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FINANCIAL AND MARKETING INNOVATIVE MANAGEMENT OF ECOLOGICAL AGRIBUSINESS

ABSTRACT

The current activity of agricultural enterprises is characterized by instability, which is caused by the changing external environment and numerous challenges. The low adaptability of agricultural enterprises does not allow them to respond to these challenges in time, which leads to a negative trend in the development of the agricultural sector as a whole. Most enterprises do not have an effective strategy for the development of financial and marketing innovative management, which, moreover, does not correspond to the policy of resource conservation and environmental friendliness of production. In this case, there is a need for an in-depth study of the concept of financial and marketing innovative management of ecological agribusiness. The article proposes innovative directions for evaluating the effectiveness of financial and marketing innovative management of ecological agribusiness and modelling the forecast of such management. The dynamics of financial and marketing innovation management were determined using the method of longitudinal data analysis with marginal and random effects, optimization and statistical modelling. Statistical information of five agricultural enterprises of the Poltava district, which have approximately the same production volumes and similar areas for sowing crops, were used to optimize the sown areas and model the management of ecological agribusiness. Also, these enterprises are ecologically oriented and grow ecologically safe products. The results of modelling made it possible to determine the individual effects of financial, marketing and production innovation management. The proposed method of determining the financial and marketing innovative management of ecological agribusiness is simple for practical use by interested market stakeholders who take care of the timely assessment of the current activity of the agricultural enterprise and the forecast of its prospects.

Keywords: ecological agribusiness, management, innovation, finance, marketing, market, production

JEL Classification: G17, M31, Q57

INTRODUCTION

The profitable and productive activity of agricultural enterprises is determined by effective financial and marketing management based on innovative tools. This is especially important for the agricultural sector because these enterprises are the most vulnerable to changes in the market, financial policy, innovations and natural conditions. Effective financial and marketing management of agribusiness should ensure the sustainable development of enterprises based on resource conservation, which is an important condition for the convergence of the domestic agricultural sector with the European one. This issue is especially relevant in the context of improving financial support strategies that take into account the peculiarities of ecological agribusiness, such as the use of organic methods of cultivation, waste management, etc. There is a need to develop a management concept that combines the principles of financial, marketing and innovation management with a special emphasis on aspects of environmental sustainability and economic production in the agricultural sector. At this time, the concept of financial and marketing innovative management of ecological agro-enterprises is practically absent in the scientific world. As a result, managers of agricultural enterprises are not able to respond in a timely and effective manner to the challenges of the external environment

and to form an effective further strategy for financial and marketing innovative management. This emphasizes the need to develop such a concept and further adapt it to domestic agricultural enterprises.

LITERATURE REVIEW

The problems of financial and marketing innovative management of ecological agro-enterprises are almost not covered in scientific sources. Separate aspects of financial, marketing, and innovative management of agricultural enterprises or enterprises of other sectors of the economy, including education, health care, etc., were considered by many scientists. In particular, the work (Aranchiy et al., 2022) proposed and tested a system of integral assessment of the financial condition of domestic economic entities. Useful for our research is the method of selecting indicators for assessing the financial efficiency of enterprises and their recombination.

A non-standard evaluation monitoring system was proposed by scientists (Oseredchuk et al., 2022), who formed a set of indicators for diagnosing the quality of education. Certain methods of such monitoring, namely those based on systemic and adaptive approaches, are appropriate for use within the scope of our study. In another work (Rasul and Thapa, 2004) directions of ecological, economic and social perspectives for supporting the sustainability of agricultural enterprises in Bangladesh are proposed. The authors proposed a set of 12 indicators for determining the environmental friendliness and economy of households. Adaptive methods of managing the system of agricultural enterprises based on innovation and environmental friendliness were proposed by the authors (Klerkx et al., 2010). As an example, the scientists emphasized the need to create an environment with innovative connections in which innovative projects in agribusiness will be implemented and financially supported. The author's approach (Long et al., 2016) is interesting within the scope of our research, which deals with the barrier to creating ecological production and the diffusion of technological innovations in agriculture in the Netherlands, Italy, France, and Switzerland.

The authors update the issues of challenges for agricultural production and detail directions for adapting agriculture and reducing waste. Important models for calculating the financial security of subjects of the national economy are discussed in the works of scientists (Zhyvko et al., 2022; Kuznyetsova et al., 2022). In this work, mathematical models of accounting and financial stability of individual subjects of the economy are given, taking into account globalization changes. Important issues of financial management are raised by scientists (Wang and Zhi, 2016), who defined "green" finance as a new financial model for achieving ecological balance. Researchers specified a system of solutions to overcome internal contradictions between green finance and environmental support.

The answer to the question of stimulating corporate environmental management can be found in the works of Chinese scientists (Zhang et al., 2008). These scientists conducted large-scale research on China's environmental policy and developed a system of indices for evaluating the effectiveness of corporate environmental management. Necessary research for the theory of financial and marketing innovations is analyzed in the work (Mariadoss et al., 2011). The article analyzes the marketing activities of forty-seven enterprises and determines the relationship between sustainable consumption and the competitive advantages of the firm. Important within the scope of our research are proposals for modelling ecoclusters in the context of globalization (Ovcharenko et al., 2022). In particular, the system of a set of indicators to support the functioning of environmental associations is of interest.

The scientific article (Iliashenko et al., 2022) defines the aspects of the implementation of innovative technologies in the conditions of pandemics that are important for our research. Scientists indicate the most optimal ways of minimizing risks in the process of diffusion of technologies, which are also useful for the agricultural sector. It is important to note that the financial and marketing innovative management of ecological agribusiness should be based on the sustainable development of education, certain aspects of which have been considered by a group of researchers (Bakhmat et al., 2022). In particular, scientists focus on comprehensive support for the development of education, which is a necessary component of innovation, support for ecology, and attracting finance to the national economy. In a scientific article (Cary and Roberts, 2011), the problem of the management system of the environment, land and water resources of Australia is raised. In particular, scientists detail the system of financing land management, stimulating the development of the rural population and supporting biodiversity as a necessary component of supporting Australian agriculture.

It is worth focusing our attention on studies (Hinson et al., 2019) devoted to the problems of agribusiness transformation in developing countries. Scientists rightly emphasized the need for the development of financial technologies, in-depth marketing research and innovations in the agricultural sector. In the process of improving the financial and marketing innovative management of ecological agribusiness, special attention should be focused on human capital and human

ability. Thus, the authors (Voznyuk et al., 2021) emphasized the need to develop human abilities in the process of informatization of society. These studies are of particular importance for the dissemination of innovative solutions, including in marketing, financial management and education promotion.

Key aspects of innovation diffusion, deepening marketing and financial support are identified by researchers (Morgan and Murdoch, 2000). In particular, scientists determine the chains of dissemination of innovations and knowledge in ecological agriculture. Important directions for improving marketing, innovation, competitiveness and sustainable development of firms are discussed in the work (Augusto and Coelho et al., (2009). Scientists emphasize the need to stimulate organizational culture as a necessary component of the formation of effective managerial management of innovative development of the firm. Necessary aspects of competence formation of future managers in the conditions of the knowledge economy are violated at work (Bazeliuk et al., 2021). Without the aspects mentioned in the article, it is impossible to form an effective strategy for financial and marketing innovative management of ecological agribusiness. Scientific work is needed in which it is proposed to note the methods and tools of optimal programming in the development of agricultural production tasks (Kalinichenko et al., 2019). These methods and tools are appropriate for use within the scope of our research.

Mathematical methods for evaluating efficiency are noted in the work (Shevchenko and Lupan, 2014), which analyzed panel data modelling technologies that can be used to evaluate the financial and marketing management of any enterprise. Of particular interest for our study are the conclusions of scientists (Chishti and Sinha 2022). Thus, scientists at a professional level determined the impact on the environment of shocks, crises and bifurcations and detailed the directions of the spread of technological and financial innovations. The problem of the formation of connections between ecological innovations, economic growth, urbanization and financial globalization was investigated (Ahmad et al., 2021). The authors rightly identified the need to deepen environmental innovation, marketing research and adaptive management in the G7 countries. In our opinion, it is worth focusing attention on the work of scientists (Fareed et al., 2022), which emphasizes the need to stimulate innovative activities for financial support of the environment in the Eurozone.

The above-mentioned scientific works of scientists are undoubtedly of great importance for the formation of modern science regarding innovative technologies for managing the agricultural sector. At the same time, as we can see, the issue of financial and marketing innovative management of ecological agribusiness has been investigated fragmentarily in scientific works. That is separate tools for improving financial, marketing, innovative management and environmental policy are thoroughly considered. At the same time, the set of measures for evaluation and diagnosis of financial and marketing innovative management of ecological agro-business remains understudied. The specified problem violates the need to form a comprehensive vision on the phasing and directions of formation and evaluation of financial and marketing innovative management of ecological agro-entrepreneurship.

AIMS AND OBJECTIVES

The purpose of the article is to determine the most effective method of evaluating financial and marketing innovative management of ecological agribusiness, taking into account current trends. For this purpose, the following problems are solved in the article:

- the myths and the role in the modern scientific opinion of the theory of financial and marketing innovative management of ecological agribusiness are defined;
- the method of optimization of sown areas, determination of maximum profit and efficiency of application of the optimal structure of sown areas is proposed;
- the effectiveness of the financial and marketing management of the gross production of five agricultural enterprises was analyzed based on the results of the optimization of sown areas;
- the method of calculating the individual effects of financial and marketing innovative management of ecological agro-business was developed;
- the forecast of the efficiency of the production activity of five agrarian enterprises was calculated using the optimization of sown areas and the determination of the maximum profit and individual effects of innovative management in terms of production activity and financial and marketing effects.

METHODS

Modelling of financial and marketing innovative management of ecological agribusiness is proposed to be implemented using a system of methods. In particular, the main method is optimization modelling, which allows for determining environmental and resource-saving measures to increase the profitability of agricultural enterprises in the best way using the smallest financial resources. In order to evaluate the innovative management of agribusiness, it is advisable to take into account the ecological effect, which is based on the minimization of the negative impact on the environment. To determine it, we involved the method of statistical modelling using electronic spreadsheets. To forecast financial and marketing innovative management, we used longitudinal data modelling methods with marginal and random effects. We propose to determine the evaluation of the effectiveness of innovative management by production activity and the evaluation of the effectiveness of innovative management by financial effect with the involvement of the method of factor modelling. For a comprehensive assessment of the effectiveness of financial and marketing innovative management of ecological agribusiness, we used the linear programming technique. The methods of analysis and synthesis made it possible to systematize the evaluation indicators of financial and marketing innovative management of ecological agribusiness and draw conclusions. When choosing the methods, we focused on the fact that increasing the financial and economic efficiency of innovative management of ecological agribusiness is based on the productivity of agricultural land, and resource conservation while simultaneously increasing the production of agricultural products. That is why, when planning financial and marketing innovative management, it is necessary to determine the optimal structure of the sown area. In order to maintain the environmental friendliness of production, a selective system of crop rotation and territorial planning of agricultural lands depending on land resources is expedient. In this case, it is advisable to model conditions of this type with the involvement of the objective function. Thus, when constructing the optimal structure of the sown area of agricultural production, the optimal areas are denoted by the variables $X_1, X_2 \dots X_n$, taking into account the condition of their non-negativity.

Statistical information of five agricultural enterprises of the Poltava district, which have approximately the same production volumes and similar areas for sowing crops, were used to optimize the sown areas and model the financial and marketing innovative management of ecological agribusiness. Also, these enterprises are ecologically oriented and grow ecologically safe products. The purpose of their innovative activity is the purchase of new varieties of plants, modernization of agricultural machinery, and variety renewal. These business entities are among the budget-generating enterprises of the region. Adhering to the norms of confidentiality of statistical information and for the convenience of processing the results, we will mark agricultural enterprises: 1 enterprise, 2 enterprise, 3 enterprise, 4 enterprise and 5 enterprises, thereby not violating the norms of the law and conducting scientific research. Let us denote the appropriate sown areas of agricultural crops by the variables $X_1, X_2 \dots X_n$: corn for grain, dried legumes, wheat winter wheat, buckwheat, spring barley, peas, sunflower and soybeans. For the purpose of modelling, we have entered information: yield of agricultural crops, labour costs for growing these crops, production cost, sales price and profit from 1 t of products, as well as the volume of sold products.

In the next stage, we set limits on the cost of production, labour costs, the volume of products sold, the total area of sowing and the area of sowing of each agricultural crop.

In order to optimize the sown areas and model the financial and marketing innovative management of ecological agribusiness, we took into account that according to agrotechnical norms in the agricultural enterprises of the Poltava region, no more than 65% of the structure of the total area is allocated to the grain group (22% for winter wheat), no more than 25% for corn for grain and legumes no more than 16%. No more than 31% of the total land area is allocated to the cultivation of industrial crops, namely: no more than 20% for sunflower; soy no more than 15%. Taking into account that these enterprises are ecological and seek to save production resources, the differentiation of sunflower and soy is an important condition, since these crops deplete chernozems and have a negative impact on the soil. These environmental requirements should be taken into account when optimizing the sown area, marketing the agricultural sector, and greening the production of the studied agricultural enterprises.

Therefore, the objective function of the maximum profit from the sale of plant products will have the form:

Enterprise	Function
Enterprise 1	$33,16 X_1 + 4,97X_2 + 16,93X_3 \rightarrow Z_{max}$
Enterprise 2	$18,64X_1 + 4,71X_2 + 24,68X_3 + 3,53X_4 + 4,10X_5 + 16,60X_6 + 17,08X_7 \rightarrow Z_{max}$
Enterprise 3	$18,85X_1 + 4,16X_2 + 24,17X_3 + 3,67X_4 + 3,78X_5 + 16,67X_6 + 18,04X_7 \rightarrow Z_{max}$
Enterprise 4	$18,72X_1 + 4,41X_2 + 24,33X_3 + 3,42X_4 + 4,21X_5 + 16,90X_6 + 17,12X_7 \rightarrow Z_{max}$
Enterprise 5	$18,04X_1 + 4,13X_2 + 24,18X_3 + 3,19X_4 + 4,06X_5 + 16,58X_6 + 17,44X_7 \rightarrow Z_{max}$

To determine the optimal area for sowing agricultural crops and obtain the maximum profit, as mentioned earlier, we use Microsoft Excel spreadsheets, built-in mathematical functions and the "Solver" tool of Microsoft Excel spreadsheets, which allows you to quickly and optimally find solutions to the problem, which are then adapted in conditions of the enterprise when planning financial and marketing innovative management of ecological agribusiness.

RESULTS

As a result of the processing of statistical data of five agricultural enterprises, the optimized areas of agricultural crops, the maximum financial profit from the sale of products of the plant industry and the effectiveness of the application of the optimal ecological structure of the cultivated areas of the studied agricultural enterprises were obtained (Table 1).

Table 1. Summarized information on the results of optimization of planted areas, determination of maximum profit and efficiency of application of the optimal structure of planted areas of five agricultural enterprises of Poltava district, 2022, 2025.

Enterprise	Profit of the crop industry, thousand UAH		Deviation +,-. Economic effect of optimization of sown areas	Efficiency of gross production, %	Ranking by the ef- fectiveness of fi- nancial and mar- keting manage- ment gross production
	Profit of the crop industry, 2022, thousand hryvnias	Maximum profit according to the opti- mization results, thousand hryvnias			
Enterprise 1	31194.20	43166.17	11971.97	0.43	4
Enterprise 2	39180.50	53343.18	14162.68	0.93	2
Enterprise 3	30150.60	49610.15	19459.55	0.14	5
Enterprise 4	28460.00	45242.03	16782.03	1.16	1
Enterprise 5	29220.40	48776.56	19556.16	0.66	3

The result of optimization of sown areas, determination of maximum profit and efficiency of application of the optimal structure of sown areas of five agricultural enterprises of the Poltava district is the economic effect of optimization of sown areas, it is positive, that is, each investigated enterprise will receive a financial profit from the sale of products of the crop industry in the forecast year of 2025. The rating evaluation of the effectiveness of financial and marketing management of gross production shows the rating place of each enterprise - 1st place 4th enterprise, the best result. A graphical representation of the point value of the efficiency of gross production of five agricultural enterprises, in 2025, is shown in Figure 1.

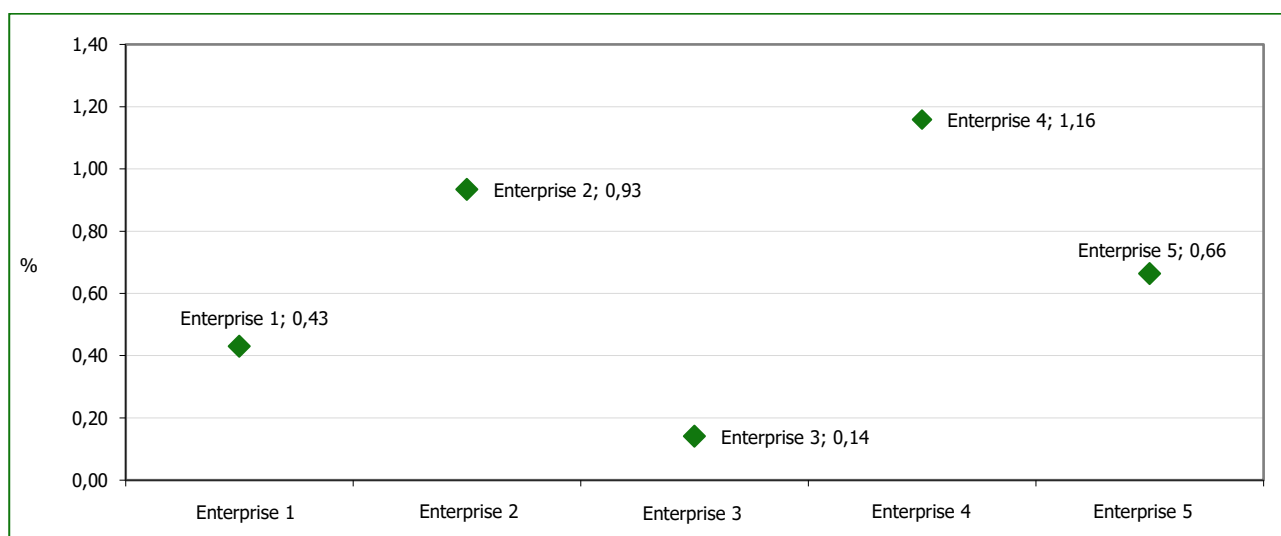


Figure 1. Effectiveness of the financial and marketing management of the gross production of five agricultural enterprises based on the results of the optimization of sown areas, 2025.

In the next stage, we will calculate the integral indicator of the evaluation of the effectiveness of the innovative management of the enterprise over the past five years, in particular, the evaluation of the effectiveness of the innovative management by production activity and the evaluation of the effectiveness of the innovative management by the financial and marketing effect (Table 2).

Table 2. Calculation of the integral indicator of the evaluation of the efficiency of the innovative management of the enterprise, 2018-2022.

Indicator	Years				
	2018	2019	2020	2021	2022
Enterprise 1					
Evaluation of the effectiveness of innovative management by production activity, S_{prod}	2.12	2.12	2.16	2.01	2.40
Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}	2.72	2.06	2.31	2.02	2.12
Enterprise 2					
Evaluation of the effectiveness of innovative management by production activity, S_{prod}	2.07	2.12	2.16	2.21	2.25
Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}	2.49	2.37	2.25	2.12	2.00
Enterprise 3					
Evaluation of the effectiveness of innovative management by production activity, S_{prod}	2.12	2.17	2.21	2.26	2.30
Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}	2.54	2.42	2.30	2.17	2.05
Enterprise 4					
Evaluation of the effectiveness of innovative management by production activity, S_{prod}	2.18	2.23	2.27	2.32	2.36
Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}	2.60	2.48	2.36	2.23	2.11
Enterprise 5					
Evaluation of the effectiveness of innovative management by production activity, S_{prod}	2.24	2.28	2.33	2.37	2.42
Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}	2.66	2.54	2.41	2.29	2.16

The calculation of the integral indicator of the evaluation of the efficiency of the innovative management of the enterprise, in particular the evaluation of the effectiveness of the innovative management according to the production activity and the evaluation of the effectiveness of the innovative management according to the financial and marketing effect, carried out for further research, calculation, analysis and forecasting of the influence of these factors on the profit of the crop production industry of the studied economic entities.

At the next stage of the study of agricultural enterprises of the Poltava region, we will process statistical information, modelling, and forecasting of factors and indicators that are key in managing the financial and marketing functioning of ecological agribusiness. At the same time, we will use longitudinal data with fixed and random effects, which take into account the specifics of the development of agricultural enterprises and the factor of uncertainty of the external environment. Longitudinal data with fixed effects is a separate type of data used to examine temporal changes within the life cycle of agribusinesses with fixed effects. Fixed effects include factors that remain constant during the observation period and may affect the results of the study. For example, it can be the region in which the agricultural enterprise is located or specific characteristics of this agricultural enterprise. The study of agribusiness using longitudinal data can include the analysis of various aspects, such as yield, use of resources (water, fertilizers), weather conditions, technological innovations and other factors that can affect the success of the agribusiness. The input data for calculating and modelling the individual effects of five agricultural enterprises over the past five years using longitudinal data models with fixed effects is presented in the Table 3.

Table 3. Input data for calculating the individual effects of financial and marketing innovative management of ecological agribusiness of five agricultural enterprises, 2018-2022.

Enterprise	Years	Profit of the crop industry, thousand UAH, Y	Evaluation of the effectiveness of innovative management by production activity, S_{prod}, X_1	Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}, X_2
1	2018	17745.29	2.12	2.72
1	2019	19555.48	2.12	2.06
1	2020	21365.67	2.16	2.31
1	2021	23175.86	2.01	2.02
1	2022	31194.20	2.40	2.12
2	2018	10572.20	2.07	2.49
2	2019	20044.90	2.12	2.37
2	2020	-93.90	2.16	2.25
2	2021	23319.10	2.21	2.12
2	2022	39180.50	2.25	2.00
3	2018	23245.29	2.12	2.54
3	2019	25055.48	2.17	2.42
3	2020	26865.67	2.21	2.30
3	2021	28675.86	2.26	2.17
3	2022	30150.60	2.30	2.05
4	2018	19677.29	2.18	2.60
4	2019	21487.48	2.23	2.48
4	2020	23297.67	2.27	2.36
4	2021	25107.86	2.32	2.23
4	2022	28460.00	2.36	2.11
5	2018	16737.29	2.24	2.66
5	2019	18547.48	2.28	2.54
5	2020	20357.67	2.33	2.41
5	2021	22167.86	2.37	2.29
5	2022	29220.40	2.42	2.16

We will briefly describe the methodology for calculating, modelling and forecasting the individual effects of five agricultural enterprises over the past five years using longitudinal data models with fixed effects. Let's calculate the average value within the variable models in the section of each agricultural enterprise (Table 4)

Table 4. Determination of the average value of the indicator and factors for calculating the individual effects of financial and marketing innovative management of ecological agribusiness of five agricultural enterprises, 2018-2022.

Enterprise	Profit of the crop industry, thousand UAH, Y	Evaluation of the effectiveness of innovative management by production activity, S_{prod}, X_1	Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}, X_2
Enterprise 1	22607.30	2.16	2.25
Enterprise 2	18604.56	2.16	2.25
Enterprise 3	26798.58	2.21	2.30
Enterprise 4	23606.06	2.27	2.36
Enterprise 5	21406.14	2.33	2.41

We carry out additional calculations, namely the deviation of the actual values of the indicator and factors from their average values for agricultural enterprises, their product and square. Calculation of the consistent score according to the formula using Microsoft Excel spreadsheets and built-in matrices "MINVERSE" and "MMULT":

$$\hat{\beta}_{FE} = (\sum_{i=1}^n \sum_{t=1}^T (x_{it} - \bar{x}_i)(x_{it} - \bar{x}_i)')^{-1} (\sum_{i=1}^n \sum_{t=1}^T (x_{it} - \bar{x}_i)(y_{it} - \bar{y}_i)') \quad (1)$$

As a result of the calculations, the following coefficients were obtained:

$$b \quad \begin{matrix} -1,18 \\ -48,56 \end{matrix}$$

We find the individual effects of five agricultural enterprises, 2018-2022 for each investigated enterprise according to the formula:

$$\hat{\alpha}_i = \bar{y}_i - \bar{x}_i' \hat{\beta}_{FE} \quad (2)$$

So, as a result of the calculations, we have the following result:

Enterprise 1	a ₁ =	22,72
Enterprise 2	a ₂ =	18,72
Enterprise 3	a ₃ =	26,92
Enterprise 4	a ₄ =	23,88
Enterprise 5	a ₅ =	21,53

Graphically, the individual effects of financial and marketing innovative management of ecological agribusiness of five agricultural enterprises, 2018-2022, are presented in Figure 2.

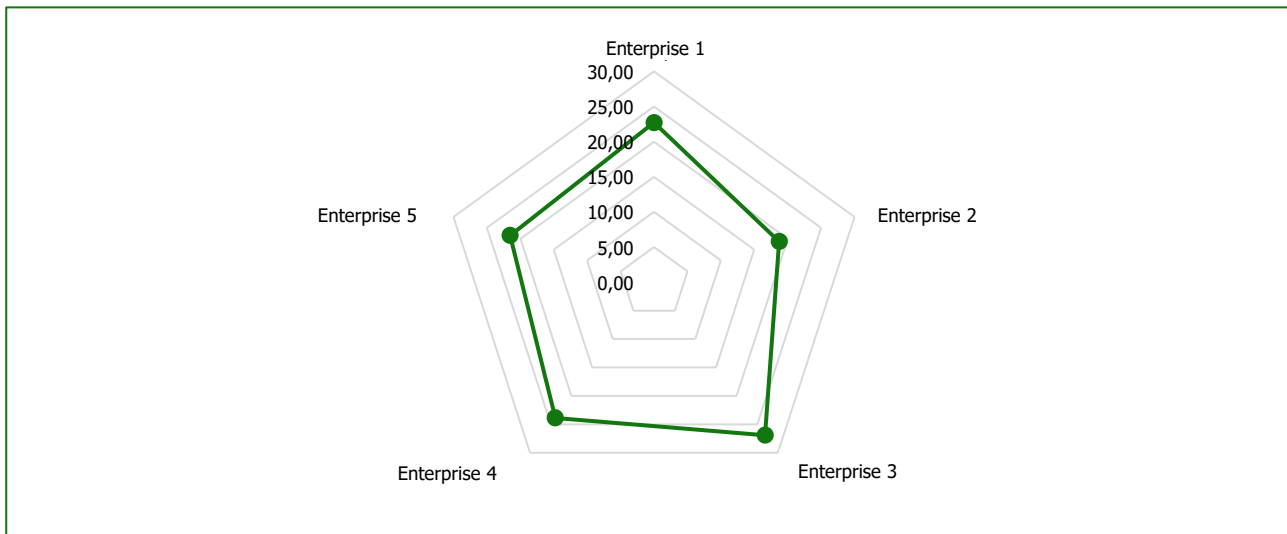


Figure 2. Graphic presentation of the individual effects of financial and marketing innovative management of the activities of five agricultural enterprises, 2018-2022.

According to this methodology, we will forecast the individual effects of the activities of five agricultural enterprises for 2025. It should be noted that the value of the effective indicator of the profit of the crop production industry of each agricultural enterprise in 2025 was taken based on the results of optimizing the sown areas, determining the maximum profit and the effectiveness of applying the optimal structure of the sown previously calculated areas. The value of the factor characteristics of the evaluation of the effectiveness of innovative management by production activity and the evaluation of the effectiveness of innovative management by the financial and marketing effect was carried out by the built-in statistical function "TREND" of Microsoft Excel spreadsheets, which is linear and most accurately reflects the actual and theoretical values of the study (Table 5).

Table 5. Prediction of the effective indicator of financial and marketing innovative management of ecological agribusiness and factor characteristics, 2025.

Enterprise	Years	Profit of the crop industry, thousand UAH, Y	Evaluation of the effectiveness of innovative management by production activity, S_{prod}, X_1	Evaluation of the effectiveness of innovative management by financial and marketing effect, S_{fin}, X_2
Enterprise 1	2025	43166.17	2.39	2.00
Enterprise 2	2025	53343.18	2.39	1.87
Enterprise 3	2025	49610.15	2.44	1.99
Enterprise 4	2025	45242.03	2.50	2.00
Enterprise 5	2025	48776.56	2.55	2.06

We calculate the consistent assessment according to formula (1) using Microsoft Excel spreadsheets and built-in "MINVERSE" and "MMULT" matrices.

As a result of the calculations, the following coefficients were obtained:

$$b = \begin{matrix} -7,46 \\ 33,81 \end{matrix}$$

Forecast values of individual effects of five agricultural enterprises for 2025 were obtained.

Enterprise 1	$a_1 =$	25,96
Enterprise 2	$a_2 =$	24,34
Enterprise 3	$a_3 =$	30,54
Enterprise 4	$a_4 =$	27,15
Enterprise 5	$a_5 =$	26,21

Graphically, the forecast values of the individual effects of financial and marketing innovative management of five agricultural enterprises for 2025 are shown in Figure 3.

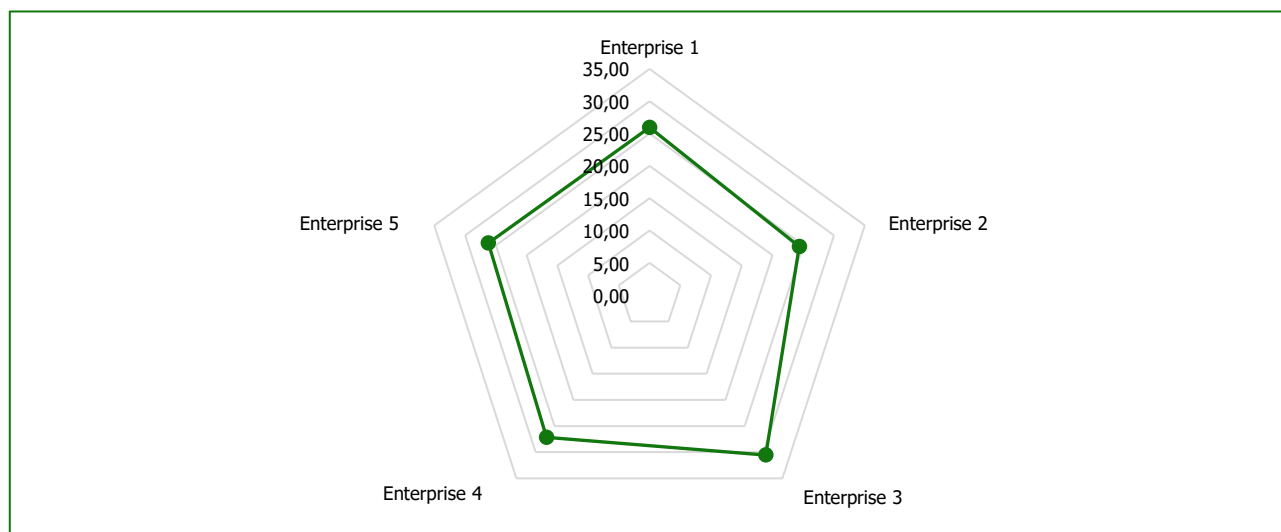


Figure 3. Graphic presentation of the forecast values of the individual effects of the activities of five agricultural enterprises, 2025.

Using Table 6, the value of the individual effects of the production activity of five agricultural enterprises in 2018-2022 and their forecast value in 2025 are summarized. From the data in the table. 6, it is possible to observe the growth of the forecast value in 2025 of the studied agricultural enterprises, which can be a positive phenomenon.

Table 6. Individual effects of financial and marketing innovative management of ecological agribusiness activities of five agricultural enterprises, 2018-2022, 2025.

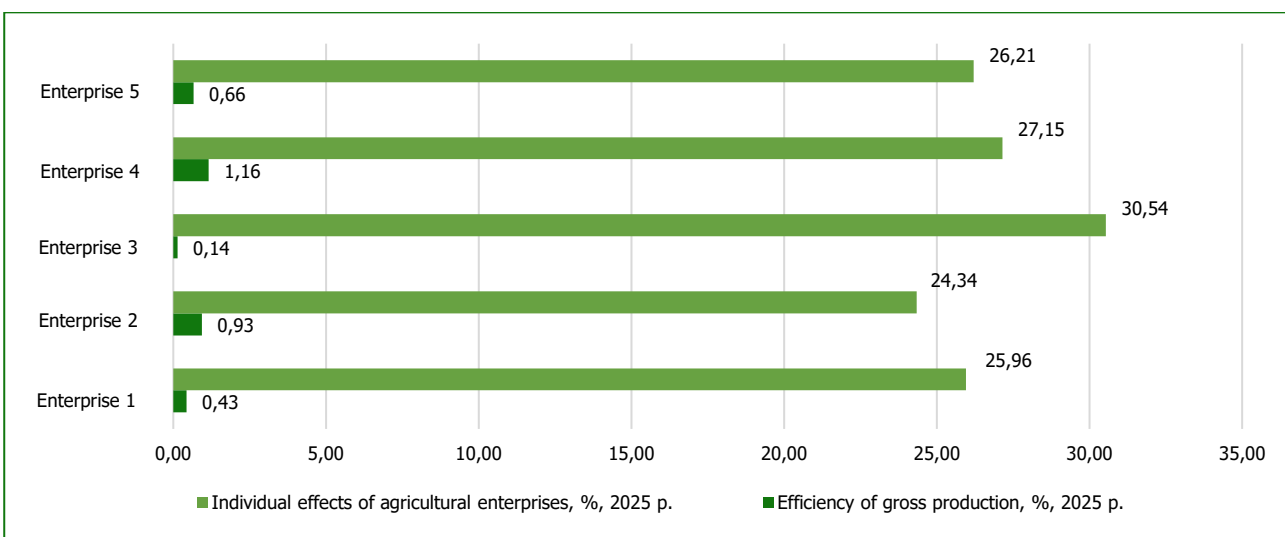
Enterprise	Individual effects agricultural enterprises, %, 2018-2022	Individual effects agricultural enterprises, %, 2025 p.
Enterprise 1	22.72	25.96
Enterprise 2	18.72	24.34
Enterprise 3	26.92	30.54
Enterprise 4	23.88	27.15
Enterprise 5	21.53	26.21

So, as a result of this study, it can be concluded that longitudinal (spatial) data models should be used in modelling the processes of financial and marketing innovative management of an ecological agro-enterprise. Thus, the use of longitudinal data models in the activities of ecological agribusiness has significant advantages because it allows to evaluate the management taking into account the current data of the financial and economic activity of the enterprise. Finally, we will conduct a comparative analysis of the forecast values of gross production efficiency, carried out using the optimization problem of linear programming and individual effects of financial and marketing innovative management of agricultural enterprises, carried out using longitudinal data models with fixed effects (Table 7).

Table 7. Forecasting the efficiency of the production activity of five agricultural enterprises using the optimization of planted areas and determining the maximum profit and individual effects of financial and marketing innovative management, 2025.

Enterprise	Efficiency of gross production, %, 2025	Individual effects of agricultural enterprises, %, 2025
Enterprise 1	0.43	25.96
Enterprise 2	0.93	24.34
Enterprise 3	0.14	30.54
Enterprise 4	1.16	27.15
Enterprise 5	0.66	26.21

Graphically, the data of forecasting the efficiency of production activity of five agricultural enterprises using the optimization of planted areas and determining the maximum profit and individual effects of activity under the influence of the main factors of the efficiency of innovative management in terms of production activity and financial and marketing effect, 2025 are presented in Figure 4.


Figure 4. Forecasting the efficiency of production activity of five agricultural enterprises using the optimization of planted areas and determining the maximum profit and individual effects of innovative management by production activity and financial and marketing effect, 2025.

Judging from the comparative analysis, it can be concluded that the use of these two methods of economic-mathematical modelling is permissible, optimal and effectively justified in the conditions of specific agricultural enterprises. However, optimization modelling of linear programming more specifically details the modelling of production processes, while longitudinal data with fixed effects allow to take into account the scale of agricultural enterprises more broadly. Therefore, in the modern conditions of the development of the agricultural sector, their combination is expedient, which will allow obtaining financial and economic results in a specific economic environment.

DISCUSSION

Therefore, we have proposed a comprehensive methodology for evaluating the financial and marketing innovative management of ecological agribusiness. Note that this technique is not proposed in any scientific source. It is worth conducting a discussion on labour (Aranchiy et al., 2022), which depicts a method of comprehensive assessment of the financial condition of domestic economic entities. Indeed, the authors proposed a revolutionary technique that can be used in our research. However, this methodology does not take into account the ecological components of enterprise development, which are very important and relevant in today's conditions. It raises many questions about the effectiveness of the methods proposed by the authors (Oseredchuk et al., 2022; Zhyvko et al., 2022; Illiashenko et al., 2022), which, in our opinion, are very complex and do not meet the needs of the modern market. In particular, these methods do not take into account the principles of resource conservation at agricultural enterprises and therefore do not meet the requirements of ecological production. The proposals of researchers (Long et al., 2016; Bakhmat et al., 2022) are questionable for use in practical activities because they do not allow for effective and timely identification of threats to the external environment that systematically enter and affect environmental enterprises. The recommendations of scientists are outdated and do not correspond to modernity (Mariadoss et al., 2011; Cary and Roberts, 2011; Shevchenko and Lupan, 2014). Thus, these recommendations do not meet the modern requirements in which business entities operate. Also, the science of marketing, innovation, management and finance does not stand still, but is constantly developing, so all scientific articles must be reviewed and improved in accordance with the challenges faced by agricultural enterprises. In the scientific work (Fareed et al., 2022), attention is focused on the need to stimulate innovative activities for financial support of the environment in the Eurozone. However, it is not defined how to stimulate such activity and what tools the state should implement for such stimulation. The works (Rasul and Thapa, 2004; Wang and Zhi, 2016; Ahmad et al., 2021) are characterized by fragmentary views and a weak methodological base because they lack innovative methods of stimulating management and making managerial decisions in the most critical situations. The conclusions of the authors (Klerkx et al., 2010; Zhang et al., 2008; Ovcharenko et al., 2022) need to be re-evaluated because they do not reflect the directions for solving the problem of effective enterprise management, taking into account limited resources and the need for ecological development of enterprises. Scientific articles (Hinson et al., 2019; Chishti and Sinha 2022) do not consider comprehensive approaches to evaluating the marketing, financial, and innovative activities of enterprises. Therefore, we can state that only our research helps to solve the problem of complex evaluation of financial and marketing innovative management of ecological agribusiness.

CONCLUSIONS

Thus, we determined that the highest level of individual effects as of 2018-2022 will be at the third enterprise, namely 26.92%. It was followed by the fourth enterprise with an indicator of 23.8%. The third position according to the indicator of individual effects was taken by the first enterprise with an indicator of 22.72%. The penultimate place in terms of individual effects is held by the fifth enterprise – 21.53%, respectively. And the lowest efficiency indicator was recorded by us at the second enterprise - 18.72%. Forecasting of the individual effects of financial and marketing innovative management of ecological agribusiness activities of five agricultural enterprises for 2025 showed that the highest indicator was also recorded in the third enterprise - 30.54%, followed by the fourth enterprise - 27.15%, the fifth enterprise – 26.21%, the first enterprise – 25.96% and the second enterprise – 24.34%. It should be stated that the use of longitudinal data models in the activities of ecological agribusiness has significant advantages because it allows to evaluate the management taking into account the current data of the financial and economic activity of the enterprise. The calculation of forecasting the efficiency of production activity of five agricultural enterprises with the help of optimization of sown areas in order to support environmental friendliness and resource conservation of agricultural enterprises showed that such a forecast looks different for enterprises. The highest efficiency of gross production will be obtained by the fourth enterprise - 1.16%, and the lowest - by the third enterprise - 0.14%. Therefore, the proposed method of determining the financial and marketing innovative management of ecological agribusiness is simple for practical use by interested stakeholders of the market,

who take care of the competent assessment of the current activity of the agricultural enterprise and the forecast of its prospects.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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ФІНАНСОВО-МАРКЕТИНГОВИЙ ІННОВАЦІЙНИЙ МЕНЕДЖМЕНТ ЕКОЛОГІЧНОГО АГРОПІДПРИЄМНИЦТВА

Поточна діяльність агропідприємств відзначається нестабільністю, яка викликана мінливим зовнішнім середовищем та численними викликами. Низька адаптивність агропідприємств не дозволяє їм вчасно реагувати на зазначені виклики, що призводить до негативного тренду розвитку агросектора загалом. У більшості підприємств відсутня ефективна стратегія розвитку фінансово-маркетингового інноваційного менеджменту, яка до того ж не відповідає політиці ресурсозбереження та екологічності виробництва. У такому випадку існує потреба глибокого дослідження концепції фінансово-маркетингового інноваційного менеджменту екологічного агропідприємництва. У статті запропоновано інноваційні напрями оцінювання ефективності фінансово-маркетингового інноваційного менеджменту екологічного агропідприємництва та моделювання прогнозу такого менеджменту. За допомогою використання методики аналізу лонгітюдних даних із граничними та випадковими ефектами, оптимізаційного й статистичного моделювання визначено динаміку фінансово-маркетингового інноваційного менеджменту. Для оптимізації посівних площ і моделювання менеджменту екологічного агропідприємництва використана статистична інформація п'яти аграрних підприємств Полтавського району, які мають приблизно однакові обсяги виробництва, схожі площі для посіву культур. Також ці підприємства є екологічно орієнтованими та вирощують екологічно безпечну продукцію. Результати моделювання дозволили визначити індивідуальні ефекти фінансово-маркетингового та виробничого

інноваційного менеджменту. Запропонована методика визначення фінансово-маркетингового інноваційного менеджменту екологічного агропідприємництва є простою для практичного використання зацікавленими стейкхолдерами ринку, які опікуються вчасним проведенням оцінювання поточної діяльності сільськогосподарського підприємства та прогнозу перспектив його розвитку.

Ключові слова: екологічне агропідприємництво, менеджмент, інновації, фінанси, маркетинг, ринок, виробництво

JEL Класифікація: G17, M31, Q57