Barriers and Drivers of the Implementation and Management of Green Agri-Food Supply Chains in Azerbaijan

Irada Mehdiyeva[#1], Vugar Kerimli[*2], Nizami Gafarov[¥3], Naila Sultanova[§4], Kufiya Heydarova[ǂ5], Ayaz Taghiyev[≠6]

[#]*Department of Economics, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan*
[*]*Institute of Economics, Azerbaijan National Academy of Sciences, Baku, Azerbaijan*
[¥]*Department of economics of industry and the agricultural sector, Azerbaijan Cooperation University, Baku, Azerbaijan*
[§]*Department of State Regulation of Economy, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan*
[ǂ]*Research Institute of Economic Reforms under the Ministry of Economy, Baku, Azerbaijan*
[≠]*Department of Management of Business, Azerbaijan State University of Economics (UNEC), Baku, Azerbaijan*
[1]irada_mehdiyeva@inbox.ru
[2]kerimli.vugar79@gmail.com
[3]qafarovnizami@mail.ru
[4]naile.sultanova@mail.ru
[5]heydarova.kufiya@mail.ru
[6]ayaz.tagiyev@dri.az

***Abstract*— The object of the study is the barriers and drivers of the implementation and management of green agricultural supply chains in Azerbaijan. The main characteristics of the country's agricultural logistics have been considered; it was found that the development of agriculture is one of the most important non-oil sectors of the country. Recently, the introduction of advanced technologies in agriculture has been observed; this is evidenced by an increase in labor productivity and the expansion of organic farmland. The hypothesis of the study is that productivity in agriculture (including, organic farming) directly correlates with the volume of investments in the development of transport and storage. Statistical confirmation of the research hypothesis allowed us to highlight the development of the logistics infrastructure as the main driver of the implementation and management of green agricultural supply chains. The negative factors hampering the industry development are the lack of modern storage facilities, transport infrastructure, state support for agricultural producers, the lack of information technologies for supply chain management and cooperation between agricultural producers. Within the framework of the study, the feasibility of an agricultural cluster has been proposed and substantiated. A model to increase the competitiveness of agricultural producers has been developed.**

Keywords*—agriculture, green supply chains, logistics infrastructure, cluster.*

1. Introduction

In modern times, the issues of greening all types of economic activity are becoming particularly relevant. Green supply chains are not a fashion trend, but a modern approach to the interaction of all elements of the supply chain. Agriculture uses a huge amount of natural resources (in particular, land and water) and affects almost all spheres of life; thus, it is a relevant objective to make it follow the "green philosophy" principles.

Today Azerbaijan's agriculture is confronted with a number of problems; however, at the same time, it is a priority sector of the national economy [1]. The current strategy for the development of agriculture in Azerbaijan [2] provides for food security, poverty reduction, creation of new workplaces, and focus on locally produced goods. At the same time, the strategy for the development of agriculture in Azerbaijan also involves the solution of the following tasks: increasing the digitalization of the industry, introducing modern technologies, increasing customer-centricity.

The focus on agriculture is due to the fact that the development of the industry and its management from the perspective of modern approaches can become drivers of the country's economy. Demand for the country's agri-food products is stably high [3] and the top exporting countries are highly developed economies. Therefore, agriculture can become a driver

of the development of logistics, transport, agricultural machinery, and food industry, which should increase the production of high value added products.

Moreover, the introduction of modern methods of managing agriculture and supplies is a particularly relevant issue as Azerbaijan is characterized by high logistics costs. Thus, in Azerbaijan, logistics costs for the delivery of agricultural products from the field to the port make up 18% of all costs while in France, Germany, and the USA, this indicator is 8% and 6%, respectively [3].

In world agriculture, a new economic space is being formed based on the principles of sustainable development, which involves economic, social and environmental aspects [4]. The introduction of green supply chain management allows obtaining a synergistic effect of industrial activities and integrating the interests of all participants. The concept of green supply chain management involves the optimization of service, material, financial and information flows, and also provides specialists with real opportunities to improve, implement and further develop the logistics of the agricultural enterprise taking into account its management specifics.

2. Literature review

Traditionally, the oil and gas industry has dominated the economy of the Republic of Azerbaijan, but the modern concept of the country's development provides for economy diversification by raising the profile of agriculture [1, 5] and its sustainability. As part of the Eastern Partnership (EaP), the country has committed itself to the transition to a green economy, in particular it aimes:

- to improve the measurement and valuation of natural capital;
- to introduce environmental infrastructure;
- to develop environmentally conscious consumer behavior;
- to promote the development of trade based on the principles of green economy and green supply chain management.

At the same time, Azerbaijan agriculture experiences environmental challenges, and there is a high probability of a decrease in yield due to weather conditions (droughts, high temperature, early frost and / or floods) caused by climatic changes [6].

Thus, eco-friendly consumption of water resources, the use of water conservation technologies, agroforestry, the use of conservative growing technologies, raising public awareness, and the introduction of the green supply chain management concept are of particular importance for agriculture [7]. These approaches are implemented at the country level, including with the help of international donor organizations (for example, the AMDA project funded by USAID) [5]. However, due to the fact that about 83% of farms in the country are small businesses (up to 10 ha), most farms are not profitable and do not implement the principles of green supply chain management. Agricultural management in Azerbaijan is characterized by [8, 9, 10]:

- poor access to finance, lack of informatization of management processes and excessive dependence on land productivity reduce opportunities for innovation;
- low-level agricultural technologies;
- subsidization of farmers does not lead to an improvement in the applied technologies;
- a small number of medium- and large-scale farms work on market principles and effectively use advanced agricultural methods and innovations [11].

In Azerbaijan, agricultural supply chain management system is characterized by the following features [12]:

- warehouse infrastructure that is inadequate to modern conditions;
- road deterioration caused by excessive loading of vehicles, which leads to an increase in delivery time;
- non-compliance of logistics processes with modern requirements and standards;
- slow cooperation of farmers for the formation of sales consignments and reduction of logistics costs;
- slow implementation of food safety and quality standards (Hazard Analysis and Critical Control Point, ISO, EN, Codex Alimentarius, etc.) in the agricultural sector.

In this case, innovations can be introduced in agriculture through combining system-environmental and individual factors. Innovation takes place if there is a joint interaction of several factors: the technological parameters of the innovation itself (for example, financial entry barriers, the scale of costs, gross profit), personal factors (acceptance), and structural factors (farm size, access to credit, proximity to bureaucracy). In this situation, random improvement of one factor, such as providing access to credit, developing value chains or raising awareness of farmers, cannot lead to sustainable results due to the complexity of the problem [8].

Unfortunately, Azerbaijan farms are unprofitable on the whole, and farmers do not make money by selling their products, but receive it from various sources

using a combination of strategies, including wages, remittances from migrant relatives, and subsistence farming. In general, farming does not bring stable income to small farmers [13].

Currently, the introduction of green supply chains is not a relevant issue to individual farmers; however, it is relevant to the state as a whole as it allows implementing comprehensive solutions to diversify the economy and reduce the importance of the oil industry [14].In agriculture, the introduction of green supply chains is associated with a high product quality, in particular the production of organic products, which helps to attract customers from developed countries (EU, USA and other developed economies) [12]. The introduction of green supply chains in the agricultural sector of the country would provide the following competitive advantages [2]:

- increase the attractiveness of the industry by attracting environmentally-conscious customers;
- increase the profitability of the industry through efficient logistics management (transportation, warehousing, storage, repair, reduced downtime, and fines for environmental pollution);
- minimize waste; introduce energy-saving technologies, including waste recycling;
- improve the quality of logistics services through the introduction of Euro 4 and Euro 5, alternative fuel, safer vehicles, as well as increasing the productivity of the main logistics processes;
- introduce new agricultural technologies and increase personnel efficiency: staff development, cultivating environmental consciousness.

2.2 Problem Statement

The concept of green supply chains in agriculture involves an integrated approach to managing all types of flows, and also covers complete resource and functional range of flow processes that arise during the project implementation. Today, the introduction of advanced technologies in agriculture requires state support due to the amount of investment needed. Production and logistics management based on the environmental approach involves a systematic process organization taking into account the likely environmental impacts, and requires significant investment, which is often impossible for individual entrepreneurs [15]. Consistent implementation of green supply chains implies the availability of appropriate infrastructure.

The purpose of the study is to identify key drivers and barriers to the implementation of supply chain management through the example of the Republic of Azerbaijan.

2.3 Research hypothesis

Productivity in agriculture (including, organic farming) directly correlates with the volume of investments in the development of transport and storage.

The research objectives are

- to determine the impact of the dynamics of value-added per employee (taking into account inflation), as well as the area of the land allotted for organic farming [2], [16] on the volume of investments in the development of transport and storage by constructing a regression dependence [19];
- to compare the data obtained with similar data from other countries;
- to analyze the results for improving approaches to supply chain management.

3. Research Methods

3.2 Research context

The infrastructure of Azerbaijan is characterized by the trends peculiar to the post-Soviet countries [13]. According to the World Bank data [13], strategic infrastructure is resource-intensive and its maintenance and development require a lot of funds. In the context of the poor public sector efficiency due to significant bureaucratization, this leads to a delayed development of all sectors of the economy. At the same time, the negative factors affecting the implementation of supply chain management are the lack of infrastructure (primarily modern warehouses and transport infrastructure), information tools for supply chain management, and qualified personnel.

Effective supply chain management requires a well-developed infrastructure. Government agencies are developing external (state) logistics infrastructure in order to improve the quality of logistics services and attract foreign investment for the implementation of projects of various technical levels.

3.3 Research factors

The study considers the impact of the dynamics of value-added per employee (taking into account the inflation rate), as well as the area of the land allotted for organic farming [2], [16] on the volume of investments

in the development of transport and storage based on the regression analysis [17].

3.4 Research methods

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- to compare the data obtained with similar data from other countries;

Within the framework of the statistical hypothesis testing, a relationship between the above indicators will be built; based on the results obtained, a comparison of the dependencies will be made to develop approaches to the improvement of supply chain management.

Theoretical and practical developments in business process management and general scientific methods of system analysis were used to develop regression models and determine their efficiency.

The dependencies are built based on the data from [2] and [16].

4. Results

Table 1 shows the relationship between the dynamics of agricultural value-added per employee (taking into account the inflation rate) [2], [16] and the volume of investments in the development of transport and storage capacities [17].

Table 1. The relationship between the dynamics of agricultural production (including organic farming) [2] and the investment in the development of transport and storage capacities

Volume of investments in the development of transport and storage capacities, million manats		Agricultural value-added per employee (taking into account the inflation rate), million manats		land allotted for organic farming, thousand ha	
Year	Indicator	Year	Indicator	Year	Indicator
2000	44.1	2013	2093	2013	18170
2005	517.2	2014	2003	2014	20300
2011	2449.1	2015	1906	2015	21900
2012	2515.7	2016	1825	2016	23700
2013	2621.1	2017	1914	2017	22400
2014	3251.1	2018	2216	2018	22800
2015	3750	2019	2295	2019	37850

Note: the four-year time lag between the volume of investments and the increase in value-added is explained by the period of the implementation of investment projects.

Based on the statistics, the following dependencies have been obtained:

- for the agricultural value-added per employee (taking into account the inflation rate), million manats as a function of the volume of investments in the development of transport and storage capacities, million manats

$$y = 0{,}0001x^2 - 0{,}3896x + 2133{,}8$$

$$R^2 = 0{,}8895$$

- for the area of land allotted for organic farming, thousand ha as a function of investment in the development of transport and storage capacities, million manats

$$y = 0{,}0025x^2 - 5{,}6417x + 20261$$

$$R^2 = 0{,}7751$$

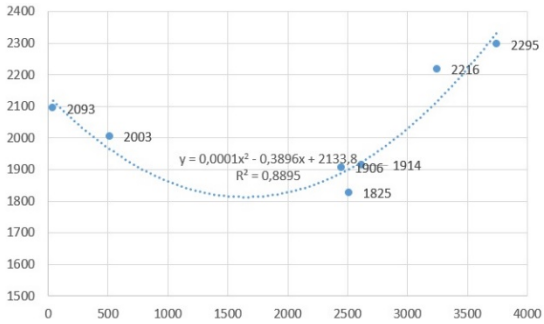

Figure 1. The relationship between the agricultural value-added per employee (taking into account the inflation rate), million manats and the volume of investments in the development of transport and storage capacities, million manats

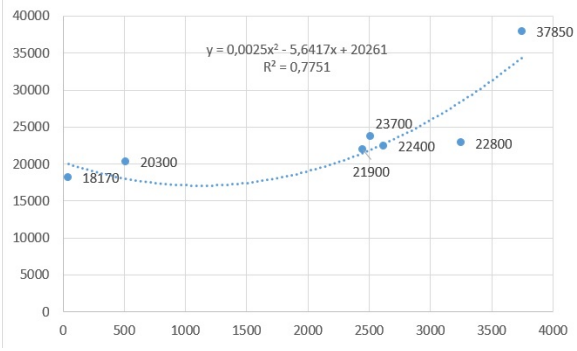

Figure 2. The relationship between the area of land allotted for organic farming, thousand ha and the volume of investments in the development of transport and storage capacities, million manats

There is a high correlation coefficient in the dependencies obtained, which indicates a direct relationship between the studied factors and, accordingly, confirms the research hypothesis.

Azerbaijan logistics infrastructure is not holistic; this fact does not contribute to the implementation of green supply chain management. Agricultural producers give little attention to cooperation, which negatively affects the competitiveness of agricultural enterprises. Green supply chains can be introduced in agriculture provided that the development of infrastructure market elements is intensified, in particular through investment. In recent years, in Azerbaijan there has been an increase in agricultural productivity, which indicates the importance of the industry in the country's development. At the same time, a sharp increase in the production of organic agricultural products demonstrates the awareness of the importance of the green technology introduction, including in supply chain management.

State investments in warehousing, transport and other infrastructure allowed the country to introduce modern supply chain management technologies and achieve sustainable labor productivity growth in agriculture.

The practice of foreign countries shows that it is possible to meet new market requirements by creating a system of transport and logistics centers that can minimize logistics costs and increase the efficiency of agricultural producers [18]. At the same time, there are two basic approaches to the development of the transport and logistics infrastructure, which can conditionally be differentiated as “European” and “American”. The first one involves the implementation of an active state policy aimed at improving the efficiency of cargo transportation and the development of logistics centers by providing tax incentives, state subsidies or grants. The second one is based on the market regulation of the logistics sector; it minimizes the need for government intervention and encourages private companies and investors to invest in the development of logistics infrastructure [12].

The introduction of agricultural clusters is one of the ways to develop the logistics infrastructure as a driver of the introduction of progressive supply chains in Azerbaijan agriculture. The analysis of the impact of factors on the development of agriculture shows that the development of infrastructure within one cluster contributes to competitive advantages. By developing the logistics infrastructure, the state will receive the following benefits: more efficient agricultural production, transparent and open agricultural market, product quality monitoring, competitiveness, orderly distribution of agricultural commodities, especially in retail trade, pumped up budget, better living standards of the population.

To shape a market for high-quality agricultural products, it is necessary to implement the philosophy of green supply management in addition to the development and strengthening of service structures (refrigeration, packaging, and transportation), develop the activities of intermediary firms providing information and marketing services, the examination of the quality of commodities, and commercial banks serving trading enterprises and insurance companies.

It is feasible to develop integration and create joint ventures with the participation of agricultural producers, processing enterprises, banking institutions, and various foreign business entities. Modern agriculture follows the path of enlarging production [12]; thus, the industry clusterization is a necessity. The association of small producers does not allow introducing new technologies and attracting investment; thus, it is necessary to use a cluster approach to the development of national agriculture.

An important component of the successful functioning of the market infrastructure is proper information support as a tool to monitor and manage the supply chain.

The available infrastructure (roads and highways, water supply, sewage, schools and hospitals) is of primary concern; the development of new directions for the infrastructure improvement (the possibility of broadband Internet access and wireless telephony) should not be ignored. Better infrastructure will also produce results in the distant future. It will directly improve the quality of life and help to achieve the other goals: modernization of agriculture and the creation of non-farm workplaces, including by reducing production costs and attracting and retaining skilled personnel. The creation of appropriate infrastructure is a prerequisite for the development of competitive agricultural and non-agricultural enterprises.

5. Discussion

Further development of the agricultural sector in Azerbaijan requires deeper reforms that would contribute to qualitative changes in the structure of production, the development and effective use of investment potential, the growth of agricultural production, and the improvement of the quality of life of rural residents. Today, the country does not have a

financial and credit system that fully meets the needs of producers.

Azerbaijan's agriculture is steadily growing along with the labor productivity in the sector. This is due to the implementation of significant infrastructure projects; for example, 13 agricultural parks have already been introduced (Baku agricultural park, Agstafa agricultural park, etc., which specialize in the production of certain types of products).

The adoption of the best agricultural practices and innovations is important for the commercialization and modernization of the national agriculture. The favorable geographic location and climatic resources of Azerbaijan make its agriculture one of the most promising platforms for the rapid development of non-oil industry in the country. The cluster approach is being implemented in the management of modern agricultural enterprises, which allows introducing the latest technologies, including the logistics ones.

The implementation of large investment projects, as well as the implementation of the EaP commitments and the philosophy of green supply management, require state participation.

Foreign practice of clustering economies confirms the feasibility and relevance of creating clusters; agricultural clustering provides resources for the implementation of the best agricultural technologies, improves the interaction between farmers and supply chain participants [19], as well as creates opportunities for income generation, which significantly reduces poverty in the region [20]. According to the FAO data, the introduction of the cluster approach in the agricultural sector gives a synergistic effect of the interaction of producers, suppliers of resources and services, brokers, as well as better access [12]. However, in this case, developing countries need intermediaries to coordinate the operation of green supply chains, which is impossible without the digitalization of management processes [14].

The cluster model of agriculture is based on a cluster-forming enterprise around which small enterprises unite (for example, the Scottish cluster model [21], which has become popular in the EU countries). An Italian cluster model is also possible [21], which provides for more flexible interaction between the supply chain participants. The American approach to cluster formation involves the maximum use of the resources of the region where it is located, thereby reducing the length of supply chains [21]. The Chinese approach to the development of agricultural clusters [18] requires significant state intervention to manage the cluster.

There are certain prerequisites [12] contributing to the implementation of supply chain management based on the concepts of green logistics and green supply chain management in the agricultural sector of Azerbaijan [12]: access to modern agricultural technologies, national farming traditions, investment attractiveness of agricultural projects, state interest in the development of agriculture as the main driver of the non-oil sector development.

On the other hand, the development of green supply chains within the framework of agricultural clusters in Azerbaijan is hindered by the following factors [4]:

- lack of interest and cooperation between small producers;
- lack of confidence in the implementation of state investment programs;
- lack of state support for the cluster;
- low-level agricultural technologies;
- poor structure of potential agricultural clusters;
- lack of communication between science and production;
- lack of foreign investment and venture capital;
- lack of access to grant funding;
- lack of modern supply chain management information systems.

Within the framework of the present study, a competitiveness model of an agricultural enterprise has been developed as part of the implementation and management of green supply chains.

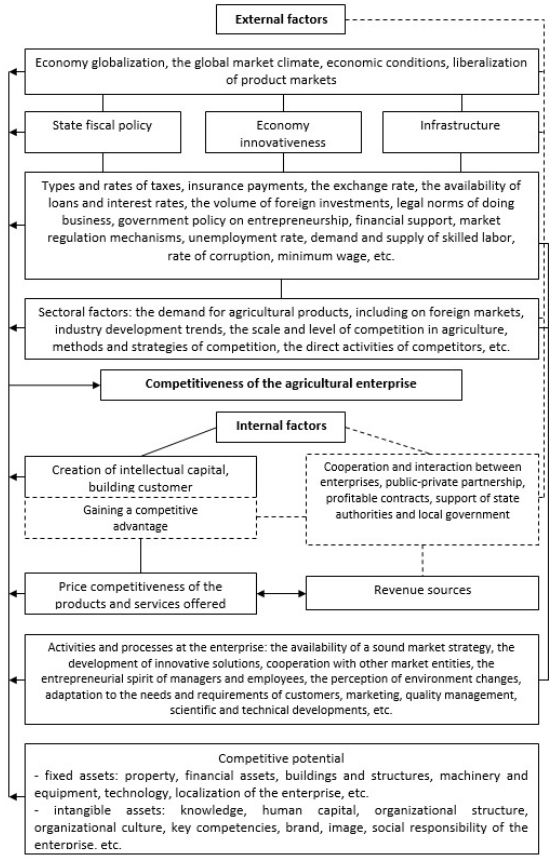

Figure 3. A model of the competitiveness of an agricultural enterprise within the framework of the implementation and management of green supply chains.

The state plays a pivotal role in the agricultural cluster formation as it is unlikely that entrepreneurs will take the initiative. The state has to improve the macroeconomic, political, legislative and social climate; establish a stable and predictable macroeconomic, legislative and political environment; improving the conditions for doing business through timely response to the needs of the cluster taking into account the entrepreneurial, geographical and historical context; support the creation and development of the cluster; increase competitiveness by providing the necessary infrastructure for cluster development.

Thus, the cluster model involves effective and coordinated cooperation with authorities and allows economizing on the scale through the joint purchase of large quantities of the necessary resources and order of research or scientific developments. Another advantage is the ability to solve collective problems, build a joint logistics infrastructure and promote products in the domestic and foreign markets. For example, the agricultural cluster model implemented in Asian countries [2] provides for the coverage of other agricultural enterprises, processing companies, consultancies, research institutes, credit unions, retail chains, etc.

The following agricultural clusters can be found in the EU: a wine cluster in France, a flower cluster in the Netherlands, a rural cluster in Poland [6]. The prominent experience of China is worth noting [22]; the introduction of clusters is initiated by state authorities, national or regional governments. The government constantly supports industrialization and modernization of agriculture. The Regional Distribution Planning of Advantageous Agricultural Products 2 (2003-2007) Project has already been implemented. Perfect project planning and state support contributed to the introduction of modern agricultural technologies and complex information solutions, which made it possible to flood the domestic market with the food products produced within the country.

Agriculture is characterized by significant risks (production risks, disease risks, price fluctuations, changes in market requirements, climate risks, the introduction of new technologies [23]); therefore, there is a need for state support at the initial stage of cluster formation.

In order to create and develop agricultural clusters, it is necessary to

- improve the agricultural management system by enlarging the power of local authorities to control the environmentally safe and efficient use of land and water resources;
- implement green supply chain management at all management stages;
- the state and regional authorities should encourage business activities and the development of small and medium-sized enterprises to increase the employment in production processes and promote the growth of population well-being. Budget expenditures should be concentrated only on those areas that are capable of creating a synergistic effect of the economic growth in this sector;
- create service cooperatives to provide small and medium-sized enterprises with agrotechnical services. - develop consumer cooperation in rural areas and introduce agricultural contracts that would guarantee the sales of manufactured products;
- The creation of large-scale production and distributive structures should rely on the construction of cluster networks that are based on production and service cooperatives, farms and small agricultural enterprises, which will allow more efficient use of the resource potential of each association participant and an expanded renewal of fixed assets. Government agencies, the owners of land, elevators, processing enterprises, etc., can become cluster participants when

required;

- improve information support in supply chain management;

- improve the advisory service as an intermediary between scientific institutions and producers, which will allow more efficient use of the investment potential of the industry, help to introduce innovative technologies, receive and sell organic products that are in great demand as evidenced by the production rate which increased by half in 2018-2019.

In order to achieve political goals, it is necessary to improve the mechanism for introducing the concept of state investment policy aimed at the development of agriculture, as well as to concentrate efforts to increase loans provided by international financial organizations (IBRD, IMF, EIB, EBRD, etc.) to finance production modernization projects, restoration of the natural environment, construction of hard surface roads, development of high value-added exports, efforts to obtain funding from the EU and other organizations.

6. Conclusions

Green supply chain management is not a fashion trend, but a management philosophy. Therefore, the introduction of green supply chain management technologies requires a government approach.

It should be noted that when implementing agricultural modernization programs, Azerbaijan uses the best practices of other countries (for example, China) and closely cooperates with international organizations (projects within the framework of the Eastern Partnership, the AMDA project funded by USAID).

Based on the research results, we can conclude that the major driver of the implementation of green supply chain management is the demand for high-quality products and the availability of modern infrastructure. Modern infrastructure is the basis for the formation of green supply chains, that is, the major driver of the process.

On the other hand, infrastructure projects require significant investments; thus, they cannot be implemented without state support. Public funding and foreign investment are the factors that ensure sustainable development of agriculture, improve the living standards of the rural population, protect the environment, preserve natural, labor and production resources, increase the competitiveness of agricultural production.

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