E3S Web of Conferences **542**, 03008 (2024) https://doi.org/10.1051/e3sconf/202454203008
YIFHG 2024

Improving digital services and algorithms for planning subsidies in the agricultural sector

Denis Samygin[1,*], *Andrey* Tuskov[1,2], *Ekaterina* Grosheva[2], *Botagoz* Saparova[3], and *Altynai* Saparova[3]

[1]Penza State University, Institute of Economics and Management, 440026 Penza, Russia
[2]K. G. Razumovsky Moscow State University of technologies and management (the First Cossack University), 109004 Moscow, Russia
[3]Eurasian National University named after L. N. Gumilyov, 010008 Astana, Kazakhstan

Abstract. The paper addresses the issue of developing methodological support for digital platforms and services in the field of strategic planning for the resource provision of the agricultural economy. It is shown that the methodological apparatus embedded in software complexes makes it difficult to justify the required amount of financial resources for expanded (simple) reproduction and does not make it possible to identify the amount of budget funds for the effective functioning of agriculture. The authors have developed a methodology for planning subsidies to support agriculture, the essence of which lies in calculating, in the first stage, the level of financial results that create conditions for the expand-ed reproduction of agricultural resources. In the second stage, the calculation considers the volume of proprietary and budgetary funds, considering their effective utilization, to achieve the required level of financial results. The calculation scheme based on this methodology became the fundamental basis of the algorithm embedded in the development of a software module for determining support to agricultural product manufacturers. The application development was carried out using modern methods of functional modelling and applied programming. The functionality of the software is designed for inputting initial data and outputting results based on the principle of balanced reconciliation of indicators such as activity profitability, producers' in-come, workers' wages, and subsidy volume. The research results are aimed at improving the decision support system for strategic subsidization of agriculture and developing recommendations for management bodies to integrate it as a software block into the digital services information system of the APC being developed by the Ministry of Agriculture of the Russian Federation.

1 Introduction

Today, the Ministry of Agriculture of the Russian Federation is implementing a departmental project "Digital Agriculture" scheduled for 2019-2024, aimed at facilitating the digital transformation of the industry through the adoption of digital technologies and platform solutions [1]. The "Digital Services in Agriculture Information System" being

* Corresponding author: vekont82@mail.ru

developed within the project has reached the stage of practical operation in pilot regions. The main goal of the system is to digitize and expedite the processes of obtaining state support measures in the field of agriculture, enabling enhanced administration within the industry. This initiative seeks to accelerate the disbursement of subsidies, enhance transparency, and provide targeted allocation of budgetary funds to agricultural producers. It is anticipated that this IT service will contribute to the creation of a unified digital space and enable the realization of the task of digitally transforming agriculture, addressing the interactive provision of state support measures to agricultural entities [2].

Essentially, the functionality of the developing information system is aimed at automating the established procedure for allocating budgetary appropriations to recipients in accordance with existing measures. Previous research has revealed [3] that as a result of implementing such measures, it's not the scale of support that determines the activities and out-comes of producers, but rather, the scale of activities and achieved results determine the volume of support received. This approach only exacerbates the regional differentiation in terms of the share of government support. This arrangement raises specific questions, as the problem lies not so much in the transparency and dissemination of government support as it does in justifying its necessary sizes to ensure the normal functioning of industry enterprises. Nevertheless, expectations from the service as a whole are associated with new possibilities for increasing the gross production of products and creating conditions for expanding the country's export potential. In the given context, it is necessary to ensure investments in agriculture in the volumes required for its functioning at growth rates that create conditions for ensuring food security [4]. According to the authors of the article, the desired effect can be achieved through a symbiosis of strategic planning methods and the digital economy. In this scenario, the IT platform should enable, among other things, support for making scientifically grounded strategic decisions regarding resource provision and government support of APC. A strong aspect of the information-analytical system could be the methodological framework for strategically planning the volume of budgetary funds – serving as an algorithm that forms the fundamental basis for digital solutions and digital services in the field of APC planning. This is necessary, as noted by researchers [5, 6], also to enhance competitiveness management within the digital platform system.

2 Research methodology

2.1 Methodological approaches to subsidy planning

By the present time, several fundamentally different approaches have emerged in the methodology of planning the volumes of agricultural support: (1) comparing the level of support per unit of production between regions; (2) maintaining inter-industry price parity; (3) providing conditions for the reproduction of invested funds (Figure 1).

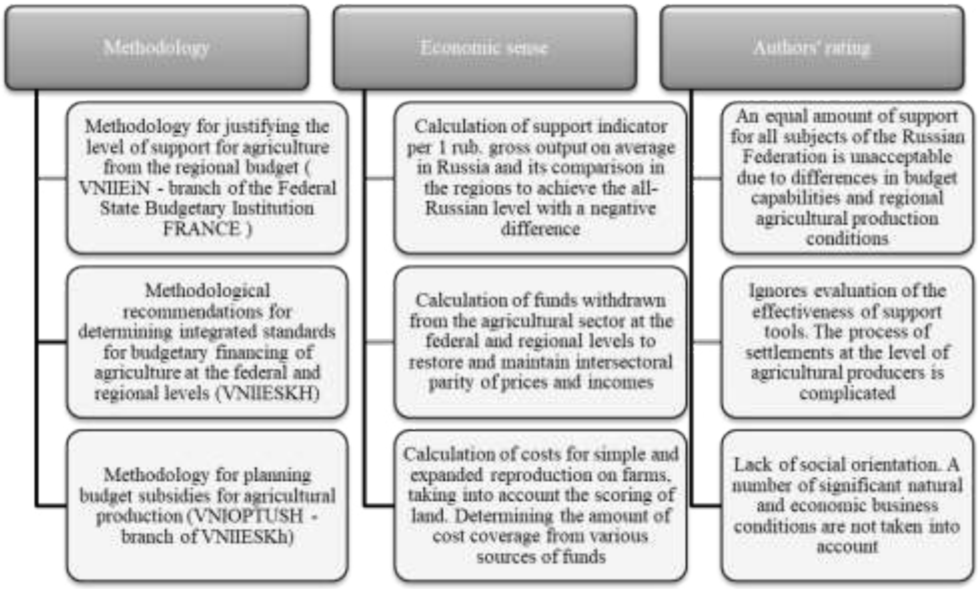

Fig. 1. Analytics of functional capabilities of methods for planning government support in agriculture.

Overall, the results of a critical analysis conducted indicate the impossibility of successfully applying these methodological approaches in the practice of strategic planning for agricultural development support and ensuring food security as a complex problem. Their main draw-back lies in the inability to justify the total volume of financial resources for agriculture and the proportion of government support within these resources, as well as the absence of a focus on the social direction of increasing the income of workers employed in the industry.

2.2 Methodology and algorithm for support planning

After studying the strengths and weaknesses of support planning methodological approaches, the authors concluded that it is necessary to develop a methodology based on norms of costs, subsidies, and profitability. This methodology, when combined, allows creating conditions for producers to reproduce labor and material-technical resources engaged in production. By the present time, the methodology has been slightly modified in terms of indicators and utilization algorithm (Figure 2). Sample Heading (Third Level). Only two levels of headings should be numbered. Lower level headings remain unnumbered; they are formatted as run-in headings.

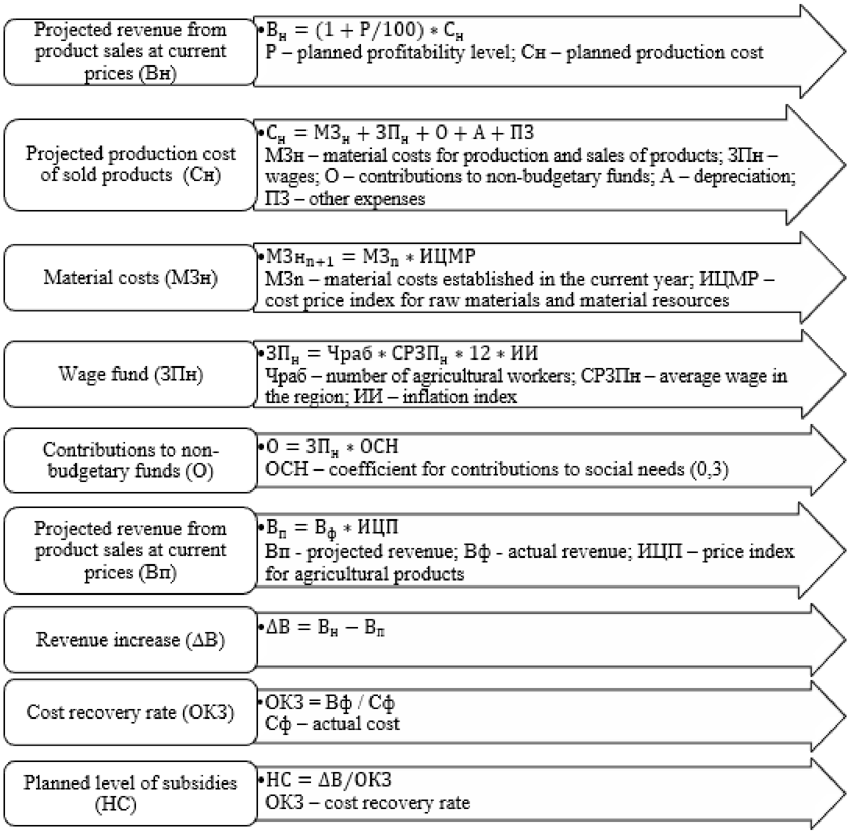

Fig. 2. Author's methodology for planning resource provision and subsidies for agricultural development.

The methodology is based on methods of costing, budgeting, and normative planning. Some researchers believe that the combined application of these methods produces a greater synergistic effect than each one separately [7, 8], and that for the implementation of strategic planning for agricultural development, the use of norms and standards is necessary [9, 10].

Gross product costs consist of material costs, labor costs, social contributions, and depreciation. Labor costs are calculated based on the number of employees and wages that ensure the necessary level of labor resource reproduction. To achieve profitability at a level of 25%, the gross production must exceed the costs of its production by 1.25 times. In our view, to ensure simple reproduction, profitability should not fall below the index of prices for mate-rial-technical resources, but also not below the weighted average deposit rate; otherwise, the purpose of conducting business is lost. For expanded reproduction, it is important to ensure a certain annual growth in production. In Russia, we believe that an annual growth of no less than 5% is necessary. The required increase in gross production is achieved through the volume of support, considering its effectiveness. Figure 3 presents the algorithm of the process for planning the overall level of budget subsidies based on the proposed methodology. The sources of initial data for calculations are the Forecast of Socio-Economic Development of the Russian Federation, Consolidated Financial Statements of Agricultural Product Manufacturers, and other strategic documents related to agriculture.

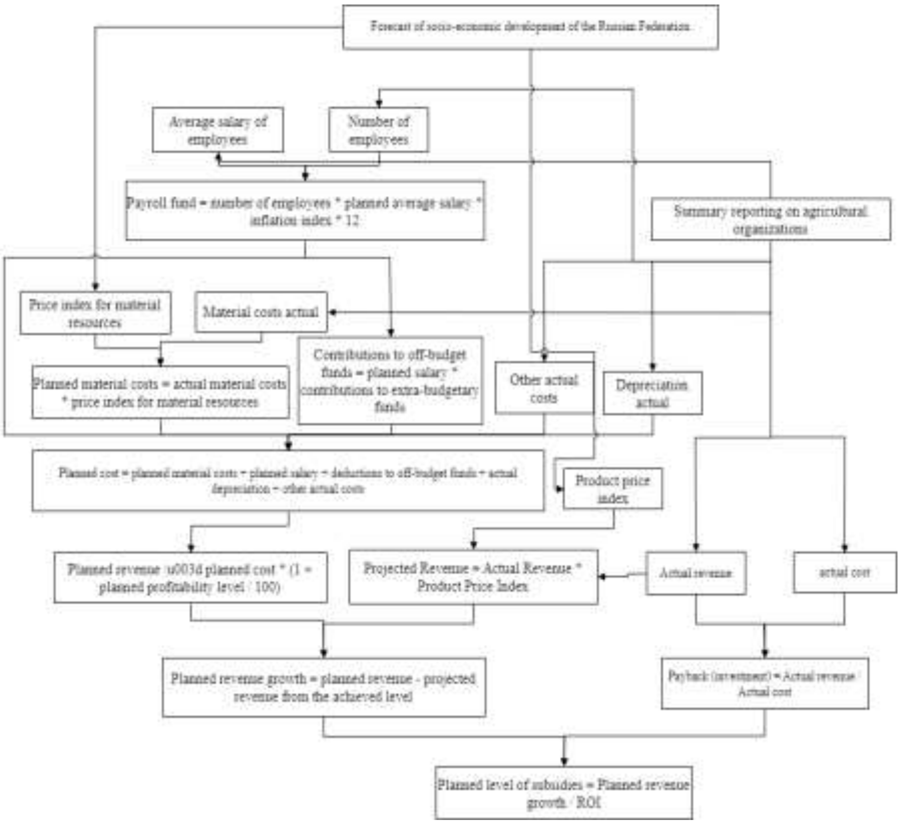

Fig. 3. Algorithm of the subsidy planning process for agricultural product manufacturers.

The algorithm and key iterations for substantiating the size of agricultural support, as described in Figure 3, formed the basis for the development of an applied software tool by a team of researchers. This tool is intended for automating the process of planning the level of budget appropriations for agriculture.

3 Research results and discussions

3.1 Description of the digital solution forms

During the design phase, it was decided to create an application consisting of several modules. Each module corresponds to a specific screen form: "Initial Form," "Input Data," "Planning Results," and "Information Menu." The development of the application employed built-in tools that make the development visual, significantly simplifying the programming process.

The process of designing and developing applications is thoroughly described in contemporary scientific and educational literature [11, 12, 13], serving as the foundation for this research.

As a result, a business application has been developed for automating the process of planning the level of budget appropriations for agriculture. It contains forms for entering input data, generating reports, displaying planning results, and providing reference information. The program prompts the user to input the following data: actual revenue, actual cost, product price index, actual depreciation, actual material costs, material resource price index, average salary, number of workers, and other actual expenses. After entering the data, the user needs to click the "Enter Data" button, after which the data is processed instantly, and the following indicators are calculated: planned level of subsidies, projected revenue growth, return on investment, planned revenue, projected revenue at the achieved level, planned cost, planned material costs, contributions to extrabudgetary funds, and planned salary.

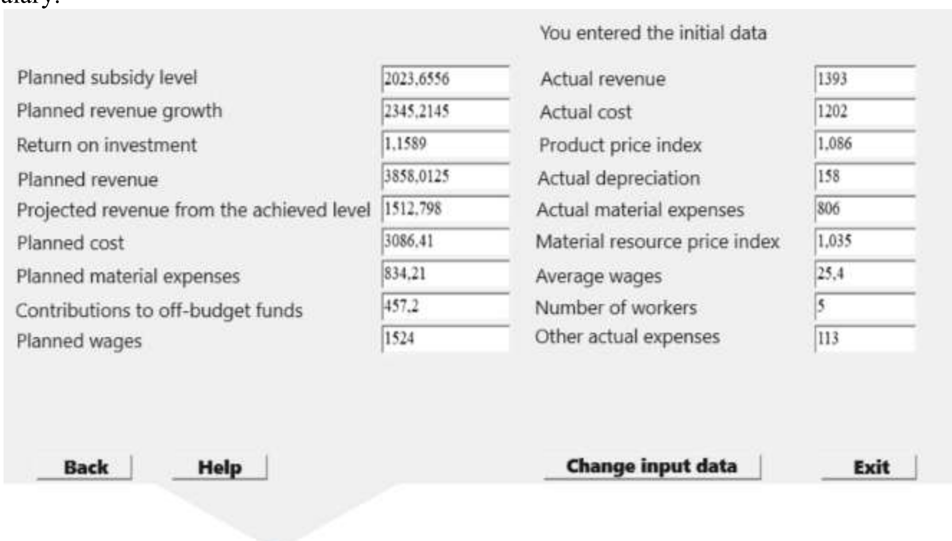

Fig. 4. User interface of the "planning results" form.

Each form features "Help" and "Exit" buttons. The "Exit" button allows the program's operation to be stopped at any moment and closed. The "Help" button enables users to access an informational menu, which can be used to search for answers to questions or address difficulties encountered while using the program.

3.2 Analytical calculations

The developed application is designed not only to automate activities involving numerous repetitive operations but also to support the strategic decision-making process for subsidizing agriculture based on desired industry development parameters. The essence of calculations within the developed program lies in determining the necessary volume of commodity production to sustain an uninterrupted process of material and labor resource reproduction. Additionally, the application determines the sizes of the funds required to ensure its production through the resources of agricultural organizations and through support funds. The inter-relation between producers' income and industry workers' wages, on one hand, and the volume of government subsidies, on the other hand, is considered, facilitating the continuous process of reproducing expended resources.

Table 1. Volume of Agricultural Support in the Russian Federation for Simple and Expanded Reproduction of Resources, billion rubles.

Level of reproduction	**2022**	**2023**	**2024**
Simple	418,2	458,5	502,1
Extended	688,3	758,2	833,6

The calculations using the developed subsidy planning program indicate that the necessary level of support, calculated per 1 hectare of agricultural land for simple reproduction, should amount to 4631 rubles in 2022 and 7170 rubles in 2024. For expanded reproduction, this figure is 2 to 2.5 times higher. These are substantial amounts, especially considering that the actual agricultural support in Russia is approximately 1200 rubles per hectare.

The share of support in resource provision for simple reproduction will be around 11-15%, and for expanded reproduction, it will be 26-30%, of the gross product, approximately 9-12% and 19-21%, respectively. Such a share of support in the gross product is quite acceptable. According to the calculations of researchers [14, 15], the share of support for rice in Ja-pan and South Korea is 76%, and the share of support for dairy products in EU countries is 48%.

4 Conclusion

Thus, based on the author's methodology for determining budgetary support for agriculture as a basis for digitalizing the planning process and using the integrated programming environment Builder C++, a digital solution (business application) was created that can calculate scientifically substantiated subsidy levels for agricultural producers. The application essentially serves not only as a means of automating routine calculations but also as an applied tool to support strategic decision-making regarding resource provisioning and agricultural subsidization. Considering the embedded algorithm (methodology) for planning, this digital solution logically integrates as an analytical block into the IT platform of digital services for APC, developed by the Russian Ministry of Agriculture and currently being tested.

The research was funded by the Russian Science Foundation (RSF) and Penza Region, grant number 23-28-10277, https://rscf.ru/en/project/23-28-10277/

References

1. IS CS AIC - Information system of digital services of the agro-industrial complex of the Ministry of agriculture of the Russian Federation (2023), http://mcxac.ru/digital-cx/interaktivnyy-modul/
2. A. Gordeev, D. N. Patrushev, FGBNU "Rosinformagrotech" **48** (2019)
3. S. Kelejnikova, N. Shlapakova, D. Samygin, IOP Conference Series: Materials Science and Engineering **753**, 5 (2020)
4. S. Sharipov, Advances in Science, Technology and Innovation **43** (2021)
5. V. Zakshevsky, O. Charykova, I. Merenkova, IOP Conference Series: Earth and Environmental Science **274**, 012007 (2019)
6. D. Khmelev, A. Ulezko, V. Reimer, Agricultural Economics of Russia **7**, 78-82 (2022)
7. L. Gryzun, O. Shcherbakov, S. Lytvynova. CEUR Workshop Proceedings **9**, 28-38 (2022)
8. D. Samygin, A. Kudryavtsev, Ekonomicheskaya Politika **13(5)**, 156–175 (2018)
9. V. Kuznetsov, A. Tarasov, N. Gaivoronskaya, O. Egorova, G. Grigorieva, A. Bakhmut, *Strategic forecasting of the development of agricultural sectors based on a system of norms and standards* (FGBNU VNIIEiN, Publishing House of AzovPechat LLC, 2016)
10. A. Shalyto, Automation and Remote Control **62(1)**, 1-29 (2001)
11. G. Surovitskaya, E. Grosheva, R. Malayeva, “The potential of scientific and educational centers as a tool for sustainable innovative development”, in *Proceedings of the European Conference on Innovation and Entrepreneurship* (2021)
12. V. Kureichik, B. Lebedev, O.Lebedev, Journal of Computer and Systems Sciences International **46(4)**, 578 (2007)
13. P. Roth. Dr. Dobb's Journal: Software Tools for the Professional Programmer **26(8)**, 124 (2001)
14. M. Slozhenkina, I. Gorlov, D. Mosolova, Arquivo Brasileiro de Medicina Veterinaria e Zootecnia **73 (5)**, 1159-1170 (2021)
15. A. Subaeva, E. Khudyakova, N. Zaruk, Journal of Environmental Accounting and Management **10(4)**, 391 (2022)