

Supply Chain Logistics in Agricultural Sector – Assessing Opportunities for Competitiveness Increase

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Abstract—This article discussed the problem of logistics management of the agricultural supply chain on the example of Kazakhstan. The article aims to justify the impact of logistics as a factor of increasing the supply chain competitiveness in the agricultural sector using Kazakhstan as a case study. The relevance of the topic is conditioned by the fact that agriculture is one of the budget-forming sectors in Kazakhstan. Thus, the improvement of supply chains in this area is a factor for increasing the competitiveness of the national economy. The transportation industry is determined to be the key factor that affects supply chains. For the Republic of Kazakhstan, the investment in large road projects is directly proportional to the production cost in the agricultural sector with a time lag of several years. Such national projects with the international partners' participation promoted the regional development of the country and thereby made the pattern of national development less uneven. Once the projects completed, the domestic demand for various goods and the profitability of the agricultural sector have increased. Taking into account the country context was offered a conceptual approach to the development of the logistic infrastructure, as a level regional system in Kazakhstan. At the level of unique logistics groups and the national coordinating council an integrated logistics management system was developed.

Keywords— *agricultural sector, logistics, supply chain, competitive advantages, national logistics system.*

1. Introduction

Nowadays, during the rapid development of agricultural markets and technologies, adequate logistics is one of the most important factors in ensuring agricultural business competitiveness and meeting the needs of consumers efficiently. The agricultural logistics is extremely relevant within the context of globalization, the formation of a new agricultural sector's structure, escalation of production volume, and food export.

The development of the economy and the competition sharpening in a globalized market requires changes in the economic entities targeting and raise of interest in the modern logistics concepts. The globalization of the world economy and the internationalization of national economies have promoted the growth of logistics roles for efficiency enhancement and competitiveness in the market. Mentioned factors have led to the formation of international transport corridors, global and regional delivery chains, powerful logistics clusters, and alliances [1, 2].

Although Kazakhstan has a significant potential for the development of the agricultural sector, the country still passes the early stages of agricultural policy formation [3]. Problems and obstacles that arise on the way to its creation require a systematic and integrated approach to their solution. The new millennium has ushered by the beginning of the active reestablishment of the Kazakhstan agricultural complex. The interest of foreign investors and the capital infusion into the agricultural sector contributes to the active introduction of modern foreign business technologies, in particular, the implementation of a logistics concept. The concept is optimized according to various criteria through diverse changes in the supply chain. Among them, total costs reduce, market coverage and total profit increase, and focus on individual projects.

As a result, there is a need for the use and development of modern integrated logistics systems. The ability of logistics to adapt and integrate into any field, for example, into the agricultural sector, gives it a new meaning and transforms it into agricultural logistics, taking into consideration the peculiarities of production and product sales in the agricultural sector of the economy.

In comparison with the other activities, the agricultural business considers being very risky, since it depends on external factors (weather conditions, water supplies, the quality of raw materials and fertilizers). For that reason, a systematic approach to supply chain management is becoming particularly relevant. The systematic approach

allows moving from fragmented logistics to holistic management of resource flows, finances, and information, which in turn ensures the rationalization of all logistics processes at all stages of resource transformation.

2. Literature review

At the current stage of social development, especially in the agricultural sector, the optimization of logistics and supply chains through cost reduction is among the keys to the high competitiveness of enterprises [1]. The reason for this is a transition from a product-oriented business to client-centricity [2].

In the context of supply chain management (SCM), competitiveness is defined as the ability to carry out individual product deliveries at low cost, high quality and short delivery time with high reliability [3]. This approach has led to the outsourcing of some operations and high competition level [4].

Researchers identify the following elements of the supply chain: purchasing, production, and distribution [5]. According to Ila Manuj and her colleagues, there are three degrees of supply chain complexity: direct supply chains (the manufacturer, its suppliers, and consumers), extended supply chains (the manufacturer, its suppliers, distributors, and direct consumers) and ultimate supply chains (all organizations involved in all flows of products, services, finances, information from the ultimate supplier to the ultimate customers) [6]. Meanwhile, the flows direction in the supply chains is not only forward, from the first supplier to the ultimate consumer. Items can flow back up the supply chain for reasons such as maintenance or repair, restoration or disposal [7].

Several basic SCM concepts are distinguished [5]. They differ the main criterion for optimizing the supply chain:

- minimization of the supply chain total costs;
- maximization of the supply chain total profit;
- coordination of geographically distributed independent companies;
- company synchronization;
- maximum customer satisfaction;
- control of material, information and cash flows.

Food and Agriculture Organization (FAO) considers the agri-food supply chain as a complex of agricultural manufacturers and organizations that consistently in a coordinated manner ensure the creation of added value for the specific types of agricultural goods-producing and processing. Their purpose is to obtain food stocks that are sold to the ultimate consumer and go to waste after consumption, to ensure profitability at every stage, and to give significant benefits for the society without constant depletion of natural resources [8].

The specificity of the creation and functioning of agri-food supply is determined by the following conditions

[9, 10, 11]:

- they are of strategic significance in national and global food security;
- in agricultural countries they are the backbone of the economy and also provide economic security;
- supply chains are under the influence of national traditions, eating habits and other factors;
- agricultural production process is closely linked to the natural environment – soils, ponds, air, biological factors, as plants and animals.

The value creation in a supply chain is the result of internal (the profitability of stakeholders) and external factors (customer satisfaction) [12].

The latest trends in the supply chain are evident in empowering and importance recognition. For the first instance, the green supply chains have gained relevance [13]. They aimed to get a generalized environmental effect as a result of streamlined processes in the production logistics system, improve the overall and environmental quality of products or services, increase the equipment productivity, reduce logistics cycle, defects and loss of resources during storage and transportation, perform timely commitment execution, and decrease amounts of waste [14].

Secondly, the «Smartchain» conception is actively introduced via short supply chains of agricultural products for local rural areas, farmers, and agribusiness [15].

Moreover, the role of social networks increases, since the number of «perfectly performed orders» becomes a productivity indicator. Thus all the participants of a supply chain are under pressure to ensure the increase of perfectly performed orders delivered to the right place, at the right time, in proper condition, in appropriate packaging, with the correct documentation and in the right amount [16].

What is more, with the increase of digitalization, the use of mobile devices, and data visualization to reduce operation time, it may also be seen standardization of each operation in the supply chain, and increased demand to provide the necessary service in the supply chain [17].

An increasing trend of supply shortfall risks, as well as distortions in data transmission due to the growing number of links in the supply chain, and a continuous transformation from standard lean-processes to elastic and situational ones are typical.

Taking into account the importance and significance of carried out researches, nowadays, a number of issues require further discussions. Numerous studies contemplate agricultural logistics only as a component of supply chain management in agribusiness. The fact that the supply chain manifests both within and outside the material flow was ignored. Furthermore, little attention is paid to assessing the growing-

competitiveness opportunities in agricultural supply chain logistics.

In particular, there are no concepts of logistics systems developing and methods for managing business processes in the agricultural sector in combination with other means of modeling solutions in management.

2.1 Research objective

Management of a supply chain requires a systematic approach to control all the informational flows, materials, and services from raw material suppliers passing through the enterprise and warehouses to the ultimate customer. For developing countries, supply chain management acquires special significance, as long as the problems of managing the development of the logistics services market affect the efficiency and competitiveness of the national economy.

The main objective of the article is to review and explain the logistics influence as a factor positively influencing the supply chain competitiveness in the agricultural sector, using the example of Kazakhstan. For the Republic of Kazakhstan, the following peculiarities that affect the formation of supply chains at the national level are noted:

- agriculture is one of the budget-forming sectors in Kazakhstan. As of 2017, agriculture accounted for 4.4% of the GDP and 18% of employment. However, the country has been acting as a net importer of agricultural products since 2004 [17];

- logistics development of the Kazakhstan regions is uneven [17, 18], therefore an integrated approach to the evolution of a multi-level transport and logistics infrastructure is required for the development of the regions and the country as a whole. Such an approach should provide favorable conditions for the stimulation of economic growth;

- Kazakhstan's agricultural sector is developing in the context of exacerbated ecological and water supply problems, the use of physically and morally outdated equipment and technologies [17].

The research tasks include:

- analysis of the logistics supply chains peculiarities in the agricultural sector of the country;

- argumentation of the logistics impact as a factor of the supply chains competitiveness increase in the agricultural sector;

- development of the national logistics system concepts formation and determination of its effectiveness;

- comparison of the developed model of the system with global experience in national logistics managing.

3. Materials and methods

3.1 Research context

The transport industry of Kazakhstan is represented by all types of transport. In the service market, it is characterized by the monopoly position of a limited number of companies (air, rail, and pipeline transport). Meanwhile, automobile and water transport are considered to be competitive industries [18]. The basis of the country's logistics is road and rail transport, whereby the delivery of the products to or from small farming enterprises, that form the agricultural sector basis [18].

Research hypothesis

The investment made in large road projects is directly proportional to the cost of production in the agricultural sector.

3.3 Research factors

The paper discusses investment statistical data in Kazakhstan road sector and the dynamics of production costs in the agricultural sector, using the materials from the official website of the republic's statistics [19], international sources [20], and studies [21].

3.4 Research methods

As part of the hypothesis test, a relationship between a statistical relationship between the indicators of investment volumes in large road projects and the production cost in the agricultural sector will be built. And due to the obtained results, a model will be developed to ensure competitive advantages by improving the supply chain logistics in the agricultural sector.

The study involved:

- establishing a correlation relationship between the attributes with the use of the graph method;

- assessing the density of the relationship between the signs of x and y based on an empirical correlation relationship;

- building of a one-factor linear regression model of the relationship between x and y ;

- determination of the adequacy and practical suitability of the constructed model.

Theoretical and practical developments in the supply chain management field, organizations, and management of logistic business processes, general scientific methods of system analysis used to develop a model for the formation of a national logistics system and determine its effectiveness.

4. Results

The Kazakhstan 2050 national strategy provides for the creation of logistics facilities outside Kazakhstan with

the help of joint investment projects [22]. The Government of Kazakhstan, the World Bank, and the European Bank for Reconstruction and Development implement various programs in the agricultural logistics field [23].

The table presents statistical data of the Republic of Kazakhstan on the amount of investment in road construction (both state and the international) and the production costs changes over the years in the agricultural sector.

Table 1. Statistical data on the amount of investment in road construction in the Republic of Kazakhstan [19, 20, 21]

Year	2012	2011	2010	2009	2008	2007	2006
Amount of investment in road construction, mln USD	1256	540	281	802	607	77	246
Year	2016	2015	2013	2012	2011	2010	2009
Production cost in the agricultural sector, mln USD.	7266	6951.3	6740.5	591	7462	5777	6493

Note: 4-year time lag caused by the average time of road construction facilities implementation and the investment payback period in agricultural enterprises.

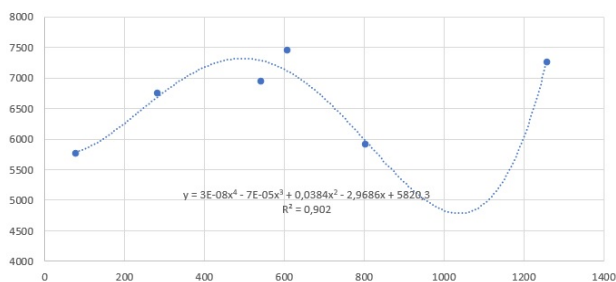


Figure 1. Yearly relation of manufacturing costs in the Kazakhstan agricultural sector from the amount of investment in road construction

According to the received information regressive dependence was build:

$$y = 3E-08x^4 - 7E-05x^3 + 0.0384x^2 - 2.9686x + 5820.3$$

Correlation Coefficient: $R^2 = 0.92$

A correlation of 0.9 suggests a direct relationship between two indicators under consideration and sufficient adequacy of the model.

Consequently, being the main interlink between all regions and a key factor influencing the supply chain of Kazakhstan, road investment has become a determinant

in the agricultural sector development. Investment projects implemented with the help of the state and the World Bank [20] helped the separated regions' growth, reducing the uneven development, and increasing domestic demand for various goods and the profitability of the agricultural sector.

Meanwhile, the industry is facing with the following problems: [24, 25, 26]:

- failure to provide a holistic concept to supply chain management and lack of financial resources to create a wide network of logistics centers and terminals in Kazakhstan and abroad;
- inefficient transportation links between regions in the West-East direction, which increases logistics costs;
- low level of business interest in the development of public-private partnerships in logistics;
- lack of marketing and logistics managing personnel;
- obsolete equipment of processing industry enterprises;
- insufficient amount of own seed base;
- limited opportunities for obtaining loans in the logistics field;
- lack of private business interest in public-private partnerships in the logistics field;
- ability to transport goods between China and the European Union using routes bypassing Kazakhstan;
- desire of the Russian Federation to develop its logistics for goods export and import using Russian logistics operators;
- low level of logistics service quality.

Concerning the importance of Kazakhstan's agricultural sector, it is necessary to consider the probability of creating a national agricultural logistics network.

In the world practice of doing business, there is a tendency for organizational and technical supply chains complication, which imposes greater responsibility for the final result on all the partners. Thus, in connection with outsourcing, globalization, and innovation in the field of information technology, the supply chain partners are becoming increasingly dependent on each other. However, along with benefits grow, increases also the degree of risk and uncertainty.

To solve these problems, supply chain participants have to strive to maximum interaction by taking advantage of world trends. They have to determine coordination mechanisms that will help rationally allocate resources and promptly develop market strategies. Compliance with the following conditions will increase the supply chain efficiency, maximizing its emergence. Consequently, for the country where logistics in the agricultural sector is a determining factor in development (such as Kazakhstan), supply chain management requires a systematic approach.

Agricultural production specificity allows identifying the main directions of competitiveness increase in the agricultural sector supply chain:

- customer orders fulfillment and service channels organization;
- agricultural products demand forecasting and optimization of the consumption distribution;
- managing stocks of raw materials and finished products, minimizing transportation, warehousing and storage losses, ensuring the rhythm of supplies;
- access to communication systems, online management of transport, material, informational and financial flows;
- optimization of control objects localization;
- service management;
- talent management.

The aspects that make up a modern logistics service include centralization of logistics functions, cooperativity, differentiation, and diversification. A government body, regional offices and a special approach to work with state bodies and carrier organizations are also required.

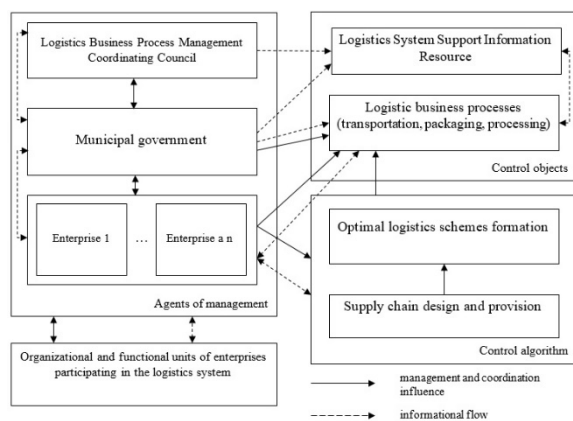


Figure 2. Integrated logistics management system

Offered transport and logistics infrastructure allows synchronizing transportation, loading complexes, warehouses, customs, and supervisory agencies by organizing logistics services for freight traffic.

Lately, the agricultural sector has become extremely attractive for the reproduction of external funds. However, the growth of investment requires improving a mechanism for investment. Such a demand arose from a range of newly emerged needs to ensure investor protection, employ insurance mechanisms, reduce investment risks, and so on. Financial flow management involves investing in agricultural logistics, with the aim to expand agricultural production. The main tasks of financial flow management can be regarded as the search for optimal alternative solutions in the process of attracting financial resources and their effectiveness in project implementation.

In a multi-level logistics system, the state, on the one hand, stimulates the efficiency and innovativeness of the logistics market participants, but on the other hand, monitors adherence to regulatory legal acts, logistics services quality standards, and environmental

requirements.

State management of logistic flow processes in supply chains or networks, clusters, and other organizational forms will enable an increase in the total value added in the national gross product structure and competitiveness of the national economy.

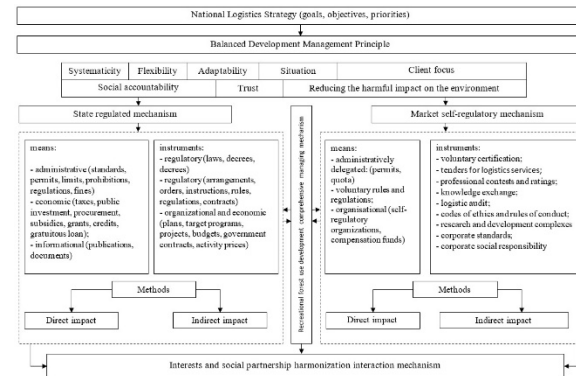


Figure 3. Regulatory factors and levers of influence on the national logistics system development

5. Discussion

The Kazakhstan's national policy in the field of agricultural production is designed to increase the level of product processing and form supply chains based on multilateral partnerships. In these conditions, it is appropriate to coordinate the material, informational, and financial flows within the national supply chains using a single management system.

The impact of transport and logistics infrastructure on long-term economic growth can be observed in the following major fields:

- 1) production volumes and freight traffic increase;
- 2) aggregate demand increase;
- 3) increase in personal and enterprises savings;
- 4) possibility of implementing state agricultural and transport programs.

In the advanced world and many less developed countries, agricultural supply chain management is centralized, however, centralization is not national but at the level of multinational companies [26, 27-34]. Although, some other countries have been created agricultural sector logistics management structures (for example, The National Bank for Agriculture and Rural Development in India) [27]. Such centralization makes possible cost reductions in the entire supply chain [26]. Among the EU countries, Germany stands out with the most systematic logistics policy. The minimization of the system total cost there was chosen as the optimization criterion [28]. There the national logistics system provides for the logistic centers' existence and is managed by the supervisory bodies with holding companies (investors, consortiums, cities, municipalities and various associations) [28]. At the same time, in China, 11 free trade zones have been transformed into

the logistics and financial nodes [28].

The Russian Federation is facing the extension of logistics services within the logistics service providers and the entrance to the market of international companies formed with the foreign state capital. The purpose of these actions is to ensure the regularity of supplies oriented on Asia-Europe routes [28].

Thus, the proposed approach will avoid the main problems with product packaging and storage in developing countries [29]. Even in advanced countries, small-scale farmers are faced with the challenge of inadequate supply chain management while ensuring reasonable transport links with logistics centers, wholesale depots or processing enterprises [29]. In such circumstances, the centralized management of the national agricultural sector based on the logistic approach becomes optimal.

At the same time, agricultural logistics serves as the most effective tool for the innovative development of the national economy's agricultural sector [29, 30]. A crucial factor that actualizes the importance of logistics in modern economic realities is the realization that the development of the country's economies is impossible without a centralized approach to managing the agricultural sector. The introduced approach will provide an opportunity to optimize costs for logistics planning, control, and audit. Moreover, the strategy will implement high-quality logistics services to customers to improve competitiveness, consolidation, and strategic partnership. Mentioned actions will increase the speed of material flow in the supply chain. Furthermore, the introduction of modern information technologies will facilitate the control implementation at each link of the chain [29].

The proposed strategy resulted from the need to respond to challenges that globalization and high competition pose to the national economy. Studies on logistics confirm the increasing interdependence of the agricultural sector and logistics since a systematic approach to the study of this issue can help logistics become a driver for the development of the entire national economy.

6. Conclusion

The development of Kazakhstan agricultural sector is one of the Republic's primary tasks. Therefore, its solution should base on the logistic approach. The necessity for centralized agricultural logistics is due to the following factors:

- uneven development of the regions;
- steady supplies necessity;
- possibility of bypassing Kazakhstan during the supply of goods from China to the EU.

With regard to the findings of the study, it may be affirmed that the transport industry is the key factor

affecting the supply chain. Road investments, as the main connecting link between all regions of the Republic of Kazakhstan, have become a determinant factor for the agricultural sector development. Investment projects implemented with the help of the state and the World Bank [20] helped to reduce the uneven development of the country, increase the inner demand for various goods and the profitability of the agricultural sector.

The advancement of an effective national system defines several macro effects:

- cost reduction for logistics service of freight traffic in the GDP structure;
- inflation decrease;
- increase in the investment of the whole country and individual projects (not only agricultural).

Realization of the suggested organizational and economic mechanism is achieved within two areas:

- at the level of coordinating logistics groups that are created for each specific project, which are the optimization of logistic business processes, strengthening the integration function at the industry level, «exporting innovations» mechanism developing, overcoming the negative determinant factors that hinder the development of multilateral partnership between regional enterprises;
- at the level of the permanent coordination council, which initiates the formation of integrated logistics systems within the industry.

Thus, the creation of the Kazakhstan national logistics system and its integration will become a powerful production development factor, both by domestic sources and foreign investment. Moreover, national logistics system creation will increase the international competitiveness of individual producers and the whole economy, allowing a more advantageous position in the international division of labor.

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