MITIGATING SPATIAL DISPROPORTIONS IN AGRICULTURE THROUGH REVEALING COMPETITIVE ADVANTAGES

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ARTICLE INFO

Review Article

Received: *02 October 2023*

Accepted: *30 November 2023*

doi:10.59267/ekoPolj23041157E

UDC 338.43.01:631.1.017

Keywords:

accessibility, availability, food security, spatial planning, specialization, territory

***JEL**: O13, Q13, Q18*

ABSTRACT

Spatial development of agriculture has always been among the core agendas of food security. Amid the increased volatility of food markets globally, low diversification of agricultural production depresses competitiveness and flexibility of farmers. To narrow spatial development gaps, the study presents the five-stage approach to revealing territory-specific competitive advantages in producing nine categories of agricultural products. The data is collected across all administrative territories of Russia categorized according to the cadastral value of farmland. The revealed mismatches between the parameters of food self-sufficiency, productivity of crops, and profitability of farmers show that agricultural policy should aim at stimulating production of competitive products with due account to the spatial features of agriculture to ensure the highest return per unit of inputs along with adequate accessibility of staples for consumers. Determining proportions in which agricultural facilities should be allocated across territories would allow governments to tailor the resource provision programs, including subsidies to territories, agricultural sectors, and individual producers.

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Introduction

Food security reflects certain conditions of a food market under which all consumers at any time have full physical, social, and economic access to sufficient, safe, and nutritious food (Food and Agriculture Organization of the United Nations, 2009). Since recently, many of the conventional threats to food security in Russia, such as environmental and economic aspects of agricultural production, have been aggravating under the pressure of economic sanctions on the country (Samygin, Kudryavtsev, 2018). Against the background of new challenges to food security, there are arising problems of dependence on imports across a variety of food sectors, low self-sufficiency of the country on certain agricultural products, increasing costs in agriculture, and deteriorating accessibility of staples due to degrading real incomes spurred by food inflation (Kuznetsov, 2022; Loginova, 2022).

Zakshevskii et al. (2019), Erokhin et al. (2022), and Kumar (2022) recognize the potential of developing existing competitive advantages, as well as revealing the new ones as most promising ways of adaptation to the contemporary challenges to the agricultural sector. Carbone and Rivers (2017) and Donaldson (2019) demonstrate the importance of promoting competitiveness of local farmers for achieving the food security and food self-sufficiency goals. Promoting competitive advantages allows agricultural producers to raise the quality of their products, reduce prices, increase efficiency, and thus improve the parameters of physical availability and economic accessibility of food (Mahajan, Tomar, 2021). According to Addai et al. (2023), an important issue in the transformation of approaches to strategic planning in agriculture is the convergence of the spatial development tasks with those of agricultural production and sustainable rural development. This approach makes it possible to identify the features of spatial development of various types of territories, identify their strengths and weaknesses, and determine the individual set of spatial development tools (Harbiankova, Gertsberg, 2022). As demonstrated by Li et al. (2022) and Shi et al. (2023), sustainable development of rural areas is facilitated by spatial development mechanisms, including attraction of resources from periphery territories to centers of agricultural and economic development (the agglomeration effect) and the spread of innovations from the center to the periphery areas. The resource allocation processes ultimately aggravate uneven development and concentration of economic activity in more developed territories (Mishchenko, 2012). Liu et al. (2022) and Widomski and Musz-Pomorska (2023) advocate a need for using an integrated approach in the "competitiveness - spatial development - sustainable rural development" paradigm to ensure a more efficient and rational use of scarce natural, labor, and financial resources in agriculture.

In addition to the external pressures on the competitiveness of Russian farmers, one of the most significant internal constraints is the spatial disproportions of agricultural production. In Soviet times, command allocation of production forces considered natural conditions of individual territories, but it still contributed to emerging over-specialization of particular areas on farming particular crops (Erokhin et al., 2020b). Low

spatial diversification of agricultural production depressed both the competitiveness positions and flexibility of farmers in addressing challenges to food security, such as degradation of agricultural lands, climate change effects on productivity of crops and agricultural animals, and social stratification issues in rural areas (Wegren, Elvestad, 2018). Spatial disproportions aggravate inter- and intra-regional differentiation, thereby threatening competitiveness in agriculture (Zakshevskii et al., 2019). Significant natural and economic differences between territories in Russia stipulate the need for regional specialization in the cultivation of the most suitable crops (Samygin et al., 2019; Erokhin et al., 2020a).

Taking into account the load of challenges to competitiveness of agricultural producers in Russia, as well as the fact that not all national food security tasks have been solved, the revision of approaches to strategic planning in agriculture is required. The research hypothesis is that in order to secure domestic supply of food at the adequate consumption threshold, the government needs to mitigate spatial disproportions of agricultural production and employ all of the available agricultural capacities across the country. The research question is whether the purely market concept of competitive advantage could be converged with the government's intervention into adjusting spatial development processes in agriculture. It is assumed that the latter allows for focusing agricultural producers on achieving strategic development goals from the perspective of rational use of natural, economic, and social potential of a territory. Therefore, it is important to focus research on investigating spatial development patterns beneficial for both producers and consumers. Addressing the relevance of bridging spatial development gaps in allocation of production forces in agriculture, this study aims at elaborating and testing of the approach to revealing competitive advantages across agricultural sectors in diverse territories of Russia.

The rest of the paper is organized as follows. The Materials and Methods section explains the research framework used to assess competitive advantages of territories, as well as overviews the set of variables along the stages of the study. The Results section reports major findings. In the Discussion, the authors discuss the findings and point out the potential contributions of the study to the literature. Conclusion summarizes authors' findings and outlines their implications.

Materials and methods

Common criteria used in the assessment of competitive advantages of territories include gross output and yield per unit of land area, cost intensity and labor intensity of production, cost per unit of inputs, average producer price and export price, share of exports in the volume of production and that of imports in the domestic supply, transportation and logistics costs, and the volume of government support of domestic farmers. None of the methods of assessing competitive advantages is free from limitations (Table 1). As argued by Sachitra (2016), the comprehensive assessment of competitive advantage should take proper account of not only producer-specific, but also territory-specific features of agricultural production, as well as it should expand

the scope of analysis from merely physical parameters of availability of food supplies to wider dimensions of food security. Among the approaches to assessing advantages, the OECD methodology of comparative analysis of state support for agricultural production most comprehensively reflects spatial features of competitive advantages (Fukasaku, 1992). In Russia, the methodology was adjusted by the Gaidar Institute for Economic Policy to measure the productivity of crops and agricultural animals, cost of production, and protection and support of producers (Serova et al., 2003).

Table 1. Major approaches to assessing competitive advantages of territories in spatial development of agricultural production

Approach	Sources	Essence	Limitations
Comparative analysis of government support for agricultural production	Fukasaku (1992), Serova at al. (2003), Aliyeva et al. (2019)	The approach aims at determining the degree of dependence of markets on import tariffs and state support, identifying comparative advantages of a territory, and quantifying the level of government support	The method is applicable to the assessment of agrarian policies. The parameters fail to capture competitive advantages of territories in ensuring accessibility of staples
Strategic spatial distribution of crop production	Feng et al. (2014), Siptitz et al. (2016), Pei et al. (2021)	The distribution scheme is based on the biological and climatic potential of territories. The formulation of the optimization problem is reduced to maximizing the net economic result of the agricultural sector.	The optimal sectoral structure of agriculture ensures the promotion of higher profitable activities while restraining the development of lower-performing sectors
Composite assessment of competitive advantages	Bogoviz et al. (2016), Maslova et al. (2019), Warlina et al. (2023)	Territories for favorable crop production are identified based on the use of a cumulative score and an composite index based on productivity, cost, and labor intensity indexes. Assessment is based on an integrated indicator	A limited set of crops/products and parameters used to assess competitive advantages. The method allows for assessing the competitiveness of products, but not to identify competitive advantages
Business and financial performance of agricultural producers	Romantseva (2010), Kuzmenkova (2013), Hayat et al. (2020)	Parameters characterize the level and size of agricultural production, the development of agriculture in a territory, and the use of production potential	The indicators show the efficiency, but not advantages of territories, which does not allow assessing advantages by product type
The conventional - green nexus of spatial development	Hussain et al. (2019), Akram et al. (2020), Wang et al. (2022)	The patterns of spatial distribution of agricultural production are determined by the transformation of conventional sectors and the development of organic agriculture and the green economy	The approach overemphasizes the role of environmental parameters of agricultural production in determining competitiveness of agricultural produces

Approach	Sources	Essence	Limitations
Behavioral aspects of allocation of production forces	Small et al. (2016), Gao et al. (2018), Raza et al. (2023)	Spatial distribution of productive forces are influenced by the behavioral paradigms in rural communities such as coping strategies, financial literacy of farmers, and sustainable development awareness	The competitive advantages nexus shifts from spatial development issues to community-specific issues of economic and social parameters of rural communities

Source: Authors' development

For the purpose of this study, the OECD-Gaidar set of parameters was supplemented by twelve authors' variables to better capture the aspects of physical availability and economic accessibility of agricultural products. The calculation algorithm was built along five stages (Table 2).

Table 2. Variables per stages

Stages	Variables	Indexes	Specification
Stage 1	Share in total	S	Contribution of the output of product i to the total agricultural output of a territory
	Productivity	$Prod$	Output of product i per unit of land or unit of input
	Cost	C	Cost of production per unit of product i
	Profitability*	$Prof$	Cost-price ratio for a unit of product i
	Self-sufficiency	S_S	Output-consumption ratio of product i per capita
	Availability*	A_V	Ratio of the output of product i per capita to the standards of rational and adequate consumption of this product
	Accessibility*	A_C	Ratio of the consumption of product i per capita to the standards of rational and adequate consumption of this product
Stage 2	Localization index	I_L	Ratio of the share of output of product i in the total agricultural output of a territory to the share of output of product i in the total agricultural output of a country
	Productivity index	I_{prod}	Ratio of the yield (productivity) of product i in a territory to the yield (productivity) of product i in a country
	Cost index	I_C	Ratio of the cost of product i in a country to that in a territory
	Consumer protection index	I_{CP}	Ratio of the price of product i in a country to the price of product i in a territory
	Self-sufficiency index*	I_{SS}	Ratio of the level of self-sufficiency of a territory in product i to the level of self-sufficiency of a country in product i
	Availability index*	I_{AV}	Ratio of physical availability of product i in a territory to the level of physical availability of product i in a country
	Accessibility index*	I_{AC}	Ratio of \economic accessibility of product i in a territory to the level of economic accessibility of product i in a country
	Product quality index*	I_{PQ}	Ratio of the quality parameter of product i in a territory to the quality parameter of product i in a country
	Profitability index*	I_{prof}	Ratio of the profitability of product i in a territory to the profitability of product i in a country
Stage 3	Composite index of competitive advantage*	I_{CA}	Geometric mean index per agricultural products

Stages	Variables	Indexes	Specification
Stage 4	Conditional output, territory*	O_T	Product of the gross output of product *i* in a territory and the composite index of competitive advantage of a territory
	Conditional output, country*	O_C	Sum of conditional outputs of territories under study
Stage 5	Weighted contribution coefficient*	C_{CW}	Ratio of the conditional output of product *i* in a territory to the conditional output of product *i* in a country

Note: * = introduced by authors. *Source:* Authors' development

Stage 1 captures availability and accessibility of staples at the regional and national levels. At Stage 2, indexes of comparative advantages are calculated on the basis of the obtained per-territory values. Localization index is the critical parameter to reveal areas of specialization, where $I_{Li} > 1$ shows competitive advantage of a territory in production of product *i*. Therefore, in this study, specialization is interpreted as a consequence of components of competitive advantages (yield, cost, profitability, etc.) of a territory. Agrarian policy is considered rational if both the localization index and the related component-specific indexes of competitive advantages exceed one. Based on the Stage 2 indexes, the study proceeds with calculating the composite index of competitive advantage (Stage 3) and parameters of conditional output at the territorial and national levels (Stage 4) and concludes with finding the weighted contribution coefficient at Stage 5. The study is based on the data for 2017-2019 collected across territories of Russia grouped according to the cadastral value of farmland (from the lowest in Type I territories to the highest in Type V territories).

Results

Spatial patterns of agricultural production in Russia do not entirely reflect competitive advantages of respective territories. In contradiction to the specialization principle, for certain products, prices and costs are higher in territories majoring in producing them ($I_L > 1$) than those in territories where $I_L \leq 1$. Thus, for grain, sunflower, sugar beet, potatoes, vegetables, and meat, lower I_L values are associated with higher production costs I_C (Table 3). Similar patterns are observed for the localization-productivity ratio for dairy and meat and the localization-profitability ratio for potatoes, vegetables, sunflower, milk, and eggs. The paradox is that in territories specializing in the production of the above products, profitability of those products is lower than that in non-specializing territories.

Table 3. Parameters of competitive advantages of territories

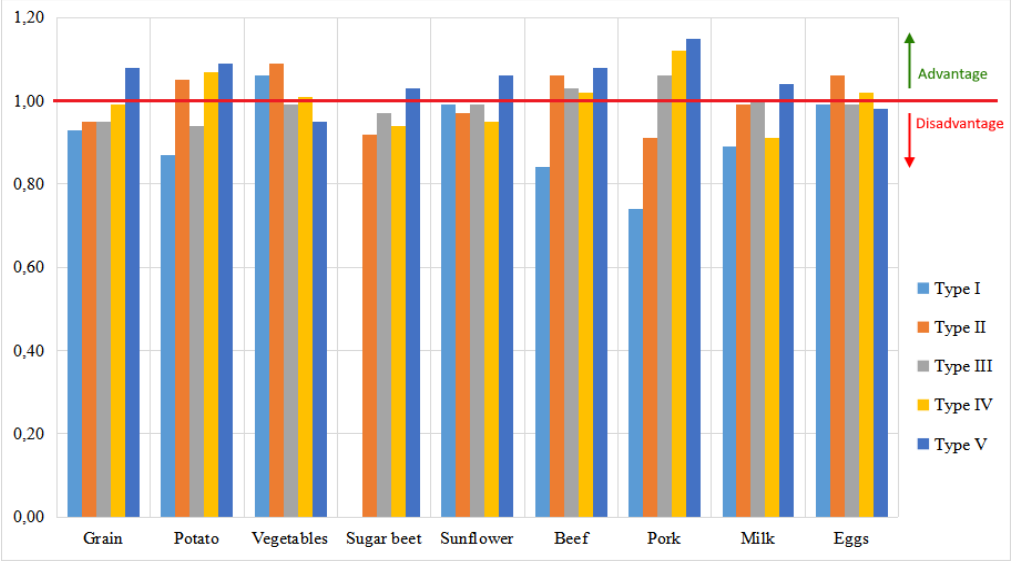
Products	Territories on I_L	Indexes								
		I_L	S	I_{prod}	I_C	I_{CP}	I_{SS}	I_{AV}	I_{AC}	I_{prof}
Grain	≤1	0.51	28.00	0.92	1.05	1.09	0.50	0.51	1.01	0.97
	>1	1.59	72.00	1.03	0.98	0.97	2.37	2.46	1.04	1.01

Products	Territories on I_L	Indexes								
		I_L	S	I_{prod}	I_C	I_{CP}	I_{SS}	I_{AV}	I_{AC}	I_{prof}
Potatoes	≤1	0.52	33.00	0.92	1.22	1.16	0.88	0.90	1.02	1.05
	>1	1.57	67.00	1.04	0.92	0.94	1.25	1.34	1.07	0.98
Vegetables	≤1	0.60	43.00	0.92	1.26	1.20	0.75	0.73	0.97	1.05
	>1	1.60	57.00	1.00	0.87	0.89	1.58	1.83	1.16	0.97
Sugar beet	≤1	0.58	13.00	0.79	1.02	1.11	0.47	0.49	1.01	0.92
	>1	2.65	87.00	1.04	1.00	0.99	2.31	2.34	1.03	1.00
Sunflower	≤1	0.37	9.00	0.80	1.15	1.01	0.41	0.42	1.00	1.13
	>1	2.17	91.00	1.06	0.99	0.99	2.52	2.55	1.02	1.00
Beef	≤1	0.63	52.00	1.04	0.82	1.01	1.21	1.24	1.02	0.81
	>1	1.73	48.00	0.94	1.32	0.92	0.97	0.90	0.93	1.44
Milk	≤1	0.61	31.00	1.16	1.01	0.98	1.09	0.98	0.90	1.03
	>1	1.42	69.00	0.94	1.00	1.01	1.15	1.23	1.07	0.99
Eggs	≤1	0.57	34.00	0.94	1.18	0.99	0.73	0.72	0.99	1.19
	>1	1.83	66.00	1.02	0.83	1.05	1.57	1.63	1.04	0.79

Source: Authors' development

Based on the Stage 2 data, there were calculated quotas for production of selected agricultural products at Stages 3-5 across five types of territories (Figure 1). Type V territories are the most suitable locations for the majority of staples (six products out the nine included in the study). Respectively, Type I territories demonstrated competitive advantage ($I_{CA} > 1$) in vegetable growing only.

Figure 1. Composite indexes of competitive advantages of types of territories



Source: Authors' development

When allocating quotas, the authors considered earlier findings of Sachitra (2016) and Erokhin et al. (2020b), who recommended taking into account returns per unit of agricultural resources, the availability of food for consumers, and the efficiency of agricultural production for farmers. The above approach highlights the relevance of parameters of yield and productivity (*Prod* and I_{prod}), cost (*C* and I_C), profitability (*Prof* and I_{prof}), and consumer protection (I_{CP} and I_{PQ}). Focusing on the geometric mean of I_{prod}, I_C, I_{prof}, and I_{CP}, the study resulted in revealing competitive advantages in producing selected staples across five types of territories (Figure 1). In these territories, the corresponding products occupy a significant share of production, as well as they are most affordable for consumers and most profitable for producers.

Discussions

Since the early 2000s, Russia's agrarian policy has been prioritizing self-sufficiency in basic foodstuffs (Wegren, Elvestad, 2018). This study's findings show that the parameters of self-sufficiency, availability, and accessibility of selected items (except meat) are higher in those territories, which specialize in producing those products. Nevertheless, while meeting national food self-sufficiency targets in quantitative terms, domestic producers fail to secure the domestic supply in accordance with international standards of adequate access to healthy nutrition for all. As demonstrated by the revealed relationships between the localization of production (sugar beet, potatoes, vegetables, meat), on the one hand, and cost and productivity indexes, on the other, prioritizing self-sufficiency in all categories of staples in all types of territories may turn into a detriment to local consumers. In case of the localization-productivity and the localization-profitability mismatches (meat and dairy and potatoes, vegetables, sunflower, milk, and eggs, respectively), agrarian policy is carried out to the detriment of farmers. In other territories, similar categories of agricultural products are either more affordable for consumer or more cost-effective for producers. Therefore, the spatial allocation of production forces should be optimized from the standpoint of both availability and accessibility of staples.

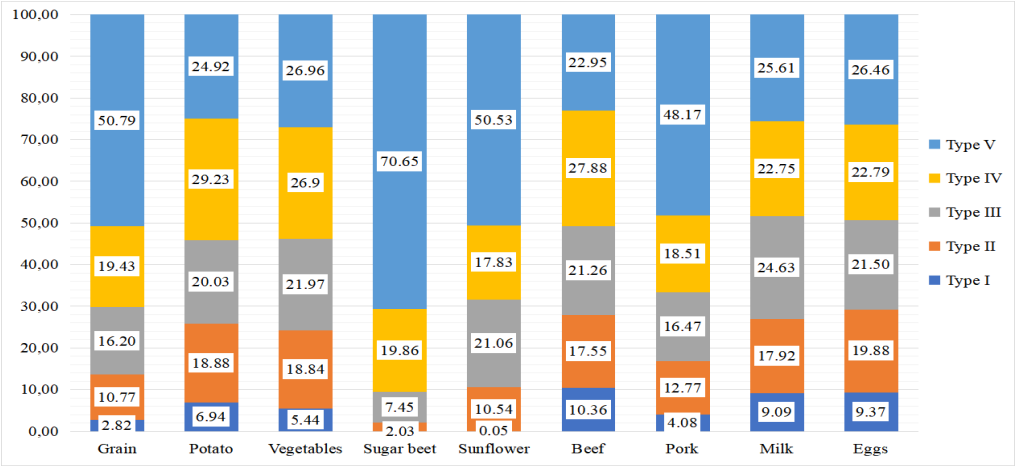
Fertö and Hubbard (2003) showed that the pursuance of self-sufficiency in all foods could result in the misallocation of scarce resources across territories. Asadullah and Savoia (2018) and Al-Abdelmalek et al. (2023) have been advocating higher thresholds of overall self-sufficiency due to the increased volatility of food markets and prices and disruption of food supply chains. However, as evidenced by Carbone and Rivers (2017) and Erokhin et al. (2020b), for lower-diversified agricultural sectors, self-sufficiency policy could hardly promote competitiveness across all sectors as it diverts resources to products with lower values of I_{prod} and it thus triggers underutilization of competitive advantages. The mismatches between the parameters of localization, productivity, and profitability show that agricultural policy should aim at stimulating production of competitive products ($I_{CA} > 1$) with due account to the spatial features of production in

order to ensure the highest return per unit of resources along with adequate accessibility and profitability of a product.

Advantages of only Type V territories could not be enough to ensure self-sufficiency in staples at the national level. Mishchenko (2012) and Li et al. (2021) show that the availability of high-productive arable land and pastures is one of the key determinants of competitive advantages of a territory, but they are not enough to ensure sustainable development of rural areas. Economic factors, such as the proximity of rural areas to product sales markets or centers of alternative non-agricultural employment of rural dwellers, are particularly significant in the development of rural areas in Russia. The stability of territorial systems depends on the concentration of economic activity in those places that have comparative advantages. The first-tier advantages include natural resources, climate, and geographical location (Krugman, 1991). They little depend on the efforts of local government or businesses. At the territorial level, governments may only affect second-tier factors, such as institutional environment, human capital, or agglomeration effect. According to Zubarevitch (2010), in Russia, conventional factors of competitive advantages, such as labor and capital, determine spatial development of rural areas by only 30%, while the remaining 70% of variables can be neither predicted nor assessed. Therefore, allocating production facilities in certain proportions across all types of territories is critical to mitigating spatial disproportions between first-tier and second-tier factors and encouraging the use of advantages (Figure 2).

Optimization of the structure of agricultural production could not only improve availability of staples on the market. It could also release misallocated resources and engage them in boosting the output of competitive products. Once the allocation of production facilities is adjusted, one can expect both accessibility of foods for consumers and the return on inputs for producers to go up.

Figure 2. Distribution of quotas for the production of staples across types of territories, %



Source: Author' development

By using advantages of a territory in crop yields (productivity of animals), it is possible to increase the total output (consequently, food availability). By using advantages in prices, it is possible to increase the total volume of food consumption in a territory (food availability). Also, by using advantages in cost and profitability of agricultural products, it is possible to improve the performance of farmers. As a result, the approach tested in this study could provide a tool for supporting strategic decisions on mitigating spatial disproportions in agriculture. It could be used to identify the optimal size of quotas for production of certain products in certain territories. Matching self-sufficiency targets with the localization parameters of advantages would allow governments to tailor the resource provision programs.

Conclusions

Contemporary challenges to establishing food security degrade the effectiveness of many conventional approaches to strategic planning in agriculture. A more flexible approach is needed to implement existing advantages and generate new ones at the regional level. Amid the new rise in food trade protectionism and increasing volatility of food supply chains, the implementation of competitive advantages should be focused on the improvement of availability and accessibility of food on domestic markets. The study demonstrated that an approach to revealing competitive advantages of territories should escape from overemphasizing efficiency and over-concentrating on measuring returns on inputs. The assessment framework should capture the parameters of availability and accessibility of food products. Localization and self-sufficiency targets should be flexible to reflect individual sets of advantages of individual territories. They should be measured against the parameters of productivity and profitability to narrow the gaps between self-sufficiency thresholds at the national level and varying agricultural production capacities of territories. The integration of composite indexes to the assessment framework allows for determining proportions in which production facilities should be allocated across types of territories. At the national level, these distribution patterns could be linked to both food self-sufficiency targets and rational consumption standards by categories of food products. Quotas at the national and regional levels act as a quantitative expression of the strategic goals of spatial development. The approach becomes an effective means of supporting strategic decision-making on spatial planning in agriculture.

Acknowledgements

This study was funded by the Russian Science Foundation (RSF) and Penza Region, Russia, Project No. 23-28-10277, https://rscf.ru/en/project/23-28-10277/

Conflict of interests

The authors declare no conflict of interest.

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