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IDENTIFICATION OF ECONOMIC RESOURCES AND REGULATIONS IN GRAIN PRODUCTION

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Abstract

The issues of the agricultural sector development of the Russian Federation require a deep knowledge the relevant economic processes, including the laws and the impact of agricultural enterprises in one period on the change in the amount of resources available in the next production cycle. The study examined the composition, degree and nature of the impact of financial, production, resource indicators of grain producing organizations of the Nizhny Novgorod region on the dynamics of the amount of land, labor, financial, technical resources at their disposal next year. These indicators were collected for 55 organizations in the region in the period 2014–2017. The amount of some resources in most agricultural organizations remain unchanged (crop area), and the fluctuations in the amount of financial resources invested in production stay significant. The analysis of the composition, nature and degree of factor influence on the performance conclude there is no single set of factors affecting the change in the amount of all resources, but the most often influencing factors were the average wage (included in 4 models) and the number of staff. This indicates the special influence of human capital on the development of agricultural organizations. The universality of the applied approach is noted, due to which it can be used to analyze the patterns of reproduction in agricultural organizations with diversified production, the thesis is put forward on the possibility of using the identified patterns to develop appropriate programs for regulating the work of the grain sector in the region.

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Keywords: Reproduction, economic resource, type of reproduction, logistic regression, non-linear regression, sown area.



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1. Introduction

The analysis of research on grain production shows the increasing complexity of the analysis of processes in this industry. Thus, most studies are devoted to the dynamics of the spatial distribution (Wang et al., 2018) of grain production, trends in land structure and the impact on grain production (Ge et al., 2018), and the identification of factors affecting grain production for different regions of the country (Yu et al., 2019), a simultaneous spatial-temporal analysis of grain production (Chai et al., 2019), the structure of grain production and trade in independent countries (Wang et al., 2018) and the world research on productive grain functions (Araya et al., 2018), various economic aspects of agriculture (Duchene et al., 2019), the impact of farm type on grain production (Power et al., 2011; Wang et al., 2017). This shows that scientific community is deeply interested in studying the grain sector issues.

2. Problem Statement

There is a growing importance of information on the laws of functioning and response to external and internal influences of both the entire sub complex of the system and its individual components.

Nowadays the Russian economic environment lacks clear understanding of the laws regarding agricultural organizations, the composition of factors affecting the needed resources. The research is devoted to study and analyze this problem.

3. Research Questions

The mechanisms for supporting the activities of agricultural companies are mostly aimed at supporting their financial condition. Though the issue of resource support for the company activities is still relevant, but there is no information on the patterns of changes in the amount of resources in agricultural organizations depending on the results of the previous production cycle. In particular, the question of the structure and results of investing funds by agricultural companies of profit or trends in resource reductions in unprofitable operating results which remains unexplored.

4. Purpose of the Study

The aim of the study is to identify and mathematically formalize existing laws on changes in the number of basic economic resources at the disposal of agricultural organizations concentrating on grain production, depending on their size and results of past activities.

5. Research Methods

The research is based on the data of the annual financial statements of 55 grain producers in the Nizhny Novgorod for 2014–2017.

The independent indicators were the growth rate of indicators of the quantity and quality of economic resources (sown area, cost of fixed assets, value of production costs, number of staff and average salary). There is an influence of the amount of economic resources and the financial results of organizations in the last financial year.

The study was conducted using general scientific methods (analysis), as well as specialized mathematical methods (nonlinear regression and regression logit models). Corresponding calculations were performed using the R computer system (Rizzo, 2007).

6. Findings

A study of the correlations of dependent and independent variables showed the absence of strong relationships.

The absence of strong correlations means the absence of linear relationships between dependent and independent variables. This is due to the varying degree of variability of the parameter values in agricultural organizations. All studied indicators are divided into 2 main types – those that change for most agricultural organizations (production costs and average wages), and those that change for a smaller part of agricultural organizations.

As a result of this, it is logical to use two types of models: logit regression models to determine the probability of changes in the sown area, fixed assets, number of employees and the classical regression model to predict the new value of production costs and average wage.

The logistic regression model is a non-linear model used when the dependent variable can take only two values. Logit models were used to analyze soil properties (Piccini et al., 2019), to study the farmers' perceptions of trends in precipitation and temperature, and their influence on assessing the prospects for agricultural production (Song et al., 2019), to study the factors determining demand agricultural insurance (Sihem, 2019), bankruptcy forecasting for agricultural organizations (Boratyńska & Grzegorzewska, 2018), etc.

Models 1 and 2 evaluated the likelihood of changes in the sown area of agricultural organizations (Tables 1 and 2).

Table 01. Model 1 parameters (Logit model of the probability of changes in sown areas)

Parameter	Model equation index	Value
Constant term	-2.342	0.0124
Property assets	0.00001	0.0209
Number of personnel	-0.07871	0.0038
Land productivity	0.0838	0.02138

The probability of a change in the size of cultivated areas is affected by the amount of the organization's fixed capital, the number of personnel and the yield of grain crops. The probability of a change in the studied indicator increases for organizations with higher productivity and with a higher value of capital, but decreases for organizations with a small number of personnel. Thus, high-tech agricultural organizations with high yields are most prone to abandoning the simple type of reproduction in sown areas.

Table 02. Parameters of model 2 (Logit model of the probability of increase in sown area)

Parameter	Model equation index	Value
Constant term	-1.422	<0.0001
Grain production income	0.015	0.0154

Though there are indicators affecting the increase or decrease the number of sown areas – so, the probability of a decision to increase the sown area is affected by grain production income. According to the results of model parameters analysis zero production profitability causes the probability of transition to an expanded type of land reproduction in grain-producing agricultural institutes by 19.43 %, and within 1 % of profitability this indicator rises up to 0.3 % (Table 03).

Table 03. Model 3 parameters (Logit model of the probability of sowing area reduction)

Parameter	Model equation index	Value
Number of personnel	-0.105	0.001
1/Number of personnel	-3.493	<0.0001

The probability of a decrease in sown area is affected by the number of personnel in the organization. The model analysis shows the probability of transition to a narrowed type of agricultural activity with a small number of personnel (5–7 people) – within about 22 % (Table 04).

Table 04. Model 4 parameters (Logit model of the probability of changes in the value of fixed assets)

Parameter	Model equation index	Value
Constant term	-3.083	<0.0001
Number of personnel	0.023	0.001
Average wage	0.000023	<0.0001

The probability of value changes is mostly affected by the number of personnel and their salaries. The more workers the organization has, the higher their wage is, so the lower fixed assets of a simple type of reproduction.

Table 05. Parameters of model 5 (Logit model of the probability of an increase in the value of fixed assets)

Parameter	Model equation index	Value
Constant term	-2.611	<0.0001
Average wage	0.000177	<0.0001

According to model 5 (table 5) the average wage increase by 1 thousand rubles causes an increase of the fixed assets cost in the organization by 3–4 %. So, with an average salary of 10 thousand rubles an expanded type of reproduction of fixed capital is 30 %, with 15 thousand rubles. – 51 %, with 20 thousand rubles – 71.7 %.

Table 06. Parameters of model 6 (Logit model of probability of decreasing the value of fixed assets)

Parameter	Model equation index	Value
Constant term	-1.59	<0.0001
Fixed assets value	0.00002666	0.0082
Fixed assets value square	-0.0000000001	0.0395

The decrease probability of fixed assets value depends on the value of this indicator. For organizations with fixed assets value up to 133 million rubles the probability of transition to a narrowed type of agricultural activity increases with an increase of fixed assets value and reaches a maximum of 54 % (Table 06).

Table 07. Model 7 parameters (Model for estimating the growth rate of production costs)

Parameter	Model equation index	Value
Constant term	1.028	<0.0001
The product of the grain production profitability by the profitability of the organization	0.00007153	<0.0001
F-statistics	30.14	<0.0001

The value of production costs varies every year for each agricultural organization. As seen on model 7 (table 7), the trends in this change are affected by both the profitability of grain production and the profitability of the work of the whole organization. The simultaneous profitability or loss-making of grain production and the organization activity, an increase in production costs considers to be expected.

Table 08. Model 8 parameters (Logit model of the probability of changing the number of personnel)

Parameter	Model equation index	Value
Agricultural area	0.0004782	0.000486
1/grain price-point	-2.5259493	0.033119

Changing the number of personnel causes set of difficulties for agricultural organizations. As the index of model 8 show (table 8), the probability of a change in the number of personnel directly depends on the agricultural area and hyperbolic on the grain price-point. The greatest likelihood of implementing a simple type of reproduction of the number of workers for agricultural organizations with a large amount of sown area and with a high price of grain sales. Accordingly, a decrease in the grain price-point, the likelihood of a change in the number of personnel in the organization increases.

Table 09. Model 9 parameters (Logit model of the probability of increasing the number of personnel)

Parameter	Model equation index	Value
Constant term	-4.571	<0.0001
Grain price-point	0.23	0.00662
Average wage	0.0001357	0.00129

Moreover, according to the table 9, the price directly causes the increase in the number of employees, as well as their average wage. Within the same conditions, an increase of wage by 1000 rubles will positively affect the productivity of workers by 3–4 %.

The main indicator in the transition of organizations to a narrowed type of production activity is the grain production profitability. For organizations with zero profitability the grain production income stays 37.5 %, for organizations with a loss ratio of 10 % – more than 41 %, for organizations with a profitability of 10–34 % (Table 10).

Table 10. Model 10 parameters (Logit model of the probability of reducing the number of personnel)

Parameter	Model equation index	Value
Constant value	-0.5065	0.00373
Grain production income	-0.01447	0.01148

Table 11. Model 11 parameters (Model for estimating the average wage growth rate)

Parameter	Model equation index	Value
Constant term	1.226	<0.0001
Wage	-0.000026	<0.00010
Grain Productivity	0.0013	0.000282
F-statistics	14.27	<0.0001

According to the model 11 (table 11), the growth rate of wages is directly affected by productivity (an increase of 1 centner per hectare increases wages by an average of 0.13 %). There is also an inverse connection between the growth rate of wages and its size – the more wages the organization has, the lower the growth rate.

7. Conclusion

According to the models above the study reveals the following trends in the reproduction of resources in agricultural organizations of the Nizhny Novgorod which conducts the grain production only:

- successful technological organizations (high cost of fixed assets, small number of personnel, high productivity) are prone to stability of the sown area;
- all other organizations make a decision on increasing the sown area at high production profitability, and on the reduction, depending on the number of personnel in the organization. As the calculation showed, organizations with 5–7 employees are most prone to reduce sown areas;
- the average wage also influences the choice of the strategy of fixed assets – agricultural organizations with a large number of personnel and high wages mostly choose simple reproduction of fixed capital, while there is an increase in an expanded strategy of reproduction of fixed capital along with an increase in wages. This indicates that grain producers having small but highly paid personnel invest in main budget;
- the probability of a simple type personnel activity is greatest for small-sized agricultural organizations with a low price of grain sales. At the same time, the decision to expand the staff is affected by the high price of selling grain and the high salary of employees, and the decision to reduce the staff is affected by the profitability of grain production.

In general, the identified trends and patterns of reproduction of the economic resources in agricultural organizations indicate the complex, multidimensional and multifactorial dependencies that determine the development strategies of grain producing regions. This is one of the most important issue when developing appropriate regulatory programs.

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