The model of financial support for the sustainable development of agriculture

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Abstract. The article is devoted to the importance of implementing methodological approaches and methods of evaluating an economic system effectiveness in the field of finance to optimize operational decision-making based on modeling. Expert tools are considered, including: databases and knowledge, systems for modeling economic situations, intelligent decision-making systems. A simulation model has been built that covers the full range of relationships between blocks and indicators-factors that determine the essential characteristics of the economic development of the territory, which made it possible to find out the proportional dependence of the subsystems of financial support for agriculture development.

1 Introduction

In modern conditions, when the leading role is occupied by the globalization development processes in the agricultural sector, the key element in the priority of this issue is the financial support of sustainable development of the agro-industrial complex [12].

If there is a sufficient amount of literature on expert systems, economic problems are quite rare in it [1].

To financially ensure the sustainable development of the agro-industrial complex as the most important component of the balanced development of the region's economy, an analytical assessment of social, environmental, and economic indicators is necessary, acting as a basic block of information support for the simulation moderation of processes [7, 10].

A broad view of the problem requires the definition and systematization of terminology, the description of basic models and methods that are at the intersection of informatics and economics. Expert systems are complex programs of knowledge accumulation, analysis, and forecasting to obtain effective solutions in subject areas [2]. In a narrow sense, it is a class of artificial intelligence systems designed to carry out the functions of accumulating and correcting knowledge on a certain subject area at the specialist expert level [3].

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2 Materials and Methods

The research is based on the methodology of cognition and the use of the dialectic method within the boundaries of the study of a systematic approach, the basic principles of consistency and complexity, as well as fundamental scientific works of foreign and domestic scientists in the field of financial support for sustainable development of agriculture and simulation modeling of the relationship of factors affecting the performance indicator.

3 Results and Discussion

In the modern economy, the idea of a multiplier approach in the financial sphere has been used quite widely, especially in banking and stock exchange activities. Nevertheless, the principle of "money makes big money" in conditions of instability, restrictions, and sanctions practically ceases to function. This leads to the idea that it is advisable to move this multiplier approach to the production sphere, including the sphere of the agro-industrial complex of the country.

Exploring the basic principles of the movement of financial resources, the peculiarities in their regeneration and obtaining the multiplier effect were revealed. The multiplier effect in the interpretation of N. Stefanov refers to "an approach to economic development problems, in which the effect of each decision at a separate level (enterprise or industry) manifests itself repeatedly in different and even distant from each other areas and activities. Exactly this increasing effect is designated as multiplying" [4, p.36].

Based on the need to set and achieve strategic goals, in our opinion, the use of the multiplier approach in financial support of sustainable development of the agro-industrial complex will allow solving urgent problems in the economy. Here it is important to consider three characteristic points that are based on environmental, economic, and social efficiency, since the combination of the above components has a decisive impact on the sustainable development of any system, including the agro-industrial complex [8, 9].

The first one is that the multiplier effect has the ability to constantly increase and multiply. It is implemented, as a rule, along the subsystem chain to the rest of the economic system, multiplying accordingly during the transition from one subsystem to another.

The second one – the multiplier effect is a joint effect. It is incomparably greater than the total effect of the individual parts of the system, because it manifests itself jointly and simultaneously.

The third one – the multiplier effect is an integral effect. It tends to manifest itself both in a metric form (sphere of material production) and in a non-metric form (consumer culture, ideology, spiritual values).

The schemes of the movement of financial resources in the formation of agricultural output and its distribution show the possibility of obtaining the multiplier effect, since the chains and interrelations of the movement of material and monetary resources are mainly outlined.

Obtaining the multiplier effect in this case will depend on the application of the multiplier approach and the acceleration effect, i.e. such a form of the animation approach that makes it possible to more accurately characterize the pace of phenomenon development, the speed of propagation, and the creation of the final result. In this regard, it is advisable to introduce the following concepts in the methodology of financial support for sustainable development:

- accelerator factor - a factor that accelerates the process of movement of financial resources in a particular area and leads to the multiplier effect;
- financial acceleration – the acceleration of the movement of financial resources (by types, terms, forms of ownership, territories, etc.);

- financial acceleration effect – the effect of acceleration from the movement of financial resources.

If there is an acceleration of financial support processes, then we can talk about the action of a certain factor-accelerator with one or another multiplier effect.

In this study, it is advisable to apply the accelerator factor of investment in fixed assets. Analysis of financial support effectiveness for sustainable development is the most important criterion for assessing the results of the work of business entities at various levels, while it is necessary to consider aspects of state regulation of innovation and investment activities, since the agro–industrial complex provides food security of the state [11].

Based on the conducted research, it has been established that models are used to evaluate the effectiveness, which by their logic and structure are quite voluminous and time-consuming, which significantly slows down the analysis and evaluation process. An express method of assessing the financial potential or financial support for the development of regions and industries is proposed.

Because, at present, the problem of speeding up the analysis process and the need for rapid decision-making in an unstable economic situation has become much more acute. A promising approach to assessing the financial potential of the region is to use the methodology of multifactorial complex analysis using a combination of indicators reflecting the effect of the main factors and their effect results.

Formation of a matrix of standardized coefficients:

$$a_{ij}^{c} = \frac{x_{ij}}{ma_x x_i}, \quad a_{ij}^{d} = \frac{mi_n x_i}{x_{ij}} \tag{1}$$

Rating assessment:

$$R_i = \sqrt{k_1} a_{1j}^2 + k_2 a_{2j}^2 + k_3 a_{3j}^2 + \cdots + k_n a_{nj}^2 \tag{2}$$

Calculation of the integral index of the financial potential of sustainable development of the region:

$$I_{fp} = \frac{R_{j\,\mathrm{fsec}} + R_{j\,\mathrm{fsav}}}{2} \tag{3}$$

Grouping regions by financial potential level:

$$r = \frac{I_{max} - I_{min}}{g} \tag{4}$$

With the help of the Vensim program, a simulation model was created that allowed to graphically see the dynamics of financial support processes for the sustainable development of the agro-industrial complex. Based on the analysis, groups of factors that affect the development state of these economy sectors are identified, and the relationship between the indicators-factors and their mutual effect is substantiated. This allows the program to build a simulation model of factors affecting the sustainable development of the agricultural sector to ensure the main result – an increase in the production and sale of agricultural products (Fig. 1).

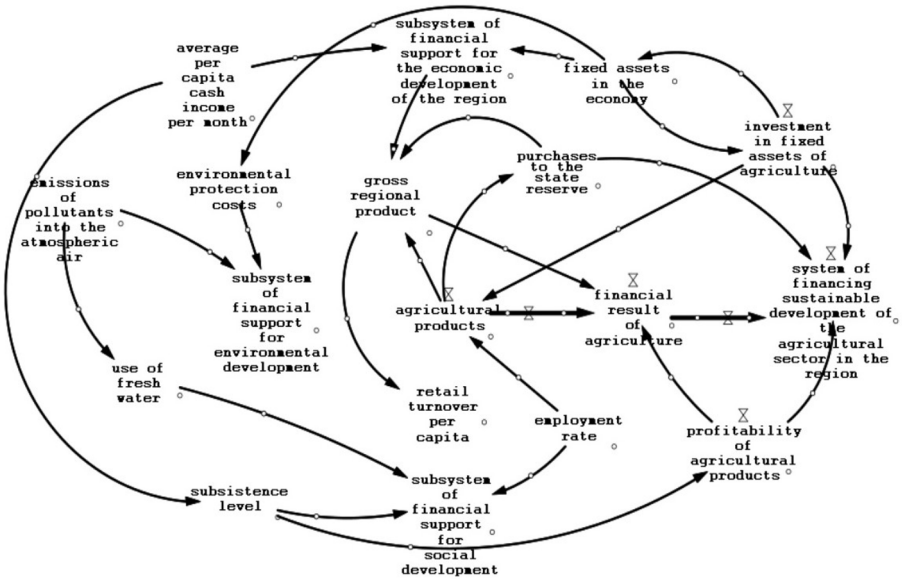

Fig. 1. Simulation model of the relationship of factors affecting the performance indicator

Contours of the proposed simulation model have the following structure:

Block 1 – subsystem of financial support for the economic development of the region:

- gross regional product;
- fixed assets in the economy;
- average per capita cash income per month;

Block 2 – subsystem of financial support for social development of the region:

- subsistance level;
- employment rate;
- retail turnover per capita;

Block 3 – subsystem of financial support for the environmental development of the region:

- environmental protection costs;
- emissions of pollutants into the atmospheric air;
- use of fresh water;

Block R - effective block – system of financing sustainable development of the agricultural sector of the region:

- agricultural products;
- investments in fixed assets of agriculture;
- profitability of agricultural products;
- purchases to the state reserve;
- financial result of agriculture.

The subsystem of financial support for the economic development of the region is basically designated by such indicators as the gross regional product, fixed assets in the economy, average per capita monetary income per month.

Interfactor relationships are represented by the following pairs of components:

- gross regional product - retail turnover per capita;
- fixed assets in the economy - gross regional product;
- fixed assets in the economy - investments in fixed assets of agriculture;
- average per capita cash income per month - subsystem of financial support for the economic development of the region.

The subsystem of financial support for the social development of the region is represented by such indicators as cost of living, employment level, retail trade turnover per capita.

Interfactor relationships are represented by the following pairs of components:

- subsistance level - average per capita cash income per month;
- subsistance level - subsystem of financial support for social development of the region;
- employment rate - agricultural products;
- employment rate - subsystem of financial support for social development of the region;
- retail turnover per capita - agricultural products.

The subsystem of financial support for the ecological development of the region includes the interrelationships of the following indicators-factors: environmental protection costs, emissions of pollutants into the atmospheric air, use of fresh water.

Interfactor relationships are represented by the following pairs of components:

- environmental protection costs - subsystem of financial support for the environmental development of the region;
- emissions of pollutants into the atmospheric air - use of fresh water;
- emissions of pollutants into the atmospheric air - fixed assets in the economy;
- use of fresh water - subsystem of financial support for social development of the region.

The system of financing the sustainable development of the agricultural sector of the region, as an effective block of the model, is provided by the interrelationships of such indicators-factors as agricultural products, investments in fixed assets of agriculture, profitability of agricultural products, financial result of agriculture.

Interfactor relationships are represented by the following pairs of components:

- agricultural products - gross regional product;
- investments in fixed assets of agriculture - agricultural products;
- subsistance level - profitability of agricultural products;
- profitability of agricultural products - financial result of agriculture;
- agricultural products - financial result of agriculture;
- agricultural products – purchases to the state reserve;

– purchases to the state reserve - system of financing sustainable development of the agricultural sector of the region.

- financial result of agriculture - system of financing sustainable development of the agricultural sector of the region.

For further construction of the simulation model, we use a modern system of economic modeling, which uses a scheme of multivalued expert parameterization

$$S < \sum_{i=1}^{k} P_i \,, \tag{5}$$

where S is the available amount of financial resources (>0);

P_i is the amount of financial resources required to provide financing for k-types of activities (economic, social, environmental, agricultural sectors).

The modified multiplier formula for our model will have the form:

$$k = \frac{fQ(e,c,ek,agr}{R_{n<\frac{1}{(n+1)A^2}}} \tag{6}$$

$$(n + 1)\, A^2 \neq 0$$

where, *fQ (e, c, ek, agr)* is a function of the arguments that depend on the indicators-factors. Characterizes the income received in each individual branch of the economy or type of activity;

R_n – the total costs of these types of activities and economy sectors. With a successful choice of a solution at a lower cost, a greater effect can be achieved and vice versa.

The basis of the economic and mathematical model is based on the parameters of limiting financial resources when necessary, the ranking of expenditure directions by the importance of investment and by types of autonomous costs.

At the "output" of the program model, the most optimal expenditure of available financial resources is provided, which allows for their effective use in volumes that ensure the sustainable development of the industry and the achievement of a multiplier effect on the regional scale (territory, state). The economic meaning of constructing a model is the optimal distribution of financial resources by areas and types of expenditures, considering the importance of economic, social, environmental, and agricultural development and the given constraints. With the help of the fetures of the variable tools, the final construction of the model relationships was performed (Fig. 2).

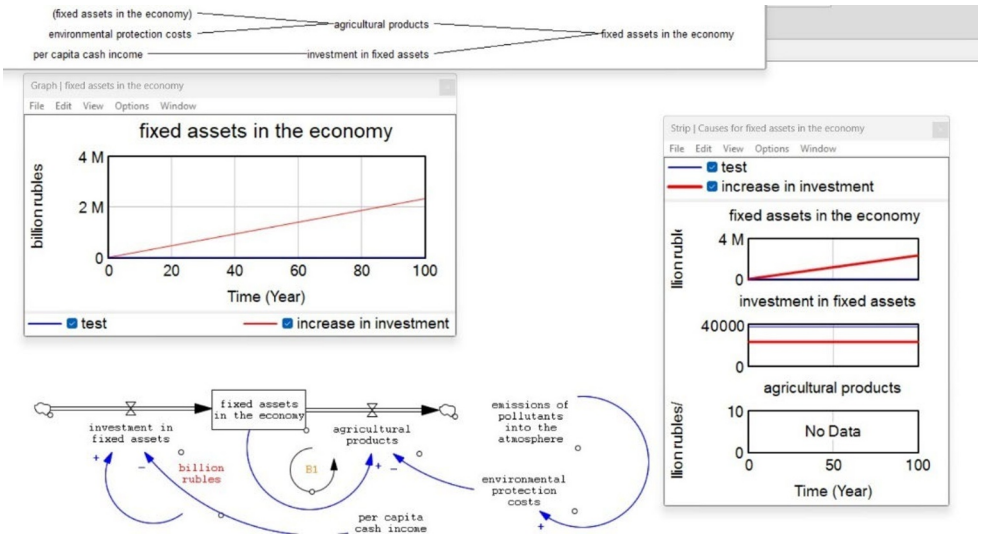

Fig. 2. The model of financial support for the sustainable development of agriculture

With the help of graphs of the fixed assets model in the economy, we see the dynamics of growth depending on the investment. The diagrams allow to trace the agricultural production growth from the amount of investment in fixed assets of agricultural enterprises. The analysis tool creates automatic links showing dependencies and variables. Thanks to this model, the construction of interacting connections takes place.

4 Conclusions

Thus, the constructed simulation model indicates the effect of individual factors (investments in fixed assets of agriculture) and fixed assets in the economy directly on the growth of agricultural products, which allows to identify the main measures to balance structural shifts in the economy regions, thereby ensuring their overall social,ecological, and economic development. Such expert tools allow for more effective scenario modeling of regional economic development based on changes in structural shifts.

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