Forecast of Agricultural Production in Ukraine Under Martial Law: Results of the Regression Analysis

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Abstract: Due to Russia's aggressive invasion, Ukraine is losing not only infrastructure and industrial facilities, but also sown areas. This situation will have a negative impact on food security not only in Ukraine, but also in Europe, the Middle Eastm and North Africa. According to official data of the State Statistics Service of Ukraine, regional military administrations, and from open sources, in 2022 Ukraine could not sow a significant area of crops, which according to authors' estimates could be 75%, 50%, or 25%. Therefore, the issue of providing agricultural products not only to Ukraine, but also to partner countries that import Ukrainian grains, vegetables and other crops is of practical interest. It is obvious that crop losses are significant if 75%, 50%, or 25% of the lands of a particular region are active in combat, and it is impossible to conduct a sowing campaign. The relationship between the volume of production (gross harvest) of cereals and legumes and their sown area on the basis of many years of research has been done on the basis of correlation-regression modeling for more than thirty years. According to FAO estimates, between 20% and 30% of fields used for growing crops in Ukraine, such as winter cereals, maize, or sunflower, may not be sown or will remain unharvested during the 2022-2023 season. In addition, crop yields are expected to decline by 10% due to the delayed or missed fertilizer application times, inability to control possible diseases, pests, delayed harvesting, lack of manpower or infrastructure capacity for autumn harvesting. According to Ukrainian experts, in 2022 the sown area in Ukraine is 78% of last year's figures, and the total area under crops decreased by 2.5 million hectares. In this work. made on the basis of an analytical method, the forecast of productivity in the conditions of military aggression of Russia against Ukraine at change of sown territories has been formed. Management of agriculture is now an important area that covers not only the science of food production, but also the practical activities of creating an agricultural product. A set of measures for economic stimulation of agricultural cultivation of important crops has been developed, the foundations for the development of partnership between the government and agricultural business and the population have been formed. The best principles of decentralization reform, such as the Republic of Poland in the field of agricultural production, have been applied.

Keywords: Crops, Sown area, Economy, Cereals, Legumes, Correlation-Regression Modeling, Martial Law.

JEL: Q 1, Q 13, Q17, F16, M38

Introduction

Ukraine provides grain crops to many countries around the world. Therefore, a reduction in crop yields will affect food security in the world's poorest countries. All this requires the development of a mechanism for maintaining sown areas at least at the level of 2021 in Ukraine and the joint progress of European countries against the aggression of the Russian Federation.

During the war, farmers seek to increase the area under crops and change their structure in relatively peaceful regions where there are no active hostilities. For example, this year, the farmers of Lviv region want to increase the sown area. Additionally, the areas that have been deforested will be used. The total sown area will be over 707 thousand hectares. In particular, spring crops are planned to be sown on an area of 440 thousand hectares, which is 5 thousand hectares more than last year. The structure of sown areas will depend on the supply of imported resources and parts for agricultural machinery. In case of shortage of imported seeds, farmers will sow those crops whose seeds are in stock.

The main *objectives* of this work are the integration of different knowledge of the field of cultivation and evaluation of economic indicators of sales of agricultural products and research from different sectoral, managerial, military, political, economic points of view and the development of an effective system for crop yields in modern military conditions of Ukraine, including the introduction of international experience in food security in the context of sustainable development. The *object* of this article is the sown area and yield of grain crops in Ukraine in the current state of martial law during the Russian aggression. The *subject* of research is the process of overcoming the food crisis based on the combined efforts of Poland and Ukraine, as well as the development of international trade between Ukraine and the European Union. The main *purpose* of this article is to establish the relationship between simple sowing of cereals and yield, as well as forecasting yields in Ukraine in the near future for different authors' scenarios of sowing areas – 75%, 50%, and 25%. Important for Ukraine is Poland's positive experience in developing international trade and improving food security, comparing the economic performance of the two countries and developing recommendations for promoting food security and overcoming the food crisis.

Theoretical premises

As the world population grows, global food production is projected to double by 2050 to feed the population. All this requires an increase in the harvest and the search for new areas for planting agricultural crops. In addition, the cultivation of agricultural products faces the negative impact of such factors as climate change, the reduction of biodiversity, the deterioration of soil and water quality, and the demands of the world market are steadily growing. New effective mechanisms for stimulating the activities of farmers in the cultivation of agricultural products are needed. It is worth noting that, at the same time, EU agricultural policy has changed significantly in recent years in line with the need to help farmers overcome these challenges and respond to changing attitudes and expectations. The current EU agricultural policy covers a wide range of areas and instruments, including economic, organizational, food quality, traceability, trade and promotion of EU agricultural products. Developed countries promote and protect the development of agricultural business. The EU has long supported its farmers financially and encouraged sustainable and environmentally friendly farming, as well as a significant increase in investment in rural development. EU institutions cooperate in the formation of food and agricultural policy, its implementation, monitoring and evaluation. National and local authorities form and enforce laws agreed at the EU level. Through the EU budget, funds are provided to member states in accordance with rules established at the EU level. The EU also monitors how these laws are applied, how effective they are, and coordinates the necessary overdue changes (Vibrant rural areas and quality agricultural products, 2022).

As noted by scientists W. Edwards, P. Duffy, existing problems related to the state of the environment and climate significantly affect the state of agricultural production. Because the cultivation of crops has always involved exploitation of resources such as water, soil and energy. Challenges regarding the necessary increase in production must be overcome to feed the growing world population. This must be done while preserving resources for future generations, so it is worth finding such sustainable methods of farming. At the same time, farmers should be aware of the need to preserve the environment, have a long-term view of tireless methods of soil cultivation, when deciding which technologies to use and which products to produce. Farmers cannot and should not give up profit, so they

need to find a balance and adapt their production methods according to the sustainable development of their territories (Edwards W., Duffy P., 2014).

Researchers K. Garbach, F.A.J. DeClerck emphasize that hydrological services, namely flow regulation and the need for water treatment, must be considered when growing agricultural crops. In their opinion, in general, agricultural production depends on many ecosystem services, primarily water-related, from water supply to water quality and treatment and flood protection. Because agroecosystems are the main consumers of groundwater and surface water, they account for approximately 70-90% of freshwater use worldwide. Scientists consider irrigation to be the main consumptive use of water, as water is not returned directly to rivers and streams (Garbach K., DeClerck F.A.J., 2014).

Russia's military aggression against Ukraine makes fundamentally new demands on the spring sowing campaign in Ukraine in 2022. According to FAO estimates, between 20% and 30% of fields used for growing crops such as winter cereals, maize or sunflower in Ukraine may not be sown or remain unharvested during the 2022-2023 season. In addition, crop yields are expected to decline by 10% due to the delayed or missed fertilizer application times, inability to control possible diseases, pests, delayed harvesting, lack of manpower or infrastructure capacity for autumn harvesting (Проблемні аспекти посівної кампанії в Україні, 2022). Management of agriculture is now an important area that covers not only the science of food production, but also the practical activities of creating an agricultural product. This concept is quite broad and also includes farming techniques, domestication of animals, and general food processing. There is a lot of agricultural work that requires guidance, especially on projects that work in scientific disciplines and with agricultural work. Given the changing dynamics of world food production, this area is now one of the fastest growing in the world.

Literature Review

A large number of scientists have studied and are currently studying ways to provide the population with food produced by agriculture. Agro-industrial production of the crop industry occupies a prominent place in the structure of consumption. David Leclere believes that climate is now one of the promising factors in European agricultural production. According to the researcher, the demand for agricultural products will increase with the

increase of the world's population and the share of disposable income. Global trade in agricultural products will also increase, and ongoing research and development will help increase agricultural yields. Future agricultural harvests will also be affected by such factor as climate change (Leclere, D., 2022).

Moreover as M. Kriesberg points out; in LDCs the consumer frequently spends in excess of fifty percent of the household's income on basic foodstuffs – much of which is inadequate both in quality and nutritional content. By contrast Americans on food spend approximately twelve percent of their total disposable income. In Western Europe the figure ranges from about sixteen to nineteen percent of disposable income. Furthermore, whereas in developed countries the poor are relatively few in number, and therefore it is economically possible to establish special food distribution programmes to meet their needs, the scale of poverty in most LDCs is such that the commercial marketing system must be relied upon to perform the task of food distribution to poor and not-so-poor alike. This being so, it is imperative that the marketing system performs efficiently (Kriesberg, M., 1974). G. Dixie suggests that as countries experience economic growth, their rate of urbanisation tends to increase substantially (Dixie, G., 1989). Famous scientist P. Rosson conceives of agricultural and food marketing systems as consisting of four main sub-systems: distribution, production, consumption and regulatory (Rosson, P., 1974). P. Kotler emphasizes that: "ost firms practice the selling concept when they have overcapacity. Their immediate aim is to sell what they can make rather than to make what they can sell". There is no denying that 'high pressure selling' is practiced, where the interests of the consumer are far from foremost in the mind of the seller (Kotler, P., 1988).

The EU produces around 300 million tonnes of cereals per year and it is traditionally a net exporter. Cereals in the EU are not only used for food and feed, but also as feedstock for the bio economy (European Commission, Agri-food data portal).

Methodology

This paper analyzes the impact of the transformation of the agricultural production regime, the dynamics of sown areas on the efficiency of agricultural production of farmers based on the model of correlation-regression analysis, classical theory of division of labor and specialization, transaction costs and cooperation. The work is based on real statistical

indicators of agricultural production and their analysis of data for 1991-2021. The methodology of the statistical survey is the official data of the State Statistics Committee of Ukraine. The model of agricultural production allowed to predict the yield of grain crops under martial law in Ukraine. Such a long-term model should be used when assessing food security indicators for management decisions and regulating the area of land allocated for different crops. The methodology of this article is based on the correlation-regression model of the dependence of crop yields on their sown areas in compliance with national security indicators. Farmers involved in the agricultural division of labor and cooperatives are transforming their agricultural production from a traditional self-sufficient way to a specialized and intensive one. The agricultural division of labor, measured by farmers' participation in the agricultural division of labor at the stages of production or in agricultural production, and agricultural cooperatives, measured by farmers' participation in farmers' cooperatives, have a significant and positive effect on their agricultural production after endogenous adjustment. The originality of the work is based on a unified basis for the analysis of the impact of the transformation of the regime of agricultural production of farmers on the efficiency of their production in modern military conditions in Ukraine. The methodological basis of this article is the publications of domestic and foreign scientists in the field of agricultural production and public administration.

An interdependence between the volume of production (gross harvest) of cereals and legumes in Ukraine and their sown areas on the basis of correlation-regression modeling (years 1991-2021) has been detected. The relationship between the volume of production of cereals and legumes in Ukraine and their sown areas in is close to linear, so in this case, as a relationship between variables, it is advisable to choose a linear function.

The selective linear regression function in this case will look like:

(1) $$\hat{y} = b_0 + b_1 x$$

whereas $\hat{y}$ – estimation of mathematical expectation of the dependent variable model (volume of production (gross harvest) of cereals and legumes in Ukraine); *x* – independent model variable (sown areas of cereals and legumes in Ukraine); *b*, *b* – selective regression parameters.

The research methodology is based on the assessment of international trade between Ukraine, Poland, and other European Union countries in order to assess the current

state and place of agricultural production of cereals and legumes. According to EU concepts and definitions, non-EU trade statistics (trade between the EU Member States and non-EU countries) do not record exchanges related to transit goods placed in customs warehouses or temporary admission (for fairs, temporary exhibitions, tests, etc.). This is known as “special trade”. The partner is the country of final destination of the goods for export and the country of origin for import.

Results

In many developing countries, including Ukraine, agriculture is the largest separate sector of the national economy. Agriculture typically employs more than 50 % of the workforce, and industry and trade depend on agricultural resources as a source of raw materials. It is obvious that the development of agriculture and marketing systems that affect it are the basis of the process of economic growth of each state. Economic development itself gives impetus to more sophisticated and effective marketing systems. While population growth rates in developing countries average about three percent per year, their cities increase their population by about four percent annually. Of course, this means that the number of people in cities in need of agricultural products will double in a quarter of a century. This has clear implications for agricultural production and marketing systems that direct this production and distribute products to places of consumption. The value of subsistence farming is likely to decline as farmers respond to the opportunities offered by development and urbanization. As a result, the number of farms will decrease with a simultaneous increase in their size; and agriculture is likely to become less labor-intensive and more capital-intensive (Agricultural and Food Marketing Management, 2022).

In 2022, in the conditions of the Russian war, Ukraine managed to sow a significant area of crops. Of course, compared to 2021, all indicators of crops in the territories are significantly lower. The area under sunflower is 4.27 million hectares (87% of the planned 4.93 million hectares), corn – 4.41 million hectares (91% of 4.85 million hectares), spring barley – 928.4 thousand hectares 91% of 1.02 million hectares), spring wheat – 189.3 thousand hectares (99.7% of 189.6 thousand hectares), oats – 156.9 thousand hectares (96% of 163.6 thousand hectares). peas – 125.9 thousand hectares (86% of 145.7 thousand

hectares). The sown area under potatoes in Ukraine in 2022 is 1.11 million hectares (93% of 1.19 million hectares), soybeans – 1.15 thousand hectares (92% of 1.25 million has), sugar beet – 182.1 thousand ha (88% of 206.9 thousand ha), spring rape – 31.7 thousand ha (plan implemented), millet – 41.3 thousand ha (66% of 62.3 thousand ha), buckwheat – 57.7 thousand hectares (70% of 81.6 thousand ha). It is noted that the sown area has already amounted to 78% of last year's figures, in which 16.92 million hectares were sown. Also, according to the Ministry of Agrarian Policy, in 2021 winter crops were sown for the 2022 harvest on a total area of 7.7 million ha, including 6.5 million ha of winter wheat, 1 million hectares of barley and 0.16 million hectares wheat. Throught the war, about a third of the area could not be sown, but sown areas could be increased if the fields were cleared of destroyed military equipment (Посівна в Україні підходить до завершення, 2022).

In Ukraine, the sowing campaign in 2022 has a number of important features:

1. the need to reseed frozen crops, which are expected to be in demand in domestic and foreign markets (especially socially important cereals);
2. restricting the export of certain food groups (oats, millet, buckwheat, sugar, rye) introduced by Ukraine in connection with the martial law;
3. inability to conduct field work in those areas with active hostilities (southern and eastern regions of Ukraine);
4. violation of the logistics of supply of fuels and lubricants, fertilizers, and seeds for field work;
5. change in regional domestic demand due to the relocation of a significant number of people forced to flee their homes due to active hostilities and the destruction of social infrastructure.

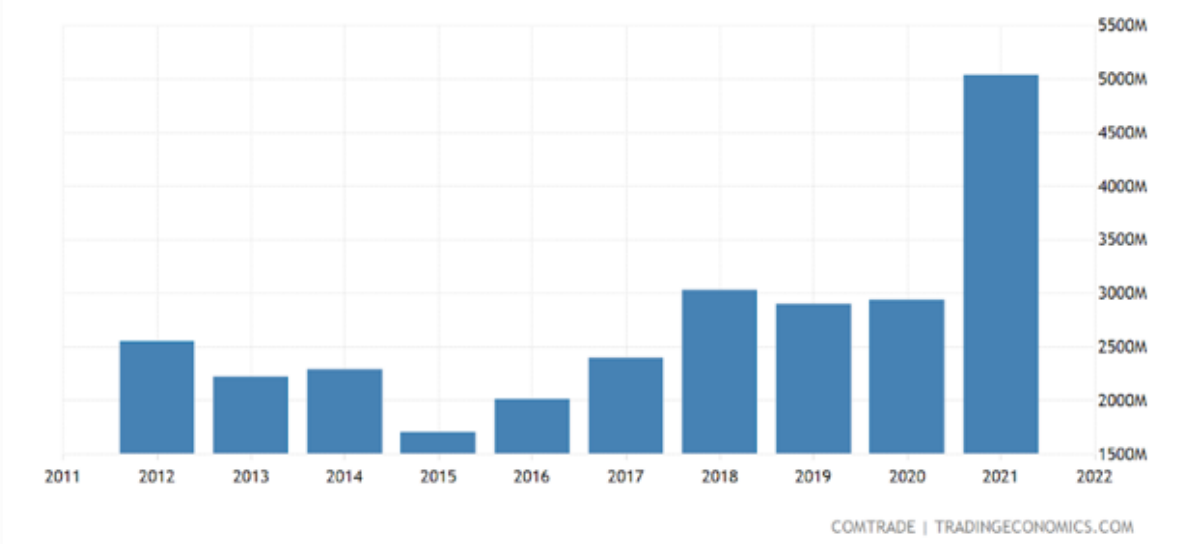
Thus, the sown area of winter crops for the harvest of 2022 in Ukraine as a whole was 0.5% higher than in 2021. Rapeseed crops increased by 39.7%, while the area under other winter crops decreased: wheat – by 2.6%, rye – by 34.9%, barley – by 10.4%. The structure of sown areas of winter crops for the harvest of 2022 has been investigated. Sown areas of winter wheat for the harvest of 2022 in In Sumy region the area of crops was 2.6% of total crops in Ukraine Odessa – 8.4%, Mykolaiv – 6.7%, Kherson – 7.0%, Kharkiv – 8.8%, Zaporizhia – 10%, in total it is 43.4%. The sown area for the harvest of winter rye in 2022 in general in the specified areas makes 11,4% (Kharkiv and Kherson – 2.1%, in the Sumy – 5.1%;

Nikolaev area – 0,1%, Odessa – 0,4%, Zaporizhia – 1,7%), barley – 65.8% (in Sumy – 0.4%, Kharkiv – 1.3%, Zaporozhye – 8.2%, Kherson – 10.8%, Mykolaiv – 20.0%, Odessa – 25.2%), rape – 40.7% (in Kharkiv – 1.1%, Sumy – 2.0%, Kherson – 7.2%, Mykolaiv 8.3%), Zaporizhia 8.8%, Odessa 13.2%) of the total in Ukraine.

In 2021, the EU countries remained the main supplier of agricultural products to Ukraine. In 2021, Ukraine imported 8.2 billion $ worth of agricultural products, 19% more than in 2020, when imports amounted to 6.9 billion $. Total imports from these countries reached 4,217 million $ (3,554 million $ in 2020). The share of EU products in the structure of total agricultural imports last year was 51.6%. Although purchases from other regions increased, the absolute and relative rates of imports from those regions were much lower. Imports of food products from Asia amounted to 1,533 million $ (18.7% of total imports), from Latin America – 634 million $ (7.8%), from CIS countries at 343 million $ (4.2%), and from Africa at 342 million $ (4.2%) (Ukrainian imports of agricultural products, 2021).

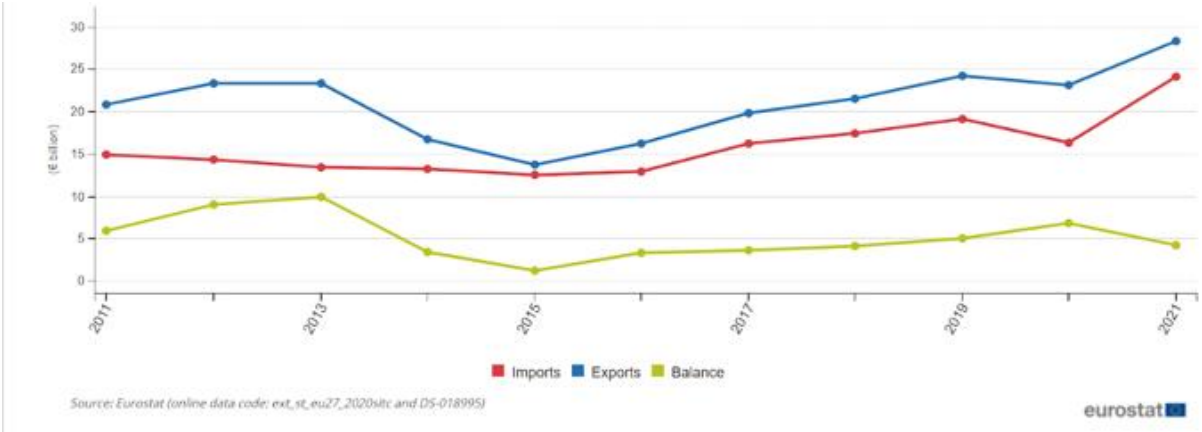
According to the United Nations COMTRADE database on international trade (Poland Imports from Ukraine, 2022), Poland imports from Ukraine amounted to 5.04 billion $ during 2021 (Fig. 1). In 2021, Poland has imported from Ukraine cereal, flour, starch, milk preparations and products for the total value of 15,55 mln dollars. The exports, imports and trade balance between the EU and Ukraine have been analyzed from 2011 to 2021. EU exports to Ukraine were highest in 2021 (28 billion €) and lowest in 2015 (14 billion €). In 2011, the EU had a trade surplus with Ukraine of 6 billion €. The trade surplus remained throughout the whole period, reaching 4 billion € in 2021. EU imports from Ukraine were highest in 2021 (24 billion €) and lowest in 2015 (13 billion €). Both exports to and imports from Ukraine increased between 2011 and 2021 (Ukraine-EU – international trade in goods statistics, 2022). The analytical data show that 58.6% of products exported from Ukraine were bought by importers in: China (14.4% of the global total), Poland (7%), Russia (5.5%), Turkey (4.9%), Germany (4.2%), India (4%), Italy (3.9%), Netherlands (3.7%), Egypt (3.3%), Belarus (2.7%), Hungary (2.5%), and Spain (also 2.5%).

Figure 1. Dynamics of Polish import from Ukraine, 2012-2021



Source: from the data (Poland Imports from Ukraine, 2022).

Figure 2. Dynamics of international trade between European Union and Ukraine, 2011-2021



Source: from the data (Ukraine-EU – international trade in goods statistics, 2022).

A sovereign state in Eastern Europe, Ukraine exported 68.9 billion $ worth of goods around the globe in 2021. From 2020 to 2021, the value of Ukraine's exports accelerated by 33.4%. The five most valuable exported products from Ukraine generated 41.9% of the Eastern European country's total international sales in 2021. At the more detailed 4-digit Harmonized Tariff System (HTS) code level, Ukraine's top money-making shipments were for: iron ores or concentrates, sunflower-seed or sanfflower oil, corn, wheat and semi-finished products made from iron or non-alloy steel. That dollar amount reflects a 51.7% increase since 2017. Based on the average exchange rate for 2021, the Ukrainian hryvnia depreciated by 2.6% against the US dollar since 2017 and fell by 1.2% from 2020 to 2021.

Ukraine's weaker local currency makes its exports paid for in stronger $ relatively less expensive for international buyers (Ukraine's Top 10 Exports, 2021).

In this work, an interdependence between the volume of production (gross harvest) of cereals and legumes in Ukraine and their sown area on the basis of correlation-regression modeling (1991-2021 years) has been detected (table 1).

Table 1. Regression model of interdependence between the volume gross harvest of cereals and legumes in Ukraine and their sown area (1991-2021 years)

Results (indicators) of modeling	Sowing area of agricultural crops (cereals and legumes), thousand hectares (*x*)		Volume of production (gross harvest) of agricultural crops (cereals and legumes), thousand tons (*Y*)		
Yield forecast for 2022, thousand tons (*Y*)		60198,38	**1991**	14671 (*x*)	38674 (*y*)
Year	**1992**	**1993**	**1994**	**1995**	**1996**
x	13903	14305	13527	14152	13248
y	38537	45623	35497	33930	24571
Year	**1997**	**1998**	**1999**	**2000**	**2001**
x	15051	13718	13154	13646	15586
y	35472	26471	24581	24459	39706
Year	**2002**	**2003**	**2004**	**2005**	**2006**
x	15448	12495	15434	15005	14515
y	38804	20234	41809	38016	34258
Year	**2007**	**2008**	**2009**	**2010**	**2011**
x	15115	15636	15837	15090	15724
y	29295	53290	46028	39271	56747
Year	**2012**	**2013**	**2014**	**2015**	**2016**
x	15449	16210	14801	14739	14401
y	46216	63051	63859	60126	66088
Year	**2017**	**2018**	**2019**	**2020**	**2021**
x	14624	14839	15318	15392	15995
y	61917	70057	75143	64933	86010
Indicators	**df**	**SS**	**MS**	**Fisher's Cr. (*F*)**	**Significance *F***
Regression	1	3266775247	3266775247	17.89677884	0,00021328
The rest	29	5293493484	182534258.1	F_{cr}	4.182964
Total	30	8560268731		t_{cr}	2.045229642
Standard Error	***t*-Statistics**		***P*-Meaning**	**Coefficients**	**Upper 95%**
6.936926579	–3.072099665		0.004590022	b_o=–122541	–40960,3178
0.186223649	4.230458466		0.00021328	b_1= 11.424812	16.94817679
Multiple Correlation coefficient *R*	**Coefficient of Determination *R*-square**		**Normalized *R*-square**	**Standard Error**	**Observations of Analysis**
0.617755	0.381621		0.360297	13510.52	31

Source: own work.

The authors estimate the planned harvest of cereals and legumes in Ukraine according to three scenarios. Such scenarios are possible due to forecasts of yield in Ukraine for the near future for various sown areas – 75%, 50%, or 25%. Based on modeling, the authors calculated the yield forecast for 2022, which is 60.2 million tons in regular conditions. So, then we calculate on this basis the amount of harvested crop in martial law: 75% (45.1 million tons); 50% – 30.1 million tons; 25% – 15.1 million tons.

According to the results of Table 1, the correlation model obtained in this study of the dependence of volume of production (gross harvest) of cereals and legumes in Ukraine and their sown area on the basis of correlation-regression modeling (1991-2021 years) has the form:

(1) $$Y=–122541x +11,43$$

To find estimates of the parameters of the model *b*, *b* used the value of the sowing area of agricultural crops (cereals and legumes) and volume of production (gross harvest) of agricultural crops in Ukraine, for 1991-2021. As a result of calculations, the values of the model parameters were obtained *b*=–122541; *b*=11.423. Since Fisher's criterion is *F*=17.896, which is more than its critical value of *F*=4.183, the model is adequate and statistically significant. Since the values of *b*=–122541 and *b*=11.424812 are greater than its critical value, *t*=2.045, which also confirms the adequacy and significance of this regression model.

The degree of closeness of the linear relationship between the model variables was estimated using the correlation coefficient (*R*=0.62), it was concluded that there is a close linear relationship between the indicators of the model.

The scientific result of this study is that the authors were able to predict the yield of crops in Ukraine in 2022, which will be 60.2 million tons. This is much less than in 2021. However, given the loss of sown areas under martial law in Ukraine, the actual harvest will be even smaller and will range between 50-75%, according to the authors, it will be only a 30.1-45.15 million tons. Under the conditions of martial law in Ukraine, the growing agricultural crops have deteriorated. The area of crops has decreased, there are crop losses due to drought, rodents, it is difficult to harvest under of mining fields by Russian aggressors. The sowing campaign was significantly complicated in Ukraine in 2022, the price of plant growth stimulants, pesticides, and herbicides increased significantly. This is an extremely unfavorable situation that will hinder the export of these crops to the markets of the

European Union and other countries. Due to the decrease in harvests, there is a threat of a humanitarian disaster, a decrease in the volume of exports of products of the agricultural sector, and there remains a threat of famine in poor countries due to the non-export of finished products and crops.

Summary, recommendations

The authors summarize the state of the agricultural production of Ukraine in conditions of war in order to implement the best Polish experience. The results of the analysis show that the Poland has developed trade relations with world countries, but needs to import quality Ukrainian grain crops. Therefore, today it is extremely important to preserve and increase the Ukrainian grain harvest in the face of Russian aggression to avoid famine in poor countries.

The authors predict the yield of crops in Ukraine in 2022, which will be 60.2 million tons in regular conditions. Given the loss of sown areas under martial law in Ukraine into account, the actual harvest will be even much smaller (50-75%), it will be only a 30.1 - 45.2 million tons. This is an extremely unfavorable situation that will hinder the export of these crops to the markets of the European Union and other countries. According to the authors' estimates, the planned harvest can fluctuate to three scenarios of yield in Ukraine for various sown areas – 75%, 50%, or 25%. So, the amount of harvested crop: 45.1 million tons (75%); 30.1 million tons (50%); 15.1 million tons (25%).

During seasonal field work, it is proposed to use agricultural machinery on a cooperative basis, in particular at the level of inter-municipal cooperation, to increase the intensity of equipment use by attracting IDP who have relevant practical knowledge as operators of machinery. Today, in conditions of uncertainty, storage and primary processing of agricultural products are of special importance in Ukraine. Therefore, in this aspect, it is advisable to use the results of decentralization and increase the capacity of communities, as happened in the Republic of Poland at the time. In particular, it is necessary to conduct an inventory of the property complex transferred to the ownership of communities in order to possibly re-profile individual facilities for storage, refrigeration and other facilities for storage and primary processing of agricultural raw materials in them.

According to the Ministry of Agrarian Policy of Ukraine, sowing in 2022 is the most difficult in the history of independent Ukraine. It began later, due to the long winter and the destruction of oil depots by Russian missiles and troops. This paper develops measures to improve agricultural production. In particular, the most important thing today is to buy basic means of production: fuel, mineral fertilizers, plant protection products. According to the Ministry of Agrarian Policy and Food of Ukraine, mineral fertilizers have already been purchased in proportion of 80%. It is worth noting that this is enough to get a yield above average. In such circumstances, public-private partnership programs will be effective in addressing food security in Ukraine and around the world. The authors of the article also propose to develop a state program to compensate for interest on loans to cover any costs associated with agricultural activities. State regulation of agricultural activities is also essential. After all, the government will supply fuel and lubricants to enterprises that agree to sow crops defined by the state, as well as forward state and local purchases of new crops. All this will allow adjusting the structure of sown areas of crops in accordance with the priorities of meeting the domestic and foreign markets with important social foods.

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