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REGIONAL ASSESSMENT OF STABILITY OF THE IRRIGATED AGRICULTURE

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Abstract

The article examines the influence and interrelation of factors of production - capital and labor on the economic sustainability of facilities operating in the system of irrigated agriculture. The studies were conducted on the basis of statistical data of agricultural producers who use irrigation technology. The article examines a significant differentiation of the basic parameters of agricultural production (security of labor, land, material and technical resources), significantly affecting the conditions and performance of the studied farms. The relationship of production factors and the increase in the value of gross output is considered taking into account the basic performance parameters. The article uses the most universal and acceptable Cobb-Douglas production function for the agricultural production industry, which represents the interrelation of production factors - in our case for a quantitative assessment of the interrelation of fixed assets, labor resources and their impact on the sustainability of production. The results show a relative change in the volume of production, expressed as a percentage, with a relative increase in the corresponding factor of production by 1%.

Key words*: agriculture, agricultural economy, irrigated agriculture, sustainable functioning, potential*

INTRODUCTION

The ameliorative complex is a complex system, which is aimed at eliminating adverse climatic conditions that adversely affect the sustainability of agricultural production. The uneven income of agricultural products produced, not only by year but also by season, associated with the specific conditions of agricultural production, allows modern scientists to consider such negative and positive fluctuations from the position of creating opportunities to combat adverse conditions. This is, first of all, ensuring the sustainable functioning of agricultural production in a stable development of production with minimal dependence on the prevailing weather conditions [8, 9]. Thus, it is possible to assert that sustainability determines the stable development of production, including in irrigated agriculture. The stagnation of actually watered areas, deterioration of the quality of the reclamation fund, reduced operational readiness of irrigation systems, downsizing of agricultural producers and the violation of the technological integrity of irrigation systems leads to a decrease in the productivity of irrigated land [7, 10]. The need to address the pressing problems of ensuring the country's food security, achieving stability, increasing the volume and efficiency of agricultural production, reducing its negative environmental impacts has recently attracted the attention of many government bodies [13]. Assessment of the steady state and development prospects of irrigation land reclamation in Russia is relevant. The parameters of the structural units (objects) in irrigated agriculture should ensure that each economic entity sustainability and long-term normal and economically efficient farming.

MATERIALS AND METHODS

The article assesses the financial sustainability of enterprises using a system of relative indicators (financial ratios), using the method of comparisons to establish compliance of their values with regulatory restrictions. The

integral indices [2, 4] of the commercial potential (Icp) and production potential (Ipp) are calculated:

$$I_{cp} = \sqrt[3]{i_A + i_B + i_C} \qquad \textbf{(1)}$$

where: i_A – index of land potential;
i_B – index of labor potential;
i_C – index of the fixed and current assets;
When calculating indices of land and labor potentials, fixed and current assets for Icp, we used the profit indicator (P), and for Ipp – the indicator of the value of gross output.
For the construction of the production function for 30 farms with irrigated lands, the data of statistical reports on average for the past three years were used. In our case, the Cobb-Douglas production function has an appearance:

$$Y(K, L) = A \times K^{\alpha} \times L^{\beta} \qquad (2)$$

where: Y – agricultural output (gross output), thousand rubles;
A –constant which is responsible for scale number (coefficient of neutral technical progress);
K – cost of fixed capital, thousand rubles;
L – farm labour (the average annual number of the workers occupied in agricultural production), the people;
α – coefficient of elasticity on the capital;
β – coefficient of elasticity on labour.

RESULTS AND DISCUSSIONS

This section presents the calculated integral indices of the commercial potential (Icp) and production potential (Ipp) based on the methodology presented above. The cost of gross output and fixed assets are given at comparable prices with the help of deflator indices. Schematically presented factors (Fig.1) that determine the sustainability of irrigated agriculture, allow us to conclude that stably stable production within reasonable indicators provides basic resource factors in both simple and expanded reproduction.

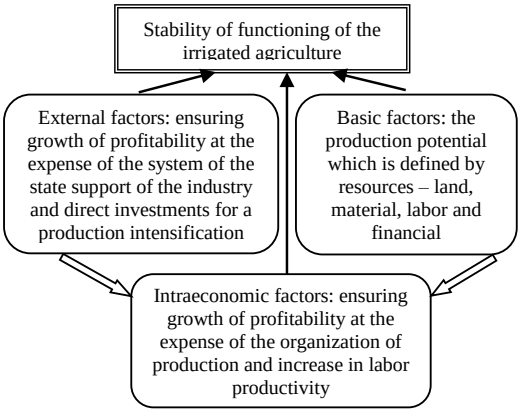

Fig.1. Factors affecting stability of the irrigated agriculture
Source: Own determination.

A group of 30 enterprises with different areas of irrigated land, typical of existing microzones of irrigated agriculture in the forest-steppe, steppe and semi-desert zones of the region, was chosen as the objects of economic research. The degree of sustainability of their functioning was assessed by means of the production potential of irrigated agriculture on the basis of indicators: the returns of the factors of production used, the structure of resources and the established cost of commercial products. Table 1 shows the grouped data of the integral evaluation of the management of the existing potential of the objects studied: the integral indices of commercial (Icp) and production potentials (Ipp) [12]. Depending on the autonomy ratio (in our case, sustainability) and the area of irrigated land, 9 groups are allocated.

Influence of resource providing on firmness of irrigated agriculture

Successful choice of production structure, sales success lead to an increase in gross product and an increase in Ipp. Businesses that did not achieve positive returns had a negative Icp. Practice has shown that preference is given to the most commercially attractive, i.e. most profitable crops. This situation is due to changes in production orientation in farms, as well as product prices. The correlation of the magnitude of the potential with the end results of operation provides a comprehensive picture of the degree of utilization of productive resources to achieve economic sustainability.

Table 1. Integrated assessment of economic stability depending on the area of the irrigated lands and autonomy coefficient

Variables (Years)		Equity Ratio								
		0.14-0.28	0.42-0.56	0.7-0.84		0.84-0.98				
		The area of the irrigated lands, ha								
		601-1,000	>1,700	1,001-1,700	>1,700	51-100	251-600	601-1,000	1,001-1,700	>1,700
		1	2	3	4	5	6	7	8	9
Index of labor potential (i_B)	2015	1.55(6.45)	0.58(11.29)	0.42(11.27)	11.62(26.61)	0.26(4.44)	-0.55(3.09)	2.01(1.28)	1.77(9.04)	1.15(6.50)
	2016	1.91(10.33)	0.87(12.40)	0.89(10.05)	13.7(34.48)	0.03(4.53)	1.99(14.73)	0.86(6.87)	1.81(13.19)	2.74(16.84)
	2017	0.84(7.80)	1.26(13.70)	0.66(10.54)	4.64(18.73)	-0.52(3.88)	0.19(17.05)	2.16(7.74)	0.81(10.26)	2.72(10.06)
Index of the fixed and revolving funds (i_C)	2015	0.13(0.54)	0.02(0.43)	0.01(0.28)	0.43(0.99)	0.03(0.51)	-0.02(0.14)	0.15(0.09)	0.09(0.43)	0.07(0.41)
	2016	0.12(0.62)	0.03(0.42)	0.02(0.25)	0.36(0.89)	0.003(0.49)	0.08(0.61)	0.06(0.51)	0.08(0.58)	0.15(0.93)
	2017	0.05(0.49)	0.05(0.49)	0.02(0.31)	0.15(0.62)	-0.06(0.42)	0.007(0.61)	0.21(0.75)	0.03(0.43)	0.19(0.74)
Index of land potential (i_A)	2015	0.13(0.54)	0.28(5.32)	0.06(1.63)	0.59(1.37)	0.07(1.10)	-0.07(0.42)	0.40(0.26)	0.09(0.45)	0.05(0.29)
	2016	0.14(0.77)	0.38(5.38)	0.13(1.45)	0.69(1.75)	0.008(1.13)	0.27(1.99)	0.17(1.37)	0.09(0.65)	0.13(0.77)
	2017	0.07(0.64)	0.62(6.79)	0.13(2.03)	0.34(1.39)	-0.13(0.99)	0.03(2.57)	0.67(2.39)	0.04(0.54)	0.19(0.71)
Integral index of the commercial potential (Icp) in the current prices	2015	0.29	0.15	0.06	1.45	0.08	-0.09	0.49	0.24	0.16
	2016	0.32	0.21	0.14	1.50	0.009	0.35	0.21	0.23	0.37
	2017	0.14	0.33	0.12	0.63	-0.16	0.03	0.67	0.10	0.47
Integral index of the production potential (Ipp) in the current prices	2015	1.24	2.96	1.73	3.31	1.36	0.57	0.32	1.20	0.92
	2016	1.70	3.04	1.54	3.78	1.36	2.62	1.69	1.71	2.29
	2017	1.35	3.58	1.88	2.53	1.17	2.98	2.41	1.34	1.74

Source: (1) Own calculation, 2015-2017; (2) in brackets – assessment is determined by the cost of a gross product in the current prices.

If there are enough resources, their inefficient use leads to a decrease in the production potential and at the same time to an over-expenditure of all factors of production [6]. The conducted studies allow us to further formalize the task of developing methods for the sustainable functioning of irrigated agriculture in the region, given that the industry is a dynamic multi-criteria system with a sectoral structure and many management parameters.

Assessment of the influence of production factors on the economic sustainability of irrigated agriculture

The objects functioning in the branch of irrigated agriculture in the region include the territories of irrigated lands - more than 257 thousand hectares (3.0% of the total agricultural land in the region). The share of the value of the main ameliorative funds is 35.5% of the fixed production assets of the agro-industrial complex of the region, which indicates a high capital intensity of production using irrigation technologies. The cycle of capital turnover in the industry is much longer than in industry, and especially in trade [5]. The most significant problem is the provision of continuous expanded reproduction of the main production and non-production assets in the industry. In accordance with the fundamentals of the microeconomic theory of production [3], the stability of the functioning of irrigated agriculture in the economic interpretation is assessed as such use of production resources, which has a direct impact on the final results of production, which does not lead to their reduction. At the same time, the interrelation of factors of production and the increase in the value of gross output must be considered taking into account the basic performance parameters. To determine and assess the factors influencing economic sustainability for the agricultural industry, we use the Cobb – Douglas production function (2) [11, 14], in our case:

$$Y(K,L) = 46{,}17 \times K^{0,49} \times L^{0,5} \quad (3)$$

An inspection of the equation on adequacy (significance) and check on adequacy of regression coefficients was respectively carried out: A=46.14, α=0.49, β=0.5>0; α+β≈1(049+0.5=0.99) – the condition is satisfied.

The results of the study allow us to draw the following conclusions. With an increase in the fixed capital by 1%, the gross output increases by 0.49%, and with an increase in the number of employees by 1%, the gross output increases by 0.5%.Since α <β, it can be concluded that in the studied period there is a saving effect, i.e. labor resources were used more intensively than fixed assets. The increase in gross production is characterized by elasticity coefficients with production factors showing a relative change in the volume of production, expressed as a percentage, with a relative increase in the corresponding factor of production by 1%. The received results are presented on graphics (Fig. 2).

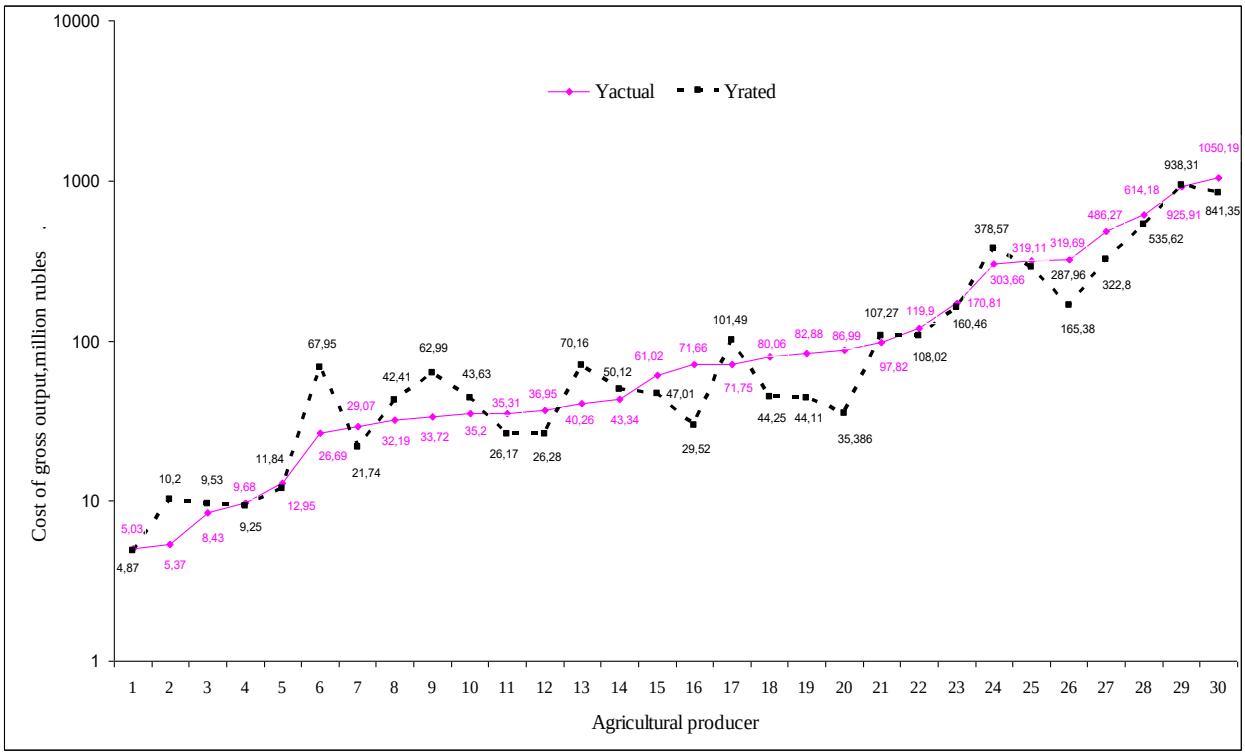

Fig.2. Dependence of sustainable functioning of agricultural producers on the volume of gross output
Source: Own calculation.

In 18 agricultural producers out of 30 studied, the actual gross output (Y_{actual}) is higher than the calculated gross output (Y_{rated}), which indicates a fairly stable functioning of these agricultural enterprises. In 12 farms, the estimated value of gross output exceeds the actual level, which indicates unused stocks of production factors (capital and labor). Thus, the calculated data allow us to predict options for the development of enterprises, to choose the most optimal size, to determine the required amount of fixed capital.

Sustainable development in relation to the agricultural sector is specified in the materials of the FAO session in Rome in 1996 [1], which is justified as increasing food production in a sustainable way and ensuring food security. N.K. Vasilyeva [15] argues that the sustainability of agricultural production requires understanding the ability of the system, under any conditions of the internal and external environment, to carry out progressively expanded reproduction to meet the vital needs of present and future generations while preserving and increasing the natural potential. F.A. Ward [16] proved that each component of sustainability has a quantitative expression in the relevant group of economic indicators. Therefore, the category of sustainability of the functioning of irrigated agriculture should be viewed as a constant process of interaction and interaction of its structural elements, in the context of the development of agricultural reproduction in

general. Accordingly, the achievement adopted at the enterprise profitability of production and preservation of the number of working personnel. This research position is confirmed by the theory of J. Hicks - E. Lindahl [5] maximum flow of total income, in terms of the economic approach, which proves that the necessary conditions for achieving optimal economic growth rates are not only efficient use, but also the preservation of productive resources, through which a social product was produced, i.e. this flow can only be produced if the total capital is preserved, with which this income is obtained.

CONCLUSIONS

The stability of the functioning of irrigated lands, as an integral part of the agricultural sector, is characterized by the preservation of agricultural land areas, without assuming a decrease in their fertility, while simultaneously obtaining the maximum economic income per unit area. The objectives of the operation are achieved by developing the industry through renewal and adaptation to a changing external environment.

In modern conditions, the main criteria for the sustainability of structural units (objects) in irrigated agriculture are the economic parameters that allow to compare the costs and profits from the sale of products, to ensure that each economic entity has a long duration of economically efficient management.

Building a production function using the Cobb-Douglas production function confirms the conclusions about the significant influence of internal factors that increase profitability at the expense of cost savings at the production and sales stages, and significantly affects the economic sustainability of irrigated agriculture. Using this production function, you can practically determine by how many percent the production will change, labor productivity, capital productivity will change when the values of resource provision are changed.

The sustainable functioning of irrigated agriculture, within the established economic indicators, is determined by the basic factors of economic sustainability, affecting the internal possibilities for the effective use of the resources available, and external conditions - market conditions of consumers and suppliers, pricing, monetary and fiscal policies of the state. Economic sustainability is determined through an assessment of its main elements, as well as factors affecting the sustainable development of the industry.

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