Empirical evaluation of state support measures for the agricultural industry in modern practice

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Abstract. The article presents the results of the study of the effectiveness of the state program "Development of Agriculture" in the Kaliningrad region; econometric analysis of the dependence of the results of the economic activity of agricultural enterprises on the amount of state subsidy is proposed as a research method; on the basis of the econometric models the regression-correlation analysis of the effectiveness of financial resources distribution on the main directions of the state agricultural program is conducted.

1 Introduction

In modern economic practice, the issues of food security and sustainable development of the agricultural sector are becoming increasingly important. This is explained by the importance of the role that agriculture plays in the system of general economic reproduction. According to representatives of classical economic science, this sector of material production, which provides the overwhelming bulk of food and raw materials for many industries, is an important factor in the growth of the country's production capacity. Moreover, the effective organization of the agricultural sector is a priority of any state development program. At the same time, the results of economic relations in this sector are quite difficult to predict, since to a certain extent they are directly dependent on climatic and weather conditions. This predetermines the need for direct state support of agriculture in the form of direct financing, which in modern economic practice is a fairly common phenomenon.

In particular, the most common instruments of financial support to the agricultural sector include the following: preferential tariffs for rail transportation of agricultural products, as well as products for the organization of agricultural production, preferential lending, subsidies to compensate part of the interest rate on investment loans, preferential leasing, compensation to agricultural producers of part of the costs of reclamation measures, subsidies to manufacturers of agricultural machinery, co All these and other methods of financial support are quite common, and are at the heart of state mechanisms to stimulate entrepreneurial activity in agriculture and the agro-industrial complex as a whole, are the core of many state development programs, but in terms of economic efficiency and

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direct positive impact on the result of labor in agriculture are not sufficiently studied and not comprehensively investigated [2-4].

The agricultural sector occupies more than 4.5% of the gross national product and provides a return on assets of 6.6. (Table 1) According to official sources of the Ministry of Agriculture in 2022, the industry has become one of the fastest growing industries, showing an increase in production of more than 10%.

Table 1. Indicators of agricultural development in Russia.

Indicators	2019	2020	2021
Sales in the industry, billion rubles.	5801.40	6110.80	7572.3
Share in gross domestic product (GDP), %	3.4	3.6	4.5
Return on assets	4.7	6.1	6.6
Investments in fixed capital of the agro-industrial complex, billion rubles.	844.2	855.9	769.3

At the same time, it should be noted that the system of state support for agricultural producers is now functioning quite smoothly. Its main goal is to ensure financial stability and increase the number of farmers.

Today, several sectoral strategies are being implemented to stimulate the development of agriculture and the agro-industrial complex as a whole:

- Thus, in April 2020, the Russian Government approved the "Strategy for the development of the agro-industrial and fishery complex of the Russian Federation for the period up to 2030", which provides for an increase in gross added value created in agriculture: up to 5374.8 billion rubles by 2024 (7000 billion rubles by 2030), including through a significant increase in exports.
- A law "On Viticulture and Winemaking" was adopted, which introduced a ban on the use of imported wine material for wine production in Russia.

In addition, since 2012 Russia has been implementing the State Program of Agricultural Development and Regulation of Markets of Agricultural Products, Raw Materials and Food [1]. 285 billion rubles have been allocated for this program in 2022 and 304.7 and 326.9 billion for the following years 2023 and 2024 respectively.

But at the same time, the key ways to support farmers today are concessional lending and subsidies. It should be noted that concessional lending is the issuance of loans at a minimum rate, but not more than 5% per annum for certain agricultural needs.

Subsidies are state financial support in the form of compensation for a certain part of the costs for specific purposes, namely, for the construction of agricultural facilities, the purchase of agricultural equipment, breeding stock, etc. Subsidized funds are provided on a grant basis.

In the Kaliningrad region since 2013, the program of state support "Development of Agriculture" is also being implemented, and its purpose is to provide the population of the Kaliningrad region with agricultural products and food of its own production. This program includes:

- Subprogram "Support for agricultural production".
- Subprogram "Sustainable Development of Rural Areas".
- Subprogram "Development of agricultural land reclamation".
- As well as a number of individual activities [5].

Target indicators and indicators of the state program are: the index of agricultural production in farms of all categories (in comparable prices) to the previous year; the volume of crop production in farms of all categories; the volume of livestock production in farms of all categories. The program is financed from the federal and regional budgets.

2 Materials and methods

Traditionally, to assess the effectiveness of state support of agriculture such indicators are used as the increase in the value of production per one ruble of spent budgetary funds; criteria associated with the growth of value added, increase in labor productivity, etc. are applied. Also in modern studies econometric approach is often used [2].

Econometric analysis based on such mathematical methods as regression and correlation analysis was chosen as the main method of this study. On the basis of the regression analysis it is possible to build a mathematical model of the dependence between the attributes. The main task of correlation analysis is to identify the relationship between random factors by means of paired and partial correlation coefficients, multiple correlation and determination coefficients, elasticity indicators and assessment of their statistical significance. By calculating the correlation indicators, the task of selecting the factors that have the most significant impact on the resulting indicator, based on measuring the closeness of the relationship between them is solved. Econometric models built on the basis of correlation and regression analysis make it possible to assess the degree of influence of different types of support and subsidies on financial performance of agricultural enterprises, to study their efficiency in the context of support directions and to identify the most effective directions.

For computer processing and analysis of the collected statistical data, special Excel spreadsheet processing capabilities were used.

3 Results

Based on statistical data from the information handbook on measures and directions of state support of agro-industrial complex of the Russian Federation [6] the equation of a pairwise linear regression was built (Figure 1) and it was found that in Russia as a whole the change in production volume by 49.4 % is determined by the amount of state support (R^2 = 0.494). This is quite a high indicator.

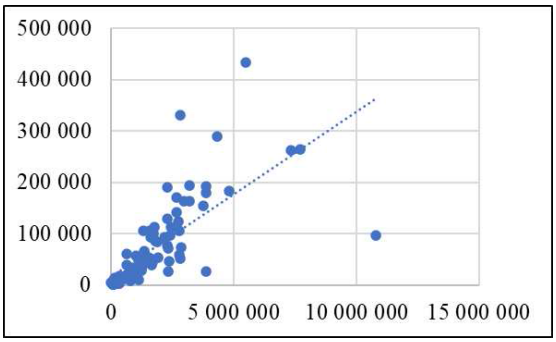

Fig. 1. Linear pairwise regression graph between production volume and subsidies in Russia.

Does Kaliningrad region correspond to all-Russian indicators? In order to answer this question the necessary statistical data on Kaliningrad region were collected, regression models were built and analyzed.

When constructing a pairwise regression model, the volume of production of agricultural enterprises was chosen as the resultant indicator (y), and the amount of state subsidies was chosen as the factor indicator (x). On the basis of statistical data for the Kaliningrad Oblast for the period from 2014 to 2021 [7] these indicators (x) were chosen. [7] for these indicators (Table 2) a pairwise linear regression equation was built (Figure 2).

Table 2. Initial data on subsidies and production volume from 2014 to 2021, thousand rubles.

The Year	Subsidies for s/he (x)	Production volume (y)
2014	1353 584	20 814
2015	2210 981	24 402
2016	2141 528	31 048
2017	2233 900	28 580
2018	2614 878	32 396
2019	1971 313	34 739
2020	1916 340	40 752
2021	2510 823	46 135

According to the results of calculations, it was found that there is a direct moderate correlation between these indicators, the growth of output depends on agricultural subsidies only by 23.7%. This is significantly lower than the overall figure for the country.

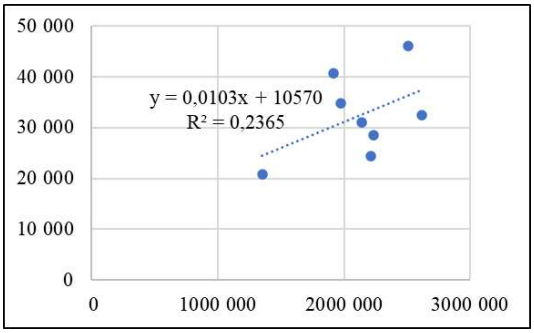

Fig. 2. Linear pairwise regression graph between production volume and subsidies for the Kaliningrad region.

To determine the reasons for low efficiency of state subsidies in the region, it was decided to take a closer look at the dynamics and structure of distribution of state financial resources, which have a greater impact on the volume of production: development of rural areas, development of land reclamation for agricultural purposes and stimulation of investment activities (Table 3) [8].

Table 3. Initial data on the three factor (subprograms) and the resulting (volume of products) signs, thousand rubles.

The Year	Reclamation (x1)	Sustainability (x2)	Investment lending (x3)	Production volume (y)
2013	0	0	1403 946	20 814
2014	0	0	2480 722	24 402
2015	442	47 502	2937 027	31 048
2016	1 696	46 410	2229 716	28 580
2017	71 400	40 144	1931 997	32 396
2018	64 935	66 740	599 610	34 739
2019	65 112	38 032	854 643	40 752
2020	70 857	206 821	1214 426	46 135

The graphical analysis of these data is shown in Figure 3. It shows that during the period under consideration, investments in rural development increased markedly, while those in subsidizing land reclamation and investment lending practically did not change.

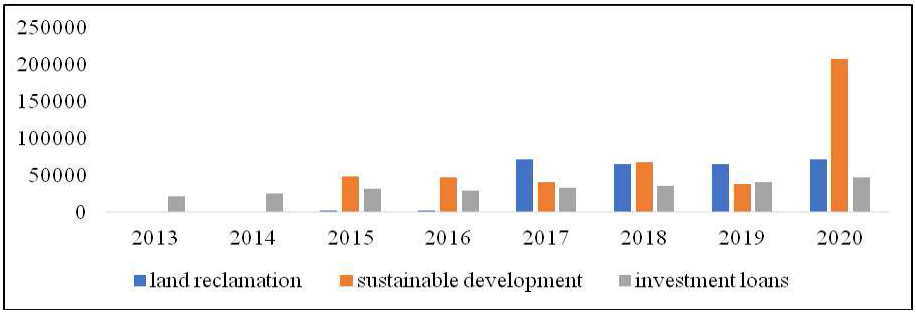

Fig. 3. Dynamics of main subsidies from 2013 to 2020, thousand rubles.

To analyze the efficiency of such a distribution of state support funds, a multiple regression model was built, where the volume of agricultural products was chosen as the resulting indicator, and subsidies for land reclamation, sustainable development of rural areas and lending were chosen as the factor indicators. The results of the data analysis are presented in Figure 4.

Regression Statistics						
Multiple R	0,918984232					
R-Square	0,844532019					
Normalized R-Square	0,727931034					
Standard Error	4312,46393					
Observations	8					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	3	4,04E+08	1,35E+08	7,242924	0,042897634	
Residual	4	74389381	18597345			
Total	7	4,78E+08				
	Coefficients	*Standard Error*	*t-Stat*	*P-Value*	*Lower 95%*	*Upper 95%*
Intersept	23071,56173	6578,782	3,506966	0,02474	4805,935949	41337,1875
Land reclamation (x1)	0,126181916	0,072099	1,750124	0,154994	-0,073996603	0,326360435
Sustainable development (x2)	0,067588109	0,030174	2,239935	0,088628	-0,016188721	0,15136494
Investment lending (x3)	0,000699037	0,002784	0,251135	0,814084	-0,007029242	0,008427317
y=23071,56+0,126182·x1+0,067588·x2+0,000699·x3						

Fig. 4. Indicators calculated by multiple regression.

Analysis of calculations and decoding of the model presented in figure 4 allows us to draw the following conclusions: increase in state expenditures for land reclamation by 1 thousand rubles leads to increase in the volume of agricultural production by 0.13 thousand rubles; similar change in expenditures for development of rural areas increases the volume of agricultural production by 0.07 thousand rubles; subsidizing loans to agricultural producers has almost no effect on changes in production volumes (value of regression coefficient with the corresponding variable in the model 0.0007). In spite of high value of coefficient of determination (0.84), analysis of the data demonstrated statistical insignificance of the multiple regression model coefficients (P-values - 0.15, 0.09 and 0.81 respectively) and low statistical significance of the regression equation in general (statistical significance of F-criterion is 0.05), which means low quality of the model built and prevents its use in further researches. The reason for this could be multicollinearity of the factor signs.

A matrix of pairwise correlation coefficients was compiled to examine the built model for multicollinearity (Table 4).

Table 4. Matrix of pair correlation coefficients.

Subsidies	**Reclamation (x1)**	**Sustainability (x2)**	**Investment lending (x3)**	**Products (y)**
Reclamation (x1)	1	0.55	-0.69	0.79
Sustainability (x2)	0.55	1	-0.31	0.82
Investment lending (x3)	-0.69	-0.31	1	-0.48
Products (y)	0.79	0.82	-0.48	1

Based on the calculation of the determinant of the interfactor correlation matrix (Δr=0.35), the conclusion was made about the presence of multicollinearity, i.e. the presence of linear relationship between the factor variables. This leads to uncertainty and statistical insignificance of regression model parameters.

In order to exclude the factors creating multicollinearity, private correlation coefficients were calculated, on the basis of comparative analysis of which it was found out that investment crediting (x3) has the least effect on the volume of agricultural production in Kaliningrad region, which agrees with the data of the regression analysis conducted earlier (x3 - statistically insignificant). The same conclusion was confirmed by standardized regression coefficients and average elasticity coefficients, which allow ranking the factors by the degree of their influence on the result: x3 ended up in the last place (Table 4). Thus, the factor x3 - investment lending - can be excluded from the multiple regression model.

Table 5. Indicators of multiple regression model analysis.

Name of indicators	**x1**	**x2**	**x3**
Partial correlation coefficients	0.66	0.75	0.12
Standardized regression coefficients	0.55	0.53	0.07
Average elasticity coefficients	0.13	0.12	0.04

After excluding investment lending from the model, a detailed analysis was conducted again (Figure 5). The model equation of linear multiple regression is as follows: y = 24622.8 + 0.011 x1 + 0.07 x2. No multicollinearity was found (Δr=0.7); both factors are statistically significant (P-values 0.05); the built model is statistically significant as a whole (significance of F-criterion was 0.01). The variation of agricultural output in the region by 84.2% is explained by changes in subsidies aimed at land reclamation and development of rural areas, and only by 15.8% by other factors not considered in the model (coefficient of determination R^2 = 0.842).

Regression Statistics	
Multiple R	0,91764957
R-Square	0,842080733
Normalized R-Square	0,778913027
Standard Error	3887,474466
Observations	8

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	4,03E+08	2,01E+08	13,33087	0,009910323
Residual	5	75562289	15112458		
Total	7	4,78E+08			

	Coefficients	*Standard Error*	*t-Stat*	*P-Value*	*Lower 95%*	*Upper 95%*
Intersept	24622,7878	2041,069	12,06367	6,91E-05	19376,05347	29869,52214
Land reclamation (x1)	0,114199989	0,048727	2,343647	0,06608	-0,011057968	0,239457947
Sustainable development (x2)	0,068534708	0,026987	2,539504	0,051925	-0,000838721	0,137908137

y=24622,79+0,1142·x1+0,06855·x2

Fig. 5. Data analysis after exclusion investment loans (x3).

4 Discussion

According to the results of the study, we can conclude that investment lending does not contribute to an increase in agricultural production, subsidies in this area are not effective, and further funds will be rationally redirected to the subprogram "Sustainable development of rural areas", "Development of land reclamation of agricultural purposes".

Econometric analysis of efficiency of state support to agriculture in Kaliningrad oblast based on construction and analysis of multiple regression model according to time series data allowed to draw the following conclusions: growth of agricultural production volume by 84% is determined by subsidies aimed at land reclamation and development of rural areas; at that, increase in state expenditure on reclamation by 1 thousand rubles will increase agricultural production volume by 0.11 thousand rubles on average; similarly, subsidizing of interest rate on credits does not have a significant impact on growth of production volume and is not efficient. Subsidizing the interest rate on loans does not have a significant impact on the growth of production volumes, is not effective, and in the future it would be rational to redirect the funds to other purposes, for example, to increase funding for the subprogram "Sustainable development of rural areas", "Development of land reclamation of agricultural land", or to consider opportunities for financial support in new directions.

5 Conclusion

Thus, the analysis of measures of state support for agricultural enterprises allowed us to give an empirical assessment of the effectiveness of the state measures. In particular, investment lending is not effective, that is, an effective tool that affects the performance of labor in the agricultural sector, while land reclamation activities and their financing allow to obtain better results along with the financing of programs for sustainable development.

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