

# THE DIRECTIONS FOR OPTIMIZING UKRAINE'S EXPORT POTENTIAL OF GRAIN CROPS IN THE CONTEXT OF CHANGING CLIMATIC CONDITIONS

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**Abstract:** The production and yield of grain crops in Ukraine from 2000 to 2019 was analysed in the article. The comparative analysis of gross harvest and export of grain during these years was carried out and the dependence of exports on gross harvest and its share was determined. The results point out that the export of grain crops has increased over the years under research, which indicates Ukraine's significant export potential. Thus, leaving for the needs of the country from 16.0 to 36.6 million tons of grain (on average, 25.9 million tons), Ukrainian farmers export an average of 40.7% of the crop. During the period from 2000 to 2019, the gross harvest of grains in the country averaged 48.4 million tons resulting in the annual potential share of exports of at least 22.4 million tons.

It was also found that the increase in the share of exports was made possible by a qualitative change in yield, which was due to the changes in crop growing technology. However, with global warming and climate change, new challenges for agricultural producers are emerging. The recommendations were given in order to improve the crop growing technology that will allow to overcome these challenges, further increase yields and Ukraine's export potential.

**Key words:** grain crops, crop acreage, gross harvest, yield, export

## 1. Introduction

The beginning of the XXI century was marked by the increased interest in food and energy security. The favourable geographical location and acceptable natural and climatic conditions together with exceptional chernozems make Ukraine one of the most promising food producers in the world.

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Ukraine is a highly agrarian country. In 20 years, the yield of grain crops in Ukraine has tripled. It allows us to talk about Ukraine's significant export potential. At the same time, there is a number of problems, both internal and external, that do not allow our country to fully unleash its potential. Along with the military conflict in the eastern part of the country and political instability, there is a number of problems connected to the transformation of foreign trade and the integration into the EU.

## **2. Material and methods**

The aim of the study is to analyse Ukraine's export potential of grain crops, to determine the relationship between gross harvest, yield and export of grain crops, as well as to form the recommendations for determining the efficiency of Ukraine's exports, its capacity and opportunities to increase due to the transition to new technologies in the conditions of climate change.

The study was started in 2000 and finished in 2019. It has covered a period of 20 years. The data for the study was taken from the State Statistics Service of Ukraine (the Official site of the State Statistics Service of Ukraine) and the Official website of the European Union (Eurostat).

The statistical analysis methods, including MS-Office software, were used for the analytical study.

Research tasks:

- the comparison of acreage, gross harvest and grain yield during the years under research;
- the comparison of grain exports for the years under research and its share in gross harvest;
- the analysis of the obtained data and forecasting of the increase in the share of exports by finding opportunities to increase the yield of grain crops.

## **3. Literature Review**

A. Esfahani's research (Esfahani et al., 2019) aims to draw public attention to the food crisis in the world and different strategies to achieve food security in different countries. The provision of the country with grain crops forms its food security.

The change in the technology of growing crops, according to A. Barrera (Barrera A., 2011), namely the use of precision farming, changing the quality of seed, the use of technological processes to preserve soil moisture are the links of one food production chain, and are the strategy used to achieve a country's food security.

According to I. Kyrylenko (Kyrylenko, 2017), Ukraine is not a part of any leading economic formations in the world, does not have sufficiently branched bilateral economic ties, confirmed by free trade agreements. In general, Ukraine exports a significant share of agricultural products through transnational corporations, mostly without long-term agreements, and therefore at this stage of cooperation there is no stability in the agro-industrial complex to ensure the consistency of foreign exchange earnings and direct investment.

Also, at the current stage of development of the economy of Ukraine there is a question of transformation of foreign trade, which is connected, first of all, with integration into the EU (Tochylin et al., 2012; Tanchyk et al., 2012; Wysokiński et al., 2020). K. Nakonechna (Nakonechna et al., 2018) claims that the Ukrainian agricultural sector with production potential that far exceeds the needs of the domestic market can become a driving force in the development of the national economy, but it is not possible without moving to international quality standards and loosening of customs regimes for Ukrainian products.

At the same time, in connection with the expansion of the free trade zone between the EU and Ukraine, the reorientation of the market after the annexation of Crimea and the military conflict in the eastern part of the country, there is an urgent need to analyse Ukraine's grain exports, to determine its efficiency and its possibility of increasing. The dependence of grain exports on its yield in the context of climate change also needs to be analysed. The growing technologies that were used earlier can no longer ensure the increase of yields.

Thus, determining the efficiency of Ukraine's grain exports in the context of modern integration processes and climate change is an urgent problem.

The group of grains includes three botanical families: cereals, legumes, and buckwheat. That is, the seeds of these crops are as follows: cereals have caryopsis, buckwheat has nucula and legumes have seeds.

Historically, the main grains in Ukraine are winter crops: wheat, rye, barley, triticale, the acreage of which averages 7-8 million hectares. The yield of a crop depends on natural and man-made resources (Mostipan et al., 2019; Mostipan, 2017).

Natural factors include potential (natural) soil fertility, provision of plants with moisture and heat, the level of receipt and use of photosynthetically active radiation by the crops. However, the natural factors in Ukraine have changed significantly, especially climatic (because of the warming), during the studied period. The climate is changing and it has to be taken into account when growing crops. The introduction of the so-called ecological and adaptive technologies for growing field crops, in particular, winter crops is one particularly important direction to develop in this situation (Mostipan et al., 2019; Mostipan, 2017; Barrera, 2011; Makhanova, 2015). Their use will significantly increase the resistance of plants to adverse environmental conditions, which will ensure sustainable grain production. In return, this may be a reliable basis for concluding long-term contracts for grain exports to other countries.

#### **4. Results and Discussion**

The grain production in Ukraine is mainly concentrated in forest-steppe and steppe zones. Along with fertile soils, the main limiting factor for the yields of all field crops, including grains in these areas is the lack of moisture. Due to the climate change that took place in recent decades, the relevance of this factor is increasing. In the steppe zone, droughts during the sowing of winter crops are becoming more frequent, thus significantly affecting not only the acreage of these crops, but also the yield. The yield of grain crops is also influenced by the following factors: seed quality, timely and quality

sowing, even stands, productive tillering and sufficient carbohydrate contents in plants. That is, without a gradual change in the growing technology, the use of more reasonable selection of varieties suitable for growing in adverse moisture conditions, and possibly the use of irrigation, it is impossible to further increase the yield of grains.

As we see (fig. 1), the acreage of grain crops has remained almost unchanged since 2000, resulting in the average acreage of grain crops over the years under research of 14.9 million hectares.

At the same time, the gross harvest of grains was different, but the general trend remained the same. The gross harvest increased every year, except during the extremely unproductive years: 2000, 2003 and 2007. In 2000 and 2007, the acute drought took place in the main regions of Ukraine that are engaged in grain production, which once again emphasizes the importance of regulating the water regime of grain crops for the purpose of sustainable grain production.

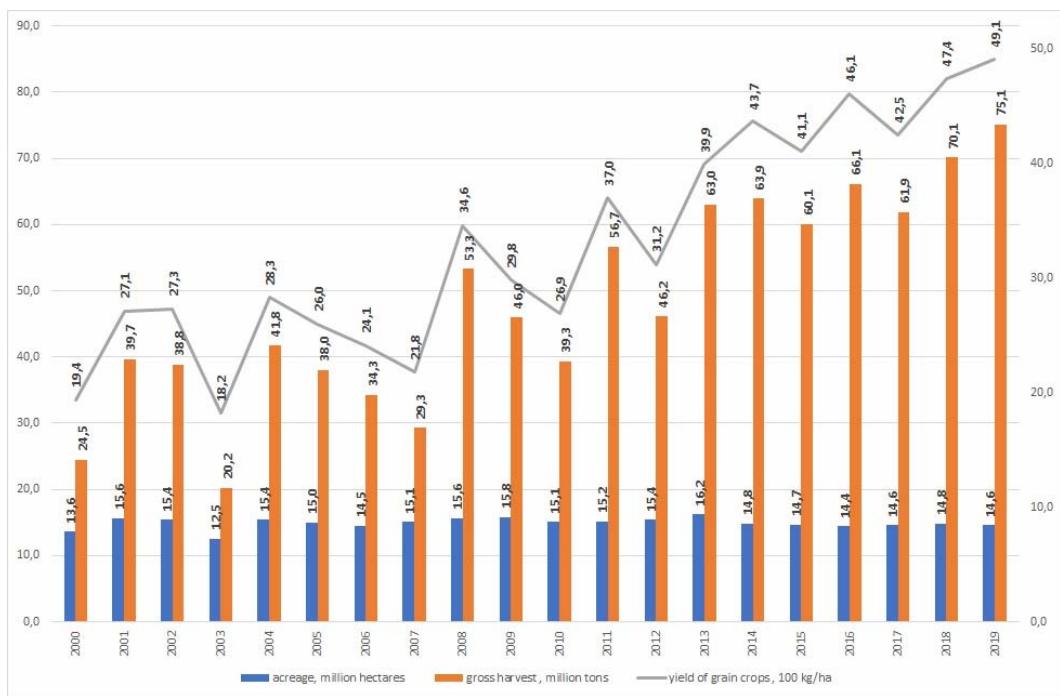


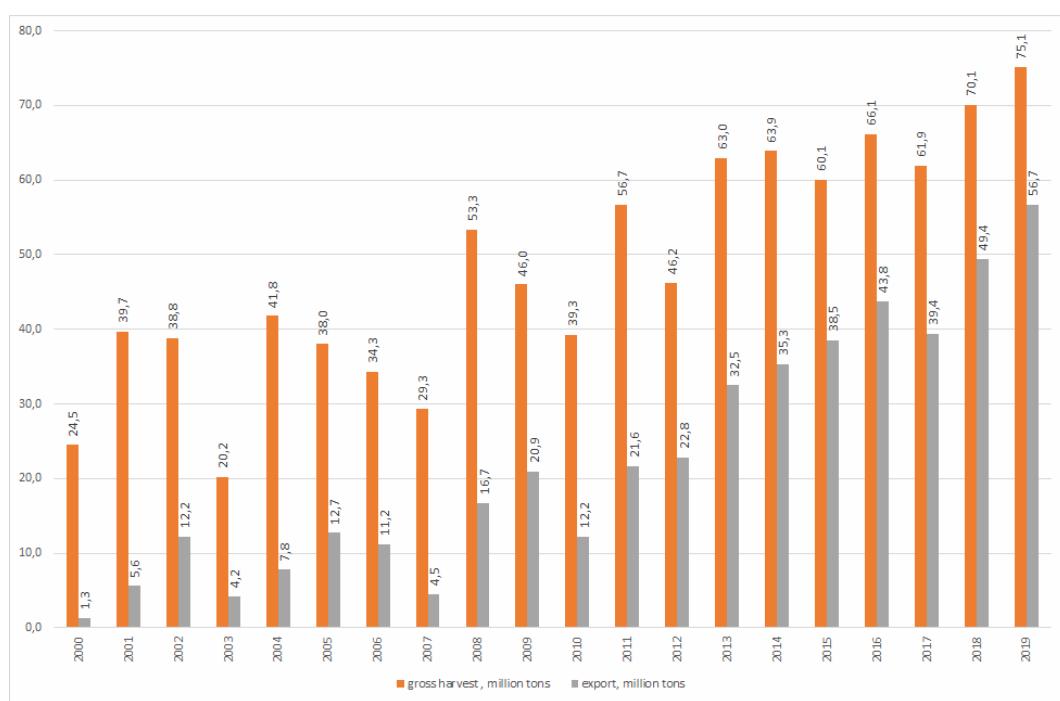
Fig. 1. *The dynamics of acreage, gross harvest and yield of grain crops in Ukraine for 2000-2019 (the Official site of the State Statistics Service of Ukraine)*

From 2000 to 2019, the value of the gross harvest has increased from 24.5 million tons in 2000 to 75.1 million tons in 2019. Thus, with an almost constant acreage of grain crops, there was a significant increase in their gross harvest, namely, 3.06 times.

Analysing the yield of grain crops for the period under research, we see the increase in yield from 1940 kg/ha in 2000 to 4910 kg/ha in 2019. The average yield of grains over the years of research was 3310 kg/ha. That is, due to the increase in yields of grain crops, as a consequence, we have the increase in their gross harvest. The rapid increase in

grain yields was due to a set of factors. First of all, the genetic resources of grain crops have changed significantly. The agrotechnology of growing has also changed significantly, primarily due to the introduction of new agricultural machinery.

The analysis of the dynamics of gross grain harvest and Ukraine's export (fig. 2) in recent years shows that leaving for the needs of the country from 16.0 to 36.6 million tons of grains (on average, 25.9 million tons) Ukrainian farmers export an average of 40.7% of the harvest. If we take into account that on average for the period from 2000 to 2019 (including the extremely low-yielding years of 2000, 2003 and 2007) the gross harvest of grains in the country averaged to 48.4 million tons, it becomes clear that at least 22.4 million tons of grain form the potential share of annual exports (Kobuta, 2010; Vasylkovska et al., 2019).



**Fig. 2. The dynamics of Ukraine's gross harvest and export of grain crops in for 2000-2019 (the Official site of the State Statistics Service of Ukraine).**

However, these are the average rates over 20 years. The grain export rate was gradually increasing every year starting from 1.3 million tons in 2000 and ending with 56.7 million tons of grain in 2019. If we compare the data for each year and find the share of exports in the gross harvest, we will see a clear dependence on its annual increase. The increase takes place not only in gross collection in numerical values, again, according to the export, but also in the increase of its share in the gross harvest. Thus, we see an increase in the share of grain exports from 5.3% in 2000 to 75.5% in 2019. The average share of exports during that period was 40.7% (tabl. 1).

That is, the share of exports has been growing every year, especially during the year of

accession to the WTO and the years of Ukraine's commitment to European integration. Ukraine's movement towards the integration to the world community and accession to the WTO has created new prospects for the development of agricultural production and the production of grain crops in particular. The transition to international quality standards has made it possible to sell quality grain at world prices. The increase in export quotas and the loosening of customs regimes contributed to the expansion of the market.

**Table 1**  
*The gross harvest, export and share of grain exports in Ukraine for 2000-2019*

Year	Gross harvest, million tons	Export, million tons	Interest, %
2000	24.5	1.3	5.3%
2001	39.7	5.6	14.1%
2002	38.8	12.2	31.4%
2003	20.2	4.2	20.8%
2004	41.8	7.8	18.7%
2005	38.0	12.7	33.4%
2006	34.3	11.2	32.7%
2007	29.3	4.5	15.4%
2008	53.3	16.7	31.3%
2009	46.0	20.9	45.4%
2010	39.3	12.2	31.0%
2011	56.7	21.6	38.1%
2012	46.2	22.8	49.4%
2013	63.0	32.5	51.6%
2014	63.9	35.3	55.2%
2015	60.1	38.5	64.1%
2016	66.1	43.8	66.3%
2017	61.9	39.4	63.7%
2018	70.0	49.4	70.6%
2019	75.1	56.7	75.5%
Average value	48.415	22.465	40.7%

(the Official site of the State Statistics Service of Ukraine, )

The world consumption will also increase due to the increase in the world's population and the aggravation of the food crisis. Therefore, the changes taking place in the economy of Ukraine have increased the importance of the agro-industrial complex, and hence increased the share of foreign exchange earnings from grain exports and led to opportunities for further increase in the share of such exports.

Despite the unstable situation in the country, the annexation of the Crimean Peninsula, the Joint Forces Operation, and the risk of a large-scale war with Russia, the grain traders continue to actively conquer foreign markets.

African, Asian and European countries have been the biggest buyers of Ukrainian grain during the recent years. Egypt remains the leader in the ranking of the largest importers

for several years in a row (14.1%). China (9.6%), Spain (7.5%), Turkey (7.4%), the Netherlands (6.8%), Indonesia (5.1%), Bangladesh (3.9%), Israel (3.4%), Tunisia and Italy (3.1% each) also accounted for significant shares of Ukrainian grain exports (Kyrylenko, 2017; Vasylkovska et al., 2019).

A further increase in grain exports is possible due to the increase in yield. Despite the fact that the average grain yield in Ukraine is slightly lower than the European average, there is a strong potential for grain production in Ukraine.

Increasing grain yields in the conditions of climate change and the expansion of areas with a deficit of moisture is possible through the use of the latest technologies and drought-tolerant varieties. All these things are impossible without the use of public financial instruments, namely lending to agricultural producers on favorable terms, their subsidizing and attracting investment.

All of that will provide an opportunity to improve the technology of growing crops and increase yields and as a result, increase exports and foreign exchange earnings for the country.

## 5. Conclusion

Therefore, with a constant average value of the acreage of grain crops of 14.9 million hectares over the years of research, the gross harvest tended to grow steadily, and accordingly there were prospects for an increase in the share of grain exports. This became possible due to a change in growing technology, and consequently in the increase in the yields of grain to 49100 kg/ha in 2019, which is 3 times higher than in 2000 (19400 kg/ha).

The share of exports in gross harvest also tended to increase. In 2000, the share of exports was 5.3%, and in 2019 it amounted to 75.5%. Leaving for the needs of the country from 16.0 to 36.6 million tons of grain (on average, 25.9 million tons), Ukrainian farmers export an average of 40.7% of the crop.

The study shows that Ukraine has the potential for increasing grain exports, which is facilitated by such external factors as the accession to WTO, integration processes, the orientation of market towards the EU. At present, Ukrainian grain is bought by Egypt, Western Asian countries, China, the EU and South Asia, and the interest in Ukrainian grain from Western Asia and China tends to increase.

At the same time, it was substantiated that considerable attention should be paid to the organizational and technological factors of the internal environment of agricultural producers. Due to the changing climatic conditions, there is a gradual change in the grain crops growing technology. The change in growing technology involves the transition to new agricultural units that will ensure the moisture-saving agriculture. Without the state support for agricultural production, it is impossible for farms to make a qualitative and quantitative transition to higher yields. That is, the direct support of farms by the state in the process of transition to the latest systems of growing technology is the key to increasing Ukraine's yields of grain crops and consequently its export potential.

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