

Measurement of Agricultural Supply Chain Performance: A Systematic Literature Review

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Abstract. *This research aimed to describe supply chain performance measurements and performance matrices, which are performance assessment points, and identify the causes of high and low supply chain performance scores and the impact of supply chain quality on economic sustainability. This research takes the form of a systematic literature review consisting of various selected Scopus-indexed international journals, selected based on journal content that is relevant to the topic discussed in the research. Most of the previous articles only focused on supply chain topics in general. Hence, the results of this research are in the form of an explanation of agricultural supply chain performance issues using the BSC, SCOR, AHP, and DEA methods, as well as a description of the supply chain performance matrix in assessing supply chain performance. – Due to the research approach chosen, this research may lack specificity due to the large number of articles sampled. Therefore, researchers are encouraged to carry out further documentation refinement. This article includes implications for measuring supply chain performance by the agricultural company's managerial needs as well as for research that adapts to the form of the company.*

Keywords : Supply chain, supply chain measurement, supply chain performance

INTRODUCTION

The agricultural supply chain has extraordinary complexities and characteristics in its handling (Jia *et al.* 2020). What makes the agricultural supply chain special is that the agricultural sector has received the highest advantage among other sectors to achieve sustainable growth (Kamble *et al.* 2020). Agricultural products are attractive because of their role in environmental sustainability (Jia *et al.* 2020). The agricultural supply chain includes several organizations, such as pre-production organizations, production, storage, processing, retail, and final product distribution before reaching consumers (Sharma *et al.* 2020). However, agricultural supply chains face pressure to increase agricultural efficiency driven by depleting water, shrinking land availability, and increasing consumer demand for transparent food chains (Sharma *et al.* 2020).

Supply chain management is the flow of information, goods, money, capital equipment, and labor. Managing such a complex network requires understanding how companies and individuals interact with each other, which will ultimately understand the impact of their behavior on each other in making changes and fluctuations in supply chain decisions and strategies, ultimately affecting performance (Farsi *et al.* 2020). This is related to the fact that supply chain performance management is dynamic. After all, it will increase complexity resulting from factors such as global sourcing, mass customization, shortened product life cycles, and technological disruption (Chand *et al.* 2020).

To predict, evaluate and make decisions in the supply chain can first be done by measuring supply chain performance (Lima-Junior dan Carpinetti 2019; Hwang *et al.* 2008; Bukhori *et al.* 2015; Dewi *et al.* 2015). Performance measurement according Shah dan Singh (2001) the supply chain is an essential and powerful management tool whose relationship depends on the ability to identify measures that drive the success of the supply chain. Supply chain performance is helpful for the smooth functioning of the economy and overcoming disruptions that can harm productivity and economic growth (Goel *et al.* 2021). Performance goals are set for the processes and actions to be carried out, and then performance progress in achieving the goals will be monitored, reported, and controlled (Vegter *et al.* 2020).

Due to the increasingly complex and diverse nature of agricultural supply chains, making decisions requires appropriate measurement methods and involves considering many factors. Various methods for evaluating supply chain performance are in the form of SCOR which is a supply chain model that carries out systematic analysis based on processes, performance evaluations, and best practices and looks at the five main elements in SCOR, namely plan, source, make, deliver and return (Trkman *et al.* 2010; Dissanayake dan Cross 2018; Defrizal *et al.* 2020). Then, the measurement model uses the Analytic Hierarchy Process (AHP) method, which defines the relative terms of each supply chain alternative based on actual data (Bukhori *et al.* 2015; Djatna *et al.* 2020). The Data Envelopment Analysis (DEA) method uses qualitative and quantitative data to measure supply chain performance regarding input and output (Reddy *et al.* 2019; Djatna *et al.* 2020). As well as fuzzy-based methods for evaluating cost-competitive supply chain performance (Arif-Uz-Zaman and Ahsan 2014).

This article is a systematic review of the literature on agricultural supply chain performance measurement with references to different articles related to supply chain performance and agricultural products, which provide much information regarding supply chain performance measurement models supply chain evaluation only, so this article intends to provide further explanation regarding agricultural supply chain performance issues. The first part of this article contains the basis for deciding to raise this topic, the second part of the article contains the objectives of this research, the third part concerns the methods and steps used in conducting a systematic literature review, the fourth part contains the findings obtained in the articles used. The fifth section, presenting conclusions from the systematic literature review process, has been collected.

An essential aspect of successful supply chain management lies in measuring and monitoring information about operational parameters and their central performance. In addition, high-quality partnerships between buyers and suppliers can also be an opportunity to increase performance benefits when the company's management capabilities also have a high focus (Srinivasan *et al.* 2011; Qrunfleh dan Tarafdar 2014). Based on previous articles relevant to supply chain performance, this paper was created to look further at the dynamics of supply chains, especially in the agricultural sector. The research objectives are made in the form of points, namely as follows:

1. Describe the supply chain performance measurements and the supply chain performance matrix, which is the point for assessing supply chain performance.
2. Identify the causes of high and low supply chain performance values and the impact that supply chain performance has on economic sustainability.

METHODS

The topic of agricultural supply chain performance was chosen to analyze previously published literature in more depth and consider it the main source of material for primary research. Therefore, the method chosen to analyze and further review the topic of this problem is to use a systematic literature review method. This method combines content analysis (Kamble *et al.* 2020). An organized and managed literature review helps gather knowledge scattered across a particular type of work or study area. This systematic review synthesizes research in a systematic, transparent, and reproducible manner, aiming to increase the knowledge base and inform policymaking and practice. A systematic review of the literature is carried out in addition to synthesizing the previous literature that is already available; this method also helps in investigating, compiling, and examining a detailed analysis of previous research in supply chain integration and its relationship with performance through the prism of a contingency approach (Vegter *et al.* 2020; Hassan dan Abbasi 2021). Systematic literature observations provide practitioners with valuable articulations to guide policy and practice in any field or discipline, even research results from literature reviews that are more significant in assisting logical decision-making and other future research efforts (Hassan dan Abbasi 2021).

The methodology applied uses a three-step iterative process consisting of: (1) review process, which consists of journal search and selection activities, (2) descriptive analysis, which explains the profile of the selected journal, (3) thematic exploration, namely sorting to develop detailed understanding of the journal (Kamble *et al.* 2020; Vegter *et al.* 2020; Hassan dan Abbasi 2021).

Review Process

After formulating the topic to be researched, the search process for various scientific articles in this paper was obtained and cited from various websites of science, namely Elsevier, Science Direct, Emerald Insight, and Google Scholar, and opening the Scopus site to see the index of the selected journal to be able to review further. The keywords to find relevant articles to select are 'supply chain performance,' 'supply chain management,' 'agriculture supply chain,' 'systematic literature review in the supply chain,' 'SCOR models in supply chain performance,' and several other keys are typed spontaneously. On the Science Direct site, searches for several articles are classified into two categories: review articles, which contain literature reviews, and research articles, namely articles written through prior research.

In the first stage of the article search, 46 articles deemed relevant to meet research needs were found. The articles were selected based on the accuracy and suitability of the title to the topic of discussion, namely supply chain performance. After progressing to the next stage, namely, reading the journals one by one and starting to document their profiles based on the title, author's name, year of publication, and journal name, a total of 41 articles of agricultural supply chain in general were selected. This journal was selected after reading the abstracts in each journal. Next, more detailed and complex documentation is carried out for each selected journal based on research background, research design, research question, method, findings, and limitations. The results of this complex documentation resulted in as many as ten articles not being selected to be used as research references because the contents of the articles were not very relevant to the research design that would be created.

Descriptive Analysis

The results of reviewing articles through descriptive analysis are more focused on understanding and explanations in journals, publication patterns, chosen time frames, data collection tools, and classification of articles based on the country or industry considered (Hassan dan Abbasi 2021).

In observing the agricultural supply chain performance field, the 31 selected articles had a publication time span of 20 years, namely from 2001 to 2020. Of all these articles, the year of publication with the most was 2020, namely ten articles, followed by 2019 with four articles, 2021, 2018, and 2015, with three articles each and seven articles published from 2017 onwards. Relevance and newness are an added value to this research because most of the articles are still new. The distribution of papers by year is depicted in the following graph.

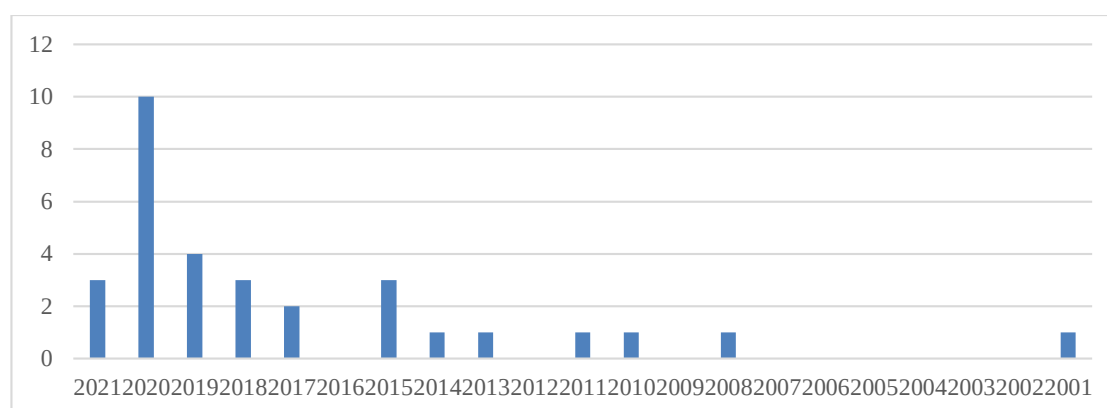


Figure 1. Paper Distribution graph by year

DISCUSSION AND FINDINGS

Agricultural Supply Chain Performance Issues

The supply chain focuses on the forward flow of goods and consists of the Plan, Source, Make, Deliver, and Enable processes. The supply chain concept creates cooperation between supply chain actors to meet consumer needs with a structured supply chain that will provide satisfaction and create customer trust. Supply chain management application to determine the performance position of the existing supply chain. Marketing activities can run efficiently if they have clear marketing channels.

Supply chain management (SCM) is the flow of information, goods, money, capital equipment, labor, etc. In an interactive network of suppliers, service providers, customers, and other stakeholders in the supply chain. Managing such a complex network requires understanding how these individuals interact with each other and, ultimately, understanding their behavior's impact on each other in creating changes and fluctuations in supply chain decisions and strategies (Farsi *et al.* 2020).

A supply chain will involve business parts such as manufacturing, suppliers, transportation, warehouse, retail, and even consumers, both directly and indirectly, to meet the needs of final consumers (Apriyani *et al.* 2018). Companies face considerable challenges in meeting customer needs in today's volatile market environment. Additionally, competition has shifted from individual companies to entire supply chains (SCs). In this context, supply chain management (SCM) plays a vital role in keeping companies in the global market by effectively managing activities from suppliers to end customers. SCM handles and manages the business from raw material procurement to manufacturing, distribution, customer service, and finally, product reprocessing and disposal. Every SC wants to improve its performance to achieve customer expectations (Reddy *et al.* 2019).

Research conducted by Peng *et al.* (2020) said that traditional supply chains consume large amounts of energy and resources and emit unprecedented amounts of polluted waste, severely negatively impacting environmental protection and clean production. To reduce the dilemma between corporate social responsibility and environmental protection, implementing green supply chain management, including green design, green purchasing, clean production, waste reduction, and life cycle cost accounting, is essential for environmental protection, circular economy, and sustainable development. The supply chain emphasizes greening the entire process, from purchasing raw materials to designing, producing, selling, recycling, and waste processing.

Supply chain performance assessment is a transversal process involving the collaboration of several member companies. There are several reasons for implementing a performance measurement system, namely to identify success, to identify whether customer needs are being met, to help organizations understand their processes and confirm what they know or reveal what they do not know, to identify where there are problems, bottlenecks, waste, etc., and where improvements are required, to ensure decisions are based on facts, not on guesswork, emotion, belief or intuition; and to show whether planned improvements are occurring.

However, as shown by evaluating supply chain performance, it is a complex task. There are several barriers to implementing and using a supply chain performance measurement system, such as data access difficulties, scattered information technology infrastructure, time and financial resources required, uncertainty about what should be measured at the supply chain level, lack of cohesion between performance metrics, the existence of multiple conflicting metrics, and poor reporting communication (Mani *et al.* 2018; Lima-Junior dan Carpinetti 2019).

Agricultural Supply Chain Performance Issues

A performance measurement system is needed to carry out monitoring and control, communicate organizational goals to functions in the supply chain, know where an organization is relative to competitors and the goals to be achieved, and determine the direction of improvement to create competitive advantage. The most popular supply chain performance measurement system (SCPMS) is the BSC approach, followed by SCOR, AHP, hierarchy-based approaches, simulation techniques, process-based approaches, and DEA. Initially, most researchers focused on identifying performance measures. Later, that focus shifted to prioritizing selected actions based on the nature of the metrics.

Balanced Scorecard Model (BSC)

Kaplan dan Norton (2005) have proposed the BSC to evaluate company performance from four perspectives: financial, internal business processes, customers, and learning and growth. Most researchers have used the Balanced Scorecard (BSC) approach to evaluate SC performance. The BSC approach is generally applied to select and combine SC performance metrics from a balanced view. This emphasizes balancing four classes: customers, finance, internal processes, and innovation. The BSC consists of traditional financial measures representing the organization's past and adds non-financial measures (operational measures) representing drivers of future performance distributed among the initial four classes. The fundamental quality of the BSC is that it measures performance in four key areas, which are linked to strategic objectives.

Supply Chain Operations Reference (SCOR)

The Supply Chain Council popularized the SCOR model. SCOR is a conceptual model consisting of three main elements: business process reengineering, benchmarking, and process measurement. SCOR comprises five elements: flexibility, reliability, responsiveness, assets, and costs. These five attributes are tools for measuring supply chain performance, which is divided into two parts, namely internal performance, and external performance. Internal performance attributes are assets and costs, while external performance attributes include reliability, flexibility, and responsiveness. Reliability is the ability to perform work as expected, on time, with quality according to requested standards and quantity according to request. Responsiveness is the speed in carrying out work, which is measured, among other things, in the order fulfillment cycle. Flexibility is the ability to respond to external changes to remain competitive. They are measuring tools, including flexibility and adaptability. Meanwhile, assets are the ability to use assets productively, demonstrated, among other things, by low inventory levels and high-capacity utility.

SCOR (Supply et al.) provides standard process definitions, terminology, and metrics. The Supply Chain Council developed SCOR, which aims to evaluate supply chains. SCOR provides a common performance framework, standard terminology, and optimal practices. SCOR also has advantages in terms of process details and can be used for benchmarks. The SCOR model proposes attributes and metrics to evaluate supply chain performance. The scope of applying the SCOR model is all supplier or consumer interactions from order entry to payment invoices, all product transactions from suppliers to consumers, all market interactions from aggregate demand to fulfilling each other's needs, and the last is returns.

Analytical Hierarchy Process (AHP)

AHP is a multi-criteria decision-making tool developed by Saaty (1990). AHP is a systematic procedure for hierarchically representing any problem's elements. The analytical hierarchy process (AHP) is a decision-making method that carries out pairwise comparisons between choice criteria and also pairwise comparisons between existing options. Decision-making problems with AHP are generally composed of criteria and choices. The hierarchy is structured from the top (goals from a managerial point of view) through the middle level (criteria/sub-criteria on which subsequent levels depend) to the lowest level (which is usually a list of alternatives). It organizes essential rationality by breaking down the problem into smaller and smaller constituent parts. Then, it guides the decision maker through a series of pairwise comparison judgments (which are documented and can be rechecked) to express the relative strength or intensity of the impact of the elements in the problem. Hierarchy. This assessment is then translated into numbers. AHP uses pairwise comparisons of the same hierarchical elements at each level (criterion or alternative) using a scale that indicates the importance of one element over another concerning the higher-level element.

The scaling process produces elements' relative priority or weight concerning the highest-level criteria or elements. Comparisons are made for all elements in a level concerning all elements in the level above. The final and global weight of the elements at the lowest level of the hierarchy is found by adding up all the contributions of the elements in a level to all the elements in the higher level. AHP includes procedures and principles used to synthesize multiple assessments to derive priorities among criteria and subsequently to alternative solutions. It is important to note that the figures obtained are approximate ratio scales and correspond to the so-called complex numbers (Saaty 2008). Once pairwise comparisons of alternatives or sub-criteria are made concerning the elements in the higher criteria (formed as a matrix).

Data Envelopment Analysis (DEA)

DEA was developed by Charnes *et al.* (1978) and is a methodology used to evaluate the relative efficiency of a set of comparable entities called Decision Making Units (DMU) with some inputs and outputs by some particular mathematical programming model. DEA is suitable for use in measuring supply chain efficiency because it can handle many inputs and outputs and does not require prior unrealistic assumptions on variables inherent in typical supply chain optimization models (i.e., known demand levels, lead times, etc.). This advantage of DEA allows managers to evaluate any action efficiently because they do not need to find any relationships that connect them.

Research with DEA can be structured in various ways depending on the situation and problems. The product or organization whose relative efficiency will be measured is DMU, measured by comparing the input and output used with a point on the efficient frontier line. This efficient frontier line surrounds or covers the data of the organization in question, from which the name DEA is taken

Furthermore, research by Wong *et al.* (2008) regarding the supply chain performance measurement system: a DEA Monte Carlo-based approach, with research results that they succeeded in proving that the combination of the Monte Carlo technique and the DEA supply chain model is an efficient and effective tool in measuring supply chain performance in a stochastic environment. This new methodology has provided a more meaningful interpretation of efficiency estimators. In contrast to the point estimates of efficiency scores provided by conventional DEA models, DEA models can make statistical inferences on efficiency estimators.

Impact of Supply Chain Performance on Activities

The results of research conducted by Mani *et al.* (2018) show that in 18 validated social measures (scales), the underlying five social dimensions include diversity, health and safety, product responsibility, human rights, and social responsibility in developing countries, where these results serve as input important in building theory about social sustainability in upstream supply chains. There are collaborative efforts by companies focused on adopting social sustainability that can be beneficial in avoiding supply risks and improving reputation and performance in developing countries. Companies can invest in and commit to suppliers' socially sustainable adoption practices, which generate performance benefits for the company.

Research on supply chain performance during the COVID-19 pandemic carried out by Goel *et al.* (2021) shows possible feedback from growth in logistics performance: countries with higher growth have more significant resources devoted to logistics and infrastructure that perform well. The aggregate, input, and output dimensions of supply chain performance results contribute positively to economic growth.

Improving supply chain logistics performance will benefit countries with low growth rates. Supply chain disruptions will likely create a double whammy in low-growth countries on top of the problems of fighting the pandemic. The body driving economic growth was impacted by COVID-19, which resulted in negative growth impacts due to disruption of supply chain value. Lacking a direct supply chain (few exports), affected countries will experience more difficulties obtaining supplies to produce goods (Mani *et al.* 2018; Hassan dan Abbasi 2021).

Implementing logistics performance improvements takes time and effort. In the case of this pandemic, supply chain performance will depend on the opening and ending times of the event. Apart from shortages and timely delivery of products, the impact of COVID-19 includes reduced product diversity for consumers and greater monopoly for companies, which will reduce the performance of companies' supply chains (Mani *et al.* 2018).

CONCLUSION

This research, which takes the form of a systematic literature review, was created to determine the measurement and performance of agricultural supply chains. A total of 31 main articles were used as references in carrying out this systematic literature review activity. Supply chain performance is helpful as a tool that can evaluate, measure, and become a consideration tool for companies in making decisions. This research discusses four types of supply chain performance measurements, each with its uses and characteristics, namely the SCOR, BSC, AHP, and DEA methods.

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