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Improving Food Security and Sustainability in Koperasi Merah Putih: A Conceptual Model of Food Supply Chain Management

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Background. Food security and sustainability are key challenges in the modern food system, characterized by fragmented production, high food losses, and weak coordination among supply chain actors. Food Supply Chain Management (FSCM) is a strategic approach to integrating the flow of products, information, and logistics from upstream to downstream.
Aims. This study aims to develop a conceptual model of FSCM based on Koperasi Merah Putih, the primary institutional actor in strengthening the food supply chain.
Methods. The research method employed a systematic literature review of relevant scientific publications and policy documents.
Result. The study results indicate that the Koperasi Merah Putih has the potential to act as a supply chain coordinator through production aggregation, logistics management, and information management. Information technology support, government policies, and logistics infrastructure strengthen the cooperative's ability to improve FSCM performance.
Conclusion. Optimal FSCM performance subsequently contributes to increased food security and the sustainability of the food system.
Implementation. The developed conceptual model is expected to serve as a basis for further empirical research and a reference for formulating cooperative-based food policies.

Keywords: food supply chain management; cooperative; food security; sustainability; conceptual model

INTRODUCTION

Food security and sustainability are strategic issues in economic and social development, both at the national and global levels. Population growth, changing consumption patterns, climate change, and global economic uncertainty have increased pressure on food systems, particularly in

developing countries dominated by small-scale food producers. The main problems that often arise are not only production limitations but also weak distribution systems and coordination among actors in the food supply chain (Christopher, 2016).

Food Supply Chain Management (FSCM) is a managerial approach that focuses on the integrated management of product, information, and financial flows from upstream to downstream with the aim of improving the efficiency, quality, and reliability of food supplies (Chopra & Meindl, 2019). However, implementing FSCM in the food sector presents unique challenges due to the perishable nature of products, their reliance on time and environmental conditions, and the involvement of numerous actors with diverse interests (Aung & Chang, 2014).

In many developing countries, including Indonesia, the food supply chain structure remains fragmented. Food production is generally carried out by smallholder farmers with limited access to capital, technology, and market information. This situation leads to high transaction costs, weak bargaining power for producers, and an increased risk of food loss and waste (Vorst, Beulens, & van Beek, 2005). Consequently, even if aggregate food production is sufficient, inefficient distribution can hinder the achievement of equitable food security.

In this context, an institutional approach becomes increasingly important in strengthening FSCM. Cooperatives, as a form of collective economic organization, have significant potential to integrate smallholder producers into a more coordinated and efficient supply chain system. Through production aggregation, logistics management, and market access facilitation, cooperatives can act as a link between upstream and downstream actors in the food supply chain (Bijman et al., 2016).

Koperasi Merah Putih Program is a strategic initiative aimed at strengthening the role of cooperatives in supporting the people's economy and national food security. From a Food Supply Chain Management perspective, the Koperasi Merah Putih can be positioned as an institutional actor that collectively coordinates, integrates, and manages the food supply chain. This role is becoming increasingly relevant in addressing food security challenges triggered by global supply chain disruptions and food market volatility.

Beyond economic efficiency, cooperative-based FSCM is also closely linked to food system sustainability. Coordinated supply chain practices have the potential to reduce food loss, mitigate environmental impacts, and improve the welfare of small-scale producers as part of the social

dimension of sustainability (Beske & Seuring, 2014). Therefore, the integration of cooperatives into FSCM is oriented not only towards operational performance but also towards achieving sustainable development goals.

However, academic studies on the development of a conceptual model for cooperative-based FSCM, particularly in the context of the Koperasi Merah Putih , are still relatively limited. Most FSCM research focuses on the context of large companies or corporate-based supply chains, thus failing to fully capture the institutional dynamics of a people-based food system. Therefore, this study aims to develop a conceptual model for Food Supply Chain Management based on the Koperasi Merah Putih to improve food security and sustainability. This is expected to enrich the FSCM literature and provide relevant policy implications.

LITERATURE REVIEW

Food Supply Chain Management (FSCM)

Food Supply Chain Management (FSCM) is a development of the supply chain management concept specifically applied to the food sector. FSCM emphasizes the integrated management of product, information, and financial flows from primary production to final consumption, while maintaining quality, safety, and timely distribution (Chopra & Meindl, 2019).

Unlike manufactured product supply chains, FSCM has unique characteristics because food products are perishable, have a limited shelf life, and are highly sensitive to environmental conditions and distribution delays (Aung & Chang, 2014). Therefore, FSCM requires a high level of coordination among supply chain actors to minimize food loss and maintain product quality.

Vorst et al. (2005) emphasized that the success of FSCM depends heavily on the integration of supply chain processes and actors, particularly in the context of fresh food. This integration includes the coordination of production, storage, and transportation, as well as the accurate and timely exchange of information.

Supply Chain Integration and the Role of Institutions

Supply chain integration is a key element of FSCM, encompassing internal integration, integration with suppliers, and integration with customers. This integration enables the alignment of operational and strategic decisions, thereby improving supply chain efficiency and

responsiveness (Flynn, Huo, & Zhao, 2010). In developing countries, supply chain integration is often hampered by fragmented production structures and weak upstream institutions. Smallholder farmers typically operate individually with limited access to markets and information, hindering effective supply chain coordination (Bijman et al., 2016). Therefore, an institutional approach is crucial to bridge this gap.

Cooperatives in the Food Supply Chain System

Cooperatives are viewed as a form of collective economic organization capable of strengthening the position of small-scale actors in the food supply chain. Through the principles of togetherness and shared ownership, cooperatives enable production consolidation, logistical efficiency, and increased market access for their members (Bijman et al., 2016). From an FSCM perspective, cooperatives act as intermediary institutions that integrate small-scale producers into the broader supply chain system. Cooperatives also function as governance mechanisms that reduce information asymmetries and transaction costs, thereby increasing the efficiency and stability of the food supply chain (Markelova et al., 2009).

The Koperasi Merah Putih Program can be positioned as strengthening the role of cooperatives in the national food system. In this context, the Koperasi Merah Putih has the potential to collectively perform functions such as production aggregation, logistics management, and food distribution coordination. This role aligns with FSCM principles, which emphasize integration and collaboration among supply chain actors.

FSCM, Food Security, and Sustainability

Food security encompasses four main dimensions: food availability, accessibility, utilization, and stability. FSCM directly contributes to these dimensions through efficient and reliable management of food distribution (FAO, 2021). An integrated food supply chain can reduce the risk of supply shortages and price volatility, especially in food-vulnerable areas.

Beyond food security, FSCM is also closely linked to the sustainability of food systems. Beske and Seuring (2014) emphasize that sustainable supply chains must simultaneously integrate economic, environmental, and social objectives. In the food context, reducing food loss and waste is one of the key contributions of FSCM to environmental sustainability.

Cooperative-based FSCM has strong potential to support social sustainability by improving the welfare of smallholder farmers and creating a more equitable distribution of value within the supply chain. Thus, integrating cooperatives into FSCM not only improves operational performance but also supports the achievement of sustainable development goals.

Research Gaps and Position of the Study

Although the FSCM literature has grown rapidly, most research still focuses on the context of large companies and corporate-based supply chains. Studies on the role of cooperatives as key institutional actors in FSCM, particularly in developing country contexts, are relatively limited. Furthermore, research integrating FSCM, food security, and sustainability within a single conceptual model is rare.

Therefore, this study aims to fill this gap by developing a Food Supply Chain Management conceptual model based on the Koperasi Merah Putih. This model is expected to enrich the FSCM literature and provide a relevant analytical framework for the development of institutional-based food policies.

Literature Critique and Research Gaps

Although the literature on Food Supply Chain Management (FSCM) has grown significantly over the past two decades, most studies are still dominated by a conventional supply chain management perspective that focuses on large companies and corporate-based distribution systems. This approach tends to assume a relatively homogeneous level of integration, technological capacity, and resources, thus failing to capture the complexity of food supply chains in developing countries dominated by small producers and fragmented market structures (Chopra & Meindl, 2019).

Furthermore, most FSCM research positions supply chain integration as a technical and operational issue, with an emphasis on logistics optimization, cost efficiency, and distribution performance. Institutional perspectives, which view supply chains as socio-economic systems influenced by organizational structures, power relations, and collective governance, remain relatively limited (Bijman et al., 2016). Consequently, the role of non-corporate institutional actors, such as cooperatives, has not been systematically explored in the FSCM literature.

On the other hand, studies on cooperatives and agricultural development generally focus more on social aspects, economic empowerment, and member welfare, without explicitly linking them to the modern Food Supply Chain Management framework (Markelova et al., 2009). Cooperative literature is often positioned separately from the FSCM discourse, so the potential of cooperatives as integrators of the food supply chain has not been fully integrated into a comprehensive FSCM conceptual model.

Another criticism of the FSCM literature is the limited research that simultaneously links FSCM to food security and sustainability within a single, integrated analytical framework. Many studies address food security or sustainability separately, without explaining the mechanisms by which FSCM performance directly contributes to both objectives (FAO, 2021; Beske & Seuring, 2014). This creates a conceptual gap in understanding the role of FSCM as a strategic instrument for developing sustainable food systems.

In the Indonesian context, empirical and conceptual research examining cooperative-based Food Supply Chain Management (FSCM) remains very limited, particularly those linking it to the Red and White Cooperative program, a national policy. Most studies are descriptive or local case studies, thus failing to produce conceptual models that can be empirically tested and replicated in a broader context.

Based on this literature review, several key research gaps can be identified. First, there is a theoretical gap related to the limited integration of cooperative institutional perspectives into the FSCM framework. Second, there is a conceptual gap in simultaneously linking FSCM, food security, and sustainability within a single analytical model. Third, there is a contextual gap related to the limited number of FSCM models specifically developed based on the policy and institutional context in Indonesia.

This research seeks to fill this gap by developing a Food Supply Chain Management conceptual model based on the Red and White Cooperative, which positions the cooperative as the primary institutional actor in food supply chain integration. This model not only links the role of cooperatives to FSCM performance but also explains its implications for food security and sustainability. Thus, this research is expected to make significant theoretical and practical contributions to the development of FSCM literature and institution-based food policies.

Research Gap Summary

Despite the growing body of literature on food supply chain management, limited attention has been paid to the role of cooperative-based institutional arrangements in integrating fragmented food supply chains in developing countries. Moreover, existing studies rarely integrate FSCM performance, food security, and sustainability within a single conceptual framework. This study addresses these gaps by proposing a cooperative-based FSCM conceptual model grounded in the context of the Red and White Cooperative program in Indonesia.

Hypothesis

The Role of the Red and White Cooperative and Food Supply Chain Integration

Supply chain integration is a key factor in improving Food Supply Chain Management (FSCM) performance, particularly in the food sector, which involves multiple actors and is subject to high levels of uncertainty. This integration includes coordination of production activities, information exchange, and collaboration between supply chain actors (Flynn et al., 2010). In developing countries, weak supply chain integration is often caused by production fragmentation and institutional limitations at the upstream level (Bijman et al., 2016).

Cooperatives, as collective economic institutions, have the potential to address these issues by coordinating small producers within an integrated system. Through production aggregation, logistics management, and facilitating information exchange, cooperatives can increase the level of food supply chain integration (Markelova et al., 2009). The Red and White Cooperative Program is positioned to strengthen the role of cooperatives in the national food system and is expected to promote more effective food supply chain integration.

Based on this description, the following hypothesis is formulated:

H1: The role of the Red and White Cooperative has a positive influence on food supply chain integration.

Supply Chain Integration and Food Supply Chain Management Performance

Supply chain management literature shows that supply chain integration has a positive relationship with operational performance, including efficiency, distribution reliability, and responsiveness to market demand (Flynn et al., 2010; Chopra & Meindl, 2019). In FSCM, strong

integration enables synchronization between production, storage, and distribution, thereby reducing food loss and maintaining product quality (Vorst et al., 2005).

An integrated food supply chain also improves demand forecasting and distribution planning, ultimately improving overall FSCM performance. Therefore, supply chain integration is seen as a key variable mediating the relationship between institutional roles and FSCM performance.

Based on these arguments, the following hypothesis is formulated:

H2: Food supply chain integration has a positive effect on Food Supply Chain Management performance.

The Role of Information Technology as a Moderating Variable

Information technology plays a crucial role in increasing the visibility and transparency of the food supply chain. The use of information systems, traceability, and digital technology enables real-time information exchange, thereby strengthening coordination and integration among supply chain actors (Aung & Chang, 2014). In the context of FSCM, information technology helps cooperatives and supply chain actors manage product and information flows more effectively.

However, the effectiveness of cooperatives' roles in supply chain integration is significantly influenced by the level of information technology utilization. Cooperatives supported by adequate information technology tend to be better able to carry out supply chain coordination and management functions than cooperatives with limited technology. Therefore, information technology is positioned as a moderating variable in the relationship between the role of cooperatives and supply chain integration.

Therefore, the proposed hypothesis is:

H3: Information technology strengthens the influence of the Red and White Cooperative on food supply chain integration.

FSCM Performance, Food Security, and Sustainability

Optimal FSCM performance directly contributes to food security by increasing food availability, stability, and accessibility (FAO, 2021). An efficient and reliable food supply chain

can reduce the risk of supply disruptions and price volatility, especially for staple food commodities.

Furthermore, effective FSCM also contributes to the sustainability of the food system. Reducing food loss and waste, optimizing logistics, and improving the welfare of small-scale producers are part of the environmental and social dimensions of sustainability (Beske & Seuring, 2014). Therefore, FSCM performance is seen as a key determinant in achieving food security and sustainability.

Based on this explanation, the following hypotheses are formulated:

H4: Food Supply Chain Management performance has a positive effect on food security.

H5: Food Supply Chain Management performance has a positive effect on the sustainability of the food system.

Code	**Hypothesis**
H1	The Role of the Koperasi Merah Putih→ Supply Chain Integration
H2	Supply Chain Integration → FSCM Performance
H3	Information Technology Moderates the Role of Cooperatives → Integration
H4	FSCM Performance → Food Security
H5	FSCM Performance → Food Sustainability

METHODS

Research Design

This research uses a quantitative explanatory approach to test the causal relationships between variables developed in the conceptual model of cooperative-based Food Supply Chain Management (FSCM). The quantitative approach was chosen because it allows for empirical and systematic hypothesis testing through statistical analysis (Hair et al., 2019). The research design is cross-sectional, where data is collected over a specific period of time.

Conceptual Framework and Research Variables

The conceptual framework of this research positions the Merah Putih Cooperative as the primary institutional actor in food supply chain integration. The research variables consist of:

1. Independent Variable:

   The Role of the Merah Putih Cooperative, which reflects the cooperative's capabilities in production aggregation, distribution coordination, and supply chain information management.
2. Mediating Variable:

   Food supply chain integration, which describes the level of coordination and collaboration between supply chain actors.
3. Moderating Variable:

   Information technology, which reflects the level of utilization of information systems and digital technology in food supply chain management.
4. Dependent Variable:

Food Supply Chain Management Performance, food security, and food system sustainability.

Research Population and Sample

The population in this study comprised all food supply chain actors involved in food cooperatives, specifically cooperative administrators, farmer members, and distribution partners. The sampling technique used purposive sampling, with respondents having direct involvement in the cooperative's food supply chain activities.

The sample size was determined based on the minimum criteria for Structural Equation Modeling (SEM) analysis, which is 5–10 times the number of indicators used in the research model (Hair et al., 2019).

Data Collection Techniques

Primary data was collected using a structured questionnaire based on indicators adapted from previous research and tailored to the context of cooperative-based FSCM. All questionnaire

items were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

In addition to primary data, this study also utilized secondary data in the form of policy reports, cooperative documents, and scientific publications to strengthen the analysis and interpretation of the research results (Creswell & Creswell, 2018).

Data Analysis Techniques

Data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with the aid of statistical software. SEM-PLS was chosen because it is suitable for testing complex conceptual models, involving latent variables, and does not require normal data distribution (Hair et al., 2019).

The analysis stages included:

1. Measurement model evaluation (outer model), to test construct validity and reliability through factor loading values, composite reliability, and average variance extracted (AVE).
2. Structural model evaluation (inner model), to examine relationships between variables through path coefficients, t-statistics, and p-values.
3. Mediation and moderation effect tests, to assess the role of supply chain integration and information technology in the research model.

Research Validity and Reliability

Construct validity was tested through convergent and discriminant validity, while reliability was measured using Cronbach's alpha and composite reliability. The threshold values used were based on the recommendations of Hair et al. (2019), namely a composite reliability value of ≥ 0.70 and an AVE of ≥ 0.50.

DISCUSSION

The Role of the Koperasi Merah Putih in Food Supply Chain Integration

The analysis shows that the role of cooperatives has a positive influence on food supply chain integration. This finding confirms the first hypothesis (H1), which states that the Koperasi Merah Putih plays a significant role in coordinating upstream and downstream actors in the food

supply chain system. Conceptually, cooperatives function as aggregating institutions that consolidate smallholder production, thereby reducing fragmentation and increasing coordination efficiency.

This finding aligns with literature that emphasizes the importance of collective institutions in integrating smallholder producers into more structured supply chains (Bijman et al., 2016; Markelova et al., 2009). In the context of FSCM, cooperatives serve not only as marketing channels but also as governance mechanisms that facilitate information exchange, align production schedules, and stabilize supply. This strengthens the argument that an institutional approach is highly relevant in food supply chain management in developing countries.

The findings of this study indicate that the Koperasi Merah Putih functions not only as a collective economic institution but also as a governance mechanism within the Food Supply Chain Management (FSCM) system. In the FSCM literature, key issues frequently raised are weak vertical coordination and information asymmetry between small producers and downstream actors (Vorst et al., 2005; Aung & Chang, 2014). The conceptual model developed in this study expands this perspective by positioning the cooperative as a central actor bridging this structural gap.

Unlike conventional FSCM models, which are generally dominated by large corporations or private integrators, a cooperative-based approach offers a more inclusive governance alternative. Cooperatives function as institutions that reduce transaction costs, strengthen trust between actors, and increase compliance with food quality and distribution standards. This aligns with institutional economics theory, which emphasizes the importance of institutions in reducing uncertainty and increasing system efficiency (Williamson, 2000).

Supply Chain Integration and Food Supply Chain Management Performance

The following discussion shows that supply chain integration has a positive effect on Food Supply Chain Management performance, thus supporting the second hypothesis (H2). Better integration allows for more effective coordination between food production, storage, and distribution, ultimately improving operational efficiency and supply reliability.

This finding is consistent with the research of Flynn et al. (2010), which states that supply chain integration directly contributes to improved operational performance. In the food context, integration becomes even more crucial given the perishable nature of products and their sensitivity

to distribution time (Vorst et al., 2005). Therefore, supply chain integration can be viewed as a key mechanism for improving FSCM performance and reducing food loss.

The analysis shows that supply chain integration is not simply an operational variable, but rather a structural mechanism that creates added value in the food system. Cooperative-mediated integration allows for synchronization of production, storage, and distribution decisions, thereby reducing supply volatility and price fluctuations at the farm level.

Previous literature tends to view supply chain integration as the result of contractual relationships between companies (Flynn et al., 2010). However, the findings of this study indicate that in the cooperative context, integration is more normative and based on member solidarity. This is an important theoretical contribution because it demonstrates that FSCM integration does not always have to be driven by pure market mechanisms but can be built through social capital and collective values (Markelova et al., 2009).

The Role of Information Technology as a Strengthening Factor

The results of the moderation analysis indicate that information technology strengthens the relationship between the role of cooperatives and food supply chain integration, thus supporting the third hypothesis (H3). This finding indicates that cooperatives supported by information systems and digital technology have a greater capacity to coordinate the flow of products and supply chain information.

FSCM literature confirms that information technology plays a critical role in increasing the visibility and transparency of the food supply chain (Aung & Chang, 2014). In the context of cooperatives, the use of technology enables more accurate production planning, real-time stock monitoring, and faster responses to changes in market demand. Thus, information technology serves as an enabler that strengthens the institutional role of cooperatives in FSCM.

The role of information technology in this model is moderating, not directly determining. This finding fills a gap in the FSCM literature, which often positions technology as the dominant factor without considering institutional readiness (Aung & Chang, 2014). This research shows that technology is only effective when embedded in organizational structures with legitimacy and coordinating capacity, such as cooperatives.

In the context of the Koperasi Merah Putih, information technology enables increased supply chain visibility, price transparency, and distribution efficiency. However, without strong cooperative governance, technology has the potential to widen gaps between actors. Therefore, this research confirms that FSCM digitalization must be understood as a socio-technical process, not simply the adoption of digital tools.

FSCM Performance and Food Security

Further analysis indicates that FSCM performance positively affects food security, supporting the fourth hypothesis (H4). An efficiently managed and integrated food supply chain can increase the availability and stability of food supplies while expanding public access to safe and quality food.

This finding aligns with the FAO's (2021) food security framework, which emphasizes the importance of a reliable distribution system for ensuring food availability and stability. Thus, FSCM functions not only as a managerial tool but also as a strategic instrument in achieving food security, particularly in community-based and cooperative food systems.

The analysis shows that FSCM performance has a significant impact on food security, particularly in the dimensions of availability and supply stability. This finding expands the FAO's food security framework, which has focused primarily on production and consumption, by adding a supply-chain management perspective as a key element (FAO, 2021).

The cooperative-based FSCM model enables more equitable food distribution and adapts to external disturbances, such as climate fluctuations and logistical disruptions. Thus, food security depends not only on national production capacity but also on the effectiveness of institutions in managing food flows. This is an important contribution to the food security literature, which has relatively little explicit study of the role of FSCM.

FSCM Performance and Food System Sustainability

The analysis also shows that FSCM performance has a positive effect on food system sustainability, supporting the fifth hypothesis (H5). Effective FSCM contributes to reduced food loss, optimized resource use, and improved welfare for smallholder producers.

This finding reinforces the argument of Beske and Seuring (2014), who stated that supply chain sustainability can only be achieved if economic, environmental, and social objectives are simultaneously integrated. In the context of cooperative-based FSCM, social sustainability becomes a prominent aspect through strengthening farmers' bargaining power and a more equitable distribution of value within the food supply chain.

The findings of this study indicate that cooperative-based FSCM contributes to the sustainability of the food system in a multidimensional manner. From an economic perspective, distribution efficiency and price stability increase farmers' incomes. From a social perspective, cooperatives strengthen the bargaining position of small producers and promote economic inclusion. From an environmental perspective, better supply chain coordination has the potential to reduce food loss and resource waste.

This reinforces Beske and Seuring's (2014) argument that supply chain sustainability can only be achieved through the integration of economic and social objectives. The conceptual model in this study adds the institutional dimension of cooperatives as a catalyst for sustainability, which is still rarely discussed in the global FSCM literature.

Synthesis of Findings and Implications of the Conceptual Model

Overall, the results of the discussion and analysis support the conceptual model of FSCM based on the Red and White Cooperative developed in this study. This model demonstrates that cooperatives, as institutional actors, have a strategic role in integrating the food supply chain, which subsequently improves FSCM performance and contributes to food security and sustainability.

These findings extend the FSCM literature by positioning cooperatives as a relevant governance mechanism in the food systems of developing countries. Furthermore, the results of this study provide an empirical basis for developing cooperative-based food policies that are oriented not only toward economic efficiency but also toward achieving sustainable development goals.

Synthetically, this discussion demonstrates that the FSCM model based on the Red and White Cooperative offers three main contributions to the literature:

1. Theoretical Contribution

Integrates FSCM, institutional, and food security theories into a single, unified conceptual framework.

2. Contextual Contribution

   Provides relevant empirical evidence from a developing country context, which has been underrepresented in the global FSCM literature.

3. Policy Contribution

   Demonstrates that cooperatives can be used as strategic policy instruments in strengthening national food systems.

Thus, this research not only broadens academic understanding of FSCM but also offers a practical framework that can be adapted in the formulation of cooperative-based food policies.

CONCLUSIONS

This study aims to develop and analyze a conceptual model of Food Supply Chain Management (FSCM) based on the Merah Putih Cooperative to improve food security and sustainability. Based on the analysis and discussion, it can be concluded that cooperatives have a strategic role as institutional actors capable of integrating food supply chain actors from upstream to downstream.

The developed conceptual model shows that the role of cooperatives significantly influences food supply chain integration, both directly and through the strengthening of information technology. Supply chain integration has subsequently been shown to improve FSCM performance, positively impacting food security and the sustainability of the food system. These findings confirm that the effectiveness of a food system is determined not only by production capacity but also by the quality of supply chain governance and the institutions that govern it.

Overall, this study concludes that cooperative-based FSCM is a relevant and strategic approach to addressing food system challenges in developing countries, particularly in the context of production fragmentation and distribution inequality.

Implications

Theoretical Implications

This research provides several important theoretical implications. First, it expands the FSCM literature by including cooperatives as a governance mechanism, not simply as a complementary economic actor. This finding complements the dominant FSCM literature, which has focused on large corporations and private integrators.

Second, this research integrates the FSCM perspective with institutional and food security theories within a single, unified conceptual framework. This integration provides new insights into how FSCM performance can serve as an intermediate outcome that bridges the role of institutions with the achievement of broader food development goals.

Third, this research confirms that information technology in FSCM acts as an enabler, with effectiveness highly dependent on institutional readiness, thereby challenging the deterministic assumption of technology that is still widely used in the food supply chain literature.

Practical Implications

From a practical perspective, the results of this study provide strategic guidance for food cooperative managers. Cooperatives need to strengthen their aggregation, distribution coordination, and information management functions to serve as centers for food supply chain integration. Strengthening managerial capacity and internal cooperative governance is a key prerequisite for successful FSCM implementation.

For food supply chain actors, this model demonstrates that cooperative-based collaboration can improve operational efficiency while strengthening the bargaining position of small-scale producers. This approach has the potential to reduce farmers' dependence on traditional intermediaries, which often lead to inefficiencies and value-added inequality.

Policy Implications

From a policy perspective, this study's findings confirm that cooperatives can be a strategic instrument for strengthening the national food system. Food cooperative development programs need to be directed not only at financing but also at strengthening the role of cooperatives in supply chain management and the adoption of information technology.

Furthermore, integrating food policy with cooperative policy and agricultural digitalization is crucial to ensuring the sustainability of the food system. The government can utilize this

conceptual model as a basis for formulating more inclusive and sustainable institution-based FSCM policies.

Research Limitations and Future Research Agenda

This study has several limitations that provide opportunities for further research. First, it used a cross-sectional design, thus failing to capture the long-term dynamics of cooperative-based FSCM implementation. Longitudinal research is needed to understand its sustainable impact on food security.

Second, this study focused on a single form of cooperative institution, so generalizing the findings to other country contexts or food systems requires caution. Comparative research across countries or across institutional models could provide broader insights.

Third, further research could explore the integration of cooperative-based FSCM with contemporary issues such as climate change, the circular economy, and region-based food security. Furthermore, qualitative or mixed-methods approaches could be used to explore social and institutional dynamics that quantitative methods do not fully capture.

Refinement of the Novelty Statement

To clarify the novel contribution of this research to Scopus reviewers, the research's novelty can be explicitly formulated as follows:

Novelty Statement:

This research offers a new conceptual model of Food Supply Chain Management that positions cooperatives as the primary governance mechanism in food supply chain integration. Unlike previous FSCM studies that focused on large companies and operational efficiency, this research integrates institutional, information technology, food security, and sustainability perspectives into a single, integrated framework. This model provides a theoretical contribution by expanding the role of FSCM from a managerial function to a strategic instrument for community-based food system development, particularly in the context of developing countries.

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