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Collaborative Performance Metrics Model with Lateral Structure in Fresh Produce Supply Chains: A Review

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ABSTRACT

Performance measurement regarding collaborative supply chain of fresh produces such as fruit and vegetables that combines vertical and horizontal collaboration structures is rarely found in the literature. Performance metrics in this lateral collaborative structure are useful for tracking and measuring the achievement of more comprehensive business goals that are not found in only vertical or horizontal structures. This research aims to explore and propose the best model for collaborative performance system (CPS) in the fresh produce supply chain (FPSC) and success factors in CPS implementation, including CPS metrics and matching collaborative individual performance (CIP) and supply chain performance (SCP). Papers from the last seventeen years including journal papers, working papers and conferences were selected in three steps. From 175 articles found in the first step, 63 articles matched the topic. In the third step, 48 articles were selected as important topics of discussion focused on the field of fresh products, with three classifications of collaboration structures and identifying CIP and SCP metrics which were then analyzed. The results of this review provide good opportunity as reference material for further research, through a comprehensive analytical description complete with a conceptual model presented to complete the gaps in this field.

LIST OF ABBREVIATIONS

AHP: Analytical Hierarchy Process
CIP: Collaborative Individual Performance
CPS: Collaborative Performance System
DC: Distribution Center
FPSC: Fresh Produce Supply Chain
LTL: Less Than Truckload
PLC: Product Life Cycle
QAS: Quality Assurance System
SC: Supply Chain
SCM: Supply Chain Management
SCP: Supply Chain Performance
SCPt: Supply Chain Partner
TBL: Triple Bottom Line
TOPSIS: Technique for Other Preferences by Similarity to Ideal Solution

1. INTRODUCTION

The level of loss of fresh products during the logistics process is one of the significant threats to sustainable development (Surucu-Balci & Tuna, 2021), is a big problem. Approximately 14 percent of food produced was lost before reaching the retail stage (Santeramo & Lamonaca, 2021). It is important for companies to make efforts to maintain freshness to prevent spoilage, especially for retailers who must meet the varying demands for freshness from consumers (Yang &

Tang, 2019, Beshai *et al*., 2020, Marques *et al*., 2021). It has great potential to develop performance systems for players in the horticultural sector (Pearce *et al*., 2018), especially fresh produce commodities, which continue to experience growth and increase in demand due to fairly high market demand. This condition needs to be anticipated as an opportunity and economic benefit for improvements in the systems and strategies of the actors in the FPSC organization in this sector. However, on the other hand, improvements are needed, especially in relation to the importance of performance measurement in this sector, which is still weak, because most farmers in this sector do not yet have a collaborative performance system in their cooperation with their supply chain (Susanto *et al*., 2022).

Several agricultural countries in the developing nations. The agricultural sector is growing positively amidst the weakening economy in Southeast Asia (FAO, 2020) stated that the agricultural gross domestic product (GDP) grows; achievement grew by an average of 1,37% (year on year) in 2020, and contributes 12.98% to the national economy. (Ekon, 2022). The main strategies for horticultural development initiated in many agricultural countries, especially in Southeast Asia, are: 1) Development of horticultural areas, 2) Growth micro, small, and medium enterprises (MSMEs) on horticulture, and 3) Digitalization of agriculture through the development of an integrated information system between upstream and downstream to realize optimal development of horticultural commodity areas.

Furthermore, in facing the industrial era 4.0, digitalization of agriculture through several information systems is crucial (important, essential). An information system and horticultural digital platform need to be designed that can be used by farmers, entrepreneurs, and the public. The system is important to increase the implementation of an early warning system (EWS), registration of horticultural areas, Geographic Information System for Plant Pest Organisms for Horticultural commodities, and Horti-Trade room as a channel and application for introducing products that can be utilized by buyers and suppliers so that information and trade transactions are profitable, this application can be downloaded with a mobile phone (Simatupang & Rina, 2019). Fresh products are a source of income because they are supported by potential land and climate, human resources, and extensive domestic and international market opportunities.

This study, which is relevant to identification and exploration process in determining appropriate performance metrics for collaborative performance system (CPS) in FPSC, discusses performance metrics for company individual performance (CIP), supply chain performance (SCP), and CPS in FPSC for each farmer/company by consider the success factors of CPS implementation. This paper explains the relevance of the literature underlying the topic discussed, explaining how CPS in SC, which includes the dimensions of the performance metrics used, collaborative structures, and factors that influence CPS success factors (Susanto & Othman, 2021), the relationship between SCP performance metrics, CIP and FPSC performance metrics are applied to the development of a conceptual model of CPS performance metrics on FPSC from the perspective of agricultural countries. The areas where each construct is present in the conceptual model and hypothesis are also discussed, then it is explained what constructs are involved in the research and how one construct is related to other constructs based on the implementation, background and objectives of the research (Everill, 2020, Lundy *et al*., 2007).

2. METHODS

We collected 175 from journal articles (World of Science, Scopus, and Sinta) about CPS implementation and its factors published between 2005-2023, intending to investigate CPS in horizontal and vertical collaboration structures and then classify them by integrating them into lateral collaboration structures in implementation in the field managerially applicable. Several keywords, such as "Collaborative Performance System", "Supply Chain", and “Performance Metrics ", Performance metrics," are used in the search process to find publications. The flow of this research methodology is depicted in the flowchart shown in Figure 1: the following four types of attributes provide insight into the implementation of CPS in CPS practices that are suitable for FPSC: 1) Implementation metrics that are using in measuring CPS performance. 2) The extent to which the integration of collaboration structures used by chain actors implements performance metrics in their CPS. 3) Level of participation or interaction between actors in CPS. 4) The extent of integration between SC actors in collaboration model. Furthermore, careful analysis of 63 articles with three classifications of collaboration structures and identified CIP and SPO metrics.

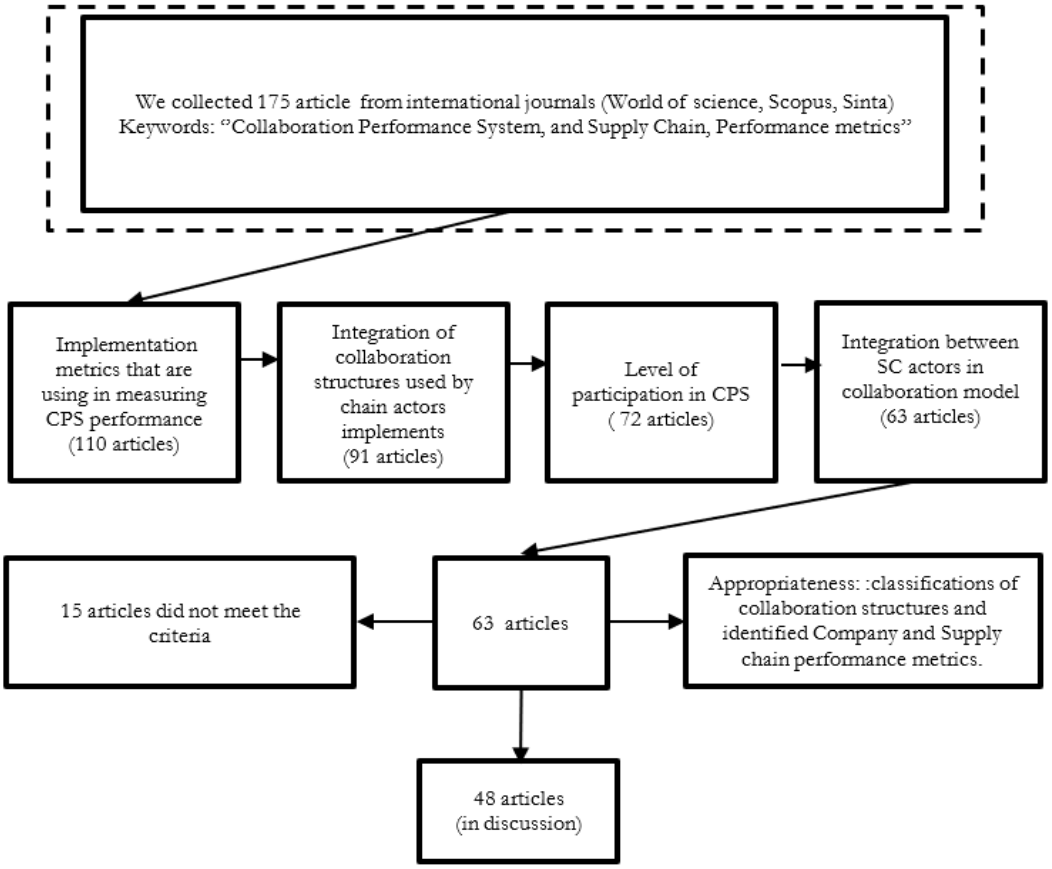

Figure 1. Flow of study methodology

Our efforts to validate it are through experts who care about CPS practices in the fresh produce agro-industry sector. By ensuring that actors in the SC collectively use the four existing implementation attributes, they can provide benefits and a complete picture of the CPS performance metrics used in management and use appropriate performance metrics for both CIP and SPO in their services and businesses, based on consideration of gaps and developing an integrated performance metrics model that is used also appropriate in CPS practice in the FPSC.

3. RESULTS AND DISCUSSION

Over the last decade, FPSCs in agroindustry countries have begun to emerge, as demonstrated by the expansion of the supermarket channel globally (Vetter *et al*., 2019).The role of conventional markets fell 0.1 percent because supermarkets sell more than 60 percent of the fresh fruit vegetable modern market. As discussed, prominent players dominate the market; supermarkets lead the chain, avoiding wholesale markets and creating direct trade with many importers (Maertens *et al*., 2012). The FPSC structure studied at CPS during this research consists of Farmers, Collectors/Distributors, Distribution and Transportation Modes, and modern Retail/Supermarkets. Some of the gaps in this sector, currently relate to SC in their organizations, such as 1) many supplier farmers who still need to be present as partners join collaborative CPS to check how well each SC member performs with shared indicators. 2) Supermarkets are still dominant and are the second alternative market after conventional markets. As supermarkets expand, the position of farmers declines, and strict regulations pose challenges in pricing, quality, distribution, and transportation costs. These factors burden farmers, making stricter regulations more challenging to implement. 3) Many farmers still need a new performance system to improve their performance. 4) Government agencies, universities and research institutions do not effectively promote the welfare of farmers, especially fresh products, which are very important for sustainable public health. That aligns with SDGs program. We focus on environmentally friendly technological

innovations such as organic supported by a strong human resource capacity, farmer institutions, and a bio-industrial system designed to be cost-efficient and environmentally friendly to highlights the potential of green and quantum-based technologies in the agricultural community, focusing on efficient and essential products. However, implementation still needs to be improved because many farmers still face quality problems and need assistance (Damang and Munizu, 2019) and institutional strengthening problems (Nugroho *et al*., 2022). In addition, climate change, land conversion and farmer regeneration are significant issues that affect stakeholders, including the FPSC area.

The dominance of "old farmers" in the region and the need for regeneration mechanisms for young farmers is a significant concern. Technological innovation is essential to overcome these challenges and ensure appropriate land use meets food demand and industrial needs. That aims to transition to area-based agriculture, utilizing technology and stakeholder collaboration. It involves developing clusters with similar products and requires farmers to implement performance measurement mechanisms. The SDGs in the agroindustry program focuses on sustainability, social justice, economic prosperity, human resource readiness, and stakeholder collaboration. Harmonized performance systems at the company/individual farmer, SC and CPS levels are critical for a holistic and sustainable strategy. Implementing workable ways to overcome challenges and develop robust, sustainable, and inclusive food systems is critical to achieving this goal.

3.1. Collaborative Performance in Supply Chain

The importance of CPS being adopted by organizations in long-term partnerships to align sustainable supply chains (Zimon *et al*., 2020). Performance metrics and targets are defined in written statements, measurable and timely, challenging a chain of actors to achieve them. There is, in turn, motivates chain members to improve their SCP and overall performance (Bahinipati, 2014). It also allows chain partners and members to access their performance information, making it easier to identify weaknesses and bottlenecks in business processes (Pradabwong *et al*., 2017).

Companies in the supply chain can benefit from CPS by improving their management performance and integrating their performance data into CPS (Gichuru *et al*., 2015). This integration allows them to unify the performance of the entire chain and identify the problems and companies that cause them. The study is used collaborative metrics in the fresh food industry for information sharing (inventory levels, development of new products, marketing planning) and resource sharing (skills and knowledge-specialization, and investment capabilities); however, only use two channels (supplier-buyer) (Gichuru *et al*., 2015). Researchers often focus on firm-level performance metrics, study, developing a collaborative network involving many suppliers and retail stores using performance metrics: inventory levels, forecast accuracy, product availability, and order imperfections (Papakiriakopoulos & Pramatari, 2010). They used two distributed channels as a case study and established performance metrics to measure overall SCP. In contrast to (Zimmermann & Seuring, 2009), their study focuses on combined performance metrics at the supply chain level using a business service center, and the results can be better controlled. Meanwhile, Simatupang & Sridharan (2008) argue that a superior CPS must have a system to measure the level of performance of the company and SC, which is essential for maintaining and increasing its effectiveness. As an illustration, we present a comparison of performance metrics for CPS levels used in previous literature and will be used for this study, as shown in Table 1.

3.2. Collaboration Structure

In developing a supply chain partner (SCPt), according to (Cao & Zhang, 2011), SCC creates a commitment to SCPt to operate as a partnership and collaborate on core operations to achieve common goals. Obtaining common goals in this literature is divided into types of cooperation, cooperation factors, and SC cooperation. In the literature, SCCs have been classified into several collaborative structures: horizontal and vertical. SCC divided into horizontal by (Soosay *et al*., 2008, Solaimani & van der Veen, 2022), vertical and lateral collaboration (Chan & Prakash, 2012). The type of collaboration depends on the parties involved and the scope of the collaboration (Soosay & Hyland, 2015). Vertical collaboration involves sharing responsibilities, resources, and data information flows between organizations, whereas horizontal collaboration involves unrelated or competing organizations exchanging private information or resources. Lateral collaboration aims to gain additional flexibility by combining and sharing capabilities vertically and horizontally (Chan & Prakash, 2012).

Table 1. Performance metrics for CPS level.

Author, year	Performance Metrics	
(Zimmermann & Seuring, 2009)	**Case 1:** • Cash-to-cash cycle • Sales index • Complaint quota • Availability • Stock outs • Forecast accuracy • Credit notes • Online-volume	**Case 2:** • Turnover • Market share • Customer satisfaction index • Complaint number • Complaint quota • Delivery reliability • Inventory • Sales days' coverage • Sales volume
(Papakiriakopoulos & Pramatari, 2010)	• Inventory level • Forecast accuracy • Product availability • Imperfect orders	
(Hernández *et al*., 2011)	Joint of Transportation Mode	
(Bahinipati, 2014)	Contract Farming	
(Chan & Prakash, 2012)	Channel SC 1; • Inventory storage costs • Reorder costs • Ordering fee	Channel SC 2; • Impact of inventory policies • Inventory policy on performance and total costs.
(Gichuru *et al*., 2015)	Information sharing; • Inventory level • New product development • Marketing planning	Resource sharing; • Skills and knowledge • Specialization • Investing capabilities
(Hidayat *et al*., 2015)	Trust: • Maintenance relationship • Short-term gains • Long-term focus • Enthusiasm relationship	Relationship quality: • Credibility • Accountability • Experience • Quality of goods offered
(Dunning, 2016)	Mutual Contract: • Inventory level • Forecast accuracy • Imperfect orders • Responsiveness • Product availability	
(Orjuela-Castro *et al*., 2017)	• Information and data sharing • Benefit sharing • Risk sharing • Managing trust • Inventory level • Forecast accuracy • Responsiveness • Product availability	
(Damang *et al*., 2019)	• Quality strategy • Flexibility strategy • Responsive strategy • Efficiency strategy • Business competitiveness	

A detailed explanation of the three collaboration structures is in the Figure 2. The type of collaboration depends on the parties involved and the scope of the collaboration (Soosay & Hyland, 2015). Vertical collaboration involves sharing responsibilities, resources, and data information flows between organizations, while horizontal collaboration involves unrelated or rival organizations exchanging private information or resources. Lateral collaboration aims to acquire additional flexibility by merging and sharing capabilities vertically and horizontally (Chan & Prakash, 2012).

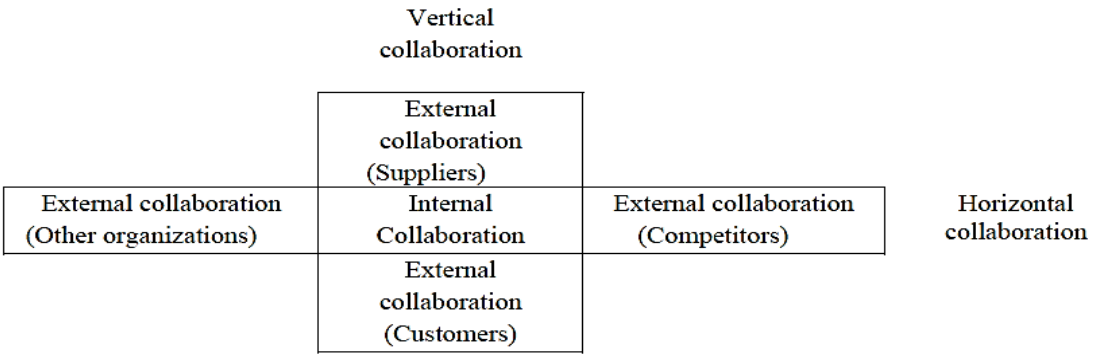

Figure 2. Types of collaboration (Solaimani & van der Veen, 2022, Barratt, 2004)

1) *Vertical collaboration structure*: The different types of vertical collaborative structure models used in previous research draw attention to performance metrics at the SC level, as previously discussed in the study of (Zimmermann & Seuring, 2009). Their research results show that the direct impact of trust on inventory flow performance and the direct impact of the quality of relationships between dealers and manufacturers on inventory flow performance is positive. Similar to (Papakiriakopoulos & Pramatari, 2010), their model measures only the retail distribution center (DC) and Store/backroom store levels, not the Supplier/product Supplier level. The model by Gichuru *et al*. (2015) has proven the benefits of this system, which uses CPS indicators, namely resource and information sharing. However, its implementation only measures company performance level and does not discuss overall SCP. Meanwhile, Damang *et al*. (2019) tested the influence of SC strategies consisting of quality, flexibility, responsiveness, and efficiency strategies on the business competitiveness of the passion fruit industry in South Sulawesi, Indonesia. Their research shows that apart from responsive strategy, all SC strategy factors in the vertical collaboration structure significantly affect business competitiveness. Other literature, in research in Indonesia regarding the impact of supplier and buyer relationships on SC performance in the manufacturing industry, describes the relationship between commitment, communication, satisfaction, trust, and the quality of relationships between dealers and manufacturers and SC performance (Hidayat *et al*., 2015).

2) *Horizontal collaboration structure:* A horizontal collaboration structure is a business agreement between two or more companies or units in a supply chain or network to enable ease of work and cooperation to achieve common goals (Tella & Virolainen, 2005). Other literature on horizontal collaboration structures in CPS, such as Bahnipati's (2014) research, discusses short product life cycle (PLC) lifetimes, integrating farmer networks, food processing, and supply to end customers, and using contract farming in horizontal FVSC channels. Hernández *et al.* (2011) discuss the problem of deterministic dynamic single transportation collaboration for small and medium-scale less than truckload (LTL); the multi-commodity minimum cost flow problem with shared transportation modes can be a solution to reduce distribution and transportation costs (Hernández *et al*., 2011). However, this has disadvantages such as loss of flexibility, loss of control by individual members of the supply chain (SC) (Moutaoukil *et al*., 2012), high coordination costs due to competition, and anti-trust issues (Paul, 2020). Practitioners can help develop CPS by increasing capacity, encouraging earlier market interactions, and supporting individuals/companies or groups to become "vendors of choice" for retail shopping chains in a more specific scope of uniform commodity products.

3) Lateral collaboration structure: Integrated logistics and intermodal transportation synchronize carriers and freight forwarders from various companies in a smooth and effective freight transportation network (Gronalt *et al*., 2019). However, explaining how other components, such as transport distribution mechanisms and essentials but intangible aspects, such as trust, flexibility, collaboration mechanisms (Novirani *et al*., 2023), and The SCPt relationships, are used more comprehensively is necessary. Chan & Prakash (2012) examined the manufacturing SC from an inventory management perspective. Their goal is to provide insight into the types of inventory policies adopted that can minimize costs. Their study examines lateral collaboration in linear supply chain management (SCM) using two linear SCs with different inventory policies. The lateral collaboration structure outperforms horizontal collaboration due to individual SC members' decision-making freedom. Higher reorder points lead to higher total costs, but lateral collaboration has a

lower total cost. It is due to inventory policy impacting CPS and SCM performance. The results suggest that lateral collaboration is more effective than horizontal collaboration in manufacturing SCs. Their proposed model solely discusses the inventory management perspective (Elsayed & Wahba, 2016, Michalski *et al*., 2018). However, it needs to explain how other components, such as transportation, sharing mechanisms, and essential but intangible aspects, such as trust, flexibility, and mechanisms and SCP of collaboration, are used more comprehensively (Zhao *et al*., 2023, Lohachab *et al*., 2021). A study by Castro & Jaimes (2017) found that lateral collaboration is better than horizontal collaboration because of each committee member's decision-making freedom (Lohachab *et al*., 2021).

This lateral structure was chosen as the best choice for this model, supported by Chan & Prakash (2012) who stated that Lateral collaboration aims to acquire additional flexibility by merging and sharing capabilities vertically and horizontally. Combining these models and packaging types highlights better performance in seasonal stock sizes, delivery duration and quality (Doberstein, 2016). However, the weakness of this research lies in not examining performance metrics that show that responsive structures have the lowest loss values and the highest flexibility with the lowest transportation losses. This research also has limitations, such as not providing a CPS planning and evaluation mechanism for SCP indicators, risks arising from exchanging information and technology, and interactions between cooperation partners, primarily developing and maintaining trust. This problem generally occurs in collaborative activities, as in previous literature (Susanto *et al*., 2022, Green Jr *et al*., 2012, Soosay & Hyland, 2015, Kamble & Gunasekaran, 2020, Susanto et al., 2020; Chen *et al*., 2007). To assist the collaborative structure in implementing CPS, it is also necessary to discuss the collaborative planning structure used in the analysis to differentiate planning carried out at the implementation level to be more appropriate at each category level. The following section is the basis for collaborative network analysis in SC organizational strategies in implementing CPS in FPSC as factors that influence the success of CPS, CIP, SPO (Susanto *et al*., 2022).

Several factors that impact CPS and SCP have been proven positive. The first factor is SCM practices (Soosay & Hyland, 2015). Customer interactions, level of information sharing, strategic supplier partnerships, quality of information sharing, and delays are some SCM practices that contribute to performance. Another factor is the quality of SC partnerships and integration (Srinivasan *et al*., 2011). Internal and external integration between organizations is critical to achieve satisfactory performance. Collaborative planning and forecasting also improve SCP (Chen *et al*., 2007) and marketing alignment (Green Jr *et al*., 2012). SC maturity, characterized by capabilities in planning and control, excellent business processes, and better management capabilities, is also identified as a positive factor in performance (McCormack *et al*., 2008) and performance management maturity (Kamble & Gunasekaran, 2020). Other factors that influence the success of CPS, summarized from previous literature based on studies by Susanto & Othman (2021), such as 1) Knowledge of the benefits of collaboration, 2) Reluctance to change, 3) Collaborative culture, 4) Social relations; 5) Trust; 6) Technology; 7) Environmentally friendly; 8) Safety-security for sustainability. However, company owners or managers must consider these positive factors in developing their business strategies. Likewise, two factors interfere with performance: supply-demand risk and lead time uncertainty (Wagner & Bode, 2008).

Define CIP is a company's ability to achieve its goals using resources effectively (Arbelo *et al*., 2021). It describes how effectively a company achieves performance results compared to previous performance/performance of other organizations also on how effective its goals are. Moreover, superior targets have been set for now and in the future because cooperation in the CPS assessment system requires long-term goals. Another thing often overlooked in previous research is the lack of role of farmers in the collaboration system. Where farmers have not received significant benefits from collaboration The SC collaborative part of the CIP is an integral part of the SC-CPS for farmers, distributors, modes of transport, and supermarkets. Although high supermarket product standards lead to consolidation at the farm level, the chain of impacts on welfare remains significant because poor farmers are still involved in this chain, which is a complement to labour and SC. Many small land-owning farmers need more capital to join the supermarket channel, and the farmers who directly supply the channel are medium and large farms owned and managed by middle-class farmers. Small farmers involved in SC managed by supermarkets have better welfare than those not involved in SC, according to data confirmed by (Minten *et al*., 2009), and a study addressing CPS-based SCC employs CIP metrics (revenue and cost, lead time, customer satisfaction, and product quality) by (Aramyan *et al*., 2007).

Following a business management perspective, performance assessment must examine performance metrics with the financial and economic consequences of management decisions that can affect operations, investment, and financing

(Chen *et al*., 2023). It can be done individually, including farmers in the FPSC collaboration who must be able to respond to consumer desires by providing cheap products, improving product quality, and providing timely and varied products. In offering it, the company makes internal improvements and requires integration of all aspects of its SC, starting from suppliers, products, partners, and consumers (Tarigan *et al*., 2021).

In addition, state that a significant relationship exists between increasing management capability and organizational performance, and the SC is an essential concern for all SC members (Martinette & Obenchain-Leeson, 2012). Managing collaboration in FPSC includes four issues (Mena & Stevens, 2010). The first problem is assessing the performance of collaboration. The SC practices require each member to interact well because collaboration will result in better overall chain performance. The second problem is the inequality of power in the food sector. It should prove that the SC-food relationship is asymmetrical and unbalanced but lasts extended periods (Michalski *et al*., 2019). This issue examines how relationships improved in these situations and how performance is maintained when power remains unequal. The third issue is assessing suppliers. This issue focuses on the buyer-seller relationship of two or more committee members. Assessment is a communication process between two or more dyadic partners that strengthens collaboration to achieve common goals. A final concern is innovation in food SC; competition is fierce, and SC, with more significant innovation, will lead and win the competition; chain members need to leverage their relationships to drive innovation in their chains (Wei *et al*., 2023).

A study about five traits that SCs should have in relationships: reliability, communication, personal relationships, stability, and trust highlighted by (Novirani *et al*., 2023, Dania *et al*., 2022, Bezuidenhout *et al*., 2012). Lack of these qualities will lead to fragmentation, opportunism among SC members, and excessive control from members with higher power. There is also an argument that the development of collaboration in FPSCs is more complicated than in other SCs due to the unique characteristics of food and the resources used to produce it (Pieter van Donk *et al*., 2008). So far, four integration strategies can be implemented: (1) buyer-operations focus, (2) virtual buyer-operations focus, (3) aggregate hierarchical planning, and (4) integrated planning and scheduling. Each strategy has constraints, such as volume uncertainty, shared capacity, processing and packaging issues, and plant complexity. Although this strategy is emphasized in the context of the food production chain, it also applies to other food chains. Discussing the FPSC relationship, research on two cases of UK food chains revealed interesting findings (Mena & Stevens, 2010). In this case, inter-organizational relationships are more significant than intra-organizational relationships. This finding contradicts the assumption that intra-organizational relationships are more substantial than inter-organizational relationships. These findings suggest that shared ownership across multiple entities does not inherently imply deeper relationships. In other words, ownership variations do not necessarily prevent business entities from collaborating and are less suitable for specific problems such as FPSC (Kumar *et al*., 2020).

3.3. Developing Performance Metrics Model

From the review of this study, it is essential as a basis for developing a performance metrics model to answer the problems in the problem formulation and the gaps that exist in implementing CPS in FPSC from most of the events reviewed in the literature related to previous research. The development of this model consists of a review that explores, designs, develops, and proposes CPS and performance metrics of the influence of individual and supply chain performance from previous models used in this study, then reviews and investigates the factors that influence or improve CPS performance. Next, integrate each of them into a complete conceptual model of performance metrics in implementing CPS in FPSC with a lateral collaboration structure. Every analysis in this field has contributed to the body of knowledge and is suitable for developing countries that produce fresh produce products, such as Indonesia.

3.3.1. Models of CPS Metrics

The development focus of the CPS model performance metrics in FPSC is knowledge suitability as a sub-framework. It examines collaboration structure models, metrics, and factors influencing the successful implementation of CPS, SPO, and CIP. The performance metrics are determined and targeted by considering the interests of all actors involved in the chain. In addition, the collaborative performance planning process must begin by collecting all updated performance data from each actor in the chain and then identifying problems or weaknesses to concentrate on improvement plans. In

addition, involving all the organization's main target stakeholders (chain members) in planning and implementing performance targets together is very important in implementing CPS.

The growth of CPS as a research field is still in its infancy, and the number of articles discussing it is relatively rare (Gichuru *et al*., 2015). Several papers try to leverage existing PMS models for the supply chain context. In other sectors, proposed performance indicators in the "Balanced Scorecard (BSC)" model for SC assessment of the mining sector integrate BSC with AHP (Park *et al*., 2005). Varma performance indicators are more useful in intra-company SC than inter-company. A good CPS must include the ability to monitor company-level and SC-level performance (Simatupang & Rina, 2019, Simatupang & Sridharan, 2008). These capabilities are critical to maintain and develop the efficacy of collaborative SC. However, most performance metrics are intended for enterprise-level use only.

Study focused on SC-level performance metrics using a business service centre and two distribution channel pairs as case studies. This study aims to identify standard metrics for overall SCP measurement (Zimmermann &Seuring, 2009). Meanwhile, developed a PMS for collaborative networks of many suppliers and retail stores (Papakiriakopoulos & Pramatari, 2010). The models are generally depicted but only measure the Retail Distribution Centre (DC) and Store/backroom levels, not the product Supplier/Supplier level. This study does not include product suppliers in the performance of CPS integration within the SC organization. The selected SPO performance metrics are inventory levels, forecast accuracy, product availability, and imperfect orders). Only two metrics can measure performance: inventory levels and product availability. Inventory levels and forecast accuracy cannot be achieved due to research limitations, often involving data from collaboration platforms and specific case settings.

The main problem is the gap between accessible data and the business processes supported by the collaboration network. Collaboration and information exchange are fundamental in business process management (Papakiriakopoulos & Pramatari, 2010). This study confirms that SCC contributes positively to SPO; the results align with (Gichuru *et al*., 2015). They use CPS metrics in the fresh food industry to share information, including inventory levels, new product development, marketing planning, resource distribution, skills and knowledge, specialization, and investment capabilities. Performance metrics are in Table 1 for the CPS levels of this study. In addition, to identify metrics, researchers' attention was also paid to applying CPS. Despite the potential benefits of CPS, various issues point to inability and reluctance as the main problems preventing organizations from implementing CPS today.

It is essential to realize that collaboration in measuring and managing performance creates opportunities to correct weaknesses and improve overall SCP, which can benefit the company. Schneider (2018), states that the main obstacle is the successful implementation of CPS. First, companies need support in cultivating a collaborative culture with chain partners, enabling effective planning and implementation of business initiatives (Simatupang & Sridharan, 2008). Second, companies cannot define standardized measurements as a collaborative effort with partners. Adopting CPS challenges arise from bringing together diverse organizations and employees, requiring communication and confidence to improve CPS. CPS is aimed at non-profit organizations, such as government agencies, because they collaborate with various groups to achieve their goals, thus requiring performance measurement of their partnerships. Collaboration between government agencies and non-governmental organizations and suggests eight steps to improve performance: executive leadership, network promotion, bridging, capacity building, public investment, technical assistance, value-added assessment, and feedback and learning examined by (Agranoff, 2005).

In another study, the interactions between government agencies and their vendors in overseeing contracts studied by (Amirkhanyan, 2009). He suggested that government agencies measure vendor performance to prevent contract errors rather than punish them. Collaborative performance measurement will be more effective when all parties know and are involved in the collaborative network in their SC organization. Applying CPS based on network theory helps to analyse how collaboration achieves policy goals and meets stakeholder expectations. Policy networks can come in many forms, from closed and tight to extensive control, resulting in open and distributed networks. CPS-based approaches emphasize the importance of network managers in directing collaboration. They play two roles: process management, improving interactions between members and existing networks, and policy performance. Network managers effectively identify policy goals and roles within the context of overall goals. Existing literature highlights workforce actors as frontline agents in service delivery, ensuring alignment between parties in society and policy (Hupe & Hill, 2007; Vuong, 2022).

Collaboration as an interaction method offers a new perspective on studying and measuring policy performance through collaboration. Policy network and collaboration theories emphasize the structured interactions of actors, while other literature focuses on intervening factors in network management. Collaboration network literature in FPSC focuses on observations and managers as agents of change in institutional design (Baporikar & Randa, 2020), determining the PMS designed and implemented in an organization. In this study, the organizational development model for the CPS level model begins with collaborative structures and metrics, using a vertical collaboration structure based on the analysis of (Gichuru *et al*., 2015). Meanwhile, Bahinipati (2014) and studies used two horizontal dimensions to evaluate collaboration performance in contract farming (Susanto *et al*., 2022). CPS performance metrics are used in contract/mutual benefit farming to distribute goods between producers and consumers (see Figure 2), while the preferred supplier concept reduces governance costs and transportation costs. Alternative horizontal metrics proposed by (Hernández *et al*., 2011), such as shared mobility mode, improve collaboration performance. The choice combined lateral collaboration (CPS) structure to facilitate and answer problems such as the problem formulation and research objectives and to address gaps in the Indonesian FPSC, including the lack of supply for farmers who are members of the joint CPS. This model aims to improve performance based on performance metrics matching and provide benefits for all partners, not just supermarkets, as the presence of supermarkets increases, and the position of farmers is no longer marginalized.

In the 21st century, collaboration is a fundamental approach that can replace the hierarchical approach to improve farmers' welfare. This principles-based process produces integrity and results through building consensus, ownership, and appropriate alignment across all aspects of the organization. Collaboration's fundamental emphasis is on processes that generate trust, integrity, and breakthroughs by achieving consensus, ownership, and integration across all aspects of the organization. By developing metrics/indicators of CPS implementation for FPSC actors, experts and researchers can shift their perspective towards FPSC actors, thus contributing to the overall improvement of the agricultural sector.

3.3.2. Model of Factors Influence the Success of CPS Metrics.

Performance is influenced by activity, with factors having a positive impact on CPS and SCP. This framework examines the importance of strategy and inter-organizational network theory, highlighting the relationship between levels of collaborative planning in information flows at the strategic, operational and tactical levels (Susanto & Othman, 2021). Their performance metrics include knowledge of benefits, desire for change, collaborative culture, trust, technology, social relationships, environmental friendliness, and safety-security sustainability. The theoretical approach integrates elements of SCC network theory from previous literature and CPS success factor models based on past rigorous evaluations.

3.3.3. Models of Supply Chain Performance Metrics

Many chain members' operational activities require contributions from their partners. Mena & Stevens (2010) highlight the importance of cooperation between chain members in various activities, such as harvesting, shipping and storage, and vegetable chain operations. Collaborative adjustments can prevent product spoilage and loss. CPS is a system used by SC actors to plan, encourage, and review performance measures and targets, including metrics used in supply chain performance, aiming to achieve overall SC success. Therefore, a well-defined PMS should reveal the contribution of each chain actor to the overall chain performance (Wang *et al*., 2021, Papakiriakopoulos & Pramatari, 2010, Aramyan *et al*., 2007). Bahnipati's (2014) study highlights the importance of chain members monitoring the performance of the entire chain to identify problems and companies that cause these problems to find solutions. Meanwhile, Cao & Zhang (2011) found that strong SCC significantly influences competitive advantage because strong teamwork can result in better performance. A study by Simatupang & Sridharan (2008) has proven that performance metrics in the supply chain, order fulfilment, inventory and responsiveness can improve the overall performance of the supply chain (Figure 3).

3.3.4. Models of Individual Farmer/Company Performance Metrics

Research on the SCC model shows that collaboration positively impacts performance at both the SC and company levels (Shukor *et al*., 2021), supported by research of Srinivasan *et al.* (2011); Green *et al*. (2012); Gichuru *et al*. (2015);

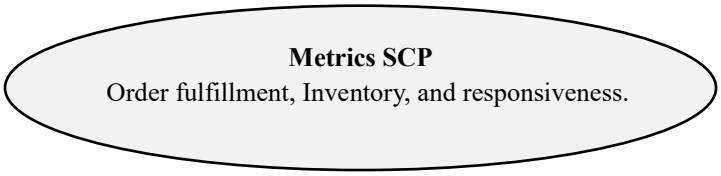

Figure 3. Model metrics SCP in the FPSC (Adopted from: Simatupang & Sridharan, 2008)

Castro *et al*. (2017); and Damang *et al*. (2019). Individual Performance Measurement (CIP) framework in a complete CPS in FPSC was proposed, focusing on efficiency, flexibility, responsiveness, and food quality (Aramyan *et al*., 2007). The approach and indicators were validated on tomato SC examples from the Netherlands to Germany, with nine indicators selected as essential performance criteria; the adopted model is in Figure 4. A model for assessing innovation and performance in cold chain fruit (SC fruit) using categories that assess performance (i.e., efficiency, flexibility, responsiveness, and quality) combined in a matrix with categories that assess innovation (i.e., product, process, market, and organization) efficiency, flexibility, responsiveness, and quality proposed by (Trienekens *et al*., 2008). This model has been implemented in various apple supply chains in the Netherlands, focusing on the cold chain, i.e., perishable commodities stored in ambient conditions. A performance improvement strategy using the Delphi, AHP, and TOPSIS methods, proposed by (Joshi *et al*., 2011). Delphi discovers, synthesizes, and prioritizes critical performance elements and sub-factors, while AHP analyses them and TOPSIS creates viable options for performance improvement. That applied was an approach to a case study of chilled goods traders in India.

FPSCs are highly dependent on natural resources, which requires environmental performance metrics to measure food supply chain. Based on the European Community product policy, a PMS has proposed to measure environmental performance in Swedish SC tomato sauce (Mintcheva, 2005). Mathematical modelling is also used for PM in SC diets, offering a stochastic approach to quantify the spread of salmonella in the broiler chicken chain (Tromp *et al*., 2010). This model can help policymakers and business organizations determine optimal transmission levels and determine necessary actions and interventions in line with institutional theories guiding CPS implementation. The institutional approach emphasizes the role of institutional variables in fostering collaboration and collaboration (Doganay & Ergun, 2017). The importance of appropriate behavioural logic in determining something in a particular context, highlighted by (Hoskisson *et al*., 2013). This logic gives rise to distinctive rules and norms, provides organizational stability, enables adaptation to environmental changes, and helps companies understand why they favour or reject collaborative approaches. The importance of this logic in understanding transformative collaborative performance (March & Olsen, 2010). This theory allows for breakthrough behaviour in certain circumstances, in contrast to the stability demonstrated by institutional analysis. Overall, this theory is valuable for examining collaboration's transformative performance and synergistic potential.

Examined factors that enhance or adversely impact food SC performance in performance measurement research. A survey of Chinese vegetable SCs showed that Chinese social networks can improve relationships and performance (Lu *et al*., 2008). Their research coverage of SC companies in the Guanxi network strengthens buyer-seller relationships, improving business performance. Likewise, the solid collaboration between small companies in a cluster positively benefits marketing performance (Lamprinopoulou & Tregear, 2011). However, the same study also found that vertical

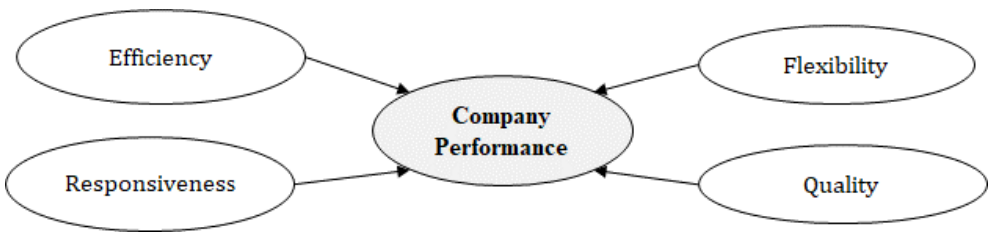

Figure 4. Model metrics CIP in the FPSC (Adopted from: Aramyan *et al*., 2007)

relationships (relationships between one cluster member and other actors in the supply chain) have a more significant impact on marketing performance than horizontal relationships (relationships between clusters), and lateral relationships are more potent for increasing inventory—management performance (Chan & Prakash, 2012). Suppliers are critical in food supply chain management. Improving their ability to produce better products and services can improve their performance (Shokri *et al*., 2010). Retailers can gain financial and operational benefits from supplier interactions (Zhan *et al*., 2018), as demonstrated in research involving US food and SC grocery items. Quality assurance, such as implementing a Quality Assurance System (QAS), also influences SCP performance (Aramyan *et al*., 2007). Implementing this strategy can significantly improve overall supplier performance in food SCM.

CPS in SC is a new field of research divided into two types: examining factors that enhance collaboration and examining the impact or benefits of collaboration. SC integration levels highlight the importance of information sharing as the backbone of collaboration among SC members (Tsanos *et al*., 2014). Their study showed a significant relationship between collaboration and performance, and Liao et al. (2017) confirmed the importance of incentives and information sharing for efficient collaboration in SC. In another study, effective information exchange and trust with collaborators are essential for collaborative planning (Klein & Rai, 2009).

Furthermore, the importance of information sharing and supply chain dynamics in collaboration emphasized by (Zhou & Benton Jr, 2007). Fawcett *et al* (2008) advise managers to focus on information, technology, and measurement systems while addressing human issues such as trust, culture, resistance to change, and collaboration readiness. The human aspect is significant for the success of an organization because human problems may be more challenging than information and technology. Over the past fifteen years, more comprehensive investigations have explored collaboration factors. Simatupang & Sridharan (2008) proposed an SCC architecture consisting of five aspects: information exchange, collective performance systems, continuous SC process improvement, incentive alignment, and decision synchronization.

Similarly, Cao & Zhang (2011) proposed seven component metrics for effective supplier-retailer collaboration: decision synchronization, information sharing, incentive alignment, collaborative communication, resource sharing, goal alignment, and joint knowledge creation. Meanwhile, improving metrics include shared decision-making, investment in communications technology, information sharing, quality, forecasting, product availability, and feedback. Functional driver metrics include front-end agreements, business strategy, procedures, capacity utilization, plan compliance, material availability, inventory, service levels, and feedback. Five quality factors of supplier-retailer collaboration: information sharing, joint partnership management, trust, partner symmetry, and asset sharing, which mutually influence the quality (Tsang *et al*., 2018, Sodhi & Son, 2009), value chain (Hernández *et al*., 2015), and performance of the collaboration between the actors (Novirani *et al*., 2023).

3.4. Conceptual Model of CPS Performance Metrics

The description of a constructed model of each relationship is from the identification, exploration, and analysis results in the discussion of gaps and the development of CPS performance metrics with lateral structure collaboration in the FPSC. The formulation strengthened of a conceptual model of CPS performance metrics in FPSC can by previous literature is proven that collaboration to boost company performance (Srinivasan *et al*., 2011, Gichuru *et al*., 2015), and CPS performance metrics will improve overall SC performance. Simatupang & Sridharan (2008) emphasize that collaboration will improve performance at the supply chain level in terms of fulfilment, inventory, and responsiveness. Business people who understand the benefits of a performance system will better implement CPS (Khuntia *et al*., 2021). In addition to knowledge, it influenced CPS implementation by reluctance to change, collaborative culture, and trust. Successful collaboration in FPSC requires companies to adapt their management of individual companies to integrated SC activities (Shukor *et al*., 2021). Reluctance to change can reduce CPS levels, while a collaborative culture is considered an essential prerequisite for CPS success and trust (Fawcett *et al*., 2008, Murphree & Breznitz, 2020). Another prediction regarding the factors influencing the implementation of CPS comes from social networks. Lu *et al.* (2008) and Bahnipati (2014) reveal that social relationships positively influence collaboration by increasing trust between social change actors. Social relationships can also facilitate efforts to plan and drive performance metrics and targets. Additionally, communication technology can encourage partner collaboration by supporting communication and coordination between chain members (Wu & Chiu, 2018).

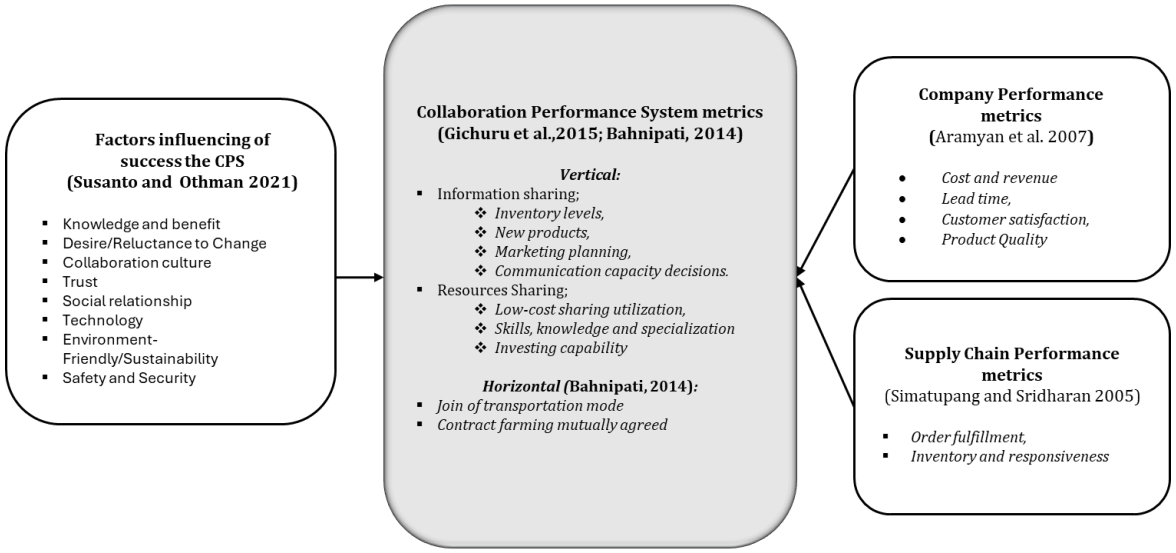

Figure 5. Conceptual of performance metric model of CPS with lateral collaboration structure [Sources: Susanto & Othman (2021); Liu *et al*. (2020); Gichuru *et al*. (2015); Aharonovitz *et al*. (2018); Bahnipati (2014); Hernández *et al.* (2011); Aramyan *et al*. (2007); Simatupang & Sridharan (2008); Susanto *et al*. (2024)]

According to the study of Graca & Matos (2016), sustainability as a factor contributing to collaboration, discussed in the business ecosystem enabled by the increasing use and improvement of communication networks, currently offers a strong competitive advantage for businesses and entrepreneurs by proposing a series of indicators to assess the benefits of work equality, safety and food security (Tian, 2017, Gardas *et al*., 2018). Meanwhile, Susanto & Othman (2021) proposed eight factors influencing the implementation of CPS to improve performance: knowledge of benefits, desire for change, collaborative culture, trust, technology, social relationships, environmental friendliness, and safety-security sustainability. From the results of this review and explanation above, the construction of a conceptual performance metric model in CPS where the relationship between factors that influence the success of CPS and CPS performance metrics, as well as the relationship between CIP metrics and the SCP in CPS can improve the quality of CPS implementation, as in Figure 5, Conceptual of performance metric model of CPS with lateral collaboration structure.

4. CONCLUSION

Based on the analysis that has been built, a performance management of CPS performance metric model with a lateral structure. The results show that the CPS performance metrics with this lateral collaboration structure have comprehensively considered and combined the principles of collaborative planning theory and supply chain collaboration networks obtained in previous literature. With a combination of two collaborative structures that are rarely found in previous literature; consists of inventory levels, new products, marketing planning, communication capacity decisions, utilization of low-cost sharing, skills, knowledge and specialized resources, investment capabilities (vertical), as well as a mix of modes of transportation and mutually agreed work contracts/farm contracts (horizontal). Performance metrics that have a positive influence on the implementation of CPS on the performance of each company are costs and revenues, waiting time, customer satisfaction, and product quality. Meanwhile, performance metrics for supply chain performance consist of order fulfillment, inventory, and responsiveness. The model also produces eight factors that influence CPS: knowledge about the benefits of collaborative work systems, desire to change, collaborative culture, trust, technology and information, social relationships, friendliness, safety-security sustainability. From this model, considering the business interests of strategic theory and inter-organizational networks, we obtain evidence of a relationship between levels of information flow collaboration planning, both strategic, operational and tactical levels, in the fresh product supply chain as a reference for factors that influence the success of chain collaboration. supply this fresh product.

Limitations and further Study

There are limitations because it only discusses the relationship between influencing factors on CPS, so it is necessary to study further the relationship between the influencing factors themselves; for example, the relationship between Knowledge and benefit of CPS on reluctance of change, social relations between chain actors increases the trust between them, and others. In terms of lateral structure performance metrics in implementing CPS, this study found a combination of vertical structure performance metrics, namely inventory levels, new products, marketing planning, and communication capacity decisions as part of information sharing. Meanwhile, other performance metrics such as low-cost sharing utilization, skills, knowledge and specialization resources and investment capability are part of resource sharing. The horizontal collaboration structure includes mutually agreed upon joint transportation and work contract modes. The discussion about the importance of business strategy theory, collaborative planning, and inter-organizational networks provides evidence of the relationship between the level of collaborative planning in the flow of information at the strategic, operational, and tactical levels in FPSC, referring to the factors that influence it.

The further study focuses on implementing CPS at FPSC regarding organizational culture, which plays a vital role in supply chain collaboration and performance by paying attention to the success factors of CPS implementation and the influence of individual company performance metrics and the fresh product supply chain. It requires an in-depth study of actors' motivation in relationship with different strategies and operations to build a structural equation model in the broader sample for different types of companies and supply chains and compare within national borders within the same research object at FPSC.

Further studies can test this conceptual model with sufficient research data and in-depth to see the relationship between performance metric constructs, both at the CPS success factors, CPS, CIP, and SCP metrics on FPSC to get answers and the accuracy of existing hypotheses. Further research could include the relationship between the eight existing CPS success factors and whether there is an interplay between each of these factors. Further studies as part of research that is still developing in the future at the practical level, field testing can also complement and explain the theory behind the CPS performance assessment system, with a focus on characteristics and objectives that focus on two main aspects of CPS: achievement and achievement metrics, where This part of the research does not include and adopts a CPS definition that reinterprets the triple bottom line (TBL) concept, emphasizing that companies must contribute to society and protect the surrounding environment or the earth we live on. Developed theory-based and supporting perspectives can be used in studies to understand how CPS involves small farmers as performance units in their chain to ensure business continuity and equal roles in CPS, which still needs to be discovered in previous research.

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