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**Research Article**

# Structural Analysis of the Material Specificity of Agriculture in the Context of Institutional Changes

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**ABSTRACT**:
The work is devoted to the consideration of institutional and sectoral changes in agriculture in the period 1990 - 2017. The outlined tendencies of integration and concentration of production, growth of investment appeal of branches of agriculture and growing interest on the part of the state in the development of the agroindustrial complex with the aim of ensuring the country's food independence are revealed. The need to reduce the material intensity of production is determined. The aim of the work is to develop approaches to assess the impact of structural changes in agricultural production on the level of material-output ratio of products. The proposed approach of analysis is based on index analysis with changing weights using expert estimates.On the basis of the calculations carried out, we estimated the changes in the material intensity under the influence of institutional changes in the agroindustrial complex and the sectoral relationships in agriculture, i.e. the growth of material intensity by increasing the share of large and medium-sized agricultural organizations and by increasing the share of livestock sectors in the total output.The directions of the state policy in relation to agriculture are proposed, such as increasing investments in the conditions of capital diversification and the development of territorial clusters in the agroindustrial complex, which will increase production efficiency and product competitiveness by reducing scale effect on the level of material consumption and the ability to optimize the industry structure of production from point of view to ensure consumer demand and reduce material costs.

**Key words:** farm categories, production structure, efficiency, materials-output ratio

## 1. INTRODUCTION

The conditions for the development of agriculture in Russia are now characterized by the formation of positive trends. There were created such powerful incentives for developing the industry as the relatively low exchange rate of the ruble against the US dollar and the euro, trade bans on the import of food to Russia. They allowed to make significant adjustments to the rules of trade, than the Russian producers of agricultural products and foodstuffs took advantage of. The dynamics of agricultural production exceeded the same indicator for industry and the economy as a whole.

In 2016, the index of agricultural production was 104.8% to the level of 2015 [6]. We can note an increase in the physical volume of investments to the agricultural sector for the first time in recent years: in 2016, compared to 2015, 110.4% at constant prices. In 2016, the Ministry of Agriculture proposed seven directions of state

support for the branches of agricultural sector, the most costly of which was Development of the Agro-industrial Complex (69.7 billion rubles) and Stimulation of Investment Activities in the Agro-industrial Complex (78.6 billion rubles, of which 58.8 billion rubles are proposed to be used to support investment lending to agrarians, 8.2 billion rubles for preferential loans, and 11.5 billion rubles for compensation of direct costs for construction and modernization of agro-industrial complex facilities).This positive matter of fact should be emphasized, since it means strengthening the factors for the further development of agricultural production. In 2017 (January-July of this year to the corresponding period of 2016), the production index was 102.2% (for comparison - in industrial production - 101.9%) [7].Thus, there is a need to clarify the approaches to analyzing the directions of the application of financial resources and the effectiveness of their use in agriculture.

Interest in industry processes remains, and the search for reasons that lead to production growth is expanding [4]. This is due to the growing role of food in ensuring the economic security of the state, the expected rise in the cost of food resources in conditions of the climate instability and the growth of population,leading to increased consumer demand.A significant role in scientific research in modern conditions has information support and its accessibility for researchers at various levels.At present, Russian statistics has expanded information on producer prices for agricultural products, publishing separately average prices for agricultural organizations (AO) and peasant farms (PF).It turned out that producer prices in PF are higher, so, in the 1st quarter of 2017, the average prices for cattle sold by producers for all categories of farms were 16.4% higher than prices for agricultural organizations, the excess for milk was 4.6%.Therefore, the issue of disparity in prices in agriculture remains relevant.Disparity of prices is still observed in comparison with the sectors providing agricultural producers with means of production (for example, in 2014, 2015 and 2016, the price indices of agricultural producers in the Russian Federation were 114.1, 108.5 and 101.8% while the indices for the main types of mineral fertilizers in the same periods were 142.8, 130.7 and 103.5%, respectively).Thus, the further development of the branches of agriculture must be based on a reduction in the material intensity of production. This study is aimed at determining approaches to assessing the influence of structural changes in agriculture on the efficiency of the industry in the context of the material intensity, which is relevant from the point of view of the need to increase production in conditions of limited resources.

The structure of production of agricultural products can be considered from the following positions: as a set of different categories of farms and as a set of industries. That is, the formed multistructured agriculture of Russia is currently represented by two sectors of production units: "Non-financial corporations" and "Households", each of which includes different categories of farms. The complex agriculture industry is represented by two groups: livestock and crop production. The main indicator that allows to evaluate the structure of production is the indicator of gross output. The published preliminary results of the All-Russian Agricultural Census (RAC), conducted in 2016, confirm the heterogeneity of institutional units in terms of the number and size of the land area. According to the operative monitoring of the Federal State Statistics Service, in 2016 there were 36.1 thousand agricultural organizations (AO), 174.8 thousand peasant farms (PF) and individual entrepreneurs (IE), 23.5 million personal subsidiary plots and other individual households (PSP).When comparing the preliminary data of the RAC 2016 with the results of the 2006 census, it was determined that the number of AO decreased by 23.1 thousand units, PF - by 110.3 thousand units. [1, 8].

Has the size of land use changed the institutional units of the industry? The total area of land on AO on average by one object in 2016 compared to 2006 increased by 1147.1 hectares or 16.6%, and significantly increased in PF - from 103.0 hectares to 247.8 hectares, i.e. in 2.4 times. In 2016, micro enterprises were identified as an

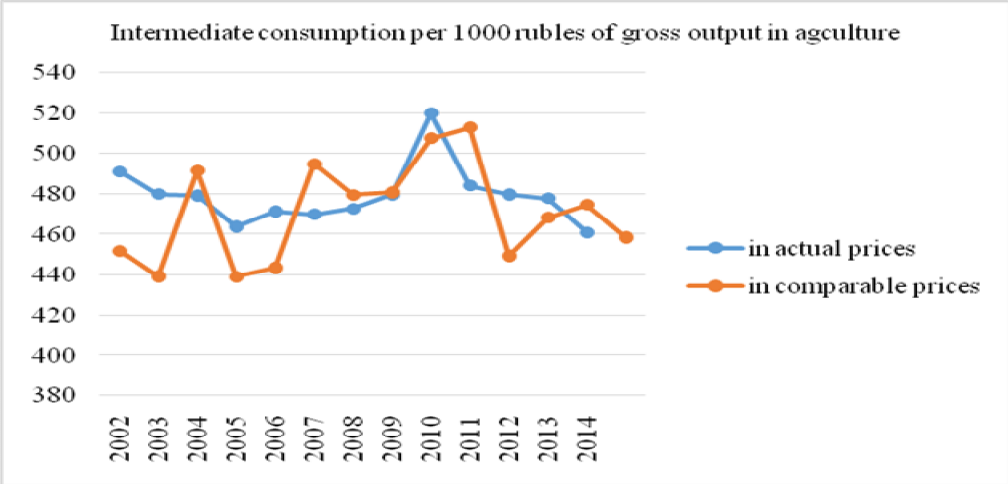
object of observation - there are 17.0 thousand of them, the total land area per one object is equal to 1597.6 hectares [1].Comparative analysis showed that the role of small-scale production in agriculture is growing. The number of agricultural organizations is declining: for 1990-2015 the share of agricultural organizations decreased by 30.3 percentage points, and PF - increased by 9.1 percentage points. For 2000-2010the rate of growth in the output of agricultural products stabilized, which led to an increase in the share of the total agricultural output in 2015 to 51.5%, but in 2016, its value fell to 49.5%.This category of farms did not reach the level of production in 1990. The small-scale sector, represented by personal subsidiary plots and other individual households, has a significant impact. And although their share is declining, they occupy a rather large segment - 37.5%. If we take into account a long period, then the factor of influence of shifts in the structure of production will be indicated more strongly. Presented calculations take a 20 - year period.

## 2. RATIONALE FOR THE METHODOLOGICAL APPROACH TO ASSESSING THE IMPACT OF STRUCTURAL CHANGES

Methodical decision on the choice of an indicator, the value of which allows you to evaluate the effectiveness of the use of invested funds and changes under the influence of the institutional structure of production, is presented below. As an alternative, three indicators were considered: the production volume index, profitability and the materials-output ratio. The structure of gross agricultural output in actual and comparable prices is calculated annually and published by FSSS. In actual prices, this indicator is inappropriate to use because of the impact of inflation. The indicator in comparable prices expresses the dynamics of the physical volume of output, however, it is the result of the action of environmental factors as well, which pushes the influence of structural shifts to the secondary and third-rate importance. Thus, this indicator can not be the basis for assessing changes in the institutional structure of agricultural production. There is also no direct relationship between profitability and shifts in the structure of production. One of the reasons is the lack of the possibility of calculating this indicator for households because of the absence of such a cost item in this category of producers as wages and, consequently, the cost price, as well as differences in the level of product marketability by farm category. The most significant from the perspective of the relevance of information is the indicator of the materials-output ratio.

Materials-output ratio - the cost of consumed raw materials and materials per unit of gross output. In the system of national accounting (SNA), material costs are intermediate consumption, that is, part of the output produced and services rendered, which should be directed to the resumption of a new production cycle[12, p.18, 29].These are seeds and feed, fertilizers, fuels and lubricants, repair parts, etc. The specific weight of material costs in gross output depends on specialization and can range from 60 to 68%. The rest of the product is gross value added (GVA), consisting of depreciation, labor and profit. GVA is the basis of economic development.[13]Therefore, the decrease in materials-output ratio is a factor in increasing profitability. For these reasons, it is the materials-output ratio that is used in further calculations.

According to the SNA, the indicator of the material intensity can be defined as the ratio of intermediate consumption to gross output [14] (fig.1).It is also possible to assess the changes in the institutional structure of production on the basis of the share in the total volume of the gross output of the “Nonfinancial corporations sector”, which characterizes the agricultural organizations, and the sector "Households" reflecting the activity of the peasant farms and personal subsidiary plots and other individual households (fig.2)




Source: authors' calculations based on statistical information

**Fig. 1** Change in the materials-output ratio of agricultural production in the period 2002-2014

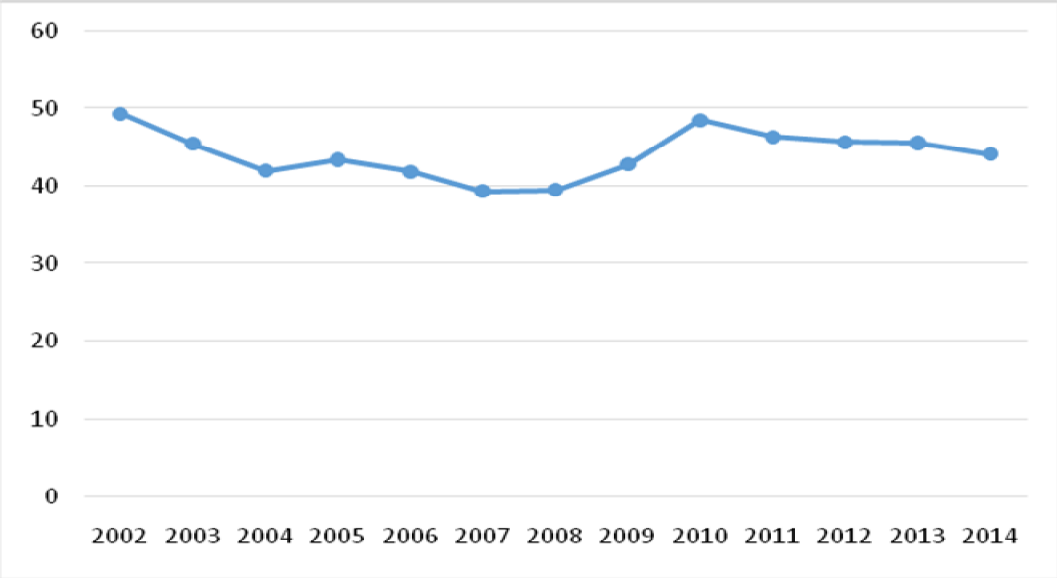



**Fig. 2** Dynamics of the share of the sector "Households" in the total volume of gross output in agriculture in the period 2002-2014

Having considered the relationship between these indicators in the dynamics from 2002 to 2014, found that (in the absence of a trend component in the time series presented), the growth in the share of the household sector in the total production volume leads to a decrease in materials-output ratio by an average of 3.1 thousand rubles within the given period with a correlation coefficient of 0.65 and $R^2$ = 0.43.However, it should be noted that the consideration of cost indicators in the dynamics has difficulties associated with inflationary processes, which are not the same for different types of economic activity at different periods. Thus, the prices for products sold by agricultural organizations during the period from 2000 to 2015 increased by 4.98 times, and prices for products purchased by agricultural producers - 5.89 times. In order to represent the material intensity of the SNA data at comparable prices, we adjusted the indicator of intermediate consumption for the index of prices of industrial goods and services purchased by agricultural organizations, and the gross output for price indices for products sold by agricultural organizations (fig.1).At the same time, for different categories of farms, the ratios are different. Thus, we see that in order to apply the regression analysis, it is necessary to correct the data in actual prices, which requires detailed information on different types of prices in terms of farm categories.[ 12 p.5] The most objective method for assessing the influence of structural shifts on the change in the materials-output ratio of production is the index analysis [3].

## 3. METHODOLOGY FOR ASSESSING THE IMPACT OF CHANGES IN THE STRUCTURE OF PRODUCTION BY CATEGORIES OF FARMS

In the proposed methodology, the base period is 1995, characterized by the participation of all currently existing main categories of farms in the production process (since in 1993 a law was passed on the formation of such a category of producers as peasant farms, and by the designated period their specific weight in the structure of agricultural production amounted to 1.9%), therefore the requirement of the index analysis method to the comparability of the composition of the studied population is fulfilled. The calculation was carried out in dynamics according to the categories of farms with a periodicity of 5 years. Based on the data on the material intensity of production calculated on the basis of the SNA data, characterizing the ratio of material consumption in the sector "Households" and "Non-financial corporations" in the period 2002-2014 in the range from 0.43 to 0.55 (Fig. 3), the following relationships were adopted for further calculations in the materials-output ratio: agricultural organizations - 1.0; peasant farms - 0.6; personal subsidiary plots and other individual households - 0,4.

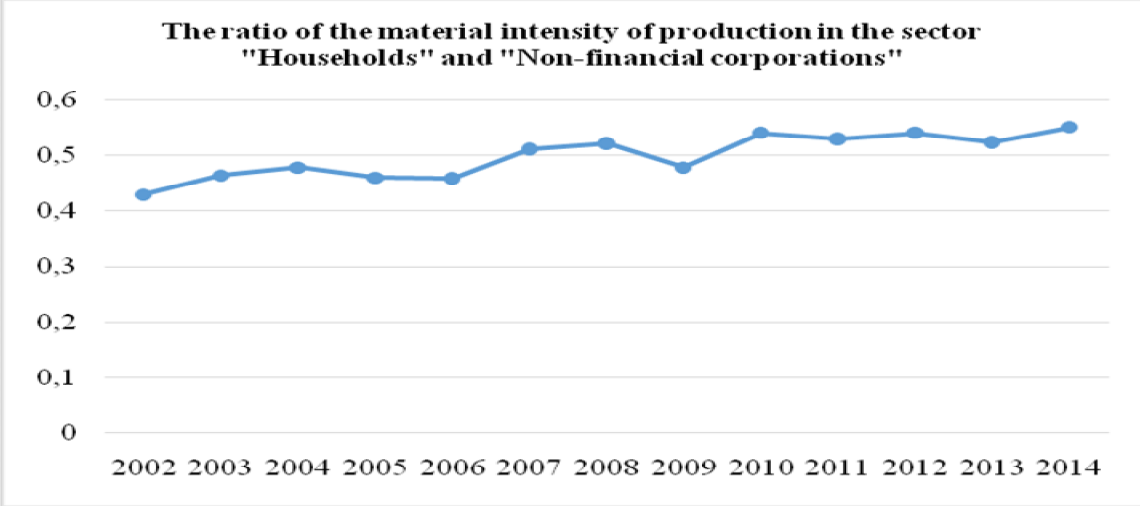



**Fig.3**Dynamics of the indicator of the ratio of material consumption in households to the material intensity in non-financial corporations

These are indexable values. Weights are their relative values in the structure of gross output,so:

$I_i = \sum V_i / \sum V_o * 100$, where

$\sum V_i$ - sum of weights of a particular year (2000, 2005 and so on)

$\sum Vo$ - the sum of the weights of the base year 1995

I.e. $I_{2016} = 81.8 / 89.5 \times 100 = 91.4$ (table 1).

**Table 1** Calculation of the index of the materials-output ratio of production due to the changesin the institutional structure, %

| Year / Farm Category | 1995 | 2000 | 2005 | 2010 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| Agricultural Organisations | 50.2 | 45.2 | 44.6 | 44.5 | 51.5 | 49.5 |
| Peasant Farms | 19.1 | 20.6 | 19.7 | 19.3 | 14.9 | 16.2 |
| Personal Subsidiary Plots | 1.1 | 1.9 | 3.7 | 4.3 | 6.7 | 6.0 |
| Sum of weights | 70.40 | 67.7 | 68.0 | 68.1 | 73.1 | 71,7 |
| Index of the materials-output ratio | 100.0 | 96.1 | 96.4 | 96.7 | 103.7 | 101.7 |

Source: authors' calculations based on statistical information

## 4. ANALYSIS RESULT

So, the changes in the institutional structure of production in the period under review were subordinated to the principle of reducing large-scale commodity production, developing production for own consumption from the

survival of the population in rural areas, further within the framework of public-private partnership, clustering and aggregation processes, the share of large and medium AO increased, which led to a slight increase in materials-output ratio in 2016 compared with 1995, which is associated with an increase in the proportion of peasant farms (by 8.1 percentage points) due to a decrease in the share of PSP with the lowest indicators of materials-output ratio. Earlier it was noted that the concentration of production increased both in agricultural organizations and in peasant farms. However, it should be noted that the orientation toward increasing gross output, in parallel with the increase in production efficiency (by decreasing the materials-output ratio), requires the determination of the optimal production structure by category of farms. One of the reasons for increasing the share of AO in total production since 2010 has been the best socio-economic conditions of life and production activity of workers compared to small enterprises, as well as the possibility of expanding production based on the use of government-proposed financial mechanisms, such as concessional lending and participation in other government programs to support agricultural development. The scale effect, under the influence of which in the large production represented by agroholdings, clusters and other forms of associations, including on the basis of public-private partnership, reduces the level of material consumption, gives grounds for the assumption that a decrease in the proportion of large and medium-sized agricultural organizations, based on which is the concentration and further expansion of the scale of production, can lead to an increase in the material intensity of production and adversely affect competitively and the opportunities for expanded intensive development of agriculture.

Can we assume that agriculture has become less expensive compared to the post-reform period? To answer this question, it is necessary to recalculate material costs into comparable estimates. To do this, we use the index method, which is acceptable in the recalculation of indicators in the interval of 5-7 years. For a longer period (for example, for 20-25 years), this method is not entirely correct.

## 5. METHODS FOR ANALYZING THE IMPACT OF CHANGES IN THE BRANCH STRUCTURE

Structural analysis of material costs for the production of agricultural products and in the context of crop and livestock sectors is based on the example of agricultural organizations. For other categories of farms, such a calculation is more difficult to carry out because of the lack of free access to official data on the costs of production. There are some proposals to evaluate production costs not only in monetary units (using prices), but also in natural measuring instruments. For example, to determine costs by labour intensity, that is, on the basis of man-hour labor costs of agricultural employees [5].

In the research to determine the index of the material consumption of agriculture under the influence of shifts in the structure of production, constant weights of the basic 1990 were used.

In the base year in the total volume of output, the share of crop production is 37.9%, livestock - 62.1%. For each year, the structural distribution of material inputs and outputs was compared by industry. For example, in 2016 the specific weight of crop production in the structure of aggregate material costs was 36-37% by preliminary calculations, and 56% in the structure of gross agricultural output [11].This means that one percent in the output structure corresponds to 0.66% in the structure of material costs. In animal husbandry, the same indicator is 1.43%, since livestock production is more expensive than crop production. These values are indexable values in the proposed methodology, and weights are the shares of crop production and animal husbandry in the product structure. The calculation is carried out according to the formula below.

$I_m = (Y_{pl} * K_{an}) + (Y_{pl} * K_{an})$,

where $I_m$ – Index of materials-output ratio

$Y_{pl}$, $Y_{an}$ – specific weights of crop and livestock production in the base and accounting periods;

$K_{pl}$, $K_{an}$ – coefficients of the percentage ratio of material inputs to output in crop production and livestock production.

The values of the index of the materials-output ratio are given in Table 2.

**Table 2** Calculation of the index of the materials-output ratio of production due to the changes in the branch structure, %

| Year | Crop production | | Livestock production | | The index of materials-output ratio in the 1990 estimate, % |
|---|---|---|---|---|---|
| | specific weight in the product structure, % | percentage of material inputs to production, % | specific weight in the product structure, % | percentage of material inputs to production, % | |
| 1990 | 37.9 | - | 62.1 | - | 100.0 |
| 1995 | 44.3 | 0.99 | 55.7 | 1.01 | 100.4 |
| 2000 | 56.2 | 0.78 | 43.7 | 1.28 | 105.3 |
| 2005 | 53.4 | 0.85 | 46.6 | 1.17 | 105.0 |
| 2010 | 43.1 | 0.91 | 56.9 | 1.06 | 100.6 |
| 2015 | 49.2 | 0.71 | 50.8 | 1.28 | 106.5 |
| 2016 | 56.4 | 0.64 | 43.6 | 1.45 | 114.2 |

Source: authors' calculations based on statistical information

## 6. Analysis Result

Analyzing the data of Table 2, we can draw conclusions that the materials-output ratio as a whole by branches of agriculture increased by 14.2 pp, despite the reduction in the share of livestock sectors in the total volume of production, the percentage ratio of material inputs to livestock production has increased, as a result of the accelerated development of dairy and beef cattle on an industrial basis.

The agro-food policy of the state, oriented to self-sufficiency and export, will expand the investment potential of agriculture primarily in relation to agricultural organizations. Nevertheless, changes in the scale of activities will occur in the farm sector. This is confirmed by the preliminary results of RAC 2016, which indicate an increase in the scale of production of the farming sector. Consequently, the problem of increasing profitability to ensure its sustainable development will be resolved by constantly seeking ways to reduce material costs, rather than rising prices. Rising prices for agricultural products will lead to higher prices for raw materials in the food industry and will become a deterrent to their development in conditions of containing prices for certain types of food products on the part of the state and the market through consumer demand based on the low level of income of the main part of the population.

The solution of the problem of reducing the materials-output ratio affects another - the ratio of the scale of large and small-scale production [9]. A large agrarian business is represented by agroholdings and agro-food companies. Large-scale production makes it possible to use modern technology more efficiently, to introduce innovative technologies. The reduction in production in large and medium-sized agricultural organizations is difficult to compensate for by the increase in output in small forms of management, the bulk of which has a low level of product marketability and is the basis for ensuring the survival of rural areas due to the lack of other income-generating opportunities. The demand for the import of products and the consumption of currency for the purchase of food will increase. This chain can be continued. All this can lead to a significant reduction in tax revenues to budgets of different levels.

Agro-food policy of the state should provide the diversification of production and capital. Consider the diversity of conditions for the sustainable development of differently-sized agricultural producers [10].The importance of agriculture remains extremely high. But the conditions of the external market environment

remain tense. In the Draft Strategy of Russia's Economic Development until 2030, the agrarian sector is given priority in changing the ratio of exports and imports of agricultural products and food. This means that the problem of finding ways to reduce the material intensity of production should become the basis for in-depth studies on the analysis of agricultural efficiency with a view to clarifying the strategic tasks of its development. One of the directions of the development of agriculture can be its concentration in order to increase the scale of production in the context of the optimal institutional structure that provides needs and employment in rural areas and an industry structure corresponding to the domestic consumer demand and the development of the country's export-import relations. Such a form of production organization can become territorial clusters [2, p.345-346]. The main advantage of territorial clusters, including various categories of agricultural producers, industrial enterprises that provide them with basic and circulating assets, is a reduction in transaction costs, especially transportation costs. In addition, by interacting, enterprises have the opportunity to reduce investment risks by distributing them among themselves. This is a more significant reason for the formation of a territorial cluster. At the same time, clusters increase labor productivity and production efficiency by reducing logistic and transaction costs, which in agriculture, which exists in conditions of availability of a seasonal factor, is of great importance. Also for enterprises that make up the cluster, there is the opportunity to develop production on the basis of modern innovative technologies, because the exchange of knowledge, information, qualified personnel is promoted, opportunities for interaction with educational institutions of the territories in terms of consultative processes are enhanced. The interaction provides for a bilateral exchange of information on the specific features of the territories (natural and economic) for the implementation of agricultural production, which also provides the basis for selecting the optimal production structure and stimulates the training of qualified personnel for the further development of agriculture as a type of economic activity. Clusters provide commercialization of knowledge by stimulating the participation of science in the development of practical activities with the possibility of rapid testing in the market of innovative food products, which have the potential to reduce the material consumption of production in the future.

## 7. CONFLICT OF INTERESTS

The authors confirm that the presented data do not contain a conflict of interest.

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