

## Artículo de investigación

**Optimization of interaction of agrarian entities as an imperative of ensuring food security of the state****ОПТИМИЗАЦИЯ ВЗАИМОДЕЙСТВИЯ СУБЪЕКТОВ АГРАРНОЙ СФЕРЫ, КАК ИМПЕРАТИВ ОБЕСПЕЧЕНИЯ ПРОДОВОЛЬСТВЕННОЙ БЕЗОПАСНОСТИ ГОСУДАРСТВА**

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**Abstract**

The interaction of agricultural entities is based on modern market relations and the state agrarian policy. Managing the subjects of the agricultural sector of the economy is the primary task of the state, since the provision of food security of the state depends on this.

The subject of the study is the establishment of relations of the agricultural sector of the country. In the grouping method, a direct relationship was established between the sum of agricultural production in farms of all categories in the constituent entities of the Russian Federation and the number of employees in the regional agro-industrial complex of the agricultural sector, as well as the number of departments in them.

The purpose and objective of the study is to highlight the main functions of state administration of the agricultural sector at the regional level, to identify the lack of an effective mechanism for interaction of the subjects of the

**Аннотация**

Взаимодействия субъектов аграрной сферы, базируется на современных рыночных отношениях и аграрной политики государства. Управление субъектами аграрной сферы экономики первоочередная задача государства, так как от этого зависит обеспечения продовольственной безопасности государства.

Предметом исследования является установление связей агропромышленного комплекса страны. В работе методом группировки установлена прямая связь между суммой производства продукции сельского хозяйства в хозяйствах всех категорий в субъектах РФ и количеством служащих в региональных органах государственного управления АПК, а также количеством отделов в них.

Целью и задачей исследования является выделение основных функций государственного управления АПК на

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agricultural market with each other and with the regional authorities of the agricultural sector.

The presented model of optimizing the relationships between the agrarian entities of the region will increase the efficiency of the agrarian sector of the region's economy and ensure its food security.

The necessity of planning and forecasting the volumes of production and use of agricultural products and raw materials is substantiated. The system of such forecasting includes such subsystems as agricultural enterprises, processing enterprises, and the population of the region.

It is concluded that each subsystem works on a well-formed and well-founded functional model, which includes input and output information, controls that regulate functioning, as well as mechanisms that ensure such functioning. A special role in the forecasting process is assigned to the regional management bodies of the agro-industrial sector represented by the department for optimizing the interaction of agricultural entities in the region. The final forecast result should be a balance model of the degree of food security in the region's population.

**Keywords:** Agriculture, food security, optimization.

## Introduction

The effective functioning of the country's agro-industrial complex, the construction of mutually beneficial, parity relations between agricultural and processing enterprises is possible only with the competent management of the agricultural sector by state executive bodies. The activities of agribusiness management entities of various levels (state administration, local government administration, economic management) should be aimed at creating and ensuring the functioning of such mechanisms and regulatory methods that, by creating "rules of the game", make possible the effective operation of management objects. This leads to an increase in food production, contributes to providing them with the country's population, guaranteeing its food security.

региональном уровне, выявление отсутствия эффективного механизма взаимодействия субъектов аграрного рынка между собой и с региональными органами управления АПК.

Приведенная модель оптимизации взаимоотношений субъектов аграрной сферы региона, позволит повысить эффективность деятельности аграрной сферы экономики региона, обеспечить его продовольственную безопасность.

Обосновано необходимость планирования и прогнозирования объемов производства и использования сельскохозяйственной продукции и сырья. Система такого прогнозирования включает такие подсистемы как сельскохозяйственные предприятия, перерабатывающие предприятия, население региона.

Сделан вывод о том что, каждая подсистема работает на сформированной и обоснованной функциональной модели, включающей входную и выходную информацию, управления, регламентирующие функционирования, а также механизмы, обеспечивающие такое функционирование. Особая роль в процессе прогнозирования отводится региональным органам управления агропромышленным сектором в лице отдела по оптимизации взаимодействия субъектов аграрной сферы региона. Итогом результатом прогнозирования должна стать балансовая модель степени обеспеченности населения региона продовольствием.

**Ключевые слова:** агропромышленный комплекс, продовольственная безопасность, оптимизация.

At the moment, there is a need in the country for the formation of methods for regulating the sustainable development of agricultural enterprises (Ostaev, Gogolev, Kondratev, Markovina, Mironova, Kravchenko and Alexandrova, 2019).

## Methodology

In many ways, the causes of the crisis in the functioning of agricultural production, which are currently observed, are due to the loss of control over the processes taking place here. Currently, there are a number of certain obstacles that do not allow such regulation to be carried out with the maximum degree of efficiency, in particular:

- there was a loss of integrity of the agro-industrial complex as an object of management, which does not make it possible to effectively resolve the issues of harmonizing the economic interests of agricultural producers, processors, traders, and agricultural service enterprises, to overcome the existing disparity in prices;
- there is insufficiently complete identification, distribution and consolidation of the functions of state governing bodies, which does not allow to solve all the existing urgent tasks of the development and functioning of the agro-industrial complex;
- there is no clear vertical structure of state administration of the agro-industrial complex, there is no clear and understandable system of subordination, distribution of powers and responsibilities between federal, regional and local authorities, which leads to the disordering of such activities;
- the regional agro-industrial complex management bodies are in an uncertain state, due to the fact that, on the one hand, they are independent in carrying out their activities as local self-government bodies, and on the other, they perform the functions of state regulation of the agro-industrial complex, which includes them in the vertical of state bodies with relevant relations and submissions.

Another important issue of the effectiveness of the functioning of the country's agribusiness management system at the regional level is the number of employees, departments in the relevant governing bodies, since the quality of the ongoing managerial work, the completeness of the necessary functions, the amount of work assigned to specific performers, the continuity of management processes at various levels levels, its stability and consistency, the adoption of effective managerial decisions (Molchan, Ternavshchenko and Francisco, 2017).

Table 1 shows the grouping of constituent entities of the Russian Federation by the number of employees in the government bodies of the agro-industrial complex (The agro-industrial complex of Russia in 2017, 2018).

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Table 1 shows the grouping of constituent entities of the Russian Federation by the number of employees in the government bodies of the agro-industrial complex (The agro-industrial complex of Russia in 2017, 2018).

**Table 1** - Grouping of subjects of the Russian Federation by the number of employees in the management bodies of the agro-industrial complex

No	Groups of subjects of the Russian Federation by the number of employees, people	The number of subjects in the group	The number of employees in regional government agribusiness on average for the group	The average number of departments in the agro-industrial complex management body	Agricultural production on farms of all categories in 2017		
					total in the group, million rubles	on average in the group, million rubles	in% of the total
1	до 30	11	22	5	165240,6	16524,1	3,23
2	31 – 50	19	43	8	522558,8	27503,1	10,21
3	51 – 70	22	61	11	1072436,9	48747,1	20,95
4	71 – 90	14	78	13	772033,7	55145,3	15,08
5	91 – 130	11	111	15	1166835	106075,9	22,79
6	over 130	8	149	20	1420738,8	177592,4	27,75
Total and average		85	69	11	5119844	60950,5	100,0

\* Compiled by the author

These groups indicate that there is a direct relationship between the sum of agricultural production in farms of all categories in the constituent entities of the Russian Federation and the number of employees in regional government agencies of the agro-industrial complex, as well as the number of departments in them: the higher the production amount, the number of employees and departments more. However, a more detailed analysis of the structure and composition of the regional agro-industrial complex management bodies showed that there is an excessive "swelling" of the administrative apparatus in some cases. For example, in the Republic of Karelia - 90 people, in the Komi Republic - 130 people, in the Republic of Sakha (Yakutia) - 121 people, etc., while the volume of agricultural production in these regions is 4153.4, 9922.6 and 25,288.8 million rubles, respectively, which corresponds to 0.08, 0.19 and 0.49% of the total agricultural production in the country as a whole. Thus, it turns out that non-agricultural regions have a significant management apparatus in the agricultural sector. All this testifies to the need to optimize the number of employees in the regional agro-industrial complex management bodies in

order to increase the efficiency of managerial activities to coordinate and regulate the agricultural sector of the economy.

### Results and discussion

The effective functioning of the agrarian sector of the country's economy is possible only when there is an effective state management of it, including certain areas of activity and the performance of a number of functions. Moreover, all these functions at the federal level of government of the agro-industrial complex should be clearly performed; at the regional and district level, it is possible to distinguish the general functions necessary for implementation regardless of the specialization and specifics of the region, and private (special) functions, the implementation of which is advisable in accordance with the conditions of the functioning of the region. Having examined and analyzed the structure of regional administrative bodies of the agro-industrial complex of the constituent entities of the Russian Federation, we present in table 2 the performance of the main functions in them.

**Table 2** - Performing the basic functions of public administration of the agricultural sector at the regional level

No	The function of public administration in agriculture	The number of subjects of the Russian Federation implementing it
1	Legal regulation	85
2	Implementation of state agribusiness development programs	85
3	Forecasting and Economic Analysis	85
4	Property, land management	37
5	Veterinary control	8
6	Agricultural processing	55
7	Fisheries development	31
8	Integrated rural development	70
9	Small business development	41
10	Development of cooperation and integration processes	11
11	Provision of elite seeds, breeding stock	48
12	Reclamation	15
13	Implementation of technical supervision, technical policy	42
14	Attracting investment in the industry	36
15	The development of agricultural science	22
16	Foreign economic activity	3
17	Agricultural Market Regulation	46
18	Information support of agricultural entities	19

\* *Compiled by the author*

The analysis showed that functions that are of a general nature are not always carried out by regional administrative structures. For example,

one of the priority areas for increasing the efficiency of the agricultural sector and solving existing problems is integration and cooperation,

which is indicated in the State Program for the Development of Agriculture for 2013-2020 (2012). For the implementation of this direction, appropriate departments and employees are needed, the functionality of which should be assigned certain responsibilities in this area, but at the moment, this function is implemented in one way or another only in 11 out of 85 subjects of the Russian Federation. Thus, if there is no corresponding department in the structure of the governing body of the agro-industrial complex, there is no assignment of functions to employees, then there is no one to implement this priority direction either. It turns out a paradoxical situation when an effective, correct managerial decision is made at the federal level, it does not find proper implementation at the level of regions, districts, and accordingly it cannot bring any significant positive results. Other important, in our opinion, and deserving close attention to the functions are regulation of agricultural markets and information support of agricultural entities. At the moment, they are being implemented to one degree or another in 46 and 19 constituent entities of the Russian Federation, respectively. One of the main problems restraining the development and functioning of the agricultural sector is the difficulties associated with the sale of manufactured products. Government bodies must clearly coordinate and regulate the development of agri-food markets, logistic flows of agricultural products and raw materials, conduct marketing research on consumer demand, make demands on the quality of the goods offered, determine the volumes needed to satisfy the physiological needs of the population of the territory. Moreover, all this information should be timely and fully communicated to agricultural producers so that they can adjust the types and volumes of products in advance (before the sowing campaign, the purchase of young farm animals and birds). Since the peculiarities of agricultural production are such that the products are obtained with a certain time lag, and if the information was received inopportune, then changing the assortment is no longer possible until the new season.

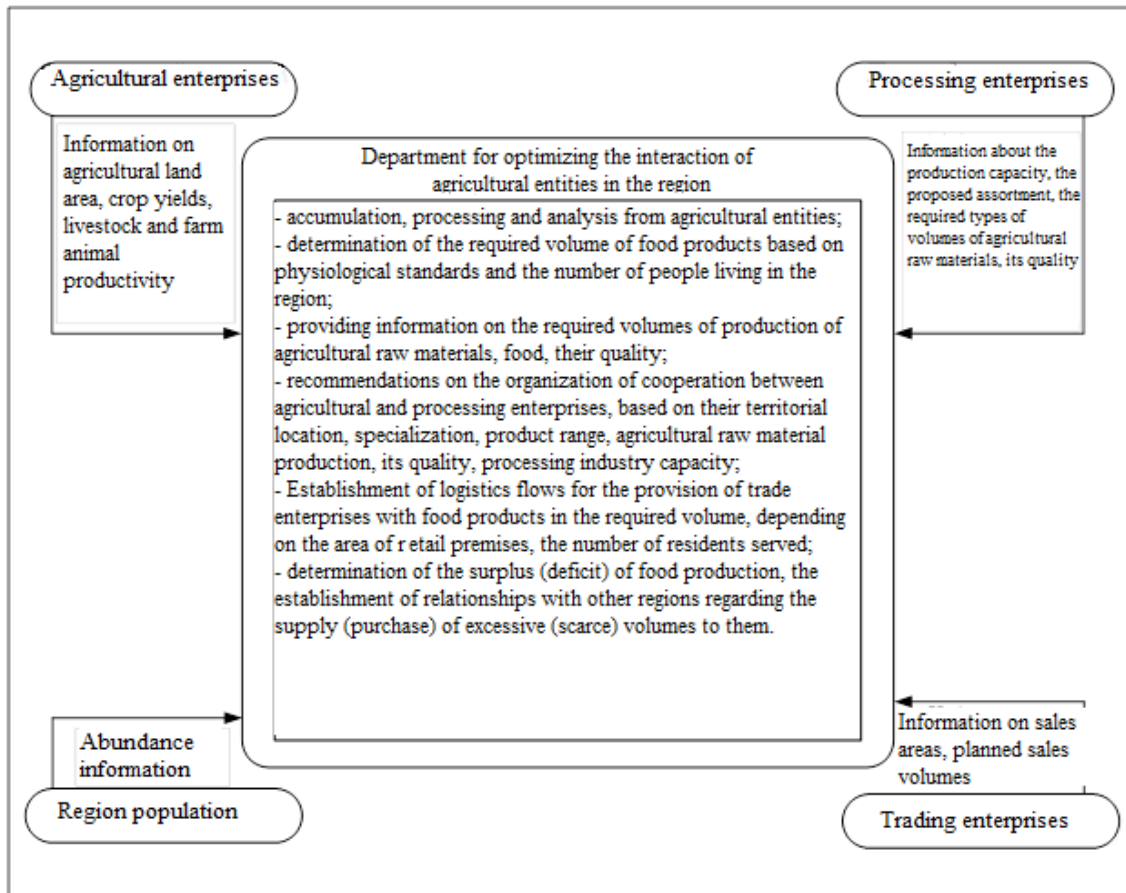
Thus, it can be argued that at the moment there is no effective mechanism for interaction between agricultural producers and regional agro-industrial complex management bodies regarding the provision of relevant and comprehensive information on the state and needs of agricultural food markets, the latest achievements of scientific and technological progress, innovations in agricultural production, and new high-yielding varieties of agricultural

plants, highly productive breeds of agricultural animals, new agricultural equipment and technologies, etc.; with processing and trading enterprises on issues of agro-industrial integration and cooperation, taking into account the interests of all entities included in such structures, which, in our opinion, should be coordinated by executive authorities.

For the optimal interaction of the links of the agrarian system, the most important and necessary is the creation and functioning of such an organizational structure of the agro-industrial complex. This would allow, on the one hand, to take into account the interests of all systems of the food security process (agricultural, processing and trading enterprises, end consumers) and form a complex of relations and interconnections between them that are adequate to the requirements of modern business conditions. On the other hand, this led to the achievement of the ultimate goal of this mechanism - ensuring the food security of the region. In addition, in order to ensure food security, which consists in guaranteeing the population of the country high-quality products of their own production, in an amount sufficient for normal life, fully satisfying the needs for a set of nutrients, trace elements and vitamins, the issues of planning and forecasting production volumes are becoming urgent and the use of agricultural products and raw materials in order to have a clear idea of its profits those or deficit and on time to take proactive measures to equalize imbalances.

Moreover, the issues of such planning and forecasting should be the responsibility of state authorities, which accumulate all the necessary information from participants in the agricultural sector of the economy about their existing production capacities, and the ability to produce certain types of products. Since without such a coordinating and regulatory body, the subjects of the agricultural market often operate in the conditions of either a complete lack of information, or too little of it, insufficient to respond in a timely manner to changing trends in market conditions and market needs. Meanwhile, information is one of the most important factors in increasing the competitiveness of agricultural entities, an integral part of market infrastructure (Krylatykh and Mazloeva, 2016).

For this, a department should be allocated in the regional bodies of state executive power, the functioning scheme of which can be represented as follows (Figure 1).



**Figure 1** - A model for optimizing the relationships of subjects of the agricultural sector of the region (Author's development)

Since the optimal interactions between agricultural entities, in our opinion, are difficult without a coordinating and regulatory influence on the part of government bodies, the creation and functioning of such a department will solve a number of pressing issues, increase the

efficiency of the agricultural sector in the region's economy, and ensure its food security. The forecasting system for the use of agricultural raw materials and food production consists of a number of subsystems (Figure 2).

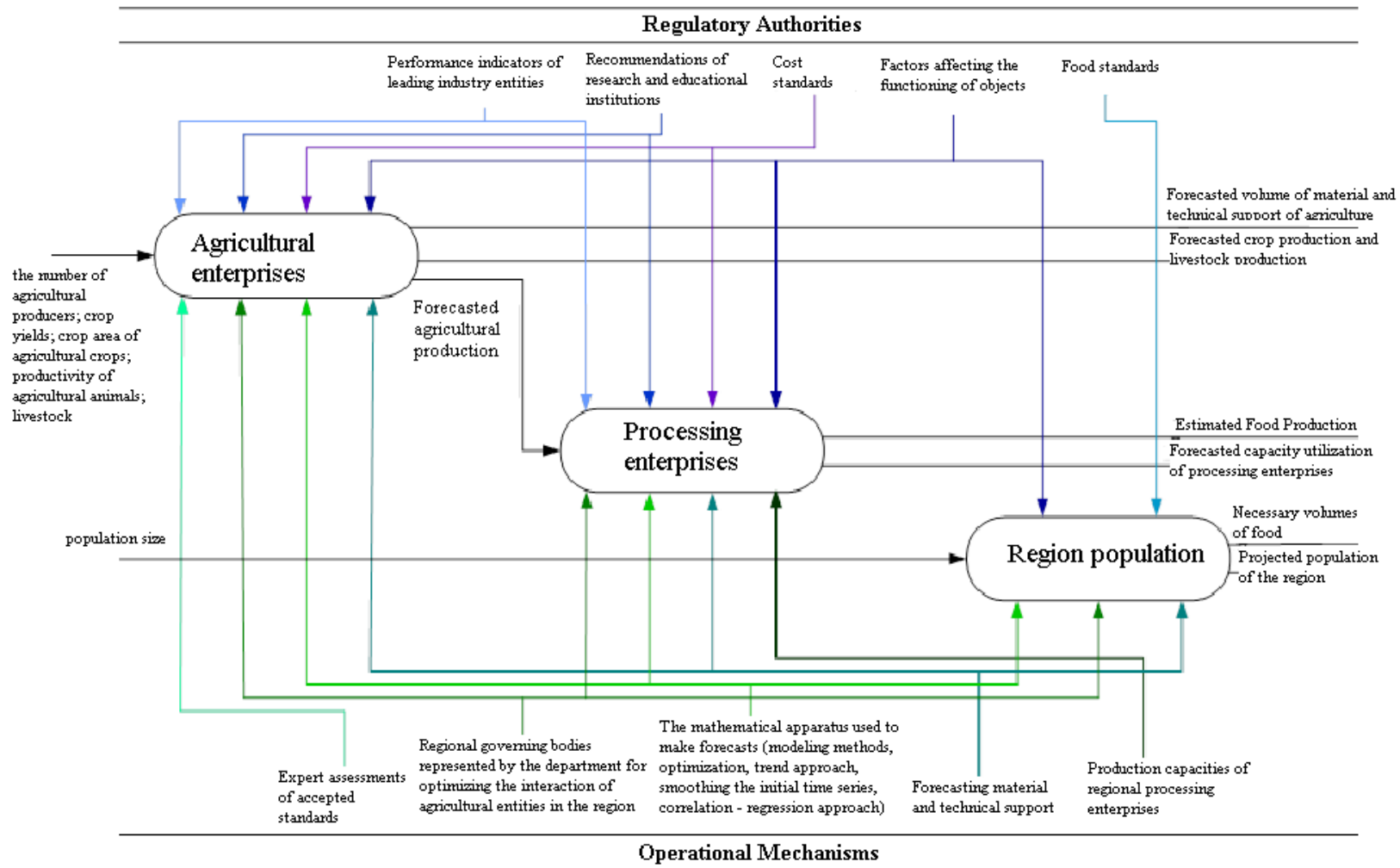


Figure 2 - Forecasting system for the use of agricultural raw materials and food production (Author's development)

The subsystem "Agricultural enterprises" acts as a key element of the system under consideration, since agricultural products and raw materials are produced for further processing. This subsystem is designed to predict the volume of production of crop and livestock products to provide the population of the region in them and agricultural raw materials for delivery to industrial enterprises.

Prediction of the activity of this subsystem clarifies the potential of the region in the production of agricultural products and raw materials. Volumes of agricultural products and raw materials of the plant growing industry are determined by multiplying, summing the forecast values of crop yields by the corresponding forecast values of their sown area, livestock industry - by multiplying, and summing the forecast productivity of farm animals by the corresponding forecast values of their livestock. In addition to predicting directly effective indicators of agricultural production, it is advisable to determine the volume of material and technical support for the industry, the marketability of agricultural products, the volume of its use for on-farm needs and other parameters of the functioning of agricultural enterprises. For these purposes, in our opinion, it is most appropriate to use modeling and optimization methods with the caveat that since we are talking about modeling the activities of not a specific business entity, but of all entities operating in the region, it seems not entirely correct to include optimization models here, since it is impossible to take into account and calculate the optimality criterion, therefore, we propose to make an economic and mathematical model for determining the optimal parameters of the functioning of agricultural -agricultural enterprises into a single unit subsystem "agricultural enterprises" (Molchan, Frantsisko, Ternavshchenko, Illarionova and Prokhorova, 2017).

The economic and mathematical model for determining the optimal parameters of agricultural enterprises includes the following groups of restrictions:

- conditions for the use of resources of agricultural enterprises (labor, land);
- conditions on the level of concentration of the livestock and the structure of the herd of farm animals;
- the conditions for the cultivation of crops, taking into account scientifically based crop rotation;
- conditions on the volume of feed production;
- the balance of nutrients and the structure of diets for feeding farm animals;
- conditions for the amount and calculation of production costs and annual payments of agricultural producers for the production of agricultural products (cost of raw materials, remuneration of labor, electricity, fuel and lubricants, costs of management, freight transportation, depreciation, costs of repairs and maintenance, costs of feed production, veterinary services, fertilizers and plant protection products, insurance premiums for unforeseen expenses, loan servicing expenses, etc.) (Burda, Frantsisko, Baranovskaya, Trubilin and Loiko, 2016).

### Conclusions and recommendations

As a result of solving optimization problems, this model determines the necessary volume of material and technical support for agricultural enterprises, sufficient to cover the costs associated with the production of agricultural products and raw materials so that their activities are cost-effective and bring maximum profit under these conditions.

As a result of forecasting the activities of the subsystem "Agricultural enterprises", it is possible to obtain the forecasted volume of material and technical support for agriculture, which will allow more accurate, more detailed planning of the volumes of state support for agricultural producers, timely identification and elimination of the deficit, and updating the material and technical base of farmers.

Predicted volumes of crop and livestock production allow us to assess the degree of provision of the region's population with food products, industrial enterprises - agricultural raw materials to load production capacities and further processing.

The subsystem "Processing enterprises" is aimed at collecting data on the forecast volumes of food products obtained from the processing of agricultural raw materials in order to provide them with the population of the region, to determine their deficit or excess.

The forecasting of food production volumes should be carried out separately for each branch



of the processing industry, since they differ significantly from each other in terms of the nature of the processed raw materials, location in the region, capital intensity, technology for producing the finished product, etc. The sum of the forecast production volumes for each selected industry will give the total amount of food obtained (Kovaleva, Rusetskiy, Okorokova, Antoshkina and Frantsisko, 2018).

Based on the forecast volumes of agricultural raw materials, the standards of its costs for the production of 1 ton of finished products, the available production capacities of processing enterprises, it is possible to obtain the forecast volume of food production.

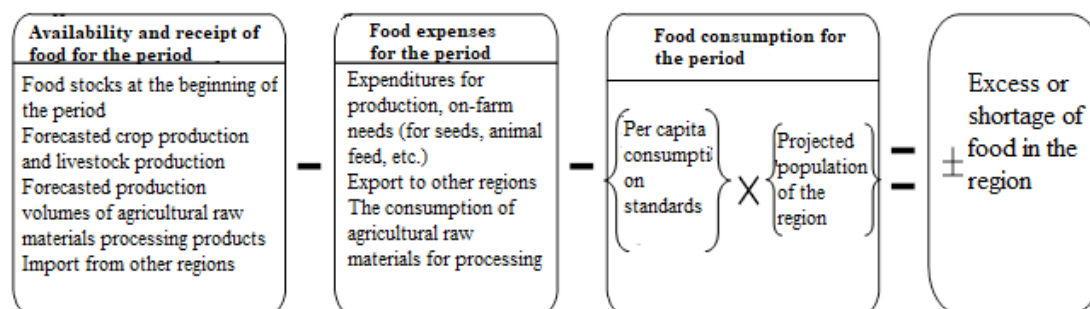
As a result of forecasting the subsystem's activities, regional authorities receive, on the one hand, information on forecast volumes of food production, and on the other hand, on the degree of congestion of production capacities of processing enterprises, which makes it possible to understand the degree of efficiency of their use and take measures to eliminate identified "bottlenecks". The insufficient workload of production capacities indicates the available

reserves; the need to increase the raw material base, their lack indicates the need for the construction of new processing plants.

The subsystem "Population of the region" is designed to predict the necessary amounts of food sufficient to ensure normal life, based on the norms of average per capita consumption of food, as well as trends in the current population of the region.

After collecting and processing all the necessary information, the result of the functioning of this subsystem should be the volume of food products necessary and sufficient to meet the demand for them in the forecasted population of the region (Ostaev, Khosiev, Nekrasova, Frantsisko, Markovina and Kubatieva, 2019).

The aggregate result of the activity of the forecasting system under consideration should be information on the degree of provision of the region's population with food products in an amount sufficient for normal life. The balance model of the degree of provision of the region's population with food will look as follows (Figure 3).



**Figure 3** - Balance model of the degree of food security in the region *Compiled by the author*

The department for optimizing the interaction of subjects of the agrarian sphere of the region coordinates and adjusts the further activities of the selected subsystems based on all the information coming to it from various participants in the agrarian sector and the forecasting made using various methods (economic and statistical methods, modeling and optimization methods, attracting experts). The obtained forecast indicators can serve as a tool for making informed management decisions aimed at improving the development and functioning of the agro-industrial sector of the region.

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