Ekonomika i Organizacja Logistyki
2 (1), 2017, 5–15

DOI: 10.22630/EIOL.2017.2.1.1

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The use various branches of transport on the grain market in Ukraine

Wykorzystanie różnych gałęzi transportu na rynku zbóż na Ukrainie

Synopsis. Celem artykułu jest ocena potencjału transportowego w logistycznych procesach zaopatrzenia na rynku zbóż. Na podstawie dialektycznej metody poznawania obiektywnej rzeczywistości i stosując technikę porównawczą dokonano charakterystyki transportu kolejowego, samochochodowego, morskiego i rzecznego w zakresie przewozu ładunków zbożowych na Ukrainie. Ustalono, że najsłabszym ogniwem w transporcie kolejowym jest brak wagonów do przewozu zboża, ich niedostateczny stan techniczny oraz niski poziom wykorzystania taboru, co w konsekwencji ogranicza rozwój innych elementów logistycznego systemu. Średnioroczny udział kolejowych przewozów zboża wynosi na Ukrainie tylko 11% w przeciwieństwie do USA, gdzie udział ten stanowi 95%, co prowadzi do wzrostu logistycznych kosztów i do obniżenia czasu wykorzystania wagonów do przewozu zboża. Udowodniono, że Ukraina ma sprzyjające warunki i duży potencjał dla rozwoju morskiego i rzecznego transportu, co niestety nie jest właściwie wykorzystywane. Ustalono, że problemem w transporcie samochodowym są złe warunki drogowe. Drogi nie spełniają międzynarodowych standardów jakości, co powoduje, że średnia prędkość na drogach jest kilkakrotnie mniejsza niż w krajach Europy Zachodniej. Najgorsza sytuacja panuje na terenach wiejskich, co znacznie komplikuje logistyczny system i transport zboża z pól do elewatorów.

Słowa kluczowe: logistyka, środki transportu, ładunki zbożowe, prędkość przewozowa, odległość przewozu

Abstract. The purpose of the article is to assess the transport potential of the logistic supply of the grain market. In the article, on the basis of the dialectical method of cognition of objective reality and using the comparison technique, the logistic characteristics of railway, automobile, sea and river transport in transportation of grain cargoes in Ukraine are considered. It was determined that the weakest link in railway is the lack of grain wagons, their insufficient technical condition and a low

level of rolling stock. That in turn limits the options of other elements of logistics system. The average annual rail route shipment of grain in Ukraine makes only 11% as opposed to 95% in the USA, for example. It leads to increased logistics costs and reduces the duration of grain wagons turnover. Ukraine has favorable conditions and a big potential for marine and river transport but unfortunately it is not used properly. It was established that the problematic issues of automobile shipment are the bad condition of roads. They do not meet international quality standards, and the average speed on the roads is several times lower than in Western European countries. The worst situation is in the rural areas that significantly complicates the logistics system and transporting grain from fields to elevators.

Key words: logistics, means of transport, grain cargo, transport speed, distance transportation

Introduction

Food security is defined by the ability of the state to form the required amount of food resources, including grain. Favorable soil and climatic conditions as well as geopolitical location of Ukraine are the basis not only to meet domestic food needs but to form strong export-oriented industries. It could provide the state budget with the stable source of foreign currency. To solve these problems we must ensure efficient movement of product flows between the whole elements of logistics chain and potential customers that actualizes the role of the transport component in logistics system to ensure grain market. The problem of further dynamic development of grain production and the formation of Ukraine's export potential is the development of various types of vehicles (both quantitatively and qualitatively) adapted for grains transportation, which operate on the basis of effective organizational schemes.

The purpose and methodology of the study

The purpose of the article is a heuristic evaluation of transport potential and the development of measures for the efficient use of rail, road, sea and river transport in the logistics of grain flows. To achieve this goal, we solved the following tasks: on the basis of the dialectical method of knowing the objective reality and using the method of comparison, present a logistic assessment with a definition of a set of advantages and disadvantages of each mode of transport in the transport of grain cargoes, as well as analyze the use of Ukraine's communication routes and transport infrastructure in view of fighting in the east of the state.

The main results of the study

Logistics characteristic shows a set of advantages and disadvantages of each type of transport, giving reasons for the selection of compromise criterion in grain shipment taking into account the individual configuration of the logistics system.

In grain cargo logistics the four modes of transport are used: rail, road, sea and river. Let's consider a general description of organizational and economic conditions of each of these types of transport in Ukraine and present them in Table 1.

Table 1. Transport characteristic of grain cargoes shipment*
Tabela 1. Charakterystyka transportu ładunków zbożowych

Transport type	Advantages	Disadvantages
Railway	1) high power and strength of the grain flow; 2) full compliance with the schedule of delivery of grain, regardless of weather conditions; 3) relatively low unit cost of transportation of grain mass; 4) high speed delivery of grain in interregional traffic.	1) monopoly position of "Ukrzaliznytsia" with corresponding negative consequences; 2) deficiency (especially seasonal) of grain wagons and considerable wear and tear of rolling stock; 3) time spent in the materials handling shipment of grain during peak loads; 4) lack of access to transport small batch of grain (minimum shipment regulation); 5) the absence of railways routs to t elevators; the need for additional cargo multimodal transportation.
Automobile	1) highly competitive market with positive effects of service and tariff policy; 2) accessibility to transport small quantities of grains of different users; 3) greater agility and flexibility of route selection and delivery schemes; 4) the use of the unimodal system of grain carriage; 5) high tension of grain flow; 6) a greater mechanization of cargoes in points of sending and receiving the grain cargoes.	1) the probability of disruption of delivery of grain due to weather and road conditions requiring the consignee establishment of insurance reserves to ensure continuity of its manufacturing process; 2) low power grain flow; 3) the relatively high cost of transportation over long distances (transportation costs up to 300 km); 4) higher amortization costs due to the poor quality of roads in Ukraine; 5) time spent idle during peak times in the "field – the elevator."
Sea	1) ability to intercontinental connections (provides 91.2% of export shipments of grain compared to other modes of transport); 2) high power of grain flow; 3) low cost of grain mass units' transportation; 4) unified organizational and technological conditions for transport grain containers; 5) single legal field of the 400-year history.	1) depending on the geography, weather and navigation conditions; 2) the unavailability of many of Ukraine berths for ships of class Panamax (displacement 60–80 thous. tons), Handymax (40–60 thous. tons), Handysize (10–40 thous. tons), and the more Capesize (150 thous. tons); 3) additional logistics costs for the use of multi- and intermodal transportation schemes of grain; 4) limited extensive development of port infrastructure and substantial capital intensity measures for its intensification; 5) discrete low grain flow across long distances and a limited number of linear and tramp vessels; 6) low speed and time spent handling grain.
R river	1) high power and strength of grain flow in deep rivers; 2) low cost of grain mass shipment; 3) the use of rivers flow to reduce operating costs; 4) the trend of investment holdings focused on building elevator companies with the possibility of river transshipment of grain (extensive development).	1) seasonal work, because of river freezing navigation; 2) dependence ways of moving grain flows from uneven depths of rivers and reservoirs; 3) additional logistical costs of using multimodal scheme of transportation of grain; 4) low speed of delivery and time spent handling grain.

Source: own elaboration based on Kolodiichuk [2015].

Railway transport

The length of the state railways routs in 2013 was 21 604.9 km. The first railway in Ukraine was constructed in 1861 in the west (Przemysl – Lviv) and in 1865 in the south (Odessa – Balta). The industrial era of human development has contributed to the formation of the railway network. Today the density of railways in Ukraine is 38 km per 1 thous. km as opposed to 65 km per 1 thous. km in France, for example. The highest density of railway network is in the south-eastern parts of Ukraine (Donbas) and in the west.

Foreign trade of railway transport under the Law of Ukraine "On Railway Transport" [On the rail... 1996] is determined by treaties and domestic economic rules. The documents that regulate rail freight are the following:

− collection of rules on freight rail transport;

− rules of transportation of dangerous goods by rail;

− specifications for loading and securing of cargo.

According to the International Union of Railways the train speeds should be 100 km/h for freight trains and 120 km/h – for passenger ones. Today the freight trains in Ukraine have an average speed of only 32 km/h.

One of the weakest links in the logistics of grain in Ukraine nowadays is the limiting options of grain wagons. Today there are 12.2 thousand of grain wagons in Ukraine and less than 84% of which are in good working order. Most of these cars are the property of "Ukrzaliznytsia".

The average age of is grain wagons is 26.4 years. Thus, 69% of wagons have been exploited more than 28 years on the legislative life of 30 years [On approval… 2010]. The above transport capacity provide traffic volumes of 3.5 million tones of grain per month and over 42 million tons per year but this is not enough, as traders application, for example, in August–November 2014 satisfied only 50–60%. Figure 1 shows grain wagons turnover, which demonstrates the intensity of the seasonal use. This graph demonstrates the low turnover of cars (an average of nine days), resulting from the current practice shipments of grain. An important indicator of evaluating the effectiveness of rail transport is the level of routing traffic that characterizes the system of centralized cargo shipments by a train composition between different points of loading – unloading. The average level of routing goods in Ukraine is only 11%, which leads to higher logistics costs. Routing traffic turnover provides cars for four days. Meanwhile, the US level routing rail transportation of grain cargoes reaches 95% [Study…2009]. This is achieved through the loyal tariff policy that provides customers 30% discount compared to per wagon shipment of grain. Even greater discounts (59%) provide in the case of transportation technology "shuttle train" [Kenkel 2004], which provides for the train to 100–110 cars moving on a regular schedule and it provides a 50% saving on the use of cars and infrastructure and 75% savings on locomotive traction. The current US system allows nodes elevators consolidate grain elevators linear flows using mainly road transport and load path "shuttle train" in the short term. In the transportation of grain cargoes concluded long-term contracts (6 to 9 months), which agreed schedule of departure and penalties for failure to comply with the download of the owners and transportation – from the railroad.

In terms of uneven demand for transport services the big problem in Ukraine is the lack of coherence and grain carriers through poor information provision on objective

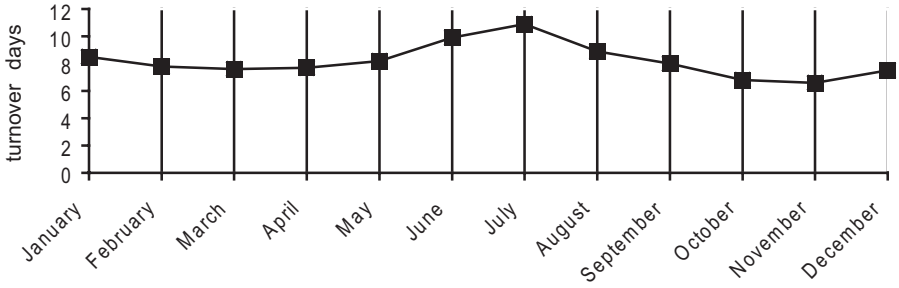

Figure 1. Seasonal intensity of grain wagons use
Rysunek 1. Intensywność użytkowania wagonów zbożowych
Source: Study of Railroad Rates [2009].

parameters of logistic system. The result is the orders for cars, grain, making it difficult to work on UZ coordination with host stations (ports) of grain cargoes. According to the investment centre, FAO (Food and Agriculture Organization) Ukraine should increase grain wagons for transporting crop grains and oil seeds to 15 thous. before 2023 investing 500 mln USD in their construction. Increasing grain raw materials, those numbers of cars can provide annual traffic volumes crops at 90 mln tons.

The problem of seasonality loads on rail transportation is complicated by the state of repair of rolling stock. Grain wagons are on current and major repairs on the Stryi car-repair plant and under carriage depots like Kherson (Odessa railway) VCHD Krasny Liman, Sloviyansk, Ilovaysk, and Popasna Konstantinovka (Donetsk railway). But after the military conflict in the east, all depots practically stopped working apart VCHD Kherson. One of the most problematic issues of railway transportation of export grain discrepancy is the width of tracks which in Ukraine is 1520 mm, while in Western Europe has 1435 mm gauge, which creates significant barriers to transit because at the border we need to overload or change the wheels. This causes additional organizational difficulties, delay time and additional costs.

Road transport

Road transport has undeniable advantages (Table 1). It outgoes water one but gives way to railway. In 2012 in Ukraine 21 million tons of grains and oilseeds were transported by railway to the seaports while by the road and river – only 2 and 5.3 million tons accordingly. Road transport is indispensable for transporting grain from the field to elevators as well as on domestic and international routs at maximum distance of 300 km. In Ukraine, the most important motorways are: Odesa – Kyiv – Chernihiv; Kharkiv – Donbas; Dnipropetrovsk – Zaporizhia, Simferopol; Lviv – Kyiv; Kharkiv – Kyiv; Poltava – Kyshyniv, Rostov – Reni. In the harvest season of 2014 the use of motorway transport in logistics of grain was significantly deteriorated. Some vehicles, because of military action in the area, came under mobilization, and about 23% [Agrologistyka… 2014] of vehicles were not exploited through a difficult financial position of owners of, caused by a sharp rise

of fuel and spare parts for trucks on the devaluation of the hryvnia and the corresponding growth rate of foreign currencies. According to statistics from the Association of Agricultural carriers [Agrologistyka… 2014], the loss in grain harvesting due to lack of vehicles and untimely removal of products from the fields accounted for 10% in 2012–2013. According to preliminary data, in 2014 these losses accounted for at least 11% and this is despite the fact that corn yield in 2014 was 28 million tons, which is 18% more than in 2013. Grain harvest in 2014 also increased compared to the previous year by 1.3% with a record 63.9 million tons. That is why; it is not permissible to bear such losses only through imperfection of transport logistics, taking into consideration the strategic importance of grain for the state economy.

Maritime transport

Ukraine has favorable geographical and historical background for the development of maritime transport. In the south it is washed by the Black Sea and the Sea of Azov which do not freeze and have a link with the Mediterranean Sea through the Bosporus, the Sea of Marmara and the Dardanelles. The total length of the marine shoreline of Ukraine is more than 2000 km. Regular sea freight using the Black Sea and the Sea of Azov began in the XVIII century. Analysis of port infrastructure in Ukraine demonstrates the significant potential of maritime transport to ensure export shipments of grain and leguminous crops. Problematic issues of port elevators are old technology and a significant depreciation of manufacturing equipment which reduces the efficiency of cargo handling. The main functions of port elevators are the formation of consignment of grain with subsequent loading. After sending the ship, the elevator should be ready for the next batch of grain accumulation. Technological operations of the port elevator are identical with the technology of linear elevator. It is evidenced by the following operations: analysis of the grain, its weight, providing technological freight for unloading grain etc. Port and linear elevators are also in charge of cleaning, drying and storage units. The only difference between them is the shipment of grain to the ship, which provides significantly more power equipment on leaving the storage of grain.

River transport

Significant potential to improve logistics in Ukraine is seen in development of river transport (Table 1). The use of transport potential of Ukrainian rivers has a very long history. The first who mentioned the Dnieper River were the Greeks in the V century BC. when Herodotus called it the Borysthenes – the river on the north. The Slavic name of it during the Kievan Rus period was Slavutych. In those days the River Dnepr was an important part of the southern route “from the Vikings to the Greeks” (called Varangian Way) and connected Scandinavia with the developed countries of those times like ancient Greece and Byzantium. This was the main way for the development of Kievan Rus, in particular to strengthen its commercial, cultural and religious ties.

The decline of Byzantium and the constant attacks of nomads on vehicles in the steppe regions led to the loss of value of the logistics of the way. After North Dnieper went to

Lithuania (XVI–XVIII centuries.), Part of the Dnieper the way served to inland connections, including logging. The lower part of the Dnieper was widely used by Cossacks for military and commercial purposes.

At present, the t navigation on the Dnieper River with the length of 1200 km, became possible by the construction Dniprohess in the mid 30's of the XX century and flooding Dnieper Rapids.

Shipping company "Ukrrechflot" is monopolistic logistics operator in the market of grain in river transport [Ukrrechflot… 2014]. It has positioned itself as transport infrastructure as well as comprehensive logistics operator in transport infrastructure (ports, fleets of different types and areas of navigation etc). Besides, it has highly professional staff. Through the combination of these assets the company is able to adjust to any customer's logistic requirements and implement complex solutions of any complexity [Ukrrechflot… 2014]. The company "Ukrrechflot" consists of five major river ports of Ukraine: Dnepropetrovsk, Zaporozhye, Nikopol, Kherson and Mykolaiv. In the Dnepropetrovsk river port it has its own modern grain elevator with the capacity of 30 thous. tons which was commissioned in 2012. The elevator has a gage rail and road weighbridges, certified laboratory and unloading station with two road transport tippers. Linear speed unloading of each station is 100 tons/per hour (t/h). linear speed the reception unloading rail transport – 150–200 tons/per hour (t/h).

The length of the pier (140 m) is able to download goods at speeds of 150–200 t/h with a maximum draft of vessels at berth in 4 m, for a fine day, depending on the culture provides transshipment volume of 2500–4500 tons. Production equipment elevator configured to implement the scheme directly to loading vehicles without removing the car with axes. Technological parameters processing grain mass during its cleaning and drying determine the following: cleaning (2 separators): pre-treatment (elevator mode) – 70 t/h, final cleaning – 140 t/h; drying (1 grain dryer), depending on the culture and humidity – from 44 to 120 t/h.

The shipping company "Ukrrechflot" has a very powerful navy in the amount of about 100 vessels of various types, including barge-towing storage, which allows to providing annual capacity of grain infrastructure of the company at 600 thaus. tons per one year.

According to logistics management positions of Ukraine, the river transport has the greatest potential for its development compared to other modes of transport. It is necessary to use heavy vehicles in the domestic transport of bulk goods, increase the share of container transport grain and intensify the export flows through the use of vessels of "river – sea" at minimum road and rail transport between the regions of Ukraine grain and its seaports. Along with the rehabilitation of the existing fleet of vehicles must refresh qualitatively new type and expand transportation tug fleet.

To ensure stable operation of river transport advisable it would be a good idea to reconstruct the ship lifting facilities Zaporozhye and Kherson shipbuilding, ship repair plants, individual objects at Kiev shipyard, ship repair, Chernihiv, Dnipropetrovsk repair-operational fleet bases, three-chambered shipping gateway in Zaporozhye, build Vylkove repair and operational base Navy on the Danube and others.

The actual task of river transport is to provide a year-round navigation in certain areas and on port infrastructure – equipping ports with modern cargo handling equipment to reduce downtime not only vehicles, but also vehicles and rail cars.

The power of river fleet is described with the following dates: to transport 10 million tons of agricultural products it should be provided with 400 thous. trucks, 166 thous. cars or 2 thous. craft. The cost of domestic road shipment is 28 USD per ton, railway and the river ones – 21.5 and 12.5 USD per ton accordingly

In the transport system there are different means of communication or vehicles, for example cars, locomotives, automobiles, ships, other rolling stock as well as technical equipment and such facilities as stations, depots, ports, workshops etc. The most important indicators of the work of transport costs refer to its use, speed of delivery and constancy, which refers to the degree of deviation of actual velocity of the load of routine. As many as 51.1% of Ukrainian roads did not meet international standards of equality, 39.2% – strength; the average speed on highways is 2–3 times lower than in Western European countries [Approval… 2010]. Almost 90% of Ukrainian roads are designed under the vehicle axle load up to 6 tons, which is much less compared to European roads. Quantitative parameters of railways public in Ukraine are given in Table 2 as well as significant changes in the length of the period of the study.

Table 2. The length of routes general use in Ukraine, [thaus. km]
Tabela 2. Długość dróg ogólnego zastosowania na Ukrainie [tys. km]

The length of the routes by mode	Years							2009 to 2015 % p
	2009	2010	2011	2012	2013	2014	2015	
The operational length of railways	21.7	21.7	21.6	21.6	21.6	20.9	21.0	96.8
Operating length of river shipping routes	2.2	2.2	2.1	2.1	2.1	1.6	1.6	72.7
The length of roads	169.5	169.5	169.6	169.7	169.6	163.0	163.0	96.2
Including paved roads	165.8	165.8	166.0	166.1	166.1	159.5	159.4	96.1

Source: Ukraine in Figure [2016, p. 169].

In rural areas over the last decade there was a significant reduction of projects because of improper road conditions. In 1990 in Ukraine 7023 km of paved roads were put into operation, in 1995 this figure decreased by 3.9 times – up to 1823 km, and after 2000 (294 km) of paved roads covering virtually no paved, as evidenced by the following figures: 2005 – 35 km, in 2010 – 67 km, in 2011 – 48 km, in 2012 – 131 and 2013 – 65 km, in 2014 – 63 km, in 2015 – 62 km [Statistical… 2014, p. 184].

In logistics grain transportation and manufacturing process the conditions in rural areas can be divided into two stages:

1) transportation "field – tick (or inside the elevator)",

2) transport "tick – central elevator or transshipment port".

Low quality of roads was caused by some carriers who refuse to provide transportation services as significantly increasing the risk of damage to facilities and security threats to drivers. According to the Association of Agricultural Carriers of Ukraine (AAPU) in season 2013, about 15% of grain shipments was frustrated by the refusal of drivers to overcome the emergency routes to include downloads [Logistics… 2014] According AAPU in 2014 were registered 137 cases of overturning loaded grain cars in the ditch because of the poor state of roads [Agrologistyka… 2014].

Analyzing the reasons for the catastrophic state of the access ways, one could argue that it is the result of improper use. The quality of road construction, which is also the cause of accidents, the problem is the total operating overload vehicles, which provides significant advantages as the owner of the grain by reducing the cost and the carrier which forms tariffs taking into account the overload. As a result, there is a macroeconomic problem total deterioration of the quality of roads, especially enhanced during high summer temperatures, which accounts for peak traffic. As you know, in the summer reduced ability to resist the pressure of pavement overloaded axles of vehicles, which greatly speeds up the process of destruction.

Table 3 shows the dynamics of cargo transportation in Ukraine by different modes of transport, suggesting an intensification of the transport component for grain and products of its processing (for the 2005–2013 biennium + 45%). This caused an increase in grain parameters of raw materials, which in turn increases the operational burden on the railways.

Table 3. Cargo modes of transport in Ukraine [mln t]
Tabela 3. Rodzaje transportu ładunków na Ukrainie [mln t]

Type of transportation	Years							2009 to 2015 % p
	2009	2010	2011	2012	2013	2014	2015	
Transportation, total	**1625**	**1765**	**1887**	**1853**	**1837**	**1623**	**1507**	**92.7**
Terrestrial	1615	1754	1877	1845	1831	1617	1501	92.9
– train, total	391	433	469	457	444	386	350	89.5
including grain shipments	20	13	15	24	23	–	29	145
– automobile	1069	1168	1253	1260	1261	1131	1054	98.6
– pipeline	155	153	155	128	126	100	97	62.6
Water	10	11	10	8	6	6	6	60
– marine	5	4	4	4	3	3	3	60
– river	5	7	6	4	3	3	3	60
Air	0.1	0.1	0.1	0.1	0.1	0.1	0.1	100.0

Source: Ukraine in Figure [2016, p. 163].

Ensuring the efficiency of grain sub complex of APC in Ukraine, we can state that it greatly depends on the development of public transport and the relevant road services. Railway is certainly a key, along with motorway in internal grain logistics of Ukraine, and in the structure of exports by rail to average 7.1% sent grain by road – only 1.7%, while the sea – 91.2% of the total export transshipment of grain.

Conclusions

1. Thus, in grain logistics are used the four modes of transport: rail, road, sea and river.
2. Rail transport is capable of carrying more than 42 million tons of grain per year, but this is not enough, since grain traders' applications, for example, for August–November 2015, were met only on 50–60%, due to the seasonal discreteness of grain flows.

The moving park of grain wagons in Ukraine is one of the weakest links in the logistics of grain, limiting the options of other elements of the logistics system. Today there are 12.2 thous. of grain wagons, of which only 84% are in satisfactory working condition. The average annual level of cargo routing in Ukraine is only 11%, which leads to higher logistics costs, and reduces turnover of grain wagons.

3. Road transport is indispensable in the transportation of grain from the field to the elevator as well as domestic and international flights at 300 km maximum. The problematic issues of development is the poor quality of roads, 51.1% of which do not meet international standards of equality, 39.2% – the strength, and the average speed on highways is 2–3 times lower than in Western European countries. The most acute problem is the quality of roads in rural areas, leading to complications in logistics transportation system.
4. Not fully used in Ukraine is the potential of the development of sea and, especially, river transport, where the monopoly logistics operator is Public Joint Stock Company "Shipping Company Ukrrichflot", which consists of the five largest river ports of Ukraine: Dnipropetrovsk, Zaporozhye, Nikopol, Kherson and Mykolaiv. It should be noted that for transportation of 10 mln tons of agricultural products we need 400 thous. trucks, or 166 thous. cars or 2 thous. craft. Besides the cost of internal river transport is 2.2 times cheaper than motorway and 1.7 times – than railway.

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Acknowledgement

The research was carried out in the context of tasks of the scientific project: "Management over the development of agricultural markets, agrarian and ecological logistics in the system of food safety" (ID:64770 26.08.2016 (00009-1)). The project was recommended by the Scientific Council of the Ministry of Education and Science of Ukraine to be funded by the government budget.

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