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## Article

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## Digitalization for agricultural supply chains resilience: Perspectives from Indonesia as an ASEAN member

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### ABSTRACT

The COVID-19 epidemic has highlighted the vulnerability of international trade, forcing an increase in domestic supply reserves in Indonesia and other ASEAN countries. This transition underlines the need of sustainable practices in addressing the changing expectations of organizations and consumers in the field of supply chain management. Recognizing the importance of agriculture in Indonesia's context, this study investigates into the digital implementation throughout agricultural supply chains. The study explores the benefits and challenges of incorporating digitalization in agricultural supply chains by conducting in-depth interviews with stakeholders from many sectors, including farmers, experts, industry practitioners, academia, and government representatives. Stakeholder insights provide information about the possible benefits of digital transformation, such as greater income, cost savings, and improved collaboration. Furthermore, the report identifies important challenges such as insufficient infrastructure and data security problems that must be addressed. In addition to improving agricultural supply chain efficiency, digitalization is found to have broader implications for maritime logistics, a crucial component of Indonesia's archipelagic trade system. By optimizing the coordination between agricultural production and shipping schedules, digital tools can reduce delays, streamline logistics operations, and enhance overall supply chain resilience. This study not only addresses challenges in Indonesia's agricultural sector but also contributes to the broader goal of promoting innovation and sustainability in logistics and shipping within Indonesia and across the ASEAN region.

### 1. Introduction

Agriculture plays a pivotal role in the economies of Indonesia and the ASEAN region, contributing significantly to both employment and GDP. In Indonesia, approximately 30 % of the workforce is engaged in agriculture, accounting for around 14.2 % of the nation's GDP (Purba et al., 2023). This sector encompasses various activities, including plantation crop production, food crop cultivation, horticultural crop farming, and farmer trade, all of which exert notable positive impacts on the economic growth of agriculture (Purba et al., 2023). The sector drives economic growth and supports rural communities. However, despite its importance, the sector faces several challenges, including vulnerabilities in its supply chains, exacerbated by external shocks like the COVID-19 pandemic.

Numerous studies underscore the role of agricultural sector growth in poverty reduction, job creation, and income enhancement within local communities (Afriyanti et al., 2023). The COVID-19 crisis

highlighted the fragility of agricultural supply chains in Indonesia and other ASEAN nations. Disruptions to transportation, labor shortages, and increased demand for domestic food security have underscored the urgent need for a more resilient and responsive supply chain. In this context, digitalization offers a promising solution for enhancing agricultural supply chain resilience. Technologies such as the Internet of Things (IoT), blockchain, and big data analytics have demonstrated their potential to improve coordination, transparency, and efficiency in supply chains (Ebinger & Omondi, 2020). Moreover, digitalization can improve logistics coordination by aligning agricultural production with shipping schedules, which is particularly important for a country like Indonesia, where maritime logistics plays a vital role in distributing agricultural products across its islands and beyond.

Despite these promising developments, significant gaps remain in our understanding of how digitalization can be effectively integrated into agricultural supply chains, particularly in the ASEAN region. While some studies have explored the potential benefits, there is limited

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research that focuses on the unique challenges faced by Indonesia and its neighbors, especially in terms of infrastructure, digital literacy, and stakeholder collaboration. This research gap calls for a deeper investigation into how digital tools can address the specific needs of agricultural supply chains in the ASEAN region, particularly in enhancing resilience against external disruptions.

In ASEAN countries, particularly Indonesia, digitalization efforts are increasingly recognized as crucial for strengthening agricultural supply chain resilience. Governments and private sectors are gradually adopting technologies to improve agricultural productivity, reduce costs, and enhance market access (Montesclaros & Teng, 2023). However, the adoption of digital tools remains uneven, with significant disparities between urban and rural areas. Moreover, challenges such as inadequate infrastructure, lack of technical know-how among farmers, and concerns over data security continue to hinder widespread digitalization in the sector.

Indonesia's initiatives to fortify the resilience of its agricultural supply chain extend beyond local impacts, presenting broader implications for the ASEAN region as a whole (Delfiyanti, 2023). As Indonesia plays a significant role in ASEAN trade, improvements in agricultural logistics, particularly through maritime transport, can support regional trade networks and foster sustainable practices across borders (Amin et al., 2021). Prioritizing infrastructure improvement, technological advancement, and trade cooperation, the government aims to support economic growth and food security across the region (Miryanti & Linggarwati, 2014).

Given the increasing importance of building resilient supply chains to ensure food security and economic stability in the ASEAN region, this study seeks to address these challenges by exploring the current state of digitalization in Indonesia's agricultural sector. By examining the benefits and barriers to digital integration, this research aims to contribute to the broader understanding of how digital tools can enhance supply chain resilience in the ASEAN context.

Thus, this study aims to bridge the existing research gap by examining the role of digitalization in strengthening agricultural supply chains in Indonesia and the broader ASEAN region. The findings of this research will provide insights into how digital tools can be effectively implemented to enhance resilience and ensure sustainable growth in the agricultural sector. In doing so, the study aims to support efforts towards building more responsive, resilient, and efficient agricultural supply chains, contributing to regional food security and economic development.

## 2. Literature review

### 2.1. The importance of farming in the economies of ASEAN nations

Agriculture stands as a cornerstone of the economies of ASEAN member states, playing a crucial role in contributing to GDP, providing employment opportunities, and ensuring food security across the region (Than, 1998; Bello, 2005; Kanō, 2014; Aksenov et al., 2021; Quibria, 2023). The significance of agriculture transcends mere economic metrics, as it also encompasses social-cultural and environmental dimensions crucial for sustainable development (Lee, 2005). Agriculture contributes substantially to the GDP in many ASEAN countries, reflecting its economic importance. For instance, in Indonesia, agriculture contributes approximately 14 % to the country's GDP (BPS, 2020; Purba et al., 2023), while in countries like Vietnam and Thailand, its contribution is even larger, reaching around 24 % and 9 %, respectively (Maitah, Smutka, Sahatqija, Maitah, & Anh, 2020; Warr & Suphannachart, 2020). Additionally, the agricultural sector remains a primary source of employment for millions of people in ASEAN countries, especially in rural areas where alternative livelihood opportunities are limited (Than, 1998; Lohmann & Liefner, 2014).

The agricultural sector plays a critical role in ensuring food security in ASEAN member countries, particularly in Thailand, Indonesia,

Vietnam, the Philippines, and Malaysia (Golan & Kohli, 2013; Mizik, 2021; Arifah & Kim, 2022). With the continuously growing population and increasing urbanization, the demand for food continues to rise, placing greater pressure on agricultural production systems (Wu et al., 2011; Satterthwaite et al., 2010; Chen et al., 2022; Beckers et al., 2020). ASEAN countries rely on agriculture not only to meet domestic food demand but also to contribute to regional food security through trade and intra-regional cooperation (Bandara & Cai, 2014; Faqih & Siswoyo, 2020; Mukhlis et al., 2021; Sundram, 2023).

ASEAN member countries are known for a diverse range of agricultural products, reflecting the agroclimatic diversity and fertile land in the region (Saravanamuttu, 1994; Golan & Kohli, 2013; Mizik, 2021). For example, Indonesia is renowned for its production of rice, palm oil, and rubber, which are not only essential for domestic consumption but also for export to global markets (Rulli et al., 2019; Hutapea et al., 2022). Similarly, Vietnam is one of the major exporters of rice and coffee (Thuy, 2021), while Thailand is known for its exports of rice, fruits, and fisheries products (Suvannus, 1980). These agricultural products serve as significant drivers of economic growth, export earnings, and rural development within the ASEAN economy.

### 2.2. Digitalization in agricultural supply chains

Numerous studies emphasize the critical role of digitalization in strengthening agricultural supply chain resilience. For instance, according to research by Wrzecińska et al. (2023) and Montesclaros and Teng (2023), digital technology enables real-time monitoring of farming processes, facilitating proactive decision-making and risk management in response to disruptions. Similarly, Ebinger and Omondi (2020) argue that digitalization enhances visibility and transparency in the supply chain, enabling stakeholders to identify vulnerabilities and implement targeted interventions to mitigate risks.

Recent research indicates a trend towards digitalization in the agricultural sector, driven by advancements in technologies such as the Internet of Things (IoT) and blockchain. According to Yang et al. (2021), IoT-enabled sensors and devices are increasingly being used across the agricultural supply chain to monitor crop conditions, track inventory, and optimize logistics operations. Additionally, blockchain-based platforms are gaining popularity for their ability to enhance tracking and transparency in agricultural transactions (Salah et al., 2019; Yang et al., 2023). The literature emphasizes numerous benefits associated with digitalization in the agricultural supply chain. Studies by Sharma et al. (2021) found that digital technology enables precision farming practices, resulting in increased yields and resource efficiency. Furthermore, according to research by Syromyatnikov et al. (2020), digitalization enhances the agility and responsiveness of the supply chain, enabling farmers to adapt to changing market conditions and consumer preferences more effectively.

Despite its various potential benefits, the adoption of digital technology in the agricultural supply chain faces several challenges. For example, inadequate digital infrastructure, high implementation costs, and concerns regarding data security and privacy (Kamble et al., 2019; Ageron et al., 2020; Song et al., 2020; Tzachor et al., 2022; Gupta et al., 2020). Additionally, according to research by Kamble et al. (2019) and Sahebi et al. (2020), limited digital literacy among farmers and supply chain stakeholders is a significant barrier to the widespread adoption of digital technology.

### 2.3. Policies and initiatives for agricultural supply chains

Governments across ASEAN have implemented various policies and initiatives to support the agricultural sector and promote its development. In Indonesia, for instance, the government has launched programs such as the Food Estate Program and the Village-Owned Enterprises (BUMDes) initiative to enhance agricultural productivity, improve farmer welfare, and ensure food security (Viphindartin et al., 2018;

Marwanto & Pangestu, 2021; Siborutorop, 2023). Similarly, countries like Vietnam have implemented agricultural restructuring policies aimed at modernizing the sector, enhancing competitiveness, and promoting sustainable development (Dao & Nguyen, 2022; Pham, 2022). The adoption of digitalization has profound implications for agricultural stakeholders across the supply chain. Governments and policymakers play a critical role in creating a supportive environment for digitalization adoption through supportive policies, investments in infrastructure, and capacity-building initiatives (Pena-Lopez, 2010; Booth, 2018; Apriliyanti et al., 2020; Testa, 2023).

Governments worldwide have implemented various policies and initiatives to promote digitalization in agriculture. For example, the Korean Government aims to provide digital infrastructure and services to rural areas, including access to agricultural information and market data (Moon et al., 2012; Park & Moon, 2019). Similarly, regional organizations such as the ASEAN Secretariat have launched initiatives to support digitalization efforts in agriculture, such as the ASEAN Digital Integration Framework (ASEAN, 2020; Montesclaros & Teng, 2023).

### 3. Methodology

In this study, a qualitative research approach was employed, utilizing semi-structured interviews to gather data from various stakeholders within Indonesia’s agricultural sector. Semi-structured interviews were selected for their flexibility, allowing for a combination of pre-determined questions with open-ended discussions, thereby enabling the exploration of a wide range of perspectives and the emergence of unanticipated insights (Braun & Clarke, 2006; Patton, 2014).

A total of 15 participants were included in the study, as outlined in Table 1. The sample comprised 11 males and 4 females, with ages ranging from 20 to 59 years. While all participants were originally from Indonesia, during the interview process, one participant was interviewed while temporarily located in Korea. Participants represented a variety of stakeholder groups, including government officials, farmers, academics, startup employees, and employees from trade companies. This diverse representation ensured that a comprehensive range of perspectives regarding the digitalization of agricultural supply chains was captured.

Participants were selected through purposive sampling, followed by snowball sampling, to ensure that individuals with relevant expertise and experience were included. Table 2 provides details on each participant’s background, identified by a unique code and professional role. Specifically, 3 participants were from the government sector (P1, P9, P13), 3 were academics (P2, P4, P8), 3 were farmers (P3, P7, P14), 4 were startup employees (P5, P11, P15), and 2 were trade company employees (P6, P10). The inclusion of these different stakeholder groups

**Table 1**  
Interview Participant Characteristic.

Total		15
<b>Gender</b>		
Male		11
Female		4
<b>Age</b>		
20–29 Years old		4
30–39 Years old		5
40–49 Years old		3
50–59 Years old		3
<b>Location</b>		
Indonesia		14
Korea		1
<b>Stakeholder Group</b>		
Government		3
Farmers		3
Academics		3
Startup Employee		4
Trade Company Employee		2

**Table 2**  
Interview Participant backgrounds.

Code	Gender	Description
P1	Male	Government
P2	Female	Academic
P3	Male	Farmer
P4	Male	Academic
P5	Male	Startup Employee
P6	Male	Trade Company Employee
P7	Male	Farmer
P8	Female	Academic
P9	Male	Government
P10	Male	Trade Company Employee
P11	Male	Startup Employee
P12	Male	Academic
P13	Female	Government
P14	Male	Farmer
P15	Male	Startup Employee

was deemed essential to obtain a comprehensive understanding of the challenges and opportunities associated with digitalization in the agricultural sector.

Interviews were conducted either via online platforms or face-to-face, depending on the availability of participants. All interviews were recorded and transcribed professionally to ensure accuracy. The collected data were then coded and analyzed using thematic content analysis (Braun & Clarke, 2006), allowing for the identification of key themes and recurring patterns in participants’ views. This method was chosen to extract meaningful insights regarding the role of digitalization in enhancing the resilience of agricultural supply chains, particularly within the ASEAN context.

### 4. Result

#### 4.1. Challenges of digitalization for agriculture supply chain resilience

Fig. 1 illustrates the critical challenges identified from the interview results regarding the integration of digitalization in agricultural supply chains. The primary challenge in integrating digitalization into agricultural supply chains in Indonesia is the lack of infrastructure, as emphasized by several participants. This perspective reflects the direct difficulties faced by farmers in embracing digital innovations.

*"Limited access to reliable internet connection and electricity in rural areas restricts our ability to implement digital technology."* (P3)

Moreover, participants from the government (P1) highlight the importance of rural infrastructure improvement as a priority to support agricultural supply chain resilience. This indicates the government’s awareness and commitment to improving infrastructure conditions in rural areas. Participants from the private sector, such as trading companies (P10), also emphasize the need for private sector support in enhancing rural infrastructure. This underscores that cross-sector collaboration is key to addressing infrastructure challenges.

*"Collaboration between the private sector and the government is crucial to accelerate rural infrastructure development."* (P10)

Another challenge is the lack of skills among farmers to effectively adopt digital technology. Eleven participants express concerns about farmers’ lack of skills in adopting digital technology.

*"I lack understanding in utilizing digital tools effectively to enhance productivity."* (P14)

On the other hand, an academic participant (P2) highlights the lack of training and education focused on digital technology, inhibiting farmers’ ability to benefit from innovations in the agricultural sector.

Another challenge raised by participants is the low visibility of the benefits of digitalization in agriculture. Eleven participants highlight farmers’ lack of awareness of the benefits of digital technology, leading to reluctance in adoption.

*"Among farmers, many are unaware of the benefits of digital technology,*

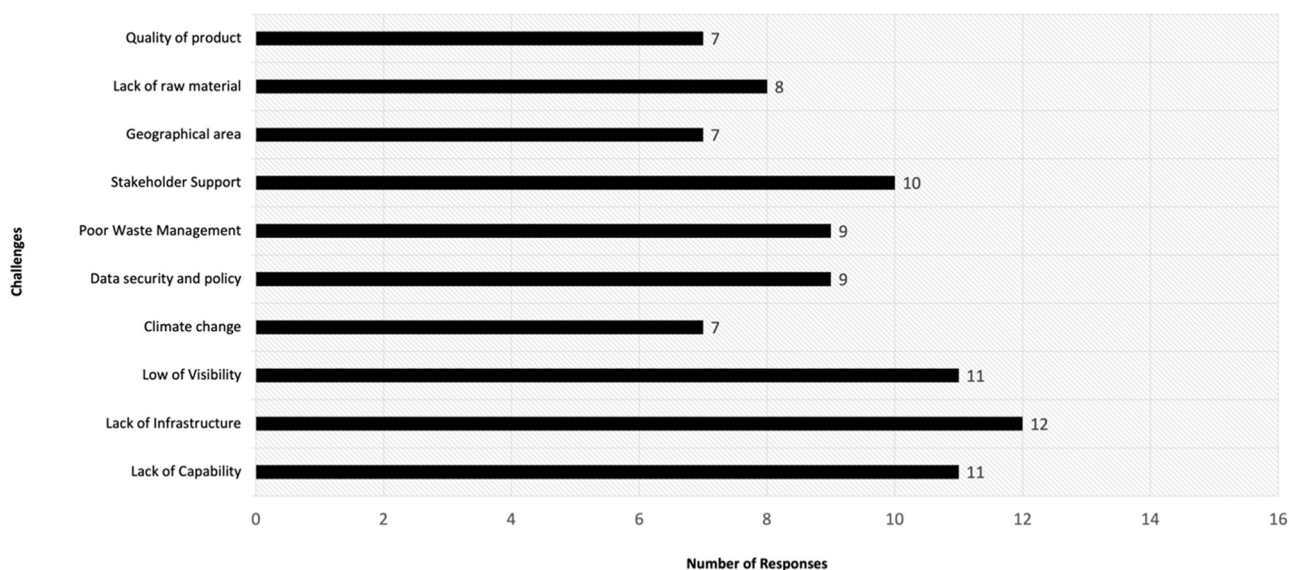


Fig. 1. Challenges of Digitalization for Agriculture Supply Chain Resilience.

causing us farmers to be reluctant in using technology.” (P7)

This perspective emphasizes the importance of awareness and education in promoting digital solution adoption among farmers. Academic participants (P8) also support this view, highlighting the low visibility of the potential benefits of digitalization hindering widespread adoption of digital technology in agriculture. This underscores the importance of initiatives aimed at increasing awareness and knowledge about the advantages of digital tools among stakeholders in the agricultural sector.

The importance of support and collaboration from stakeholders is also highlighted by participants. Ten individuals emphasize the significance of building greater cooperation among stakeholders to advance digitalization in agriculture.

“Collaboration among stakeholders, including government agencies, private companies, and farmer organizations, is crucial to drive digital innovation in agriculture.” (P6)

This sentiment aligns with views shared by participants from various sectors. For example, government representatives (P9) acknowledge the need for multi-stakeholder partnerships to effectively leverage resources and expertise. Similarly, participants from the private sector, such as startups (P15), highlight the value of collaborative efforts in driving digital innovation. Participant (P14) also emphasizes the importance of stakeholder collaboration.

“Government agencies should collaborate with private companies and farmer organizations to develop comprehensive digitalization strategies and initiatives.” (P9)

“Working with government agencies and farmer organizations enables us to collectively create solutions that address the specific needs and challenges in the agricultural sector.” (P15)

“Communicating with government agencies and private companies allows us to advocate for policies and technologies that benefit farmers and promote sustainable agriculture.” (P14)

Climate change emerges as a significant concern among seven participants, highlighting its adverse impacts on agricultural supply chain resilience.

“Changing weather patterns and unpredictable climate conditions pose significant challenges to agricultural production and management.” (P4)

In addition to climate change, poor waste management practices are identified as an urgent issue by nine participants. They highlight the detrimental effects of inefficient waste management on environmental health and long-term agricultural sustainability.

“Inefficient waste management practices contribute to environmental degradation and pose threats to long-term agricultural sustainability.” (P10)

#### 4.2. Benefits of digitalization for agriculture supply chain resilience

Fig. 2 highlights the benefits of digitalization for agricultural supply chain resilience, as identified by the interview participants. Thirteen participants emphasize the crucial role of digital platforms in facilitating synergy with agricultural stakeholders. This view underscores the transformative impact of digitalization in breaking down barriers and facilitating smooth communication and collaboration among various parties.

“Digital platforms serve as catalysts for collaboration and knowledge sharing among stakeholders across the agricultural value chain.” (P6)

Participants from various sectors emphasize the importance of synergy with stakeholders in driving digital innovation. Government representatives (P13) acknowledge the role of digital platforms in promoting multi-stakeholder partnerships and collective action. Private sector participants, such as startup employees (P15), also highlight the value of synergy with stakeholders in driving digital transformation.

“Digitalization enables government agencies, private companies, and farmer organizations to collaborate effectively, resulting in innovative solutions and sustainable practices.” (P13)

“Collaborative initiatives involving stakeholders from various sectors promote innovation and accelerate the adoption of digital technology in agriculture.” (P15)

Participants also recognize the broader implications of synergy with stakeholders beyond technology adoption.

“Synergy with stakeholders promotes knowledge exchange, capacity building, and inclusive decision-making processes in agriculture.” (P2)

The importance of educational support from digital technology in agriculture emerges as a frequently recurring theme among participants, highlighting the transformative role of digital platforms in knowledge dissemination and capacity building. Twelve participants emphasize the significant educational support offered by digital technology.

“Digital platforms play a crucial role in providing farmers with access to information, training, and consulting services.” (P8)

“Startups leverage digital platforms to provide interactive learning experiences and personalized training modules for farmers, facilitating skill development and technology adoption.” (P11)

Moreover, participants acknowledge the broader implications of educational support beyond individual capacity building.

“Educational support through digital platforms promotes innovation and entrepreneurship in agriculture, fostering a culture of lifelong learning and continuous improvement.” (P4)

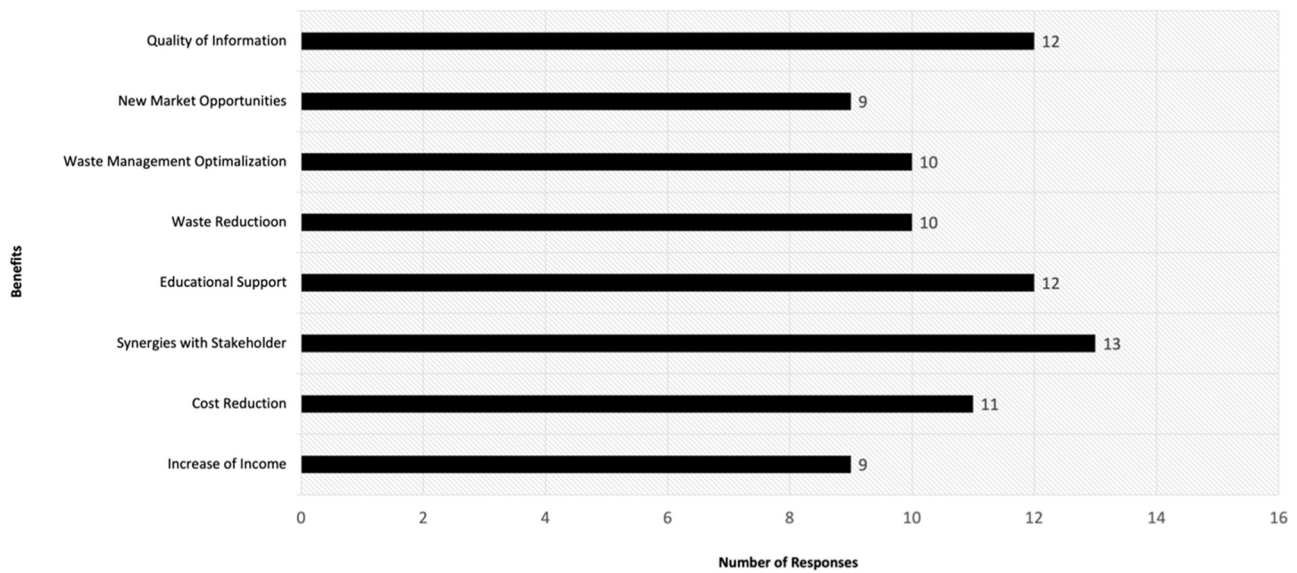


Fig. 2. Benefit of Digitalization for Agriculture Supply Chain Resilience.

Twelve participants highlight the value of digital technology in improving the quality of information available to agricultural stakeholders. Government representatives (P13) acknowledge the role of digital platforms in providing policymakers with data-driven insights to inform evidence-based policy decisions.

"Digital platforms enable stakeholders to access real-time data, market intelligence, and agronomic insights, empowering them to make informed decisions." (P5)

"Digital technology allows policymakers to access reliable data and analysis, facilitating evidence-based policymaking and resource allocation." (P13)

"Access to high-quality market intelligence and agronomic data through digital platforms enables companies to identify opportunities, optimize supply chains, and enhance product offerings." (P6)

The potential for cost reduction through digital technology adoption in agriculture emerges as a highlighted theme among participants, reflecting the transformative impact of digitalization on operational efficiency and resource management. Eleven participants emphasize the significant cost reduction potential through digital technology adoption. Views shared by participants from various sectors further emphasize the impact of cost reduction in driving digital transformation.

"Digital tools offer opportunities to minimize input costs, optimize resource utilization, and improve operational efficiency." (P10)

"Digital technology enables government agencies to support farmers with tools and solutions that optimize resource use and reduce production costs." (P9)

"Adopting digital technology allows companies to lower production costs, increase profit margins, and remain competitive in the market." (P6)

"Cost reduction through digital technology promotes sustainability by minimizing resource waste and environmental impact in agriculture." (P4)

Nine participants acknowledge the potential of digitalization to increase farmers' income through various means such as optimizing production processes, improving market access, and enabling better price negotiations. Similarly, nine participants recognize the potential to access new market opportunities through digitalization. Government representatives (P1) acknowledge the role of digital platforms in enabling farmers to leverage market intelligence and consumer insights to identify and capitalize on emerging market trends.

"Digital platforms provide opportunities for startups to explore new markets, innovate in product offerings, and create value for farmers and consumers." (P15)

Ten participants emphasize the potential waste reduction through

digitalization, acknowledging that digital tools can play a significant role in optimizing resource management practices, minimizing losses, and reducing environmental impacts in agricultural production. Participants from various sectors emphasize the connection between waste reduction and optimization of waste management practices with broader sustainability goals.

"Digital technology enables government agencies to implement data-driven approaches to waste management, promoting resource efficiency and environmental sustainability." (P9)

"Optimizing waste management practices through digitalization enhances brand credibility and demonstrates commitment to environmental sustainability." (P6)

"Efficient waste management through digital technology contributes to environmental conservation and climate resilience, promoting long-term sustainability in agriculture." (P12)

## 5. Discussion

Semi-structured interviews were conducted with stakeholders in the agricultural sector to explore the challenges and benefits of digitalization in the context of sustainable agriculture in Indonesia, with broader implications for ASEAN.

The limitations of digital infrastructure, such as limited internet access and unstable electricity supply in rural areas, pose major obstacles to integrating digitalization into the agricultural supply chain in Indonesia. Significant investment is needed to improve digital and physical infrastructure in rural areas, with collaboration between the government and other stakeholders (Rozikin et al., 2023; Rahman, 2022; Montesclaros & Teng, 2023).

The inability of farmers to acquire adequate training in digital technology and the lack of digital literacy among farmers are significant barriers to adopting digital technology in the agricultural sector. Sustainable investment is needed in educating and training farmers on the use of digital technology in agriculture (Deichmann et al., 2016; Bocharova, 2020). Collaboration between the government, educational institutions, and the private sector needs to be enhanced to improve farmers' capabilities in adopting digital technology.

The lack of awareness and understanding of the benefits of digitalization in agriculture, as well as the lack of support and collaboration among stakeholders, are crucial challenges in integrating digitalization into the agricultural supply chain in Indonesia. The importance of cross-sectoral cooperation in addressing challenges in agriculture related to

climate change has been highlighted (Ammar et al., 2023). However, challenges in integrating digitalization into the agricultural supply chain may hinder efforts to improve food security in affected regions (Montesclaros & Teng, 2023). Research by Deichmann et al. (2016) and Febrianda (2021) shows that the adoption of digital technology in agriculture can significantly reduce production costs, improve operational efficiency, and strengthen farmers' economic resilience.

In addition to enhancing the efficiency of agricultural supply chains, digitalization has broader implications for Indonesia's maritime logistics environment. As an archipelagic country, Indonesia relies heavily on maritime transport to distribute agricultural products across its islands and to international markets. Digital platforms can facilitate better coordination between agricultural producers and logistics providers, reducing shipping delays, optimizing transport schedules, and improving overall logistics efficiency (Amin et al., 2021). The integration of real-time data from digital systems can help align agricultural production cycles with shipping schedules, reducing idle time at ports and improving cost efficiency. This is particularly relevant for the ASEAN region, where maritime logistics is a critical component of regional trade. By enhancing both agricultural supply chain resilience and maritime logistics efficiency, digitalization supports broader goals of innovation and sustainability in Indonesia and the ASEAN community.

These results highlight the importance of addressing infrastructure challenges, lack of digital knowledge and skills, and lack of awareness and support from stakeholders in integrating digitalization into the agricultural supply chain in Indonesia and ASEAN. Godin et al. (2020) demonstrate that the lack of coordination and collaboration among stakeholders can be a barrier to implementing digital solutions in agriculture. Investment and efforts in agricultural digitalization can be an effective strategy in strengthening food supply chain resilience in the region, by enhancing operational efficiency, product quality, and farmer income. Cross-sectoral cooperation between the government, private sector, educational institutions, and civil society organizations is needed to create an environment supportive of the adoption of digital technology in agriculture.

## 6. Conclusion

This research highlights the challenges and benefits of digitalization in the agricultural supply chain, focusing on the perspectives of stakeholders in Indonesia as a member of ASEAN. The aim was to explore perceptions of the importance of digitalization in enhancing agricultural supply chain resilience. Through semi-structured interviews, a significant gap in awareness of the benefits of digitalization was identified, with most participants expressing concerns about a lack of understanding of digital technology. Other challenges, such as limited infrastructure, lack of digital literacy, and insufficient stakeholder support, were also identified. However, the potential benefits of digitalization, including increased income, cost reduction, and improved operational efficiency, have been emphasized.

While the focus of this study is on the agricultural sector, the findings suggest that broader implications for maritime logistics in Indonesia and ASEAN could arise from digitalization. As an archipelagic country, Indonesia heavily relies on maritime transport to distribute agricultural products both domestically and internationally. By facilitating better coordination and optimizing shipping schedules, delays could be reduced, and overall logistics efficiency improved through the use of digital platforms. This is aligned with ASEAN's broader goals of enhancing regional connectivity and fostering sustainable trade practices.

It has been emphasized that raising awareness and knowledge about digital solutions in agriculture and logistics is crucial. This research provides insights into the complexity of challenges and benefits associated with digitalization in the agricultural sector, with potential spill-over effects on logistics and shipping.

The practical implications of this research are seen as relevant for policymakers, agricultural organizations, and technology providers, with the potential to build a more resilient, efficient, and sustainable agricultural supply chain. Moreover, it is suggested that the adoption of digital solutions could enhance maritime logistics and support cross-border trade within ASEAN, thereby promoting innovation and sustainability across the region's supply chains. However, the study's limitations, particularly the small sample size and the focus on qualitative data, highlight the need for further research. Future studies should consider employing larger sample sizes and incorporating quantitative methods to validate and expand upon the findings of this study. Additionally, further investigation into the specific impact of digitalization on maritime logistics in Indonesia and ASEAN is recommended to provide deeper insights and a more comprehensive understanding of the subject.

## CRedit authorship contribution statement

**Hyunmi Jang:** Supervision, Methodology. **Ji-Min Sur:** Writing – review & editing, Methodology. **Dimas Harris Sean Keefe:** Writing – original draft, Investigation.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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