

ORGANIZATIONAL AND ECONOMIC FACTORS FOR INCREASING THE SUSTAINABILITY OF GRAIN PRODUCTION IN UKRAINE

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Abstract

The purpose of the article is to solve the following tasks: to analyze the trends of grain production and to determine the optimal indicators of the enterprises for the production of grain; to conduct an analysis of the influence of state regulation instruments on ensuring the sustainability of grain production; to substantiate directions of leveling economic risks of growing of cereals on the basis of diversification of production, harmonization of national standards of Ukraine on grain, insurance of price and natural and climatic risks. The study of the economic information was held and the sustainability of grain production was carried out. It is determined, that the next important component of the economic sustainability of grain production in agricultural enterprises is to ensure the high quality of manufactured products. The methodical approach of the complex estimation was made.

Keywords: *agricultural enterprise, grain crops, risks, stability, state regulation.*

JEL Classification: *O 13, Q 17*

1 Introduction

The reference of crisis phenomena in agricultural production leads to a decrease in the level of intensity, which, in turn, leads to a deterioration in the sustainability of grain production in agricultural enterprises. The intensity of grain production is reflected in increasing the return on costs, increasing production volumes for

each unit advancing in the production of resources and improving quality, which contributes to economic sustainability. Increasing the sustainability of grain production should be carried out not only due to quantitative increase of resources, and above all - their rational use, as well as search for ways to ensure the effectiveness of state support to the industry, the use of the benefits of specialization and concentration of production, diversification, and the formation of a risk management system in agricultural enterprises, -economic factors.

2 Data and Methods

When writing the article, data from official statistics, economic reviews, monographs and scientific and analytical articles of domestic and foreign authors, and the reporting of certain agricultural enterprises for the production of grain were used. The processing of economic information was carried out on the basis of the use of methods of economic-statistical analysis, expert evaluations and optimization methods in the process of optimizing the specialization of grain production, the development of diversification and assessment of the impact of state regulation instruments.

3 Results and Discussion

The study found that the dynamics of changes in grain production in the world has a tendency to increase (over the past 50 years, world grain production has more than tripled), which was mainly due to higher yields. However, the intensity of the increase in the yield of cereals in the main producing countries is uneven. In accordance with the adopted classification, the vibration variables are divided into three main groups: weak, if $v < 10\%$; the average if v from 11-25%, and then significant for $v > 25\%$.

So, the average level of grain yield fluctuations is Ukraine, Australia, Russia, as the coefficients of fluctuation are equal to 22.48, 18.46, 12.26%, respectively. High stability of the grain production dynamics per unit of land is observed in China, India, France, where the coefficient of stability of yield levels exceeds 90%.

Table 1 Trend equation, volatility and yield stability indices of grain crops in selected countries of the world for 1990-2016

Countries	Trend equation	Oscillation rates		Stability factor,%	Average annual growth rate (downturn),%
		absolute, ts / ha	relative, v%		
China	$Y_{(t)} = 42,072 + 0,6588 t$	1,18	2,32	97,7	1,29
USA	$Y_{(t)} = 45,071 + 1,1248 t$	4,15	6,96	93,0	1,99
India	$Y_{(t)} = 18,522 + 0,4179 t$	0,83	3,45	96,5	1,92
Russia	$Y_{(t)} = t 13,872 + 0,3342$	2,23	12,26	87,7	1,05
Ukraine	$Y_{(t)} = t 13,872 + 0,3342$	6,51	22,48	77,5	1,05
France	$Y_{(t)} = t 65,247 + 0,3003$	3,78	5,47	94,5	0,95
Argentina	$Y_{(t)} t 23,718 + = 0,9154$	3,21	9,00	91,0	3,23
Brazil	$Y_{(t)} = t 16,544 + 1,1153$	2,33	7,50	92,5	4,13
Australia	$Y_{(t)} = t 17,662 + 0,0418$	3,36	18,46	81,5	0,92
Canada	$Y_{(t)} t 23,106 + = 0,525$	2,41	8,05	91,9	1,39

Source: Author's calculations.

In order to study the yield stability indices in agricultural enterprises, we calculated the variation indices for the main types of grain crops (Table 2).

Table 2 Calculation of yield variability of grain crops in agricultural enterprises of Ukraine for 1990-2016

Indexes	Crops	Including		
		wheat	barley	corn for grain
Average value, ts / ha	29,3	28,9	25,7	39,9
Coefficient of variation in rms deviation,%	29,9	24,2	23,3	41,1
Minimum crop yield, ts / ha	17,4	14,0	14,8	19,0
Maximum crop yield, ts / ha	50,0	41,9	38,1	72,4
Swing variation, ts	32,6	27,9	23,3	53,4
Coefficient of variation (in variational scale),%	111,0	96,6	90,5	134,1

Source: Compiled and calculated according to the data of the State Statistics Service of Ukraine.

According to the calculations in Table 2, there is an average level of yield fluctuation over barley and wheat over the period 1990-2013, and a high level of variation in maize variation. This is evidence of a significant dependence on natural and climatic factors, confirming the high correlation between maximum and minimum values. Thus, wheat is 27.9 centners / hectare, barley - 27.9, corn for grain - 53.4. Also, in our opinion, such fluctuations are also the result of the transition from extensive to intensive cultivation of grain crops by agricultural enterprises. Natural soil fertility, coupled with modern cultivation technologies, allows you to get high yields. For example, in the Dnipropetrovsk region, winter wheat can yield a yield of 5 tons / ha, winter barley - 4 tons / ha, spring barley - 3 tons / ha, winter rape - 2.8 tons / ha, sunflower-2,5 t / ha, corn - 7 t / ha, and soybeans-3 t / ha. And this despite the fact that the agricultural seasons 2015-2016 years were characterized by prolonged drought, which negatively affected the yields.

Analyzing the influence of natural and climatic conditions on the yield of the main types of grain crops, we will analyze the variation rates depending on the location in the climatic zones (Table 3).

Thus, the high level of fluctuation of corn yield on grain is observed in the Polissya zone, for all other types of grain crops and climatic zones, the average level is characteristic. This fact indicates that the introduction of modern production technologies that offset the negative impact of natural and climatic factors is a significant factor that influences the value of yield stability indices, which is especially evident in large-scale agricultural enterprises.

The results of the conducted researches indicate that with an increase in the volume of production of grain crops declines during 2006-2016, the level of yield variation is reduced. This circumstance indicates an increase in the level of technological processes in the cultivation of grain, which makes it possible to level the impact of industrial risks.

Table 3 Indicators of variation of crop yields in agricultural enterprises of Ukraine for 1997-2016

Indexes	Cereals of everything			Wheat			Barley			Corn		
	Step	Forest-steppe	Polissya	Step	Forest-steppe	Polissya	Step	Forest-steppe	Polissya	Step	Forest-steppe	Polissya
Average value, ts / ha	25,8	35,9	31,8	27,7	33,8	29,6	21,0	26,9	26,4	33,5	51,7	54,0
Coefficient of variation in rms deviation, %	14,2	19,6	15,7	11,1	15,6	18,4	11,3	18,2	16,1	14,3	22,6	30,7
Minimum crop yield, ts / ha	36,9	60,1	57,6	37,2	50,7	47,6	30,8	42,2	45,8	52,5	78,3	80,9
Maximum crop yield, ts / ha	22,7	40,5	41,9	26,1	35,1	29,2	19,5	24,0	29,7	38,2	55,7	50,2
Swing variation, %	87,9	112,7	131,9	94,3	103,7	98,8	92,7	89,1	112,3	114,1	107,7	93,0

Source: Compiled and calculated according to the data of the State Statistics Service of Ukraine.

Thus, in the last group of agricultural enterprises there is a decrease in the value of grain yield variance versus the corresponding indicators in 2006 and 2016, which is a sign of high-tech farming (Table 4).

Table 4 Dynamics of coefficients of variation of wheat yield depending on wheat production volumes at agricultural enterprises

Groups of enterprises by volume of production	Year				2016 to		
	2006	2010	2013	2016	2006	2010	2013
up to 5000	52,24	57,76	70,6	59,0	6,8	1,2	-11,6

Groups of enterprises by volume of production	Year				2016 to		
	2006	2010	2013	2016	2006	2010	2013
5001-10000	37,22	47,63	52,85	49,6	12,4	2,0	-3,2
10001-20000	32,73	39,18	49,63	44,9	12,2	5,7	-4,7
20001-50000	30,7	33,99	41,75	38,6	7,9	4,6	-3,2
50001-100000	29,64	35,39	37,95	34,5	4,9	-0,8	-3,4
100001-500000	31,57	32,38	33,87	34,0	2,4	1,6	0,1
more than 500,000	32,15	31,76	30,48	27,7	-4,5	-4,1	-2,8

Source: Compiled and calculated according to the data of the State Statistics Service of Ukraine.

In order to systematize the factors that affect the efficiency and stability of grain production in Ukraine, a correlation-regression model of yield and cost of 1 ts of wheat was constructed. For this purpose, in the first stage, we constructed a matrix of pair coefficients of correlation of yield and elemental costs per 1 hectare of sowing in agricultural enterprises using the following symbols: yield index Y - yield, c / ha; factors: X1 - seed costs per 1 hectare, UAH; X2 - fertilizer expenses per 1 hectare, UAH; X3 - costs for petroleum products per 1 hectare, UAH; X4 - expenses for payment of services of outsized organizations on 1 hectare, UAH; X5 - labor costs with deductions for 1 hectare, UAH; X6 - depreciation costs per 1 hectare, UAH.

The matrix of the pair coefficients of wheat yield correlation with all factors is given in Table 5.

Table 5 **Matrix of pair coefficients of correlation of wheat yield**

	Y	X1	X2	X3	X4	X5	X6
Y	1						
X1	0,1805	1					
X2	0,5459	0,1730	1				
X3	0,2614	0,2837	0,2273	1			
X4	0,2787	0,1459	0,1575	0,0797	1		
X5	0,2188	0,0569	0,0726	0,2295	0,0075	1	
X6	0,2611	0,0787	0,1660	0,1338	0,0035	0,1429	1

Source: Author's calculations.

The calculated pair coefficients of correlation in Table 5 indicates that there is a moderate link between wheat yield and fertilizer costs, while other cost items have a weak correlation.

In order to further study the influence of elemental costs on wheat yield, a multi-factor correlation-regression model was constructed. Parameters of the equation and their estimation were calculated by methods of statistical analysis, namely, "Regression" in the Microsoft Excel environment. The calculations of the probable boundaries use the values of the distribution tables of Fisher and the Investigator with a probability $P = 0,95$. By Fisher's criterion, the equation is statistically significant: the calculated value is 486.4 more than the table 2.65. True factors of the impact on yield are all items of expenditure per 1 hectare, calculated values of the Student criterion are higher than the 1.96 table.

The presented data show that the relationship between the values of the function and the independent variables (correlation coefficient) $R = 0.6327$, therefore, the degree of the tightness of the connection between the investigated features is significant.

The unit of measurement of simultaneous influence, caused by the variation of all factors, is the coefficient of multiple determination R^2 . The determination coefficients for individual factors of influence are calculated by the formula:

$$d_i = a_i \times r_{yx_i} \times S_{x_i} / S_y \quad (1)$$

where d_i - factor number;

a_i - coefficients of regression of the i -th factor;

r_{yx_i} - coefficient of correlation of the sign in with the so-called factor;

S_{x_i} - standard deviation of the i -th factor;

S_y -is the standard deviation of the sign Y .

According to the determination coefficients, wheat yield levels (B) by 40.04% depend on the total impact of all investigated factors, including: 0.55% of seed costs per ha (X1); on 24,91% of expenses for fertilizers (X2); 2,11% of the cost of petroleum products (X3); on 5,42% of expenses for payment of services of the third-party organizations (X4); on 3.12% of depreciation expenses (X5); at 3.94% of the labor costs (X6).

Then the total determination coefficient is:

$$0,55\% + 24,91\% + 2,11\% + 5,42\% + 3,12\% + 3,94\% = 40,04\%$$

Correlation-regression model of the dependence of wheat yield on the listed factors takes the form:

$$Y = 24,7890 + 0,0007 X_1 + 0,0039 X_2 + 0,0016 X_3 + 0,0024 X_4 + 0,0043 X_5 + 0,0035 X_6$$

The value of the coefficient of the regression equation ($a_1 = 0,0007$, $a_2 = 0,0039$, $a_3 = 0,0016$, $a_4 = 0,0024$, $a_5 = 0,0043$, $a_6 = 0,0035$) determines the coefficient of increase of the variable Y with increasing X_i on unit relative to the average. Consequently, it can be concluded that for agricultural enterprises, the increase in the cost of seeds, fertilizers, petroleum products, payment for services of outside organizations, depreciation and payment for 1 ha of seed per 100 UAH increase the yield of wheat, respectively, by 0.07; 0.39; 0.16; 0.24; 0.43 and 0.35 c / ha. The most influential factor was exposure to fertilizers. Consequently, we found the stability of the dependence of wheat crop productivity on the elemental costs of production.

At the second stage of the study, a correlation-regression model based on the cost of 1 ts of wheat (Y) and the following factors was constructed: X1 - wheat yield, c / ha ; X2 - seed costs per 1 hectare, UAH; X3 - fertilizer costs per 1 hectare, UAH; X4 - costs for petroleum products per 1 hectare, UAH; X5 - expenses for payment of services of outsized organizations on 1 ha, UAH; X6 - labor costs with deductions for 1 hectare, UAH; X7 - depreciation costs per 1 hectare, UAH.

The matrix of the pair coefficients of the cost of 1 ts of wheat with all factors is given in Table 6.

Table 6 Matrix of even coefficients of the cost of wheat

	Y	X1	X2	X3	X4	X5	X6	X7
Y	1							
X1	-0,3064	1						
X2	0,2295	0,1805	1					
X3	0,2465	0,5459	0,1730	1				
X4	0,2072	0,2614	0,2837	0,2273	1			
X5	0,2165	0,2787	0,1459	0,1575	0,080	1		
X6	0,1477	0,2188	0,0569	0,0726	0,230	0,0075	1	
X7	0,1719	0,2611	0,0787	0,1660	0,134	0,0035	0,1429	1

Source: Author's calculations.

Coupling coefficients of correlation reflect the moderate relationship between the cost and yield of wheat, costs have a weak link to the cost. The correlation-regression model of the dependence of the wheat production cost on the listed factors is constructed statistically significant (Fisher's calculation criterion $F = 693,31$).

The coefficient of multiple correlation $R = 0,7254$, hence the model explains 52.63% of the variation in cost. However, among all the investigated factors, wheat yield was found to be the most significant factor in the yield of wheat - 15.2%.

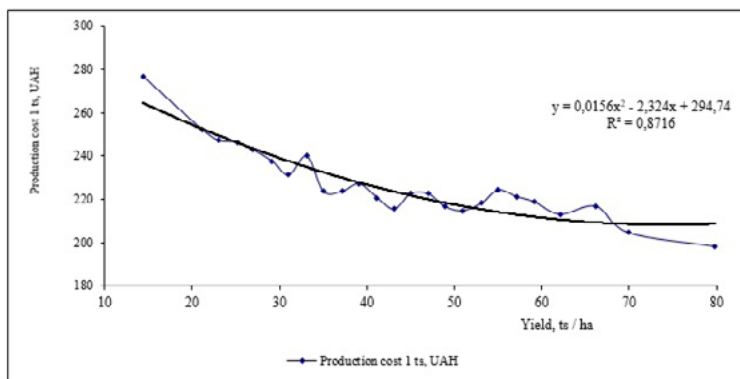
The equation of the dependence of the cost of wheat on the investigated factors has the form:

$$Y = 247,08 - 3,539X_1 + 0,026X_2 + 0,019X_3 + 0,022X_4 + 0,018X_5 + 0,026X_6 + 0,024X_7$$

The regression equation shows that the increase in wheat yield by 1 centner per hectare reduces the cost of 1 cent to UAH 3,539, with increasing costs for seeds, fertilizers, petroleum products, payment for services of outsiders, depreciation and pay for 1 hectare of sowing for 100 UAH, the cost of wheat increases respectively 2.6; 1.9; 2.2; 1.8; 2,6 and 2,4 UAH ha 1 ts.

At the third stage of the study, a correlation was found between crop yield and wheat cost (Figure 1). Dependence is described by a parabola of the second order, which shows the deceleration of the values of cost with increasing yield.

Figure 1 Relationship between yield and production cost of wheat in agricultural enterprises of Ukraine, 2016



In order to identify the optimal areas for improving the efficiency of wheat (reducing the cost of production), it is necessary to carry out a combined grouping on two main factors - production costs and yield, as they have the greatest impact on the formation of the cost of production (Table 7).

It should be noted that such a regularity of connection between production costs and productivity of production costs is observed also in the production of barley and corn.

Economic stability of grain production in agricultural enterprises depends on the level of its availability by technical means and their specific composition. They

belong to the most active part of the resource potential, which significantly affects the competitiveness of agricultural production and its efficiency. All this is connected with the rational use of other resources - fuel, electricity, own production, and others [1]. In the practical activity of agricultural enterprises, the formation and use of technical resources is in such a contradiction: on the one hand, it is necessary to provide technical resources in the necessary structure, and, on the other hand, the economy is limited in their acquisition for a long period and, accordingly, there are difficulties in their effective use. This should be considered as a condition for increasing the volume of agricultural production, improving the financial situation of agricultural enterprises, and increasing the incomes of commodity producers.

Table 7 Grouping of agricultural enterprises at the level of production costs per 1 hectare / UAH

Groups by production costs per 1 hectare, UAH	Yield, ts / ha	The share of enterprises, %	Costs of 1 hectare, UAH	Yield, ts / ha	Production cost 1 ts, UAH
to 5000	to 25	6,7	3512	16,9	207,31
	25,1-50	4,6	4142	32,9	125,83
	more 50	0,4	3702	55,1	67,22
	Total	11,7	3794	24,9	152,37
5001-9000	to 25	5,3	6205	21,7	285,98
	25,1-50	31,3	7307	36,4	200,82
	more 50	3,6	7760	57,6	134,67
	Total	40,2	7256	37,1	195,55
more 9000	to 25	0,4	10990	21,1	520,46
	25,1-50	23,7	11016	42,0	262,30
	more 50	24,0	13864	61,8	224,34
	Total	48,1	12619	53,1	237,77
In Ukraine		100,0	9986	45,1	221,42

Source: Author's calculations.

It should be noted that in the leading countries where there is a high level of production efficiency, this issue is given top priority. Over the past 15 years, the energy intensity of agricultural production in Ukraine has been reduced by 15%. At the same time, energy consumption in the USA, France, Britain, Japan decreased

by 70-78%. Energy analysis provides an opportunity to obtain a comparative assessment of agricultural technology and a complex of machines taking into account the costs of different types of energy at all stages of agricultural production [2].

The insufficient level of technical support for the production of grain determines the manifestation of technical and technological risks. Thus, 78% of the country's combine park is outside the amortized and economically expedient period of exploitation. Annual losses due to the untimely harvest of more than 6 million tons of grain, which, on average, is equivalent to 12 billion UAH [3].

According to the results of the survey, it turned out that 40.5% of respondents are conducting or trying to manage price risks, the rest - 59.5% - do not use risk management tools at all. It should be noted that respondents among the tools for managing price risks distinguish: state programs - 51%, insurance - 20%, lending on a mortgage - 18%, and forward contracts - 11%. The main instrument of insurance of price risks of grain crops by agricultural commodity producers is the conclusion of agreements with the Agrarian Fund.

An important factor contributing to the economic sustainability of grain crops is the effective state policy for agricultural enterprises - grain growers. During 2011-2017 there were tax collisions regarding the mechanism of the special VAT regime in the export of grain and oilseeds.

For producers of export-oriented agricultural products (primarily grain crops - wheat, corn, barley, and rape), it was more economically advantageous to restore the zero rate when taxing export supplies.

In the case of resumption of the zero VAT rate, when exported, the purchase price could increase as much as a percentage of VAT, which would have a positive impact on the incomes of producers of such export-oriented products. And they have an absolute majority in Ukraine - more than three quarters of the total number of agricultural enterprises. Even taking into account the cost of money for three to four months, which "hangs" financial resources of grain traders between the period of purchase of a batch of grain and the actual receipt of VAT refunds from the budget, as well as the existing risks of non-reimbursement of VAT due to the recognition of "insignificant" operations for the purchase of individual lots of grain and the cost of "persuading" the fiscal in the need to return, purchasing prices of grain traders would have increased by at least 13-15%.

Instead, the operation of a special VAT regime for producers of export-oriented products provided only about 10-11% of additional financial resources. Accordingly, the decision to abolish the special VAT regime and restore the zero rate for exports guaranteed the producers of export-oriented agricultural products at least 3-4% of additional revenues.

Given the obvious benefits for cereal producers, unity was not observed in positions - if livestock farming was of the utmost importance to maintain the special VAT regime, given the higher value added than in crop production, the recovery of export oriented producers was more urgent zero VAT rate when exporting (so-called VAT refund). Simultaneous application of special regime of VAT and zero rate regimes for export was excluded.

4 Conclusions

Consequently, the main direction of leveling out the economic risks of growing crops and ensuring the sustainability of agricultural enterprises is the diversification of the production of grain crops. Today, the diversification of the grain industry can be achieved by producing high protein crops: peas, soybeans, beans, nut and cereals: millet and buckwheat, as well as forage crops: stomatosis of the direct, stonecrosis, honeydew, alfalfa, espresso and chives.

The next important component of the economic sustainability of grain production in agricultural enterprises is to ensure the high quality of manufactured products. One of the obstacles to the sustainability of the development of grain crops is the lack of unity in standardizing the products sold between domestic and European legislation. The main directions of harmonization of the national standards of Ukraine for grain should be: harmonization of requirements to the indicators of quality; harmonization of quality control methods; harmonization of the principles of recognition of test results and certificates.

The directions of achievement and increase of economic stability of agricultural enterprises for grain production are grounded, taking into account the results of estimation of its parameters, the level of adaptation to the changing changes of the external and internal environment on the basis of modernization of the state regulation instruments of the industry and the full use of internal reserves by the commodity producers for increasing the efficiency of production, as well as strengthening information-analytical function of economic regulation. Among the instruments of a flexible system of state support and regulation of the investigated industry, priority should be given to: subsidizing interest rates on commercial bank loans; financing of targeted programs, compensation of part of the cost of grain crop insurance as a result of price and weather risks, harmonization of national standards for grain, support of export activity.

The main organizational and economic directions of ensuring economic stability of grain production at the enterprise level are: observance of scientifically grounded requirements to the structure of grain sown area taking into account

the region; development of specialization and diversification of activities, strategic and tactical planning of production.

In order to increase the effectiveness of managing the economic stability of agricultural enterprises for the production of grain, it is expedient to create an organizational subsystem within the framework of a general management system in which the important components are risk management and a system of quantitative indicators. The methodical approach of the complex estimation of the potential of the agricultural enterprise for ensuring the sustainability of grain production is proposed, which will enable the use of operational management tools such as organizational-coordinating, informational-analytical and planning, ensuring the balance of interests of structural and functional subsystems, which will increase economic stability in the long-term perspective.

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