

Decision Support Systems for Stable Development of Agricultural SMEs.

Valery Akinfiev*, Anatoly Tsvirkun**

* *Institute of Control Sciences of RAS Moscow, Russian Federation (e-mail: akinf.valery@yandex.ru)*

** *Institute of Control Sciences of RAS Moscow, Russian Federation (e-mail: tsvirkun@ipu.ru)*

Abstract: The problems of agricultural development for small and medium enterprises (SMEs) are considered. The features of modeling business processes in agriculture are analyzed. A financial decision support system is proposed to increase sustainability and reduce risks in the development of agricultural SMEs. The software modules are based on TEO-INVEST. The developed financial decision support system takes into account the specifics of business processes in agriculture: duration of the production cycle exceeding the planning period, accounting for complex processing technology, the use of financial leasing for the purchase of agricultural machinery, etc.

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1. INTRODUCTION

Small and medium-sized enterprises (SMEs) play a decisive role in ensuring economic development of the regions. They create a socio-economic foundation that allows maintaining a rural lifestyle, establishing mass agricultural production, and responding flexibly and in a timely manner to changing conditions of supply and demand. The share of small agricultural enterprises in Russia is about 30% (Grudneva, 2016).

The development of small and medium enterprises in the agro-industrial sector is a complex task, the solution to which depends on a complex combination of economic, social and institutional conditions. It is important to identify the factors that influence the innovation policy of agricultural SMEs and to contribute to their sustainable development (Korauš et al. 2020). Managing development of small and medium enterprises is largely determined by the specifics of agro-industrial production and the associated features of the agrarian economy (Nguyen, 2001).

Factors negatively affecting the development of agricultural enterprises include insufficient access to financial services and markets, poor business management culture, risks associated with seasonality and climatic conditions of farming (Doran A et al., 2009).

The production cycle for agriculture consists usually of a year in crop production or several months in livestock production. This determines a significant time lag between costs and financial results. Therefore, debt financing is usually a major issue at the beginning of the production cycle, before harvesting and selling products. In addition, the size of production, the level of technology used, and the general culture of producing and marketing affect the sustainability of a business.

For the development and expansion of agricultural business, investments in buildings and structures, the purchase of agricultural machinery and equipment are required. There is an existing differentiation in investment in development

among small and large holdings in the agricultural sector in Russia (Pinkovetskaia and Slepova, 2018). It is important to direct investments in the development of technologies 4.0 (Annosi et al, 2019). The purchase of agricultural machinery is carried out, as a rule, under a lease agreement. The large financial burden in the form of lease payments as well as loans requires careful financial planning, taking into account possible risks.

We propose a system for planning and supporting financial solutions for SMEs, which can increase stability and reduce development risks for small and medium-sized agricultural enterprises. The software modules of the system are built on the basis of the TEO-INVEST platform, developed at the Institute of Control Sciences of the Russian Academy of Sciences (Akinfiev and Tsvirkun, 2013). When creating a system for planning and supporting financial decisions, the specifics of modeling processes in agriculture were taken into account: duration of the production cycle exceeding the planning period, accounting for complex processing technology, the use of financial leasing for the purchase of agricultural machinery, etc. These features distinguish TEO-INVEST Agro from other systems.

Note that similar financial management technologies can be used to improve the environment for small businesses, increase the sustainability of their operations and create new jobs. New technological developments in this area can contribute to increased international stability.

2. TEO-INVEST AGRO DECISION SUPPORT SYSTEM

The TEO-INVEST Agro software package developed at the Institute of Management Problems of the Russian Academy of Sciences is an effective tool for financial management of an enterprise. It allows you to build a financial model of the business, develop medium- to long-term production and financial plans, conduct scenario analysis of management decisions and choose the most effective solutions (Akinfiev and Tsvirkun, 2013).

In addition, TEO-INVEST Agro allows you to analyze and justify investment decisions: assess effectiveness of

reorganization and expansion of production; assess the introduction of new technologies for growing and processing; assess risks and sustainability of proposed solutions; select and justify the optimal financing scheme.

TEO-INVEST Agro allows you to generate financial statements of an enterprise for the planning period (Profit and Loss statement and Cash Flow statement), depending on the version of the production and investment program being implemented. Also, TEO-INVEST Agro allows you to implement the mode of calculating and comparing the company's cash flows for the production and investment program, calculate efficiency indicators, and choose the best plan options (Figure 1).

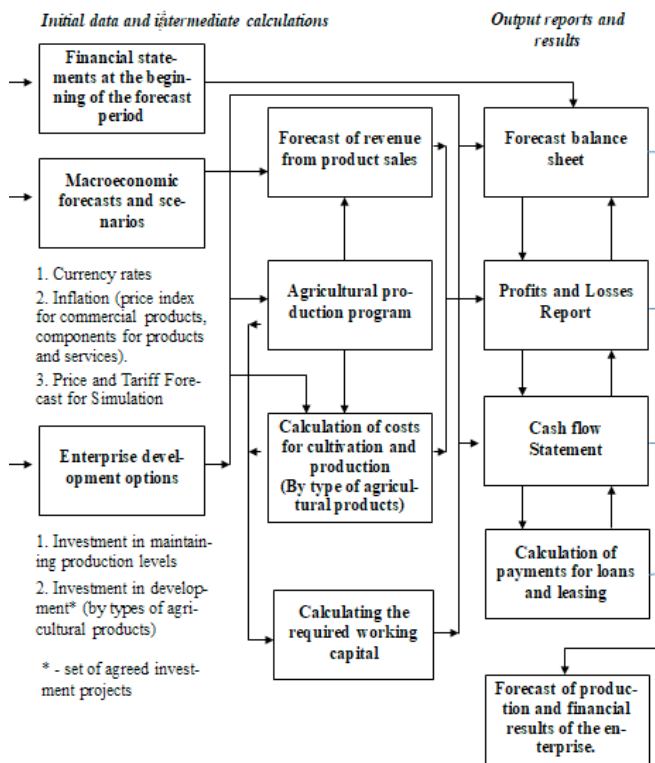


Fig. 1. Simulation scheme.

TEO-INVEST Agro allows you to easily adapt the financial model, taking into account the characteristics of the enterprise, specify several types of products, as well as current and investment costs, duration and number of planning periods. Figures 2 and 3 show the types of tables and diagrams generated with TEO-INVEST Agro.

Financial reports are generated automatically as a result of calculations carried out in the system. The presence of a tax generator in the system, which makes it possible to automatically attribute the specified taxes to the cost of production or to the financial result, allows you to customize the system for the taxation specifics of each type of business.

| TEO-INVEST Investment project | | | | | | | | |
|--|----------|---------|---------|---------|---------|---------|---------|---------|
| Cash Flow statement - Calculation with project | | | | | | | | |
| Item, ths. Rbl. | Total | I'18 | II'18 | III'18 | IV'18 | I'19 | II'19 | III'19 |
| <i>Production and sales activity</i> | | | | | | | | |
| Cash inflow: | 57074,27 | 3135,16 | 3020,80 | 2523,63 | 2796,34 | 2649,89 | 4645,66 | 6238,27 |
| from them: | 57074,27 | 3135,16 | 3020,80 | 2523,63 | 2796,34 | 2649,89 | 4645,66 | 6238,27 |
| Sales proceeds | 38083,04 | 2185,64 | 2212,16 | 1867,02 | 2082,05 | 1850,43 | 3222,03 | 3977,11 |
| Cash outflow: | 26224,85 | 1607,49 | 1632,34 | 1420,65 | 1613,39 | 1737,25 | 2243,09 | 2631,33 |
| from them: | 26224,85 | 1607,49 | 1632,34 | 1420,65 | 1613,39 | 1737,25 | 2243,09 | 2631,33 |
| Production cost: | 11658,19 | 576,15 | 579,83 | 446,37 | 468,66 | 113,18 | 978,95 | 1345,78 |
| Taxes: | 8533,92 | 334,80 | 334,80 | 272,03 | 280,34 | 0,00 | 555,80 | 774,36 |
| VAT in budget | 5142,06 | 239,06 | 240,98 | 170,39 | 183,65 | 97,45 | 398,27 | 547,72 |
| Profit tax | 182,21 | 4,28 | 4,05 | 3,95 | 4,67 | 15,73 | 24,88 | 23,70 |
| Other taxes | 1891,22 | 949,52 | 808,64 | 656,61 | 714,29 | 789,45 | 1423,63 | 2261,16 |
| Net Cash Flow | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| <i>Investment activity</i> | | | | | | | | |
| Cash Inflow: | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| from them: | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Fixed assets sales revenue | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Sale of securities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Cash Outflow: | 4586,36 | 0,00 | 1328,00 | 2526,60 | 651,76 | 0,00 | 0,00 | 0,00 |
| from them: | 4586,36 | 0,00 | 1328,00 | 2526,60 | 651,76 | 0,00 | 0,00 | 0,00 |
| Investments in fixed capital and intangible assets | 4586,36 | 0,00 | 1328,00 | 2526,60 | 651,76 | 0,00 | 0,00 | 0,00 |
| Acquisition of securities | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |

Fig. 2. Cash Flow statement.

TEO-INVEST Agro is focused on accounting standards adopted in Russia, which simplifies the work of business leaders and financial managers. Analysis and views of the final financial reports prepared by TEO-INVEST Agro are carried out in the Tables and Charts sections. The corresponding tables and graphs are placed in the business plan of the enterprise development project and make it more descriptive.

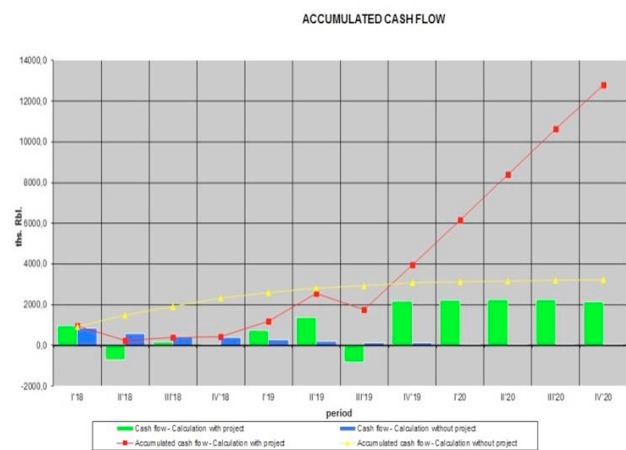


Fig. 3. Accumulated Cash Flow.

3. MODELING A PRODUCTION PLAN

TEO-INVEST Agro allows to simulate various types of business processes for the production and sales of products. The most common investment projects are implemented in enterprises with a continuous production process. Such enterprises are characterized by the fact that the duration of the production cycle of a unit of production is much shorter than the time of the adopted planning step, which, as a rule, is a month or more.

As noted earlier, in agriculture the production cycle is longer than the planning period. Thus, modeling business processes of production and sales has a number of specific features associated with taking into account costs and the formation of a financial result.

In this regard, when setting up the dimension of the financial model of an enterprise, two types of products are provided:

- “Type 1” products with a production cycle duration less than the planning step duration;
- “Type 2” products with a production cycle longer than the planning step.

If “Type 2” products are used, then the business process of manufacturing and selling a product is divided into two interrelated phases: phase 1 – the period of production, which ends with the appearance of finished products, and phase 2 – the sales period for these products. In this case, two items are used in the product list (*product – phase 1* and *product – phase 2*, respectively). This distinction is necessitated by existing accounting practices and regulations.

The cost of production at the first stage is summed up and reflected in the balance sheet on the account “Work in progress” and at this stage is not used in calculating profit. At the second stage, these costs are included in the costs of the finished product and are used to determine the financial result, while the cost of the finished product should also include the costs of the second stage associated with the process of selling the product (Figure 4).

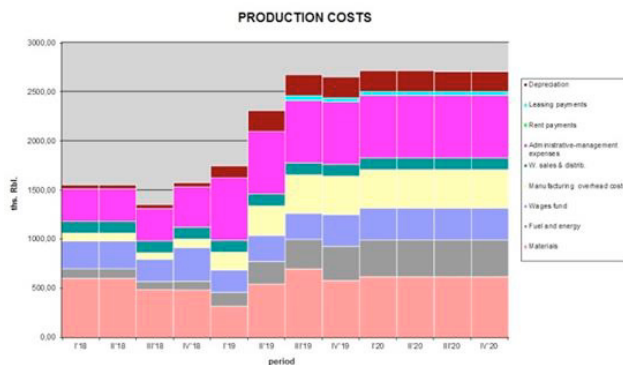


Fig. 4. Production costs.

Consider the business process of growing sugar beets on an area of 100 hectares. The calculation is carried out for two years, the planning step is one month. The beginning of the cycle is the month following the harvest (for example, October) starting from which all costs are attributed to the next year’s harvest.

For the cultivation of agricultural products, it is convenient to use the size of the area occupied by the cultivation of sugar beets as such a parameter. In this example, in the line “Production, units. measurements” you would enter a value of 100 ha. For growing agricultural products in the line “Products, pcs. measurements” it is necessary to enter the predicted value of the sugar beet yield, which will be harvested from 100 hectares, for example, 500 tons.

4. MODELING A COMPLEX TECHNOLOGY FOR PROCESSING AGRICULTURAL PRODUCTS.

The TEO-INVEST Agro software package provides an opportunity to build models for enterprises with a technologically complex production structure. In the

calculation methodology, a situation is considered when one or more products are also used for the production of other products within the enterprise, that is, they serve as semi-finished products.

In this case, it is possible to declare some of the products as products used for internal consumption. This way, it is possible to simulate production processes with complex and interconnected technology (Figure 5).

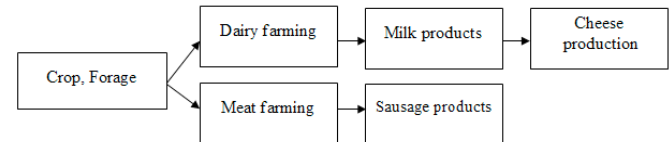


Fig. 5. An example of a process chain in animal husbandry

The structure of interaction of elements can be very diverse, for example, a sequential chain, assembly, and others. The production technology is determined by the composition and parameters of the technological equipment and by the production processes themselves. Changing production technology should be linked to the investment program.

If the program for production and sales of products is not coordinated with, for example, a seasonal nature of production or sales, then a production program must be set. Moreover, the warehouse stock must be at the level required for the normal operation of the enterprise. If products are produced for sale and intra-firm consumption then production volumes for intra-firm consumption are calculated too.

TEO-INVEST Agro allows to build complex models of business processes. Selecting the appropriate settings allows you to simulate the business processes with products of the first and second types at the same time, which can be declared as products used for internal consumption.

5. MODELING CREDIT POLICY AND WORKING CAPITAL MANAGEMENT.

The enterprise development project is unrealizable without solving the problem of its financing. TEO-INVEST Agro provides for the possibility of modelling various sources of raising funds (funds of owners and shareholders, loans and borrowings, financial leasing schemes, etc.).

When developing a project, it is necessary to develop a rational financing scheme, including choosing the ratio between funds raised by the owners of the enterprise, borrowed funds, state financing and use of leasing agreements, as well as choosing the conditions for attracting funds. When modelling the selected project financing scheme, the system allows using various combinations of these methods. The advantage of TEO-INVEST Agro is that the need for financing is determined taking into account many factors, including inflation, which allows you to avoid mistakes in planning the company’s budget.

The need for funds at various stages of the project is determined on the basis of the data calculated in the table “Cash flow statement”, which is the main document designed

to determine the need for funds at different stages of the project (Figure 2).

The value of the accumulated cash flow in the table "Cash Flow statement" reflects the predicted state of the current account of the enterprise implementing the project in different periods of time. It is necessary to form the project in such a way that at each period of time this value is positive. A negative value means that the company does not have sufficient funds to finance the costs of the project. In this case, it is necessary to adhere to the basic principle – capital should be attracted only when it is really necessary (Figure 6).

| TEO-INVEST Investment project reconstruction woodworking plant | | | | | | | | | | | | | |
|--|----------------|-----------------------|----------------|----------------|---------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| Project financing. | | | | | | | | | | | | | |
| Sources of financing | Total | Income money ths. RUB | | | | | | | | | | | |
| | | I'18 | II'18 | III'18 | IV'18 | I'19 | II'19 | III'19 | IV'19 | I'20 | II'20 | III'20 | IV'20 |
| Own means: | | | | | | | | | | | | | |
| Investments | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Monetary assets | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Total of own means | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| in % | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% |
| Loan capital: | | | | | | | | | | | | | |
| Loans received | 2200,00 | 0,00 | 0,00 | 2200,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Total Loan capital | 2200,00 | 0,00 | 0,00 | 2200,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| in % | 44,27% | 0,00% | 0,00% | 74,91% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% |
| Plowed back of the incomes: | | | | | | | | | | | | | |
| Plowed back profit | 2516,06 | 0,00 | 1242,00 | 691,51 | 581,55 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Plowed back Depreciation | 253,75 | 0,00 | 85,00 | 43,13 | 45,63 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 80,00 |
| Total Plowed back of the incomes | 2769,81 | 0,00 | 1328,00 | 734,64 | 627,17 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 80,00 |
| in % | 55,73% | 0,00% | 100,00% | 25,03% | 100,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 100,00% |
| Budgetary resources: | | | | | | | | | | | | | |
| Subsidy | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| State credits | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Tax privileges | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Total | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| in % | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% | 0,00% |
| Total financing: | 4969,81 | 0,00 | 1328,00 | 2934,64 | 627,17 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 80,00 |

Fig. 6. Financial plan.

TEO-INVEST Agro allows to solve the problem of enterprise cash management. For the current production activity of the enterprise, financial resources are required. It usually takes considerable time to start receiving revenue from product sales. To ensure production in conditions of a discrete nature of supplies, it is necessary to create stocks of raw materials and materials, which value depends on the volume of production, regularity and reliability of other supplies. These factors must be taken into account, while evaluating management decisions, otherwise the company may face a lack of working capital, necessary to pay off suppliers on time or issue wages.

6. CONCLUSIONS

A support system for financial decisions TEO-INVEST Agro has been developed. It is a software product with a flexible structure of tabular forms and graphs. The openness and transparency of the financial calculation scheme makes it possible to adapt and customize to the specifics of the project implementation. For the convenience of work, the program is equipped with an input data validation module. If errors are found, then a list of errors is displayed, which indicates the name of the table where the error was found, the type of the error, a list of positions in which the error was made and recommendations on how to eliminate it.

Note that the system allows you to take into account environmental and climatic risks when calculating using the subsystem of scenario analysis and probabilistic modeling.

The developed system for supporting financial decisions is used at a number of agricultural enterprises. Its usage helps to reduce financial risks, which contributes to the stable

development of small and medium-sized businesses in the agro-industrial sector.

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