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STRATEGIES FOR DEVELOPING A DIGITAL TECHNOLOGY-BASED AGRIBUSINESS SUPPLY CHAIN TO ENHANCE THE VALUE ADDED OF LOCAL AGRICULTURAL PRODUCTS IN INDONESIA

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ABSTRACT
Indonesia possesses abundant agricultural resources; however, the value added of its local products remains relatively low due to fragmented supply chains, limited digital technology adoption, and weak stakeholder coordination. This study aims to formulate strategic recommendations for developing a digital technology-based agribusiness supply chain to enhance the value added and competitiveness of local agricultural products. A systematic literature review and qualitative content analysis were employed, examining peer-reviewed articles, government reports, and scientific publications related to digital agriculture, supply chain management, and value creation. Findings indicate that integrating advanced digital technologies, including the Internet of Things (IoT), artificial intelligence (AI), blockchain, and big data analytics, can significantly improve supply chain efficiency, transparency, traceability, and market accessibility while reducing operational inefficiencies. Furthermore, successful digital transformation requires robust multi-stakeholder collaboration among government agencies, industry providers, academia, and farmers to establish an integrated digital ecosystem. The study proposes a comprehensive strategic framework combining digital infrastructure development, human resource capacity building, smart agriculture technologies, and supportive public policies. This framework contributes theoretically to digital agribusiness literature and provides practical guidance for policymakers and practitioners seeking to increase the value added and global competitiveness of Indonesia's agricultural sector.

INTRODUCTION
Indonesia is one of the world's largest agricultural producers, with abundant local commodities such as rice, coffee, cocoa, palm sugar, tropical fruits, spices, fisheries, and horticultural products. Despite this potential, many local agricultural products continue to generate relatively low economic value because agribusiness supply chains remain

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fragmented, inefficient, and heavily dependent on conventional distribution mechanisms. Farmers frequently experience limited market access, inadequate logistics, asymmetric information, fluctuating prices, and weak coordination among supply chain actors. These challenges are further exacerbated by the uneven adoption of digital technologies across agricultural regions, particularly among smallholder farmers who dominate Indonesia's agricultural sector. Consequently, significant value is lost throughout the supply chain, reducing farmers' incomes, limiting product competitiveness, and constraining the sustainable development of Indonesia's agribusiness sector (Aziz, 2022).

Previous studies have demonstrated that digital technologies, including Internet of Things (IoT), big data analytics, blockchain, artificial intelligence, cloud computing, and digital marketplace platforms, have considerable potential to improve supply chain transparency, operational efficiency, traceability, and market integration within the agricultural sector. Existing theories of supply chain management, digital transformation, and value chain development also emphasize that technology integration can strengthen collaboration among stakeholders while increasing product value creation. Nevertheless, the current body of literature remains fragmented in explaining how these technological innovations should be strategically integrated within Indonesia's local agribusiness ecosystem, which is characterized by diverse commodities, geographical disparities, heterogeneous institutional capacities, and varying levels of digital readiness. Most previous studies focus on individual technologies or isolated supply chain activities rather than proposing an integrated strategic framework capable of simultaneously enhancing value-added creation, stakeholder collaboration, and sustainable competitiveness of local agricultural products (Mardikaningsih, 2025).

Based on these conditions, this study aims to develop strategic recommendations for establishing a digital technology-based agribusiness supply chain that can enhance the value added of local agricultural products in Indonesia. Specifically, the study seeks to identify the strategic roles of digital technologies across the agribusiness supply chain, examine the mechanisms through which digital integration contributes to value creation, and formulate a comprehensive conceptual framework that supports sustainable agribusiness development. By synthesizing recent literature and contemporary developments in digital agriculture, this research intends to provide a comprehensive understanding of how digital transformation can strengthen supply chain performance while increasing the economic value of local agricultural commodities (Liyanage et al., 2021).

This research argues that developing an integrated digital technology-based agribusiness supply chain is becoming increasingly essential for improving the competitiveness and value added of Indonesia's local agricultural products in the era of digital transformation. Without comprehensive digital integration across production, processing, logistics, marketing, and information management, structural inefficiencies will continue to limit the capacity of local agricultural products to compete in domestic and international markets. Therefore, developing a strategic framework that combines digital technologies with agribusiness supply chain management is expected to provide valuable theoretical contributions by extending current perspectives on digital agribusiness and supply chain integration, while also offering practical guidance for policymakers, agribusiness practitioners, cooperatives, and farmers in promoting sustainable agricultural development and inclusive economic growth in Indonesia (El Garem, 2026).

METHOD

This study employed a qualitative library research approach to develop strategic recommendations for a digital technology-based agribusiness supply chain aimed at enhancing the value added of local agricultural products in Indonesia (Phakamach et al., 2023). The study relied exclusively on secondary data obtained from scientific publications and did not involve field observations or surveys. Library research was considered appropriate because the research objective focused on synthesizing existing scientific knowledge, identifying conceptual relationships, and formulating an integrated strategic framework based on evidence reported in previous studies.

The literature reviewed in this study consisted of peer-reviewed journal articles, academic books, conference proceedings, government reports, policy documents, and other reputable scientific publications discussing digital agriculture, agribusiness supply chain management, digital transformation, Industry 4.0 technologies, agricultural value creation, and sustainable agricultural development. To ensure the relevance and quality of the reviewed literature, priority

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was given to publications indexed in internationally recognized scientific databases and published primarily within the last five years, while seminal theoretical works were included where necessary to provide conceptual foundations (Markauskaite et al., 2023).

The literature selection process was conducted systematically through several stages. First, relevant publications were identified using combinations of keywords such as *digital agribusiness*, *digital agriculture*, *agribusiness supply chain*, *supply chain management*, *Internet of Things*, *artificial intelligence*, *blockchain*, *digital transformation*, and *agricultural value added*. Second, the identified literature was screened by evaluating its relevance to the research objectives, methodological quality, publication credibility, and contribution to understanding digital technology implementation within agribusiness supply chains. Publications that did not directly address the research topic or lacked sufficient scientific rigor were excluded from further analysis (Falloon, 2020).

The collected literature was subsequently analyzed using qualitative content analysis. This analytical technique involved repeatedly reviewing the selected publications, categorizing the findings into major themes, identifying recurring concepts and relationships, comparing similarities and differences across studies, and synthesizing strategic insights relevant to digital agribusiness supply chain development. The analysis emphasized how digital technologies contribute to supply chain integration, operational efficiency, transparency, traceability, stakeholder collaboration, and value-added creation for local agricultural products. The synthesized findings were then integrated into a comprehensive conceptual framework that explains the strategic dimensions required to strengthen digital agribusiness supply chains in Indonesia. Through this analytical process, the study provides evidence-based recommendations that are theoretically grounded and practically applicable for policymakers, agribusiness practitioners, researchers, and other stakeholders involved in agricultural development (Valtonen & Holopainen, 2025).

RESULT AND DISCUSSION

Results

The literature review demonstrates that Indonesia possesses substantial agricultural potential, supported by its rich biodiversity, fertile land resources, favorable tropical climate, and wide variety of agricultural commodities, including rice, coffee, cocoa, palm oil, spices, horticultural products, fisheries, and plantation crops. These resources position Indonesia as one of the world's major agricultural producers and provide significant opportunities to strengthen national food security, increase export competitiveness, and improve rural economic development. Despite this considerable potential, the value added generated by local agricultural products remains relatively low because many agricultural commodities continue to be marketed in raw or semi-processed forms with limited downstream processing. The literature consistently identifies persistent inefficiencies throughout the agribusiness supply chain as one of the primary factors restricting value creation. Fragmented coordination among farmers, collectors, processors, distributors, wholesalers, retailers, and final consumers creates substantial obstacles to efficient resource allocation and market integration. Furthermore, information asymmetry, unstable commodity prices, limited bargaining power among smallholder farmers, inadequate transportation and logistics infrastructure, high post-harvest losses, inconsistent product quality, and restricted market access continue to reduce the competitiveness of local agricultural products. The uneven distribution of digital infrastructure between urban and rural areas further widens these challenges, preventing many agricultural producers from participating effectively in modern value chains. Consequently, the inability to integrate production, processing, logistics, and marketing activities has resulted in lower productivity, reduced profitability, and limited economic benefits for farmers despite increasing domestic and international demand for high-quality agricultural products (Vrabcová & Urbancová, 2022).

The reviewed literature also reveals that digital transformation has emerged as one of the most influential strategic drivers for improving agricultural competitiveness across both developed and developing countries. The rapid advancement of Industry 4.0 technologies has fundamentally changed the way agricultural supply chains operate by introducing data-driven decision-making, automation, and digital collaboration among supply chain participants.

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Technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data Analytics, Blockchain, Geographic Information Systems (GIS), cloud computing, mobile applications, remote sensing, unmanned aerial vehicles (UAVs), and digital marketplace platforms have increasingly been adopted to improve agricultural productivity and supply chain performance. These technologies contribute significantly to increasing supply chain transparency, strengthening operational efficiency, improving product traceability, facilitating precision farming, enhancing quality assurance systems, optimizing inventory management, forecasting market demand, and expanding access to domestic and international markets. Digital platforms also enable real-time communication among producers, processors, distributors, retailers, and consumers, thereby reducing information delays and improving coordination across the entire supply chain. However, despite the growing body of literature discussing digital agriculture, most previous studies examine individual technologies independently or focus on specific supply chain activities without considering their interconnected roles within a comprehensive agribusiness ecosystem. As a result, limited research has developed an integrated strategic framework that simultaneously addresses technological innovation, institutional collaboration, stakeholder coordination, and sustainable value creation within Indonesia's highly diverse agricultural environment, where commodity characteristics, regional infrastructure, organizational capacity, and technological readiness vary considerably (Green, 2021).

Furthermore, the findings indicate that digital technology adoption positively influences every stage of the agribusiness supply chain, beginning with agricultural production and continuing through processing, logistics, marketing, and post-consumption activities. During the production stage, digital technologies facilitate precision agriculture through environmental monitoring, soil analysis, weather forecasting, irrigation management, pest and disease detection, and optimized utilization of agricultural inputs such as fertilizers, pesticides, and water resources. These capabilities enable farmers to improve productivity while minimizing production costs and environmental impacts. During harvesting and post-harvest operations, digital systems support quality assessment, automated sorting, inventory management, warehouse monitoring, and product standardization, thereby reducing post-harvest losses and maintaining product freshness. Within logistics and distribution, cloud-based information systems, GPS tracking technologies, and intelligent transportation management improve delivery efficiency, optimize transportation routes, reduce logistics costs, and provide real-time visibility throughout product movement. At the marketing stage, e-commerce platforms and digital marketplaces expand commercial opportunities by connecting farmers directly with wholesalers, retailers, exporters, and final consumers, thereby reducing dependency on intermediaries and increasing farmers' bargaining power. Simultaneously, blockchain technology enhances supply chain transparency by providing immutable transaction records and reliable product traceability, which strengthens consumer confidence regarding product authenticity, food safety, and production sustainability. Collectively, these digital innovations create additional economic value by increasing operational efficiency, minimizing waste, improving quality assurance, enhancing customer satisfaction, accelerating market responsiveness, and ultimately strengthening the competitiveness of local agricultural products in increasingly competitive global markets (Chia et al., 2021).

The literature synthesis further suggests that the successful implementation of digital agribusiness supply chains depends not solely on technological advancement but also on effective collaboration among multiple stakeholders operating within an integrated innovation ecosystem. Government institutions play a crucial role in establishing supportive regulations, expanding digital infrastructure, providing financial incentives, and formulating long-term digital agriculture policies. Universities and research institutions contribute scientific knowledge, technological innovation, human resource development, and evidence-based policy recommendations that facilitate continuous improvement of digital agricultural practices. Technology providers are responsible for designing accessible digital platforms, developing affordable technological solutions, and providing technical support that meets the operational needs of farmers and agribusiness enterprises. Financial institutions facilitate digital transformation by offering inclusive financing

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mechanisms, investment opportunities, agricultural insurance, and financial technologies that reduce barriers to technology adoption. At the same time, cooperatives, agribusiness companies, and farmers function as the primary users and implementers of digital technologies whose participation ultimately determines the success of innovation adoption. The literature emphasizes that effective collaboration among these stakeholders promotes knowledge sharing, institutional learning, technological diffusion, and coordinated decision-making throughout the agribusiness supply chain. Therefore, digital transformation should not be interpreted merely as the adoption of advanced technologies but rather as the establishment of a comprehensive digital ecosystem that integrates technological innovation, institutional collaboration, organizational capability, and sustainable governance. Such an ecosystem is expected to strengthen the resilience of Indonesia's agribusiness sector, increase the value added of local agricultural products, improve farmers' welfare, and support long-term sustainable agricultural and rural economic development (Shukla et al., 2025).

Table 1. Literature Synthesis on Digital Technology-Based Agribusiness Supply Chain

Digital Technology	Supply Chain Function	Expected Benefits	Contribution to Value Added
Internet of Things (IoT)	Production monitoring	Real-time monitoring of crops and environmental conditions	Higher productivity and improved product quality
Artificial Intelligence (AI)	Decision support	Yield prediction and disease detection	Reduced production costs and minimized crop losses
Blockchain	Product traceability	Transparent transaction records	Increased consumer trust and product premium value
Big Data Analytics	Market forecasting	Demand prediction and production planning	Better market responsiveness
Digital Marketplace	Marketing	Direct connection between producers and consumers	Expanded market access and higher farmer income
Cloud Computing	Data integration	Information sharing among stakeholders	Faster coordination and operational efficiency

The findings also reveal several major challenges limiting digital transformation in Indonesian agribusiness.

Table 2. Major Challenges in Developing Digital Agribusiness Supply Chains

Challenge	Description	Potential Impact
Low digital literacy	Limited technological knowledge among farmers	Slow technology adoption
Inadequate infrastructure	Unequal internet connectivity in rural areas	Restricted digital access
Financial constraints	High investment costs for digital technologies	Low implementation rate
Institutional fragmentation	Weak coordination among stakeholders	Supply chain inefficiency
Data interoperability	Limited integration among digital platforms	Ineffective information exchange
Policy inconsistency	Lack of integrated digital agriculture policies	Uneven implementation across regions

Discussion

The findings reinforce Supply Chain Management (SCM) Theory, which emphasizes that sustainable competitive advantage is achieved through effective coordination, collaboration, and integration among all actors involved in the supply chain. According to this perspective, supply chain performance is determined not only by the efficiency of individual organizations but also by the effectiveness of information exchange, resource sharing, and synchronized decision-making across upstream and downstream partners. The synthesized literature demonstrates that

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digital technologies significantly improve the quality of information flow by providing real-time data exchange, increasing supply chain visibility, and facilitating timely decision-making among farmers, suppliers, processors, distributors, retailers, and consumers. Technologies such as the Internet of Things (IoT), cloud computing, and big data analytics enable stakeholders to monitor production conditions, forecast demand more accurately, optimize inventory management, and improve logistics coordination. These capabilities reduce transaction costs, minimize operational uncertainties, shorten distribution lead times, and enhance responsiveness to changing market demands. Furthermore, digital platforms facilitate collaborative planning and resource allocation among supply chain participants, resulting in higher operational efficiency and reduced post-harvest losses. Consequently, digital transformation strengthens supply chain integration while simultaneously improving productivity, increasing customer satisfaction, and generating greater economic value for local agricultural products (Khan et al., 2024).

The findings are equally consistent with Porter's Value Chain Theory, which argues that organizational competitiveness is created through a series of interconnected value-creating activities rather than isolated operational functions. Within the agribusiness context, every stage of the value chain, including input procurement, production, harvesting, processing, storage, transportation, marketing, and after-sales services offers opportunities for value creation through digital innovation. The reviewed literature indicates that digital technologies enhance these activities by improving production planning, facilitating precision agriculture, strengthening quality control systems, enabling real-time monitoring of product movement, and providing accurate market intelligence. Artificial Intelligence (AI) assists producers in predicting crop yields and detecting plant diseases at an early stage, while blockchain technology improves traceability and product authenticity, thereby increasing consumer trust in agricultural products. Digital marketplaces further expand market accessibility by connecting producers directly with buyers, reducing dependency on intermediaries and increasing farmers' bargaining power. Rather than serving merely as operational support tools, digital technologies function as strategic organizational resources that foster product differentiation, improve customer value propositions, strengthen brand reputation, and create sustainable competitive advantages. Consequently, digital transformation enables agribusiness enterprises to optimize every component of the value chain while maximizing the economic value generated from local agricultural commodities (Abedalrhman & Alzaydi, 2025).

Furthermore, the results support Rogers' Diffusion of Innovations Theory, which explains that the adoption of technological innovations is influenced by several interconnected factors, including perceived relative advantage, compatibility with existing practices, organizational readiness, communication channels, trialability, observability, and institutional support. The literature consistently indicates that the adoption of digital technologies within Indonesia's agribusiness sector remains uneven, particularly among smallholder farmers who dominate agricultural production. Financial constraints, inadequate digital literacy, insufficient technical skills, limited access to digital infrastructure, and weak institutional assistance continue to hinder the widespread implementation of digital innovations. In addition, socio-cultural factors, educational disparities, and varying levels of technological awareness contribute to differences in adoption rates across regions. These findings suggest that technological innovation alone cannot guarantee successful digital transformation without complementary investments in human capital development and institutional strengthening. Therefore, governments, universities, agricultural extension agencies, technology developers, and private-sector organizations should collaborate to enhance farmers' digital competencies through continuous training programs, knowledge-sharing initiatives, technical assistance, and accessible digital advisory services. Such collaborative efforts will accelerate innovation diffusion while reducing technological disparities among agricultural communities (Kulkarni & Jain, 2023).

Based on the synthesized literature, this study proposes an integrated conceptual strategy for developing a digital technology-based agribusiness supply chain consisting of five mutually reinforcing components. First, digital infrastructure should be strengthened by expanding reliable internet connectivity, cloud computing facilities, agricultural databases, and integrated information systems, particularly in rural and remote farming areas where digital access remains limited. Second, human resource capacity should be continuously improved through digital literacy education, technical training, agricultural extension services, and innovation incubation programs that enhance farmers' readiness to adopt emerging technologies. Third, integrated digital platforms should be established to connect all agribusiness stakeholders,

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including farmers, cooperatives, processors, distributors, logistics providers, financial institutions, government agencies, technology companies, and consumers, within a unified digital ecosystem that enables seamless information exchange and collaborative decision-making. Fourth, advanced technologies such as blockchain, IoT, artificial intelligence, and big data analytics should be systematically implemented to improve supply chain transparency, product traceability, quality assurance, demand forecasting, and operational efficiency across every stage of the agricultural value chain. Finally, supportive public policies should encourage digital investment through financial incentives, innovation grants, infrastructure development, regulatory harmonization, public-private partnerships, and long-term digital agriculture strategies. Collectively, these five strategic dimensions provide a comprehensive framework for accelerating digital transformation, strengthening agribusiness competitiveness, increasing the value added of local agricultural products, improving farmers' welfare, and supporting sustainable agricultural and rural economic development in Indonesia (Gryshova et al., 2024).

Table 3. Proposed Strategic Framework for Developing a Digital Technology-Based Agribusiness Supply Chain

Strategic Dimension	Strategic Action	Expected Outcome
Digital Infrastructure	Expand internet access and cloud services	Improved digital connectivity
Human Resources	Digital literacy and technical training	Increased technology adoption
Digital Integration	Develop integrated agribusiness platforms	Better stakeholder collaboration
Smart Agriculture	Implement IoT and AI technologies	Higher productivity and efficiency
Supply Chain Transparency	Utilize blockchain technology	Improved traceability & consumer trust
Digital Marketing	Strengthen e-commerce and digital marketplaces	Expanded market reach
Government Support	Incentives, regulations, and public investment	Sustainable digital transformation

Overall, the synthesized evidence indicates that digital technology-based agribusiness supply chains offer a comprehensive strategy for increasing the value added of local agricultural products in Indonesia. Digital transformation enhances operational efficiency, improves market integration, strengthens product traceability, reduces information asymmetry, and increases farmers' bargaining power. However, these benefits can only be fully realized through coordinated collaboration among government agencies, academic institutions, technology providers, financial organizations, agribusiness enterprises, and farming communities. Accordingly, the development of an integrated digital agribusiness ecosystem represents a strategic pathway toward sustainable agricultural competitiveness and inclusive rural economic development in Indonesia.

CONCLUSION

The development of a digital technology-based agribusiness supply chain represents a strategic solution to overcome structural challenges that limit the value added of local agricultural products in Indonesia. The literature synthesis demonstrates that digital technologies, including the Internet of Things, artificial intelligence, blockchain, big data analytics, cloud computing, and digital marketplaces, contribute to improving supply chain integration, operational efficiency, transparency, traceability, and market accessibility. These technological capabilities enable stronger coordination among stakeholders while reducing information asymmetry, production inefficiencies, and distribution constraints that have traditionally weakened the competitiveness of Indonesian agricultural commodities.

The successful implementation of digital agribusiness transformation depends not only on technological adoption but also on the establishment of a collaborative ecosystem involving government agencies, academic institutions, technology providers, financial organizations, agribusiness enterprises, and farmers. Strengthening digital infrastructure, enhancing digital literacy, promoting integrated digital platforms, and implementing supportive public policies are

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essential for achieving sustainable value creation. Consequently, an integrated digital agribusiness supply chain can serve as a comprehensive strategic framework for improving farmers' welfare, increasing the competitiveness of local agricultural products, and supporting inclusive and sustainable agricultural development in Indonesia.

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