

**Building a Sustainable Agri-Food Supply Chain through Collaboration**

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**Abstract: -**

Ensuring collaboration across all stages of the agri-food supply chain to achieve sustainability is a complex challenge. All stakeholders must balance their financial interests while also addressing social development and environmental responsibilities. This topic has gained the attention of several scholars. The objective of this paper is to review existing research on sustainable supply chain management and collaborative models in the agri-food industry. The study examines the three key dimensions of sustainability-economic, environmental, and social-and analyzes different models of sustainable supply chains within the sector. Additionally, it explores collaborative approaches to supply chain management, considering both vertical and horizontal collaboration. The findings indicate that few studies focus on integrated collaboration for building a sustainable supply chain system. Moreover, not all aspects of sustainability are thoroughly addressed. Scholars tend to focus more on economic and environmental factors, often neglecting social considerations. Furthermore, some research studies focus on only one type of collaboration, rather than holistically integrating all elements of the triple bottom line-people, planet, and profit.

**Introduction**

Sustainable supply chain management and collaboration are essential concepts in today's business environment, particularly in the agri-food industry. This paper aims to review current research in both areas, identify limitations, and provide suggestions for future

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research on sustainable supply chain collaboration in the agri-food sector. The study specifically examines the three dimensions of sustainability in agri-food supply chain management: economic, environmental, and social aspects. It provides a comprehensive discussion of sustainable supply chain management models in the agri-food industry. Furthermore, the paper investigates collaboration models in sustainable agri-food supply chain management, categorizing them into vertical collaboration, horizontal collaboration, and hybrid approaches that combine both types. Through this review, the paper highlights areas for improvement and offers recommendations for future research.

#### **Agri-food supply chain and sustainability**

The agri-food industry represents one of the world's most vital sectors, with significant economic, environmental, and social impacts across many countries. In the United States, this sector supports both national and international economic activities while sustaining human life. Europe experiences similar multi-dimensional impacts from this industry, while in Scotland, the food and drink supply chain serves as a major economic driver and significant employer. Developing countries also benefit economically from the agri-food industry. Malaysia has seen significant socioeconomic development through rapid innovation in

product development and processes within the agri-food supply chain. Indonesia relies on key commodities including sugar, rice, meat, soybean, corn, chili, red onion, and palm to support its long-term national development.

Supply chains play a crucial role in supporting agri-food product development. The agri-food supply chain encompasses all processes from farmers and suppliers providing raw materials, to manufacturers processing food products to add value, to distributors and retailers delivering products to customers through systematic business processes. While each stakeholder incurs costs and receives benefits, these are not always distributed fairly, highlighting the need for supply chain management that ensures equitable benefit distribution both along and across the supply chain. More complex supply chain configurations present greater challenges. Global competition and the unique characteristics of agri-food products require maintaining food quality throughout the entire process from farm to consumer to prevent waste of products that become unusable. A critical factor in food supply chains is ensuring fair collaboration among stakeholders while addressing economic, environmental, social, organizational, and marketing factors, as well as food safety and obligations to firms, consumers, and society. To address the complexity of agri-food supply chains,

sustainability offers a perspective for maintaining competitive strategies through the triple bottom line (TBL) approach, which integrates economic, environmental, and social dimensions. The economic dimension encompasses revenue, cost, consumer satisfaction, and service levels. Environmental considerations include natural resource consumption, carbon footprint, environmental legislation, waste management, and hazardous materials. The social dimension addresses impacts on society such as working conditions, community development, consumer health and safety, human rights, and child labor issues. By balancing these three dimensions, optimal competitive advantages can be achieved while supporting social development and reducing environmental impacts.

### **Collaboration in sustainable agri-food supply chain**

Strong stakeholder commitment can be achieved through collaboration. Supply chain collaboration involves partnerships across various supply chain stages and with external environments to optimize competitive advantage throughout all processes. This collaboration is crucial for sustaining long-term partnerships and distributing benefits throughout the entire supply chain system, from strategic to operational levels. Through collaboration, stakeholders can share assets (materials, labor, infrastructure, facilities,

equipment, and machinery) and capabilities (technology, business processes, policies, legislation, and finance). This sharing enables them to reduce uncertainty, distribute risk and cost, and serve customers with the right timing, quantity, and quality while respecting other stakeholders' interests. Two types of collaboration should be viewed as a single entity: vertical and horizontal collaboration. Vertical collaboration refers to relationships between upstream and downstream stakeholders along the supply chain. Horizontal collaboration involves relationships among stakeholders at the same level, including competitors and complementary businesses, as well as external parties such as government agencies, NGOs, associations, and universities. Both collaboration types must be considered to achieve a better sustainability system for all stakeholders without adversely affecting vulnerable parties like local farmers and SMEs. Without collaboration, consumer prices would be higher as each stakeholder would increase prices to maximize benefits and minimize risks. Therefore, collaboration is essential for increasing product value and ensuring food production flexibility while adhering to environmental policy integration. Over the past decade, food industry stakeholders have increasingly focused on collaboration to achieve sustainable supply chain system targets, as it provides optimal

benefits by maximizing profits and minimizing risks for involved parties. However, maintaining supply chain collaboration across all stages in supply chains like the sugar industry is complex. The system's complexity increases with more stakeholders. Obstacles to implementing collaborative systems include lack of stakeholder support, insufficient assessment systems, limited information systems, organizational culture issues, and resistance to change. Successful collaboration requires adequate technology and information support. Additionally, building mutual trust among partners demands eagerness from all parties to commit to positive collaboration.

### **Collaboration in agri-food supply chain management**

Collaboration is essential in agri-food supply chains to minimize costs, increase profits, ensure quality, and ultimately gain consumer trust. This collaboration encompasses all activities including production processes, information and infrastructure sharing, and exchange of skills and knowledge among diverse stakeholders such as farmers, food manufacturers, distributors, retailers, consumers, government agencies, NGOs, and financial institutions. Each stakeholder faces limitations that can be addressed through collaborative efforts. Successful collaboration requires strong commitment from all participating

organizations to achieve common goals. However, implementing collaboration, particularly integrated collaborations in the agri-food industry, presents significant challenges. Trust, commitment, and willingness to share risks are crucial elements for establishing strong, long-term collaborative relationships. Unfortunately, encouraging stakeholders to embrace these characteristics is difficult, especially in the food industry with its inherently complex systems. Furthermore, global regulations, international trade dynamics, and evolving consumer preferences introduce additional risks to collaborative systems.

### **1. Vertical Collaboration**

Various studies have examined vertical collaboration in agri-food supply chains. Research on the dyadic relationship between growers and millers in Swaziland's sugar industry shows that organizational behaviors like commitment, trust, and cooperation are crucial for supporting contractual relationships. Their study found that individual trust is more significant than formalized relationships. Conversely, in fresh product and food processing supply chains, it's essential to consider both macro factors (globalization, consolidation, consumer attitudes, and fixed regulations) and micro factors (industry structure and product characteristics). These factors connect with two fundamental supply

chain pillars: the design and governance of supply chain activities, and the establishment and maintenance of supply chain relationships. Theoretical frameworks can help analyze stakeholder collaboration in supply chains. Complexity theory, when applied to upstream supply chain interactions among sugarcane farmers, hauliers, and millers, reveals that differing goals, interests, power levels, and perspectives create obstacles to effective collaboration. Other theoretical approaches such as supply chain management, transaction cost economics, and resource-based view theories can be used to examine sustainable relationships and collaboration. These studies suggest that vertical collaboration is a key driver of sustainability that influences sustainability performance. The Viable System Model (VSM) offers another approach to analyzing supply chain collaboration complexity. In farmer-miller interactions, inefficiencies tend to stem from soft issues and organizational behavior rather than hard issues. The research also highlights the importance of local autonomy in supporting farmer-local mill relationships. Qualitative approaches provide additional insights into vertical supply chain collaboration. By dividing supply chains into upstream and downstream categories and analyzing their different characteristics based on product attributes, business relationships, business

processes, supply chain positions, and information sharing, this research identifies business relationships as the most important collaboration drivers. Furthermore, it reveals that a higher level of collaboration exists in upstream supply chains.

## **2. Horizontal Collaboration**

Studies have also analyzed horizontal collaboration-relationships among stakeholders operating at the same level, including external organizations. These studies examine collaboration from various perspectives and variables. In dairy industries, cooperative and non-cooperative organizations show different preferences in implementing horizontal collaboration. Cooperative organizations tend to favor joint ventures, mergers, general collaboration, and licensing agreements. In contrast, non-cooperative organizations find equity shareholdings and acquisitions more suitable. Cooperative strategies work better for industries with limited equity capital, those needing minimal risk, and businesses in growth stages. When applied to sugarcane farmers' collaboration, horizontal collaboration through strategic alliances, farm management, and ratoon management funds helps address common challenges such as high production costs, poor ratoon management, low income, and high debt levels. This collaboration enhances productivity and competitiveness among local



farmers. Horizontal collaboration can also be implemented to reduce outbound transportation costs among confectionery SMEs participating in logistics system consortiums. SMEs with small orders can benefit by combining loads with other parties. Horizontal collaboration can strengthen relationships among food retailers as well. Research indicates that successful retailer collaboration requires enthusiasm, strong commitment, a high level of maturity, and willingness to prioritize collaborative actions over individual interests. Companies typically prefer to cooperate with organizations of similar size, structure, capabilities, and resources. However, securing strong commitment to collaboration and supporting sustainability remains challenging.

### **3. Combining Vertical and Horizontal Collaboration**

Despite the independent study of different collaboration types, some researchers recognize the importance of comprehensively investigating both vertical and horizontal collaborations together. Wright, Score and Conner (2007) examined collaboration among local governments, universities, agri-businesses, and local communities, finding that stakeholder motivation to engage in collaborative efforts is crucial. This motivation stems from community dependence on agricultural aspects for prosperity and

socioeconomic development. Collaboration strategies also influence innovation in agri-food supply chains, enhancing value creation. While vertical collaboration improves coordination across supply chain stages in product design and development, horizontal collaboration can significantly reduce processing time by enabling parallel innovation processes. Research on traditional food supply chains in Belgium, Hungary, and Italy revealed the existence of both vertical and horizontal collaborations. The findings showed that vertical collaboration is well-established, but horizontal collaboration only emerges when associations exist among organizations. The primary barriers to establishing collaboration include lack of understanding, trust, knowledge, and insufficient financial and physical resources.

Similar challenges in developing fair collaboration appear in Tanzania's banana supply chain. Farmers bear the highest costs while receiving the least benefits compared to other stakeholders, indicating inefficient collaboration. To address this inequity, horizontal collaboration through farmer associations is essential. Additionally, power sharing and agreements among stakeholders within vertical collaboration are crucial for achieving quality collaboration. Other research suggests that external collaboration has greater importance than internal organizational

collaboration for performance control. In the seafood industry, sustainable organizations develop through strong commitment and organizational clarity. Sustainable collaboration also depends on effective management systems and performance tracking mechanisms. Risk management plays a vital role in achieving flexibility through both vertical and horizontal collaboration. The flexibility of primary suppliers significantly impacts supply chain resilience, highlighting the importance of collaborative risk management among stakeholders.

## CONCLUSIONS

Sustainability and collaboration are crucial concepts for managing complex agri-food supply chain systems. Sustainability provides a perspective for maintaining competitive strategies through the triple bottom line (TBL) approach, which integrates economic, environmental, and social dimensions. While various studies address all these elements, economic aspects still dominate the variables considered when analyzing sustainable supply chains. Creating a better sustainability system for all stakeholders without negatively impacting vulnerable parties such as local farmers and SMEs is essential. This can be achieved by reducing uncertainty and sharing risks and costs among all involved stakeholders. Only limited research considers both vertical and

horizontal collaboration as a network for achieving positive competitive advantages. Collaboration as a network supports long-term partnerships and distributes benefits throughout the entire supply chain system, from strategic to operational levels. Both sustainability and collaboration concepts significantly impact the agri-food industry by promoting socioeconomic development while supporting the reduction of environmental impacts globally. This literature review concludes that developing models that accommodate both sustainability and integrated collaboration is essential. Future literature reviews should comprehensively analyze methods used to develop sustainable supply chains and collaboration in supply chain management. Additionally, reviews of assessment methods to examine the robustness of stakeholder collaboration should be considered.

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