

Agri-Food Supply Channels in Supply Chains

Subjects: Economics

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Improving the efficiency in the links in the supply chains of agri-food products is relevant in terms of the assessment methodology and practical aspects for ensuring and supporting sustainable supply chains of products not only in individual channels of product movement but also in the end-to-end supply chain of products, i.e., from the field to the end consumer.

Keywords: supply chain ; agri-food supply chain ; commodity movement ; turnover ; trade ; supply chain performance ; profitability ; chain link ratio ; distribution channels ; economic sustainability

1. Introduction

In the domestic market of Kazakhstan, agricultural products pass through many channels in the supply chains before reaching the final consumer. At the same time, the number of intermediaries in supply chains increases, the price of products increases, and the quality of services decreases ([Raimbekov et al. 2021](#)). In recent years, the prices for products in the domestic market of Kazakhstan have been growing faster than in the foreign market, which could be explained by a significant number of intermediaries in retail trade, a low level of integration, and an undeveloped mechanism for the interaction of small producers (almost 80% of agricultural products in Kazakhstan are produced by small-scale farms and households) with vegetable and potato stores and warehouses for agricultural products, as well as with retail chains ([National Trade Development 2021](#)). All these facts lead to a considerable increase in the cost of goods for the end consumer (up to five to ten times), to an increase in the share of the shadow economy (24% in 2021), and to a decrease in the efficiency and sustainability of the commodity distribution network in Kazakhstan. The share of the non-observed (shadow) economy in wholesale and retail trade is 7.2% of GDP, and in agriculture is 2.0% of GDP¹.

Thus, the question arises of reducing the shadow economy by decreasing the number of intermediaries arising (reduction of the number of links in the movement of goods) while increasing the efficiency in supply chains not only through individual channels but throughout the entire supply chain: agricultural enterprises, processing enterprises in the agricultural industry, industrial production enterprises, and trade.

Improving the efficiency in each link in food supply chains (production, processing, delivery, and sale) is of great interest in terms of improving the sustainability and competitiveness of agri-food supply chains ([McCullough et al. 2008](#)). As world experience shows, it is possible to increase the efficiency in organizing the sale of agricultural products, processing, and food industries through the rational organization of supply chains and the development of a commodity distribution network and the system as a whole ([Baibardina and Yakimik 2018](#); [Closs et al. 2011](#); [Ilyina 2013](#); [Kireenko 2015](#); [Touboulie and Walker 2015](#)).

The process of bringing agricultural or agro-industrial products to end consumers includes a multi-link chain, and the overall effectiveness of this system depends on the efficiency in each link: production, sales, trade, and the entire system. Therefore, to identify reserves for improving the efficiency in supply channels, it is necessary to consider supply channels not only individually but also as a supply chain in general. Identification of crucial links in supply chains and formation of a system of indicators to assess their effectiveness are required.

The impact of agri-food supply chains on efficiency has been explored in papers from various perspectives: economic, environmental, and social ([Despotovic et al. 2016](#)). While the influence of supply channels on the linkage of supply chains is poorly understood, it has great practical importance. This could be explained by the lack of a developed assessment methodology. The repeated and unjustified increase in the number of links in supply chains negatively affects supply chains' efficiency, competitiveness, and sustainability ([Bowersox et al. 2014](#)) and the support of end-to-end supply chains ([Closs et al. 2011](#)). In this regard, there is a need to study them and determine the key factors influencing the coefficient of links in the distribution of agri-food products.

2. The Impact of Agri-Food Supply Channels on the Efficiency and Links in Supply Chains

Both foreign and domestic scientists are devoted to studying the issues of the formation and development of the supply chain in the activities of enterprises. Among foreign authors, the following should be noted: [Barrett et al. \(2019\)](#); [Harrison and Van Hoek \(2008\)](#); [Ilyina \(2013\)](#); [Kireenko \(2015\)](#); [Kotler and Armstrong \(2005\)](#); [Zinovieva et al. \(2020\)](#).

A complete schematic diagram of possible economic relations in the supply chain of agri-food products is considered ([Callado and Jack 2017](#); [Van der Vorst et al. 2007](#)) as a commodity producer–processing enterprise–a wholesale buyer–retail chain–the consumer.

Each of these structures has a variety of activities: trade, production, advertising, information, scientific, etc., and all of them are combined into one system, which is the commodity distribution system.

The theoretical analysis of supply chain management is closely related to concepts such as the efficiency, sustainability, and competitiveness of supply chains. Theoretical aspects of supply chain management and its relationship with sustainability and competitiveness are reflected in the works of [Constantin et al. \(2023\)](#); [Touboulic and Walker \(2015\)](#). Improvement in the efficiency in supply chains is ensured by reduction in costs, which consequently has a positive effect on enhancing competitiveness and quality of services and on the stability of the supply chain.

According to the economic component, supply chain sustainability management makes the supply chain less costly and more efficient while not harming the environment and social groups ([Pagell and Shevchenko. 2014](#)). A highly efficient supply chain will provide significant benefits to the enterprise, such as integrated resources, reduced logistics costs, improved logistics efficiency, and high quality of the overall service level ([Fan and Zhang 2016](#)).

Of particular interest is the construction of a composite sustainable economic competitiveness index (SECI), which is aimed at direct use in value chains in the agri-food sector ([Constantin et al. 2023](#)), in particular for grain chains and a system for assessing sustainability performance with the use of an integrated triple profit ([Kumar et al. 2022](#)). These mentioned studies do not consider the coefficient of connectedness of supply chain participants. One of the critical vectors for building sustainable economic competitiveness is a reasonable supply. At the same time, the emphasis should be placed on exporting agri-food products with a high level of added value.

Improving the sustainability of the supply of agri-food products can occur by increasing the efficiency in organizing sales channels for agricultural products, processing, and food industries, as well as trade; improving the structure of supply chains is possible through the rational organization of supply chains with a decrease in the number of intermediaries on the way to selling agricultural products.

The link between efficiency and sustainability in the agri-food sector has shown that the best sustainable companies tend to improve future profitability ([Cupertino et al. 2021](#)). Conversely, the worst of them should focus on the reasons (innovation, commitment of management, and management to sustainable development) that positively affect their profitability. In the short term, a study on the impact of economic sustainability of development on the company's profitability shows that companies have better stability with an increase in their future profitability ([Cupertino et al. 2021](#)).

The formation and development of the food supply chain is closely related to assessing the effectiveness of the functioning of food supply chains.

There are the following methods for assessing the effectiveness of supply chains: balanced scorecard ([Kaplan and Norton 2005](#)); functional cost analysis ([Mouritsen et al. 2001](#)); SCOR (Supply Chain Operations Reference) ([Wang et al. 2009](#)); and cost-benefit analysis ([Ableeva et al. 2019](#); [Grigoreva et al. 2019](#)).

Further, [van Hoek et al. \(2001\)](#) propose methods for measuring flexible supply chains. In each case, one or another indicator is selected based on the economic, social, or environmental aspects of the supply chain and the type of industry. Knowledge management mechanisms (KMM) based on trust, reciprocity, and contracts positively impact product quality, efficiency, flexibility, agility, and quality of processes in the agri-food supply chain (AFSC).

Meanwhile, domestic businesses could already assess the efficiency in their supply chains using the average performance indicators (API) developed by Deloitte. According to Deloitte, the effect of supply chain management (SCM) optimization is sometimes measured by a significant increase in inventory turnover and a decrease in logistics costs ([Harrison et al. 2005](#)). To date, that area of SCM also needs to be studied further. For example, the issues of assessing

sustainability, approaches to assessment, and indicators for such an assessment still need to be developed. This issue is further complicated by the fact that the overall composition of indicators will differ for each of the industries.

When assessing the economic efficiency in an enterprise's functioning in the food and trade market, the method of a balanced scorecard and the process of analyzing the economic effect based on Key Performance Indicators (KPIs) are used more often than the others, taking into account the specifics of the industry and the business model being implemented. The discussed methods are used by companies depending on the goals and objectives being solved, and they obtain excellent results. Nevertheless, without detracting from the advantages of each of the above methods of evaluating the effectiveness of supply chains, it should be noted that these methods require the use of very many indicators; therefore, collecting information is a time-consuming process, and sometimes complex, and it takes a long time to obtain the results.

Regarding the efficiency in the commodity movement system, the total costs of performing the commodity movement operation, the quality of logistics operations, labor productivity, and the duration of logistics operations are usually considered ([Harrison and Van Hoek 2008](#); [Tyapukhin and Ermakova 2022](#)).

The analysis shows that the factors of supply management, transportation, and logistics positively influence the economic stability of the supply chain of agri-food products. At the same time, the impact of demand and production management on sustainable productivity are not considered significant ([Ardekani et al. 2023](#); [Alassane et al. 2020](#)). The positive impact of the productivity and efficiency in the logistics infrastructure of various intermediaries (wholesale and retail trade, warehouses, transport, etc.) on the economic growth of developing countries has been established ([Khadim et al. 2021](#)).

The study results of the impact of economic sustainability on a company's short-term profitability ([Cupertino et al. 2021](#)) show that companies have better sustainability with an increase in their future profitability.

In the studies of various authors on the product supply chain, multiple indicators are proposed to measure the performance of supply chains (efficiency, flexibility, operational efficiency, and quality of products) ([Aramyan et al. 2007](#)); (cooperation, trust, and efficiency) ([Gajdić et al. 2023](#)).

Various models and methods are also used to quantify the efficiency and sustainability of the agri-food supply chain: fuzzy AHP method, fuzzy MICMAC analysis method ([Ramos et al. 2022](#)), and data coverage analysis method ([Raimbekov et al. 2021](#)).

Measuring the productivity and risks of the agri-food supply chain based on a survey and a system of indicators for dairy products ([Kataike et al. 2019](#); [Moazzam et al. 2018](#)) and for rice ([Chopra et al. 2017](#)) has limitations associated with only one sector of agriculture.

[Fan and Zhang \(2016\)](#) proposed systems of performance indicators and methods for evaluating the effectiveness of the supply chain (SC). However, there are no generally accepted systems of indicators that could be practically used in the assessment of the activity of the SC activity because the indicators in different systems are defined without a common understanding of the values and relationships between them; they are non-linear and very complex.

The overall effectiveness for all partners in the agricultural supply chain (resource suppliers, farmers, distributors, and retailers) is customer satisfaction, that is, their ability to buy products ([Callado and Jack 2017](#)). The company's overall efficiency, among other factors, is negatively affected by the company's inventory ([Woo and Suresh 2022](#)).

Efficiency or inefficiency in the agri-food supply chain on short or long supply chains ([Majewski et al. 2020](#)); assessment of the managerial effectiveness of agricultural products in companies ([Kim and Hyun 2017](#)); and measurements of the sustainability of supply chains based on economic, social, and environmental indicators ([To et al. 2021](#)) show that they are all related to the links of commodity movement in supply chains, which plays a vital role in ensuring efficiency ([Makarevich 2017](#); [Tyapukhin and Ermakova 2022](#)).

The study based on a survey of the company's employees showed that sales channels (variety of channels, integration to attract customers) and strategy factors (finance, innovation, personnel, etc.) have a positive impact on the company's productivity (growth, profit, market share) ([Bui and Nguyen 2021](#)).

It could be observed from the research that increasing the sustainability of the supply chain ensures profit at all levels, provides social benefits to society, and has a positive impact on the environment. At the same time, the existing methods of assessing sustainability and effectiveness are mainly associated with a survey in each specific area of research or an

analytical assessment of existing data. This approach is limited to using only particular products or agricultural industries and does not consider the influence of sales channels in supply chains.

In the work of [Makarevich \(2017\)](#), a methodological development is presented for calculating the coefficient of the links of goods in the wholesale and retail trade system. However, this approach does not assess the links and effectiveness of other supply channels.

Reduction in the links in the movement of goods and also delivery directly to the retail trade network cause a decrease in transport costs, product losses, and other costs ([Vlasova et al. 2012](#)). However, the above approaches do not consider the evaluation of linkage and effectiveness in conjunction with other supply channels.

The analysis of methods for assessing the effectiveness of the process of commodity movement ([Krasilnikova and Timiryanova 2013](#)) using statistical (dispersion, variation, and cyclicity; link of commodity movement, turnover, and others) and economic (physical volume of sales, volume, and structure of turnover, and others) indicators was carried out.

At the same time, the assessment of the effectiveness of commodity circulation should be carried out, taking into account the specifics of the movement of goods and the links of commodity circulation.

Thus, the approaches considered are focused on evaluating the effectiveness or links of supply chains in individual links and do not imply the possibility of building a mutually interconnected efficiency or links typical of the entire system at all stages of sales channels in product supply chains. In addition, they do not provide a unified system of indicators for the supply of products interconnected with quantitative indicators of production, sales, and trade with economic indicators of efficiency, turnover, prices, and others.

3. Conclusions

The research confirms that to increase the efficiency of supply chains, it is necessary to include all links of the logistics supply chains from the manufacturer to the end consumer and improve the factors affecting them.

For this purpose, a methodology is proposed for assessing the impact of agri-food supply channels on the efficiency and link of supply chains. This technique will reduce the number of intermediaries and speed up the turnover process.

The key factors influencing the efficiency and chain links of supply chains have been identified, based on which regression models have been established.

The efficiency of each link in the supply chains and the availability of their inventories are the key factors in improving the performance of the entire supply chain of agricultural products, whereas the link ratio that characterizes the number of resales, negatively affects the efficiency of supply chains. It is revealed that the efficiency in the supply chains of each link increases with the transition to each subsequent level of supply channels: from the primary source of production to the consumer. The findings of this empirical study are supported by literature analyzing the impact of supply chain efficiency and supply chain link ratio, with a particular focus on the key factors that contribute to creating efficient and sustainable links between links in agri-food supply chains.

The following recommendations could be made to reduce the link ratio and improve the efficiency of supply chains:

- 1) modernization of existing wholesale and retail trade enterprises as the infrastructure of the food market, which involves the maximum use of the capabilities of modern innovative technologies and logistics in order to speed up the process of delivering goods to the consumer with minimal costs and maximum preservation of product quality to meet the demand and needs of the population in goods and services;
- 2) reduction of stocks and creation of wholesale and retail distribution centers at the locations of manufacturing enterprises (manufacturers), which makes it possible to respond more effectively to changing consumer demands;
- 3) stimulation to increase the income of the population by increasing the number of self-employed and individual entrepreneurs in the field of agricultural production and trade, increasing their purchasing power;
- 4) increase of turnover and decrease of stock level due to optimization, monitoring, and implementation of automated logistics technologies, construction of warehouses, storage facilities, and distribution centers;
- 5) an increase in the share of retail trade in the total volume of turnover using non-standard retail sales methods (online trade, mobile retail, etc.) will lead to a decrease in the level of links of commodity movement.

The results of the analysis will allow to further carry out an integrated policy to improve the efficiency and sustainability of sales channels in the supply chains of agri-food products; to adopt a coordinated policy on measures to support and stimulate the sphere of production, sales, and trade, based on their priority and degree of influence on the level of their overall efficiency and links in the supply chains. The practical implementation of the recommendations will optimize costs, reduce the links of supply chains, increase the efficiency and stability of supply chains.

| 4. Limitation and Future Research

Due to insufficient information on other supply channels, such as the volume of transportation of food products and their costs, storage volumes and their costs, etc., studies were conducted only on three supply channels that are: production, sales, and trade. The authors suggest that the following areas of research may be related to the inclusion of other supply channels, as well as the study of more specific types of products as information accumulates. In addition, future research could be improved by further exploring the multilateral links between exports, imports, GDP, real incomes of the population, wholesale and retail turnover, and the level of links of commodity movement.

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