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## FEATURES OF ECOLOGICAL TECHNOLOGIES IN THE DEVELOPMENT OF AGROLOGISTICS

*The socio-economic development of any country consists of the positive development of the main economic sectors, where the agricultural sector plays a special role. The processes of development of globalization of modern times emphasize the requirements for the development of logistics and technologies with the help of which all participants in the logistics chain are served. And technological development constantly requires all market participants to make maximum use of the achievements of modernity, which is represented by the use of ecological technologies in logistics processes. The article is devoted to a detailed review and study of positive examples and difficulties regarding the use of environmental technologies in the agro-logistics sector in countries such as the Kingdom of the Netherlands and Germany. Agrilogistics is a relatively new interdisciplinary field in the agricultural sector, including the management of supply chains of agricultural products and raw materials from production to delivery to the consumer, combining agricultural production, marketing, management and logistics. Agrologistics is associated with the application of logistic methods and regulations in the field of agricultural production, aimed at minimizing labor costs, resources, transport costs, by optimizing transportation routes, and as a result, reducing the cost of agricultural products. The article examines in detail the program "Vision of agrologistics" according to the platform "Agrologistics Platform" of the Kingdom of the Netherlands, the main regulatory documents that were adopted at the legislative level for the support and development of agrarian logistics of Ukraine are given, and conclusions are drawn.*

*Keywords: logistics, green technologies, logistics chain, infrastructure, agro-logistics, agriculture, transport.*

## ОСОБЛИВОСТІ ЕКОЛОГІЧНИХ ТЕХНОЛОГІЙ У РОЗВИТКУ АГРОЛОГІСТИКИ

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*У статті визначено, що соціально-економічний розвиток будь-якої країни складається з позитивного розвитку головних економічних галузей, де особову роль займає галузь сільського господарства. Процеси розвитку глобалізації сучасності особо гостро підкреслюють вимоги до розвитку логістики та технологій за допомогою яких відбувається обслуговування всіх учасників логістичного ланцюжка. Технологічний розвиток неупинно вимагає від всіх учасників ринку максимально використовувати здобутки сучасності, що представлено застосуванням екологічних технологій у логістичних процесах. Стаття присвячена детальному розгляду та вивченню позитивних прикладів та труднощів щодо використання екологічних технологій в секторі агрологістики таких країн як Королівства Нідерландів та Німеччина. Зазначено, за результатами розгляду процесів організації постачання, організації процесу виробництва, організації процесу збуту, організації процесу транспортування, організації процесу транспортування по ряду країн, ступінь пріоритетності та наявності послуг які надаються, Нідерланди знаходяться на високому місці серед держав, чітко демонструючи процеси постачання, виробництва, транспортування та складування. Агрологістика є відносно новою міждисциплінарною галуззю в сільськогосподарському секторі, включаючи управління ланцюгами постачання сільськогосподарської продукції та сировини від виробництва до доставки споживачу, поєднуючи сільськогосподарське виробництво, маркетинг, менеджмент і логістику. Агрологістика пов'язана із застосуванням логістичних методів і положень у сфері сільськогосподарського виробництва, спрямованих на міні-*

мізацію витрат праці, ресурсів, транспортних витрат, шляхом оптимізація маршрутів транспортування, а в підсумку – зниження собівартості сільськогосподарської продукції. У статті детально розглянуто програму «Бачення агрологістики» відповідно платформи «Платформа агрологістики» Королівства Нідерландів, виділено ТОП-15 світових виробників молочної продукції, приведені головні нормативні документи, які було прийнято на законодавчому рівні для підтримки та розвитку аграрної логістики України та зроблено висновки.

**Ключові слова:** логістика, зелені технології, логістичний ланцюг, інфраструктура, агрологістика, сільське господарство, транспорт.

**Statement of the problem.** The economic situation in many countries, due to the coronavirus pandemic, complicated by other problems regarding the importance of the most powerful sectors of the economy, is of special importance for each country. For example, for many countries, agribusiness is one such strong economic sector. It was agribusiness that became one of the means of getting out of the protracted crisis that began with the introduction of sanctions by Western partners.

However, it should be so and it is accepted as a fact that the agricultural sector itself cannot develop separately from other sectors of the economy. In addition, it is important for other personal spheres for society and the state, for example, to ensure food security, and at the global level, which is important in view of other problems of modern society and the state. Its effective development is impossible without a developed transport infrastructure. For a large number of countries, the problem of agro-logistics is one of the main problems of this business sector.

**Analysis of recent research and publications.** The development of methodological and theoretical principles of logistics is connected with logistics science through the processes of globalization, informatization of society and environmentalization of economic relations. Each of the periods of development is distinguished by certain approaches to the improvement of logistics systems, where most scientists, such as Smirnov I.M., Kosareva T.V., Van Buren N., Li Yanbo, Paul R., Sumets. O. and others [1–4] state attention to separate personal attention to the growth of ecological problems of the natural environment and the personal role of ecological technologies in the development of the main economic sectors.

**Setting the task.** The purpose of the study is to generalize the existing global practices of applying

ecological technologies in the development of agro-logistics.

Summary of the main research material. Agrologistics refers to branch types of logistics and is responsible for material flows in the agro-industrial complex. Accordingly, the macrologistic system of agrologistics fits into the classical scheme (Fig. 1).

The peculiarity of transport is that it does not process raw materials and does not create products, and with the help of vehicles, services are provided for the delivery of the corresponding products to its consumer with a minimum duration of time with the resolution of related issues (customs, documentation, storage of cargo, etc.).

However, its role in the economy is very important, according to experts, due to outdated transport infrastructure, Ukraine loses 20–25% of whole grains, while in economically developed countries this figure is equal to 1–2%. The main shortcomings in logistics include:

- the construction of optimal routes and the correct determination of the effective distance are very important for planning the budget for the delivery of fertilizers, seeds, herbicides, crops;
- excessive financial losses (which could be avoided) affect the overall financial condition of the agricultural enterprise;
- excessive additional costs, which are initially laid on the overestimated distances of theft in the agricultural sector, which takes the situation to another level, requiring attention from law enforcement agencies.

Let's highlight some definitions regarding the interpretation of the term "agrologistics": for example, Sumets O. [5] offers the following definition: "Agrologistics is a new applied direction of logistics, connected with the application of its provisions and methods in the field of agricultural and agro-industrial production".

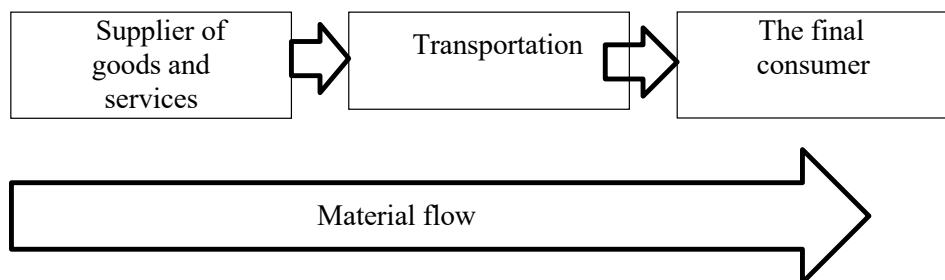


Figure 1. Scheme of the macrologistic system

The use of new technical possibilities, namely the use of "ecological transport" in agro-logistics, as a rule, is connected and considered through the provision of a logistics chain within the agro-industrial complex. The following main types of supply chain are distinguished by types of products: supply chain for agricultural products (vegetables, fruits, fish, flowers, etc.); supply chain for agricultural products (cocoa, sugar, coffee, etc.); supply chain for processed products (dairy and meat products). Example of the development of agro-logistics due to the active use of the latest technologies is the Kingdom of the Netherlands. Based on historical references, the Kingdom of the Netherlands is a country characterized by deep entrepreneurial and commercial traditions that are emphasized and "stitched through" tolerance. Area: 41.5 thousand km<sup>2</sup>, which is less than the territory of Ukraine. A quarter of the country's territory lies below sea level. Also, the Kingdom of the Netherlands includes the Dutch Caribbean islands – Bonaire, Sint Eustatius and Saba, which have the status of municipalities of the Netherlands and the "countries" of Aruba, Curacao and Saint Maarten.

Also, the Netherlands is a country in the north-west of Europe, known for its canals, tulip fields, windmills and bicycle paths. In the capital of the country, Amsterdam, there is the Rijksmuseum, the Van Gogh Museum and the house in which the Jewish girl Anne Frank wrote a diary during the Second World War. From the Golden Age of the Netherlands (XVII century), mansions along the canals, as well as famous paintings by Rembrandt and Vermeer, have been preserved.

Today, the Netherlands is one of the world's largest industrial, commercial, transport and financial centers with a modern energy sector and an automated

infrastructure developed according to the latest requirements. It is a stable socio-economic country, according to the overall level of logistics development, according to the Logistics Performance Index, it ranks high in the ranking, namely from 2nd place (2007) to 6th place (2018), among 150–160 countries that take participation in the formation of the efficiency rating of logistics development.

Agrologistics in this country is implemented through state programs for the development of this direction – the "Vision of Agrologistics" program, according to the "Agrologistics Platform" platform.

Dutch agrologistics is represented by a number of projects, such as: Milk Park, Agroport 7A, Flora of Holland, "Fresh" Logistics Network, Oil Ferry, Agricultural Product Movement Control System, Sanitary Control of Agricultural Trade Flows, Logistics Chain of Chicken Meat Production, Clustering in Pig Farming, Protein Products, corridor A1, Mixed farming, Unified delivery network and others. Each of the projects is a public effort of managers, logisticians, marketers and other specialists, equipment and transport component that ensures logistics processes.

As an example, let's consider in more detail the "Milk Park" project, which was developed on the basis of the production facilities of the DOC enterprise, for the production of milk and dairy products. The idea of the project is to unite small producers who work on "old" technologies or maintain and preserve personal recipes. For this project, over the last 5 years, new ecological technologies have been used for the packaging of finished products and transportation.

According to the conducted studies, it is the use of environmentally friendly packaging (which is returned and reused), the use of serum for other productions and the main growth of ecological

Table 1

**TOP-15 world producers of dairy products**

The company name	Country	Volume of milk processing, million tons	Revenue, billion USD
Forterra	New Zealand	21,6	16,4
DFA	USA	17,1	13,0
Lactalis	France	15,0	16,9
Nestle	Switzerland	14,9	19,1
Dean Foods	USA	12,0	13,1
Arla Foods	Denmark	12,0	12,0
Friesland Campina	Netherlands	10,1	13,4
Danone	France	8,2	15,6
Kraft Foods	USA	7,8	7,5
DMK	Germany	6,9	6,4
Saputo	Canada	6,3	7,0
Glanbia Group	Ireland	6,0	3,9
Land O'Lakes	USA	5,9	4,3
California Dairies	USA	4,6	3,0
Muller	Germany	4,4	6,5

transport in the logistics of this project that is decisive for the end consumer.

Also, it should be noted that the "Milk Park" project includes one of the world leaders in the production of dairy products – the company Friesland Compina (Table 1) [7]. The "Agroport A7" project, which is implemented in the fields in the north-west of the Netherlands, has created a cluster of entrepreneurs who are engaged in the cultivation of white and green cabbage, curly cabbage and broccoli. The main aim of this cluster is the optimization of crops of all types of cabbage. This goal has been achieved to date, as all the main sowing volumes are carried out practically in one place, where the necessary greenhouses for seedlings and equipped places for packing work are located nearby. Servicing large volumes of products and territory requires significant transport losses, and thanks to concentration, this significantly reduces the costs of these activities. This work algorithm provides all participants of the "Agroport A7" project with flawless provision of one of the main logistics concepts, "just in time".

Another positive example of development is German agrolistics, which is distinguished by the allocation of huge funds for ecological transport and the use of sunflower batteries and windmills. Today, wind remains the main source of energy supply in Germany. In 2021, wind generators produced 113.5 TWh of electricity, which is slightly lower than in previous years. "Clean" electricity is actively used in agro-logistics, but there are objective reasons to reduce the use of wind turbines. Among them: the active position of public organizations regarding the protection of birds that fall into the area of operation of a windmill and die, protests by residents of cities where wind turbines are massively installed, as residents oppose the noise and vibrations that are the result of the operation of wind turbines. This has a negative impact on logistics in the agricultural sector.

Another direction of ecological technologies is solar panels, which are very actively used in Germany, and today large areas and every gas station for ecological cars are equipped with solar panels. In German agro-logistics, the use of ecological machines is becoming the norm and one of the main logistical goals.

According to the world's leading analytical agencies, in 2019, Germany ranked 4th among all EU countries in terms of investment in agro-industry, concluding 21 deals worth \$109 million. In 2020,

AgTech startups received €29 million of investment – the smallest share among all startups in the country. More than 30% of AgTech startups are working on solutions for the production and processing of agricultural products, another 10% are developing innovations for agricultural machinery and providing agro-logistics.

Considering the agricultural logistics of Ukraine, such difficulties of this sector should be singled out as the low supply of special storage facilities and warehouses. With an average annual grain harvest of 62 million tons, according to analytical data, the existing storage capacity in the country is 38 million tons. Provision of special modern elevators is very low.

According to the results of the analysis carried out by the Nobel Resources Ukraine company, the transportation of agricultural products from the field to the elevator, taking into account additional costs, costs Ukrainian enterprises – producers 33 dollars per 1 ton (table 2) [6].

So, in view of the information above, it can be stated that the costs of logistics services for exports from Ukraine are almost two times higher than in the countries of the European Union and 1.7 times higher than in the United States of America.

Additional obstacles are the state of roads and access roads in Ukraine, which gives a huge additional percentage to the price and significantly increases the cost price.

**Conclusions from the study.** It should be remembered that the agro-industrial complex is one of the most powerful directions of the country's development and a budget generator, which creates about 12% of the state's gross added value.

To correct and improve the situation in the direction of the logistical development of the agricultural sector of Ukraine, a number of legislative acts were initiated and adopted, including the Law of Ukraine dated 17.11.2021 No. 1887-IX "On Multimodal Transportation" [8], Resolution of the Cabinet of Ukraine dated 09.04.2022 No. 427 "On the Formation of the Coordinating Council for Logistics in Agriculture" [8] and other acts, resolutions, decrees, the activities of which were aimed at helping the logistics sector develop. But the events of February 24, 2022 destroyed all the hard work, projects for plans for the future, as a result of the invasion of Russian military groups, a large number of logistics facilities and the logistics infrastructure of the country were destroyed and continue to be destroyed.

Table 2

**Transportation in the agricultural sector by country**

Costs	Europe	USA	Ukraine
Costs for transportation and certification, USD/ ton	20	18	32
Cost of transshipment USD/ ton	9	6,2	18
Expenses of everything	29	24,2	50



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