Methodological foundations for evaluating the efficiency of agrocluster management

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Аннотация. *В статье проанализированы научно-методические основы оценки эффективности управления агрокластером и даны научные предложения и практические рекомендации по повышению эффективности.*

Abstract. *The article analyzes the scientific and methodological foundations for evaluating the efficiency of agrocluster management and provides scientific suggestions and practical recommendations for its enhancement.*

Ключевые слова: *кластер, агрокластер, управление, кластерное управление, конкурентоспособность, глобальная конкурентоспособность, специализация, интеграция, продовольственная безопасность, сельское хозяйство.*

Keywords: *cluster, agrocluster, management, cluster-based management, competitiveness, global competitiveness, specialization, integration, food security, agriculture.*

Introduction:

In every sector, including the distinct agricultural sector, there is a demand for regular assessment of economic activity efficiency indicators. In this context, during the economic management process, not only can the accuracy and directionality of decisions be assessed, but also the prevailing problems can be identified. Various scientific viewpoints have emerged in the economic literature regarding the interconnected process of economic activity efficiency being tied to the appropriateness of management decisions.

Research background:

Various stages in the development of scientific-theoretical views related to the organization and management of agrocluster activities, the importance of using innovative projects in agrocluster management to increase efficiency and the factors influencing it, and primary directions for refining the methodological foundations of agrocluster management are reflected in the scientific researches of renowned foreign economists like R. Claudio, R.G. Cooper, M. Delgado, D. Doloreux, I. Laurs, and G. Linden.

Research methodology:

The research process utilized methods like grouping, systematic approach, theoretical and practical analysis, induction and deduction, and qualitative analysis.

Analysis and Results:

In the majority of scientific researches aimed at assessing management efficiency, corporations and organizations are evaluated based on the outcomes of their economic activities. For instance, A. Zemtsov has utilized statistical methods to assess management efficiency. He strived to establish the correlation between the period required for covering expenses on its own and the level of profitability when identifying it.[1] The scientist emphasizes the importance of evaluating the efficiency of investment projects being implemented in various sectors of the economy, including the agricultural sector. In rural agriculture, the agroclusters that are formed are also evaluated as investment projects. Generally, in the evaluation methodology proposed by the scholar, there is an attempt to assess management efficiency through the net discounted income value. The omission of the level of risk and uncertainty in management decisions in the proposed evaluation method appears as its drawback.

V.V. Moiseev, on the other hand, has used the following indicators system, reflecting the development potential, when assessing the efficiency of agrocluster management:

- the growth rate of production volume;
- the modernization coefficient of primary production assets;
- the volume of net profit;
- the capacity of the agrocluster's workforce and the level of its provision with labor resources;
- the profitability level of the organized agrocluster.[2]

The aforementioned approach to evaluating management efficiency can be seen to explain changes in production and financial indicators of business activity after the formation of the agrocluster. However, this approach does not take into consideration the ecological and socio-economic state of the region associated with the development of rural agriculture and its impact on business activities, which somewhat diminishes the comprehensiveness of this method.

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According to V.Yu. Chernishev, when assessing the efficiency of management by business subjects, it's essential to focus on the results of the decisions that have been taken. The correct choice of approach to evaluating management efficiency provides an opportunity to identify existing problems in a timely manner and quickly resolve them.[1] In economic literature, the majority of approaches to evaluating the efficiency of agrocluster management have been formulated based on the research object. This genesis of the approaches suggests that the proposed methods might not fully provide the capability to assess management efficiency comprehensively.
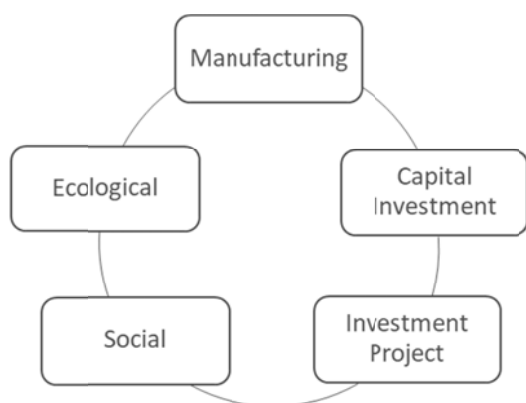

Figure 1. **Factors describing the efficiency of agrocluster management as an investment project.**[2]

In the economic literature, the organization of agrocluster activities often emerges as an investment program. Consequently, we can observe that some economic scholars approach the assessment of agrocluster management efficiency from the perspective of an investment project. In this approach, the management of agrocluster activities organized as an investment project takes into account the production, investment in the project, and the socio-ecological factors affecting efficiency (refer to Figure 1).

Concerning the production factor, the efficiency of agrocluster management is evaluated using indicators like revenue, profit, labor productivity, and added value. The integrated index of production efficiency is calculated by averaging these four indicators.

Subsequently, capital investment is assessed. Here, the efficiency of using additional financial resources attracted for the organization of agrocluster activities is evaluated. That is, the efficiency of using the agrocluster's potential to develop agriculture based on additional financial resources is assessed. Comparisons are made between results achieved before and after the formation of the agrocluster. When evaluating the efficiency of agrocluster management based on this factor, the following aspects are considered:

- A comparative assessment of the profitability level of agricultural entities before and after joining the agrocluster.

- The payback period for capital investments. This takes into account changes in total production volume after the agrocluster formation and evaluates the return period of investment funds. The plan for recovering the capital investment is developed based on this period. The alignment of practical outcomes achieved during the management of the agrocluster with the plan indicates management efficiency.

From the investment project perspective, the efficiency of agrocluster management is evaluated. Most market economies that are evolving and developing adopt agrocluster activities as investment projects. The changes in total production volume based on attracted investments are considered.

In essence, the organizational efficiency of agroclusters, especially in the context of investment projects, is a multifaceted concept that involves various economic indicators and socio-ecological factors. Evaluating these effectively can provide valuable insights into the operational success and future potential of the agrocluster.

When assessing the efficiency of agrocluster management with a focus on social factors, the following indicators are taken into account:

- Changes in the average wage suitable for every outsourced worker in enterprises that are part of the agrocluster after its formation.

- Tax incentives designated for agricultural entities after joining the agrocluster. Specifically, tax breaks given in relation to agricultural entities due to their inclusion in the agrocluster are essential in ensuring their economic activity remains efficient.

- The efficiency of investment distribution. In this context, considering the scenario of inflation, the rate of increase in agrocluster revenue during the period of distributing investments is evaluated. That is, the allocation of the designated budget for the investment project to form the agrocluster within a specified period is considered sufficient to cover all expenses.

Given the intrinsic interrelation of agricultural activities with the environmental and ecological conditions in a country or region, it is imperative to evaluate the efficiency of agrocluster management organized as an investment project from an ecological standpoint. In this respect, the reduction in environmental harm due to the investments made is assessed.

Agrocluster activity is fundamentally based on profound integration relationships between various agricultural entities and other network representatives. Specifically, in countries with developed and rapidly evolving economies where

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there is a strong emphasis on innovative development, the relationship between the real sector of the economy and the field of science and education services is intensifying. Renowned economists such as M. Delgado [1], I. Laurs [2], S.A. Tumenova [3], E.A. Gorodetsky [4], A.V. Ilyin [5], T.Kh. Sozaeva [6], and S.N. Semenov [7] have turned their attention to evaluating the synergistic efficiency of agrocluster management. According to their analyses, the evaluation of the efficiency of agrocluster management based on a synergistic approach is grounded in the following indicators:

- Increase in the revenue volume of the agricultural entities included in the agrocluster;
- Decrease in the expenditure volume of the agricultural entities incorporated into the agrocluster;
- Growth in the tax benefits availed by agricultural entities due to their inclusion in the agrocluster;
- Enhancement in the capability to attract additional investments.

From the analyses, the indicators employed in the synergistic evaluation of agrocluster management efficiency focus on the optimal allocation of resources among the enterprises incorporated in the agrocluster. This includes discerning trends in business operations, particularly enhancing labor productivity by leveraging technological advancements in the production process. The structural composition of the synergistic approach to evaluating the efficiency of agrocluster management is depicted in Figure 2.

Evaluating the efficiency of agrocluster management on the basis of synergistic integration is assessed through the following equation (1):

$$SS_{ABS} = Iqt_s + Ijt_s + Eko_s - SJ_k \qquad (1)$$

Following:

SS_{ABS} –represents the synergistic efficiency indicator of agrocluster management;

Iqt_s– denotes the economic efficiency of agrocluster management;;

Ijt_s – stands for the social efficiency within agrocluster management;

Eko_s – signifies the ecological efficiency in agrocluster management;

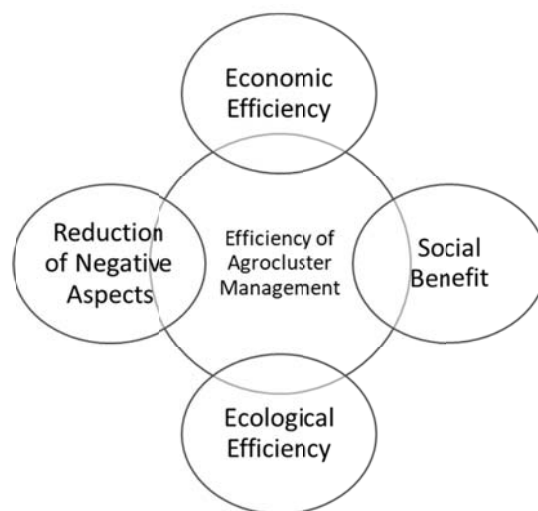SJ_k – pertains to the negative indicators within agrocluster management.

Figure 2. **Structural Composition of the Synergistic Approach to Evaluating Agrocluster Management Efficiency.** [8]

In contemporary management theories, the emphasis when evaluating managerial efficiency is placed on analyzing the final outcomes of economic activities.[9] "In the economic literature to date, no single approach has been fully formed to assess the management efficiency of all types of enterprises and organizations.[10] This can be attributed to the fact that each country has unique characteristics based on its socio-economic development.

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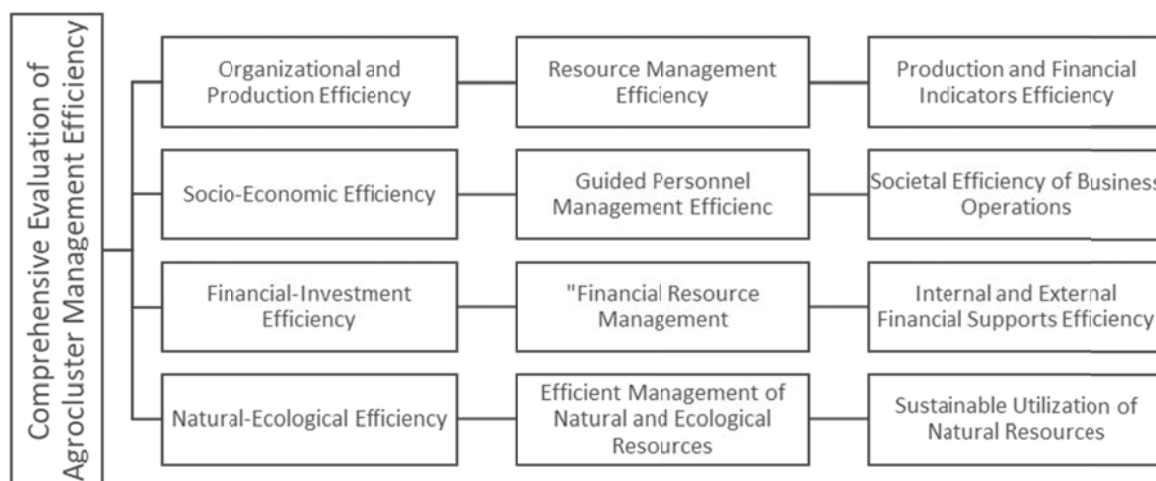
Figure 3. **Comprehensive Evaluation Method for Agro-cluster Management Efficiency.**
Compiled by the author

In light of the above, there is a clear need to develop a national method for evaluating the efficiency of agro-cluster management in our country. This necessitates a focus on the primary directions of reforms being implemented by the state in our country's agriculture and its development. Taking this situation into account, we have formulated a comprehensive evaluation method for agro-cluster management efficiency (refer to Figure 3). This method incorporates indicators from organizational-productive, socio-economic, financial-investment, and natural-ecological efficiencies.

Using the proposed method, the organizational-productive efficiency indicator for evaluating agro-cluster management efficiency is based on the interrelation between the management activities of the economic entity and the volume of production. Here, the state of utilization of material resources in production management, including the basic funds, is analyzed using the following indicators:

- Growth coefficient of the profitability rate of basic funds;
- Growth coefficient of the profitability rate of expenses;
- Growth coefficient of production volume;
- Growth coefficient of the profitability rate of product sales volume;
- Profitability coefficient of agro-cluster activities.

Thus, this approach provides a comprehensive framework for assessing agro-cluster management efficiency, integrating multiple domains and ensuring that all essential components are considered.

Table 1

Evaluation of agro-cluster management efficiency based on organizational-productive approach

Indicator	Calculation Formula	Description of the Formula Composition
Coefficient of Increase in Profitability of Basic Funds	$K_{AFR} = \dfrac{MSD_i}{AFQ_{i(o'rt)}} : \dfrac{MSD_{i-n}}{AFQ_{i-n\,(ort)}}$	MSD_i – Revenue from product sales during the reporting period; MSD_{i-n} – Revenue from product sales during the base period; $AFQ_{i(o'rt)}$ – Average value of basic funds during the reporting period; $AFQ_{i-n(ort)}$ – Average value of basic funds during the base period.
Coefficient of Increase in Profitability of Expenses	$K_{XR} = \dfrac{MSD_i}{IChX_i} : \dfrac{MSD_{i-n}}{IChX_{i-n}}$	$IChX_i$ – Average value of basic funds during the base period. $IChX_{i-n}$ – Volume of production expenses during the base period.
Coefficient of Increase in Production Volume	$K_{IChM} = \dfrac{IChM_i}{IChM_{i-n}}$	$IChM_i$ – Total volume of products produced during the reporting period; $IChM_{i-n}$ – Total volume of products produced during the base period.
Coefficient of Increase in Product Sales Volume Profitability	$K_{TR} = \dfrac{MSD_i}{MSF_i} : \dfrac{MSD_{i-n}}{MSF_{i-n}}$	MSF_i – Gross profit from product sales during the reporting period; MSF_{i-n} – Gross profit from product sales during the base period.
Agro-cluster Activity Profitability Coefficient	$K_{AFR} = \dfrac{MSF_i}{(X+S)_i} : \dfrac{MSF_{i-n}}{(X+S)_{i-n}}$	$(X+S)_i$ – Production expenses during the reporting period (taking into account subsidies and privileges); $(X+S)_{i-n}$ – Production expenses during the base period (taking into account subsidies and privileges).

Compiled by the author

The above-mentioned formulas for evaluating the efficiency of agro-cluster management based on an organizational-productive approach, including their descriptions, are presented in Table 1. The overall results are based on the arithmetic average of these five indicators

and can be determined using the following formula (2).

$$S_{TICh} = \frac{K_{AFR} + K_{XR} + K_{IChM} + K_{TR} + K_{AFR}}{5} \quad (2)$$

The socio-economic efficiency indicators were chosen as the subsequent component for the comprehensive evaluation methodology of agro-cluster management. In this context, the increase in labor productivity in rural agricultural entities that are part of the agro-cluster is examined. It's crucial to emphasize that the competence of personnel plays a significant role in enhancing labor productivity in modern agro-cluster activities. Concurrently, modern management theories highlight that the labor productivity indicator is correlated with factors such as the socio-psychological environment in the production team, social activities, and the motivation of employees.

Table 2

Evaluation of Socio-economic Efficiency in Agro-cluster Management

Indicator	Calculation Formula	Description of the Formula Composition
Labor Productivity Growth Coefficient	$K_{MU} = \frac{IChM_i}{IS_i} : \frac{IChM_{i-n}}{IS_{i-n}}$	$IChM_i$ – Volume of total production during the reporting period; $IChM_{i-n}$ – Volume of total production during the base period; IS_i Average number of workers during the reporting period; IS_{i-n} – Average number of workers during the base period.
Increase Coefficient of Revenue per Worker	$K_D = \frac{MSD_i}{IS_i} : \frac{MSD_{i-n}}{IS_{i-n}}$	MSD_i – Revenue from product sales during the reporting period; MSD_{i-n} – Revenue from product sales during the base period.
Coefficient of Average Monthly Salary Growth	$K_{IH} = \frac{IH_i}{IH_{i-n}}$	IH_i – Average monthly salary during the reporting period; IH_{i-n} – Average monthly salary during the base period.
Efficiency of Personnel Management	$K_{PBR} = \frac{IChM_i}{BH_i} : \frac{IChM_{i-n}}{BH_{i-n}}$	BH_i – Average number of managerial staff during the reporting period; BH_{i-n} – Average number of workers during the base period.
Labor Rentability Growth Coefficient	$K_{MR} = \frac{IChX_i}{BH_i} : \frac{IChX_{i-n}}{BH_{i-n}}$	$IChX_i$ – Volume of production costs during the reporting period; $IChX_{i-n}$ – Volume of production costs during the base period.

Compiled by the author

Therefore, in order to ensure clear results in evaluating this indicator, it is also required to conduct surveys among employees. In general, the socio-economic efficiency indicators of agro-cluster management consist of the following:
- Labor productivity growth coefficient;
- Increase coefficient of revenue per worker;
- Coefficient of average monthly salary growth;
- Efficiency of personnel management;
- Labor rentability growth coefficient.

The calculations for the aforementioned socio-economic efficiency indicators of agro-cluster activity are presented in Table 2. Based on the obtained results, the socio-economic efficiency indicator is evaluated according to the following formula (3):

$$S_{IIBS} = \frac{K_{MU} + K_D + K_{IH} + K_{PBR} + K_{MR}}{5} \quad (3)$$

The subsequent structural indicator selected is the efficiency of financial and investment management. The efficiency of financial and investment management of agro-cluster activities employs an analysis of capital investments, state subsidies, grants, and the use of domestic and foreign investments. This includes expenses for the direct purchase of modern, energy-saving, innovative production technologies to enhance the material and technical base of the agro-cluster, either through foreign investments or on account of innovative costs. The structural indicators of the financial and investment efficiency of agro-cluster activities include the following:

- Growth coefficient of the profitability of innovative expenses;
- Growth coefficient of production volume per unit investment;
- Growth coefficient of revenue volume per unit investment;
- Growth coefficient of investments (including state investments);
- Growth coefficient of research and staff capability enhancement expenses.

The financial and investment efficiency of agro-cluster activities is calculated based on

formulas presented in Table 3 and is holistically evaluated using the following equation (4):

$$S_{MIBS} = \frac{K_{IXR}+K_{IHMICh}+K_{IHDS}+K_I+K_{IKX}}{5} \qquad (4)$$

Table 3

Assessment of the Financial-Investment Efficiency of Agro-Cluster Management

Indicator	Calculation Formula	Description of the Formula Composition
Growth coefficient of the profitability of innovative expenses	$K_{IXR} = \frac{IX_i}{IX_{i-n}}$	IX_i – Volume of innovative costs in the reporting period; IX_{i-n} – Volume of innovative costs in the base period.
Growth coefficient of production volume per unit of investment	$K_{IHMICh} = \frac{IChM_i}{I_i} : \frac{IChM_{i-n}}{I_{i-n}}$	$IChM_i$ – Total production volume in the reporting period; $IChM_{i-n}$ – Total production volume in the base period; I_i – Total investments made in the reporting period; I_{i-n} – Total investments made in the base period
Growth coefficient of revenue volume per unit of investment	$K_{IHDS} = \frac{MSD_i}{I_i} : \frac{MSD_{i-n}}{I_{i-n}}$	MSD_i –Revenue from product sales in the reporting period; MSD_{i-n} – Revenue from product sales in the base period
Growth coefficient of investments (including state investments)	$K_I = \frac{I_i}{I_{i-n}}$	I_i – Total investments made in the reporting period; I_{i-n} – Total investments made in the base period
Growth coefficient of research and staff capability enhancement expenses	$K_{IKX} = \frac{IKX_i}{IKX_{i-n}}$	IKX_i – Total expenses directed to employee skill enhancement and scientific research in the reporting period; IKX_{i-n} – Total expenses directed to employee skill enhancement and scientific research in the base period.

Compiled by the author

The assessment of the efficiency of agro-cluster management based on natural-ecological compatibility is explained by the fact that any economic activity in the agricultural sector is directly linked to natural-ecological conditions. The efficiency of natural-ecological management of the agro-cluster includes factors for the utilization of natural resources and ecological efficiency coefficients, which are calculated as shown in Table 4.

The generalized conclusions on the efficiency of the natural-ecological management of the agro-cluster are formed based on the following formula (5):

$$S_{TES} = \frac{K_{TRF}+K_{EKS}}{2} \qquad (5)$$

The proposed assessment of the efficiency of agro-cluster management is composed of organizational-production, socio-economic, financial-investment, and natural-ecological efficiency indicators. The evaluation results are summarized based on the following formula (6):

$$S_{ABS} = \frac{S_{TICh}+S_{IIBS}+S_{MIBS}+S_{TES}}{4} \qquad (6)$$

Table 4

Assessment of the Natural-Ecological Efficiency of Agro-cluster Management

Indicator	Calculation Formula	Description of the Formula Composition
Natural Resources Utilization Efficiency Coefficie	$K_{TRF} = \frac{TRF_i}{TRF_{i-n}}$	TRF_i – volume of natural resources used in the reporting period; TRF_{i-n} – volume of natural resources used in the baseline period;
Ecological Efficiency Coefficient	$K_{EKS} = \frac{EZ_i}{I_i} : \frac{EZ_{i-n}}{I_{i-n}}$	EZ_i – volume of ecological damage in the reporting period; EZ_{i-n} – volume of ecological damage in the baseline period; I_i – total investments made during the reporting period I_{i-n} – total investments made during the baseline period

Compiled by the author

Based on the aforementioned formula (6), the obtained results, if greater or less than 1.0, are categorized as follows:

- If $S_{ABS} < 1$, the efficiency of the agro-cluster management is considered unsatisfactory.
- If $S_{ABS} = 1$, the efficiency of the agro-cluster management is considered satisfactory.
- If $S_{ABS} > 1$, the agro-cluster management is evaluated as efficient.

Conclusion

The proposed methodology for evaluating the efficiency of agro-cluster management, comprised of organizational-production, socio-economic, financial-investment, and natural-ecological efficiency indicators, is distinct due to the following features:

- Ease of gathering the necessary data for evaluating management efficiency.
- The calculation process is straightforward and comprehensible.
- It fully encompasses all sectors related to agro-cluster activities.
- The methodology is not only applicable in our country but also has potential applicability in other countries' practices.

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