

JEL: Q14

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[https://doi.org/10.60022/sis.1.\(01\).7](https://doi.org/10.60022/sis.1.(01).7)

RANKING OF PROFITABILITY AND COSTS INDICATORS OF AGRIBUSINESSES

Abstract. *The microenvironment of agricultural enterprises is influenced by the external environment, which affects entrepreneurial activity in different ways. However, any response of managers to external changes must be justified, logical and in line with the needs of the current market. Timely diagnostics of profitability and costs indicators of agricultural enterprises and forecasting of their values are of great importance. Such actions will provide managers with reference points for making the necessary decisions and allow them to respond to any impulses affecting the development of the enterprise.*

To rank the profitability indicators of business entities we have chosen the activities of agricultural enterprises. Using methods of mathematical modelling, taxonomic analysis and ranking, we have analysed the dynamics of agricultural enterprises' performance indicators. The testing of some statistical functions made it possible to forecast the rating indicator of agrarian enterprises' activity in 2023–2024.

The result of the profitability and costs ranking of agri-businesses for the reporting year 2020 showed an increase compared to previous years. At the same time, it is possible to observe an increase in expenditures by enterprises, which indicates the need for stricter and deeper monitoring of the activities of agribusinesses by top managers. This monitoring will prevent bankruptcy or inefficient allocation of finances by the enterprises.

The profitability and costs ranking of agribusinesses described in the article is a universal method, applicable to any facility or industry. Ranking can be tested not only in studies of statistical units or their totality but also for determining dynamic changes in retrospective time series. The forecasting of the investigated indicators can serve as impulses for managers concerning the improvement of strategic orientation and making correct decisions by managers of agricultural enterprises with the purpose of forming the goals of further activity.

Keywords: *profitability, direct material costs, labour costs, general production costs, forecasting, ranking, agribusinesses*



1. Introduction

The profitability of any agricultural enterprise depends on well-chosen management guidelines, which include procedures of current and future costs estimation. Given that agricultural enterprises traditionally strive to save resources, including financial and labour, it is not always possible to estimate costs. There is a need to develop an estimation method that would allow managers of enterprises to carry out costs analysis quickly and easily. A relevant issue is the comparison of these analyses retrospectively. In view of the above, the aim of the article is to develop and test a methodology for ranking the profitability and costs indicators of agribusinesses.

Taxonomies, rating and indicative comparisons have been extensively researched in the works of many scholars. In particular, Ramnath *et al.*, [1], carried out a taxonomy of studies that examined the role of financial analysts in capital markets. The scholars classified some 250 articles published since 1992, describing the evolution of analysts' statistical forecasts, research incentives and decision-making processes, and suggested combinations of indicators used for analysis. Wolf *et al.*, [2] retrospectively evaluated the financial performance of a dairy farm by applying the scientific achievements of three university programmes in business analysis. Using indicators of profitability, solvency and liquidity, the researchers assessed the credit risk of the farm using the variance components method. These achievements are particularly important for shaping government programmes to protect pricing in the dairy market. Researchers Zakirova *et al.*, [3], proposed a model of comprehensive information and analytical support for strategic management. Among other things, the practical aspects of strategic management accounting in the enterprise, modern concepts of strategic management accounting, ways of alternative costs, directions for improving the modern practice of organisation and application of strategic management accounting are developed in the article. Of interest for our study is the development of the principles of selection of key performance indicators of enterprises, the algorithm for competitor rating analysis based on information support for strategic management, practical recommendations in the field of methodological support of strategic management accounting, aimed at improving the efficiency of processes of development and implementation of strategic management decisions. Davydenko and Skrypykh, [4], proposed a definition of the investment attractiveness of enterprises, which is based on various expert assessments of statistical information, as well as the combination of several techniques. The paper proposes criteria for deciding on the feasibility of investment and develops a rating assessment of investment attractiveness, taking into account the specifics of the industry. The proposed rating assessment can be adapted to the activities of agricultural enterprises

in the formation of priority areas for investment, planning of operating costs, technology, etc. Significant scientific advances for our study are highlighted in the works of Crouhy *et al.*, [5]. Researchers have systematised the factors of effective implementation of digitalisation for innovative development of agriculture in Azerbaijan. The information base is the coverage of 1513 senior managers of agricultural enterprises. The article proposes levels of development of digitalisation of the agricultural sector of the country and empirically substantiates the qualitative nature of the impact of digitalisation factors on the innovative development of agricultural enterprises by regression modelling method. The results obtained can help develop a state strategy to strengthen the digitalisation of the country's agricultural sector in order to ensure its innovative development, food security and economic diversification. Innovative studies are the works of Kuncová *et al.*, [6] in which an assessment of the impact of firm size on economic performance is defined. In particular, economic efficiency is proposed to be determined by means of multi-criteria evaluation of alternative methods, where profitability, labour productivity, etc. are used as indicators of economic efficiency. A linear regression model is used to model the relationship between company size and profitability. Multi-criteria estimation has determined that economies of scale play an important role in pig breeding firms. Kučera *et al.*, [7], who proposed a new methodology for calculating the optimal borrowing capacity of an enterprise under conditions of maintaining a positive financial leverage function, are important. The methodology was tested in agricultural enterprises between 2012 and 2018. The modelling made it possible to determine the optimal ratio of equity and loan capital. A credit risk rating system is proposed in works of Crouhy *et al.*, [8]. The authors propose to use a two-tier rating system, where the rating of the debtor and the rating of the institution (e.g. damage in case of default, lending with a view to default, etc.) are assessed. Corporate credit rating estimation is proposed by Wang and Ku, [9]. The paper uses innovative analytical neural network training methods to improve prediction accuracy, defines function space using new input variables, develops a new algorithm for financial data selection, and proposes a model assembly of parallel artificial neural networks. Note that artificial intelligence is quite often used for ranking, but requires specific professional skills and the involvement of a large data set for analysis. Poon *et al.*, [10], have proposed ranking financial data. Using bank accounting and financial data, the authors developed logistic regression models to explain or predict lending risks. This study helps to predict the onset of banking crises and determine how credit problems affect the financial sector in Asia and Latin America. Very important issues for the preservation of the natural environment have been touched upon by

Yu *et al.*, [11]. As scientists have rightly pointed out, supporting low-carbon energy processes is an important measure for reducing greenhouse gas emissions. However, such changes typically require investments that require continued access to finance. In such a case, the determination of credit ratings is a critical factor in the financing process. The paper assesses the feasibility of using different models to predict the credit ratings of environmentally friendly companies. The authors rank 355 companies in the euro area for the period 2010 to 2019. Given that green businesses face constant risk, the results obtained in the article are important in assessing the credit risk of pro-environmental firms. Modifying traditional credit rating models Moretto *et al.*, [12]. The paper investigated how financial ratings and supplier ratings can be combined into a credit rating model. The authors detailed the advantages and challenges of using the developed model for all stakeholders using prism theory. The results confirm the value of such a rating for strategic suppliers and other stakeholders. Svanberg *et al.*, [13], make an important contribution to the greening of production. Researchers have discussed a new direction for the development of corporate eco-efficiency ratings and proposed a solution to the problem of assessing the level of the greening of enterprises. Interesting for our paper is the usage of a new machine learning approach with an innovative set of algorithmic approaches that address the issues of non-linearity while the aggregation of indicators. Sun *et al.*, [14] make a significant scientific contribution to the theory of credit assessment of small enterprises. This scientific paper presents an innovative approach to assess the credit rating of small industrial enterprises using fuzzy decision-making methods. The simulation was validated using data on bank loans to 1,820 small industrial enterprises in China. The proposed ranking procedure was based on the usage of triangular fuzzy numbers, correlation and single factor analysis, the best-worst method in combination with the entropy weight method, fuzzy c-means algorithm, etc. What is important for our study is how the authors carry out the validation of the results obtained. Thus, the paper proposes a 10-fold cross-validation to assess the predictive efficiency of the proposed approach. Bhandari and Golden, [15], which assessed the impact of the CEO's personal political ideology, on the credit rating of the firm, conducted an unconventional study. The results confirmed the theory of consistency between the behaviour of top managers and social identity.

An in-depth review of the scientific literature regarding the rating of profitability and costs indicators of agribusinesses has shown a high interest of scientists in this issue. The extensive methodologies and models that scientists use for ranking are of interest. Innovative rating tools are the usage of neural networks and artificial intelligence, which are also in demand in today's market. Given the

dynamism of the institutional environment, bifurcations in the life cycle of agribusinesses, changes in the management strategies of business entities, and transformations in the regulatory and legal support of the agribusiness sector, there is a need to review the rating system of profitability and costs indicators of agribusinesses.

2. Materials and Methods

Modern business entities are characterised by strategic orientation and purposefulness, which implies the formation of clear plans for their further development in the face of instability and change. One of the main attributes of an effectively operating agribusiness is the consideration by its managers of the conditions of the external environment and, on this basis, the adaptation of the enterprise's policy to changes in the external environment. In addition, agribusiness is a structural part of the market, cooperating with a large number of contractors (government, business, suppliers, customers, international partners, consumers, etc.), which belong to different sectors of economic activity. Therefore, it is very important to obtain timely and reliable information about the current development of both your own enterprise as well as that of other sectors to avoid production downtime, bankruptcy or unfair competition. Rating the profitability and costs indicators of agribusinesses in dynamics allows foreseeing possible difficulties in the activities of a business entity or industry, which will allow taking preventive measures in time to prevent the negative impact of the external environment on the business. There is a need to choose such a scientific method for solving this problem, which would allow for avoiding the multidimensionality and complexity of economic processes in the most effective way. It is necessary to select the tools for diagnosing the activities of enterprises, which would make it possible to construct a summary assessment of the performance of a complex object or process. This proves the importance of applying and extending multivariate statistical methods for rating profitability and costs indicators of agribusinesses or sectors of the economy as a whole. We propose to rank the profitability and costs of agricultural enterprises following a certain logic, shown in Figure 1.

At the initial stage of ranking the profitability and costs indicators of agricultural enterprises, we carry out the selection of indicators to be involved in the modelling. In this case, we should analyse the activity indicators of agricultural enterprises over the past eleven years, in particular: the level of profitability of agricultural production in the enterprises, direct material costs, direct labour costs, other direct costs and general production costs. The information base for obtaining these indicators was the data of the State Statistics Service of Ukraine for 2010–2020. The list of indicators of agricultural enterprises by areas of analytical research that

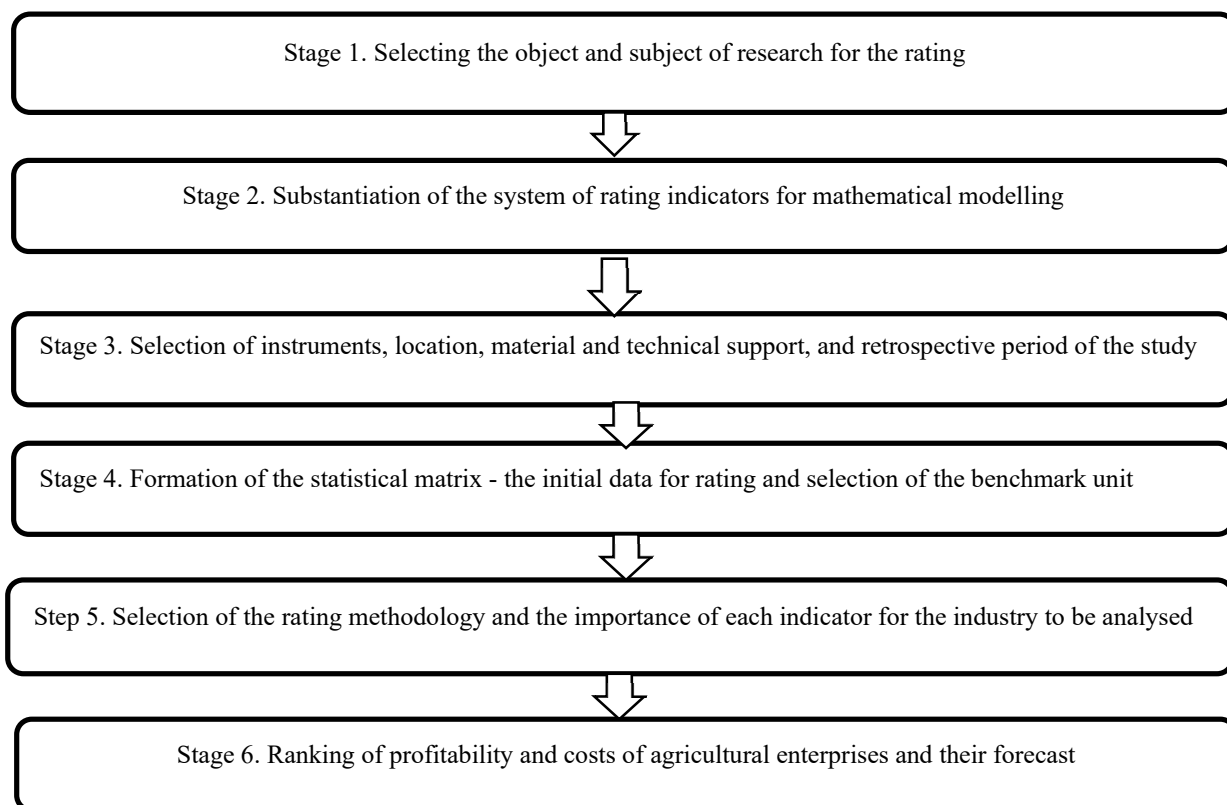


Figure 1. Algorithm for ranking indicators of profitability and costs indicators of agribusinesses

Source: Developed by the authors

form the information base for the last eleven years is presented in Table 1.

The data shown in Table 1 form the observation matrix using which we will evaluate the ranking of profitability and costs indicators of agribusinesses. A fairly convenient way of ranking is to use certain mathematical tools and methods that have been thoroughly researched in the scientific world. A ranking

is a rating, the methodology of which is purposeful, systematic, comprehensive and adaptive in nature, based on the analytical approaches of segmenting the object of research. We chose the rating method, which has advantages relative to cluster or matrix analysis or the scoring method. In particular, the ranking does not require a wide range of statistical data, nor does it require significant financial or

Table 1

Dynamics of the performance of agricultural enterprises for rating implementation, 2010–2020

Years	Initial data				
	The level of profitability of agricultural production in enterprises, %	Direct material costs — total, UAH million	Direct labour costs, UAH million	Other direct costs — total, UAH million	General operating costs — total, UAH million
2010	21,10	52528,20	6806,80	9276,90	10023,40
2011	27,00	70732,20	9028,90	11610,10	13947,50
2012	20,50	84855,70	11610,40	16496,30	16621,60
2013	11,20	88541,70	9719,40	18392,30	18656,40
2014	25,80	108700,90	11044,10	22110,50	26391,40
2015	45,60	168505,0	12425,50	33021,50	38131,80
2016	37,30	207870,2	15638,40	47357,10	50240,00
2017	22,70	242313,70	20326,70	79262,10	63067,70
2018	22,80	247997,20	25234,40	95016,80	74745,00
2019	11,80	228980,50	25228,90	83493,30	58686,30
2020	18,40	205418,50	25850,30	85807,10	52237,70

Source: <https://www.ukrstat.gov.ua/>

human resources. Therefore, any stakeholder interested in the development of the agribusiness sector can use it. It should be noted that the main purpose of using the ranking method is to construct a final indicator, which will fully characterise the activity of the complex object or process to be observed and serve as a reason to forecast the main performance indicators of agricultural enterprises. We adapt the taxonomic analysis of our study by extending its tools and modelling logic. Consequently, after selecting the information base for observing the profitability and costs of agricultural enterprises, there is a need to standardise the “dispersed” statistical data having different units of measurement. For this purpose, we will carry out a standardisation process of the observation matrix, which includes the performance indicators of agricultural enterprises. These actions will allow us to identify the reference vector, determine the distances between the indicators and the specified vector, and calculate the integral indicator of profitability and costs of agricultural enterprises. An important development in forecasting the integral indicator of the performance of agricultural enterprises for the next period. We use Microsoft Excel spreadsheets and its built-in functions to calculate using the method of ranking the performance of agricultural enterprises. In the first stage, we form a matrix of standardised performance indicators of agricultural enterprises (Z_{st}), 2010–2020.

3. Results and Discussion

The next step in ranking the profitability and costs indicators of agribusinesses should take into account that all variables assigned to the observation matrix have different effects on enterprises. They should be divided into stimulants and destimulants. Factors contributing to the development of enterprises are stimulants and vice versa are destimulants.

Then we select the vectors-etalons — the maximum value of the standardised indicator-stimulant and the minimum value for the destimulants. In this case, we can conventionally divide the performance indicators of agricultural enterprises that directly or indirectly affect the financial results of economic entities as follows: the level of profitability of agricultural production in the enterprises — a stimulant; direct material costs — a stimulant; direct labour costs — a stimulant; other direct costs — destimulant; general production costs — destimulant.

However, it should be noted that this division is arbitrary and is based solely for calculating the profitability and costs characteristics of agribusinesses (Figure 3).

The next step involves selecting between individual observations and an etalon vector metric using the Euclidean distance. This distance is calculated using Pythagoras’ theorem and allows us to calculate the smallest distance between the indicators referred to Euclidean space. The Euclidean distance or metric in space is calculated using formula (1):

$$U_{so} = \sqrt{\sum_{n=1}^m (Z_{st} - Z_{0t})^2}.$$

The calculation of the Euclidean distance or metric is shown in Figure 4.

Next, we calculate the values taken from the matrix of standardised indicators used to calculate the ranking of profitability and costs of agribusinesses, 2010–2020:

1. The average distance between the stimulant (destimulant) values and the etalon vector is calculated according to the formula:

$$\bar{U}_0 = \frac{1}{m} \sum_{n=1}^m U_{so}.$$

G4 : ✕ ✓ f _x =(B4-\$B\$15)/\$B\$16											
2	A	B	C	D	E	F	G	H	I	J	K
				Initial data				Interim calculations (Z st)			
	Years	The level of profitability of agricultural production in enterprises, %	Direct material costs - total, UAH million	Direct labour costs, UAH million	Other direct costs, UAH million - total	General operating expenses - total, UAH million	The level of profitability of agricultural production in enterprises	Direct material costs total	Direct labour costs	Other direct costs	General operating expenses - total
3											
4	2010	21.10	52528.20	6806.80	9276.90	10023.40	-0.29	-1.17	-1.24	-1.08	-1.26
5	2011	27.00	70732.20	9028.90	11610.10	13947.50	0.29	-0.95	-0.93	-1.01	-1.09
6	2012	20.50	84855.70	11610.40	16496.30	16621.60	-0.35	-0.77	-0.57	-0.86	-0.97
7	2013	11.20	88541.70	9719.40	18392.30	18565.40	-1.27	-0.73	-0.84	-0.81	-0.88
8	2014 ²	25.80	108700.90	11044.10	22110.50	26391.40	0.18	-0.48	-0.65	-0.70	-0.53
9	2015 ²	45.60	168505.0	12425.50	33021.50	38131.80	2.13	0.25	-0.46	-0.37	-0.01
10	2016 ²	37.30	207870.2	15638.40	47357.10	50240.00	1.31	0.74	-0.01	0.05	0.52
11	2017 ²	22.70	242313.70	20326.70	79262.10	63067.70	-0.13	1.16	0.64	1.00	1.09
12	2018 ²	22.80	247997.20	25234.40	95016.80	74745.00	-0.12	1.23	1.33	1.46	1.61
13	2019 ²	11.80	228980.50	25228.90	83493.30	58686.30	-1.21	1.00	1.33	1.12	0.90
14	2020 ²	18.40	205418.50	25850.30	85807.10	52237.70	-0.56	0.71	1.41	1.19	0.61
15	Average value of a feature built-in mathematical function AVERAGE	24.02	147785.40	15719.44	45622.18	38431.71					
	Standard deviation built-in statistical function STDEV.P	10.12	81317.98	7173.73	33767.87	22548.14					
16											
17											

Figure 2. Dynamics and matrix of standardised performance indicators of agricultural enterprises, 2010–2020 (List of calculations)

Source: calculated by the authors

B31

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fx

=MAKC(B20:B30)

	A	B	C	D	E	F
	Years	The level of profitability of agricultural production in enterprises, % / Stimulant	Direct material costs - total, UAH million / Stimulant	Direct labour costs, UAH million / Stimulant	Other direct costs, UAH million - total / Destimulant	General operating expenses - total, UAH million / Destimulant
19						
20	2010	21.10	52528.20	6806.80	9276.90	10023.40
21	2011	27.00	70732.20	9028.90	11610.10	13947.50
22	2012	20.50	84855.70	11610.40	16496.30	16621.60
23	2013	11.20	88541.70	9719.40	18392.30	18656.40
24	2014 ²	25.80	108700.90	11044.10	22110.50	26391.40
25	2015 ²	45.60	168505,0	12425.50	33021.50	38131.80
26	2016 ²	37.30	207870,2	15638.40	47357.10	50240.00
27	2017 ²	22.70	242313.70	20326.70	79262.10	63067.70
28	2018 ²	22.80	247997.20	25234.40	95016.80	74745.00
29	2019 ²	11.80	228980.50	25228.90	83493.30	58686.30
30	2020 ²	18.40	205418.50	25850.30	85807.10	52237.70
31	Etalon (Z _{0t}) (stimulant – max)	45.60	247997.20	25850.30	X	X
32	Etalon (Z _{0t}) (destimulant – min)	X	X	X	9276.90	10023.40

Figure 3. Determination of the etalon vector to be calculated by taxonomic analysis of business entities, 2010–2020 (List of calculations)

Source: calculated by the authors

2. Then the standard deviation is equal to:

$$D_o = \sqrt{\frac{1}{m} \sum (U_{so} - \bar{U}_0)^2}$$

3. To calculate the overall distance between the stimulants (destimulants) and the etalon, given the existence of large differences in the input standardised values of profitability and costs, it is

B38

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=КОРЕНЬ((G4-\$B\$31)^2)

	A	B	C	D	E	F
34	Determination of the distance between individual observations and the etalon vector using the formula:					$U_{so} = \sqrt{\sum_{i=1}^m (z_{it} - z_{0t})^2}$
35						
36		Built-in mathematical function SQRT				
	Years	The level of profitability of agricultural production in enterprises	Direct material costs - total	Direct labour costs	Other direct costs	General operating expenses - total
37						
38	2010	45.89	247998.37	25851.54	9277.98	10024.66
39	2011	45.31	247998.15	25851.23	9277.91	10024.49
40	2012	45.95	247997.97	25850.87	9277.76	10024.37
41	2013	46.87	247997.93	25851.14	9277.71	10024.28
42	2014 ²	45.42	247997.68	25850.95	9277.60	10023.93
43	2015 ²	43.47	247996.95	25850.76	9277.27	10023.41
44	2016 ²	44.29	247996.46	25850.31	9276.85	10022.88
45	2017 ²	45.73	247996.04	25849.66	9275.90	10022.31
46	2018 ²	45.72	247995.97	25848.97	9275.44	10021.79
47	2019 ²	46.81	247996.20	25848.97	9275.78	10022.50
48	2020 ²	46.16	247996.49	25848.89	9275.71	10022.79
49						

Figure 4. Calculation of distances between selected performance indicators of agricultural enterprises and the etalon vector (List of calculations)

Source: calculated by the authors

Results of the ranking of profitability and costs indicators of agribusinesses, 2010-2020																
51																
52	Years	$\bar{U}_0 = \frac{1}{m} \sum_{n=1}^m U_{so}$					$D_o = \sqrt{\frac{1}{m} \sum_{n=1}^m (U_{so} - \bar{U}_0)^2}$					$\bar{U}_0 = \bar{U}_0 + 2.4D_o$				
		The level of profitability of agricultural production in enterprises	Direct material costs - total	Direct labour costs	Other direct costs	General operating expenses - total	The level of profitability of agricultural production in enterprises	Direct material costs total	Direct labour costs	Other direct costs	General operating expenses - total	The level of profitability of agricultural production in enterprises	Direct material costs - total	Direct labour costs	Other direct costs	General operating expenses total
53																
54	2010	9.18	49599.67	5170.31	1855.60	2004.93	16.42	88726.59	9248.93	3319.39	3586.53	42.01	227052.86	23668.17	8494.37	9177.99
55	2011	9.06	49599.63	5170.25	1855.58	2004.90	16.21	88726.51	9248.82	3319.37	3586.47	41.48	227052.66	23667.88	8494.31	9177.84
56	2012	9.19	49599.59	5170.17	1855.55	2004.87	16.44	88726.45	9248.69	3319.31	3586.43	42.07	227052.50	23667.55	8494.18	9177.73
57	2013	9.37	49599.59	5170.23	1855.54	2004.86	16.77	88726.44	9248.78	3319.29	3586.39	42.91	227052.46	23667.79	8494.13	9177.64
58	2014 ²	9.08	49599.54	5170.19	1855.52	2004.79	16.25	88726.35	9248.72	3319.25	3586.27	41.59	227052.23	23667.63	8494.03	9177.33
59	2015 ²	8.69	49599.39	5170.15	1855.45	2004.68	15.55	88726.08	9248.65	3319.14	3586.09	39.80	227051.56	23667.45	8493.73	9176.85
60	2016 ²	8.86	49599.29	5170.06	1855.37	2004.58	15.84	88725.91	9248.49	3318.99	3585.89	40.55	227051.11	23667.04	8493.34	9176.36
61	2017 ²	9.15	49599.21	5169.93	1855.18	2004.46	16.36	88725.76	9248.25	3318.65	3585.69	41.87	227050.73	23666.44	8492.48	9175.84
62	2018 ²	9.14	49599.19	5169.79	1855.09	2004.36	16.36	88725.73	9248.01	3318.48	3585.50	41.86	227050.66	23665.81	8492.05	9175.37
63	2019 ²	9.36	49599.24	5169.79	1855.16	2004.50	16.75	88725.82	9248.01	3318.60	3585.76	42.85	227050.88	23665.82	8492.36	9176.02
64	2020 ²	9.23	49599.30	5169.78	1855.14	2004.56	16.51	88725.92	9247.98	3318.58	3585.86	42.26	227051.14	23665.74	8492.30	9176.28
65																
67	Years	$dr_i = \frac{U_{so}}{U_0}$					$MK_n = 1 - dr_i$									
		The level of profitability of agricultural production in enterprises	Direct material costs - total	Direct labour costs	Other direct costs	General operating expenses - total	The level of profitability of agricultural production in enterprises	Direct material costs total	Direct labour costs	Other direct costs	General operating expenses - total					
68																
69	2010	0.28	0.44	0.54	0.52	0.48	0.718	0.558	0.458	0.480	0.519					
70	2011	0.26	0.41	0.50	0.49	0.48	0.738	0.588	0.498	0.507	0.523					
71	2012	0.24	0.38	0.46	0.47	0.47	0.758	0.618	0.538	0.534	0.527					
72	2013	0.22	0.35	0.42	0.44	0.47	0.778	0.648	0.578	0.561	0.531					
73	2014	0.20	0.32	0.38	0.41	0.47	0.798	0.678	0.618	0.588	0.535					
74	2015	0.18	0.29	0.34	0.39	0.46	0.818	0.708	0.658	0.615	0.539					
75	2016	0.16	0.26	0.30	0.36	0.46	0.838	0.738	0.698	0.642	0.543					
76	2017	0.14	0.23	0.26	0.33	0.45	0.858	0.768	0.738	0.669	0.547					
77	2018	0.12	0.20	0.22	0.30	0.45	0.878	0.798	0.778	0.696	0.551					
78	2019	0.10	0.17	0.18	0.28	0.45	0.898	0.828	0.818	0.723	0.555					
79	2020	0.08	0.14	0.14	0.25	0.44	0.918	0.858	0.858	0.750	0.559					
80																

Figure 5. Block for the step-by-step calculation of the rating of profitability and costs of agricultural enterprises, 2010–2020 (*List of calculations*)

Source: calculated by the authors

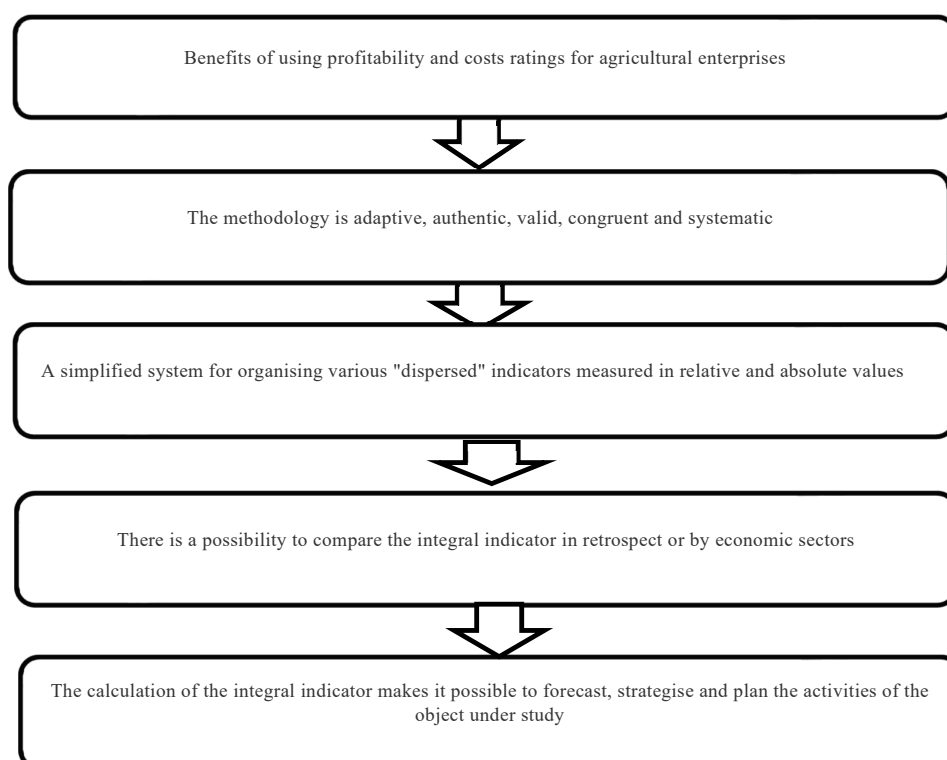


Figure 6. Benefits of applying profitability and costs ranking of agribusinesses in scientific researches

Source: Suggested by the authors

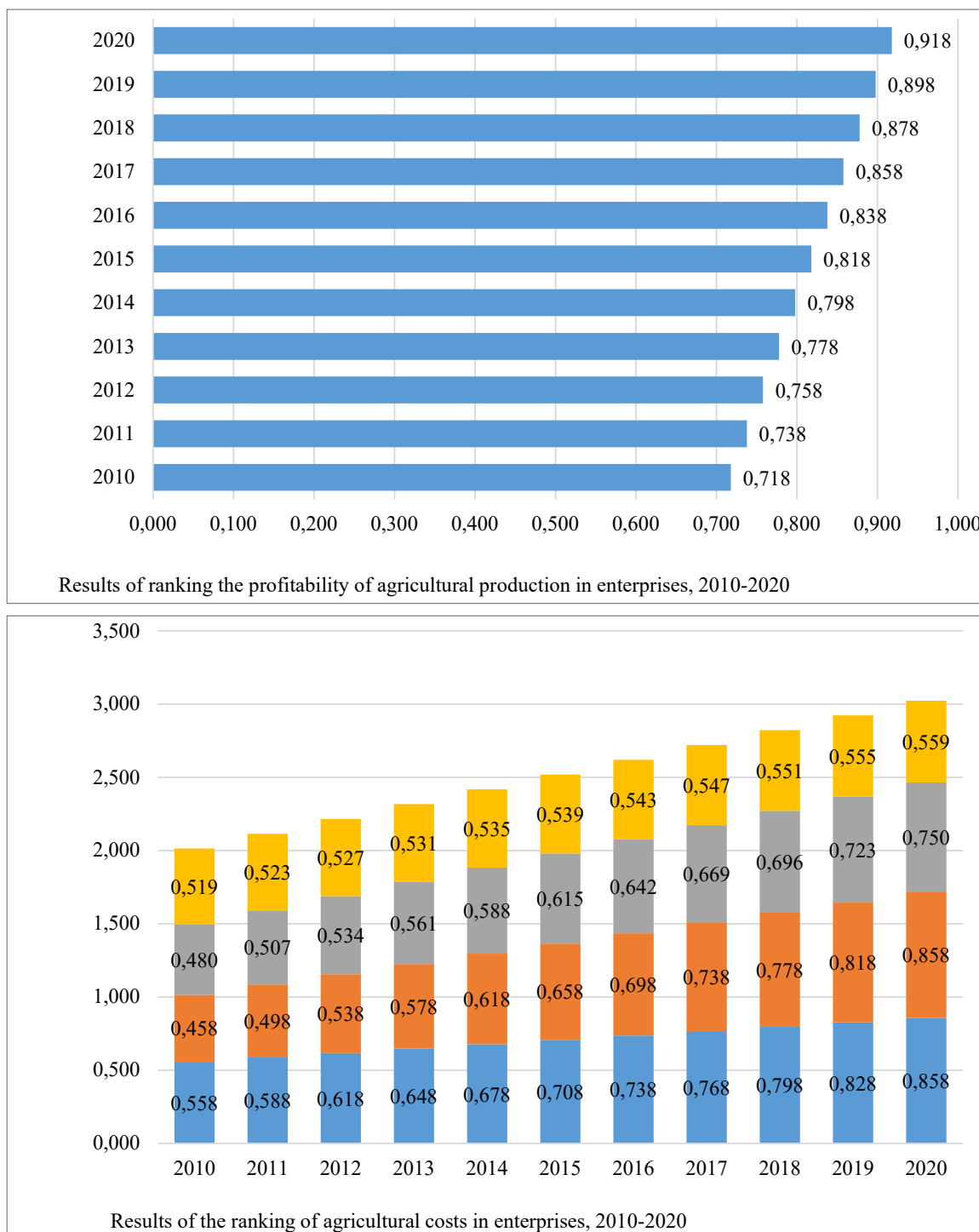


Figure 7. Dynamics of the ranking indicator of the level of profitability of production and costs of agricultural production in enterprises, 2010–2020.

Source: calculated by the authors

Table 2

Forecasting the taxonomic performance of agricultural enterprises activities, 2023–2024

Years	Forecasting indicators using the built-in statistical function FORECAST				
	The level of profitability of agricultural production in enterprises	Direct material costs — total	Direct labour costs	Other direct costs	General operating expenses — total
2023	0.978	0.948	0.938	0.831	0.571
2024	0.998	0.978	0.978	0.858	0.575

Source: calculated by the authors

proposed to increase the distance to 2.4 standard deviations:

$$\bar{U}_0 = \bar{U}_0 + 2.4D_0.$$

4. The deviation of the profitability of the i year from the etalon is calculated as:

$$dr_i = \frac{U_{so}}{U_0}.$$

Finally, to determine the ranking of profitability and costs of agricultural enterprises for 2010–2020, let us calculate the formula:

$$MK_n = 1 - dr_i.$$

As a result of the above calculations, an interpretation of the profitability and costs ranking of agribusinesses can be made. Consequently, the closer the value of the indicator is to one, the more efficient an agricultural enterprise is. Thus, the step-by-step calculation of profitability and costs ranking of agribusinesses allows us to determine the advantages of applying this method in scientific research (fig. 6).

It should be noted that based on the information given in Figure 7, the ranking of profitability and costs of agricultural enterprises is a universal method that can be applied to any object or industry (this method is derived from the classical taxonomic analysis). The rating can be adapted in not only for studies of statistical units or their totality but also for determining the dynamics of changes in an individual unit. In particular, the dynamics of changes in an individual unit according to the ranking methodology is investigated by means of a retrospective time series. Our study uses the performance of agricultural enterprises by means of time series.

Analysing the result of the profitability and costs ranking of agricultural enterprises for the last year 2020, we can observe its growth compared

to previous years. In particular, there has been an increase in:

the level of profitability of agricultural production in the enterprises from 0.898 to 0.918 units;
direct material costs from 0.828 to 0.858 units;
direct labour costs from 0.858 to 0.818 units;
other direct costs from 0.723 to 0.750 units;
general production costs from 0.555 to 0.555 units.

Graphically, the dynamics of profitability and costs ranking of agricultural enterprises, 2010–2020, is shown in Figure 7. This figure also shows the dynamics of agricultural production costs, 2010–2020.

At the final stage, we will make a forecast of the rating of a performance indicator of agricultural enterprises and their graphical representation for the next two years. The forecasting of these indicators has been made by the authors and is a proposal for improving the strategic orientation and making the right managerial decisions by the managers of agricultural enterprises in order to formulate goals for the comprehensive activities of business entities.

So, the conducted forecasting of the rating indicator of agricultural enterprises activity using the built-in statistical function FORECAST shows that the indicators of the level of profitability of agricultural production in enterprises, direct material costs, direct labour costs, other direct costs and general production costs are increasing and are approaching the normalised value of 1, which may be a positive phenomenon (table 2).

Graphically depicts the projection of the rating indicator of agricultural enterprises, 2023–2024 in Figure 8.

The obtained forecast results of profitability and costs ranking of agricultural enterprises in 2023–2024 showed the increase in profitability of agricultural production from 0.978 to 0.998 units, direct material costs from 0.948 to 0.978 units, direct labour costs from 0.938 to 0.978 units, other direct costs from 0.831 to 0.858 units, general production

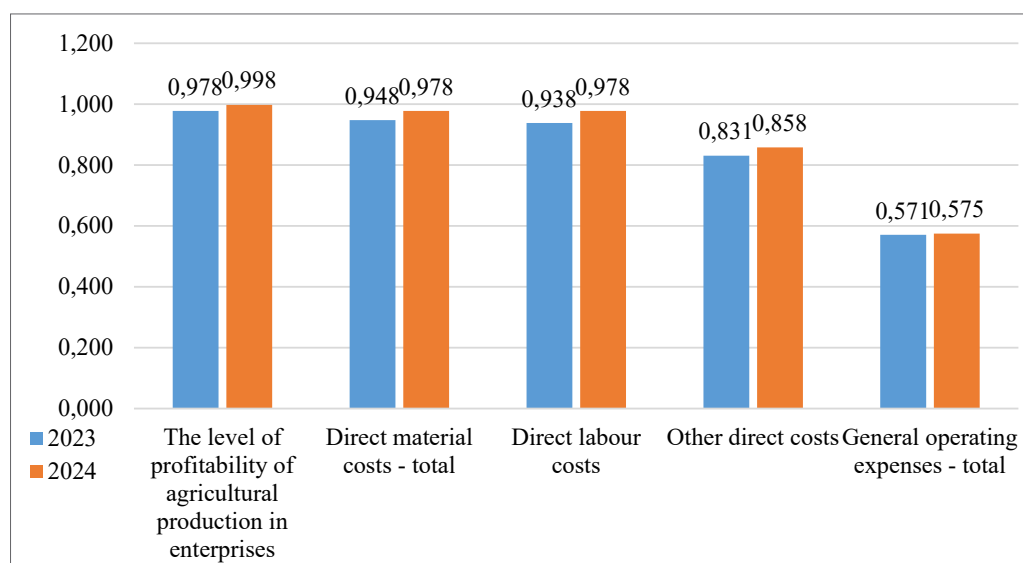


Figure 8. Forecasting the performance rating indicator of the agricultural enterprises' activity, 2023–2024

Source: calculated by the authors

expenses from 0,571 to 0,575 units. Thus, we can see an increase in all indicators during the study period. This indicates that profitability in the agricultural sector is simultaneously increasing with costs. This phenomenon can be explained by the fact that by increasing costs companies expand their production activities, and effective business management contributes to increasing profitability and timely coverage of current costs.

4. Conclusions

Consequently, the results of this study allow us to conclude that the ranking method can be used in

the study of the dynamics of the activities of enterprises engaged in agriculture. The proposed ranking method is based on taxonomic analysis and makes it possible for a manager or other interested person to summarise the totality of the activity results of enterprises engaged in various sectors and obtain an integral ranking indicator. In future studies, we will involve more performance indicators of agricultural enterprises and their comparison at the inter-industry level will be carried out, which will allow for a deeper analysis and forecasting of the further development of enterprises, taking into account the competition in the market.

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Received: 30/01/2023

Accepted: 25/03/2023

Published: 29/12/2023

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[https://doi.org/10.60022/sis.1.\(01\).7](https://doi.org/10.60022/sis.1.(01).7)

РЕЙТИНГУВАННЯ ПОКАЗНИКІВ РЕНТАБЕЛЬНОСТІ ТА ВИТРАТ АГРОПІДПРИЄМСТВ

Анотація. Мікросередовище аграрних підприємств знаходиться під впливом зовнішнього середовища, яке по-різному відбивається на підприємницькій діяльності. При цьому будь-яка реакція менеджерів на зовнішні зміни повинна бути обґрунтованою, логічною та відповідати потребам сучасного ринку. Важливе значення набуває вчасна діагностика показників рентабельності та витрат агропідприємств, а також прогнозування їх значень. Такі дії нададуть управлінцям орієнтири для прийняття потрібних рішень та дозволять реагувати на будь-які імпульси, які впливають на розвиток підприємства.

Для рейтингування показників рентабельності витрат суб'єктів підприємництва нами обрано діяльність агропідприємств. З використанням методів математичного моделювання, таксономічного аналізу, рейтингування нами проаналізовано динаміку показників діяльності сільськогосподарських підприємств. Апробація окремих статистичних функцій дозволила провести прогнозування рейтингового показника діяльності аграрних підприємств на 2023–2024 рр.

Отриманий результат рейтингування рентабельності та витрат агропідприємств за звітний 2020 рік, засвідчив його зростання в порівнянні з попередніми роками. Одночасно можна спостерігати збільшення витрат підприємствами, що говорить про необхідність більш жорсткого та глибокого моніторингу діяльності агропідприємств менеджерами вищої ланки. Зазначений моніторинг надасть змогу запобігти банкрутства або неефективності розподілу фінансів підприємств.

Описане у статті рейтингування рентабельності та витрат агропідприємств є універсальним методом, який можна застосувати для будь-якого об'єкту або галузі. Рейтингування може бути апробованим не тільки в дослідженнях статистичних одиниць або їх сукупності, але й для визначення динамічних змін за часовими ретроспективними рядами. Прогнозування досліджуваних показників може слугувати імпульсами для управлінців, щодо вдосконалення стратегічної орієнтації та ухвалення вірних рішень менеджерами сільськогосподарських підприємств з метою формування цілей подальшої діяльності.

Ключові слова: рентабельність, прямі матеріальні витрати, витрати на оплату праці, загальновиборничі витрати, прогнозування, рейтингування, агропідприємства