

## RESOURCE-UTILITY APPROACH TO ASSESSING THE EFFECTIVENESS OF LAND RECLAMATION ACTIVITIES IN THE REPUBLIC OF BELARUS

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### Abstract

This article examines the theoretical and methodological issues of assessing the efficiency of land reclamation activities in the Republic of Belarus under increasing requirements for the rational use of natural resources, ensuring food security, and promoting the sustainable development of the agro-industrial sector. The relevance of the study is determined by the need to improve existing approaches to evaluating the results of land reclamation activities, since traditional methods based primarily on cost indicators, profitability, and payback measures do not fully account for the diversity of economic, social, and environmental effects generated by the operation of land reclamation systems.

The purpose of the study is to provide a theoretical justification and develop the methodological foundations of a resource-utility approach to assessing the efficiency of land reclamation activities. The economic essence of land reclamation is revealed as a long-term investment process that affects not only the productivity of agricultural land but also the sustainability of agricultural landscapes, the condition of land and water resources, and the socio-economic development of rural areas.

A system of indicators for resource-utility assessment is proposed, including indicators of resource expenditures and indicators reflecting the overall utility of land reclamation. An algorithm for constructing an integrated efficiency indicator based on the comparison of the total utility of land reclamation outcomes with the volume of resources utilized is developed. The scientific novelty of the study lies in expanding the category of results by incorporating social and environmental effects into the efficiency assessment framework. The practical significance of the proposed approach consists in its potential application for substantiating managerial decisions, determining funding priorities, evaluating the effectiveness of government programs, and improving the management system of the land reclamation sector in the Republic of Belarus.

**Keywords:** land reclamation, efficiency, resources, utility, agricultural economics.

## РЕСУРСНО-ПОЛЕЗНОСТНЫЙ ПОДХОД К ОЦЕНКЕ ЭФФЕКТИВНОСТИ ДЕЯТЕЛЬНОСТИ МЕЛИОРАЦИИ В РЕСПУБЛИКЕ БЕЛАРУСЬ

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### Реферат

В статье рассматриваются теоретические и методологические вопросы оценки эффективности деятельности мелиорации в Республике Беларусь в условиях возрастающих требований к рациональному использованию природных ресурсов, обеспечению продовольственной безопасности и устойчивому развитию агропромышленного комплекса. Актуальность исследования обусловлена необходимостью совершенствования существующих подходов к оценке результатов мелиоративной деятельности, поскольку традиционные методы, основанные преимущественно на стоимостных показателях, показателях рентабельности и окупаемости затрат, не позволяют в полной мере учитывать многообразие экономических, социальных и экологических эффектов, возникающих в процессе функционирования мелиоративных систем.

Цель исследования заключается в теоретическом обосновании и разработке методологических основ ресурсно-полезностного подхода к оценке эффективности деятельности мелиорации. Раскрыта экономическая сущность мелиорации как долгосрочного инвестиционного процесса, оказывающего влияние не только на продуктивность сельскохозяйственных земель, но и на устойчивость агроландшафтов, состояние земельных и водных ресурсов, а также социально-экономическое развитие сельских территорий.

Предложена система показателей ресурсно-полезностной оценки, включающая показатели ресурсных затрат и показатели совокупной полезности мелиорации. Разработан алгоритм формирования интегрального показателя эффективности, основанный на сопоставлении совокупной полезности результатов мелиоративной деятельности с объемом использованных ресурсов. Научная новизна исследования заключается в расширении категории результата за счет включения социальных и экологических эффектов в систему оценки эффективности. Практическая значимость предложенного подхода состоит в возможности его использования при обосновании управленческих решений, определении приоритетов финансирования, оценке результативности государственных программ и совершенствовании системы управления мелиоративным комплексом Республики Беларусь.

**Ключевые слова:** мелиорация, эффективность, ресурсы, полезность, аграрная экономика.

### Introduction

The current stage of development of the agro-industrial complex is characterized by increasingly complex tasks related to the rational use of land and water resources, increasing environmental constraints, and the need to ensure the sustainability of agricultural production. Under these conditions, the importance of land reclamation is growing as a key element of the land management system aimed at regulating soil water regimes and increasing the productivity of agricultural land [1].

In the Republic of Belarus, land reclamation has historically occupied a special place in the structure of agricultural production, due to the sig-

nificant proportion of overly waterlogged and swampy lands [2]. Drainage and regulating land reclamation systems ensure the inclusion of significant areas of agricultural land (15.8 %) into economic circulation and contribute to increased sustainability of crop production [3, 4].

At the same time, given limited financial resources and the need to optimize public spending, the relevance of scientifically based assessments of the effectiveness of land reclamation activities is growing [5, 6]. Traditional approaches to assessing effectiveness, based on comparing costs and economic results, do not fully reflect the multifaceted nature of the impact of land reclamation [7].

A significant portion of its effects manifests itself in the social and environmental spheres, as well as in the strategic provision of food security.

Accordingly, the development of comprehensive methodological approaches that take into account both the resource component of land reclamation activities and the overall utility of their results is becoming increasingly important. One such approach is the resource-utility approach, which focuses on correlating the volume of resources involved with the integrated effect of land reclamation on the economy and society [8].

### Results and their discussion

Land reclamation today is a system of organizational, economic, engineering, and agronomic measures aimed at fundamentally improving land properties to enhance their productivity and the sustainability of agricultural production. Economically, land reclamation is a specific type of capital investment, the results of which manifest themselves in the long term. Unlike most production processes, land reclamation impacts not only the volume of output but also the state of natural resources. It shapes the stability of agricultural landscapes, regulates soil water regimes, and influences biogeochemical processes and land use patterns [9]. This necessitates a comprehensive approach to assessing its results.

The economic essence of land reclamation as an object of effectiveness assessment lies in its dual nature. On the one hand, it requires significant financial expenditures, material and labor resources. On the other hand, its results are expressed not only in increased agricultural output but also in the reduction of risks associated with unfavorable natural conditions, as well as in the conservation and restoration of land resources [10].

Thus, land reclamation is an investment process with a high degree of social significance, necessitating the consideration of both private and public effects when assessing its effectiveness.

### The concept of efficiency and its interpretation in relation to land reclamation

In economics, efficiency is traditionally viewed as the ratio of the result obtained to the resources used. In its most general form, efficiency is expressed by the formula 1

$$\Theta = P/3, \quad (1)$$

where  $\Theta$  – performance indicator;  $P$  – result; 3 – resource costs.

When applied to land reclamation, this formula requires significant clarification, as the results of land reclamation activities are multifaceted. They include not only increased crop yields or gross output, but also changes in the condition of land and water resources, farming conditions, and the social infrastructure of rural areas.

Therefore, it is appropriate to consider land reclamation effectiveness as an integrated characteristic reflecting the degree to which land reclamation objectives are achieved for a given volume of resources used. This approach expands the concept of "result" to include indicators characterizing the sustainability of land use and the quality of agroecosystems. Given this, land reclamation effectiveness can be defined as the degree of benefit of its results to the economy and society, calculated per unit of resources used.

### Limitations of traditional approaches to assessing the effectiveness of land reclamation

Traditional methods for assessing the effectiveness of land reclamation rely primarily on cost indicators, such as the payback period for capital investment, profitability, and growth in gross output. A widely used method is comparative efficiency, which compares management indicators on reclaimed and non-reclaimed lands, or indicators "before" and "after" reclamation measures [11, 12]. These indicators allow one to assess the economic feasibility of individual projects, but do not take into account the overall social and environmental impacts. Typically, the impact of land reclamation on rural employment, changes in the ecological status of land, the role of reclamation systems in preventing soil degradation, and the contribution of land reclamation to food security are often left outside the analysis.

Furthermore, the use of purely cost criteria does not allow for the long-term impact of land reclamation to be taken into account. A significant portion of its effects manifests itself over a long period, making it difficult to adequately reflect them in traditional performance indicators. The above limitations necessitate the search for alternative approaches to assessing the effectiveness of land reclamation, focused on the integration of resource and utility aspects.

The resource-utility approach fundamentally differs from traditional performance assessment methods in its expanded category of outcome. While classical models equate outcome with economic impact, this approach encompasses a system of heterogeneous effects subject to aggregation. The resource-utility approach compares the volume of resources involved in land reclamation activities with the integrated utility of the results obtained. Within this approach, resources are understood as all types of costs supporting the functioning of the land reclamation system, including financial, material, labor, and natural resources. Thus, this approach allows for the incorporation of resource costs and the overall utility of land reclamation into a unified system, creating a methodological basis for more informed management decisions in the management and development of the land reclamation complex.

### Methodological foundations of resource-utility assessment of land reclamation efficiency

The development of a resource-utility approach to assessing the effectiveness of land reclamation requires reliance on a combination of general scientific and specific economic principles. This approach is based on the recognition of the multifaceted nature of the results of land reclamation activities and the need to correlate them with the volume of resources used. The basic principles of resource-utility assessment include the principle of comprehensiveness; the principle of comparability; the principle of systematicity; the principle of long-termism; and the principle of target orientation [13, 14, 15, 16]. The implementation of these principles ensures that the assessment of the effectiveness of land reclamation is adequate to its actual socio-economic significance.

For the practical implementation of the resource-utility approach, it is necessary to develop a system of indicators that allows for the quantitative reflection of both the resource and utility components of land reclamation activities. The system of indicators should include:

- 1) *resource cost indicators*, characterizing the volume and structure of resources used;
- 2) *utility indicators*, reflecting the economic, social, and environmental effects of land reclamation.

Resource cost indicators can be expressed in physical and monetary units, while utility indicators often require standardization and aggregation to ensure comparability.

To integrate disparate indicators, it is advisable to use standardization methods that allow them to be converted to a dimensionless form in the range from 0 to 1. This creates the basis for developing integrated indices.

Within the resource-utility approach, resources are understood as a set of factors used in the creation, operation, and development of reclamation systems. They can be conveniently classified into the following main groups.

*Financial resources* include budgetary allocations, funds from economic entities, and other funding sources allocated for the design, construction, reconstruction and operation of drainage systems:

- capital investments in the construction and reconstruction of drainage systems;
- current operating costs;
- maintenance and repair costs.

This resource group reflects the monetary value of drainage activities and is traditionally used in economic calculations.

*Material and technical resources* – hydraulic structures, pumping equipment, drainage systems, canals, and technical means for monitoring and managing water conditions:

- hydraulic structures;
- pumping stations;
- drainage and irrigation networks;
- machinery and equipment.

Their condition and level of technical development largely determine the functional reliability of drainage systems and the amount of operating costs.

Labor resources are represented by personnel involved in the design, maintenance, and management of land reclamation systems:

- personnel of operating organizations;
- design and monitoring specialists;
- workers ensuring the operation of the systems.

The quality and qualifications of personnel directly impact the efficiency of land reclamation infrastructure operation and the implementation of innovative technologies.

Natural resources, in the context of land reclamation, include land and water resources involved in economic circulation:

- land;
- water resources;
- soil and ecological potential of territories.

Their use should be considered not only from the standpoint of economic benefit but also from the perspective of preserving natural potential.

*Temporal resources* reflect the duration of the operation of land reclamation systems and their payback period.

Thus, the resource component of land reclamation is a multi-element system reflecting both the economic and natural aspects of land reclamation activities.

#### The essence of the benefits of land reclamation and its main forms

The utility of land reclamation can be defined as the cumulative effect of its impact on economic, social, and natural processes. Unlike the category of economic effect, utility includes not only results measured in monetary terms but also intangible effects of social significance. With in the structure of land reclamation utility, it is appropriate to distinguish the following main forms:

*Economic utility* manifests itself in increased crop yields, increased production stability, and reduced production losses due to unfavorable hydrological conditions. Economic utility indicators may include: increased gross crop output; reduced unit costs; increased land use profitability; and reduced damage from waterlogging and drought.

Economic utility can be expressed in monetary terms, allowing for comparison with resource costs.

The *social utility* of land reclamation is expressed in improved living conditions for rural residents, expanded employment opportunities, and increased sustainability of socioeconomic development. Its main manifestations include: increased employment in rural areas; demographic stabilization; infrastructure development; and improved working conditions in the agricultural sector.

Social effects are primarily qualitative in nature and require the use of expert assessment and indexing methods.

*Environmental utility* is associated with the impact of land reclamation on the state of natural ecosystems. These benefits manifest themselves in the regulation of soil water regimes, the prevention of land degradation, the reduction of erosion processes, and the preservation of biodiversity. This list demonstrates that the benefits of land reclamation are complex and cannot be reduced to just one: preventing waterlogging and soil erosion; stabilizing groundwater levels; maintaining the productivity of agricultural landscapes; and reducing negative impacts on water bodies.

Environmental benefits can be expressed through prevented damage and indicators of the ecological sustainability of territories.

Exclusively to economic results.

#### Integral indicator of resource-utility efficiency

A generalized assessment of the effectiveness of land reclamation within the resource-utility approach can be presented as an integrated indicator reflecting the ratio of utility to resources.

In general, this indicator can be written as follows

$$E_M = \frac{\sum_{i=1}^n W_i U_i}{\sum_{j=1}^m R_j}, \quad (2)$$

where  $E_M$  – resource-utility efficiency;

$W_i$  – utility weighting indicators;

$U_i$  – standardized utility indicators;

$R_j$  – resource cost indicators.

The use of weighting coefficients allows for consideration of socioeconomic policy priorities and the specific operating conditions of land reclamation systems.

The integrated indicator can be used for comparative analysis of various land reclamation projects, regions, and time periods, as well as to substantiate management decisions in land reclamation development.

The methodological foundations of the resource-utility approach are based on the principles of comprehensiveness, systematicity, and long-term assessment of the results of land reclamation activities. Expanding the category of results to include social and environmental effects allows for a more complete reflection of the societal significance of land reclamation. The development of a system of indicators and an integrated indicator of resource-utility efficiency creates a methodological basis for the practical application of this approach in the public administration system of the agro-industrial complex of the Republic of Belarus.

#### Algorithm for Resource-Utility Efficiency Assessment

Accordingly, the algorithm for assessing the effectiveness of land reclamation within the resource-utility approach is as follows.

1. *Defining the assessment boundaries.* The object of analysis (reclamation system, district, region), time interval, and set of indicators are selected.
2. *Assessing resource costs.* The total costs for all resource groups are calculated and brought into a comparable form.
3. *Assessing utility.* The economic, social, and environmental effects of the operation of reclamation systems are determined.
4. *Standardizing indicators.* All indicators are converted to a dimensionless scale (e.g., from 0 to 1) to ensure comparability.
5. *Aggregating indicators.* An integrated utility indicator and an integrated resource intensity indicator are formed.
6. *Calculating the integrated efficiency coefficient.*

The integrated efficiency indicator is proposed to be determined using the formula 2

$$E_M = \frac{U}{R}, \quad (3)$$

where  $E_M$  – efficiency of land reclamation activities;

$U$  – integrated utility;

$R$  – total resource costs.

The resulting performance indicator values allow for comparison of the effectiveness of various reclamation systems; identification of the most resource-intensive infrastructure elements; determination of modernization priorities; and justification of public funding volumes. Dynamic analysis is particularly important, allowing for the assessment of changes in effectiveness over time and the identification of development trends in the reclamation system.

The resource-utility approach forms the methodological basis for a comprehensive assessment of reclamation effectiveness, taking into account the multifaceted nature of its consequences. The proposed methodology allows for the linking of resource expenditures with economic, social, and environmental outcomes, thereby enhancing the validity of management decisions in the development of the reclamation system.

#### Conclusion

In the context of increasing demands on the rational use of natural resources [17] and the sustainable development of the agricultural sector [18, 19], the problem of a comprehensive assessment of the effectiveness of land reclamation activities is becoming particularly relevant. Land reclamation in the Republic of Belarus is a key factor in maintaining the productivity of agricultural land [20], stabilizing production and developing rural areas, which necessitates improving methodological approaches to assessing its results.

The conducted study substantiated the feasibility of applying a resource-utility approach to assessing the effectiveness of land reclamation, taking into account not only the economic, but also the social

and environmental consequences of the functioning of land reclamation systems. Unlike traditional methods based primarily on profitability and payback indicators, the proposed approach is focused on identifying the total utility of land reclamation activities in relation to the volume of resources used. The paper reveals the essence of the category of efficiency as applied to the land reclamation complex and demonstrates that it is multifaceted in nature, determined by the interaction of production, social and natural factors. It has been demonstrated that land reclamation generates sustainable economic benefits in the form of increased crop yields and reduced production risks, as well as social benefits such as maintaining employment and rural development, and environmental benefits associated with regulating water regimes and preventing soil degradation.

A resource-utility-based efficiency assessment methodology for land reclamation activities has been developed, including a system of resource cost and utility indicators, an algorithm for their aggregation, and the formation of an integrated efficiency coefficient. Particular attention is paid to standardizing indicators and accounting for difficult-to-formalize social and environmental effects using index and expert methods. The resource-utility approach creates the methodological prerequisites for developing a more sound management system for the land reclamation complex of the Republic of Belarus, focused on achieving economic efficiency while simultaneously ensuring social stability and environmental sustainability.

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