

Modeling the efficiency of the use of production potential

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Abstract. The efficiency of modern agricultural business depends on many economic factors, the key driver of which is the production potential. At the level of certain business entities, this is the maximum possible output of the finished product in the conditions of the achieved volume of production factors (labor, capital, land). The problems of stabilization and further production increase in the agro-industrial complex of Russia require an increase in the efficiency of the use of production potential by all participants in the agricultural business. At the same time, the major impact of digital transformation on all sectors of the country's economy changes the already established models of managing the production potential thus adapting them to modern information technologies. Therefore, in the current economic conditions, the success of the agribusiness entities largely depends on the ability to calculate, model the efficiency of the production potential use. The construction of an economic and mathematical model and the practical use of its results allows optimizing the production, material, personnel components of the production potential to ensure the maximum volume of finished products and achieve the best performance indicators.

1 Introduction

The production potential in the agricultural sector is the possibility of obtaining a certain amount of agricultural products in the conditions of the technologies in operation, and with the available amount of resources and their sufficient quality. It is very important that the resources are in an optimal combination in terms of quantitative and qualitative characteristics. The amount and size of resources must be sufficient to ensure production. They must be of the required quality as poor quality requires more resources. Structural proportionality of production potential elements shall also be maintained. At the same time, the general signs of digitalization of the country's economy lay the groundwork for improving not only technological processes for the production of goods, but also methods for ensuring its efficiency [1, 2]. Therefore, it is important to ensure the information support to manage the production potential. Thus, production, material, personnel, technical-technological and information components are critical in assessing the production potential of agricultural business participants.

The maximum efficiency of the production potential is achieved provided that all its components are balanced, which determines the need for the development of information technologies to manage the production potential on the basis of economic and mathematical modeling of its effective use [3, 4].

2 Materials and methods

The methodological basis of the study included the fundamental provisions of the scientific theory on the essence of production potential, modern research by domestic and foreign scientists. The study is based on methods used in economic science: general scientific (dialectical, analysis and synthesis, comparison and analogies), special (systemic, comparative analysis, economic and mathematical).

The information base of the study included official statistics; federal and regional regulatory legal acts; data from the Ministry of Agriculture of Penza region; author's research materials; data of Internet resources (scientific articles and works of practitioners, industry portals, economic reviews).

3 Results

The efficiency of the production potential of agricultural organizations depends on the efficiency use of its components. The main components of the production potential were analyzed based on the materials of agricultural organizations of Penza region [5].

An important condition for the efficiency of agricultural production is the provision of organizations with fixed production assets. Data on the structure of fixed assets are presented in Table 1.

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Table 1. Structure of the main production assets of agricultural organizations in Penza region, % *

Indicator	2001	2011	2015	2017	2018	2019	2020
	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Main agricultural production assets – total including:							
buildings, structures and transfer devices	74.1	44.2	51.01	49.4	50.8	51.9	53.8
machinery and equipment	15.6	43.9	40.7	42.1	41.0	40.9	39.5
vehicles	3.8	6.1	4.1	4.2	4.4	4.1	4.0
working and productive livestock	3.9	5.2	3.7	3.7	3.3	2.8	2.3
other types of fixed assets	2.6	0.6	0.4	0.6	0.5	0.3	0.4

* As of the end of the year.

The table shows that in general there is a positive trend in the main indicators characterized as an active part of production assets. In comparison with the base period, their values for “machines and equipment” and “vehicles” increased for all years of the dynamic series. The ambiguous behavior of “draft and productive cattle” indicator ultimately confirms the tendency of a gradual

decrease in the specific weight of livestock in the overall structure of production assets and the focus of agricultural production on crop production.

Despite the positive trends in the behavior of certain indicators in the structure of fixed assets, their dynamics in absolute terms is the opposite. The basic equipment fleet is decreasing every year (Table 2)

Table 2. Basic equipment fleet in agricultural organizations of Penza region, units*

Indicator	2001	2011	2015	2017	2018	2019	2020	2020 in % by 2001
Tractors	10412	2954	2885	2847	2643	2625	2720	26.1
Seeders	4460	1251	1103	1068	1224	1213	606	13.6
Mowing machines	938	399	379	331	336	311	301	32.1
Pickup presses	413	240	234	211	209	192	181	43.8
Windrowers	1561	249	211	230	226	260	227	14.5
Combines:								
grain-harvesting	3420	739	670	764	731	771	741	21.7
potato-harvesting	14	12	22	17	18	19	15	107.1
fodder harvesting	780	177	156	136	118	101	96	12.3
Beet harvesters	420	78	55	74	74	84	80	19.0
Sprinkler and irrigation machines and units	140	33	44	47	51	46	39	27.9

* As of the end of the year.

The exception is potato harvesters, the basic growth rate of which was 107.1%. For all other positions, there is a significant decrease in the number of pieces of

equipment, which makes from 2 to 7 times. As a result, the production load per 1 unit of agricultural machinery increased (Fig. 1).

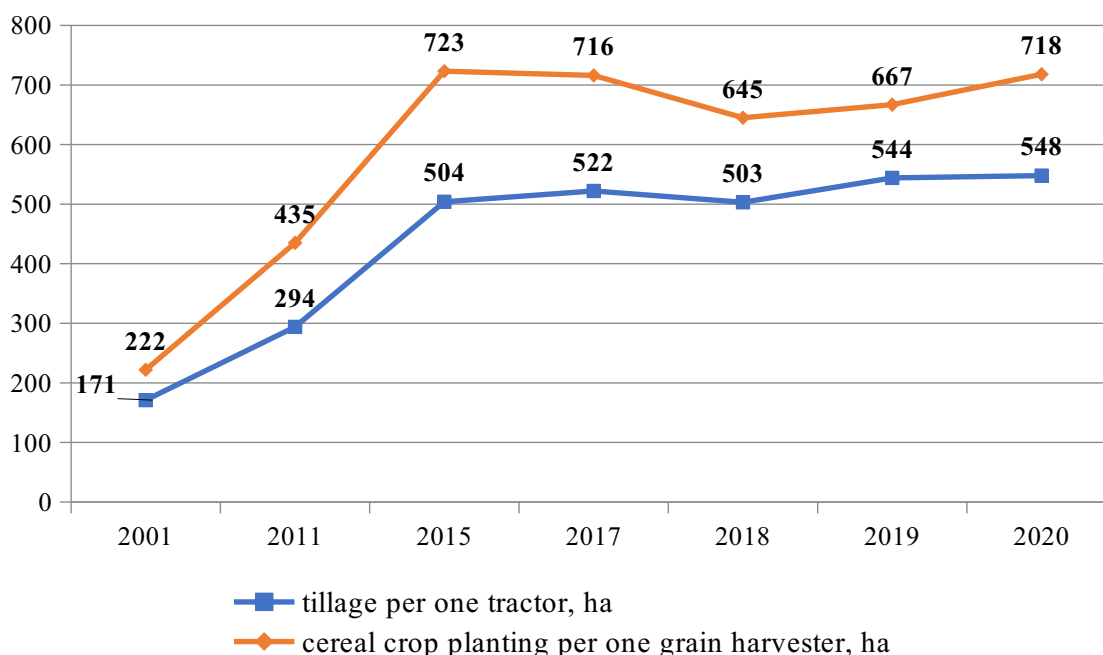


Fig. 1. Production load per 1 unit of agricultural machinery, ha

However, it should be noted that the growth of the processing area per 1 unit of agricultural machinery is caused not only by a decrease in the number of tractors and machines, but also by an increase in the area of agricultural land of Penza region over the analyzed

period by 327.8 thousand hectares, as well as an increase in the productivity of the equipment itself, due to the acquisition of new modern units.

Its material basis has a great impact on the efficiency of the production potential [6]. The current assets of agricultural organizations are shown in Table 3.

Table 3. Current assets of agricultural organizations in Penza region *

Indicator	2001	2011	2015	2017	2018	2019	2020
Current assets coverage ratio	-0.66	-0.51	-0.44	-0.37	-0.71	-1.05	-1.21
Current to personal assets ratio	0.48	1.27	1.54	1.69	1.99	2.28	2.63
Material assets coverage ratio with personal current assets	-0.95	-0.97	-1.01	-0.77	-1.56	-2.28	-2.65
Cost factor of material current assets	0.20	0.20	0.21	0.25	0.21	0.19	0.18
Current assets to asset value ratio	0.27	0.31	0.48	0.51	0.45	0.4	0.39

*As of the end of the year.

In 2001-2020 there was an increase in the share of current assets in the total assets of business entities from 27% to 39

% in agricultural organizations of Penza region. At the same time, material reserves occupied a significant share, which in different years accounted for from 18 to 25% of the value of all property. However, throughout the analysis, the increase in the share of current assets was accompanied by a significant shortage of personal current assets. The situation as a whole is such that current assets cannot be financed from personal sources of funds. This is indicated by the actual level of the equity ratio of current assets, which during the entire analyzed period did not comply with its normative value (0.1). The negative value of this indicator indicates that organizations do not have their own funds to cover the need for current assets and widely use borrowed sources for this purpose. Thus, the improvement of current assets depends on the outstripping growth of the amount of current assets compared to the overall growth of current assets, inventories and personal sources of funds.

The labor resources of organizations determine the volume and timeliness of all work, affect the efficiency of the production potential [7]. Agricultural organizations of Penza region are characterized by labor

shortage. During the study period, the number of permanent workers decreased by 46,630 people, including: tractor drivers – by 10,348 people, machine milking operators – by 4919 people, cattle workers – by 4728 people and so on. The labor resources for agricultural organizations in 2020 amounted to 19.5% of the 2001 level. On the one hand, this reduction was caused by the urbanization and mass migration of the agricultural population to the city, on the other hand – by the introduction of more advanced production technologies and a decrease in the share of manual labor [8, 9].

The reality is that high efficiency of the production potential can only be achieved by the rational interaction of all factors-resources of each level of production [10].

Therefore, in the current conditions, the problem of studying and modeling the relationship between the efficiency of the production potential and factors affecting its level becomes urgent, the role of the information component of the production potential increases.

To determine the degree of influence of each factor

and their combination on the efficiency of using the production potential, it is necessary to establish a close relationship between them based on the correlation-regression analysis. The main source in the formation of the information base was the official data of the financial statements. The analysis was carried out on the basis of 120 agricultural organizations of Penza region. The

original information array was subjected to statistical analysis. As a result, a number of factors were identified, the impact of which on the effective indicator is most significant. The effective value (Y) was the cost of gross production per 100 hectares of agricultural land. Analytical procedures were carried out based on the indicators presented in Table 4.

Table 4. Factors influencing the efficiency of the production potential of agricultural organizations*

Factor	Factor name	Factor	Factor name
X1	capital-labor ratio, thousand rubles	X5	fertilizer costs, thousand rubles
X2	energy security, hp	X6	share of subsidies, thousand rubles
X3	labor security, people	X7	feed costs, thousand rubles
X4	current assets, thousand rubles	X8	soil quality of agricultural land, ball-bonitet

*Factors are presented per 100 hectares of agricultural land.

The resulting multiple regression equation has the following form:

$$Y = -1067 + 0.051 X_1 + 0.11 X_2 + 97 X_3 + 0.21 X_4 + 1.94 X_5 + 0 \quad (1)$$

The multiple correlation coefficient $R = 0.87$ confirms a strong association between the performance indicators and the factorial features. The multiple determination coefficient $R^2 = 0.75$ indicates that 75% of variations in the performance indicators (Y) depends on the factors included in the model. The analysis of the obtained multiple regression equation showed that for the studied sample of agricultural organizations, the volume of gross production is most

dependent on such a direct impact factor as labor security. Thus, with an increase in this factor by 100 rubles, the value of production potential as a whole will increase by 97 points. The remaining factors have a significant but somewhat smaller impact on the efficiency of the production potential.

A direct indicator of the degree of the production potential is the ratio of actually achieved results to its possible (normative) value.

$$\vartheta = \frac{Y}{a^i \tilde{Y}} = \frac{a}{a^i} \quad (2)$$

Y, \tilde{Y} – actual and theoretical levels of gross production, respectively;

a, a^i – actual and normative (maximum) integral indicators of resource efficiency, respectively.

The calculations showed that none of the organizations represented in the sample uses its production potential in full. Therefore, each of them can improve its performance and increase the efficiency of the production potential due to available internal reserves.

4 Conclusion

The modeling of the relationships of factors in determining the degree of the use of the production potential is one of the vector directions for the development of information technologies in the practice of agricultural organizations. Currently, the entire agricultural business is being transformed under the influence of information technologies. The introduction of modern methods of information processing expands the boundaries of using existing databases, contributes to improving the efficiency of organizations, and gives new competitive advantages to the agricultural business.

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