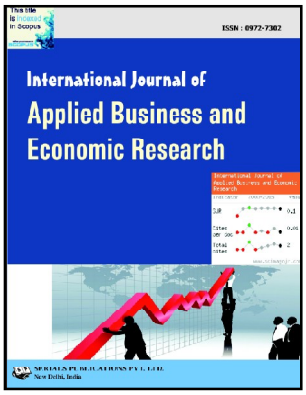

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Organizational Structure of Agro-Industrial Complex: Formation and Interaction of Subjects

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Abstract: The specifics of production at the enterprises of agro-industrial complex are determined by the peculiarities of agriculture. The economic process of reproduction in agriculture is closely intertwined with the natural cycles; labor is directed at using the forces of nature, the vital functions of plants and animals subject to biological laws. The soil as the main means of production plays a special role. More than in other industries, the working period during which the source material is directly exposed to labor, does not coincide with the period during which the source material becomes a finished product, which determines the seasonality of production. Production is unstable due to the influence of soil and climate factors, which complicates the ability to balance the volumes of produce and market needs; the financial condition of enterprises is therefore unstable. The products of agriculture are perishable, difficult to transport, requiring special conditions for harvesting, storage, processing, and sale, which causes the expansion of the industry's ties with other branches of the agro-industrial complex. This article analyzes the main directions of the development of the agro-industrial complex and prospects for its development. It is proposed to expand the number of management impacts by means of which the organizational structure of the agro-industrial complex is regulated. An algorithm for designing an organizational model has been developed, taking into account economic, technological and social factors.

Keywords: agro-industrial complex, control actions, adjustable parameters, principles and algorithm of model design

JEL Classification: Q18, R11, R58

INTRODUCTION

When forming the national economy as a whole and its individual regions, one of the strategic directions is food security. In accordance with the "Declaration of the World Summit on Food Security" adopted in

Rome in 2009, it is the responsibility of each state to ensure that everyone has access to safe and healthy foods in accordance with the right to adequate food and the right to be free from hunger.

Ensuring food security includes medium- and long-term programs in the areas of sustainable agriculture, food security, nutrition and rural development to address the root causes of hunger and poverty. An important aspect is the formation of a consistent realization of the right to physical access to safe food in sufficient quantity and, necessary to meet their dietary needs and food preferences for active and healthy living of all social groups of the population. At the same time, it is necessary to strive for autonomy and economic independence of the national food system in order to ensure food independence.

LITERATURE REVIEW

Problems of organization and management processing of agricultural products at national, regional, sectoral and household levels in an unstable economic environment required a comprehensive solution to the many logistical and economic issues. Theoretical and methodological foundations of the study of this problem is reflected in the scientific works of domestic and foreign scientists: J. Aubakirova, M.Z. Golovatjuk.

Methodology of business planning is considered in works of such scientists-economists as E. Utkin, Eric S. Siegel, Brian R. Ford, David C. Carney

Features of management and development of agricultural enterprises is reflected in researches of such scientists as Yu. Aseeva, I. Bredikhin, O. Inshakova, E. Serova., N. Soldatova, A. Romanova and others.

Problems of organization and development of investment processes in agriculture is dedicated to the works of L.I. Abalkina, I.T. Balabanov, V.M. Popov, B C. Bard and others.

Contribution to the development of theoretical and methodological questions of an estimation of efficiency of investments made by A.P. Algin, L.T. Gilyarovskaya, D.A. Yendovitsky, S.A. Koshechkin, V.V. Kovalev, I.Y. Lukasevich, I. Sergeev, V.D. Shapiro, T.B. Sevruk.

Various aspects of the innovation model of agricultural development in the regions of the Russian Federation are reflected in the research of V. Bautin, A. Belousov, E. Trunov, N. Shishkina, etc.

In the field of applied research of automation and interaction production-economic systems, agribusiness and agriculture are essential works of scientists: K.K. Abuova, V.G. Voronin, O.S. Sabdenov and others.

Specific theoretical and methodological aspects of problems of organization of production based on control of material flows and development of technical base of agricultural enterprises is investigated: by B.A. Anikin, O.B. Malikov, L.B. Sirotinin, V.A. Panfilov, N.S. Sachko, A.A. Smehova and other scientists.

MATERIALS AND METHODS

To solve the problems of ensuring food security, the state enterprises of the agrarian sector of the economy must, on the one hand, provide the population with high-quality food products in volumes that ensure a normal living, provide processing enterprises with agricultural raw materials in quantities necessary to load their existing production capacities, and on the other hand, the effectiveness and competitiveness of their activities must be maximized (Illarionov & Rykov, 2012).

The formation of an agro-industrial complex that takes into account national interests in the field of food security calls for a change in development priorities and mechanisms for implementing agrarian policy. The regulators of the agrarian policy are the reliability of the national food system, the minimization of the impact of various fluctuations in the supply of food to the population of all regions of the country, the search for alternative technologies, the full cycle of processing of agricultural products and the sustainability of the development of the food system as a whole.

It should be borne in mind that ensuring the country's food security is a complex and multifaceted process, including a set of systems, subsystems, characterized by a large variety of elements, as well as various interactions and interrelations between them. At the same time, food policy is viewed as a complex of measures for the production, storage and processing of agricultural products.

DISCUSSION

The agro-industrial complex is an important part of the economy and a complex intersectoral complex that affects diverse areas of the economy, and, along with the social aspects of development, has a direct impact on the formation of food security processes of the state as a whole (Molchan & Francisco, 2014).

In the structure of the agro-industrial complex, three main areas are singled out: industries producing means of production for agriculture; agriculture (plant and animal farming) and forestry; branches processing agricultural raw materials.

Agro-industrial complexes of individual states and regions are in close interconnection with each other and are subject to global integration processes, while preserving food, raw materials, and technological dependence.

Agro-industrial integration is aimed at the formation of mechanisms for effective interaction between various branches of agriculture, processing, retail and service enterprises. Balanced development and effective interaction of all sectors is a prerequisite for the formation of food independence and food security of the country as a whole and its individual regions. Therefore, in order to achieve the required level of food security in a country or a particular region, there is an urgent need for the complex effective development of all systems, since a failure in even one of them can level out the achievements of others.

Agriculture is one of the fundamental systems, the functioning of which is aimed at ensuring the country's food security. It is the agro-industrial complex in general, and agriculture in particular, that is the basic branch of the national economy, being a supplier of food products for the population and agricultural raw materials for further processing by industrial enterprises.

In this connection, the most urgent problem is the development of the agro-food market and supply of high-quality and safe food products of domestic production to the population. The most important condition for solving this problem is the organization of effective interaction of agricultural market participants with the subjects of retail and wholesale trade. Satisfaction of the population's demand for quality and safe food products on the basis of the formation of effective economic ties between all market participants and the improvement of the system of commodity circulation is a necessary condition for ensuring food security.

New reserves for increasing the efficiency of the functioning of the agro-food market need to be identified in the sphere of rationalization of economic ties between agricultural producers and wholesale distributors and retailers of agricultural products, in the development of more effective forms and methods of channeling food streams on the basis of effective management methods, the capabilities of modern information technologies and logistic connections.

The functional basis of modern research of the formation and regulation of economic relations in the agro-food market of the Russian Federation and recommendations in this area include reduction costs in the system of commodity circulation, and increasing the competitiveness of domestic food both on the domestic and foreign markets. In our opinion, the final goal and key characteristics of the formation of effective economic relations between all participants of the food market and the creation of the necessary conditions for the organization of the sale of products must be the quality and safety of the final food products. At the same time, quality and safety must be ensured throughout the entire production and distribution chain: the quality and safety of production, raw materials, technological processes, and sales of products (Alpysbaeva, 2006).

In this connection, economic ties in the agribusiness market can be considered as a system of economic ties between participants in the agricultural products market and wholesale and retail trade enterprises, which are formed under the influence of supply and demand, market price and competition, as well as other factors conditioned by specialization of production and features of the current stage of economic development.

Economic links between producers of agricultural products, commodity producers and wholesale and retail trade enterprises of agro-industrial products are manifested primarily in the form of a supply-demand relationship, which are realized with the help of such tools as price, quality and market competition. Market demand is at the same time an important factor in increasing or reducing production volumes. An important social factor determining the nature of the interaction of all participants in this process should be the level of consumer culture. It is the consumer who determines the requirements for quality, safety and consumer properties of goods, thereby affecting the entire process of formation of economic ties in the agro-food market.

Today, there is a sharp increase in the dependence of the economic development of agricultural organizations on the functioning of the information component of the economic system. Without timely, reliable information about the factors of the external and internal environment, about the achievements of scientific and technological progress, the level of anticipated demand for products, changes in legislation, it is impossible to form effective economic ties between producers and wholesalers and retailers of agricultural products. The accuracy and objectivity of the planned indicators depend on the level of reliability and timeliness of the information received about the factors of the macroeconomic environment. The presence of a developed information system is a key point in the development of scientific achievements and the use of innovative developments in agricultural production. The use of the results of scientific and technological progress will make it possible to transfer agricultural production to a higher organizational and technological level (Francisco, Molchan & Francisco, 2015).

The most important tasks of the formation of an integrated system of interaction processes of enterprises of the agro-industrial complex are:

1. Meeting the population's needs for high-quality food;
2. Creating conditions for delivering the food products to the consumer with minimal costs;
3. Provision of conditions for reimbursement to producers of costs for the production of agricultural products, raw materials and food;
4. Stimulating the development of production, improving the quality and competitiveness of products in the domestic market.
5. Increasing the level of consumption culture.

To solve these tasks, it is necessary to develop own commodity distribution system of economic relations on the basis of effective interaction of processing enterprises with agricultural producers and marketing organizations. The achievement of these tasks requires the creation of an organizational model of interaction between all participants of the agricultural market, ensuring effective economic links in all phases from production to consumption (Francisco & Molchan, 2015).

This predetermines the need, not only for the transformation of all production structures, but also for the formation of a new mechanism for the interaction of economic agents in various sectors of the agro-industrial complex. The basis of this mechanism should be the transformation and strengthening of planned functions while ensuring economic ties in the agro-food market.

As practice shows, in the conditions of constantly increasing information flows, agricultural producers are faced with the problem of searching, selecting and using the innovations and information they need. To solve this problem and ensure the cooperation between all participants of the food market, it is necessary to create coordination centers for interaction between the subjects of the agro-industrial complex. The ultimate goal of this area of support for the agro-industrial complex is the creation of a model that will allow, on the basis of integration of the activities of scientific, educational and market structures, with the appropriate support of agribusiness management bodies, to ensure accelerated progress in the production of scientific and technological progress, a consistent increase in the volume of production and marketing of agricultural products, as well as sustainable development of rural areas and improvement of living conditions of the rural population (Ternavshchenko, 2014).

Creation of conditions for increasing the efficiency and sustainability of the functioning of agricultural organizations of all forms of ownership through the development of partnership between executive authorities, local government and agricultural producers through the formation of single information space of the industry has become the main goal of reforming the management structure of the agro-industrial complex. In this connection, the problem of functioning of the information and consulting system from the standpoint of its formation and development, its implementation at the regional level becomes of especially important (Ternavshchenko, 2013).

Based on the current state and prospects for the development of the Krasnodar Region, the information and consulting system is developing at two levels - regional and district. At the regional level, the Kuban Agricultural Information and Consulting Center is functioning, which was established to implement the Decree of the Head of Administration of the Krasnodar Region No. 546 of 20.06.2005 "On Reforming the Management Structure of the Agro-Industrial Complex of the Krasnodar Region". Its main functions are:

1. Development (together with district administrations) of programs to address problems of regional importance. Development (together with the Federal level) of national programs that will be implemented in the region.
2. Informing the Federal authorities on the problems of agricultural producers in the region, sending proposals on their priority.
3. Interaction with regional organizations involved in the development of agriculture in order to solve the problems of regional producers.
4. Preparation of information and training materials on regional issues and interaction with regional media.
5. Coordination of programs in districts using group and individual work.
6. Informing regional authorities on the problems of rural producers, which can be solved at the regional level and joint development of programs aimed at their solution.
7. Participation in training, retraining and professional development of district employees and producers (Ternavshchenko & Baikenich, 2016).

Currently, a network of 41 information and consulting centers (ICC) of various organizational and legal forms is functioning at the district level (Figure 1).

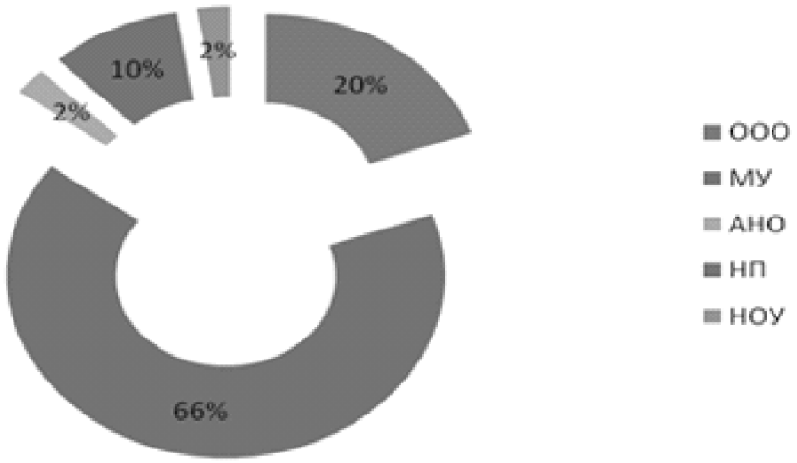

Figure 1: The structure of the district information and consulting centers of the Krasnodar Region

It is possible to identify a number of problems and shortcomings in the functioning of ICCs in the Krasnodar Region, which constrains the effectiveness of information support and does not allow it to be fully realized as an important component of ensuring effective economic ties between participants in the agricultural market.

1. Insufficiently effective management of the regional ICCs due to shortcomings in the formation of the organizational structure of the service. This, in turn, hinders the development and improvement of communication channels between services of different levels.
2. Six districts in the Krasnodar Region remain uncovered by ICCs (Yeisk, Leningrad, Tikhoretsk, Labinsk and Mostovsky), as do three cities (Goryachy Kluch, Gelendzhik, and Anapa), i.e. 16%

of the territory of the region. At the same time, in the uncovered territories, the cities are resorts whose main revenue comes from the tourist cluster. In the Labinsk and Mostovsky districts, agriculture is not the basis of economic potential. The Yeisk district is one of the largest centers of agricultural production in the Kuban region, with a high economic potential, specializing in the cultivation of grain (mainly wheat) and leguminous crops, sunflower, melons and fruits, fish production, meat and milk production. In the Tikhoretsk District, 17 large organizations, 40 small organizations, 337 farms, and more than 20,000 private subsidiary farms are engaged in agriculture. On the territory of this district, grains and leguminous crops, sunflower, sugar beet are grown. In the agrarian and industrial complex of Labinsk district there are 12 large agricultural producers, 295 farms and 15 335 personal subsidiary farms. The production of grain and oilseeds is increasing every year. The sector of dairy cattle breeding is very important for the Labinsk region. In this regard, the lack of information and consultation centers in these areas is a deterrent in the formation of a single information and consulting service in the Krasnodar Region.

3. Low level of introduction of scientific and technical achievements and advanced production experience in agricultural production.
4. Insufficient development of innovative projects and technologies.
5. The mechanism of feedback to rural producers has not been developed.
6. There is almost no influence on the formation of the order book for scientific institutions. This, in turn, leads to the fact that many scientific and technical developments are not introduced into production process.
7. Conducted monitoring of the needs of agricultural producers does not influence the formation of orders for scientific institutions.
8. Lack of prompt, reliable information hampers the work of the information and consulting service, which requires the creation of optimal conditions for satisfying the information needs of agricultural producers based on the use of information technologies in which the functions of collecting, storing, processing and transmitting information are realized.
9. Low level of attraction of alternative sources of financing. Insufficient budget financing hampers the strengthening of the material and technical base of the ICCs and the involvement of highly qualified specialists, which, in the end, affects the quality of the service. Experience shows that at the first stages of its development, the centers offer gratuitous services. Later, if the development of agriculture is stable, and the enterprises receive state support, IÑÑs start to provide paid services.
10. Low percentage of consulting services in the field of crop production and cattle breeding. As practice shows, most ICCs of the Krasnodar Region, provide consulting services concerning accounting, taxation, insurance, ecology, legal information, and sales channels. At the same time, there is practically no consultation on the interaction between raw material processing enterprises with agricultural producers and marketing organizations.

In order to invrease the efficiency management and improve communication channels between agricultural producers, commodity producers and wholesalers and retailers, we have developed an

organizational model for the formation of economic ties between the subjects of the agro-industrial complex in theKrasnodar Region, which involves improving its organizational and functional components. The organizational model of formation of economic relations between the subjects of the agro-industrial complex of the Krasnodar Region is presented in Figure 2.

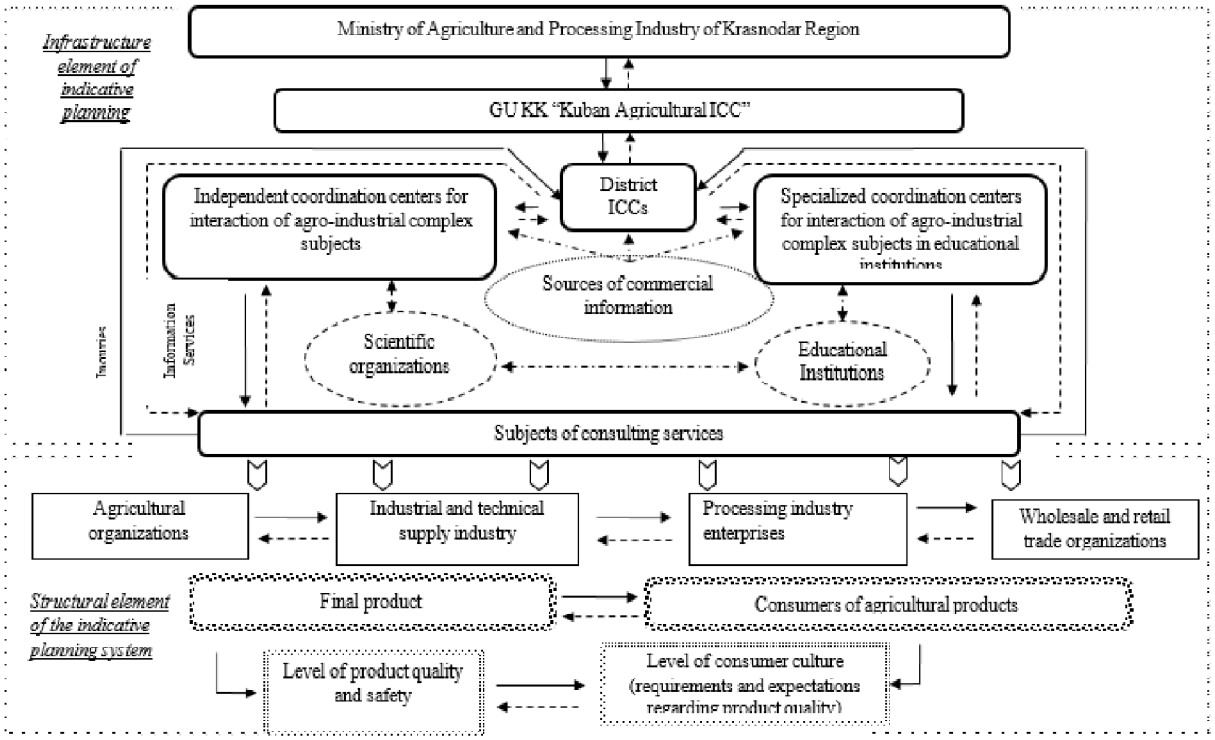

Figure 2: Organizational model for the formation of economic ties between the subjects of the agro-industrial complex of the Krasnodar Region

Currently, the functional organization of the district ICCs is based only on functions (the types of activities are grouped according to the main activities and types of work performed). There are several approaches to the formation of subdivisions of coordination centers for interaction between the subjects of the agro-industrial complex (Table 1).

Table 1
Organizational approaches to the formation of coordination centers for interaction between the subjects of the agro-industrial complex

Approach	*Functions*	*Advantages and disadvantages*
1. Depending on the program.	Groups are formed that interact with departments of educational or research institutions within the framework of a single ICC program.	The advantage of this approach, in our opinion, is that it promotes a constant exchange of information between scientific divisions and the information and consulting service. Depending on the services provided, structural units are formed to ensure the work of individual units and increase the

contd. table 1

Approach	*Functions*	*Advantages and disadvantages*
		efficiency of the organization as a whole; this saves operational costs, monitors the implementation of the organization's policy, and so on. These may be units that perform functions such as accounting and financial management, personnel management, provision of information services, etc.
2. Depending on the client.	The grouping of activities is carried out depending on the various categories of clients with which the information-consulting center works. The need for this approach is due to the specialization and variety of needs of commodity producers in certain services (for example, subdivisions to work with farms, subdivisions to work with large agricultural organizations, subdivision to work with infrastructure organizations, etc.). The matrix approach to the formation of district ICCs implies administrative management and management of individual programs forming the matrix.	As a result, many employees work in two or more groups simultaneously and, accordingly, are subordinate to several managers (one permanent administrative administrator and one or more program or project managers).
3. Creation of the ICCs on the basis of large regional multi-profile or branch-based universities, (the "land-grant" model of universities)		The main advantages of this model, in our opinion, are:- low establishment costs when creating in conditions of low budget financing, because the material, technical and educational base of universities is used;- experience and high qualification of professors, teachers and scientific personnel ensure the quality of consulting services;- wide links of "land-grant" universities with scientific, administrative, commercial and other organizations, as well as with agricultural organizations that contribute to the expansion of consultancy services; - the trust of consumers of information to professors and specialists of services not directly related to the administrative apparatus is much higher than to bureaucrats, which creates favorable conditions for the effective implementation of the core functions by the employees of the service.In our opinion, this model does not have any disadvantages. However, it should be noted that in all countries where it is used, the financing of the

contd. table 1

Approach	*Functions*	*Advantages and disadvantages*
		service is carried out mainly at the expense of budgetary (federal and regional) sources. Some centers become self-sufficient or receive partial reimbursement of costs.
4. Creation of consulting services in the structure of commercial firms and private consultancy services.	In the structure of such firms, special units are created, whose responsibilities include the selection of potential customers, conduction of consultations on the proper use of resources provided by the firm or the use of proposed technologies.	The organization of ICCs in the structure of commercial firms, in our opinion, has a number of advantages: - a lower level of bureaucracy than in public services; - consulting services contribute to additional advertising of products, expansion of sales markets, and as a result, an increase in the number of customers; - a higher level of skills of employees, due to material incentives. - a broad range of methods and techniques of consulting is applied;- paid consulting contributes to a deeper and more comprehensive study of the customer problems; - high motivation to maximize customer satisfaction. Disadvantages of the model are: - ICC employees in accordance with their duties must ensure the implementation of the interests of the firm, which may, but not necessarily, coincide with the interests of agricultural organizations; - consultations to agricultural producers are given by service agents only in the area in which the firm operates. - low objectivity of assessments of products and technologies of competing firms;- not sufficient level of communication with state institutions, scientific and educational organizations, and NGOs

In our opinion, the transformation and strengthening of planned management functions should become the basis for the functional improvement of the links between agricultural producers, processing enterprises and wholesalers and retailers. Functions for planning, analysis, monitoring of information should be delegated to coordination centers.

In the conditions of dynamic economic development, prolonged sectional restrictions, and constantly growing competition, the role of planning as a function of management greatly increases. This is due to the fact that planning is the basis for efficient production, distribution and consumption of resources. Given the limited resources available, planning for their rational use is the basis of economic efficiency. Agribusiness entities that take certain economic decisions in the marketplace should take into account the sharply increased influence on the economy, the organization and planning of the production of external

factors, and the uncertainty of the market in order to constantly maintain the variability of their functioning, where the leading role belongs to planning. Planning allows to take into account the state of the market; it is oriented towards consumer's needs, has a prognostic character due to the changeability of the external environment.

Planning in the system of interaction between the subjects of the agro-industrial complex should be built on the principle of "counter flows", i.e. interactive planning. It should be based on the interaction of management, the planning and economic service, and the relevant units of all participants in the process of production and sale of food. Coordination centers should ensure the interconnection of goals with the resources of all agribusiness entities, accumulate information about the external environment and provide information exchange based on a comparison of planned and actual indicators (Francisco & Molchan, 2016).

In the process of planning the activities of the subjects of the agro-industrial complex, special attention should be paid to the peculiarities of the region and the level of its socio-economic development. The main socio-economic objectives of planning for all subjects of the agro-industrial complex are:

1. Improving the quality of food.
2. Satisfaction of public needs in terms of achieving optimal cost parameters and economic accessibility of food.
3. Ensuring a high level of consumer properties of food, including ecological purity and modern requirements to the organization of transportation of food from the producer to the consumer in the production-consumer cycle.
4. Achieving sustainable growth in agricultural production.
5. Solution of the food problem of the country, the region and the approximation of the level of food consumption to scientifically based standards.
6. Intensification of agricultural production.
7. Improving the use of resources and increasing the efficiency of production.
8. Changing the structure of foreign trade with a view to gradually transforming the country and the region into an exporter of food products

Since we have determined the level of quality of final food products as the target indicator of effective economic relations between all participants of the food market, let us consider the most important areas of the planned work of the ICCs for interaction between the subjects of the agro-industrial complex (Figure 3).

The pecuriarities of regional agro-industrial complex are conditioned by:

– the level of its social and economic development;
– the climate;
– resource potential, forming conditions for agricultural production and development of processing industries;

- the condition, level of development and potential of other sectors of the region's economy, with which agricultural production is interconnected;
- the nature of the current and strategic tasks being solved for the development of the region;
- the dynamism and growing uncertainty of the natural, climatic, economic and other conditions of the functioning of this sector of the economy.

In order to take into account regional peculiarities when planning the indicators of agricultural development, various methods can be used; in our view, the most expedient is the application of economic and mathematical modeling. However, it should be noted that since the development of agriculture in a particular region is considered, optimization models are not taken into account. A number of researchers substantiate the use of this type of models in calculating the optimal parameters of specific economic entities operating in a static economic system. Therefore, in this study we proceed from the assumption that the optimality criterion lies outside the limits of the system considered in the model.

The economic-mathematical problem of agricultural development as an integral part of organizational structure of region's agro-industrial complex can be formulated as follows: "To determine the following: which crops must be grown on which area; livestock number; how much and what kind of fodder is needed to grow to fully satisfy the needs of the livestock; how much basic means of production is needed;

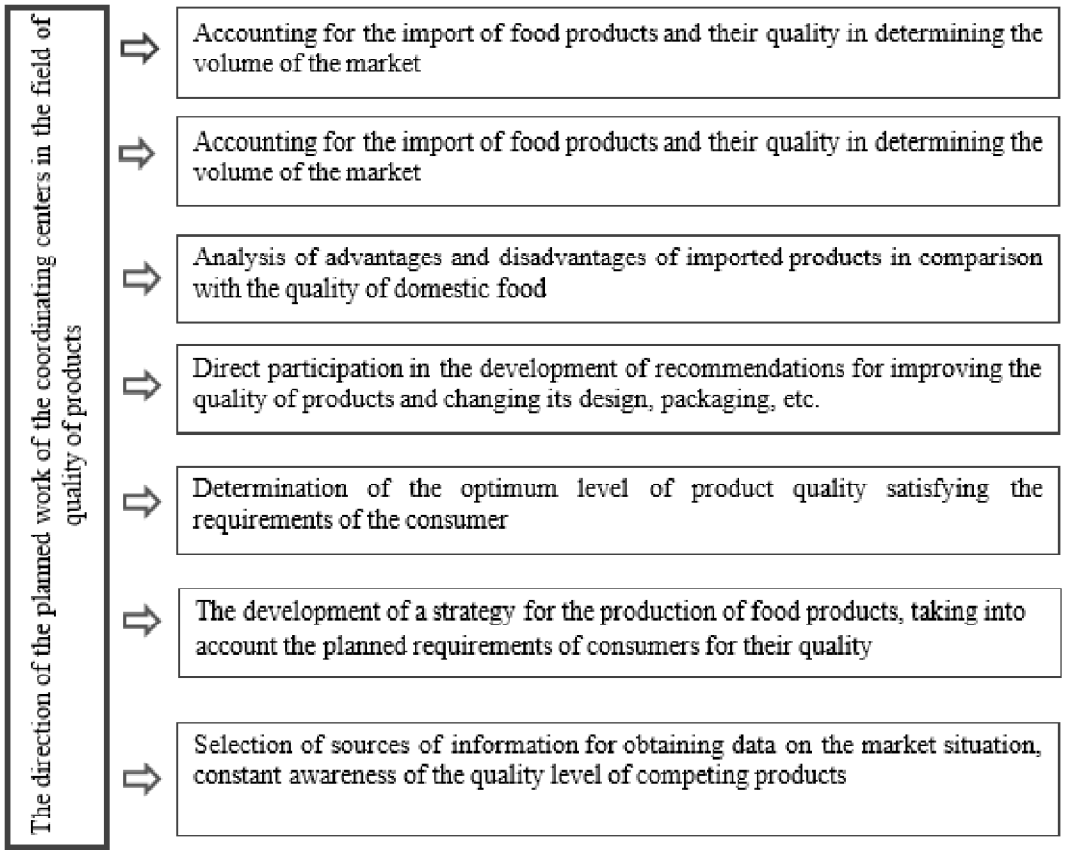

Figure 3: Directions of planned work of the coordination centers of Krasnodar Region in the area of product quality

how much and what kind of agricultural products will be produced; what will the production costs be; how much and what kind of products will be supplied to the population and processing enterprises for the production of food" (Prokhorova, Zakharova, Gladilin & Molchan, 2016).

Let us build a structural (symbolic) mathematical model, for which we introduce the following notation:

Indices:

J – Set of variables;

j – Indices of variables;

I – Set of restrictions;

i – Indices of restrictions;

x_j – Variables denoting changing parameters.

J_1 – Use of resources of agricultural enterprises (labor, land);

J_2 – Number of livestock;

J_3 – Requirements for crop rotation;

J_4 – Fodder in physical terms;

J_5 – Areas of cultivation of crops;

J_6 – Crop production in physical terms;

J_7 – Livestock products in physical terms;

J_8 – Costs of agricultural production;

J_9 – Fixed assets of agricultural production;

I_1 – Resource usage;

I_2 – Number of livestock;

I_3 – Crop rotation;

I_4 – Fodder in physical terms;

I_5 – Balance of nutrients and structure of rations of farm animals;

I_6 – Crop production in physical terms;

I_7 – Livestock products in physical terms;

I_8 – Determination of costs for agricultural production;

I_9 – Fixed assets for agricultural production.

Coefficients used in the structural mathematical model:

a_{ij} – Norms of costs of the i-th resource per unit of j-th product or type of activity;

B_i –The stock of i-th resource;

h'_{ij}, h''_{ij} – Coupling coefficients between variables in the model;

w_{ij} – Norms for output of the j-th type of product or type of activity per unit of the i-th type of resource;

v_{ij} –The norm of the consumption of i-th nutrient per unit of industry of j-th type;

l_{ij} – The nutrient content of the i-th species in the unit of the j-th type of fodder;

d^{min}_{ij}, – The minimum necessary rate of production of the j-th type to meet the needs of the population in it and to load production capacities of processing enterprises;

c_j – Product and resource estimation coefficients.

The system of restrictions, reflecting the external and internal relationships of the analyzed system, looks as follows:

1. Conditions on the use of resources of agricultural enterprises (labor, land).

$$\sum_{j \in J_1} a_{ij} x_j \le B_i, \quad where \quad i \in I_1$$

2. Conditions on the level of the concentration of livestock and the structure of the herd of farm animals.

$$\sum_{j \in J_2} x_j \ge B_i, \quad where \quad i \in I_2$$

$$\sum_{j \in J_2} h'_{ij} x_j - \sum_{j \in J_2} h''_{ij} x_j = 0, \quad where \quad i \in I_2$$

3. Conditions for cultivating agricultural crops taking into account scientifically based crop rotations.

$$\sum_{j \in J_3} h'_{ij} x_j - \sum_{j \in J_3} h''_{ij} x_j \begin{Bmatrix} \le \\ = \\ \ge \end{Bmatrix} 0, \quad where \quad i \in I_3$$

4. Conditions for the volume of fodder production.

$$\sum_{j \in J_3} w_{ij} x_j - \sum_{j \in J_4} x_j = 0, \quad where \quad i \in I_4$$

5. Balance of nutritional elements and structure of rations of feeding of farm animals.

$$\sum_{j \in J_2} v_{ij} x_j - \sum_{j \in J_1} l_{ij} x_j \le 0, \quad where \quad i \in I_5$$

6. The condition for determining the volume of crop production by type (the area of sowing of each crop is multiplied by its yield), minus the consumption of these types of products for animal feed.

$$\sum_{j\in J_5} w_{ij}x_j - \sum_{j\in J_2} a_{ij}x_j - \sum_{j\in J_6} x_j = 0, \quad where \quad i \in I_6$$

Plant production must be not less than the need for it in the region, as well as for loading production capacities of processing industries:

$$x_j \geq d_{ij}^{\min}, where \quad i \in I_6$$

7. The condition for determining the volume of production of livestock products by species (the productivity of animals is multiplied by their livestock), minus the consumption of these types of products for animal feed.

$$\sum_{j\in J_2} w_{ij}x_j - \sum_{j\in J_2} a_{ij}x_j - \sum_{j\in J_7} x_j = 0, \quad where \quad i \in I_7$$

Livestock products should be produced no less than the needs of the population of the region, as well as for the loading of production capacities of processing industries:

$$x_j \geq d_{ij}^{\min}, where \quad i \in I_7$$

8. The condition for determining the need in fixed assets for agricultural production.

$$\sum_{j\in J_2} a_{ij}x_j + \sum_{j\in J_5} a_{ij}x_j - \sum_{j\in J_9} x_j = 0, \quad where \quad i \in I_9$$

9. The condition for determining the production costs and annual payments of agricultural producers for the production of agricultural products.

$$\sum_{j\in J_1} c_j x_j + \sum_{j\in J_2} c_j x_j + \sum_{j\in J_4} x_j + \sum_{j\in J_9} x_j - \sum_{j\in J_8} x_j = 0, where \quad i \in I_8$$

10. Conditions for the non-negativity of variables.

$$x_j \geq 0$$

The presented economic-mathematical model allows to take into account the system of economic and natural conditions of production of agricultural products, to determine the volumes of crop and livestock production, necessary, on the one hand, to provide the population of the region or the country as a whole with foodstuffs sufficient to meet its needs in a set of nutrient substances, microelements that support normal life activity, the health of the nation, and on the other hand, to ensure that industrial enterprises are supplied with agricultural raw materials in the amount sufficient to load the available production capacity

CONCLUSION

Thus, the basis of the proposed model of interaction between the subjects of the agro-industrial complex of the Krasnodar Region is formed by the following adjustable parameters:

1. Economic parameters of regulation: financial, labor, production and natural resources.
2. Commodity parameters of regulation: stability of qualitative indicators of production, enrichment of products with physiologically valuable ingredients, high consumer value, priority of food products of domestic production.
3. Technological parameters – full cycle of processing, recycling, priority of food components of domestic production, stability of technological processes, application of high-tech equipment.

Socially significant parameters – the quality of consumed products, the level of consumer culture, environmental safety, closed production cycle (recycled water supply and self-sufficiency), the responsibility of consumers for the formation of a balanced diet of high nutritional value.

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REFERENCES

Alpysbaeva, R.D. (2006). *Increasing Competitiveness of Agricultural Production in the Republic of Kazakhstan.* Astana.

Francisco, O.Yu. & Molchan, A.S. (2015). Institutional Transformations of the Agrarian Sector of the Russian Economy: Directions and Priorities. *The Economics of Russia in the 21st Century, a collection of scientific papers of the 12th All-Russian Scientific and Practical Conference.* Tomsk Polytechnic University, 128-134.

Francisco, O.Yu. & Molchan, A.S. (2016). Transformation of the Structure of Management of the Agrarian Sector of the Russian Economy. *Global problems of modernization of the national economy. Materials of the V International Scientific and Practical Conference (correspondence): in 2 parts,* 141-145.

Francisco, O., Molchan, A. & Francisco, P. (2015). Institutional Reforms in the Agro-industrial Complex of Russia: Genesis, Issues, Current state. *Modern European Researches, 3,* 44-49.

Illarionov, V.V. & Rykov, D.V. (2012). The Study of the Peculiarities of Nutrition of the Inhabitants of Various Groups Living in the South of Russia. *New technologies, 3,* 115-119.

Molchan, A.S. & Francisco, O.Yu. (2014). Institutional Regulators of Strategic Transformation of the Agrarian Sector of the Economy. *Economics and Entrepreneurship, 12-4*(53-4), 669-672.

Prokhorova, V.V., Zakharova, E.N., Gladilin, A.V. & Molchan, A.S. (2016). Agro-town development as a technology of life support and socio-economic policy of the country. *International Review of Management and Marketing, 6*(6), 191-196.

Ternavshchenko, K.O. (2013). Priority Directions of Reforming the Regional Advisory and Information Service in the Agrarian and Industrial Complex of the Krasnodar Region. *Agrarian Russia, 8,* 34-38.

Ternavshchenko, K.O. (2014). *Perfection of the System of Intrafirm Planning in Dairy Cattle Breeding (based on materials of the Krasnodar Region): Dissertation for the degree of Candidate of economic sciences / Kuban State Agrarian University.* Krasnodar.

Ternavshchenko, K.O. & Baikenich, V.E. (2016). Directions of Ensuring Food Security in the Krasnodar Region in the Context of Sanctions Restrictions. *Global problems of modernization of the national economy. Materials of the V International Scientific and Practical Conference (correspondence): in 2 parts,* 117-124.