Multidisciplinary Reviews

REVIEW ARTICLE
Published Online: September 21, 2026
https://doi.org/10.31893/multirev.2027153

Logistics distribution management in the agricultural commodity supply chain in the Indonesian and global contexts: A systematic literature review

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Abstract Global developments in food logistics and distribution systems encourage the transformation of agricultural supply chain management toward a more digital, adaptive, and sustainable system. The distribution of agricultural commodities in Indonesia, as an archipelagic nation, faces particularly complex challenges due to limited infrastructure, high logistics costs, long distribution chains, the perishability of agricultural products, and low levels of technological and market information integration. These conditions lead to distribution inefficiencies, food price instability, and low competitiveness of the national agribusiness sector within the global supply chain. This study employs a Systematic Literature Review (SLR) method based on a qualitative literature review approach combined with bibliometric analysis of scientific publications from 2021 to 2025 obtained from Google Scholar, Scopus, and Crossref. The analysis was conducted using the Publish or Perish and VOSviewer applications to map research trends, thematic clusters, and inter-conceptual relationships within agricultural logistics distribution. Research findings indicate that global trends in agricultural supply chain management (SCM) have shifted from conventional efficiency-focused approaches toward systems based on digitalization, supply chain resilience, green logistics, and food sustainability. Technologies such as IoT, blockchain, Global Positioning System (GPS), Geographic Information System (GIS), Artificial Intelligence (AI), and big data have proven to enhance transparency, traceability, distribution efficiency, and real-time decision-making. The main challenges in the Indonesian context include inter-island distribution, low digital literacy among smallholder farmers, limited cold chain infrastructure, and weak integration of national logistics data. Theoretically, this study contributes to the development of SCM theory by integrating perspectives on supply chain resilience, digital agriculture, and the sustainability transition. Practically, the research findings provide recommendations for the development of smart logistics, the strengthening of food distribution infrastructure, the integration of logistics information systems, and multi-stakeholder collaboration to support a more efficient and sustainable national food security system.

Keywords: agricultural, development, food commodity, information technology, sustainability

1. Introduction

Distribution and logistics have experienced dynamic changes, making the field all the more critical with the changing roles and duties of logistics managers and employees. Their logistic activities have also involved major activities in the improvement of services and cost reduction in critical sectors of their logistics operations, supply chains, distribution, transportation, and supply chain management (Hübner et al., 2016; Raicu et al., 2024). Transport, inventory, and warehousing have become among the core aspects of logistics that have become central to business, industry, and economic ventures.

The contribution of logistics managers to improving the efficiency of the supply chain and distribution of agricultural products covers the procurement of raw materials to the final delivery of the product, which has a wide reach to consumers and will satisfy them. Effective logistics plans are needed to ensure high efficiency and timeliness of the delivery of agricultural products to the market. Such problems not only impact the productivity of farmers but also determine the prices of food and its supply to consumers. Some of the essential issues that are regularly faced in the distribution of agricultural products are (1) Geographical characteristics of an archipelago and a shortage of infrastructure; (2) product spoilage and uncertainty in the supply chain; and (3) Unavailability of technology and market information (Fauziana et al., 2023; Mulyati & Geldermann, 2017; Perdana et al., 2023)

 Received: March 28, 2026 | Accepted: May 16, 2026

Nevertheless, logistics has not been perceived as a focal activity in the last 20 years, and in certain situations, it remains a separate management activity. Studies on logistics and supply chain management (SCM) have presented more scientific approaches to understanding the interrelations among individual subsystems.These approaches address needs and how they can be accomplished through discussions on physical distribution, business logistics, materials management, procurement and supply, product flow, marketing logistics, supply chain management, and demand chain management (Ahmadi et al., 2023; Cavalcanti, 2021; Parfenov et al., 2021).

Every business enterprise, its industry or business has its own specifications, in the form of variety of strategies, product lines, and market areas. Therefore, logistics is regarded as a versatile, dynamic, and flexible operation, that should adjust to different local, national, regional, and global restrictions and requirements (Kumar & Kumar Singh, 2022; Sharma, 2024).There are other institutions, such as military, economic and academic institutions, whose roles are fascinating and hence more additions to the discourse. According to modern business and industrial methods, logistics involves the effective transportation of products at supply locations through production sites to consumption centers in a cost-efficient fashion and the ability to provide satisfactory quantities of service to customers during the process of distribution of the supply chain.

The distribution of agricultural products, however, continues to face many challenges, such as in pricing, long marketing chains, disproportionate profitability, and product quality and availability assurance. In addition to infrastructure, product decay and limited access to technology and market data are major limitations of agribusiness logistics in Indonesia. Mostrural farmers do not have access to sophisticated technology or correct market demand and prices. Such inefficiency in distribution is usually witnessed in the delivery of products in wrong markets or at the wrong time, which reduces their value or even causes a loss of money. To addres this problem, more efforts should be made to grant farmer access to digital technology and market information, whether by training or creating applications that will help themmake better logistics decisions (Ali et al., 2023; Han et al., 2021; Kamble et al., 2020).

The discussion of logistics and supply chains involves not only the physical flow and storage of raw materials to the final distribution of finished goods but also the flow and storage of information. The importance of information flows, alongside physical flows and storage, is therefore paramount. An additional, highly relevant factor is reverse logistics, which involves managing the flow of used products and packaging within a circular system in business, industrial, and other institutional management (Fang et al., 2022; Hazen et al., 2020; Julianelli et al., 2020).

Other institutions, such as military, economic, and academic entities, present intriguing differences in their roles, further enriching the discourse. Modern business and industrial approaches suggest (Christopher, 2016; Loska et al., 2025) that logistics involves the efficient movement of goods from supply sources through manufacturing facilities to consumption points in a cost-effective manner while acceptable levels of service are delivered to customers throughout the supply chain distribution process. The main task of SCM is to organize activities throughout the supply to maximize the competitive advantage and profitability for end-users. Efficient cost-cutting can help companies meet their profit objectives more effectively than simply selling more. Supply chains are currently receiving a higher level of focus because companies are aiming to improve their competitiveness by marketing their products, providing quality, and reducing costs and delivery time (Gunasekaran et al., 2017; Khawka et al., 2024; Petropoulos et al., 2026).

Suppliers can be strategic when they help to create competitive advantages through a long-term strategic alliance. Compared with traditional lead-time considerations, supply chains demand various approaches, depending on their emphasis: low costs or rapid response methods. Businesses need to incorporate their supply chain plans and expect the plans to differ according to the kind of goods and change as products pass through their life cycles (Dieu et al., 2023; Lesmana, 2023; Risanda et al., 2024)

New logistics management must overcome these challenges, which means that an integration approach to include (Castelein et al., 2020; Keefe et al., 2024; Mintje et al., 2025) the following is necessary: (1) massive investment in transportation infrastructure, especially the construction of highways, railways, and ports, to facilitate faster delivery of agricultural products; and (2) the development of cold chains, which is very important for maintaining the quality of perishable products. It is necessary that the government and the private sector cooperate with each other to develop cold storage facilities at strategic points in Indonesia and (3) the introduction of digital technology to improve the efficiency of the logistics of agribusiness. SCM systems based on information technologies allow for the tracking and control of product transportation in real time, response to changes in the market situation and demand trends. The use of digital applications and platforms that directly connect farmers to buyers can also lower the use of intermediaries, which usually increase the cost of distribution.

The agricultural commodity supply chain is an economic system, and it transfers both benefits and risks to stakeholders, which include producers, suppliers, and consumers. The synergetic relationships between different processes should result in added value, and on this basis, stakeholders will be able to coordinate distribution operations with ideal quantities, locations, and timings (Anastasiadis et al., 2022; Routroy & Behera, 2017).

Agricultural management failures may also result in the loss of the value of distributed commodities or their total loss (Kamble et al., 2020; Péra et al., 2023; Qange et al., 2024). These losses or decreases in quantity or quality may be a result of time dimensions, distance, temperature, or the mode of transport employed in every part of the distribution chain. Therefore,

the use of technology, including agricultural logistics information systems, expected to alleviate the problem of inventory level determination and the distribution process.

Distribution is a component of supply chain management and includes the purchase of raw materials through the supply of goods to the consumer across a wide and acceptable range of services. SCM is an umbrella term (Fang et al., 2022; Jamaluddin & Saibani, 2021; Prasad et al., 2019) that comprises all the parts of the supply chain process, including its components, suppliers, manufacturing companies, service providers, distributors, wholesalers, and retailers who supply goods or services to end-users.

The players in the contemporary world seem to be more pampered by manufacturers, and this manifests in the growing number of products offered in the market. This change underscores the fact that the overall strategies of companies are becoming more customer oriented. Products have become differentiated from personal interests, unlike in the past, when producers clustered consumers into general segments (Bednarski et al., 2025; Jafari et al., 2023; Petropoulos et al., 2026; Um et al., 2017). The vast diversity of products and the uncertainty in the quantity required for each have placed additional strain on producers attempting to meet consumer demands.

The shortening of product life cycles has further complicated supply chain strategies, as businesses require specific lead times to manage the supply of particular goods. In market terms, a product's life cycle refers to the duration it has been available to consumers.In the market, the product life cycle is defined as the amount of time a product has been in the market (Harfeldt-Berg & Olhager, 2024; Petropoulos et al., 2026). However logistics and supply chains provide many benefits. There are still various challenges in their implementation, especially in terms of the distribution of agricultural commodities. Some of the main obstacles that are often faced by logistics distribution in the supply chain are lack of technology, perishable products, limited access, and spatial conditions.

SCM strives to address demand growth as swiftly as possible, given that consumers increasingly expect prompt fulfillment even in the face of unpredictable demand or nonstandardized (customized) products (Han et al., 2021; Tiedemann, 2020). This relationship suggests that a supply chain represents a large network of partners, who have distinctive interests; thus, SCM is becoming more complex and time-consuming. Globalization has also made supply chain management more complex, with the involved parties being based in different countries and possibly being based in different locations around the globe. In this study, the concentration is on distribution and logistics, and the indices are large and elaborate. It aims at developing a structure of logistics distribution management in the supply chain of agricultural commodities in Indonesia.

The research gap identified in the reviewed international journal literature indicates that there remains a limited number of studies that comprehensively address agricultural logistics distribution management based on geographical and sociological characteristics in archipelagic developing countries such as Indonesia. The limited research on how geographical complexity, infrastructure constraints, disparities in access to technology, and the socioeconomic characteristics of smallholder farmers can affect the effectiveness of agricultural logistics distribution. Most international research on SCM focuses more on technical efficiency, the integration of digital technologies such as blockchain and Internet of Things (IoT), distribution optimization, and supply chain resilience in developed countries with relatively well-established logistics infrastructure.

This study aims to bridging this research gap by presenting a multidimensional perspective that links logistics efficiency, sustainability, food security, information technology integration, and distribution policies at the global level, as applicable to the Indonesian agribusiness context. Furthermore, this study also examines the fact that the international literature has not sufficiently explored the interrelationship between agricultural logistics distribution, inter-island transportation systems, and the strengthening of local institutions as part of a strategy for building a supply chain based on sustainable food security.

The theoretical framework of this study needs to be strengthened by integrating three key perspectives: supply chain resilience, digital agriculture, and the sustainability transition in agribusiness governance. The theory of supply chain resilience emphasizes the supply chain's ability to anticipate, respond to, and recover from disruptions, such as distribution delays, supply uncertainty, changes in demand, product damage, and limitations in logistics infrastructure (Ivanov & Dolgui, 2020; Ribeiro et al., 2018; Singh et al., 2019).

In the context of Indonesia's agribusiness, this resilience is critical because agricultural commodities are perishable, season-dependent, and face geographical challenges as an archipelagic nation. Furthermore, the theory of digital agriculture explains that the use of information technology, IoT, blockchain, Global Positioning System (GPS), Geographic Information System (GIS), data analytics, and digital applications can enhance transparency, traceability, distribution efficiency, and the accuracy of decision-making within the agricultural supply chain (Liu et al., 2021; Rejeb et al., 2021; Srivastava & Dashora, 2022).

International research confirms that resilient supply chains can be built through distribution flexibility, collaboration among stakeholders, integration of digital technology, supplier diversification, and the ability to share information in real time. Richey et al. (2022) define supply chain resilience as the adaptive capacity of a supply chain to prepare for disruptions, respond to unforeseen events, and maintain operational continuity and competitive advantage.

Additionally, Chowdhury and Quaddus (2017) emphasize that supply chain resilience is influenced by dynamic capability an organization's ability to innovate, coordinate, and transform rapidly in the face of changing business environments. In modern agribusiness, the integration of digital technologies such as the IoT, blockchain, big data analytics, and logistics information systems has become a key instrument in enhancing visibility, transparency, distribution accuracy, and supply chain risk management.

Recent research also indicates that the digitization of agricultural supply chains can improve distribution efficiency, strengthen coordination among stakeholders, and accelerate the recovery of food systems in the event of global or regional disruptions. Therefore, supply chain resilience theory is relevant for explaining the importance of strengthening Indonesia's agricultural logistics distribution system making it adaptive, integrated, and sustainable to address geographical challenges, market changes, and global uncertainties.

IoT Digital agriculture theory explains that digital transformation in the agricultural sector is a process of integrating information technology, communication, and automation to improve efficiency, productivity, sustainability, and the accuracy of decision-making within agribusiness systems and food supply chains. Bertoglio et al. (2021) explain that the Digital Agricultural Revolution is characterized by the use of technologies such as IoT, Artificial Intelligence (AI), big data analytics, cloud computing, remote sensing, and blockchain to improve the accuracy of production, distribution, and agricultural resource management. Digital technology enables real-time data collection and analysis, allowing farmers, distributors, and agribusiness actors to improve logistics efficiency, distribution transparency, and the resilience of the food supply chain.

In addition, Kamilaris et al. (2019) assert that the application of blockchain in the agricultural supply chain can improve traceability, transparency, data security, and trust among actors in food distribution. Recent research also indicates that the integration of IoT and blockchain can improve the quality of agricultural product distribution oversight, reduce the risk of product loss, accelerate information exchange, and support a more sustainable logistics system (El Mane et al., 2024). In the context of developing countries like Indonesia, the theory of digital agriculture is relevant because it addresses geographical challenges, limited access to market information, lengthy distribution chains, and low agricultural logistics efficiency through data-driven and digital technology-based distribution systems.

However, The implementation of this technology requires not only a technical approach; it must also be linked to the transition towards sustainability, a shift in the agribusiness system toward distribution models that are more efficient, inclusive, cost-effective, environmentally friendly, and supportive of food security. Therefore, an agribusiness governance system must be established through collaboration among farmers, suppliers, traders, processing industries, distributors, the government, and consumers so that the distribution of agricultural commodities is not solely focused on economic profit but also on social, environmental, and local institutional sustainability. This perspective aligns with documents that emphasize the importance of integrating information technology, collaborating with local suppliers, implementing integrated distribution, strengthening institutions, and developing agricultural logistics information systems to improve distribution accuracy based on quality, quantity, location, and timing.

The concept of sustainability transition in agribusiness systems explains that the transformation of the agricultural sector and food supply chains is not only focused on improving economic efficiency but must also integrate social, environmental, and institutional dimensions of sustainability. Geels (2019) explains that the sustainability transition is a multidimensional process of change involving technological innovation, changes in governance, actor behavior, and the restructuring of production and distribution systems toward a more sustainable system. In the context of the agribusiness supply chain, this transition drives the adoption of food distribution systems that are more efficient, low-emission, inclusive, and adaptive to climate change and global market uncertainties. Furthermore, El Bilali (2019) emphasizes that the success of the transition to a sustainable food system is heavily influenced by collaborative governance among farmers, suppliers, distributors, the processing industry, the government, and consumers in creating a resilient and equitable food supply chain.

Other studies indicate that the digitalization of agriculture and innovations in green supply chain management can improve distribution efficiency, reduce food loss, strengthen food security, and support sustainable economic development (Ammann et al., 2023; Liao & Zhang, 2025). Therefore, modern agribusiness governance systems need to integrate digital technology, strengthen local institutions, foster multi-stakeholder collaboration, and implement sustainability-oriented distribution policies so that agricultural logistics systems can improve farmers' well-being while maintaining environmental sustainability and national food stability.

Therefore, the following topics are important to discuss: (1) Mapping of logistics distribution research in the agricultural product supply chain (2021–2025), (2) The logistics and distribution management in the agricultural commodity supply chain in the global and national contexts of Indonesia, and (3) Literature review on key factors of Supply Chain Management (SCM) in Indonesia.

2. Materials and Methods

This study employs a qualitative literature review design, which revisits the realities, data, concepts, and theories that exist in a relationship to determine, describe, and discuss similar, different, and new contributions in the study field (Snyder, 2019). A Systematic Literature Review (SLR) refers to a type of literature review conducted in a systematic, structured, transparent, and reproducible manner to identify, evaluate, and synthesize the results of previous research on a specific topic. The SLR aims to provide a comprehensive understanding of the development of theories, methods, research findings, research gaps, and future research directions based on valid and measurable scientific evidence. In contrast to traditional literature reviews, the SLR method employs clear procedures for literature search, selection, evaluation, and analysis to minimize research bias. This method is widely used in the fields of management, agribusiness, health, technology, and the social sciences

to strengthen theoretical foundations and produce more objective scientific syntheses (Faggion et al., 2017; Robinson & Lowe, 2015).

This method will assist scholars and researchers in conserving time during the review of various studies. Nevertheless, even being nonsystematic, such a review should still follow the principles of systematicity, comprehensiveness, transparency, and reproducibility to be scientifically credible The fluidity of scientific knowledge is still in progress because of the many areas of research, such as those studies that focus on business and entrepreneurship, which are usually dispersed and may cut across disciplinary lines. Literature review analysis is among the methods that contributes greatly to knowledge development. This method is a relevant research approach for reconstructing factual and current events, as well as developments in knowledge, theories, and concepts over time, through bibliometric analysis and tabular analysis.

A literature review serves as an appropriate research methodology, similar to other types of research, where specific steps must be followed, and actions must be taken to ensure that the review is accurate, precise, and reliable. Like any research, the worth of an academic review lies in what is done, what is discovered, and how well it is reported. With respect to the aim of the review, researchers may use numerous approaches, criteria, and principles that have been created specifically to conduct a literature review (Shekarian & Mellat Parast, 2020; Tukamuhabwa et al., 2015).

The methodological procedures in this study need to be explained more transparently to ensure the scientific reproducibility of the qualitative literature review method that Identification of the problem and research objectives. Determining the research focus, research question, and objectives of the literature review.

Development of the review protocol. Determining the databases, keywords, Boolean operators, publication year range, and article inclusion and exclusion criteria. This study employs a qualitative literature review approach combined with bibliometric analysis using the Publish or Perish (PoP) and VOSviewer applications to map the development of research on logistics distribution and SCM for agricultural commodities in Indonesia.

The primary databases used include Google Scholar, Scopus, and Crossref, covering publications from 2021 to 2025. The search strategy employed a combination of keywords:“agricultural logistics” or “agricultural distribution”, “supply chain management” or “SCM”, “Indonesia”or “agribusiness”, and “food supply chain” or “logistics distribution”

The literature search process involves conducting for scientific articles through databases such as Scopus, Web of Science, Google Scholar, ScienceDirect, or Springer. Exclusion criteria included duplicate articles, non-peer-reviewed conference proceedings, articles without complete metadata, and studies not relevant to the context of agribusiness logistics. A preliminary total of 500 articles were obtained through Publish or Perish, followed by a screening process based on the relevance of titles, abstracts, keywords, and topic alignment, resulting in approximately for further analysis, and the parameters in Publish or Perish included Google Scholar as the data source.

Article selection and screening based on the relevance of the title, abstract, keywords, journal quality, and alignment with the research topic. This stage typically follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The current process included crucial components such as publication title, year of publication, name of the author, name of the journal, and number of citations received by the given works. The RIS format of the data driven out of the PoP into data files was further processed and visualized in VOSviewer.

Data extraction involves identifying key information from articles, such as theories, methods, variables, research findings, and scientific contributions. Literature analysis and synthesis. The literature is analyzed thematically, conceptually, bibliometrically, or comparatively to identify patterns of relationships, research trends, challenges, and research gaps. Formulation of conclusions and recommendations. Drawing conclusions based on the literature synthesis and providing theoretical and practical implications, as well as recommendations for further research.

3. Results and Discussion

3.1. Mapping of logistics distribution research in the agricultural product supply chain (2021–2025)

The main purpose of applying the Publish or Perish (PoP) and VOSviewer applications was to investigate the interrelationships of keywords such as “logistic distribution”, “supply chain”, “agriculture product” in the scholarly literature from Scopus indexed journals and conference articles between 2021 and 2025. The analysis results in the form of three visualizations, namely network visualization, overlay visualization, and density visualization. All the formats offer another angle of insight into the directions, trends, and research focus of the subject.

3.1.1. Network visualization

The network that was created with the help of the VOSviewer analysis represents 13 thematic clusters, which coincide with each other because of the frequent occurrence of keywords in the scholarly literature. Every cluster is a certain thematic focus of the discourse of agricultural product logistics distribution and is combined into a complex and interrelated knowledge structure. The network visualization in Figure 1, generated by VOSviewer, is a graphical representation showing the connections between items in a bibliometric dataset, such as keywords.

The main components in network visualization are nodes (circles), which represent a keyword; the larger the node, the more frequently that keyword appears or the higher its weight. Links (lines) indicate relationships between items, such as co-occurrence, citations, or collaboration. The thicker the line, the stronger the relationship. Furthermore, nodes that are positioned close to one another have a closer relationship than those that are farther apart. Colors (clusters) indicate groups of related items. Each color represents a different theme or community within the network.

The results presented in Figure 1 indicate that the red cluster emphasizes the connection between the agricultural sector and global dynamics, especially in development, international trade, and sustainability. The use of such words as agricultural sector, development, impact, international trade, Russia, and Ukraine indicates that the studies in this cluster are generally interested in understanding how geopolitical problems and trade flows impact the global distribution of agricultural goods. This emphasis is particularly applicable in light of geopolitical disputes that trigger world food crises, leading to instability in global supply chains and food distributions (Arreyndip, 2025; Hellegers, 2022; Liefert & Liefert, 2020; Lila et al., 2023)

The dark green cluster is more social-behavioral in its orientation, with special attention given to consumer perception and the adoption of a circular economy practice within the supply chain. Keywords such as consumer perception", "attitude", "waste", "coordination", "quality", and "perishable product"show that the media in this cluster discusses how consumer preferences, coordination among supply chain participants, and product quality determine the efficiency of distribution, particularly among perishable goods. Waste and cost reduction in food logistics systems are also covered in this approach (Abbas et al., 2023; Anastasiadis et al., 2022; Gajdić et al., 2021; Yan et al., 2020).

The blue cluster focuses on the incorporation of technology in supply chain management. The keywords that are dominant in this cluster are blockchain technology, IoT, traceability, and implementation. The application of digital technologies to improve traceability, transparency, and security in agricultural product distribution is discussed primarily in the research in this group. An example is blockchain, which is one of the most important instruments in establishing trustworthy and fraud-free supply chains, especially in regard to the distribution of fresh and organic foods (Glaros et al., 2023; Rochmawan et al., 2025).

The yellow cluster examines innovation and supply chain system operation structures. Such words as the supply chain of agricultural products, the distribution of benefits, big data, innovation, and uncertainty imply that the main emphasis is placed on improving efficiency, the equal distribution of benefits among stakeholders, and managing uncertainty in demand and supply. This cluster of studies includes a large variety of studies on managerial strategies and decision support that focus on creating adaptive and resilient supply chains (Centobelli et al., 2022; Krishnan et al., 2020; Ming et al., 2021; Sulaiman et al., 2023).

The purple cluster represents the reaction to significant disturbances such as the COVID-19 pandemic. Resilience, COVID-19, deep learning, insight, and pandemic are the keywords that emphasize adaptation strategies to address supply uncertainties, particularly for fresh agricultural products. Machine learning and big data analysis approaches are perceived as key to improving logistics distribution resilience during global crises (Çalı et al., 2025; Mishra et al., 2022; Zamani et al., 2022).

The teal cluster supports the significance of risk management and life cycle analysis in sustainable food systems. The dominant words are"barriers", "control", "risk management", and "life cycle assessment". The primary goal of this cluster is to discover the existence of distribution barriers and create all-inclusive risk management plans that minimize environmental effects and enhance the effectiveness of logistics.

The light green cluster represents the direct linkage between logistics distribution and food security. The keywords include food supply, food security, distribution, green logistics, and sustainable agriculture, which point to the central theme of how efficient and environmentally friendly logistics systems can optimize food security, particularly in countries where distribution systems are not yet fully developed.

The cluster of light brown addresses the technical and managerial issues of agricultural logistics. Such terms as the agriculture supply chain, livestock waste development, management, and logistics emphasize concerns with the governance of agricultural and livestock product distribution, waste management, and the role of logistics management in the design of integrated supply chain systems (Kontopanou & Tsoulfas, 2022; Li et al., 2021; Shi et al., 2025)

The pink cluster is clearly geographically inclined, namely, Indonesia. The name of the cluster, such as Indonesia, agribusiness, strategy, and food waste, implies that the cluster explores distribution management strategies within the national context, in which food waste management can be an important part of national efforts to strengthen local supply chains (Kusumowardani et al., 2022; Mulyono et al., 2021; Nattassha et al., 2020).

The light orange cluster represents technicalities such as modeling and optimization in agricultural logistics. Keywords such as optimization, modeling, agricultural product logistics, and urbanization imply that the studies in this cluster focus on the design and reorganization of effective distribution systems, especially in urban regions that face specific logistical problems (Cao et al., 2021; Prastyanti et al., 2024; Zhang et al., 2022).

The greenish cluster, which is light green, addresses environmental issues and the future outlook of agricultural systems. These concepts, such as the carbon footprint, food processing, and future prospects, highlight concerns about the environmental outcomes of agricultural distribution and processing and the approaches that sustainable farming systems should take in the long term.

The light blue cluster underlines the dimensions of policy-building and capacity-building. Keywords such as policy, biomass energy development, and training help us understand that this literature focuses on governmental or institutional actions to develop the capacity of distribution actors through training and policy development to facilitate sustainable distribution.

The yellow circle with light yellow circle has a reduced scope and focuses on the evaluation of performance and the aspects that contribute to the success of the distribution system. Keywords such as factor and performance emphasize the fact that it is necessary to measure performance to enhance the efficiency of the supply chain (Kontopanou et al., 2024; Thi et al., 2022).

This clustering and visualization shows that the study of the logistics distribution of the agricultural product supply chain focuses not only on technical and efficiency issues but also on social-environmental, technological, and policy-related issues. The connections between clusters prove that agricultural distribution issues are multifaceted and need interdisciplinary solutions that can help to establish resilient, equitable, and sustainable logistics networks.

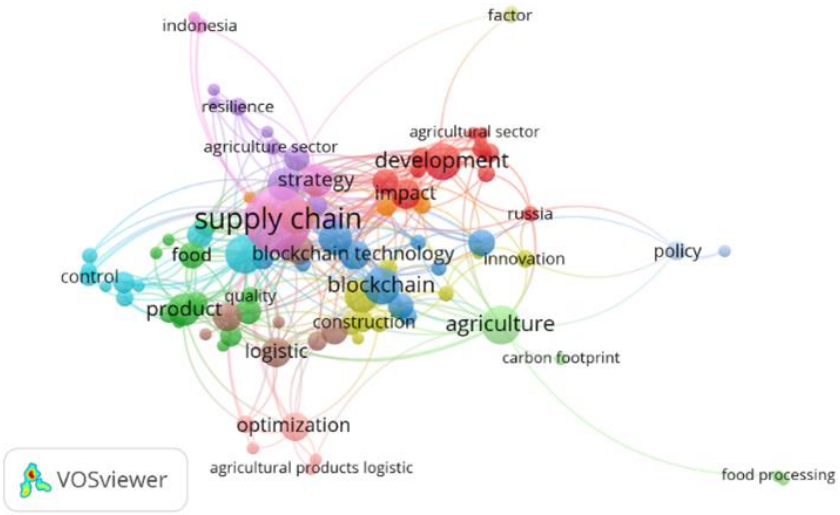

Figure 1 Network visualization based on the keywords logistics distribution, supply chain, and agricultural products.
Source: Scopus database.

3.1.2. Overlay visualization

The visualization overlay in Figure 2, produced by VOSviewer, presents a visual representation that illustrates the relationships between items while highlighting specific attribute information through color gradients. This visualization is used to examine the trends or characteristics of an item based on specific variables, such as the average year of publication, the number of citations, or other metrics.

As shown in Figure 2 overlay visualization by using VOSviewer provides a temporal view of the research dynamics on the logistics distribution of agricultural product supply chains. This visualization can be used to show the connections between terms and provide details about the mean year of publication of each keyword in academic articles. The color palette, however with dark blue (the year 2019, etc.) as one end and bright yellow (the year 2023, etc.) as the other, allows us to follow the change in the focus of research with time.

The words “optimization”, “control”, “agricultural products”, “logistics”, and “carbon footprint” were more frequently used in the dark blue to blue–green parts, which occurred in the 2019 - 2020 timeframe. This implies that during the early days of research, the focus of this area was on the technicality and distribution efficiency, as well as the environmental effects of agricultural logistics systems. The use of strategies related to operational efficiency and life cycle assessment was typical in the early history of this discussion (Onwude et al., 2020; Zhang et al., 2020).

Finally, with the goal of transitioning into the 2021 - 2022 sphere, which is marked in green, the topic of research started to change to the integration of digital technologies and more complex supply chain management systems. The keywords used were supply chain, logistics, blockchain, blockchain technology, and construction. This indicates the increasing popularity of research focused on the use of information technologies such as blockchain and the IoT to improve the transparency, traceability, and credibility of agricultural product distribution (Bigliardi et al., 2022; Mukherjee et al., 2021; Pandey et al., 2022)

The words “policy”, “innovation”, “food”, “quality”, and “consumer” appear in the brightest parts of the visualization, which refers to the period between 2023 and 2025. This implies that the research focus has moved toward policy interventions, new methodologies, and reactions to consumer preferences and needs. The availability of policy and innovation implies that research is starting to investigate the potential of policy and innovation strategies in enhancing logistics distribution systems through the establishment of policies. In the meantime, the emergence of themes such as food and quality indicatesgrowing

concern with the quality of the product, as well as the experience of the consumer in the literature of recent times (Ammann et al., 2023; Brown et al., 2022; Fahad et al., 2024)

Essentially, this overlay map vividly shows that the research direction in agricultural product logistics distribution has shifted dramatically toward a more holistic toward as the emphasis lies on technical and operational efficiency to a more comprehensive one based on technological, policy and social aspects. This development shows that the problems of logistics distribution cannot be resolved with the help of technical solutions but with a multidimensional approach that is flexible to technological shifts and socioeconomic dynamics.

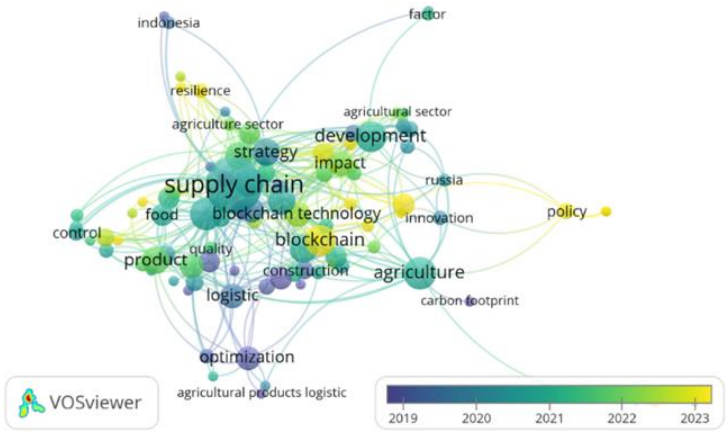

Figure 2 Overlay visualizations based on the keywords logistics distribution, supply chain, and agricultural products
Source: Scopus database.

3.1.3. Density visualization

The density visualization in VOSviewer shown in Figure 3 provides a visual representation of the density or concentration of the occurrence and interconnections of items within a bibliometric network. This visualization is used to identify the most dominant or most frequently studied areas within a particular field of research. The density visualization of the bibliometric analysis by the VOSviewer provides information about the concentration or intensity of the keywords in academic papers in the logistics distribution in the agricultural product supply chain. In this visualization, the color gradient shows the frequency of each keyword as a percentage. Bright red is the most frequent, yellow and green are the medium to high intensity, and blue is a relative rarity of the terms, or they are less frequent.

Figure 3 illustrates the middle of the visualization, the name “supply chain” is indicated in bright red, which means that this issue is the main object of interest and the most discussed in the whole range of the publications analyzed. It is surrounded by yellow and green areas that have terms such as logistics, product, blockchain, blockchain technology, strategy, and food. These words are highly “supply chain, which proves that the problems of the efficiency of logistics, the use of digital technologies in the monitoring and control of supply chains, and the problem of food products are the primary topics that are often discussed in combination in the literature (Behnke & Janssen, 2020; Mane et al., 2024; Wang et al., 2022)

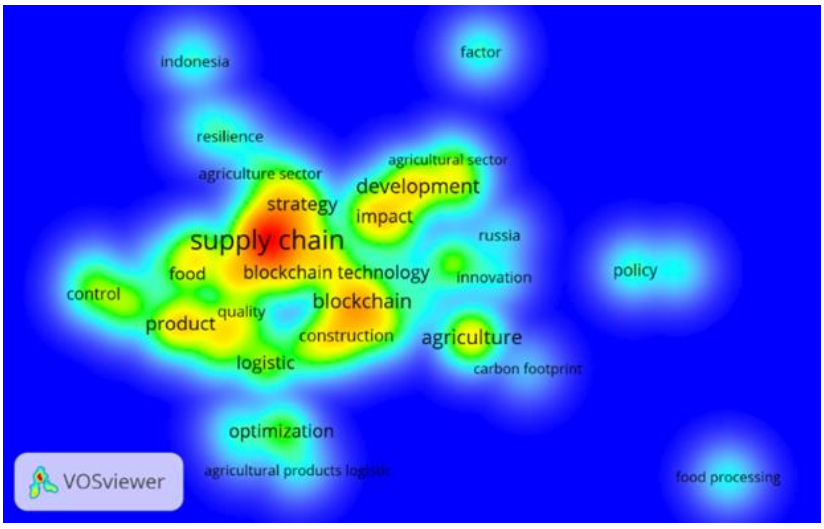

Figure 3 Density visualization based on the keywords logistics distribution, supply chain, and agricultural products
Source: Scopus database.

Further down, in the green-colored sections, keywords such as development, impact, and agriculture can be found, indicating that the idea of development of agricultural sectors and how it affects distribution systems is also popular but not as weighty as the main subjects. Other keywords, such as construction, resilience and the agriculture sector, can also be found in this zone, implying that research is starting to uncover how the concepts of infrastructure development and supply chain resilience are actually becoming a part of the agricultural logistic discourse (van Berkum, 2023; Zavala-Alcívar et al., 2020; Zhang et al., 2025).

In the meantime, the keywords found in the blue part, such as policy, food processing, carbon footprint, factor, and Indonesia, are those that are less addressed or are still new in terms of research on this topic. However, the fact that such terms as policy and carbon footprint are included in this visualization indicates that an increasing number of people are interested in public policy and environmental sustainability aspects of the agricultural logistics distribution (Ha et al., 2024; Shakoor & Ahmed, 2023). In addition, the occurrence of the keyword "Indonesia" demonstrates the elaboration of the contextual approaches or case-studies that are based locally (Kaya et al., 2022; Sadeli et al., 2023).

On the whole, this density diagram helps reveal that the existing scientific knowledge on agricultural logistics distribution is strongly oriented toward supply chain efficiency, the integration of digital technologies, and food product management. Nevertheless, it is slowly broadening the scope of its subjects to policy, the environment, and sustainability. Such a visualization also provides a visual idea of a strategy overlay to researchers to understand the prevailing topics and map out the possible areas of research that are underexplored and untapped, which could be developed further.

3.2. The logistics and distribution management in the agricultural commodity supply chain in the global and national contexts of Indonesia (2021–2025)

3.2.1. The logistics and distribution management in the agricultural commodity supply chain in the global contexts

The critical discussion of logistics and distribution management in the agricultural commodity supply chain in a global context in Table 1 follows the discussion of the VOSviewer visualization.

The table 1 that trends in logistics and distribution management in the global agricultural commodity supply chain shows that global research on logistics and distribution management in the agricultural commodity supply chain has undergone a highly dynamic transformation during the 2021–2025 period. In the early stages of this research, studies focused more on operational efficiency, transportation optimization, reduction of distribution costs, and inventory management to improve SCM performance. These studies positioned logistics as a key instrument for accelerating distribution, maintaining the quality of agricultural products, and enhancing the competitiveness of the global agribusiness (Cao et al., 2021; Han et al., 2021). However, subsequent developments indicate that agricultural distribution systems are no longer solely oriented toward economic efficiency but are evolving toward a more multidimensional approach.

The next global trend points to growing attention to digital agriculture and smart logistics through the use of IoT, blockchain, big data, artificial intelligence (AI), and digital monitoring systems. These technologies are used to enhance transparency, traceability, food safety, and real-time decision-making in the global distribution of agricultural commodities (Klerkx et al., 2019; Nurgazina et al., 2021). Supply chain digitization also strengthens integration among distribution actors, making logistics processes more responsive to market changes and consumer demand.

In addition to digitalization, the global literature also shows an increase in studies on supply chain resilience due to the COVID-19 pandemic, climate change, and global geopolitical conflicts. Research indicates that modern agricultural supply chains must possess adaptability, flexibility, and the ability to recover quickly from global distribution disruptions (Mahmood et al., 2024; Tebaldi & Vignali, 2023). These conditions have made the issue of food supply chain resilience a primary focus of international research.

Furthermore, research trends are shifting toward green logistics and the sustainability transition—that means integrating principles of environmental sustainability, carbon emission reduction, food loss reduction, and the circular economy into the global food distribution system (Geels, 2019; El Bilali, 2019). Logistics distribution was now seen not only as a business process but also as part of efforts to maintain food security, environmental sustainability, and the socioeconomic stability of communities.

Global developments in SCM increasingly emphasize the importance of collaborative governance and multi-stakeholder coordination among farmers, distributors, industry, government, and consumers in creating a resilient, efficient, and sustainable food distribution system (Dania et al., 2018; Velten et al., 2021). Consequently, global research trends in Logistics and Distribution Management within the Agricultural Commodity Supply Chain have shifted from a technical-operational approach toward an integrative approach centered on digital technology, sustainability, food security, collaborative governance, and global risk mitigation.

Critically, the table shows that the development of Logistics and Distribution Management in the agricultural commodity supply chain in Indonesia has shifted from a traditional distribution approach toward a modern logistics system based on digitalization, resilience, sustainability, and institutional integration. However, Indonesia's geographical context as an

archipelagic nation, infrastructure limitations, low technology adoption among smallholder farmers, and weak logistics data integration remain major challenges that distinguish Indonesia from the context of developed nations in the global literature.

3.2.2. The logistics and distribution management in the agricultural commodity supply chain in national contexts of Indonesia (2021-2025)

The analysis Table 2 on logistics and distribution management in the agricultural commodity supply chain in the national context of Indonesia shows that the development of logistics and distribution management for agricultural commodities in Indonesia has undergone a significant transformation during the 2021–2025 period. Research trends no longer focus solely on conventional distribution and logistics cost efficiency but are evolving toward a more integrated approach based on digitalization, supply chain resilience, sustainability, collaborative governance, and strengthening national food security. In the Indonesian context, these developments are heavily influenced by the country's archipelagic geography, infrastructure disparities, high logistics costs, and the complexity of inter-regional food distribution (Barbosa, 2021; Khan et al., 2024; Yu et al., 2025).

Regarding trends, the study indicates that key emerging issues include the efficiency of agricultural logistics distribution, digital agriculture and smart logistics, supply chain resilience, green logistics, cold chain logistics, collaborative governance, and consumer-oriented supply chains. These trends indicate that modern food distribution systems in Indonesia are beginning to shift toward the use of digital technologies such as IoT, blockchain, GIS, GPS, artificial intelligence (AI), and big data to enhance transparency, traceability, and real-time decision-making within the agribusiness supply chain (Bertoglio et al., 2021; Kamilaris et al., 2019; Sean et al., 2024). Additionally, the growing focus on food supply chain resilience has been driven by the COVID-19 pandemic, climate change, and global distribution instability, which demand that food logistics systems become more resilient and adaptive (Chowdhury & Quaddus, 2017; Ivanov & Dolgui, 2020).

From both academic and practical perspectives, the research findings indicate that strengthening SCM can improve distribution efficiency, reduce food loss, accelerate logistics flows, and enhance the stability of the national food supply and prices. Academically, this development expands SCM theory from an operational approach toward a multidimensional approach that integrates digital technology, environmental sustainability, and collaborative governance. Practically, the implementation of smart logistics, cold chain systems, and multimodal transport integration can help improve the quality of agricultural product distribution, particularly for perishable products such as horticultural goods, fish, and other fresh produce (Abbas et al., 2023; Han et al., 2021; Slot et al., 2025). Additionally, strengthening digital distribution systems and social commerce also helps shorten the distribution chain and improve direct relationships between producers and consumers (Sadeli et al., 2023).

However, the table also highlights several research gaps that remain weaknesses in the national literature. First, most studies are still focused on technical and operational aspects and have not yet sufficiently integrated social dimensions, the well-being of smallholder farmers, and local food security. Second, the adoption of digital technologies among smallholder farmers and in remote areas remains low due to limitations in infrastructure, digital literacy, and the integration of national logistics data. Third, research on green logistics, the circular economy, and carbon footprints in Indonesia's food distribution remains very limited. Additionally, studies on supply chain resilience based on the geographical characteristics of an archipelagic nation have not yet been extensively developed in the Indonesian context.

The relationship between logistics and distribution management in the agricultural commodity supply chain—both in the global context and within the Indonesian national context—can be better understood by recognizing that the logistical challenges facing Indonesia's agribusiness sector represent a concrete manifestation of the global debate on logistics resilience, the sustainability transition, and the digitalization of the food supply chain. Globally, the literature indicates that modern food distribution systems are moving toward supply chains that are more digital, adaptive, low-emission, and resilient to disruptions caused by pandemics, climate change, energy crises, and geopolitical conflicts (Mkumbukiy et al., 2025; Yadav et al., 2022).

However, most of these global models were developed in the context of developed countries with relatively stable logistics infrastructure, high digital connectivity, and integrated distribution systems. In the Indonesian context, these challenges become more complex because the country's archipelagic geography leads to high inter-island logistics costs, disparities in transportation and cold chain infrastructure, limited access to technology among smallholder farmers, and weak integration of national food distribution data (Kaya et al., 2022; Sean et al., 2024).

This situation demonstrates that the issue of food supply chain resilience in Indonesia concerns not only distribution efficiency but also the logistics system's ability to maintain supply stability, ensure food affordability, and guarantee food access for communities in remote and vulnerable areas.

Table 1 Trends in logistics and distribution management in the agricultural commodity supply chain in the global from 2021 to 2025.

Global Theme Trends	Academic and practical implications	Research gap	Actionable findings
Supply Chain Efficiency and Logistics Optimization (Cao et al. 2021; Han et al. 2021)	The study academically strengthens the analysis of SCM based on cost efficiency, time, and distribution routes. Practically, SCM helps agribusiness operators reduce transportation costs and distribution delays.	The focus remains predominantly on technical approaches, and generally lacks any connection between efficiency and the well-being of smallholder farmers.	Study of optimization models for the distribution of agricultural commodities in island and rural areas.
Digital Agriculture and Smart Logistics (IoT, AI, Blockchain, Big Data) (Bertoglio et al. 2021; El Mane et al., 2024; Kamilaris et al. 2019)	Promoting transparency, traceability, and real-time decision-making in the food supply chain.	Studies on digitalization are still predominantly conducted in developed countries; technology adoption by smallholder farmers in developing countries remains limited.	Study on the adoption of digital logistics technology in agriculture by farmers, distributors, and cooperatives.
Supply Chain Resilience and Crisis Management (Chowdhury & Quaddus, 2017; Ivanov & Dolgui (2020)	Strengthening the theory of supply chain resilience in the face of pandemics, climate change, global conflicts, and market disruptions.	There have not been many studies measuring the resilience of agricultural supply chains in high-risk areas with limited infrastructure.	Development of an agribusiness supply chain resilience index based on geographic and socioeconomic risks.
Green Logistics and Sustainability Transition (El Bilali, 2019; Geels, 2019; Kontopanou et al., 2024)	Expanding SCM from a focus on economic efficiency toward environmental sustainability and emissions reduction.	Few studies have yet to link green logistics to food loss, carbon footprints, and local food security.	Green logistics study for perishable commodities using a circular economy approach.
Food Security and Sustainable Food Systems (Ammann et al. 2023; Hellegers, 2022)	Logistics distribution is more than just a business issue; the availability and stability of food also depend on it.	The relationship between distribution efficiency, food prices, and consumer access has not yet been analyzed in a comprehensive manner.	Study of the relationship between agricultural supply chain management, price stability, and household food security.
Collaborative Governance and Multi-Stakeholder Coordination (Anastasiadis et al. 2022; Krishnan et al. 2020)	Emphasizing the importance of collaboration among farmers, suppliers, traders, industry, the government, and consumers.	Global studies have not sufficiently addressed local institutions as intermediaries in the supply chain.	Research on collaborative governance in the distribution of agricultural commodities through cooperatives or farmer groups.
Consumer-Oriented and Demand-Driven Supply Chain (Fahad et al., 2024; Jafari et al., 2023)	Research shows that supply chains are shifting toward being more customer-oriented, flexible, and demand-driven.	Research on consumer behavior regarding sustainable food logistics remains relatively limited.	Consumer behavior study on sustainable food products and digital distribution systems.
Cold Chain and Perishable Product Logistics (Abbas et al. 2023; Onwude et al., 2020)	Emphasizing the importance of the cold chain in maintaining the quality of agricultural products and reducing food loss.	Developing countries still face limitations in research on cold chain efficiency in remote areas and across national borders.	Development of an IoT- and renewable energy-based smart cold chain for perishable agricultural products.
Policy Intervention and Agricultural Logistics Regulation (Kontopanou et al., 2024; Lila et al. 2023)	Public policy plays a crucial role in supporting the stability of food distribution and investment in logistics infrastructure.	There have not been many studies comparing the effectiveness of agricultural logistics policies across countries.	Studi comparative policy analysis food logistics policy and sustainable supply chain regulation.
Geopolitical Disruption and Global Supply Chain Dynamics (Bednarski et al. 2025: Hellegers (2022)	Geopolitical conflicts such as the Russia–Ukraine conflict have heightened concerns about the stability of the global food supply	Research on the geopolitical impact on global food distribution is still evolving and remains sector-specific.	A Study on the Impact of Global Conflicts on the resilience of the global supply chain for strategic food commodities

	chain and the security of commodity distribution.		

Table 2 Trends in logistics and distribution management in the agricultural commodity supply chain in national contexts of Indonesia from 2021 to 2025.

Trending Topics in the Indonesian Context	Academic and Practical Implications of the Findings	Research Gap	Actionable Findings
Distribution Efficiency and Agricultural Logistics Optimization (Cao et al., 2021; Han et al., 2021; Routroy & Behera, 2017)	Academically, it strengthens research on SCM focused on improving the efficiency of distribution, transportation, and inventory management. Practically, this supports reducing distribution delays and logistics costs for agricultural commodities between regions in Indonesia.	Research has primarily focused on technical aspects and has not yet sufficiently linked logistics efficiency to the well-being of smallholder farmers and regional disparities.	Development of an optimization model for the distribution of agricultural commodities in island, rural, and underdeveloped regions.
Digital Agriculture dan Smart Logistics (Bertoglio et al., 2021; Kamilaris et al., 2019; El Mane et al., 2024)	The utilization of IoT, blockchain, GIS, GPS, big data, and digital applications can enhance transparency, traceability, distribution monitoring, and real-time decision-making in Indonesia's agribusiness sector.	The adoption of digital technology among smallholder farmers and in remote areas remains low due to limited infrastructure and digital literacy.	Research on the implementation of smart logistics based on digital applications and cloud systems for farmers and agribusiness cooperatives.
Agricultural Supply Chain Resilience (Chowdhury & Quaddus, 2017; Ivanov & Dolgui, 2020; Ali et al., 2023)	Supply chain resilience becomes important because Indonesia faces geographical challenges, climate change, market fluctuations, and limitations in food distribution infrastructure.	There have not been many indicators of supply chain resilience that are specific to the context of archipelagic nations and perishable agricultural commodities.	Development of a supply chain resilience index based on geographic risk, weather, and national food security.
Green Logistics and the Transition to Sustainability (Geels, 2019; El Bilali, 2019; Kontopanou et al., 2024)	Logistics distribution should be geared toward energy efficiency, reducing food loss, reducing emissions, and ensuring the sustainability of the national food system.	Research on the relationship between green logistics, the circular economy, and the carbon footprint in Indonesia's food distribution sector remains limited.	Study of green logistics based on the circular economy and a low-carbon distribution system for agricultural commodities.
Food Security and National Distribution Stability (Ali et al. 2023; Hellegers, 2022; Kontopanou & Tsoulfas, 2022)	Food logistics distribution affects the availability, accessibility, and price stability of food nationwide, particularly in remote and island regions.	The relationship between logistics distribution, food price stability, and public access to food has not yet been comprehensively analyzed.	Study of the relationship between agricultural supply chain management and food price stability and household food security in Indonesia.
Collaborative Governance and Local Institutions (Anastasiadis et al., 2022; Krishnan et al., 2020; Sulaiman et al., 2023)	Strengthening collaboration among farmers, cooperatives, distributors, the government, and the private sector is essential for creating an efficient and sustainable food distribution system.	The national literature remains limited in exploring the role of local institutions as intermediaries in food distribution.	Research on collaborative governance based on farmers' groups, cooperatives, village-owned enterprises, and local food institutions.
Cold Chain Logistics for Perishable Agricultural Products (Abbas et al., 2023; Han et al., 2021; Onwude et al., 2020)	The development of a cold chain is essential for maintaining the quality of horticultural products, fish, meat, and other fresh produce during interregional distribution.	Cold storage infrastructure and temperature monitoring systems remain limited in remote areas of Indonesia.	Development of an IoT- and renewable energy-based smart cold chain for the national distribution of fresh food.
Intelligent Transportation Systems (ITS) in Agricultural Distribution (Ravi &	ITS helps optimize distribution routes, improve transportation efficiency, monitor vehicles, and integrate agricultural logistics data in real time.	Indonesia's ITS system remains unintegrated, and data interoperability between agencies remains weak.	Development of a cloud-based ITS and an integrated agricultural logistics information system in Indonesia.

Mamdikar, 2022; Sarkisian et al. 2025)			
Inter-Island Food Distribution and National Logistics Infrastructure (Kaya et al. 2022; Sean et al. 2024)	Indonesia's status as an archipelago means that food distribution is heavily dependent on the integration of land, sea, and air transportation.	Research on inter-island food distribution and disparities in the national logistics infrastructure remains limited.	A Study on Inter-Island Agricultural Logistics and the Integration of National Multimodal Food Transportation.
Consumer-Oriented and Demand-Driven Supply Chains (Jafari et al., 2023; Tiedemann, 2020)	The agricultural supply chain in Indonesia began shifting toward a model that is more customer-oriented and focused on quality, food safety, and distribution speed.	There remains relatively little research on consumer behavior regarding sustainable food logistics and digital food systems.	Research on consumer behavior regarding digital food distribution and sustainable agricultural products.

Furthermore, the global debate on the digitalization of agribusiness through IoT, blockchain, AI, and big data also faces structural challenges in the Indonesian context, particularly regarding the digital literacy gap, limited rural internet infrastructure, and the low technological capacity of smallholder farmers (Bertacchini et al., 2025; Hasyim, 2026). Thus, the Indonesian context offers an original contribution to the global literature by demonstrating that the transformation toward smart agricultural logistics cannot be understood solely as a matter of technology adoption but must also account for social aspects, local institutions, collaborative governance, and regional development disparities.

On the other hand, the global agenda on green logistics and the sustainability transition is also highly relevant to Indonesia due to high levels of food loss, emissions from food distribution, and reliance on fossil-fuel-based transportation within the national logistics system (Melkonyan et al., 2020). Therefore, Indonesia serves as a strategic context for expanding the global scientific debate on how archipelagic developing countries can build resilient, inclusive, sustainable, and digitally-enabled agribusiness logistics systems amidst the structural constraints they still face.

In Indonesia, the agricultural sector is strategic and influences the economic development of the nation. However, this industry has not yet been maximally exploited, as shown by the welfare of farmers and its contribution to national income. This is ironic considering that there is general economic agreement that one of the best remedies for alleviating poverty, inequality, and hunger is through investment in the agricultural sector. A number of challenges continue to plague the agricultural sector of Indonesia, such as small-scale production, scarce capital, the use of traditional technology, seasonality, inadequate market access, funding problems, and market monopolies.

3.3. Literature review on key factors of Supply Chain Management (SCM) in Indonesia (2021-2025).

Moreover, distribution-related problems make the sector more ineffective. These are high levels of price differentiation, long supply lines, uneven profit margins, and inability to sustain product quality and availability. The supply chain information that may help in solving market challenges is not sufficient. This type of information is essential in the creation of successful communications between sellers, intermediaries (e.g., distributors and transport service providers) and buyers of raw materials, products, services, and renewable energy.

As an archipelagic and maritime country that spans between Aceh and Papua, Indonesia has geological peculiarities in its logistics. The SCM systems should support different forms of transport land, sea, and air. To improve the supply and quality of food throughout the archipelago, it is important to improve food logistics in the country. Moreover, there is a need to develop storage space for agricultural products, especially in remote, frontier, and poor areas. Such efforts should not be left behind in the development of agro-industrial programmes.

The difficulties are that there is no integrated transport system (intermodal or intramodal) in multiple areas, especially in places with many small islands, mountainous landscapes, and a variety of topographies, which are not developed properly (Ali et al., 2023; Mirabelli & Solina, 2020; Nunes et al., 2020). In general, agricultural supply chain actors include suppliers, farmers, collection traders, food processing industries, agents, retailing or resellers, and consumers. One of the parties that does not have adequate information will have fewer options and decisions. On the other hand, with the availability of correct and complete information, parties will make superior decisions, which will not only help but also benefit productivity and welfare.

The information needed by individual stakeholders within the agricultural supply chain is diverse, such as the information provided by the suppliers of products such as fertilizer and agricultural equipment, information about agricultural products, potential consumers, and delivery services (Ithriah et al., 2017; Sulaiman et al., 2024; Yao & Na Li, 2022)

SCM can be defined as the process of coordination and growth of activities involved in the demand,supply, procurement and storage of goods or raw materials, which results in the final distribution to final consumers. Therefore, SCM can be described as a mechanism that involves human resources, institutions, or organizations in carrying out activities such as the

provision of information, service delivery, and the distribution of other resources to enable the transfer or delivery of raw materials, products, or services between the supplier and the customer or consumers.

The main aim of the SCM is to maximize the value and profit that is realized throughout the entire supply chain. The concepts, implementation, and challenges of SCM in Indonesia are analyzed in Table 3 which is related to a literature review (Firdaus et al., 2020; Pramudiawardani et al., 2019; Relawati et al., 2024; Routroy & Behera, 2017).

In Indonesia, supply chain management is very important for ensuring operational efficiency and customer satisfaction. By using applied ideas and the obstacles that will be encountered, firms or manufacturers can develop superior strategies as more firms join the competition. To date, Indonesia does not have such a system that coordinates information among the stakeholders within the agricultural supply chain, not to mention a specific system that could be used by a wide group of users. Conversely, overcoming current difficulties is necessary for the use of smart logistics systems and customer-friendly systems.

Despite these, developments,Intelligent Transportation System (ITS) development in Indonesia has started to form. Nevertheless, these systems are not coordinated or synchronized. The disparity of information in the Indonesian ITS is an obstacle to interoperability. One of the solutions is to create a cloud-based ITS, that can accommodate transportation information-sharing platforms.

Table 3 Literature review on key factors of SCM in Indonesia.

Stages	Implementation	Challenges	Principles
Planning: Inventorying and determining the demand/needs for products or raw materials. Anticipating and predicting consumer demand.	Collaboration with Suppliers: Partnering with local suppliers to ensure that the required raw materials or products are consistently available	Fluctuating Raw Material Availability: The supply of raw materials or products lacking certainty may disrupt the production process.	Consumer-Oriented: Understanding consumer needs is crucial for designing products or raw materials that are appropriate.
Procurement: Identifying and evaluating suppliers and managing supplier relationships. Production: Managing the assembly and manufacturing processes of products.	Managing Information: Enhancing communication services with various parties in the supply chain process by utilizing information technology.	Delivery Delays: Delays in the delivery of products or raw materials to consumers, which represent a logistics issue.	Good Supplier Relations: Minimizing costs by fostering strong relationships with suppliers.
Distribution: Storing and managing the shipment of products from the factory warehouse to consumers.	Integrated Distribution: Leveraging direct sales and various distribution channels through retailers.	Changing Market Demand: Companies may struggle to plan inventory and production due to the rapid dynamics of demand.	Utilizing Information Technology: Enhancing transparency and efficiency in the supply chain process through the use of information technology.

ITS application in agricultural distribution may lead to innovation, environmentally friendly practices, and general efficiency in food logistics. ITS (Colosio & Colosio, 2024; Joshi et al., 2024; Nayal et al., 2021; Ravi & Mamdikar, 2022; Sarkisian et al., 2025) is the implementation of digital information and communication technology, where computerization and the internet are used as strategic management concepts in enhancing logistics distribution functions, especially transport and road infrastructure, to maximize and control traffic movement. The most important ITSs in agricultural distribution are: (1) GPS and GIS technology, which allows farmers and distributors to track their shipments on the fly, optimize routes, minimize time loss, etc.; (2) telematics, which combines sensors and communications technologies in vehicles to monitor and manage logistics, including vehicle health, fuel consumption, and temperature control in perishable goods; (3) autonomous vehicles, which may be used in the transportation of harvested goods, improve safety, and reduce labor costs; (4) data analytics, involving the processing of data on multiple sources (weather conditions, traffic, market demand) to make informed decisions on when to harvest and when to deliver, minimizing waste and maximizing profitability; (5) SCM systems, involving the integration of software platforms that help monitor the information and allow the supply chain agricultural stakeholders to coordinate their activities; and (6) mobile applications, sharing real-time data with farmers and distributors on the market prices, weather conditions, and the best harvesting period.

The advantages of ITSs in terms of agricultural distribution are as follows: (1) better efficiency, because the optimization of routes and schedules reduces the time of delivery and fuel consumption; (2) better product quality, as the improved monitoring of the conditions allows the farmers and distributors to be more competitive in the environment; (3) cost savings, which improves the route planning and vehicle maintenance and reduces the costs of operations, resulting in increased profit margins; and (4) flexibility to meet the needs of the market, since the opportunity to adjust to the altered conditions of demand or supply as soon as possible will keep farmers and distributors competitive.

In conclusion, Indonesia faces infrastructure challenges in terms of supporting transportation and the distribution of goods. Nonetheless, a system capable of disseminating information among supply chain stakeholders could optimize the existing infrastructure. The communication architecture involves analyzing the communication system requirements needed to connect different locations in accordance with their physical architecture.

Broadly speaking, there are three types of interorganizational communication systems based on infrastructure topology: (1) Intranet—an internal company network connecting eadquarters with geographically separate branch offices. (2) Intranet—a public computer network serving as a link between companies and their customers, potential customers, or markets. (3) Extranet—a network developed as a communication medium between a company and its business partners (Dolgui & Ivanov, 2022; Weningsih et al., 2022; Xiong et al., 2020; Zeng & Lu, 2020). The communication architecture for agricultural logistics information systems is designed to facilitate communication among users. The choice of communication format is determined by various factors, including the type of application, the users, and their locations. (4) Transportation reliability is assessed on two points: on-time delivery and the fulfillment of orders. The quality of transportation, evaluated by the capacity of the transportation system to avoid delivery failure and minimum goods or product wastage.

In the modern stage of socioeconomic development, especially in the agricultural industry, the minimization of costs in logistics and supply chain optimization is important for improving the competitiveness of manufacturing enterprises and distributors. This can be attributed to the fact that business models have been shifting toward service-oriented business models that stress client satisfaction.

Therefore, SCM and competitiveness are perceived within the context of the low cost, high quality, and short delivery time of delivering products efficiently and effectively. Hence, this necessitates maximization of the components performance components of SCM systems, such as purchasing, production, and distribution (Buendia et al., 2021; Chenini et al., 2020; Koh et al., 2020).

Academically, in the Indonesian context, this study makes a significant contribution to the development of SCM theory, moving beyond a focus on operational efficiency towards a multidimensional approach that integrates digitalization, supply chain resilience, environmental sustainability, food security, and collaborative governance. This study reinforces the understanding that modern food distribution must be supported by technologies such as IoT, blockchain, AI, big data, GIS, and smart logistics to enhance transparency, traceability, and real-time decision-making within both the global and national agribusiness systems of Indonesia. Additionally, it expands the study of supply chain resilience in the face of global disruptions such as pandemics, climate change, geopolitical conflicts, and disparities in food distribution infrastructure in an archipelagic nation like Indonesia.

Practical implications of this study are significant for the government, agribusiness operators, cooperatives, farmer groups, and the logistics sector in improving the efficiency of agricultural commodity distribution, lowering logistics costs, reducing food loss, and maintaining price stability and national food availability. The implementation of smart logistics, cold chain systems, multimodal transportation, and the integration of national logistics data can help accelerate inter-regional food distribution, particularly in remote and island regions.

This study also underscores the importance of strengthening collaboration among farmers, distributors, the government, the private sector, and local institutions in creating a resilient, sustainable food distribution system oriented toward national food security. In the Indonesian context, the results of this study can serve as a basis for developing national food logistics policies based on digitalization, green logistics, and the strengthening of inter-island distribution infrastructure to support a more inclusive and sustainable food system.

4. Conclusions

The development of the agricultural sector in Indonesia faces challenges due to suboptimal agricultural commodities and limited capital, difficult access to loans, underutilization of agricultural technology innovations, seasonal farming patterns, and market monopolies. Therefore the development of a system that allows easy access to supply chain information for agricultural commodities is needed. Strategies should focus on enhancing local agricultural product marketing, shortening the middleman chain, reducing market monopolies, and strengthening collaborative synergy between the three main parties: sellers, buyers, and transport operators.

It is critical to enhance the accessibility and services in the SCM of agricultural products to improve local agricultural economies in rural settings, which constitute the base of national, regional, and global economic growth. It is necessary to formulate strict policies concerning the protection of price, stability, taxation, transportation cost, and product pricing through government intervention. Moreover, to enhance the quality and quantity of products, empowerment must be made through training and mentoring groups of farmers and monitoring of production until harvest, as well as through the enforcement of product standardization.

SCM systems, where product distribution takes place, must consider the current logistics schemes, which are marked by numerous stages of distribution transport, and the necessity of the participation of all departments, producers, and consumers. Agricultural product distribution supply chains must be assessed continuously with a profit and loss approach, with a focus on the main aspects, including effective modes of transportation, quality service, and prompt and satisfactory delivery

as per the customer's requirements. To account for risk factors and their negative effects on distribution supply chains, decision tree methods could be implemented.

Companies need to assess and monitor the implementation of logistics distribution for agricultural products, especially those that are perishable, and evaluate the risk impacts on their supply chains. This enables business actors and companies to anticipate risks and manage them effectively, reducing or mitigating potential distribution and financial risks. The agribusiness sector in Indonesia has much potential for growth and development, as it addresses the current issue of logistics. It is important to invest in infrastructure, embrace digitization, and reinforce distribution channels. By working together with all the stakeholders, Indonesia can secure an efficient, safe, and timely supply of agricultural products, hence improving the welfare of the farmers, and providing a steady food supply to the whole population.

With changes in the market, the former mode of production and circulation of agricultural products can no longer satisfy market information needs and supply chain development. Thus, new production and circulation methods for agricultural products need to be implemented to solve these problems through the development of an agricultural product supply chain innovation system, which involves data service providers, reduces agricultural product circulation connections, minimizes costs, provides traceability, and ensures the safety of agricultural products.

Global research trends are shifting from conventional logistics approaches focused on cost efficiency and distribution toward agribusiness supply chain systems that are more digital, resilient, collaborative, and sustainable. Research trends indicate that the use of digital technologies such as IoT, blockchain, big data, artificial intelligence (AI), and smart logistics is increasingly becoming a key focus in enhancing transparency, traceability, distribution speed, and real-time decision-making within the global food supply chain.

Global research also indicates a paradigm shift toward green logistics, the circular economy, and the sustainability transition, which emphasizes the importance of reducing carbon emissions, food loss, and ensuring the sustainability of the global food system. Therefore, the Indonesian context makes an important contribution to the global literature by demonstrating that the success of agricultural logistics system modernization depends not only on technology and operational efficiency, but anche on geographical factors, local institutions, food security, and the adaptability of distribution systems in archipelagic developing countries.

Various studies can be pursued in future research, such as the development of IoT- and blockchain-based smart logistics for national food distribution, the integration of GIS and ITS to optimize inter-island distribution, the development of a renewable energy-based cold chain, and the creation of a supply chain resilience index based on geographic risk and climate change.

Additionally, research on collaborative governance based on Farmers Group Association, cooperatives, and Village-Owned Enterprises would also be important to strengthen local food distribution and sustainable food security in Indonesia. Thus, the analysis table indicates that the future of Indonesia's agricultural logistics system will be significantly influenced by the ability to integrate digital technologies, strengthen local institutions, develop logistics infrastructure, and transition toward a more resilient and sustainable food distribution system.

Agricultural supply chain management has evolved from a conventional efficiency-based approach toward a more modern, digital, resilient, and sustainable system. Academically, this research contributes to the development of Supply Chain Management theory by integrating digitalization, supply chain resilience, green logistics, and collaborative governance. Practically, the results of this study provide a strategic foundation for the government and agribusiness stakeholders to improve food distribution efficiency, reduce food loss, maintain price stability, and strengthen national food security through the implementation of smart logistics, cold chain systems, and inter-regional logistics integration in Indonesia within a global context.

Acknowledgment

We would like to thank the Promoter and Co-promoter, as well as the reviewers, for their guidance and cooperation, which enabled us to complete this article as a publication requirement for the doctoral program at the Faculty of Agriculture, Jenderal Soedirman University. We also thank the reviewers and editors for their attention, reviews, suggestions, and feedback on our manuscript, which has been published in Multidisciplinary Reviews, a reputable journal.

5. Declarations

5.1. Ethical considerations

The authors declare our publication and research ethics "Not applicable", because our research used literature studies and did not involve human informants or respondents.

5.2. Use of artificial intelligence (AI)

The authors declare that no generative artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript.

5.3. Conflict of interest

The author declared no conflict of interest regarding the research process, manuscript preparation, funding, or access to journal publication.

5.4. Funding

This research did not receive any financial support.

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