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Article

Regional dimension of the efficiency-support nexus in agriculture: Testing the land value approach in Russia

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Abstract: State support for agriculture is a crucial tool for adjusting the competitive advantages of agricultural producers to a volatile market environment. In countries with diverse natural conditions for agriculture, however, the allocation of subsidies often focuses on bridging spatial development gaps rather than maximizing the return on inputs. To improve the efficiency of resource use in agriculture, it is essential to tailor subsidy criteria to regional disparities in agricultural potential. Using the example of Russia's 81 administrative regions, the authors have tested a five-stage methodology for determining the support-generated parameters of output, efficiency, impact, revenue, and profitability. This methodology takes into account both natural and economic factors that contribute to the competitive advantages of each region. The study aims to identify the parts of the performance indicators, such as gross agricultural output and revenue, that are influenced by the amount of subsidies in five different types of territories, which are categorized by the cadastral value of their farmland. It has been found that the allocation of subsidies is not entirely based on the return on the funds allocated. There is a discrepancy between the competitive advantages of these territories in agricultural production and the amount of funds they receive through government support programs. The efficiency of government support differs significantly depending on the type of agricultural product produced in each territory. The approach developed by the authors provides a tool that policy makers can use when tuning the allocation of subsidies based on the differences in the agricultural potential of each territory.

Keywords: advantage; agriculture; cadastral value; government support; efficiency; land; revenue; subsidy; territory

1. Introduction

The spatial organization of agriculture not only forms the basis for the development of this sector, but also determines the balance of competitive advantages of different territories in the production of specific agricultural products. It also influences the specialization of these territories, cooperation between them, efficiency of land and labor use, and the parameters of food security in regional markets (Altukhov, 2021). The optimal spatial distribution of productive forces ensures the efficient use of the natural, climatic, and economic potential of a territory. It brings the production of certain agricultural products as close as possible to areas with the most suitable climate and appropriate natural and economic conditions for farming (Altukhov, 2020b).

One of the distinct features of the spatial development of agriculture in Russia is the high level of specialization in the production of certain agricultural products due to significant natural differences between regions. This is due not only to the climatic conditions, but also to the significant differentiation in the quality of farmland. As a result, the production of some types of agricultural products may be profitable in one part of the country (for example, European part of Russia), while unprofitable or even impossible in another (Siberia or the Far East) (Altukhov, 2020a; Erokhin et al., 2023). However, territorial differences in the competitive advantages of agriculture are often overlooked by producers. Small and medium-sized producers commonly focus on cultivating crops that are in high demand on the domestic regional market (Korableva et al., 2018), while large-scale production tends to decide on the location based on the price of labor (Kosenchuk, 2018). As shown by a few studies using the examples of countries such as Russia (Liefert, 2002), China (Fan et al., 2023; Yan et al., 2020), and Brazil (Hopewell, 2016; Pellegrina, 2022), the lack of consideration for the competitive advantages of different territories in the allocation of productive resources leads to a reduction in the efficiency of resource use and, in the long run, can undermine the parameters of food security of the entire country by limiting the physical availability and economic accessibility of certain agricultural products in certain regional markets (Baryshnikov et al., 2013; Erokhin et al., 2020a).

In order to narrow the gap between the current competitive advantages of territories and the structure of agricultural production, the government can use strategic planning tools to target farmers and encourage them to produce those products for which a territory enjoys competitive advantages (favorable climate, good land, less resources needed, lower cost, etc.) (Carbone and Rivers, 2017; Donaldson, 2019; Erokhin et al., 2020b). The essential aspect of a government's policy to adjust the advantages-output pattern is choosing criteria for allocating funds (Samygin and Kudryavtsev, 2018; Tyupakov, 2016). There have been developed various methods for analyzing the economic efficiency of agricultural support, but most of them have common drawbacks, such as a narrow interpretation of the effects of agricultural subsidies (Seitov, 2022).

The current approaches to the allocation of subsidies in most countries are based on indicators such as budgetary effectiveness or the volume of agricultural output per unit of subsidy. However, these indicators do not fully capture the contribution of subsidies to ensuring the competitiveness and long-term development of agriculture. Instead, they focus on compensating farmers' costs and increasing the output without considering qualitative parameters of production. Instead of forming an optimal balance between the competitive advantages of regions and their available resources, the goal of subsidizing becomes simply to increase the quantity of products. This approach does not take into account the importance of long-term planning and strategic investment in the industry, which are essential for sustainable growth and development. As a result, as is typical in Russia, subsidies are increasingly concentrated on the largest agricultural companies and agricultural holdings, while smaller farmers receive very little or no state support (Uzun, 2017). Two types of support prevail: targeted support for the best performing projects and businesses (which are primarily located in territories with favorable climatic conditions for agricultural production) and support for producers in regions with harsh unfavorable climate which are considered marginally competitive (Shik et al., 2020). In both cases, the lack of well-developed methods for identifying the relationship between the indicators of production efficiency and those of government support makes it challenging to accurately assess the direct impact of subsidies on the development of the agriculture sector (Semin et al., 2019).

Due to the shortcomings of current agricultural subsidy policies for the long-term development of the sector, based on optimizing the combination of the competitive advantages of different territories with their respective production capabilities, there is a growing consensus in the literature about the expediency of revising the criteria for allocating subsidies (Delekh, 2015; Romanov and Bezaev, 2015; Shavandina and Rein, 2015). It seems that in order to successfully achieve food security criteria with the least expenditure of budgetary resources, it is advisable to allocate state support funds to regions in a way that maximizes the benefits of their use. This can be done by providing subsidies farmers based on the efficiency of their use, allowing territories to take advantage of their competitive advantages and produce those food and agricultural products that are profitable for farmers and affordable for consumers.

Within this study, the authors aim at developing recommendations for improving the assessment and planning of subsidies in agriculture, considering the agricultural potential of heterogeneous territories with different spatial development parameters, using Russia as an example. The novel approach is based on the identification of the farmers' performance indicators influenced by the amount of subsidies in five different types of territories, which are categorized by the cadastral value of their farmland.

2. Literature review

Modern literature summons several approaches to evaluating the effectiveness of allocating agricultural subsidies. The most common method is to compare the outcomes of a specific project (area, sector) to the amount of budget funds spent on financing those projects (Barath et al., 2020; Bershitskii et al., 2016; Wang et al., 2019). Afanas'ev and Golovanova (2016) propose to evaluate the effectiveness of budget expenditures in two stages. At the first stage, the effectiveness of budget expenditures carried out in each category of expenditure (for each state program) is calculated separately. At the second stage, the effectiveness of the subsidies is assessed by comparing the results obtained with the volume of budget allocations. This is a simple economic assessment of the cost-effectiveness (the return on investment) of the funds invested. However, the indicators used in such assessment do not take into account the specific features of agricultural production.

According to Bespakhotny et al. (2005) and Sharapova (2019), the key criterion for evaluating the effectiveness of agricultural subsidies is the revenue generated from the sale of agricultural products per unit of support or spent resource. This principle is used in Russia today for state planning purposes to assess the efficiency of the use of budget funds (Ministry of Agriculture of the Russian Federation, 2017).

The distribution of subsidies across the country's regions is based on a set of key indicators, such as the share of a region in the gross agricultural output, the livestock of farm animals in a region, and the area of farmland. To evaluate the effectiveness of subsidies, additional indicators are used, such as gross harvest and output, output growth over time, and the number of new permanent jobs. This means that the methodology for distributing subsidies among territories is closely linked to achieving performance targets. This allows the government to determine only the degree to which planned indicators have been met, without providing detailed information about how these targets were achieved.

An alternative approach is to assess the impact of government support on agricultural enterprises based on such factors as the structure of government support in different sectors, the level of cost recovery, and the proportion of government subsidies in the revenue of agricultural enterprises and the prices of food and agricultural products (Fukasaku, 1992; Mironova, 2004). Thus, Mironova (2004) proposes to conduct a comparative analysis of absolute or relative changes, a comparison with planned and average indicators, as well as indicators of state support for other sectors beyond agriculture. The analysis includes an assessment of the structure of state support in the context of budgets, sub-sectors, products, forms and methods of support, administrative regions and districts, and enterprises. It also includes a monitoring of the degree of compensation for expenses and an assessment of the share of state support in income and the average salary of agricultural employees. Additionally, the analysis examines the degree of influence of state support on food prices. In furtherance of the detailed approach to assessing the returns on subsidies, Latruffe (2010) suggested capturing parameters such as the specialization of agricultural enterprises, their competitiveness, and labor productivity. Nastis et al. (2010), Tang et al. (2017), Zhu and Lansink (2010) and Zhang and Sun (2012) have all been developing a sectoral approach to assessing the effectiveness of subsidies. The approach involves assessing the impact of subsidies on different sectors in agriculture, such as crop production and livestock, as well as the organic production (Buchta and Buchta, 2009; Jovanović and Zubović, 2019; Matchaya, 2020). However, even such a detailed can hardly produce definite conclusions about the overall effectiveness of subsidies, as its results fail to distinguish the returns received on each individual subsidy. This shortcoming of the methods challenges the determination whether certain subsidies are actually effective in achieving their intended goals.

Uzun and Gataulina (2010) suggested to express the effectiveness of agricultural subsidies through the increase of a target indicator per unit of allocated funds. Efficiency is calculated as the ratio of additional tax revenues to the budget resulting from the implementation of a subsidy program compared to all budget expenses for its implementation. The impact of subsidies on production efficiency is determined by using grouping and regression analysis.

Epstein (2012) and Romanov (2015) elaborated a methodology for analyzing the correlation between state support and the elasticity of subsidies in an enterprise's production function. Epstein (2012) suggested using modified basic equations for agricultural output in the form of a Cobb-Douglas production function, which links marketable products to the main factors of production (labor, land, and capital) and an additional factor (subsidies). This approach assumes assessing the impact of subsidies on the value of marketable goods, as well as the return on government investment. Romanov (2015) recommended to use the volume of gross output generated by receiving government investments as a target function. This task allows one to estimate the maximum share of gross agricultural output received through public investments and optimize the size of investments in each group. Among the limitations of the method is that the evaluation of the effectiveness of agricultural subsidies is based solely on the values of correlation and determination coefficients, which may not fully capture the complexity and nuances of the agricultural production.

Most approaches to assessing the effectiveness of agricultural subsidies focus solely on identifying the quantitative return on invested inputs. Few scholars, such as Tang et al. (2017) and Zhang and Sun (2012) suggest incorporating environmental indicators of agricultural production and qualitative indicators of the sustainability of agricultural development into efficiency assessment systems. However, these approaches only assess efficiency at the level of stochastic dependence, without considering differences between territories in terms of natural and economic features of agricultural production (Erokhin et al., 2023). The problem with the current system of subsidy allocation based on economic return on investment is that it eliminates natural differences between regions with different competitive advantages (Bespakhotny et al., 2005) and abilities to achieve efficiency indicators. This approach does not take into account the varying territory-specific degrees of pressure on natural and economic resources. The applied indicators for evaluating subsidy effectiveness primarily serve the interests of agricultural enterprises and holdings, as they assume that the return on budgetary funds can be elevated through increasing prices or optimizing production costs. However, this approach ignores the unique characteristics of each territory and fails to consider other factors that could contribute to the overall efficiency of the agricultural production (Subić et al., 2020).

The very nature of allocating funds through government support programs means that research into the impact of subsidies on individual agricultural producers is limited (Bozik, 2011; Casolani et al., 2021; Shik et al., 2020). This makes it challenging to determine the economic efficiency of using budget funds, as it is difficult to isolate the direct effect of subsidies from all the other factors that influence the outcome (Chen and Wang, 2022; Song et al., 2022). In the context of the extreme diversity of agricultural production systems across different regions in large countries like Russia, the allocation of subsidies based exclusively on economic efficiency criteria can lead to the reduction of disparities in the agricultural potential of territories and the corresponding loss of competitive advantages for some territories (Shik et al., 2020). The distribution of subsidies based on quantitative indicators of the return on investment contributes to the concentration of budget funds in better performing territories, thereby exacerbating existing imbalances in the spatial development of agriculture. However, a number of studies (Erokhin et al., 2023; Samygin et al., 2019) have shown that territories with a lower contribution to the national total agricultural output are able to achieve a higher increase in agricultural production compared to those with a higher share. Therefore, when allocating subsidies between territories, it may be more effective to consider not only economic efficiency, but also the agricultural potential of a territory. This potential is determined by a combination of natural, environmental, and economic factors that influence agricultural production.

In this study, the authors tested the possibility of applying a three-component approach to assessing the agricultural potential of a territory using a composite indicator of cadastral value. They assumed that the rental income from a particular land plot results from the interaction of three factors: soil quality (fertility as the natural component), technological features of agricultural production (environmental component), and the spatial distribution of production forces in agriculture (economic component). Many studies have shown that a universal system of stable indicators for cadastral valuation of agricultural land serves as a fundamental basis for both solving various tasks in the fields of land relations and land management and allocating funds to support agricultural production (Awasthi, 2014; Choumert and Phélinas, 2015; Sklenicka et al., 2013). Grover (2016), Snajberga (2015), and Stopar and Kovac (2016) have investigated the country-to-country issues of real estate and land valuation and its management based on differences in value. Pamuković et al. (2021) have demonstrated the applicability of cadastral land value in determining priorities for land selection during land redistribution.

Most researchers agree that it is essential to adopt a differentiated approach to cadastral land valuation, as accurate and reliable assessments require initial data on soil quality and quantity, economic factors such as costs and profits for farmers and landowners, and production infrastructure such as logistics and markets (Janus and Ertunc, 2020; Kilic et al., 2019; Len et al., 2023; Marques-Perez et al., 2018). In modern practice, the method of mass valuation and homogenizing all indicators is commonly used to estimate the cadastral value of land in Russia. However, this approach has the disadvantage of ignoring the unique characteristics of each land plot, which can vary in terms of soil type, groundwater levels, humus content, and actual state of use. Therefore, when determining the cadastral value, this study tests a personalized approach to assessing lands across diverse territories in Russia, so that, based on the individualized data obtained, it becomes possible to adjust the parameters of government support for land owners according to the territory-specific conditions of agricultural production.

3. Materials and methods

The methodology of this study is based on the findings of previous research conducted by Aliyeva et al. (2019), Bykanova and Klochkova (2014), Laursen (2015), and Uzun et al. (2014), who emphasized the importance of assessing the performance of government subsidies in agriculture by converging the quantitative and qualitative parameters of efficiency. The quantitative dimension assumes treating efficiency as the amount of output per unit of input. The qualitative one conforms to the Russia's legal concept of efficiency as achieving a certain level of output using the minimum amount of resources, or achieving maximum output using a specific amount of resources (President of the Russian Federation, 1998). Therefore, the performance of subsidies is defined as the relationship between the achieved outcome and the inputs used. According to the International Organization for Standardization (2015), budget efficiency is a measure of the impact on the budget, i.e., the ratio of the outcome received by the budget compared to the expenses incurred to ensure its receipt.

The methodology that best reflects the above duality of the assessment is the one developed by Bespakhotny et al. (2005). It allows for the assessment of the effectiveness of state support for agriculture based on the ratio between the volume of subsidies provided and the financial results achieved from their use during a given period. The essence of the approach is that it does not take into account the efficiency of funds received from different sources (own funds of a farmer, loans, investments, budgetary funds, etc.). Instead, efficiency is expressed through the volume of gross output (revenue) generated from subsidies per unit of budgetary funding.

At the stage of subsidy planning, it is essential to align results with resources and determine the return on the use of budgetary funds in different natural and economic conditions of agricultural production. Such an alignment facilitates a rational use of agricultural potential in territories, optimizing production capabilities based on existing competitive advantages in agriculture. To capture the territory-level specifics of allocating subsidies and overcoming limitations (limited set of indicators and the difficulty in taking into account both natural and economic factors), the above methodology was modified by the authors. The modification aimed to assess the effectiveness of using budgetary investments, on the one hand, as a source of farmers' support, and on the other, as government investments. This allows the authors to identify the intended efficiency of budgetary funds (**Table 1**, column "No *C*").

Table 1. Authors' methodology for evaluating the efficiency of government subsidies in agriculture with and without considering cadastral value of farmland (*C* and No *C*).

Stages	Parameters	Notations	Units of measure	Formula	
				No *C*	***C***
Stage 1	Output generated by support	*O*	RUB/hectare	$O = \frac{GO \times S}{GE}$	$O = b_1 \times S + b_2 \times C$
Stage 2	Efficiency of support	*E*	RUB/RUB	$E = \frac{O}{S}$	$E = \frac{O}{S} + \frac{O_N}{S}$
Stage 3	Impact of support, unit of support per unit of output	*I*	RUB/RUB	$I = \frac{S}{O}$	$I = \frac{S}{O} + \frac{S}{O_N}$
Stage 4	Revenue generated by support	*R*	RUB/hectare	$R = O - S$	$R = c_1 \times S + c_2 \times C$
Stage 5	Profitability of support, the revenue-support ratio	*P*	%	$P = \frac{R}{S} \times 100$	$P = \frac{R}{S} + \frac{R_N}{S}$

Note: *C* = cadastral value of 1 hectare of farmland, RUB/hectare; *GO* = gross output, RUB; *GE* = gross expenses, RUB; *S* = amount of support per hectare of farmland, RUB/hectare; b_n = elasticity coefficient in the output model; c_n = elasticity coefficient in the revenue model; O_N = output generated by support, cleared of the influence of cadastral value of farmland, RUB/hectare; R_N = revenue generated by support, cleared of the influence of cadastral value of farmland, RUB/hectare.
Source: Authors' development.

The methodology is based on a sequential calculation of performance indicators within five stages of analysis. The target indicator identified at stage 5 is profitability, which is the amount of revenue per unit of subsidy. The methodology takes into account that in a specific territory, planned indicative prices for agricultural products are not expected to increase, and planned production costs take into account wages for agricultural workers at a level average for the regional economy, rather than the industry average. To do so, production costs are planned in terms of cost elements. The only way to increase return on subsidies is to reduce production costs per unit. This can be achieved by reorienting production towards those types of products that are cost-effective in specific natural and economic conditions in a territory, making use of the competitive potential of that territory. The idea is that territories that perform better in more challenging natural and economic conditions of agricultural production should be able to receive additional support.

However, the technique proposed by Bespakhotny et al. (2005) has several limitations that prevent the separation of the effects of natural and economic factors in agriculture from the influence of other variables. First, the methodology is limited to a specific set of indicators, overlooking some other factors that determine the impact and efficiency of budgetary funds. Second, it is not possible to assess the efficiency of the use of subsidies, considering the natural and economic potential of territories. Third, the measurement of support's impact is carried out in absolute terms, without considering the degree of land use—The main factor in agricultural production.

To objectively assess the effectiveness of state support in agriculture across territories with varying production potential, the authors calculated the impact per unit of farmland, considering the natural and economic conditions of a territory. To do so, at each stage of the analysis, performance indicators were adjusted using linear functions (**Table 1**, column "*C*").

Econometric models allow one to isolate one part of output and revenue, which is influenced by the cadastral value of agricultural land. According to Galchenko et al. (2020), Janku et al. (2016), Sapozhnikov et al. (2019), the cadastral value is a universal measure of the fertility of a particular piece of land and its economic value under specific conditions in a particular territory. Therefore, the use of the cadastral value metric allows one to quantify both the natural and economic factors of agricultural production using one indicator, unifying the approach to analysis for heterogeneous territories.

The other part is "cleared" of this influence (O_N and R_N). This approach eliminates the impact of differences in land cadastral values between territories on the efficiency of subsidies and thus increases the objectivity of assessment.

Administrative regions of Russia are grouped based on the cadastral value of one hectare of agricultural land, according to the methodology developed by the Ministry of Economic Development of the Russian Federation (2005). The cadastral value is determined by multiplying estimated rental income of one hectare of land by the capitalization period (33 years, as set by the Ministry of Economic Development). The estimated rental income from a land plot can be calculated by taking into account three main factors: fertility of land, its technological properties, and the location of a land plot (distance from sales markets) Equation (1):

$$ERI = \Delta RI_f + \Delta RI_t + \Delta RI_l \quad (1)$$

where ERI = estimated rental income; RI_f = rental income due to the fertility of the land; ΔRI_t = rental income due to the technological properties of the land.; ΔRI_l = rental income due to the location of the land.

The total number of administrative regions in Russia is divided into five groups, with the first group containing 20% of territories with the lowest cadastral value, and the fifth group containing 20% with the highest one (**Table 2**).

Table 2. Categories of administrative territories of Russia by the cadastral value of agricultural land.

Categories	Cadastral value, %[1]	Variations of cadastral values, %[2]	Territories
Category 1: Low	27.2	6.3–54.4	Amur, Buryatia, Chukotka, Kalmykia, Kamchatka, Khakasia, Kirov, Komi, Murmansk, Perm, Sakha Yakutia, Sakhalin, Tomsk, Tyumen[3], Tyva, Zabaikalsk
Category 2: Below average	76.9	57.2–98.3	Altay Krai, Altay Republic, Arkhangelsk[4], Astrakhan, Irkutsk, Karelia, Kemerovo, Kostroma, Krasnoyarsk, Magadan, Novgorod, Novosibisk, Pskov, Samara, Sverdlovsk
Category 3: Average	110.7	100.5–123.5	Chechnya, Cheryabinsk, Kaluga, Khabarovsk, Kurgan, Primorye, Saratov, Smolensk, Tatarstan, Tver, Udmurtia, Ulyanovsk, Vladimir, Volgograd, Vologda
Category 4: Above average	146.5	127.0–190.0	Bakhkortostan, Bryansk, Chuvashia, Dagestan, Ingushetia, Ivanovo, Jewish Autonomous Region, Kabardino-Balkaria, Mari El, Mordovia, Nizhny Novgorod, Omsk, Orenburg, Penza, Ryazan, Tambov, Tula, Yaroslavl
Category 5: High	301.6	198.1–645.9	Adygeya, Belgorod, Crimea[5], Kaliningrad, Karachaevo-Cherkessia, Krasnodar, Kursk, Leningrad, Lipetsk, Moscow Oblast, North Osetia Alania, Orel, Rostov, Stavropol, Voronezh

Note: [1] Ratio of the category-average cadastral value of 1 hectare of agricultural land to the Russia's average cadastral value; [2] variation of the cadastral value of 1 hectare of agricultural land in regions within a category compared to the Russia's average; [3] including the Khanty-Mansi and the Yamal-Nenets autonomous districts; [4] including the Nenets Autonomous District; [5] The Crimea Republic is included in the study due to its current position as a territory under de-facto Russia's control. Source: Authors' development based on Federal Service of State Statistics of the Russian Federation [Rosstat] (2024).

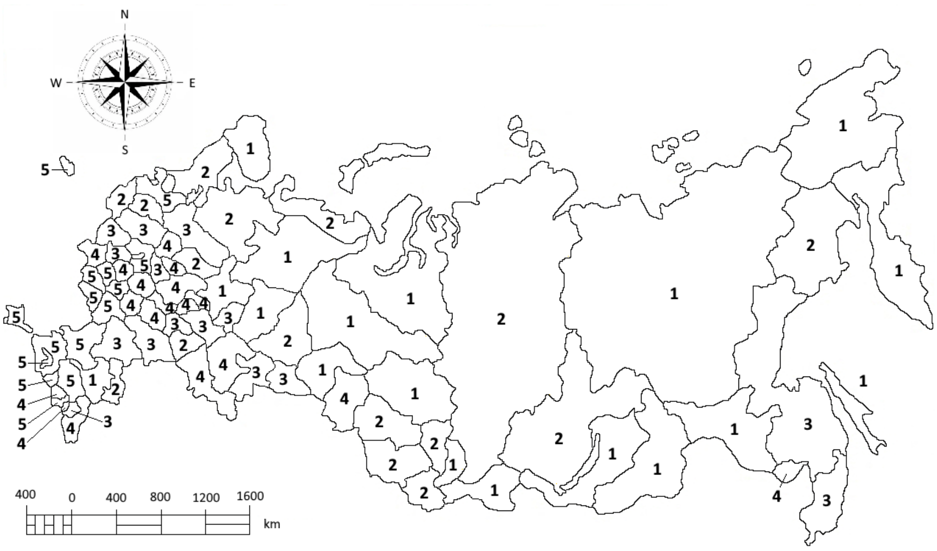

Figure 1. Location of Russia's territories by categories.

Note: 1 = Category 1 territories; 2 = Category 2 territories; 3 = Category 3 territories; 4 = Category 4 categories; 5 = Category 5 categories. Source: authors' development.

The data were obtained from a spatial development database compiled by the authors for all administrative regions of Russia (Samygin et al., 2023). The database contains indicators for the period between 2017 and 2020. This study included 81 administrative regions of Russia, excluding cities of federal subordination (**Figure 1**).

The relationship between natural and performance parameters of agricultural production is stochastic (Barath et al., 2020; Bernini and Galli, 2024). Therefore, the analysis of their impact on economic variables is based on correlation analysis. Two models are formed for two dependent variables: output generated by support (*O*) and revenue generated by support (*R*). The independent factors for both models are the amount of support per hectare of farmland (*S*) and the cadastral value of one hectare of farmland (*C*). The purpose of the analysis is to identify the part of the performance indicators that are formed under the influence of natural and economic conditions of agricultural production. The regression analysis process involved six steps: assessment of multicollinearity using the method of inflated factors; verification of uniformity and normality of the distribution; descriptive statistics and data dispersion; box diagram-based estimation of outliers in the dataset and adjustment of the dataset; least squares model construction; robustness assessment of model quality and parameter values (coefficients of correlations and determinations, P-value according to the Fisher criterion, and *t*-value for significance of regressors according to the Student's *t*-test). Calculations were performed using the Gretl econometric analysis software.

4. Results and discussion

It was revealed that subsidies are concentrated in territories with more favorable natural and economic conditions for agricultural production (**Table 3**). Category 5 territories with the highest cadastral value of farmland receive state support funds at almost 1900 RUB per unit of land compared to 700 RUB for Category 1 and Category 2 territories. The volume of gross output and profits from government support are also substantially higher in better performing Category 5 territories compared to other regions.

Table 3. Efficiency of subsidies per categories of territories.

Categories	*S*	*O*	*R*	*E*	*I*	*P*
Category 1: Low	736	827	91	1.12	0.89	12.25
Category 2: Below average	722	831	109	1.15	0.87	15.10
Category 3: Average	1077	1209	131	1.12	0.89	12.18
Category 4: Above average	1288	1424	136	1.11	0.90	10.59
Category 5: High	1890	2203	313	1.17	0.85	16.57

Note: *S* = amount of support per hectare of farmland, RUB/hectare; *O* = output generated by support, RUB/hectare; *R* = revenue generated by support, RUB/hectare; *E* = efficiency of support, RUB/RUB; *I* = impact of support, unit of support per unit of output, RUB/RUB; *P* = profitability of support, the revenue-support ratio, %.
Source: Authors' development.

According to Jordan et al. (2023), Rada et al. (2020), and Si et al. (2023), among others, territorial disparities in the allocation of agricultural subsidies are recognized as one of the most significant structural constraints on agricultural development. Gueringer (2019) and Zhu et al. (2022) show that the disproportionate economic conditions of agricultural sectors in certain territories is formed under the influence of various factors that create and determine the unevenness of economic potential and development processes. These imbalances are objective, and they are related to the existence and use of agricultural potential inherent in territories, not only in terms of natural resources, but also in terms of demographics and investment (Zhang et al., 2019). As argued by Erokhin et al. (2023), Nabokov et al. (2021), and Zielinski et al. (2024), the subjective causes of imbalances reflect the state of institutional conditions, the effectiveness of management systems, and the attitude of central government towards a territory. Therefore, the authors refer to the allocation of subsidies as the subjective reasons for the emergence or even strengthening of imbalances in the spatial development of agriculture, with better performing territories (categories 4 and 5) receiving even greater subsidies, in the hope of further increasing the returns on invested funds. This not only freezes existing imbalances but also increases the gap in the level of agricultural development between individual territories (Erokhin et al., 2023). Moreover, Seitov (2022) argues that the current support programs in Russia only exacerbate income disparities in rural areas between efficient and inefficient agricultural producers. These programs distort market signals and weaken the incentives for innovation in agriculture. Due to the redistribution of resources, a so-called spatial economic polarization in agriculture emerges (Konecny, 2017), which results in less successful territories losing their potential for self-development and becoming dependent on external food supplies (Erokhin et al., 2023). This not only poses a direct threat to the food security of these territories, but also creates a complex of economic, social, and environmental challenges for rural development (Adepoju et al., 2023; Gheorghe et al., 2022; Nedeljković et al., 2023).

However, the calculated parameters of efficiency, impact, and profitability of subsidies do not show a clear upward trend as environmental and economic conditions of agricultural production improve. To assess their impact, the data on categories of territories has been supplemented with the results of econometric analysis. At Stage 1, the study revealed no multicollinearity for all the models' regressors across the selected agricultural products. The values of the indicators are significantly lower than the boundary values (up to 10). For example, with regard to the volume of support, the obtained indices were 1.06 for gross output O and 1.25 for revenue R. The normal distribution test showed that the P-values according to the Doornik-Hansen, Shapiro-Wilk, Lilliefors, and Jarque-Bera tests (0.004, 0.005, 0.005, and 0.002, respectively) were significantly below 0.05. Analysis of the data set using distribution graphs and descriptive statistics showed a certain spread of data relative to the mean and median values. In some cases, the average value deviated from the minimum value by 149% and from the maximum value by 337%. Therefore, the median value in terms of support per hectare of farmland was 7 times lower than the maximum value and 174 times higher than the minimum value. The average value was about 45% higher than the median value. The box plot showed the presence of outliers in the dataset. Therefore, due to the removal of extreme values and the adjustment of the sample size, a different number of observations were used in the modeling process (151 for O and 133 for R). The constructed models show that the volume of state support and the cadastral value have a strong influence on the agricultural output and revenue (**Table 4**). As demonstrated by the R^2 values, gross output (*O*) is explained by *S* and *C* by 97.1%, and *R* by 56.6%. In all cases, the models' quality is significantly better than normal, as indicated by the Fisher criterion (*F*-value < 0.05). The quality of model parameters meets the student's criteria (*P*-value < 0.05) as well. The hypothesis of the presence of multicollinearity has not been confirmed by the method of inflationary factors in any case.

Table 4. Models of the impact of natural and economic factors on financial outcomes of farmers due to government support.

Parameters	**Models**	
	Model 1	**Model 2**
Dependent variable	*O*	*R*
Factors	*S*, *C*	*S*, *C*
Formulas	$O = S^{0.977} \times C^{0.017}$	$R = 0.045 \times S + 0.003 \times C$
Multiple correlation coefficient *R*	0.986	0.752
Determination coefficient R^2	0.971	0.566
F-statistic	5.21×10^{-58}	0.000423
P-value (*O*)	1.35×10^{-59}	0.000394
P-value (*R*)	0.00928	0.003412

Note: *O* = output generated by support, RUB/hectare; *R* = revenue generated by support, RUB/hectare; *S* = amount of support per hectare of farmland, RUB/hectare; *C* = cadastral value of 1 hectare of farmland, RUB/hectare.
Source: Authors' development.

The authors' results align with the findings of most studies on the impact of government support on economic performance of agricultural enterprises. Thus, Bernini and Galli (2024) and Kalinin and Samokhvalov (2020) demonstrate a strong correlation between performance parameters and the amount of financial assistance allocated through government programs. Additionally, a high level of state incentives, combined with significant financial leverage through lending and leasing, can significantly accelerate industry development compared to a lack of support (Cimpoies, 2021). However, Seitov (2022) argues that in Russia, neither subsidies nor investments in fixed assets of agricultural enterprises have a significant impact on the overall productivity of agriculture. In some territories, labor productivity in agriculture even decreases with an increase in subsidies (Seitov, 2022). This paradox could be due to allocating funds to territories with unfavorable climatic conditions, where it is difficult to obtain significant gains in output and revenue from support measures. As a result, in such territories, only the maintenance of existing production levels is achieved, rather than significant growth in performance. Instead, the effect of government support for agriculture can be achieved by combining subsidies with efforts to improve the overall conditions of agricultural production, such as developing infrastructure and providing advanced training for workers (Mamatzakis and Staikouras, 2020).

Nevertheless, in support of the findings of most studies that have previously documented the relationship between level of support and efficiency, the authors' assessment of the Model 1 parameters indicates that a 1% increase in subsidies leads to a 0.97% increase (variable *S*'s coefficient, Model 1, **Table 4**) in gross output *O*. According to Model 1, the elasticity of gross output with respect to the volume of subsidies is 0.977 and with respect to cadastral value it is 0.017 (variable *C*'s coefficient, Model 1, **Table 4**). According to Model 2, the elasticity of revenue with respect to the volume of subsidies is 0.045 (each additional unit of subsidy would increase revenue by 0.045 RUB—variable *S*'s coefficient, Model 2, **Table 4**) and with respect to cadastral value it is 0.003. As Model 2 demonstrates, the revenue from government support *R* increases by 0.003 RUB per unit of support (variable *C*'s coefficient, Model 2, **Table 4**) as the cadastral value of agricultural land increases. Therefore, the higher the cadastral value, the more efficient the use of budgetary funds in the agricultural sector. The revealed relationship represents a new contribution to the literature on the efficiency of subsidies in agriculture. There are very few estimates available on the impact of cadastral value on subsidy efficiency, as such. Galchenko et al. (2020) and Seitov (2022) argue that the applied methodological approaches focus on budgetary effectiveness or gross output indicators in agriculture, and the correlation between these development indicators and subsidies has not been sufficiently substantiated.

Calculations of the effectiveness of support, both with and without considering the influence of natural and economic factors, showed that as the cadastral value of one hectare of farmland increased, there was no corresponding increase in the efficiency of subsidies (**Table 5**). This could suggest that territories, for the most part, are not fully utilizing the strategic advantages derived from the natural and economic potential of agricultural production. This finding aligns with the general view that in agriculture, not all aspects favorable for agricultural production (such as land, climate, water, labor, and rural infrastructure) can easily be transformed into competitive advantages (Pylypenko et al., 2019; Warlina et al., 2023). A number of scholars, including Erokhin et al. (2020b), and Pan et al. (2021), Tulla (2019), among others, argue that such competitive advantages of territories, such as land quality and climatic conditions for production, cannot be considered objects of management. Instead, indicators of the efficiency of agricultural production under the natural and climatic conditions of individual territories merely signal the need for direct management intervention (through agricultural enterprises). Subsidies can be used as a tool for such intervention on the part of the government to adjust the existing specialization of agricultural enterprises and strengthen the competitive advantages of specific territories.

In the context of revealed mismatches between the availability and actual use of natural resources and comparative advantages in the agricultural sector across territories, the efficiency of government support at the regional level should be supplemented by the product-level analysis (**Table 6**). It is found that the return on subsidies varies by type of product. For example, on average, the return on support for sunflower production is almost 19%, compared to only 8% for vegetables and about 11% for beef.

Table 5. Efficiency of subsidies per categories of territories with and without the influence of cadastral value of farmland.

Categories	Output		Revenue		Efficiency		Profitability	
	O	***O_N***	***R***	***R_N***	***E***	***E_N***	***P***	***P_N***
Category 1: Low	70	757	19	72	0.10	1.03	2.58	9.67
Category 2: Below average	127	704	35	74	0.18	0.98	4.85	10.25
Category 3: Average	174	1035	47	84	0.16	0.96	4.36	7.82
Category 4: Above average	227	1197	62	74	0.18	0.93	4.81	5.78
Category 5: High	529	1674	144	169	0.28	0.89	7.62	8.95

Note: O = output generated by support, RUB/hectare; O_N = output generated by support, cleared of the influence of cadastral value of farmland, RUB/hectare; R = revenue generated by support, RUB/hectare; R_N = revenue generated by support, cleared of the influence of cadastral value of farmland, RUB/hectare; E = efficiency of support, RUB/RUB; E_N = efficiency of support, cleared of the influence of cadastral value of farmland, RUB/RUB; P = profitability of support, the revenue-support ratio, %; P_N = profitability of support, cleared of the influence of cadastral value of farmland, the revenue-support ratio, %.
Source: Authors' development.

Table 6. Efficiency of subsidies for selected agricultural products.

Products	Units of measure	***S***	***O***	***R***	***E***	***I***	***P***
Grain	RUB/hectare of farmland	649	701	52	1.08	0.93	8.01
Sunflower		713	848	135	1.19	0.84	18.93
Sugar beet		3757	4396	639	1.17	0.85	17.01
Vegetables		24,432	26,387	1955	1.08	0.93	8.00
Potatoes		8117	9010	893	1.11	0.90	11.00
Beef	RUB/head of cattle	1531	1699	168	1.11	0.90	10.97
Pork		422	485	63	1.15	0.87	14.93
Milk and dairy		4117	4611	494	1.12	0.89	12.00
Eggs	RUB/thousand birds	42,739	47,868	5129	1.12	0.89	12.00

Note: S = amount of support per hectare of farmland, RUB/hectare; O = output generated by support, RUB/hectare; R = revenue generated by support, RUB/hectare; E = efficiency of support, RUB/RUB; I = impact of support, unit of support per unit of output, RUB/RUB; P = profitability of support, the revenue-support ratio, %.
Source: Authors' development.

The efficiency of government support for different types of agricultural products varies significantly between categories of territories (**Table 7**). Producing certain types of products may not be economically viable in certain conditions. For example, in the vegetables sector in Category 2 territories, the return on unit of subsidy is only 0.85, in the potatoes sector in Category 1 territories—0.89. It is likely that the efficiency of subsidies is higher for products that are consistent with the natural and economic conditions of territories where they are cultivated. This efficiency-consistency relationship should be considered when allocating budget funds to different regions.

Table 7. Effectiveness of subsidies for categories of territories.

Products	Territories				
	Category 1	**Category 2**	**Category 3**	**Category 4**	**Category 5**
Grain	1.14	1.18	1.16	1.12	1.00
Sunflower	1.19	1.24	1.23	1.14	1.18
Sugar beet	0.00	1.20	1.11	1.11	1.18
Vegetables	1.08	0.85	1.14	0.90	1.67
Potatoes	0.89	1.09	1.09	1.11	1.15
Beef	1.09	1.16	1.14	1.26	1.17
Pork	1.12	1.16	1.11	1.17	1.16
Milk and dairy	1.11	1.15	1.12	1.11	1.16
Eggs	1.13	1.12	1.08	1.14	1.15

Note: *S* = amount of support per hectare of farmland, RUB/hectare; *O* = output generated by support, RUB/hectare; *R* = revenue generated by support, RUB/hectare; *E* = efficiency of support, RUB/RUB; *I* = impact of support, unit of support per unit of output, RUB/RUB; *P* = profitability of support, the revenue-support ratio, %.
Source: Authors' development.

5. Conclusion

5.1. Major findings

The study shows that in heterogeneous agricultural production patterns, the allocation of subsidies may not entirely follow the efficiency principle, i.e., the return on allocated funds. The latter depends largely on the competitive advantages of territories in producing certain products. Therefore, the principal mismatch revealed by the authors is the one between competitive advantages of territories in agricultural production and an amount of funds received by territories though government support programs. The regionalization of government support leads to the consolidation of agricultural production, without taking into account the differences in natural and economic conditions of agriculture. To optimize the potential of individual territories in the agricultural sector, it is essential to link the distribution of budgetary funds with the effectiveness of their use. By targeting farmers who produce products that are most profitable for a particular territory, taking into account its economic conditions and accessibility to consumers, the government can ensure a more efficient use of funds in agriculture. It is advisable to increase the efficiency of subsidies by leveraging the competitive advantages of territories, which can help to increase their output and revenue, while reducing the cost of obtaining resources. To do this, government support can be provided for territories that focus on producing agricultural products that best suit their natural and economic competitive advantages. Existing approaches do not allow for an accurate assessment of the impact per unit of input in territories with varying natural and economic potentials. The approach proposed by the authors provides a means to quantify the effects (output, revenue) and efficiencies (returns, impact, profitability) of state support in agriculture across diverse territories. The methodology is supported by the two models that help to quantify the impact of the amount of support and the cadastral value of farmland on output and revenue generated by support in order to identify the part of the performance indicators that are formed under the influence of natural and economic conditions of agricultural production.

5.2. Policy implications

On the case of Russia, the study indicates that the efficiency of government support varies significantly depending on the type of agricultural product produced in different territories. This finding suggests that the Russian government should take into account differences in cadastral values of farmland when distributing subsidies among territories and individual farmers. In particular, differences in the cadastral value of agricultural land between territories 1–5 should be considered not only when determining the parameters for state support for farmers, but also when developing a mechanism to equalize economic conditions for agricultural production on lands of different quality. This could include differentiating land tax rates and rental fees, optimizing the spatial placement of crops and the size of land plots for specific crops or livestock farming, and introducing rationing for field mechanized work in agricultural crop cultivation.

As the study shows, it is possible to use the ERI indicator for the territorial differentiation of the level of support for farmers, based on data on the cadastral value of land. This approach can be applied to optimize land use (by excluding areas with negative net income from arable land and transferring them to less intensive uses) and determine the amount of lost profits and damages caused to land users due to the seizure of their agricultural land.

Russia’s Ministry of Agriculture and the Federal Service for State Registration, Cadastre and Cartography should assess the cadastral value of land across the entire set of agricultural crops, including fallow fields, while taking into account the costs of previous years. This will allow for an adjustment of the land tax rate depending on prevailing weather conditions and natural disasters. The results of the assessment can be distributed among agricultural organizations and further divided within them, according to crop rotations, individual fields and land plots. Information about soil quality (RI_f), technological properties of the land (RI_t), and the location of the land plots (RI_l) should be taken into account during this process.

5.3. Limitations

The model developed by the authors takes into account three dimensions of cadastral land value, which means that various external factors that affect rental income may be left out of the scope. When evaluating, it is important to take into account factors such as soil parameters (humus content, nutrient availability, acidity), physical factors (terrain, rockiness), and climatic factors (precipitation, temperature) that play a significant role in crop yield formation and directly affect land rent and, consequently, land prices.

Another limitation is the accuracy of the data that is used to differentiate support measures. In order to identify different types and varieties of soil and categorize them according to their cadastral value, a complex set of expensive works must be carried out, such as selecting and conducting soil surveys. This is unlikely to happen in the context of mass assessment. It is also unlikely that the required data can be obtained from other sources, as keeping the data up-to-date requires a continuous and comprehensive soil survey nationwide.

The parameters of the model should be assessed over a longer period of time than that captured in the study (preferably, above a decade). This allows one to identify the true fertility of the soil and smooth out the influence of natural, climatic, and organizational factors over time. Updating state support parameters based on data from the cadastral valuation of land should take into account a shared distribution of economic results, which can significantly simplify calculations and improve the reliability of results. This ensures the adequacy of land taxation to the potential rental income of landowners.

5.4. Future research directions

To eliminate the limitation of the model's parameters in future studies, it would be advisable to introduce additional variables into the analysis. This will increase the potential for using the model in countries other than Russia, as it can be adapted to the specific requirements of national regulations for calculating the cadastral value of land and to the national systems for collecting agricultural statistics.

It would be promising to study the feasibility and possibility of including a normative yield parameter in the model, by type of crop, taking into account the climatic and other conditions of agricultural production in a specific territory. The group of economic factors could be supplemented with indicators of the economic development of the area where the land is located, as well as the average income level of the population in that area. The question of whether the profit of the land user (landowner) can be used as a parameter for the cadastral value of the land is debatable. Internationally, this parameter is not reported when evaluating agricultural land because it is difficult to separate the amount of profit from the rent paid for land. Within the location parameters of a land plot, a model can include such indicators as the availability of engineering communications on the territory and the proximity to transport and infrastructure facilities. The technological parameters of the land may also include characteristics hydrographic networks in addition to the terrain parameters.

A promising direction is the development of a mechanism to take into account the assessment of soil quality in the cadastral valuation of land based on an expert survey. This would allow for the use of the criterion of cadastral land price not only in determining the amount of state support but also in prioritizing newly formed land plots for land redistribution. Additionally, it would be possible to inform tenants about the condition of soils when leasing a land plot for agricultural production.

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References

Adepoju, A., Adewole, O., & Olanitori, O. (2023). Migration and livelihood of rural households in Nigeria. Western Balkan Journal of Agricultural Economics and Rural Development, 5(1), 73–89. https://doi.org/10.5937/wbjae2301073a

Afanas'ev, R., Golovanova, N. (2016). Evaluating the effectiveness of budgetary expenditures: Federal and regional practices. Financial Analytics: Science and Experience, 2, 56–61.

Aliyeva, L., Huseynova, S., Babayeva, S., et al. (2019). Food security and optimal government intervention level in agriculture (comparative analysis). Bulgarian Journal of Agricultural Science, 25(2), 12–20.

Altukhov, A. (2020a). Food security in the context of implementation of the new editors of her doctrine. Bulletin of Kursk State Agricultural Academy, 9, 82–90.

Altukhov, A. (2020b). Spatial Development of the Country's Agriculture: Problems and Possible Solutions. AIC: Economics, Management, 12, 48–55. https://doi.org/10.33305/2012-48

Altukhov, A. (2021). Spatial the agriculture development in the country need an integrated approach. Bulletin of Kursk State Agricultural Academy, 5, 95–103.

Awasthi, M. K. (2014). Socioeconomic determinants of farmland value in India. Land Use Policy, 39, 78–83. https://doi.org/10.1016/j.landusepol.2014.04.002

Baráth, L., Fertő, I., & Bojnec, Š. (2020). The Effect of Investment, LFA and Agri-environmental Subsidies on the Components of Total Factor Productivity: The Case of Slovenian Farms. Journal of Agricultural Economics, 71(3), 853–876. https://doi.org/10.1111/1477-9552.12374

Baryshnikov, N., Samygin, D., & Murzin, D. (2019). Forecasting bankruptcy models for agrarian business. IOP Conference Series: Earth and Environmental Science, 274(1), 012048. https://doi.org/10.1088/1755-1315/274/1/012048

Bernini, C., & Galli, F. (2024). Economic and Environmental Efficiency, Subsidies and Spatio-Temporal Effects in Agriculture. Ecological Economics, 218, 108120. https://doi.org/10.1016/j.ecolecon.2024.108120

Bershitsky, Y. I., Tyupakov, K. E., Sayfetdinova, N. R., et al. (2016). Efficiency of the State Support of Agricultural Producers of Krasnodar Krai. Economics of Agriculture of Russia, 9, 30–36. https://doi.org/10.32651/2070-0288-2016-9-30-36

Bespakhotny, G., Mindrin, A., Tolmanov, V., et al. (2005). Methodology for assessing the effectiveness of the use of budgetary funds in agriculture. Ural State Agricultural Academy.

Božík, M. (2011). Reform of the CAP after 2013 and its impacts on Slovak agriculture. Agricultural Economics (Zemědělská Ekonomika), 57(1), 10–20. https://doi.org/10.17221/146/2010-agricecon

Buchta, S., & Buchta, T. (2009). Impact of the investment grants from the European funds on the development of agriculture and rural areas. Agricultural Economics (Zemědělská Ekonomika), 55(2), 59–66. https://doi.org/10.17221/584-agricecon

Bykanova, I., & Klochkova, T. (2014). Statistical methods for evaluating the effectiveness of subsidies. Young Scientist, 21, 285–288.

Carbone, J. C., & Rivers, N. (2017). The Impacts of Unilateral Climate Policy on Competitiveness: Evidence from Computable General Equilibrium Models. Review of Environmental Economics and Policy, 11(1), 24–42. https://doi.org/10.1093/reep/rew025

Casolani, N., Nissi, E., Giampaolo, A., et al. (2021). Evaluating the effects of European support measures for Italian organic farms. Land Use Policy, 102, 105225. https://doi.org/10.1016/j.landusepol.2020.105225

Chen, K., & Wang, Z. (2022). A Study on the Effects and Influencing Factors of Agricultural Support and Subsidy Policies from Big Data Computing and Analysis. Mobile Information Systems, 2022, 1–9. https://doi.org/10.1155/2022/7873981

Choumert, J., & Phélinas, P. (2015). Determinants of agricultural land values in Argentina. Ecological Economics, 110, 134–140. https://doi.org/10.1016/j.ecolecon.2014.12.024

Cimpoies, L. (2021). Agricultural support policy in Moldova: A key factor to agricultural development? Scientific Papers. Series Management, Economic Engineering in Agriculture and Rural Development, 21(2), 169–176.

Delekh, A. (2015). Quality of land and raw materials potentials as the most important term of state support sharing in agribusiness. Bulletin of Novosibirsk State Agrarian University, 35(2), 129–135.

Donaldson, D. (2019). Comparative advantage and agricultural trade. Agricultural Economics, 50(S1), 29–40. https://doi.org/10.1111/agec.12529

Epstein, D. (2012). Determining the effectiveness of subsidies based on basic equations of production. AIC: Economics Management, 5, 40–46.

Erokhin, V., Samygin, D., Tuskov, A., et al. (2023). Mitigating spatial disproportions in agriculture through revealing competitive advantages. Ekonomika Poljoprivrede, 70(4), 1157–1170. https://doi.org/10.59267/ekopolj23041157e

Erokhin, V., Gao, T., & Ivolga, A. (2020). Structural Variations in the Composition of Land Funds at Regional Scales across Russia. Land, 9(6), 201. https://doi.org/10.3390/land9060201

Erokhin, V., Diao, L., & Du, P. (2020). Sustainability-Related Implications of Competitive Advantages in Agricultural Value Chains: Evidence from Central Asia—China Trade and Investment. Sustainability, 12(3), 1117. https://doi.org/10.3390/su12031117

Fan, S., Yu, B., Yue, J., et al. (2023). A Study on the Measurement of Comparative Advantage of Land Use Efficiency, Spatiotemporal Heterogeneity and Its Influencing Factors—An Empirical Test from the Panel Data of China's Provincial Sub-Industry Types. Sustainability, 15(9), 7048. https://doi.org/10.3390/su15097048

Federal Service of State Statistics of the Russian Federation. (2024). Statistics. Available online: https://rosstat.gov.ru/statistic (accessed on 2 May 2024).

Fukasaku, K. (1992). Economic regionalisation and intra-industry trade: Pacific-Asian perspectives. OECD Publishing. https://doi.org/10.1787/035300332827.

Galchenko, S., Zdanova, R., Komarov, S., et al. (2020). Improving the methodology of cadastral assessment of agricultural land in order to increase the sustainability. International Agricultural Journal, 63(5), 5–9. https://doi.org/10.24411/2587-6740-2020-15081

Gheorghe, E., Marin, I., Constantin, T., et al. (2022). The impact of agricultural reforms on rural families in Romania. Western Balkan Journal of Agricultural Economics and Rural Development, 4(1), 65–85. https://doi.org/10.5937/wbjae2201065g

Grover, R. (2016). Mass valuations. Journal of Property Investment & Finance, 34(2), 191–204. https://doi.org/10.1108/jpif-01-2016-0001

Gueringer, A. (2019). Relationship between property and use of agricultural land: the case of the area of Pisa (Tuscany). Développement Durable et Territoires, 10(3). https://doi.org/10.4000/developpementdurable.15060

Hopewell, K. (2016). The accidental agro-power: Constructing comparative advantage in Brazil. New Political Economy, 21(6), 536–554. https://doi.org/10.1080/13563467.2016.1161014

International Organization for Standardization. (2015). ISO 9000:2015. Quality Management Systems. Fundamentals and Vocabulary. Available online: https://www.iso.org/standard/45481.html (accessed on 2 May 2024).

Janků, J., Sekáč, P., Baráková, J., et al. (2016). Land use analysis in terms of farmland protection in the Czech Republic. Soil and Water Research, 11(1), 20–28. https://doi.org/10.17221/163/2015-swr

Janus, J., & Ertunç, E. (2020). The impact of differences in land fragmentation parameters on the planning, implementation, and evaluation of land consolidation projects. Case studies of Turkey and Poland. Computers and Electronics in Agriculture, 179, 105813. https://doi.org/10.1016/j.compag.2020.105813

Jordan, C., Donoso, G., & Speelman, S. (2021). Irrigation subsidy policy in Chile: lessons from the allocation, uneven distribution and water resources implications. International Journal of Water Resources Development, 39(1), 133–154. https://doi.org/10.1080/07900627.2021.1965964

Jovanović, O., & Zubović, J. (2019). The importance of subsidies for SME development in the agricultural sector of Serbia. Western Balkan Journal of Agricultural Economics and Rural Development, 1(1), 51–61. https://doi.org/10.5937/wbjae1901051j

Kalinin, A., & Samokhvalov, V. (2020). The effectiveness of financial support for agriculture: An overall assessment and inter-budgetary impact. Problems of Forecasting, 5, 142–152.

Kilić, J., Rogulj, K., & Jajac, N. (2019). Fuzzy expert system for land valuation in land consolidation processes. Croatian Operational Research Review, 10(1), 89–103. https://doi.org/10.17535/crorr.2019.0009

Konečný, O. (2017). Spatial polarization of agriculture of Czechia during the integration into the European Union. Geografie, 122(3), 257–280. https://doi.org/10.37040/geografie2017122030257

Korableva, A. A., Chupin, R. I., & Kharlamova, M. S. (2018). Assessment of the impact of resource balance and grainuse on wheat price in the regions of Russia. Perm University Herald, 13(4), 532–548. https://doi.org/10.17072/1994-9960-2018-4-

532-548
Kosenchuk, O. V. (2018). Development of rural territories on the basis of price regulation in an agro-cluster. Perm University Herald, 13(2), 196–211. https://doi.org/10.17072/1994-9960-2018-2-196-211
Latruffe, L. (2010). Competitiveness, productivity and efficiency in the agricultural and agri-food sectors. OECD Publishing. https://doi.org/10.1787/5km91nkdt6d6-en
Laursen, K. (2015). Revealed comparative advantage and the alternatives as measures of international specialization. Eurasian Business Review, 5(1), 99–115. https://doi.org/10.1007/s40821-015-0017-1
Leń, P., Maciąg, M., & Maciąg, K. (2023). Design of an Automated Algorithm for Delimiting Land Use/Soil Valuation Classes as a Tool Supporting Data Processing in the Land Consolidation Procedure. Sustainability, 15(11), 8486. https://doi.org/10.3390/su15118486
Liefert, W. M. (2002). Comparative (Dis?) Advantage in Russian Agriculture. American Journal of Agricultural Economics, 84(3), 762–767. https://doi.org/10.1111/1467-8276.00334
Mamatzakis, E., & Staikouras, C. (2020). Common Agriculture Police in the EU, direct payments, solvency and income. Agricultural Finance Review, 80(4), 529–547. https://doi.org/10.1108/afr-04-2019-0047
Matchaya, G. C. (2020). Public spending on agriculture in Southern Africa: Sectoral and intra-sectoral impact and policy implications. Journal of Policy Modeling, 42(6), 1228–1247. https://doi.org/10.1016/j.jpolmod.2020.05.002
Mironova, I. (2004). Features of the analysis of state support for agricultural enterprises. In: Proceedings of the All-Russia Conference of Young Researchers of the North-West Federal District "Young Researchers for Scientific Support for Agriculture in Modern Times"; 18–21 November 2003; Saint Petersburg State Agrarian University.
Nabokov, V., Skvortsov, E., Sharapova, N., et al. (2021). Main factors of the spatial development in promoting and hindering agriculture robotization in Russia. International Transaction Journal of Engineering, Management & Applied Sciences & Technologies, 12(11), 12A11E. https://doi.org/10.14456/ITJEMAST.2021.215.
Nastis, S. A., Papanagiotou, E., Zamanidis, S., et al. (2012). Productive Efficiency of Subsidized Organic Alfalfa Farms. Journal of Agricultural and Resource Economics. https://doi.org/10.22004/AG.ECON.134283
Marques-Perez, I., Mora-Navarro, G., Perez-Salas, J. L., et al. (2017). Agricultural land values using Geographic Information Systems: design location model and tools for information available by geoportal. Application to a Spanish Agricultural Area. Survey Review, 50(363), 545–554. https://doi.org/10.1080/00396265.2017.1350342
Ministry of Agriculture of the Russian Federation. (2017). Decree #333 from 7 July 2017 "On approval of the methodology for evaluating the effectiveness of the state program for the development of agriculture and regulation of agricultural products, raw materials and food markets for 2013–2020". Available online: https://base.garant.ru/71721578/ (accessed on 2 May 2024).
Ministry of Economic Development of the Russian Federation. (2005). Decree #145 from 4 July 2005 "On approval of methodological recommendations on the state cadastral assessment of agricultural land". Available online: https://base.garant.ru/12141374/ (accessed on 2 May 2024).
Nedeljković, D., Zečević, L., & Zečević-Stanojević, O. (2023). The importance of human capital in agribusiness and rural development of Serbia. Western Balkan Journal of Agricultural Economics and Rural Development, 5(2), 151–162. https://doi.org/10.5937/wbjae2302151n
Pamuković, J. K., Rogulj, K., & Jajac, N. (2020). Assessing the Bonitet of Cadastral Parcels for Land Reallocation in Urban Consolidation. Land, 10(1), 9. https://doi.org/10.3390/land10010009
Pan, C., Jiang, Y., Wang, M., et al. (2021). How Can Agricultural Corporate Build Sustainable Competitive Advantage through Green Intellectual Capital? A New Environmental Management Approach to Green Agriculture. International Journal of Environmental Research and Public Health, 18(15), 7900. https://doi.org/10.3390/ijerph18157900
Pellegrina, H. S. (2022). Trade, productivity, and the spatial organization of agriculture: Evidence from Brazil. Journal of Development Economics, 156, 102816. https://doi.org/10.1016/j.jdeveco.2021.102816
President of the Russian Federation. (1998). Federal Law #45 from 31 July 1998 "Budgetary code of the Russian Federation". Available online: https://base.garant.ru/12112604/#friends (accessed on 2 May 2024).
Pylypenko, N., Klietsova, N., & Stoianenko, I. (2020). An empirical analysis of competitiveness factors of the region's agrarian sector. Baltic Journal of Economic Studies, 5(5), 128. https://doi.org/10.30525/2256-0742/2019-5-5-128-135
Rada, N., Liefert, W., & Liefert, O. (2019). Evaluating Agricultural Productivity and Policy in Russia. Journal of Agricultural Economics, 71(1), 96–117. https://doi.org/10.1111/1477-9552.12338

Romanov, A., Bezaev, I. (2015). Model building of distribution of state support to optimize security investments. Bulletin of Nizhny Novgorod State Agricultural Academy, 15(1), 48–54.

Romanov, R. (2015). Main directions and methods of state regulation of agricultural production. Agrarian Bulletin of the Urals, 139(9), 97–101.

Samygin, D. Yu., Baryshnikov, N. G., & Mizjurkina, L. A. (2019). Models of Scenario Forecasting of the Region's Agriculture Development. Economy of Region, 15(3), 865–879. https://doi.org/10.17059/2019-3-18

Samygin, D., & Kudryavtsev, A. (2018). Strategic Instruments of State Support Distribution in the Agrarian Sector. Economic Policy, 13(5), 156–175. https://doi.org/10.18288/1994-5124-2018-5-156-175

Samygin, D., Lunochkin, D., Myakishev, A. (2023). Comparative advantages of the territories of the Russian Federation in the agricultural sector: Database (data on average for 2017–2020). Available online: https://elib.pnzgu.ru/files/eb/doc/zMIVtQe3mJhw.pdf (accessed on 2 May 2024).

Sapozhnikov, P. M., Ogleznev, A. K., Filippova, Yu. N., et al. (2019). Differentiation of the Cadastral Value of Agricultural Lands in Tyumen Oblast. Eurasian Soil Science, 52(11), 1456–1462. https://doi.org/10.1134/s1064229319090072

Seitov, S. K. (2022). Subsidies as a measure to increase factor productivity in agriculture of Russia. Moscow University Economics Bulletin, 6, 100–122. https://doi.org/10.38050/01300105202265

Syomin, A. N., Maltsev, N. V., & Loginov, A. L. (2019). About need of improvement of the assessment mechanism of the state support in agrarian and industrial complex. Economics of Agriculture of Russia, 9, 2–11. https://doi.org/10.32651/199-2

Sharapova, N. (2019). The mechanism of support for agricultural producers in the state regulation system of the industry: Theoretical, methodological, and practical aspects. Talent Pool Foundation.

Shavandina, I., & Rein, A. (2015). Evaluation of the methods increasing the efficiency of resources allocation of agriculture state support. Theory and Practice of Social Development, 18, 74–77.

Shik, O., Serova, E., & Yanbykh, R. (2020). Review of the budget support system for the agricultural sector in Russia. Public Administration Issues, 2, 145–167.

Si, C., Li, Y., & Jiang, W. (2023). Effect of Insurance Subsidies on Agricultural Land-Use. International Journal of Environmental Research and Public Health, 20(2), 1493. https://doi.org/10.3390/ijerph20021493

Sklenicka, P., Molnarova, K., Pixova, K. C., et al. (2013). Factors affecting farmland prices in the Czech Republic. Land Use Policy, 30(1), 130–136. https://doi.org/10.1016/j.landusepol.2012.03.005

Snajberga, O. (2015). Valuation of real estate with easement. Procedia Economics and Finance, 25, 420–427. https://doi.org/10.1016/S2212-5671(15)00753-4

Song, B., Zhao, J., & Zhang, P. (2022). A Study on Factors Influencing the Efficiency of Rural Agriculture Financial Support in China. Sustainability, 14(22), 14954. https://doi.org/10.3390/su142214954

Stopar, I., & Šubic Kovač, M. (2016). Land valuation in case of easement: the case study in Slovenia. Geodetski Vestnik, 60(04), 685–716. https://doi.org/10.15292/geodetski-vestnik.2016.04.685-716

Subić, J., Nastić, L., & Roljević-Nikolić, S. (2020). Economic effects of investment in dairy farming. Western Balkan Journal of Agricultural Economics and Rural Development, 2(2), 135–146. https://doi.org/10.5937/wbjae2002135s

Tang, X., Wang, J., Zhang, B., et al. (2017). Application of the DEA on the performance evaluation of the agricultural support policy in China. Agricultural Economics (Zemědělská Ekonomika), 63(11), 510–523. https://doi.org/10.17221/120/2016-agricecon

Tulla, A. F. (2019). Sustainable Rural Development Requires Value-Added Activities Linked with Comparative Advantage: The Case of the Catalan Pyrenees. European Countryside, 11(2), 229–256. https://doi.org/10.2478/euco-2019-0012

Tyupakov K (2016). Features of effective formation and reproduction of the technical and technological basis of crop production. Krasnodar State Agrarian University.

Uzun, V. (2017). Restriction of the size of subsidies to one agricultural producer: Need, mechanisms, consequences. AIC: Economics, Management, 11, 12–31. https://doi.org/10.33305/1711-12

Uzun, V., Gataulina, E. (2010). Methodological approaches to evaluating the effectiveness of government support for agricultural producers. All-Russian Institute of Agricultural Problems and Informatics named after A.A. Nikonov.

Uzun, V. Y., Saraykin, V. A., Karlova, N., et al. (2014). Methods of Assessing the Impact of Agricultural Policies on Agricultural Development. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.244420

Wang, S. W., Manjur, B., Kim, J.-G., et al. (2019). Assessing Socio-Economic Impacts of Agricultural Subsidies: A Case Study from Bhutan. Sustainability, 11(12), 3266. https://doi.org/10.3390/su11123266

Warlina, L., Soegoto, E. S., Supatmi, S., et al. (2023). Regional competitive advantage of agriculture as the leading sector in Garut Regency, West Java province, Indonesia. Journal of Eastern European and Central Asian Research (JEECAR), 10(1), 74–84. https://doi.org/10.15549/jeecar.v10i1.1084

Yan, B., Yan, J., Shi, W., et al. (2019). Study on the comprehensive comparative advantages of pig production and development in China based on geographic information system. Clean Technologies and Environmental Policy, 22(1), 105–117. https://doi.org/10.1007/s10098-019-01772-3

Zhang, S., & Sun, T. (2012). Study on the efficiency of agricultural subsidy policy and its influence factors: An empirical analysis based on survey data of 360 households in Henan province. Journal of Agrotechnical Economics, 12, 68–74.

Zhang, Y., Wang, Y., & Bai, Y. (2019). Knowing and Doing: The Perception of Subsidy Policy and Farmland Transfer. Sustainability, 11(8), 2393. https://doi.org/10.3390/su11082393

Zhu, L., Shi, R., Mi, L., et al. (2022). Spatial Distribution and Convergence of Agricultural Green Total Factor Productivity in China. International Journal of Environmental Research and Public Health, 19(14), 8786. https://doi.org/10.3390/ijerph19148786

Zhu, X., & Lansink, A. O. (2010). Impact of CAP Subsidies on Technical Efficiency of Crop Farms in Germany, the Netherlands and Sweden. Journal of Agricultural Economics, 61(3), 545–564. https://doi.org/10.1111/j.1477-9552.2010.00254.x

Zieliński, M., Wrzaszcz, W., Sobierajewska, J., et al. (2024). Development and Effects of Organic Farms in Poland, Taking into Account Their Location in Areas Facing Natural or Other Specific Constraints. Agriculture, 14(2), 297. https://doi.org/10.3390/agriculture14020297