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THE «INPUT- OUTPUT» MODEL. THE AGRO-INDUSTRIAL COMPLEX OF THE REGION

ABSTRACT. The method of inter-sectoral balance (IB) for the analysis, forecasting and optimization of all forms of businesses in the agro-industrial complex of the region is examined in this paper. In the inter-sectoral balance of the agro-industrial complex, every form of business is characterized by an output vector and a vector of distribution of the product, which can enable the analysis and forecasting of reproduction with the necessary detailed picture of the branches in accordance with the system of national accounts (SNA) classification. The result of choosing effective forms of businesses is the combination of the output volume of each product as an optimal plan. The technique of calculating the indices of inter-sectoral balance in the agro-industrial complex and the choice of effective forms of entrepreneurship in this complex, at municipal level and at the level of subject of the Federation, is shown in this article. The inter-sectoral balance of the agro-industrial complex is made; the calculations for an optimal plan are carried out at the level of a local district (the Bystroistokskiy district of the Altai Territory), and the subject of the Federation (Altai Territory) is suggested to integrate all forms business into an agro-industrial complex.

KEY WORDS. Region, inter-sectoral balance (IB), agro-industrial complex.

Entrepreneurship, cooperation and inter-industry linkages in the agro-industrial complex are interrelated dynamic characteristics of product reproduction and management. They are changeable together with the legal forms of enterprises, and have a significant impact on the effectiveness of activity of agro-economic structures.

For the analysis, prediction and optimization of product reproduction, it is important, on the one hand, to measure material and monetary flows, transformation of expenses into output of products of all activities, exchange on the markets and the distribution of financial resources in the distributing and consuming sectors based on microeconomic data; on the other hand, to build models of the processes involved in a single system of movement of goods and money for the analyzed and forecasted period, including the necessary details on operations, products and services, activities, industries, regions and other elements of classification in the system of national accounts (SNA). Each activity has its own characteristics and is relatively independent. At the same time, they can complement each other and eventually, the effectiveness of the activity of the entrepreneurs is determined by the rational links between them.

Each form of business has advantages and disadvantages. They, together with the quality of management, determine the efficiency and competitiveness of both enterprises and the agro-industrial complex. To make effective management decisions,

it is necessary to measure the level of management in each form of business in specific regional conditions and optimize by criteria meeting the objectives of the region.

To solve this problem, we propose to use the input-output model [3], [4]. Technically, this means to build an input-output model of production and distribution of agricultural products .The results of it can be used for analysis, optimization and forecasting as a management tool. In particular, our model for analysis and prediction has the following characteristics (1, 2, 3):

$$\sum x_{ij} + y_i = x_i, \qquad i = 1, 2 \ldots m; \qquad (1)$$

$$\sum r_{ij} + y^r_i = z_i, \qquad i = 1, 2 \ldots m; \qquad (2)$$

$$\sum q_{kj} = q_k, \qquad k = 1, 2 \ldots n, \qquad (3)$$

x_i, (x_j) — the volume of production in i (j) sector of the region;

y_i — the amount of the finished product produced by the i sector in the region ;

y^r_i — the amount of imported finished products of the i sector ;

x_{ij} — the volume of sales of production in the i sector for the output of the products in the j sector;

r_{ij} — the volume of imported goods in the i sector for output in the j sector;

q_{kj} — the volume of k resources used for provision of output j products;

z_i — the volume of imported products in the i sector;

q_k — the volume of limited resources of the k type.

The concept of the «j sector product» determines production of the j type, produced by the technology and organization of each form of business (individual farms and industrial plants) of the agro-industrial complex. Similarly, the concept of the «i sector product» determines the i form of business that has its own consumers. Hence, every form of entrepreneurship is characterized by a vector of expenses and its own vector of product distribution , which can allow us to analyze and predict reproduction with the necessary details in accordance with the classification of the SNA .

The system of identities (1) reflects the balance of production and distribution of the products of the regional agro-industrial complex for domestic consumption and for sale outside of the complex (the finished product). The system of identities (2) reflects the balance of material resources, purchased or imported. The system of identities (3) shows the distribution of limited resources (land, assets, human resources, etc.) in all sectors of j type (methods of production, i.e. all forms of business). Since the tables of IB [1], [2], [3] contain all indicators of results, costs and resources for each form of business, they can afford to calculate the efficiency of production and use of resources for each of them and compare results for selection, based on the criteria of efficiency. Each form of business can be characterized by the expenses vector and the output vector, that is, by the indicators of the coefficients of direct costs and resources for 1 unit of the product (Ruble /Ruble).

Ratio analysis of the direct costs for production of basic agricultural products in the Bystroistokskiy area of the Altai region shows significant differences in crop and cattle production. So, the material expenses to grow 1 unit of grain in agriculture are 0.52749, including fuels and lubricants (0.01088) and especially mineral fertilizers (0.02862), against 0.06337 in individual farms. That is why, with much lower wage costs (0.05821 against 0.07746 in individual farms), more profit per unit was received in return. From

this analysis, a conclusion can be made that each form of business has its advantages in the manufacture of certain products due to different intensity of labor and working conditions, and for each product there is a sector that provides the highest overall performance and a significant market share. Their combination in integration with producing enterprises allows the selection of a combination of forms of business, providing competitive structures on all levels and achieving objectives in the future.

Calculations of the effectiveness of each form of business without taking into account intersectoral linkages of the agro-industrial complex will not allow us to identify the most efficient form for a single product or a product complex in the region, on the one hand, and across all levels of the system of agriculture on the other, because they are controversial and contradictory in terms of activity (What is more profitable? A large potato complex of interrelated potato farms, or the individual fields and kitchen gardens which feed the country now?) To make this choice, you must determine the efficiency criterion and provide comparability through the strict registration of limited resources. The Inter-sectoral balances form a system of equations of input-output type ([1], [2], [3], [4]) with the introduction of the basic assumption of the method of proportionality of input to output (all costs are considered to be variables). The IB identities become optimization models for the choice of the most effective forms of entrepreneurship. We propose a model of optimization of entrepreneurship in the agrarian sector in the region, using inter-sectoral balances for the bottom area, in the form of:

$$\sum a_{ij} * x_j + y_i \le x_i, \quad i = 1, 2 \ldots m; \quad (5)$$

$$\sum a^r_{ij} * x_j + y^r_i \le z_i, \quad i = 1, 2 \ldots m; \quad (6)$$

$$\sum g_{kj} * x_j \le q_k, \quad k = 1, 2 \ldots n; \quad (7)$$

$$\sum y_i = \max \quad (8)$$

or

$$\sum p_i y_i = \max \quad j = 1,2\ldots.n; \quad (8a)$$

$$X_j \ge 0; \quad j = 1,2\ldots.m, \quad (9)$$

In addition to the previously introduced indicators, the following coefficients are given:

a_{ij} — coefficient of the direct costs of goods manufactured by *i* industry per unit of output of *j* sector in the region;

a^r_{ij} — coefficient of the direct costs of imported products of *i* industry per unit of output of *j* sector in the region;

g_{kj} — coefficient of the costs of k resources per unit of j production;

p_i — the amount of profit per unit of *i* industry finished production.

The system of equations (5) reflects the balance of production and distribution of the products of the regional agro-industrial complex for agricultural consumption within the regional complex and for sale outside the complex (the finished production). The system of equations (6) shows the balance of material resources purchased or imported. The system of constraints (7) shows the distribution of limited resources (land, productive assets, human resources, etc.) in all sectors of *j* type (by methods of production). Optimality criteria (8, 8a) require maximizing of the final production volume of the whole regional agro-industrial complex (for cooperative structures) or the total amount of profit (for corporative structures). The volume of output should

not be negative and it is reflected in the constraint (9). It should be taken into account that calculations using this model can be made on the basis of the IB data and some additional information. The whole process of preparing the information and calculations for the selection of optimal forms of business can be represented as a technique in which data processing is performed using an algorithm (Figure 1).

The result of the choice of forms of business can be presented as a combination of the production volume of each product for each form of business compared to the optimal plan.

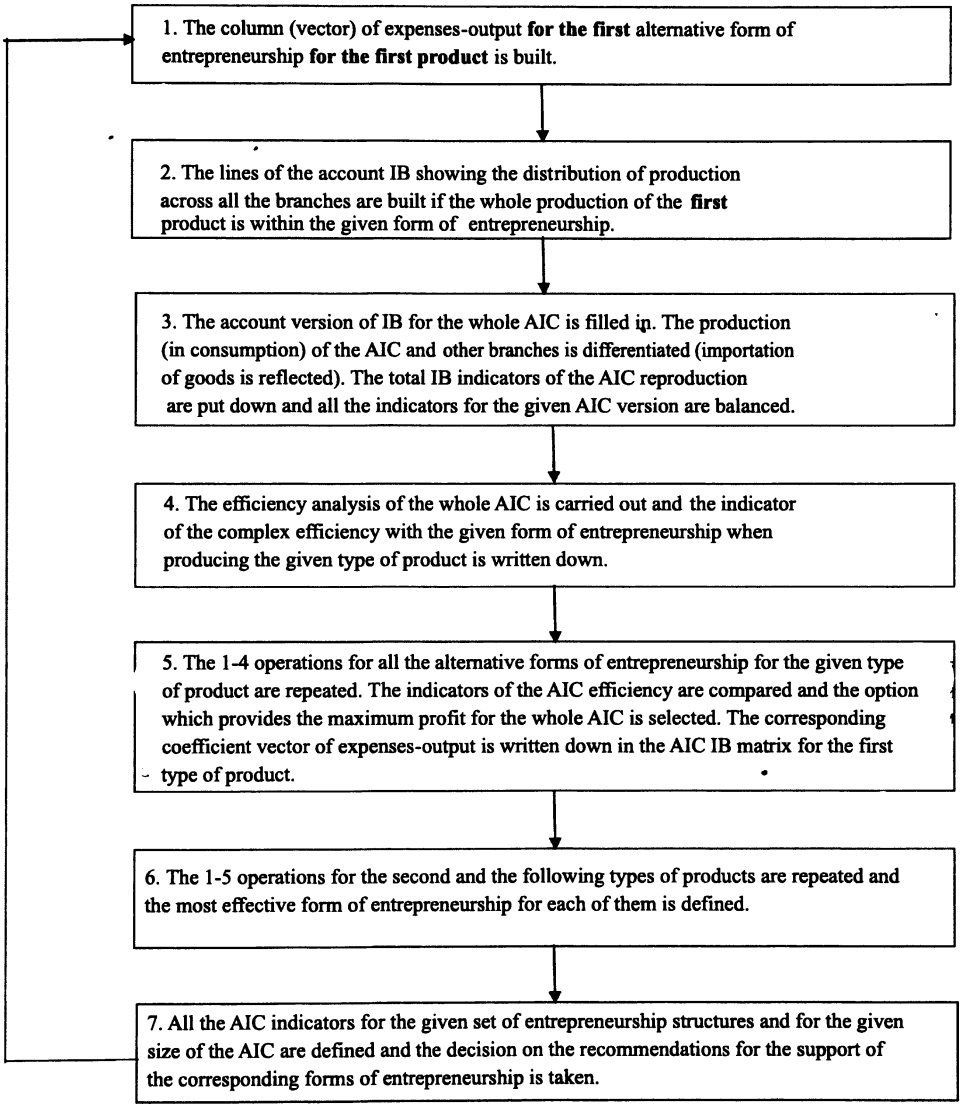

Fig 1. The algorithm of efficiency analysis of entrepreneurship development

Using the developed models and information on the IB of the agro-industrial complexes of the Altai Region and the Bystroistokskiy area, calculations on the choice of effective forms of business were made. Calculations have shown that on the basis of the large enterprises of the Bystroistokskiy district, an integrated agro-industrial business group (Bystroistokskiy AIBG) can be created, which will regulate resources and services, in particular on the basis of centralized supply and distribution. All major agricultural enterprises of the area (the Joint Stock Company «Upper Anuyskoe», JSC «Hleborobnoe», JSC «Upper Ozerninskoe») can enter it, with obligations of priority regarding grain, milk and meat supply. In its turn, the AIBG will set purchase prices for grain, milk and meat to provide agricultural enterprises to work without losses, as well as to assist in providing businesses with fuel, equipment and repair services. It is important to mention that the main processing enterprises, such as Bystroistoksky Creamery and Bystroistokskaya mill, should enter this group, which has a utilization capacity for dairy products of 2.5%, butter 4%, cheese 13%, flour 4%, and cereals and pasta 0%). Integration into the agro-industrial business group (AIBG), with its stable supply of raw materials to processing plants and the creation of marketing and central supply, will increase sales of flour twofold, of cheese tenfold, of butter, pasta and cereals tenfold and more. In general, the volume of production will be increased twofold (up to 75 million rubles). Minimal of replacement of worn and out-of-date equipment, according to the project, can be carried out from the profit, which will be increased five- to tenfold.

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