Application of Supply Chain Management to Improve Economic Potential of Dairy Enterprises

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***Abstract*- The main objective of this research is to propose the effectiveness of dairy supply chain management in economy and to illustrate the current practices of diary supply chain in Russia. A modern analysis of the effective economic development of dairy complexes should also include the economic potential assessment. Currently, there are no unified methodological approaches to the potential evaluation, adapted to the operation specifics of the enterprises, as well as facilities under consideration. When they evaluate the economic potential of a dairy complex, it is necessary to take into account economic and environmental relationships, as these factors affect its sustainable supply chain development. As the evaluation criteria of the enterprise economic potential that form a dairy complex, we need the indicators that will contribute to the development of integration between enterprises supply chains that form a complex.**

Keywords. Economic potential, dairy and food complex, assessment, symmetric matrix, supply chain management, consistency index, effective functioning.

1. Introduction

The food supply chain encompasses organizations which are responsible for the production and distribution of vegetable and animal based products [1-4]. There are various common partners of the food supply chain such as producer or grower, wholesaler, retailer, food industry and consumer market. Agri-food supply chains are quite complicated as it involved multiple multifaceted firms that usually working collectively within certain specific industry sectors. The relevance of the research topic is determined by a set of interrelated circumstances that arose due to the fact that there was some trade reduction between Russia and those states that traditionally supplied Russia with food products (including dairy products). This study entirely focused on dairy supply chain especially in developing countries.

The search for the trends that provide effective functioning in the context of import substitution, and the achievement of food security determine the need for a sustainable economic development mechanism of industrial complexes that specialize in food product manufacture (including dairy products) [5].

Thus, food import substitution contributes to the creation of such conditions under which domestic production is able to replace successfully foreign companies in the domestic market. The specified factor acts as a key economic guideline of the state in the current situation [6].

Thus, the following indicators are proposed as the main criteria to evaluate the economic potential of organizations that form the dairy complex:

- revenue from sale; - profit (net); - number of staff; - assets (non-current); - own sources.

2. Research methods

We proposed to evaluate the economic potential by the method of supply chain management analysis (SCM) by [7]. There are enormouskinds of disruption may occur in the dairy supply chain. Privatization and restructuring of farms, processor, input suppliers and retailing companies caused disruption in the exchange relationships in the dairy chain i.e long payment delays or nonpayment of delivered dairy products. In case of such kind of market behavior Albanian farmers have been decided to sell their milk directly in the urban market and get cash payment. This was the number one business problem in the Central Europein mid 1990s which has been verified by researcher

At the first stage of SCM application, it is necessary to structure the problem of choice in the form of a supply chain management or a network. In a simpler form, it is advisable to create a supply chain management from the top (goals) through intermediate levels, called criteria to the lowest level, which make a set of alternatives in the general case.

After the hierarchical mapping of the problem, it is necessary to establish the criterion priorities, and then evaluate each of the alternatives according to the criteria. The elements of a task in SCM are compared in pairs with respect to their impact on their common characteristic. The order of pairwise comparisons leads to the result expressed as an inverse symmetric matrix [8].

The key component of the matrix a(i, j) is the intensity of the supply chain management element i manifestation of the comparative supply chain management element j, which must be estimated via the intensity scale from 1 to 9, based on the method by T. Saati (table 1).

Table 1. Scale of relative importance by T. Saati's method

Relative importance intensity	Preference level
1	Equally important
3	Moderately superior
5	Substantially superior
7	Significantly superior
9	Absolutely superior
2,4,6,8	It has intermediate values

When they compare one factor i with another j, we get a(i, j) = b, and when we compare the second indicator with the first one, we get a(j, i) = 1/b.

Consequently, SCM can be used to solve weakly

structured as well as unstructured problems.

The ways of such problem solution are based on a systematic approach. With this approach, a problem should be considered as the result of the interaction and, above all, the interdependence of most heterogeneous objects, and not just as their separate and autonomous aggregate [9]. We propose to process the information received on the basis of the computer program Decision Support System (DSS) "Choice".

2.1 Main part

Based on the indicators proposed above, it is possible to assess the economic potential of economic entities included in the dairy and food complex (The dairy and food complex of the Belgorod Region includes three economic entities: "Belogorye Milk" JSC, "Agrofirm Metallurg" LLC and "Avida" MP CJSC) The criteria proposed by us are distinguished from other indicators by their great sensitivity in the process of economic potential evaluation.

Let's consider the basic functions of a modern dairy complex.

The main function of the dairy and food complex in modern conditions is meeting the needs of the population of certain territories and Russia as a whole with the necessary set of food products [4].

One of the most important needs of a man as a living organism is the supply of goods for him despite any scientific and technological progress. The benefits are created by industrial complexes, and the size of the benefits is one of the key components of the standard of living in each state. An equally important function of the dairy complex is the creation of a raw material base for processing enterprises. Based on the foregoing, it can be noted that integration is one of the main trends of sustainable economic development of the dairy and food complex in order to supply the country's population and other industrial complexes with consumed food resources. According to [5], the deeper the integration process, the more accurately they express the actual existing economic interconnections between economic entities and their integrated development. According to [6], development includes a multidimensional process containing global changes in the technical as well as in economic, social and political spheres.

The process of competitive advantage implementation within the dairy complex in some extent contributes to the growth of economic efficiency of production, as a rule, to the growth of labor productivity and profitability, since the enterprises of the complex do not restrict access to skilled labor, as well as to commercial credit organizations, financial and trading firms. We carry out an assessment of the economic potential. In our study, which is based on a structurally functional approach, we examined the dairy product complex as a socio-economic system based on the principles of interaction and the balanced functioning of its three main elements: production, processing and implementation [3]. The choice of the most optimal indicators (from the point of view of preference in relation to other criteria) is determined by practical expediency for the studied complex control [7].

To assess the economic potential, we used the indicators of the enterprise financial statements (2013 - 2017) that form the dairy complex. According to the SCM, as well as to the proposed criteria for the economic potential evaluation, they obtained a hierarchical model to determine the economic potential of dairy enterprises and the levels and nodes of the supply chain management are identified (Figure 1).

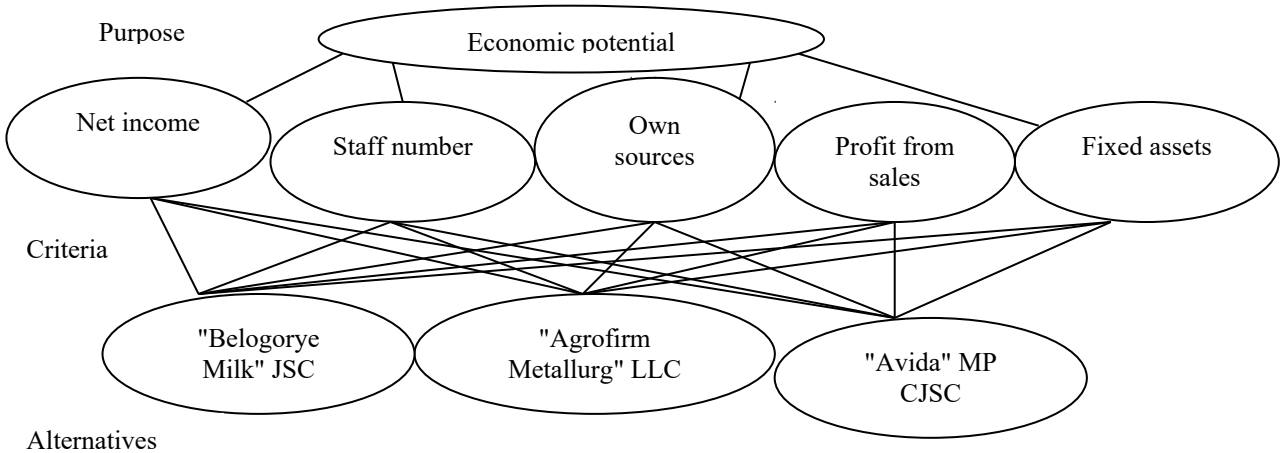

Figure 1. Supply chain management levels and nodes

Then, they developed the matrix of paired comparisons of the criteria included in the set for the economic potential evaluation (Figure 2).

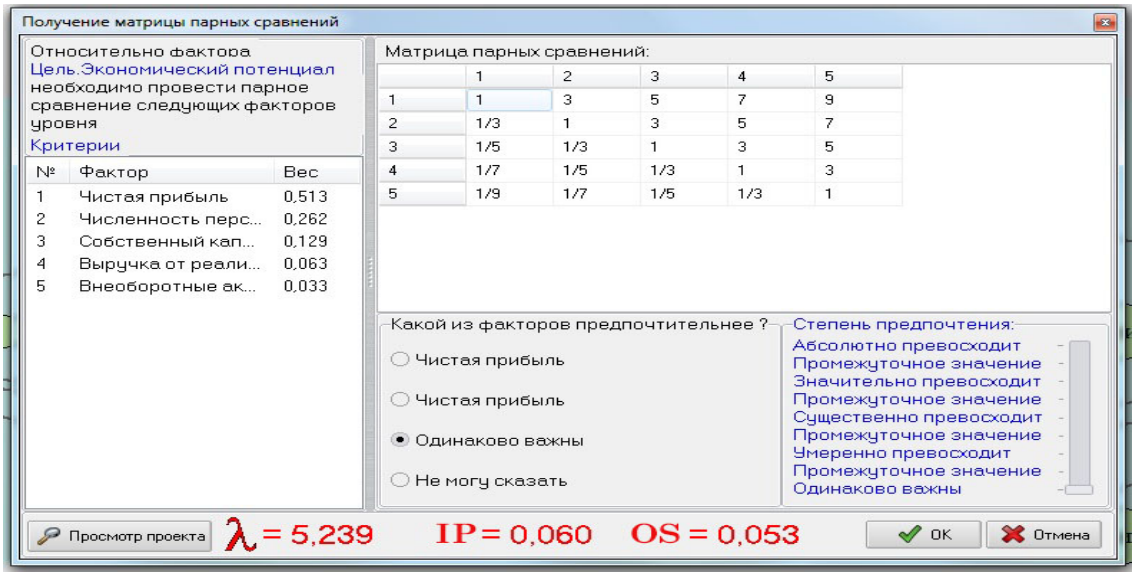

Figure 2. Paired comparison matrix

The dairy supply chain considered in this study is composed of three segments: i) production of feedstock (dairy farm), upstream; ii) processing, dairy plant (focal company); and iii) marketing, represented by the distribution center, downstream (Figure 1). The horizontal structure of the chain also contains suppliers of inputs to the dairy plant, such as hygiene/cleaning products, materials, and ingredients for processing, firewood for heat generation, packing materials, and others. The maximum eigenvalue λ_{max}= 5,239 is quite close to 5, which reflects the consistency of the result. In order to process the results of the obtained comparison matrix, it is necessary to introduce the consistency index (CI) showing the logical relationship between the criteria to be evaluated. When they calculate the consistency index of a positive inverse symmetric matrix (the matrix of pairwise comparisons contains the indicated properties), it is necessary to determine own maximum value of the matrix, as well as its dimension.

The formula for consistency index determination:

IP = λmax – n /

Randomly generated IP of inversely symmetric matrix via the scale of 1 to 9 and, as a rule, the corresponding inverse values of the elements are called random index (SI). The ratio of IP to an average SI for a matrix of the same order is called the consistency relation (OS). The value of OS less than or equal to 0.10 is considered acceptable, as a rule [3]. For the considered matrix of paired comparisons, an OS of 0.053, and less than 0.1, is acceptable in our study. The matrices for enterprise comparison with respect to their economic characteristics were formed in a similar way. When they calculated matrix elements, appropriate scales were used (table 2 and 3):

Table 2. Profit (net), revenue from sales, fixed assets

Difference	Relative importance intensity
1-2 time	2
2-3 time	3
3-4 time	4
4-5 time	5
5-6 time	6
6-7 time	7
7-8 time	8
8 time and more	9

Table 3. Number of staff and own sources

Difference	Relative importance intensity
1,01-1,15 time	2
1,16-1,30 time	3
1,31-1,45 time	4
1,46-1,60 time	5
1,61-1,75 time	6
1,76-1,90 time	7
1,91-2,05 time	8
2,06 time and more	9

Table 4 - Maximum eigenvalue and consistency ratio for the organizations forming the dairy complex (2014 - 2018)

Criteria	λ_{max}					OS				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Net profit	3.015	3.040	3.010	3.040	3.025	0.012	0.012	0.033	0.035	0.020
Number of staff	3.042	3.012	3.012	3.070	3.102	0.035	0.018	0.019	0.059	0.071
Own sources	3.006	3.003	3.040	3.006	3.042	0.003	0.035	0.001	0.016	0.039
Sales revenue	3.003	3.006	3.002	3.003	3.002	0.004	0.002	0.006	0.015	0.001
Fixed assets	3.002	3.001	3.003	3.004	3.003	0.001	0.003	0.001	0.003	0.003

The closer λ_{max} to n (the set of elements in the matrix), the more consistent the result. The maximum eigenvalue λ_{max} for all evaluation criteria is quite close to 3.

The comparison ratio for the whole complex of analyzed criteria is less than 0.10 and this is acceptable.

The weights of the alternatives are shown in table 5.

Table 5. The weights of alternatives, as well as overall supply chain management consistency

Alternatives / Years	"Belogorye Milk" JSC	"Agrofirm Metallurg" LLC	"Avida" MP CJSC
2014	0.439	0.199	0.362
2015	0.202	0.171	0.631
2016	0.268	0.136	0.591
2017	0.269	0.128	0.599
2018	0.391	0.122	0.489

The data of the table 5 indicate that the assessment of the economic potential revealed the following results in the economic entities that form the dairy complex: in 2014 JSC “Milk of Belogorye” showed the largest increase of the economic potential value. A steady increase in economic potential took shape at "Avida" MP (2015 - 2018). LLC "Agrofirm Metallurg" demonstrates the annual decrease of the analyzed criteria [8].

3. Conclusions

The findings indicated the contribution of proposed approach to the enhancement of the sustainable performance of a focal company in a dairy supply chain. This contribution occurred by the effect evaluation of the company’s major products, and through the identification and proposal of improvements that can be managed by the dairy company, with no expansion with the modeling of the upstream and downstream segments in supply chain system. An appropriate set of indicators is required to assess the economic potential of enterprises forming the dairy complex and its sustainable economic development.

The indicators considered in the study are more sensitive during economic potential evaluation. Besides, they help to identify the opportunities and limitations of each business entity for the development of integration and, thus, the formation of positive synergy.

According to the study, we characterize the benefits of the proposed indicator use to assess the economic potential of the dairy complex:

- it becomes possible to formulate a comprehensive program for sustainable economic development of the studied dairy and food complex, as well as the territory in which the complex carries out financial and economic activities;
- it contributes to the formation of a development plan for the dairy-food complex;
- the opportunity arises to identify specific areas and develop an activity plan for dairy enterprises;
- it contributes to the way out of the financial crisis for one business entity that makes the part of the complex;
- there is an opportunity to develop recommendations aimed at the goal achievement [9].

Besides, an organizational and managerial effect is achieved, expressed in the introduction of innovative mechanisms for the dairy complex operation.

The implementation of the import substitution strategy will also be achieved, consisting in the fact that regional dairy producers have the opportunity to provide the population of the Belgorod region with dairy products in the required volume.

The significance of the study from a theoretical point of view is explained by the formation of conceptual theoretical, as well as theoretical and methodological prerequisites, aimed at sustainable economic development provision of the dairy complex.

The development of integration is a revolutionary process to some extent. A revolution in society as well as in organizational systems is a sign of social and economic health [10, 11].

The practical significance of the study lies in the fact that an author’s methodology for the economic potential evaluation was proposed and tested on the basis of the study, which includes an expanded set of indicators to assess the economic level of the complex enterprise operation, as well as to identify the prospects for integration development between business entities.

The conclusions and recommendations presented in the study are aimed, first of all, at a mechanism creation

for sustainable supply chain development of the dairy and food complex and its use by the complex management to find opportunities, the implementation of which will contribute not only to a significant increase of production and processing efficiency, but also to complex enterprise competitiveness. Besides, this will allow to implement import substitution strategies, as well as to ensure the implementation of the food security program of the studied region (Belgorod region) and the country as a whole.

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