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Sustainable Development of Sugar Beet Subcomplex

Alexander Nikitin, Natalia Karamnova, Natalia Kuzicheva, Vitaly Belousov

Abstract: ***The study aims at developing theories and practical recommendations for ensuring the sustainable development of the Russian sugar beet subcomplex. The following methods were used during the study: statistical and economic, monographic, economic and mathematical, as well as calculation and constructional. The article determines that the impact of factors of the external and internal environment causes the unsustainability of the sugar beet production. The main sustainability criterion should be to ensure the beet sugar production at the level of 80 % of the national consumption. Therefore, it is possible to consider the volume of production, the supply of sugar factories with raw materials, the level of beet sugar consumption by the population, the level of food security, and the level of provision of material and technical resources for the sugar beet production as the main indicators characterizing its mission.***

According to the studies, the main producers of sugar beet are the agricultural organizations that produce 85 – 90 % of the gross production. Peasant farms (farms) produce up to 15 % of the gross production. Individual entrepreneurs and the population's households produce sugar beet insignificantly.

The analysis has revealed that the main objective and subjective reasons that hinder the development of the modern Russian sugar beet production include yield fluctuations, fluctuations of sown areas and gross production of sugar beet by beet-growing regions and by years, the lack of proportionality of development between the production capacities of sugar factories and their raw material zones.

It is possible to stabilize the production and economic activity in the context of the changing market environment and the increased competitiveness of all participants of the sugar beet production due to developing integration processes and creating a structure that can occupy its niche in the sugar beet market.

Keywords : sugar beet production, sustainable development, agricultural integration, stages of forming an integrated association.

I. INTRODUCTION

The sustainable development of the agro-industrial sector of the economy [1, 2, 3, 4], in particular the Russian sugar beet production, is important for solving the problems related to food security, as well as the raw materials independence of the country.

Over the recent years, the sugar beet production has been increasingly losing its positive impact on the economy of agricultural enterprises and the agro-industrial complex, as a whole. As a result of major violations of the reproductive process, a diverse set of relations between producers and processors turned out to be broken. The relations between the partners in the sugar beet production are characterized by inefficient use of the potential of enterprises, the lack of an efficient mechanism for the formation and regulation of relations between them. There was an organizational dissociation and opposition of some interests to others.

The problems related to rationalizing intersectoral economic relations, improving competitiveness, and investment policy in the area of sugar beet production can be solved by integrated agricultural structures.

In this term, the substantiation of the organizational and economic mechanism of intersectoral interrelation of participants in the sugar beet production is a strategically important socio-economic task, consisting in the development of scientific and methodological provisions, methodological and practical recommendations for ensuring sustainable development of sugar beet production.

II. METHODS

A. General description

During the study, the statistical and economic method was used to study the state and development trends of sugar beet production, and provision of the population of the country and its regions with sugar. The monographic method was used to study the activities performed by beet-sowing enterprises and sugar factories, the calculation and constructive method was used to substantiate the parameters of developing sugar beet production in order to ensure food security.

B. Block diagram

The functioning of the sugar beet subcomplex is largely determined by the development of the Russian sugar market, and is an important strategic area for strengthening the Russian economy because it contributes to the employment of the able-bodied population, ensures the replenishment of the state budget, and is the basis for increasing gross income.

Over the recent decade, the development of sugar beet production has been characterized by a tendency to increase production of sugar beet due to the growth of its productivity and sown areas. The above changes are caused by natural, organizational, technical and technological, as well as economic reasons (Table 1).

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* Correspondence Author
Alexander Nikitin*, Michurinsk State Agrarian University, Michurinsk, Russia.
Natalia Karamnova, Michurinsk State Agrarian University, Michurinsk, Russia.
Natalia Kuzicheva, Michurinsk State Agrarian University, Michurinsk, Russia.
Vitaly Belousov, Michurinsk State Agrarian University, Michurinsk, Russia.

Table 1: Sugar Beet Production in Russia (in Farms of All Categories)*

Years	Area, thous. ha	Whole yield, mln.t.	Yield, dt/ha
On average for 1985 – 1990	1,474.6	33.2	225
1995	1,085.6	19.1	176
2000	806.4	14.1	188
2005	811.5	21.4	282
2010	1,160.1	22.3	241
2011	1,291.9	47.6	392
2012	1,143.0	45.1	409
2013	903.8	39.3	442
2014	919.0	33.5	370
2015	1,022.0	39.0	388
2016	1,108.0	51.4	470
2017	1,199.0	51.9	442
2017 in % as to the average for 1985 – 1990	110.4	156.3	196.4
2017 in % as to 2010	103.4	232.7	183.4

**Source: according to the Ministry of Agriculture, Rosstat*

The natural and climatic conditions of the Russian Federation limit the beet-sowing area to 21 regions that differ in the applied technologies for sugar beet cultivation, yield, sugar content, cost, and profitability. Over a long period of time, eight regions have been the leaders in beet-sowing. They are the Krasnodar Territory (18.0 %), the Kursk Region (11.0 %), the Voronezh Region (10.9 %), the Lipetsk Region (10.3 %), the Tambov Region (9.0 %), the Belgorod Region (8.2 %), the Republic of Tatarstan (6.2 %), and Bashkortostan (4.9 %) [5].

It is necessary to note that during the study period from 2000 to 2017 there had been a steady tendency towards increasing the crop acres in certain regions of Russia, including the Kursk and Tambov Regions, the Republic of Tatarstan, the Krasnodar and Stavropol Territories. Moreover, in the Stavropol Territory and the Tambov Region, their level increased 2.5 and 2.2 times, respectively, as compared to 2000.

Sugar beet is mainly cultivated by agricultural enterprises, peasant farms (farms), individual entrepreneurs and people's households. In 2017, large agricultural organizations of the Tambov Region had 91.6 % of the cultivated area, and 92.8 % of the gross production of sugar beet were obtained from farms of all categories.

A considerable increase in crop acres is also observed in peasant farms. Thus, for the period under study (1995 – 2017) crop acres of sugar beet in the farms of this category had increased from 3.3 up to 7.33 thous. ha, and their share in the crop acres of all categories of farms had increased from 4.6 up to 8.4 %, and in the gross yield – from 5.4 up to 7.1 %. The share of sugar beet crops in people's households had slightly decreased from 0.03 down to 0.01 %. The same trend is observed in the gross yield.

The increase in crop acres of sugar beet in small forms of farming is associated with the increase in the profitability of this crop, low employment of the able-bodied population in rural areas, and the possibility of growing sugar beet by using manual labor.

In large agricultural organizations, there is an opposite trend related to declining beet compacting because many farms started abandoning the production of sugar beet, preferring more profitable and less labor-intensive crops such as sunflower and cereals. For example, the labor costs per one ha of grain cultivation are 5 – 7 times lower, and the yield is 10 – 15 times higher as compared to the production of sugar beet [6].

Despite the fact that large agricultural enterprises remain the main suppliers of sugar beet to sugar factories, small forms of management, including peasant farms (farms), occupy their own certain niche.

C. Algorithm

From these positions, it is interesting to make a comparative estimation of the sugar beet production development in Russian and foreign farms in order to define opportunities for increasing the production of beet raw materials in them.

It is necessary to note that in most foreign countries, the agricultural production is mainly represented by farms that make up the basis of the agricultural economy. For example, in the United States the number of farms has achieved 2.2 million, they own 89 % of all land, with an average plot size of 168 ha.

In Germany, the agricultural economy is for more than 90 % represented by family farms. Their number has reached 300 thousand, with an average size of 49 ha. In Finland, almost all agricultural production belongs to farms, with a total number of family farms of 60 thousand and an average land size of 38 ha [7].

Thus, in all countries, the emphasis is made on small forms of family farms. This model is exceptionally efficient. A family farm is a public and state value. It is the national treasure both in Norway, which is rich in gas and oil, and in Portugal, which is poor in natural resources. It is not accidental that Article 23 of the Constitution of Poland states that family farming is the "basis of the agrarian system" [8].

The achievements of these countries and their best practices are in many ways the embodiment of scientific ideas into the practice of our agricultural scientists, such as N.D. Kondratiev, N.P. Makarov, A.V. Chayanov, A.N. Chelintsev, et al.

The ideas of their theory and development were used by other countries, and Russia is increasingly importing food from these countries.

The relatively small size of foreign farms has developed historically. Beet farms with the area of up to 10 ha are the most important. The largest industrial-type farms are widespread in France and Great Britain where crops of sugar beet range from 20 to 50 ha or more. Moreover, the share of such farms in Great Britain is up to 25 % of the total number of beet farms [9].

Since farming is the basis of agriculture in many countries, their agricultural policy is almost entirely aimed at their

support and development, and is a rather coherent system of scientific, technical and innovative support, as well as aimed at the formation of a developed system of procurement and intervention of manufactured products. The level of state support for agricultural producers reaches 90 % of its total volume. In Russia, over the past three years the state support for the farming sector of the economy has been unevenly distributed: in 2015 as compared to 2010 it had decreased from RUB 14.4 bln down to RUB 12.4 bln, and in 2017 it increased up to RUB 20.1 bln.

The unevenness of the state support is associated with the constant increase in the funds allocated from the federal budget and the unstable flow of funds from regional budgets. At the same time, the bulk of support (55.3 %) falls on regional sources. In 2017 the share of farms in total subsidies for agricultural development amounted to 11 %, and slightly exceeded their share in the value of gross product [10].

At the same time, the relative level of the state support and taxation of peasant farms is not lower than that of agricultural organizations.

However, this does not mean that the level of state support for the farming sector and agriculture, as a whole, is sufficient.

In 2015, RUB 25.2 bln were allocated to support crop producers. The average amount of subsidies from the federal budget per 1 ha amounted to RUB 344, and taking into account the regional component, RUB 501 per 1ha against more than RUB 20 thous. in the USA and the EU [11].

Russian producers of beet raw materials work under the conditions of high monopolism of the processing industry towards agricultural production and certain producers, when it is very problematic to conclude contractual agreements with each of them.

In addition, transportation costs are still very high. Today they are fully paid by agricultural producers.

At the same time, in foreign countries various forms of the insurance system for production and lending to farmers are quite efficient.

The development of foreign farming is peculiar of the fact that farms are directly engaged in agricultural production subject to the extensive development of the network of the service organizations that supply the required material and technical resources, repair of technical equipment and sale of manufactured products, which are carried out both under contracts and within various types of agricultural cooperatives. A farm can be a member of many different cooperatives by type of activity, which results in a considerable economic effect.

Due to this, in terms of the further increase in the production of beet raw materials by farms, the authors consider it necessary to further develop integration and cooperative processes with their participation, which will improve the sustainability of agricultural, including beet, production.

III. RESULTS

The activities performed by the sugar industry enterprises aim at the industrial processing of sugar beet and the production of sugar that is a valuable food product of the population, consumed in its natural form and in the form of products made by canning, baking, confectionery, and other types of food industry.

Analyzing the existing production capacities of sugar factories, the authors come to the conclusion that they do not correspond to the available raw material base and violate the principle of their balanced development. The increase in sugar beet production in most regions of beet growing caused the lack of production capacities, an extended sugar period, and, consequently, the decrease in sugar content of sugar beet and sugar yield. At the same time, in other regions due to the insufficient amount of beet raw materials, underutilization of production capacities is noted.

Over the recent years, there has been a negative trend of decommissioning the production capacities of sugar factories due to their physical and moral deterioration. For example, in the Central Black Earth Zone, ten sugar factories with a total capacity of 18.3 thous. t per day were removed from the production process. This situation is also noted in other Russian beet-growing regions. On average, the shortage of production capacities is up to 50.0 thous. t of processing per day.

The republics of Mordovia and Bashkortostan, the Stavropol Territory, the Voronezh, Tambov, Ryazan, Penza, Ulyanovsk Regions suffer the deficit of production capacities. Over the recent years the volumes of harvested sugar beet have considerably increased [12].

This causes the deterioration of the main technical and economic indicators of sugar beet production (Table 2).

Table 2: Technical and Economic Indicators of Developing the Sugar Industry in Russia*

Indicators	Years							2017 in % as to 2000
	2000	2005	2007	2010	2015	2016	2017	
Sugar produced from 1 ha of seedings, t	2.09	3.11	2.86	2.40	5.04	5.60	5.50	263.2
Sugar extraction coefficient, %	0.78	0.83	0.82	0.82	0.84	0.83	0.84	107.7
Sugar content in beet when accepted, %	16.3	16.80	16.27	16.50	18.0	16.0	17.0	104.3
General dirtiness of sugar when accepted, %	11.60	10.60	11.90	10.75	11.16	11.73	10.36	89.3
Sugar content in cossettes, %	15.83	16.55	15.98	16.30	15.62	15.27	15.54	98.2
Sugar content in molassess, %	2.22	1.96	1.96	2.06	1.90	1.93	1.84	82.9
Sugar recovery, %	12.45	13.96	13.28	13.59	15.17	13.31	14.20	114.1
Factory coefficient	0.81	0.84	0.85	0.91	0.89	0.90	0.91	112.3
Consumption of coal equivalent, %	6.39	5.72	5.55	4.47	4.86	4.74	4.83	75.6
Consumption of limestone, %	7.07	5.95	5.61	5.16	4.74	5.18	4.89	69.2

*Source: according to the Ministry of Agriculture, Rosstat

As mentioned above, the growth of raw materials causes the shortage of production capacities. Therefore, a prerequisite for improving the production of beet raw materials should be a relevant increase in the production capacities of the processing industry, and accordingly, the increase in production capacities should come with the development of a raw material zone that can fully load the existing production capacities into optimal sugar production periods – 90 – 100 days.

The low level of the population's provision with the sugar produced from Russian raw materials, the inefficient use of the production capacities of sugar factories in the off-season created the prerequisites for the import of raw sugar into Russia and its processing. This process started especially rapidly in 1990 – 2001, when the production of sugar from raw materials was 3.5 – 4.5 times higher than the production of sugar from sugar beet (Fig. 1).

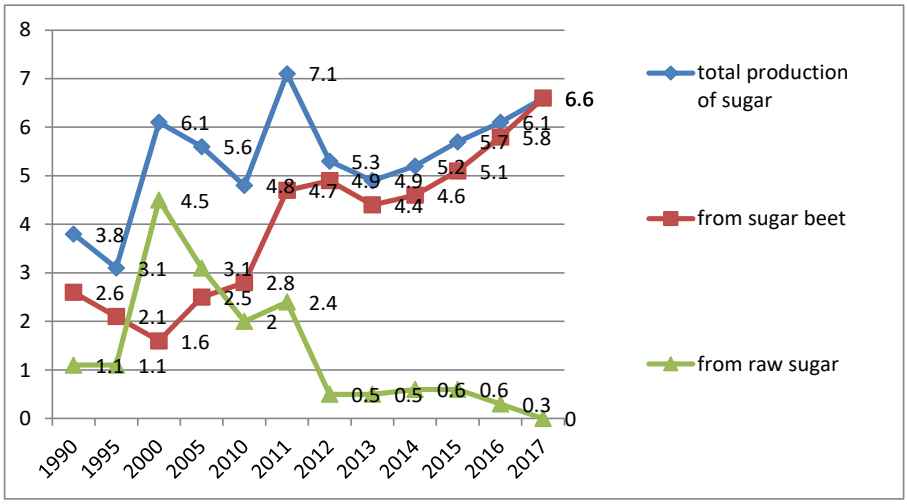

Fig. 1: Production of Sugar from Sugar Beet and Raw Sugar in the Russian Federation (Source: according to the Ministry of Agriculture, Rosstat.)

When reforming the agricultural economy, reorganizing and privatizing the property of sugar factories, the production of sugar from raw sugar increased, and the production of sugar from sugar beet decreased. This situation made the Russian beet sugar production dependent on foreign producers. Over the period of 1990 – 2000, over 5.8 mln t of raw sugar had been imported into Russia, with a total value of USD 3.1 bln [13].

In 2003, the situation changed radically. In order to protect the Russian sugar market, the Government of the Russian Federation adopted and took measures aimed at restricting the import of sugar and raw materials, focusing on processing enterprises to increase sugar production from the Russian beet raw materials. The main ones included the introduction of a duty on white sugar and tariff quotas for the imported sugar and raw materials.

The state's regulation of the sugar and raw sugar imported to Russia, adaptation of sugar industry enterprises to new business conditions created the prerequisites for sugar companies to increase financial investments in the development of their raw material zones.

For the period under study – 1990 – 2017, the sugar production in the Russian Federation had increased by 75.6 %, including 2.5 times for the sugar produced from the Russian beet raw materials. The ratio of sugar production from beets and raw materials had also changed – 30 % : 70 % in 1990 and 100.0 % : 0 % in 2017.

Up to 80.0 % of the total sugar is produced in the Central and Southern Federal Districts, and 20.0 % – in the Far Eastern, Volga, and Siberian Federal Districts all combined [14].

The changing market conditions, sales conditions, the buyers' solvent demand, supply of sugar products largely determine the conditions for using sugar production resources.

The increase in the sugar production from Russian beet raw materials has improved the balance of its resources. Over the past decade, the share of beet sugar in the balance structure has increased more than 2.5 times, and amounted to 100.0 % in 2017 (Table 3).

Table 3: Balance of Resources and Use of Sugar in Russia, Thousand Tons

Indicators	Years						2017 in % as to 2008
	2008	2009	2010	2015	2016	2017	
Resources, in total	8,884	8,301	7,663	9,655	10,427	11,387	128.2
Reserves at the beginning of the year	2,850	2,984	2,627	3,571	4,107	4,568	160.3
Total production of sugar, including	5,869	5,058	4,751	5,745	6,014	6,592	112.3
from sugar beet	3,480	3,313	2,782	5,098	5,774	6,592	189.4
from raw sugar	2,389	1,745	1,969	647	240	0	-
Import of white sugar	165	259	285	339	306	227	137.6
Total use	5,900	5,674	5,850	5,548	5,859	6,313	107.0

Consumption of other industries	450	250	250	-	-	-	-
Export	54	134	26.2	8	99	513	9.5 times
National use	5,396	5,293	5,573	5,540	5,760	5,800	107.5
Reserves at the end of the year	2,984	2,627	1,813	4,107	4,568	5,074	170.0

**Source: according to the Ministry of Agriculture, Rosstat.*

The data in the table indicate that the formation of sugar resources in Russia by 32 – 40 % is carried out due to the surplus of previous years, by 39 – 57 % due to the production of sugar from sugar beet, by 21 – 26 % due to the production from raw sugar, and up to 3 % due to sugar import.

The sugar market capacity is 5.4 – 5.5 mln t, which is estimated annually at an average of RUB 110 bln [15].

White sugar is used in two main areas: personal consumption by the population and processing in sugar-consuming sectors of the food industry.

The resource potential of sugar allows meeting national needs and exporting.

Traditionally, the main consumers of sugar are the population, the food industry and the state, which account for 53 %, 40 % and 7 %, respectively, of the sugar delivered to the market. This structure of sugar consumption considerably differs from the consumption in developed countries, where the sugar contained in finished products (up to 70 %) is preferred.

Thus, during the study, it was revealed that the main objective and subjective reasons restraining the development of the modern Russian sugar beet production were the yield fluctuation, crop acres, and gross yield of sugar beet by beet-growing regions and by years, the lack of proportionality of development between production capacities of sugar factories and their raw material zones.

An essential direction for improving the sustainability of developing the sugar beet production is to improve the relationships among beet-growing farms, the processing industry, and trade enterprises based on the development of cooperative relations and the creation of integration structures.

Integrated associations in the sugar beet production are business entities that operate on the basis of the organizational structure, financial and economic management mechanism, and management system.

The mechanism for creating such structures necessitates a methodological substantiation of the main stages and addressing challenges to achieve the set goal.

The main stages of creating integrated structures are as follows (Fig. 2):

Stage I. Organizational and economic estimation of the activity performed by sugar beet enterprises.

A detailed estimation of the results of the activity performed by sugar beet production enterprises makes it possible to scientifically determine the promising forms of integrated associations. The in-depth analysis of the functioning of sugar beet production enterprises helps to identify the features of their functioning and determine the trend of further development in the market economy.

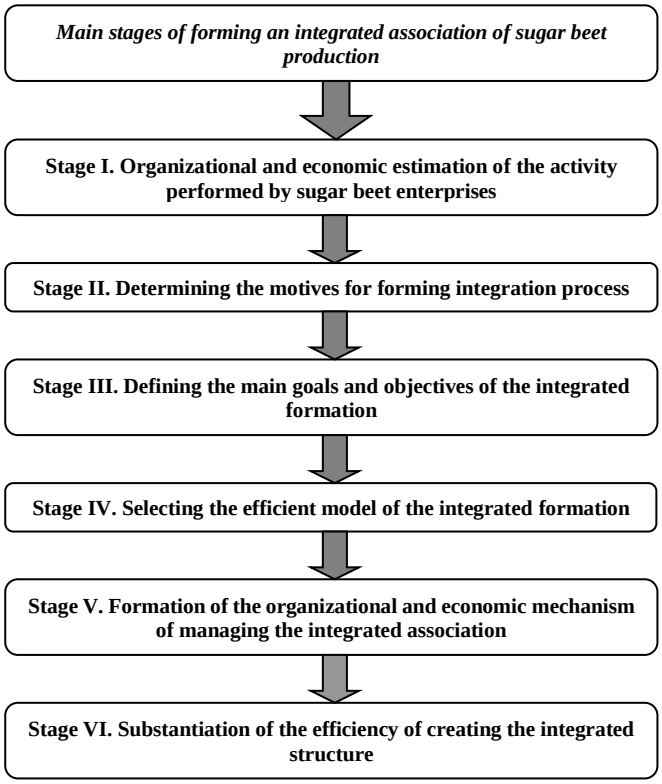

Fig. 2: The main Stages of Forming an Integrated Association of Sugar Beet Production

An important prerequisite for overcoming the crisis, low solvency, financial instability of sugar beet enterprises is the unification of the potential capabilities of individual business entities in order to form integrated structures with a closed cycle of production of final products. Integrated associations can reduce the material and monetary costs associated with the production, processing, storage and sale of final products,

reduce the risk of financial losses, create a balanced mechanism for the redistribution of income between individual participants, leveling the economic conditions for their management, eliminate nonpayments, and reduce the tax burden by reducing intermediate structures when selling products.

Stage II. Determining the motives for forming integration processes.

The determining motives for the development of integration processes in the sugar beet production include the unification of all parts of the technological chain associated with the production, processing and sale of sugar beet products, improvement of the financial condition of producers, the creation of conditions for promoting competitive sugar beet products on the market, overcoming monopolism and crowding out excessive intermediaries, the use of advanced technologies for the production and processing of sugar beet, high-performance machinery and

equipment in sugar beet production, and ensuring material interest in the production of high quality products.

Stage III. Defining the main goals and objectives of the integrated formation.

The main goals of creating integrated formations are the following:

– Achieving high rhythm and stability in the supply of sugar factories with high quality raw materials,
– Smoothing seasonality in the use of labor and production capacities of sugar factories,
– Specialization of sugar beet crops,
– Improved use of machinery, equipment, vehicles,
– Utilization and appropriate use of industrial wastes for industrial needs, and
– Reduction of production costs based on the approximation of processing to sources of raw materials [16].

The main goals determine the following tasks:

– To restore the raw material zones lost by processing enterprises,
– To develop a set of measures to restore broken inter-industry relations and to improve them,
– To create a mechanism of mutual interest in the production of final products,
– To protect the national market for products of own production,
– To provide the possibility of crediting seasonal expenses of enterprises at low interest rates, and
– To find funds for modernization and reconstruction, updating machinery, equipment of sugar beet production enterprises [17].

Participants of the association consider the solution to these problems taking into account the state and development prospects of the new formation.

Stage IV. Selecting the efficient model of the integrated formation.

The main criterion for choosing forms of the agro-industrial integration is the ability to maintain and develop industrial and economic relations that demonstrate the level of convergence of the partners' interests as a result of the integrated formations functioning.

According to the results of the study and the generalization of the legislative framework, it was determined that various forms of management had different potential in creating integrated structures and enabled the authors to define their main advantages and disadvantages in relation to the sugar beet production.

The diversity of forms of integrated associations is evidenced by the theory of "niches". According to it, each institutional structure can be used where it will show its advantages over other forms. In addition, the international experience evidences the close interweaving and convergence of various integrated structures and associations [18].

Stage V. Formation of the organizational and economic mechanism of managing the integrated association.

The organizational and economic mechanism of the integrated formation is a combination of economic means, methods, and instruments for influencing inter-industry relations arising within the organizational structure aimed at stimulating the development of production activities of interrelated participants in the technologically connected production.

The components of the organizational and economic mechanism for the functioning of integrated formations include the following:

– Organizational structure of the interaction of participants of the integrated structure,
– Organizational unity of the process of technological production of final products, and
– The creation of a single economic space, coordinating and regulating the activities of business entities, ensuring the preservation of specialized production and improving its efficiency [19].

Stage VI. Substantiation of the efficiency of creating the integrated structure.

One of the important economic problems of the sustainable development of integration processes is the matter of measuring their efficiency. This is due to incompleteness, inconsistency in the development of fundamental issues of the theory and methodology of production efficiency, including understanding of the essence of the problem itself, its main criteria, a system of indicators and factors that determine their development.

Methodologically, the estimation of the development efficiency of integration processes should be based on:

– A comprehensive approach to estimating the relationship of subsystems,
– Allocation of the main factors, taking into account their functional dependence,
– The growing role of integration and cooperation aimed at overcoming imbalances, and
– Modernization of the development of sugar beet industries and coordination of the functional relationship between interrelated factors [20].

IV. CONCLUSION

Thus, the methodological approaches that have been considered, as well as the stages of creating and functioning of integrated formations make it possible to determine the existing interrelations of the participants of integrated formations, to define the constituent elements of the economic mechanism, to identify the goals and objectives of establishing the association, and to offer practical solutions to the challenges that arise in the agricultural economy.

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