UKRAINE'S POSITION IN THE GLOBAL WHEAT SUPPLY: ECONOMIC AND LOGISTIC DIMENSIONS

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Abstract
Every war interrupts ordinary economic activities and restrains products, and consequently, income flows. Comparable circumstances have occurred since the 24 of February when Russia invaded Ukraine. Most of the regular economic activity has been constrained in Ukraine. The invasion was a crucial issue for agricultural commodities, especially the cereal sector. Ukraine is among the most important producers of agricultural commodities in the world. In the cereal sector, its contribution to global production is significant for barley, wheat, and maize. Nowadays wheat supply logistics from Ukraine have become a crucial issue worldwide, as wheat and its products are the basis of people's nutrition in many countries (especially in Egipt). So, there are reasons to consider disruption's threats of the supply chain and, consequently, malnutrition and hunger in undeveloped countries.

Keywords: *food security, Ukrainian wheat export, supply logistics, logistics costs, grain storage, wheat export price, demand variability, ABC-XYZ analysis.*

Introduction

Since 24 February, concerns have existed that the continuation of war may increase food insecurity and malnutrition, not only in Ukraine but primarily in underdeveloped countries. There could have been at least two reasons for the widening of food insecurity. The first one, keeping food prices high consequently purchasing power of the population would decrease, and the second was the lack of safe logistic channels. Disruptions in supply can cause incomplete or even below the minimum level of satisfaction of need in this product. So, there are reasons to talk about the probability of a food crisis in the world.

Wheat is, along with corn and rice, one of the most widely produced and sold grains in the world. The wheat's position results from its longevity, durability, and demand for it as flour.

The main producers of wheat in the 2021/2022 marketing year remain China, India, Russia and the USA. Since 2014, Ukraine has entered the top-10 wheat-producing country. Now Ukraine is in the 7th place (Figure 4.5).

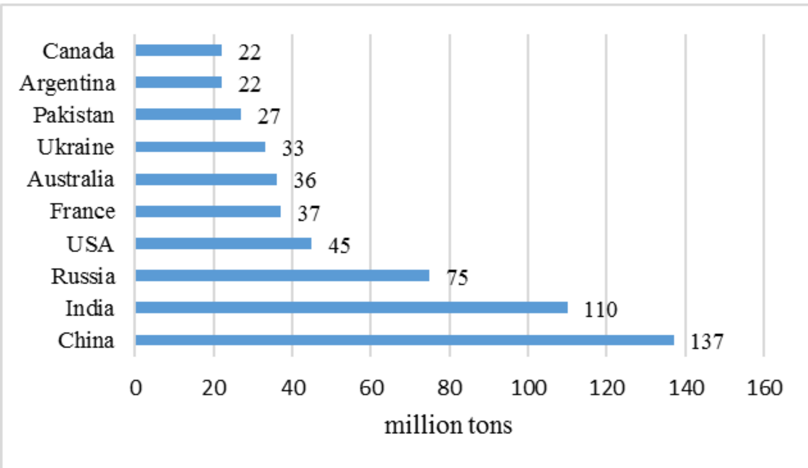

Figure 4.5 Major wheat producers in the world in the 2021/2022 marketing year

Source: latifundist.com, 2022

Because of Russia's military actions in Ukraine, according to USDA forecasts for the next 2022/2023 marketing year, world wheat production will decrease to 774.8 million tons, as it is predicted that the volume of wheat production in Ukraine will decrease by 35%, the harvesting area will decrease and the yield will be significantly lower (latifundist.com, 2022).

According to wheat export indicators in the 2021/2022 marketing year, Ukraine is in the top-5 country (Figure 4.6). China, the main producer of wheat was not included in this list, as almost all grain is sold within the country, and no more than one million tons of wheat is exported. India, another powerful producer of wheat, being ready to compensate for insufficient delivery from Ukraine, limited exports because of abnormal heat and partial loss of the harvest. So, the wheat supply system undergoes changes not only due to economic, political, military factors, but also due to uncontrollable natural and climatic factors. And an important task should be to establish a supply system for Ukrainian wheat, including its remnants from the past harvest, in order to maintain the required level of food security in the world.

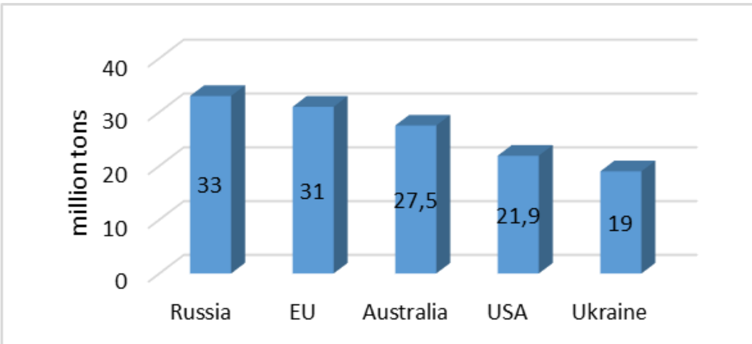

Figure 4.6 TOP-5 wheat exporting countries in 2021/2022 marketing year

Supply logistics involves not only the consumer needs meeting but also achieving maximum economic efficiency for both parties, the manufacturer and the buyer. From this, the purpose of the article is to develop a model of the Ukrainian wheat supply chain in conditions of war in the context of groups of importing countries on volume and stability of supplies, taking into account the factors that affects the way both parties act to ensure food security in the world.

The tasks of the research are:

– to indicate the role of Ukraine on the global wheat market;

– to rank the importing countries of Ukrainian wheat on the results of the ABC-XYZ analysis;

– to identify the groups of countries that at the time of war between Ukraine and Russia are the most dependent on Ukrainian wheat supplies, and which provide the main share of Ukrainian exports;

– to reveal the changes that took place in the logistics system of Ukrainian wheat supply after the beginning of the war.

Materials and Methods

The article aims is to develop a model of the wheat supply chain from Ukraine to ensure food security in import-dependent countries under war conditions. The importing countries were divided into groups, according to volume and stability of supplies. The ABC-XYZ-analysis method was used to divide the importing countries of Ukrainian wheat into groups based on the volume of purchases and the level of fluctuations in demand for grain. ABC-XYZ analysis is a method of grouping planning objects based on their value and dynamics of consumption or sales. During the analysis, the planning objects are assigned one of the classes of ABC and XYZ simultaneously. The ABC-XYZ analysis method is used to optimize economic decisions and strategies in enterprises as well as in the national economy. Taking into account the aim of the article, there were also used quantitative methods. Those methods were employed to emphasize objective, statistical measurements for example volume of production as well as export and import of wheat. Quantitative research was focused on gathering statistical data from official institutions the Food and Agriculture Organization and the State Statistics Service of Ukraine, as well as analytical reports of agricultural and financial organizations.

Results and Discution

In Ukraine during 2010-2021, the share of wheat exports in the total volume of production increased from 28 to 70%, or from 4 to 20 million tons. Since the beginning of the war about 4 million citizens have left Ukraine, so domestic demand for wheat will be reduced and this allows to increase the volume of exports. Stocks of wheat remain available for further export. The main reasons of the reserves formation are shown in Figure 4.7.

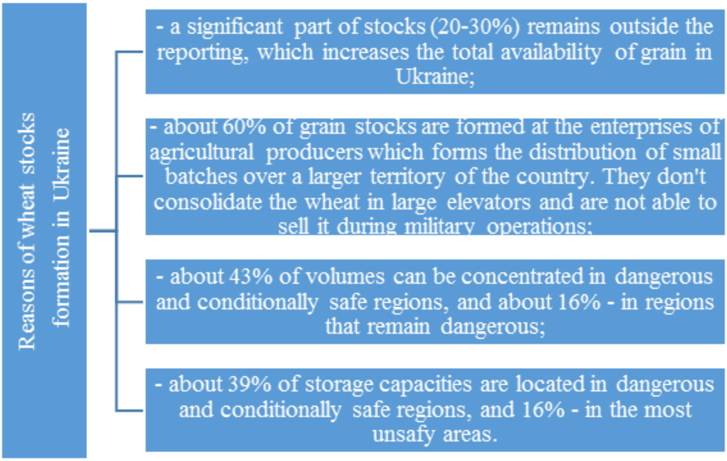

Figure 4.7 Factors of wheat stocks formation in Ukraine
Source: APK INFORM, 2022

An important factor that determines the volume of exports and the formation of demand for Ukrainian wheat is the export price. During 2010-2021, the price increased from 186 to 250 dollars per ton (34.5%). First of all, it was connected with the growth of production costs. In 2022, the factors of export price formation changed.

The price increase was influenced by the blocking of Black Sea ports through which 80% of agricultural products are exported. In such conditions the monthly export volume decreased 5-6 times from 5 to 1 million tons of grain. And logistics costs increased 5-7 times (Kurkul, 2022). If before the war Ukrainian farmers had received 80% of the value of a ton of grain, today it is only 20% (Latifundist.com, 2022). Therefore, the need to cover logistics costs became the reason for the price increase.

The increase in logistics costs is associated with the increase in the price of fuel and lubricants, an increase in the distance of transportation, the need to tranship grain from Ukrainian broadgauge wagons to European narrow-gauge wagons. There was also a need for longer storage of grain during its transportation and customs clearance. And foreign partners, which carry out transshipment and transportation of Ukrainian wheat, raised the cost of their services by 3-7 times (Tkachev, 2022).

After the partial unblocking of the Black Sea ports at the end of July, there were no significant price changes. There is no complete guarantee of safe transportation of goods, and therefore insurance companies are reluctant to take responsibility for their insurance. And expectations of future supply disruptions are also pushing up the price.

It should be noted that the export price growth was slowed down due to the formation of large temporary wheat residues inside the country and the desire of farmers to sell them in order to free up capacities for the new crop. The favorable weather for the development of spring grain crops also contributed to the price reduction.

Such countries as Indonesia, Lebanon, Libya, Thailand, Tunisia, the Philippines, and the Republic of Korea remain the main importers of Ukrainian wheat for a long time. During 2019-2020, Bangladesh and Egypt increased the share of Ukrainian wheat in the import structure. And Israel, conversely, in 2020 reduced purchases of Ukrainian wheat, although in previous periods its share reached 40%.

These countries are most dependent on imported Ukrainian wheat: their share in the total wheat demand of the countries ranges from 15 to 95%. For example, in Lebanon, this share increased from 22 to 87% (Figure 4.8, line D(%)). In 2020, Lebanon had a total need for wheat of 770,549 tons (140,000 tons of domestic production and 630,549 tons of imports), including 669,663 tons of wheat purchased from Ukraine. That is, Ukraine provided almost 90% of Lebanon's wheat needs. But the share of Ukrainian wheat exports to this country in the total Ukrainian wheat exports (E(%)) remained at the level of 2-4%. It is profitable for Lebanon to purchase smaller volumes in Ukraine than to load large ships from other countries. So such countries need to be paid attention to in order to ensure their food security.

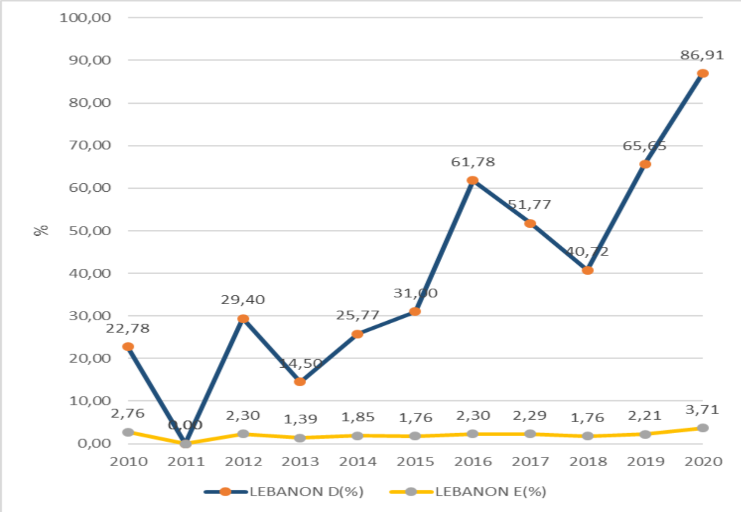

Figure 4.8 Dynamics of the share of Ukrainian wheat in the total demand in Lebanon (D(%)) and the share of Ukrainian wheat exports to this country in the total Ukrainian wheat exports (E(%))

Source: State Statistics Service of Ukraine, (2010-2021); Food and agriculture organization, 2022

According to the logistics concept of supply both consumer and manufacturer must satisfy their needs and obtain the necessary level of economic efficiency. So the main part of orders should form the large batches. Such orders can cover logistics costs. And orders for small batches should make up an insignificant share.

The major customers of Ukrainian wheat are Bangladesh, Egypt, Indonesia, and Thailand. Table 4.1 shows the dynamics of the share of Ukrainian wheat in the total demand of countries (D(%)) and the share of Ukrainian wheat imports in each country in the total Ukrainian wheat export (E(%)).

According to Table 4.1, the listed countries, except Israel and the Philippines, increased supplies of Ukrainian wheat until 2019, reducing the volume of their own production and supplies from other producers. In 2020, grain supplies decreased due to expectations of a good wheat harvest, as well as high transitional residues. However, these countries remained the leading importers of Ukrainian wheat.

Table 4.1

The dynamics of the share of Ukrainian wheat in the total demand of importing countries and the share of Ukrainian wheat imports in the total Ukrainian export of wheat

Importing country / Period	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BANGLADESH D(%)	10,1	2,9	-	7,4	10,1	16,2	27,3	24,7	15,4	40,8	21,5
BANGLADESH E(%)	8,6	2,9	-	4,4	4,2	6,3	10,5	11,4	5,6	11,4	8,4
EGYPT D(%)	4,4	2,0	12,5	9,9	14,2	8,9	11,8	12,5	6,7	18,6	17,0
EGYPT E(%)	16,1	9,0	29,1	25,2	27,0	13,4	13,4	15,4	8,5	17,7	17,0
ISRAEL D(%)	27,0	22,0	39,6	18,5	21,6	35,3	28,6	29,7	28,5	25,7	16,4
ISRAEL E(%)	10,1	9,1	8,9	3,8	3,7	4,3	3,0	3,0	3,4	2,3	1,6
INDONESIA D(%)	-	-	-	4,0	4,2	13,1	20,1	19,7	25,8	27,6	26,4
INDONESIA E(%)	-	-	-	3,5	3,0	7,2	11,8	11,9	15,9	14,8	15,1
LEBANON D(%)	22,8	-	29,4	14,5	25,8	31,0	61,8	51,8	40,7	65,7	86,9
LEBANON E(%)	2,8	-	2,3	1,4	1,8	1,8	2,3	2,3	1,8	2,2	3,7
THAILAND D(%)	-	-	-	21,9	28,1	37,2	43,4	29,4	20,1	31,5	18,2
THAILAND E(%)	-	-	-	5,0	4,1	12,6	11,1	4,6	3,5	4,3	3,1
PHILIPPINES D(%)	7,1	-	-	9,6	9,7	19,0	20,4	15,9	26,2	14,2	10,3
PHILIPPINES E(%)	2,7	-	-	3,0	2,6	4,8	5,3	5,1	10,7	5,1	3,5

Source: State Statistics Service of Ukraine, (2010-2021); Food and agriculture organization, 2022

Israel and the Philippines, on the contrary, reduced supplies of Ukrainian wheat. During the years 2010-2019, Israel supplied 20-40% of its domestic demand for wheat due to supply from Ukraine, and in 2020, Ukraine's share decreased to 16.4%. Thus, Ukraine lost part of the market, and Israel's share in the structure of wheat exports decreased from 10% to 1.6%. Although in 2021 and 2022, Israel doubled its imports of Ukrainian wheat again. Such supply instability may lead to a loss by Israel the priority in the Ukrainian wheat supply system.

The Philippines increased its dependence on Ukrainian wheat in 2016 and 2018 to 20-26%, and in 2020 this share decreased to 10.3%. Rice becomes an equivalent substitute for wheat in the country. The share of the Philippines in Ukrainian exports during 2018-2020 decreased from 10.7 to 3.5%, in 2021 the trend was similar and deliveries from Ukraine decreased by 35%.

ABC-XYZ analysis was conducted to identify strategically important wheat customers for Ukraine.

According to the results of the ABC analysis, the groups of countries on export volume were formed. The largest share of Ukrainian wheat exports is made up of orders from Egypt and Indonesia, 16.5 and 15%, respectively. The next countries are

Turkey, Pakistan, Bangladesh and others. Countries like Nigeria, Vietnam, Iran and others are in Group B. Italy, Tanzania, Sri Lanka and others are in Group C.

XYZ-analysis allows to divide importing countries into groups depending on the stability of their demand for wheat. According to the results of the analysis, four countries were included into the group X with the most stable demand for Ukrainian wheat: Indonesia, Morocco, Egypt and Yemen. The countries of Libya, Lebanon, Tunisia, and Israel are included into the group Y with an average level of demand variability. Mexico, Italy, Turkey, Thailand, the Philippines, Bangladesh and others showed the least stable demand during the analyzed period. Most countries have unstable demand for Ukrainian wheat (group Z).

As a result of combination of ABC analysis and XYZ analysis, a matrix was received (Figure 4.9).

	A	B	C
X	EGYPT INDONESIA MOROCCO YEMEN	BX	CX
Y	TUNISIA LEBANON LIBYA	ISRAEL	CY
Z	TURKEY PAKISTAN BANGLADESH SAUDI ARABIA ETHIOPIA PHILIPPINES REPUBLIC OF KOREA	KENYA THAILAND NIGERIA VIETNAM IRAN (ISLAMIC REPUBLIC) OMAN Djibouti MEXICO MAURITANIA ALGERIA SPAIN	ITALY TANZANIA, UNITED REPUBLIC SRI LANKA JORDAN MOZAMBIQUE SUDAN UGANDA SOMALI

Figure 4.9 ABC-XYZ matrix of importing countries

According to this matrix, such countries as Egypt, Indonesia, Morocco and Yemen, which are included into the AX group, and Tunisia, Levan, Libya, which are included into the AY group, are strategically important partners for Ukraine, as they have stable demand for Ukrainian wheat and provide the main share of supplies from Ukraine.

Such countries as Israel (group BY), Turkey, Pakistan, Bangladesh, Saudi Arabia, Ethiopia, the Philippines, the Republic of Korea (group AZ), have medium demand and are also important for Ukraine, as they place orders for significant supplies of Ukrainian wheat.

The rest of the countries, such as Kenya, Thailand, Nigeria, Italy, Tanzania, have unstable supplies in small volumes. Based on the experience of these countries, they can partially rely on their own production or diversify supplies from the list of countries which are the most profitable for them in terms of price, quality, distance and other delivery conditions.

As the issue of food security is acute today, placing a certain country into the ABC-XYZ group of the matrix can be done not only by the level of its priority in wheat supplies. Financial, social, demographic indicators of the country's development, climatic conditions of own wheat cultivation, geographical location relative to possible suppliers, etc. should also be taken into account. For example, if in the 2020/2021 marketing year, Turkey planned to reduce wheat imports waiting for a good harvest, then next year it plans to increase imports because of drought and giving up the main supplier – Russia.

Considering the previous experience of the cooperation of the importing countries of Ukrainian wheat with its direct producer Ukraine, their state of development, the conditions of their own wheat cultivation, it can be concluded that Ukraine remains a strategically important supplier for these countries. However, it is necessary to take into account the new changes that have taken place in the logistics system of grain supply from Ukraine (Table 4.2). The analysis in terms of such factors as optimal transportation routes, terms of payment, choice of transport mode, grain storage conditions, insurance was conducted.

According to Table 4.2, the price of the ukrainian wheat supply system increased during the war. Therefore, the price remains an important factor in grain sales.

Table 4.2

Characteristics of changes in the logistics system of the Ukrainian wheat supply during the war

Before the war in Ukraine	During the war in Ukraine
Transportation routes	
The export by sea prevailed, seaports accounted for 80% of the agricultural products export. Most of the wheat was sent to countries in the Middle East and Africa, such as Egypt.	Transportation by land and rivers prevails. Most of the Ukrainian grain is taken to Europe.
Choice of transport	
The using of water transport prevailed.	The transition to the use of rail and road transport has occurred.
Grain storage conditions	
The total volume of operating grain storage capacity is 75 million tons.	Only 45% of warehouses remain active and free; temporary polyethylene grain sleeves, handling equipment and longer-term modular storage are used.
Cargo insurance	
Insurance in accordance with international rules and conditions of delivery	Insurance companies are not ready to insure on the territory of Ukraine, as it is not known whether the safety of the Odesa region will be guaranteed when the ports are opened.
The structure of logistics costs	
Logistics costs are 20% of the price. The cost of transshipment is 5-6 euros.	Logistics costs are almost 80% of the price. One fifth of the logistics costs are the railway costs, the rest are the costs on border terminals, Romanian and Polish carriers, transshipment terminals. The cost of transshipment is 25 euros.
Terms of payment	
A significant part of Ukraine's grain agreements are the forward agreements.	The volume of forward contracts is higher than last year. After the expiration of the contracts, they are re-signed with the adjustment of the wheat price in force majeure conditions.

Source: based on Latifundist.com, 2022; Tkachev, 2022; Ministry of Agrarian Policy and Food of Ukraine, 2022; European business association, 2022; Food and agriculture organization, 2022; Lebid', 2022; Agropolit.com, 2021

It is expected that the next 2022/2023 marketing year the imports in Africa, Southeast Asia and the Western Hemisphere will increase. At the same time most of the world's leading wheat producers will have smaller yields because of fertilizer shortages and hot weather. So, both sides – the customer and the supplier are forced to review contracts, to diversify supplies, and also to change the policy of formation and use of temporary wheat residues.

As of August 12, 2022, threshed 3.8 million hectares of wheat, harvested 15.4 million tons of corn, the yield is 40.1 t/ha (Slovo i dilo, 2022). Therefore, the volume of harvested wheat is 52% less than the 2021 harvest. Last year wheat residues amountes to 6 million tons. The domestic use of wheat before the war averaged 8 million tons, including 4-4.5 million tons for consumption. Taking into account the fact that about 4 million citizens of Ukraine have gone abroad and the fact that because of occupation, the cultivated areas have decreased by 20-30%, the consumption of wheat will decrease. No more than 10 million tons of the threshed 15.4 million tons can be sent for export, that is, half of the level of the previous year in 2021.

As of August 2022 during the operation of the grain corridor, it was possible to export more than 650,000 tons of wheat (Slovo i dilo, 2022) from Ukraine to seven countries (South Korea, Italy, the Netherlands, Lebanon, Turkey, China). In the previous year, more than 2 million tons were already exported during this period. Transient wheat residues need to be sold more quickly, since their further storage affects the quality.

Conclusions

Ukraine is among the most important producers of agricultural commodities in the world. In the cereal sector, its contribution to global production of wheat in 2020 reached 3.7 percent.

Making general conclusions, it should be noted that wheat supplies both from Ukraine and from other countries are subject to changes because of the need to ensure food security. Each producing country will limit exports, and importing countries, in case of insufficient supplies, will be forced to consider an alternative to wheat, for example, corn and corn flour. Thus, China, worried about the growth of domestic consumption of wheat, limited exports and started stockpiling. Even Australia, which has already received record harvests (more than 36 million tons) for two years, and leads the USA and Canada, taking third place in the rankings of world exporters, predicts a decrease in the harvest for the 2022/2023 marketing year by 17% because of a decrease in area and yield.

It should not be forgotten that for many countries the problem of food shortages arose even before the war in Ukraine. Therefore, maximum attention should be paid to such importing countries of Ukrainian wheat so that the crisis does not turn into a dead end.

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