that digital transformation extends beyond operations to strategic value-creation redesign (Verhoef et al., 2021): digital marketplaces let SMEs bypass intermediaries and access broader markets. Digital customer engagement also had a strong positive effect, consistent with research on digital engagement strengthening customer relationships and competitive advantage (Vial, 2019), offering an alternative pathway to market access where physical reach is limited.

Firm size and age contributed to competitiveness but less strongly than the digital transformation dimensions, suggesting digital capabilities matter more than traditional firm characteristics in this context (Barney, 1991). Overall, the findings support conceptualizing digital transformation as a multidimensional strategic capability rather than a single adoption decision: competitiveness arises from the combined, complementary effects of technology adoption, process digitalization, business model innovation, and customer engagement (Teece, 2007; Bharadwaj et al., 2013; Verhoef et al., 2021). Extending this framework to Eastern Uganda's agrifood SMEs, an underexplored context of limited institutional support and resource constraints, shows digital transformation as a critical pathway for productivity, market access, and innovation, achieved by strategically integrating digital technologies into core processes and customer interfaces rather than merely adopting tools.

6. Conclusion

This study demonstrates that all four dimensions of digital transformation, technology adoption, process transformation, business model innovation, and customer engagement, significantly enhance the competitiveness of agrifood SMEs in Eastern Uganda. Technology adoption improves efficiency and reduces transaction costs; process transformation strengthens coordination; business model innovation opens new markets and revenue streams; and customer engagement builds relationships and responsiveness. Together, these dimensions matter more for competitiveness than firm age or size, though both contribute modestly.

By treating digital transformation as an integrated strategic capability rather than a set of isolated tools, this study addresses a key gap in the literature and offers a more nuanced account of how resource-constrained agrifood SMEs build competitive advantage. Cultivating comprehensive digital capabilities is

essential for these firms' long-term competitiveness in volatile markets, and future research should explore how digital transformation interacts with other strategic capabilities across sectors, regions, and time.

7. Implications of the Study

Theoretically, the study extends dynamic capabilities theory by disaggregating digital transformation into technology adoption, process transformation, business model innovation, and customer engagement, showing these play distinct but complementary roles rather than functioning as a monolithic construct. It also advances competitiveness theory by positioning digital transformation, rather than the static resource endowments emphasized in the Resource-Based View (Barney, 1991), as a critical antecedent of SME competitiveness, and extends this theorizing to SMEs in an emerging, resource-constrained agrifood context largely absent from prior digital transformation research centered on large developed-economy firms.

Practically, SME owners and managers should invest in comprehensive digital adoption, mobile payments, digital accounting, online marketplaces, rather than isolated tools, since even incremental digital upgrades yield measurable productivity and financial gains. They should also integrate digital systems into core operations and supply chains (digital inventory management, record-keeping, tracking) to strengthen coordination and quality compliance, and leverage digital platforms to innovate business models, direct-to-consumer sales, digital traceability, value-added online services, to diversify revenue and market reach. Active digital customer engagement via social media and messaging tools should be treated as a strategic asset for building relationships, gathering market intelligence, and refining products.

For policymakers and development agencies, enabling environments, expanded rural internet access, digital literacy programs, training workshops, and digital advisory services, are needed to help agrifood SMEs integrate digital technologies and strengthen competitiveness, particularly in infrastructurally and institutionally constrained markets such as Uganda's.

8. Limitations and Areas for Further Research

This study is limited by its focus on agrifood SMEs in Eastern Uganda, which may constrain generalizability to other regions or sectors with different digital infrastructure, institutional support, and regulatory environments; replication in other contexts and sectors, manufacturing, services, tourism, is warranted. Its cross-sectional design captures relationships at a single point in time, whereas digital transformation is an evolving process; longitudinal designs would better reveal how its competitive benefits unfold over time and across economic cycles. The study also relied on self-reported data, introducing potential response bias, and did not examine moderating or mediating variables. Future research should explore how entrepreneurial orientation, strategic leadership, digital literacy,

organizational culture, or access to finance interact with digital transformation to shape competitiveness.

Declarations

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Competing interests

The authors declare that they have no competing interests.

Ethical Approval and accordance

The study protocol, entitled “Strategic Digital Transformation for Enhancing MSME Competitiveness in Agriculture Value Chain: Evidence from Eastern Uganda”, was reviewed and approved by the Mulago Hospital Research and Ethics Committee (MHREC), Mulago National Referral Hospital, Kampala, Uganda (Protocol No. MHREC 3051; approval date 11 November 2025; expiry date 10 November 2026). The approval covered the study protocol and the questionnaire used for data collection. The research was carried out in accordance with the guidelines, regulations, and conditions of approval of the Mulago Hospital Research and Ethics Committee, and no changes were made to the approved protocol or study instruments.

Consent to participate

Verbal informed consent was obtained from all participants prior to data collection.

Data availability

The data supporting the findings of this study are available from the corresponding author upon request.

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Author Contribution

J.R.A.W: Conceived, conceptualized and designed the study, secured funding, supervised data collection, performed the statistical analysis and wrote the main manuscript text. I.M: contributed to the theoretical

framework and study design, provided supervision and critically revised the manuscript. A.K: Independently led field data collection across the eight study districts, carried out data entry, cleaning and management, compiled the literature and reference list, and prepared Tables 1–3.A.K.M: coordinated data collection across the study districts, managed and cleaned the dataset, and prepared Tables 1–3. All authors reviewed and approved the final manuscript.

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