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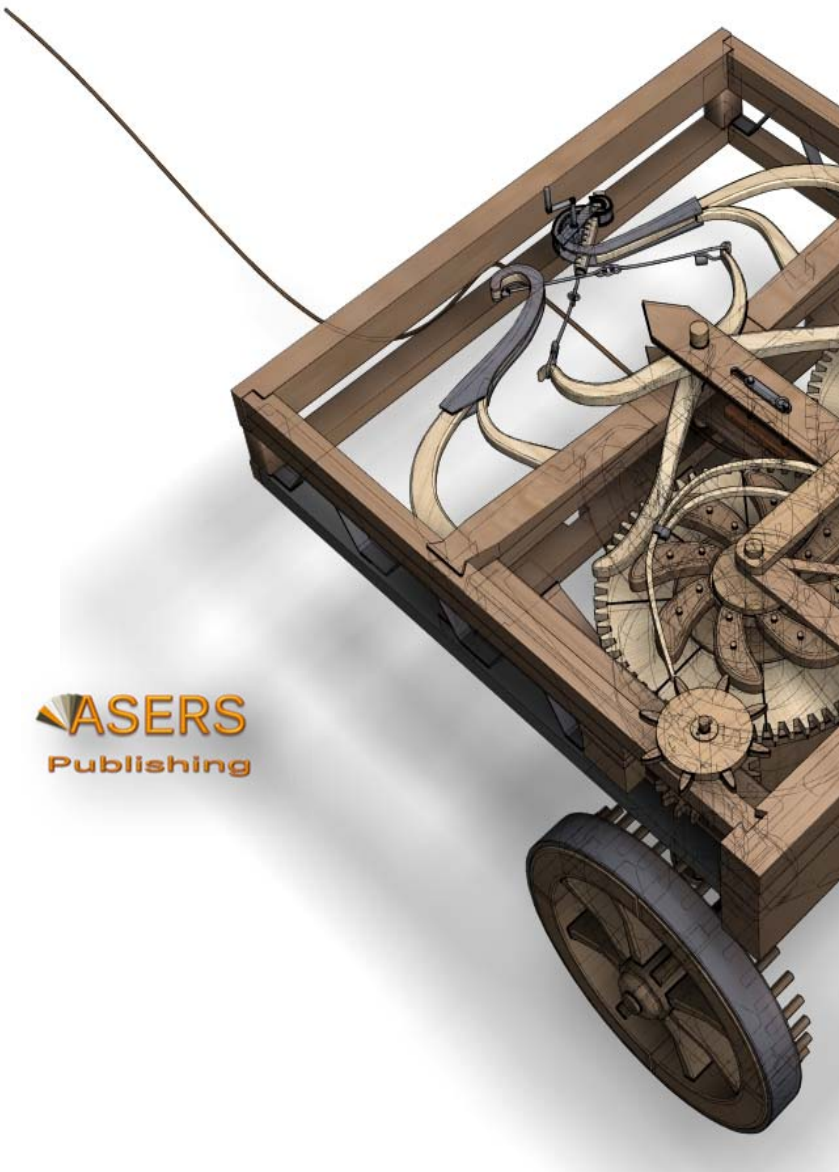

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Table of Contents:

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Efficiency of Land Reclamation Projects: New Approach to Assessment for Sustainable Soil Management

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Abstract:

The purpose of the article is to highlight the results of the study on a comprehensive methodological approach to assessing the economic efficiency of land reclamation projects in the context of sustainable soil management in the agricultural sector. The theoretical bases of determination of economic efficiency of land reclamation investment-innovation projects are generalized. The scientific and methodical principles of determination of economic efficiency of soil reclamation and reclamation investment-innovation projects are formed. The scientific and applied approaches to the determination of economic efficiency were worked out on the example of a concrete reclamation investment and innovation project, which made it possible for a first time to carry out a comprehensive assessment of the economic efficiency of the project of reclamation plowing of solonetz chestnut under non-irrigated conditions, from the point of view of systemic, situational and interdisciplinary approaches. A macroeconomic assessment of the economic efficiency of a land reclamation project in Ukraine was carried out.

Keywords: efficiency; land reclamation projects; soil fertility; soil reclamation; sustainable soil management.

JEL Classification: Q15; Q51; Q57.

Introduction

In the world, ones of the methods for substantiating the effectiveness of implementing innovative projects are the methods proposed by a structural unit for industrial development UNIDO (United Nations Industrial Development Organization). These methods relate, first of all, to the economic assessment of investments required for the implementation of planned innovations, taking into account time changes in the value (discounting) of investments. Solving the problems of increasing the efficiency of soil reclamation is an extremely urgent task in modern conditions and is largely determined by the improvement of the system for assessing the economic efficiency of this measure and reclamation investment and innovation projects. At the same time, in Ukraine, the problem of substantiation of scientific and methodical principles for determining the economic efficiency of soil reclamation and land reclamation projects remains inadequate, especially from the point of view of the system approach, there are only fragmentary developments.

So, the scientists at the Institute of Irrigated Agriculture of NAAS are investigating the scientific and practical aspects of implementing resource-saving innovative projects in the irrigated agriculture of southern Ukraine (Vozhehova *et al.* 2012). Also the scientists of this Institute substantiate the scientific and practical aspects of using the "electronic information base "Fertilizers"" and other bases in irrigated agriculture of southern Ukraine (Boiarkina 2010; Boiarkina 2013); use of the program "electronic technological maps of the Institute of Irrigated Agriculture of NAAS" for the planning of technologies for growing crops under irrigation conditions (Boiarkina, 2014); the use of the "Digitals" computer program to optimize the technology of growing crops on irrigated lands (Kokovikhin and Boiarkina 2011) and the use of information technology under irrigation conditions ((Vozhehova *et al.* 2016, 2013).

The scientists of the National University of Water and Environmental Engineering Rokochinska, Kozhushko, Rokochynskyi and Dupliak developed "Temporary recommendations on the economic substantiation of land reclamation projects in the area of drainage reclamation" (Rokochynska *et al.* 2004) and "Temporary recommendations on the economic justification of investments in projects of irrigation systems" (Rokochynska *et al.* 2004). Also, the scientists of the university developed "Temporary recommendations on optimization of water management of drained lands in projects of construction and reconstruction of water management and reclamation facilities" (Rokochynska *et al.* 2010), "Temporary recommendations on the forecast assessment of water regime and water management technologies for drained lands in projects of the construction and reconstruction of reclamation systems" (Rokochynska *et al.* 2011) and "Temporary recommendations on the assessment of investment projects for the construction and reconstruction of water facilities and reclamation systems" (Rokochynska *et al.* 2013). In recent studies by Rokochynskyi, Frolenkova and Koptyuk (2013) note that modern methods of ecological and economic substantiation of investment projects that are widely implemented in domestic practice, in most cases, are not adapted to the functioning peculiarities of each particular branch. Assessment of reclamation projects requires consideration of a large number of various natural and technical factors that have a significant effect on the final result. To solve a number of complex forecast-optimization models, it is necessary to take into account the relief and the types of soils, the level of natural water availability, agrotechnical conditions, the practice of crop rotation, etc. (Rokochynskyi, Frolenkova and Koptiuk 2013).

The methodological provisions and norms of productivity and consumption of electric power and fuel for irrigation of agricultural crops were developed by scientists of the Scientific Research Institute "Ukragropromproductyvnist" (Demchak *et al.* 2015). The scientists of this Institute also investigate the impact of hydro-amelioration measures on the productivity of farmland (Klepikov and Antohenko 2017) and expediency of investments by methods of internal norm of profitability and net present value (Borisenko and Rizhenko 2017).

The scientists of the Institute of Bioenergy Crops and Sugar Beet offer an improved method for determining the economic efficiency of the elements of technology, technical means, technologies of agricultural production (Sinchenko *et al.* 2014; Roik *et al.* 2013), as well as organizational and economic norms of costs and informational and statistical materials on crop production by bio-adaptive technologies (Organizational and economic…, 2014). An interesting methodology for grading indicators on the degree of efficiency of sales of crop production was proposed in the work by Parmacli *et al.* (2019). In the article by Dudoglo (2018), an unconventional approach to the assessment of the efficiency of agrarian production was grounded.

This issue is also relevant for foreign countries. For example, Belarusian scientists in their work considered the agronomic and economic efficiency of limestone meliorants (dolomite flour, defecate, phosphogypsum) in action and aftereffects. They showed the influence of limestone meliorants (2011–2016) on the productivity of crop rotation, annual production costs, net income and profitability indicators by growing crops on degraded peat soils (Pyrohovskaia and Soroko 2017).

The soil-degradation processes that cause significant economic losses are widespread in Ukraine (Kucher 2015), therefore there is a need for radical improvement of soil quality. The innovative practices of soil reclamation and the issue of sustainable soil management are highlighted in the works of many scientists (Ulko *et al.* 2018; Towhid 2018; Baritz 2018; Vargas *et al.* 2018).

*The scientific publications substantiate: the effectiveness of biopreparations in the system of biological agriculture on the reclaimed lands (*Polischuk 2015); the effectiveness of using organic fertilizers for improving the quality of soils (Kucher 2017); the need to ecologize agrarian production (Bahorka 2019); the connection of the efficiency of agrarian enterprises of various organizational-legal forms and sizes of land use (Pasichnyk *et al.* 2016); problems of transformation of land relations (Kononenko 2019); and structural transformations for sustainable development (Heldak *et al.* 2018).

Under conditions of the command-and-administrative economy, the economic efficiency of land reclamation projects was evaluated mainly on the basis of comparison of the size of the national economy or the cost-

effectiveness of capital investments with the norms of overall economic efficiency. Also an indicator of reduced costs was used widely. In modern Ukrainian realities and foreign practice, these indicators do not reflect the multifaceted manifestation of the economic efficiency of land reclamation projects.

Thus, there is a need for systematic formation of scientific and methodological principles for determining the economic efficiency of soil reclamation and land reclamation investment and innovation projects, which we have implemented, based on previously developed theoretical and methodological principles for assessing the economic efficiency of the application of soil protection innovations (Kucher *et al.* 2017; Kucher 2019).

1. Materials and Methods

The purpose of the article is to highlight the results of the study on a comprehensive methodological approach to assessing the economic efficiency of land reclamation projects in the context of sustainable soil management in the agricultural sector.

To achieve this goal, we used the following methods of research: abstract-logical, in particular such techniques as analysis and synthesis, induction and deduction for theoretical generalizations and formulation of conclusions, refinement of concepts related to the subject of the study; monographic – during the study of individual phenomena, processes; graphical – for a visual image of the studied phenomena and processes; calculated-analytical – by assessing the economic efficiency of land reclamation investment and innovation projects. The initial methodological basis of the study is the basic provisions of economic theory, agrarian economics, economics of nature management, development and research of domestic and foreign scientists on land reclamation. The substantiation of the scientific and methodological principles for determining the economic efficiency of land reclamation investment and innovation projects was carried out on the basis of systematic, situational, interdisciplinary and synergetic approaches to the study of economic phenomena.

2. Results and Discussion

2.1. The Place and Role of Acidic and Alkaline (Solonetzic) Soils in the Economy of Crop Production in Agricultural Enterprises of Ukraine

Acidic and alkaline (solonetzic) soils play an important role in the crop production in Ukrainian agricultural enterprises (Table 1, 2).

Table 1. The place and role of acid soils in the economy of crop production in agricultural enterprises of Ukraine, 2017

Administrative-territorial unit	Area of acid soils, mln ha	Share of acid soils in arable land, %	Estimated volume of gross crop production on acid soils, mln UAH
Ukraine	3621.0	19.1	24170.1
Crimea	0.0	0.0	0.0
Vinnytsya	556.6	53.5	4688.8
Volyn	119.5	30.7	502.2
Dnipro	0.0	0.0	0.0
Donetsk	0.0	0.0	0.0
Zhytomyr	385.0	45.6	1811.2
Zakarpattya	161.3	67.6	189.2
Zaporizhya	0.0	0.0	0.0
Ivano-Frankivsk	158.3	54.4	663.2
Kyiv	192.5	25.2	1392.0
Kirovohrad	105.9	9.6	529.4
Luhansk	0.0	0.0	0.0
Lviv	175.9	35.4	938.5
Mykolayiv	0.0	0.0	0.0
Odesa	0.2	3.4	231.2
Poltava	70.5	9.1	618.8
Rivne	159.2	32.0	595.7
Sumy	322.2	41.0	2496.4
Ternopil	158.2	31.8	1474.7
Kharkiv	159.2	13.5	867.5
Kherson	47.0	3.6	185.6

Administrative-territorial unit	Area of acid soils, mln ha	Share of acid soils in arable land, %	Estimated volume of gross crop production on acid soils, mln UAH
Khmelnytskiy	187.8	19.7	1410.2
Cherkasy	176.4	21.9	1201.4
Chernivtsi	88.8	37.6	286.1
Chernihiv	396.5	61.0	4087.9

Source: data on the area and specific weight of acid soils in the total area of arable land of the State Institution «Soils Protection Institute of Ukraine»; crop production is calculated according to the data of the State Statistics Service of Ukraine.

Thus, on acid soils in agricultural enterprises of Ukraine in 2017, approximately 22.3% of gross crop production was produced at constant prices in 2010.

Table 2. Place and role of alkaline (solonetzic) soils in the economy of crop production in agricultural enterprises of Ukraine, 2017

Administrative-territorial unit	Area of alkaline soils, mln ha	Share of alkaline soils in arable land, %	Estimated volume of gross crop production on alkaline soils, mln UAH
Ukraine	1710.0	4.5	3685.0
Crimea	No data	No data	No data
Vinnytsya	0.0	0.0	0.0
Volyn	0.0	0.0	0.0
Dnipro	132.9	5.9	304.3
Donetsk	91.3	4.8	120.5
Zhytomyr	0.0	0.0	0.0
Zakarpattya	0.0	0.0	0.0
Zaporizhya	76.3	3.7	147.5
Ivano-Frankivsk	0.0	0.0	0.0
Kyiv	72.5	4.9	230.1
Kirovohrad	3.9	0.2	9.4
Luhansk	87.9	4.9	110.6
Lviv	0.0	0.0	0.0
Mykolayiv	66.3	3.5	142.8
Odesa	72.6	3.0	173.4
Poltava	247.6	12.3	711.0
Rivne	5.6	0.6	9.5
Sumy	113.7	7.1	367.5
Ternopil	0.0	0.0	0.0
Kharkiv	139.4	6.2	338.7
Kherson	260.4	13.8	604.6
Khmelnytskiy	0.0	0.0	0.0
Cherkasy	7.3	0.6	28.0
Chernivtsi	0.0	0.0	0.0
Chernihiv	131.3	6.8	387.3

Source: data on the area and specific weight of alkaline (solonetzic) soils in the total area of arable land of the Soil Geoecophysics Laboratory of the NSC ISSAR; crop production is calculated according to the data of the State Statistics Service of Ukraine.

On alkaline (solonetzic) soils in agricultural enterprises of Ukraine in 2017, approximately 3.4% of gross crop production was produced at constant prices in 2010. However, the role of these soils would be greater if they would be meliorated and, accordingly, increased productivity, since at present, according to an expert assessment of scientists (V.B. Solovey) of the Department of Soil Resources of the NSC ISSAR, their productivity is 15% less than the average.

2.2. Methodology for Evaluating the Economic Efficiency of Soil Reclamation and Reclamation Investment and Innovation Projects

According to the results of the conducted research, the scientific and methodological principles of determining the economic efficiency of soil reclamation and reclamation investment and innovation projects are formed, which

include: basic methodological provisions; methodological approaches; principles of methodology construction; methods, criteria and system of indicators that will ensure the complexity and unification of the calculations of this efficiency.

2.2.1. Conceptual Provisions for Assessing the Economic Efficiency of Soil Reclamation and Land Reclamation Investment and Innovation Projects

During assessing the economic efficiency of soil reclamation and reclamation investment-innovation projects and justification of their economic feasibility, it is necessary to rely on such conceptual provisions (Methodical recommendation):

- determine the effectiveness of land reclamation projects, as a rule, by the growth of net income, which is the difference between the sum of net income, which is received "with reclamation" and "without reclamation". In this regard, justification and calculation of net income, both with reclamation and without reclamation, are necessary;
- determining the effectiveness, the possible risk is taken into account not during the discounting of the cash flow, but during calculating the profit from the sale of agricultural products. Many factors affect the crop yield grown on reclaimed land, but the main ones are the climatic conditions of the year. Due to adverse natural and climatic conditions of the year, yields are reduced both on reclaimed land and without land reclamation. However, the degree of influence of the mentioned factor on the yield of agricultural crops grown without reclamation is much higher than on the reclaimed land. However, net current expenses of agricultural production and net operating costs of melioration facilities, as opposed to industrial enterprises, are usually stable and differ only in harvest costs. Therefore, the risk adjustment should be taken into account in the lack of agricultural products, respectively, in the profit from their sale;
- the land reclamation projects are characterized, as a rule, by a long life cycle. At the objects of reclamation there are stages (periods) of design, construction, cultivation, development and effective use of reclaimed land. At the same time different results at different stages (periods) are achieved;
- since lands subject to land reclamation always have owners (as a rule, individuals who own land plots (shares)), land users (usually in the form of agricultural enterprises), which grow agricultural crops on reclaimed land and sell products. Thus, the results of the economic substantiation of the project are interesting not only for investors, but also for agricultural enterprises and owners, whose lands are meliorated, at the same time their differences of economic interests are possible;
- reclamation projects, as a rule, solve the problems of conservation and restoration of soil fertility, environmental protection. In this regard, evaluation of effectiveness is based on the environmental result, achieved by the project;
- in the land reclamation projects, the complex use of water resources is often considered. In connection with this, a comprehensive assessment of the effectiveness of the reclamation project is carried out, taking into account the achieved economic and socio-ecological results;
- the land reclamation projects can, and often, also require the complex application of different methods of land reclamation. In such cases, one of the objectives of the rationale for effectiveness is to find the best combination of melioration methods for specific agricultural land;
- as a rule, not only economic (increasing the value of land and income from their rational use), but also socio-ecological results (that need to be taken into account by determining the effectiveness of melioration) are typical for amelioration projects;
- designing land reclamation projects, it is usually considered several options that differ in technical, technological or other design decisions. In such cases, the effectiveness should be determined for each of the project options.

2.2.2. Methodological Approaches to Determining the Economic Efficiency of Soil Reclamation and Land Reclamation Investment and Innovation Projects

The assessment of economic efficiency (as well as economic (monetary) assessment of different types of effect) is not an end in itself but forms a platform for the making of effective management decisions on soil reclamation management and reclamation investment-innovation projects at different hierarchical levels: micro-, meso-, macroeconomic.

The following methodological approaches are the basic components of the methodology for assessing the economic efficiency of soil reclamation and land reclamation investment and innovation projects:

1. Systematic approach to assessing the economic efficiency of soil reclamation suggests that the object is

investigated as an integral set of components of its subsystems, elements and in all the variety of revealed properties and connections within the object, as well as between the object and the external environment. From our point of view, the most appropriate is the application of a systematic approach, firstly, during substantiating the system of indicators of the economic efficiency of soil reclamation, which comprehensively reveal and characterize the content of the phenomenon under study; and secondly, the implementation of the system approach is closely linked to the complexity of the application of various methods, reflecting the unity of objectives, methods, criteria and indicators for determining the economic efficiency of soil reclamation (Kucher *et al.* 2017, pp. 75–77).

2. Situational approach is based on the fact that the suitability of different methods and expediency of using different indicators to determine the economic efficiency of land reclamation and the making of management decisions based on this situation is determined by the specific situation. There is no single way to evaluate an object, since there are many factors of the internal and external environment that influence the choice of a particular method and/or indicator, so the essence of the situational approach is to apply different methods for each particular situation.

The most effective method in a particular situation should be considered the one that most of all meets the specific conditions of the situation and is maximally adapted to them. The situational approach is not a set of specific recommendations, but is a way of thinking. It retains the general concept of the process of assessing economic efficiency, which can be applied in all situations, but specific methods and indicators can vary significantly in each particular situation depending on the goal and objectives of the study and other situational conditions. In addition, it is often used a combination of methods and indicators common to different approaches to assessing the efficiency. Consequently, the situational approach involves the use of different methods and indicators for determining economic efficiency in relation to the particular situation and purposes of evaluation. It will allow making effective solutions in accordance with the current situation (Kucher *et al.* 2017, 78–79).

3. Interdisciplinary approach – consists in a comprehensive study of a single subject of research by representatives of various scientific disciplines. Interdisciplinarity is considered as a form of organization of scientific knowledge, based on certain relationships between scientific disciplines (branches of knowledge), methods and technologies that solve problems. Interdisciplinarity is characterized by the properties of the integrability of disciplines, based on the transfer of research methods from one discipline to another. Interdisciplinarity requires the synthesis of results obtained in various scientific disciplines.

According to Kolot (2014), the main rational kernel of the interdisciplinary approach in the conditions of the growth of specialization in the field of scientific research is the enrichment of related sciences on the basis of borrowing methodological tools, combining efforts to explain the nature of new phenomena and processes. An interdisciplinary approach in the practice of economic research involves cross-examination of the same issues, phenomena and processes from the point of view or through the prism of various sciences (disciplines). The cross-sectional study aims to provide a synergistic effect, to highlight the underlying causes of unsustainable economic dynamics, and to develop comprehensive, systematic solutions that promote sustainable economic and social development (Kolot 2014).

An interdisciplinary approach to assessing the economic efficiency of soil reclamation is aimed at gaining new knowledge through the symbiosis of the basic principles of economic theory, agrarian economics, economics of nature management, ecological economics, resource economics, land degradation economics, innovation management, agrochemistry, soil science, etc. Combining separate, partial aspects of each of these sciences in the integral direction creates the basis for a comprehensive study of the links between economic, environmental and social aspects of the effectiveness of soil reclamation and making (where it is possible and necessary) an economic (monetary) assessment of effects, arising from, first of all, the comparison of costs and results (Kucher *et al.* 2017, 80–82).

4. Synergetic approach to assessing the economic efficiency of soil reclamation, firstly, involves consideration of soil reclamation as an interdisciplinary phenomenon and a complex system, which includes a set of elements that interact with each other by a complex and nonlinear way; and secondly, it enables, among other things, to develop a methodology for the study of the economic efficiency of the use of melioration in terms of assessing the synergistic effect, taking into account the internal effects (Kucher *et al.* 2017, 85).

It should be noted that soil reclamation can contribute not only to obtaining direct (internal) results by the subjects of management that perform it (internal effects), but also to the occurrence of other consequences that are not directly related to the work of these entities. These effects are called external effects, and can have both positive and negative character, that is, they are able to improve or worsen the results of the work of related enterprises or industries. Depending on the main types of interaction of economic and ecological systems, I. B.

Degtyaryova distinguished the following types of synergistic effects, namely: positive, negative and neutral synergism. From the standpoint of assessing the economic efficiency of soil melioration, the main content of the first one is to enhance the processes of reproduction of soil fertility and the quality of their ecosystem functions (and/or services) and the environment as a whole, as a result of the implementation of certain innovations. Negative synergy manifests itself in the occurrence of various kinds of damage from anthropogenic load on soil resources. The content of neutral synergy is to preserve the balance between the natural environment and economic systems (Dehtiarova 2009, 5).

So the use of each of these approaches separately, as well as in their entirety, depending on the goals, creates the preconditions for the combination or integral interaction of these approaches during the study (Kucher *et al.* 2017, 85).

As a result of theoretical analysis of literary sources, taking into account our previous studies (Kucher and Anisimova, 2016), we worked out the specific (special) methodological approaches to determining the economic efficiency of soil reclamation, on the basis of which it was determined the possibility of combining existing views within the five approaches:

1) *resource approach* when the economic efficiency of land reclamation is determined on the basis of a comparison of the economic effect with the unit of used land resources and / or their economic (monetary) assessment, for improvement of which this reclamation is carried out, for a certain period, as a rule, per year;

2) *cost approach*, when the economic efficiency of land reclamation is determined on the basis of a comparison of the economic effect with the costs and/or investments for land reclamation directly related to its achievements, for a certain period, as a rule, per year;

3) *resource-cost approach*, which is a kind of compromise between the two previous ones, that is, taking into account both a certain economic assessment of available resources and an assessment of current expenses and/or investments, for a certain period, as a rule, per year;

4) *targeted approach* when the economic efficiency of land reclamation is determined as the degree of achievement of target parameters of melioration, for a certain period, as a rule, per year;

5) *value-based approach* where the economic efficiency of land reclamation is determined on the basis of growth and/or conservation of the value of soil and land resources as an environmental component, natural capital and a basic component of agricultural resource potential, for a certain period, as a rule, per a year.

The application of one approach does not usually exclude the possibility of using another one, therefore their complex (combined or integral, as previously shown on the example of general methodological approaches) may be promising in practice (Kucher *et al.* 2017, 86) of application depending on the goals. These methodological approaches, unlike traditional ones, take into account the specifics of soil reclamation and are based on consideration as a criterion for economic efficiency not only to maximize output (and/or profit) or to prevent its losses (lack of harvest), but also to maintain or increase value (cost) of land due to the improvement of quality and/or the prevention of soil degradation.

2.2.3. Principles of Constructing a Methodology for Determining the Economic Efficiency of Soil Reclamation and Land Reclamation Investment and Innovation Projects

Taking into account the results of previous studies (Kucher *et al.* 2017, 95-99) we worked out the principles of constructing a method for determining the economic efficiency of soil reclamation, which include: consistency and compliance with user requests; achievement of terminological coherence; ensuring a clear economic content of indicators and comparability in time and space; compliance with the result (economic effect) and factors (resources); taking into account the effect of economic laws and the factor of time; complexity and relevance of information; compatibility of indicators. We will give a brief description of these principles (based on work: Kucher *et al.* 2017, 95-99; Andriichuk 2006; Salyha 2005; Salyha and Melikhova 2012, 61–62 *et al*.):

- *consistency and compliance with user requests*, provides, firstly, the formation of an open (that is, such that can be supplemented) system of interconnected indicators, consideration of each indicator in correlation with others; and secondly, the focus on satisfying the requests of users of different levels of management, as well as, if possible, understanding of the content of indicators without special training;
- *achievement of terminological coherence*, where each of the indicators of economic efficiency would have a generally accepted (standardized) name, that is, the need to address the issue of standardizing the terminology of the glossary of indicators of economic efficiency and various types of economic effect;
- *ensuring a clear economic content of indicators and comparability in time and space* – means, firstly, that the indicators of economic efficiency must be either quantitative and have a real economic content, or qualitative and have a real logical content; secondly, the economic result (effect) and resources (costs) for the

calculations should not be abstract, that is, those that can be understood and interpreted differently, but rather real, that is, determined by the actual, for example, experimental data and / or based on existing information and statistical provision;

- *compliance with the result (economic effect) and factors (resources)* – provides that the costs and/or investments are the cause and the results are the consequence of these costs or investments, ie they are interconnected, therefore only those resources (expenses) that took direct part in creating the corresponding economic effect should be taken into account. On the other hand, the economic effect should include all components of consumer values of economic value. For agrarian production, this means that during determining the economic effect, it is necessary to consider not only the main but also the related and by-products;
- *taking into account the effect of economic laws and the factor of time* – provides, firstly, taking into account the effect of, first of all, such economic laws as the law of time saving, the law of decreasing income (returns), the law of synergy and the peculiarities of their action in agriculture, where they are closely intertwined with the effect of natural laws; secondly, the concept of time value of money implies the need to take into account the time factor, especially by evaluating the effectiveness of long-term investments, in particular by discounting cash flows to bring time-varying values to one accounting year (as a rule, this is the first year of investment). This principle is based on the fact of the economic inequality of the same amount of costs or results in time;
- *complexity and relevance of information* – provides, firstly, a comprehensive reflection of all significant aspects of land reclamation while simultaneously lacking unnecessary information; and secondly, sufficiency, but not excessive prevailing criteria and system of indicators; thirdly, the reliability of data that creates information support for assessing the economic efficiency of soil reclamation;
- *compatibility of indicators* – means that, firstly, among the list of established indicators, in spite of their interconnection, there should be no duplication of their logical and economic content; secondly, the indicators of the economic efficiency of soil reclamation should be related to indicators of economic efficiency of agrarian enterprises and/or use of land resources, which, among other things, will enable to identify the impact of land reclamation application on the economic efficiency of land use and economic activity in general.

Evaluating economic efficiency involves the use of a certain system of criteria and interconnected indicators. From the standpoint of economic theory, the criterion of efficiency as an economic category reflects the main goal of activity and acts as a measure of economic efficiency. The criterion of economic efficiency is to a certain extent a general scientific concept, therefore, it is specified through a system of economic indicators, the use of which allows conducting quantitative analysis.

Criterion of economic efficiency should be considered at macro and microeconomic levels. At the state level, the criterion for the economic effectiveness of soil reclamation may be as follows: maximizing the yield of gross production, net output per unit of land and/or increasing the value (cost) of soil and land resources due to radical improvement of quality and/or the prevention of soil degradation.

At the level of economic entities, the criterion for the economic efficiency of soil reclamation may be the maximization of marketable products (income (revenue) from sales) and profit per unit of land and/or increase in the value (cost) of soil and land resources due to a radical improvement of quality and/or to prevent degradation of soils.

At the same time, in a market economy, not all organizational forms of management use profit as the main criterion for the economic efficiency of their activities. So, for those farms that function only through the work of the farmer and his family members, the criterion for the economic efficiency of soil reclamation may be the increase in the value (cost) of soil and land resources and/or the maximum gross income for improving the well-being of the family.

The above criteria can be considered general, in each particular situation they can be transformed taking into account the features of the types of land reclamation and stakeholders. In development of the above we can formulate a few concrete criteria for the economic efficiency of land reclamation: maximizing the productivity of land use; maximizing the profitability of land use; maximizing the economic stability of land use; maximizing the value (cost) of land; maximizing the cost-effectiveness of production on reclaimed lands, etc.

Thus, the proposed criteria of economic efficiency to some extent reflect its essence and, firstly, allow to objectively reflect the correlation of the real economic effect and available economic resources; and secondly, they have qualitative homogeneity and quantitative comparability both in time and in space.

At the same time, from the standpoint of systemic and synergetic approaches, these criteria can be considered as an open subsystem, which, like the system of indicators, which is given below, develops and adjusts in the case of changing conditions and trends of the object of research, depending on the priority of those or other

ecological and economic problems and a specific situation (situational approach).

Given the nature and multiplicity of economic efficiency as an economic category, the system of indicators for its evaluation, built on the basis of certain principles, should include several groups: 1) indicators of productivity for the use of melioration; 2) indicators of profitability for the use of melioration; 3) indicators of economic stability of land reclamation; 4) indicators of the value of soil and land resources under the influence of melioration; 5) indicators of the cost effectiveness of melioration. It is substantiated the complex (system) of indicators of economic efficiency of soil reclamation, which includes subsystems of indicators of productivity, profitability, economic stability, value and economy (Kucher 2017). This system of indicators should not be considered as the final system, as they can be supplemented by others or reduced, taking into account the purpose and tasks of the study, situational features, the specific functioning of individual enterprises, and the available information support. At the same time, the list of proposed indicators is sufficient to objectively determine the level and perform a comprehensive analysis of the economic efficiency of soil reclamation and reclamation investment and innovation projects at the micro, meso and macroeconomic levels.

In the end, as an example, we present the key results of evaluating economic effectiveness of an investment-innovative project of land reclamation plowing.

2.3. An Example of an Estimation of the Economic Efficiency of an Investment-Innovative Project of Reclamation Plowing

As a result of the study, the scientific and applied approaches to the definition of economic efficiency have been worked out on the example of a concrete reclamation investment and innovation project. In particular, an estimation of economic efficiency of the project of ameliorative plowing is carried out. The system of proposed and tested indicators illustrates the degree of economic efficiency of long-term (45 years) project of amelioration plowing plots (Table 3).

Table 3. Calculation of the economic efficiency of a project of reclamation plantage plowing of chestnut-solonetz under non irrigated conditions, 2018

Indicators	«Without a project» – control (ordinary plowing)				«With a project» – reclamation plantage plowing			
	Average	Min.	Max.	Standard deviation	Average	Min.	Max.	Standard deviation
1. Indicators of productivity of soil reclamation (criterion – maximum productivity)								
1.1. Productivity of land use, USD/ha								
Gross production at constant prices	100.1	62.6	138.6	20.9	137.1	79.7	192.1	29.0
Production of commodity products at actual prices	574.8	359.7	795.7	119.9	787.1	457.8	1103.1	166.8
Production of net output	264.2	71.3	462.3	107.5	468.7	208.2	738.0	148.5
Additional output of gross production	x	X	x	x	37.0	17.1	53.5	8.5
Additional output of commodity products	x	X	x	x	212.3	98.1	307.4	48.6
Additional net output	x	X	x	x	204.5	127.1	282.5	43.7
1.2. Land equivalent ratio back (Zemleviddacha), coefficient								
Land equivalent ratio back by gross production at constant prices	0.11	0.07	0.15	0.023	0.15	0.09	0.21	0.032
Land equivalent ratio back by commodity products at actual prices	0.64	0.40	0.88	0.133	0.87	0.51	1.23	0.185
Land equivalent ratio back by net output	0.29	0.08	0.51	0.119	0.52	0.23	0.82	0.165
2. Indicators of profitability of soil reclamation (criterion – maximum profitability)								
2.1. Static indicators								
Level of profitability, %	16.9	-20.7	51.8	19,7	57.0	7.1	117.8	27.1
Level of price competitiveness, %	12.1	-26.1	34.1	15,1	34.4	6.7	54.1	11.3
Rate of return, coefficient	1.17	0.79	1.52	0,197	1.57	1.07	2.18	0.271
Profitability of land, coefficient	0.10	-0.10	0.30	0,112	0.32	0.04	0.60	0.156
Rate of return, %	7.5	-8.3	23.6	8,7	25.0	3.0	47.5	12.1

Income per 1 ha, USD	86.5	-93.7	271.5	100,4	286.5	34.1	537.7	140.6
Additional income per 1 ha, USD	x	x	x	x	200.1	118.7	304.5	48.9
Coefficient of economic efficiency of investments (by additional profit), coefficient					0.115			
Static payback period of investment by additional profit, years					8.71			
2.2. Dynamic (discounted) indicators								
Net present value, ths. USD					786.9			
Profitability index, coefficient					4.517			
Discounted payback period, years					9.95			
3. Indicators of economic stability of soil reclamation (criterion – maximum of economic stability)								
Scope of the variation in yield, c/ha	20.0				29.6			
Mean squared deviation, c/ha	5.5				7.7			
Coefficient of yield variation, coefficient	0.209				0.212			
Coefficient of yield stability, coefficient	0.791				0.788			
4. Indicators of the value of soil and land resources under the influence of soil reclamation (criterion – maximum of value)								
4.1. Level and dynamics of changes in the expert monetary valuation of land								
Expert monetary valuation of land, USD/ha	1534.6	1151.0	4056.0	807.6	5171.3	1151.0	13623.1	4010.2
Increment of expert monetary valuation of land, USD/ha	x	x	x	x	3636.7	0.0	10743.7	3456.8
Level of growth of expert land monetary valuation, %	x	x	x	x	327.3	100.0	934.9	218.2
4.2. Level and dynamics of the economic value of ecosystem services provided by soils								
Economic value of ecosystem services of soils, USD/ha	13052.8	12500.4	13620.2	307.8	15596.0	14750.4	16407.6	428.3
Increment of the economic value of soil ecosystem services, USD/ha	x	x	x	x	2543.2	2250.0	2787.4	124.9
Level of growth of the economic value of soil ecosystem services, %	x	x	x	x	119.5	118.0	120.5	0.539

Source: author's calculations on the basis of experimental data of the Laboratory of Fertility of Irrigated and Solonetzic (Alkaline) Soils (Drozd 2009).

Figure 1 shows the forecast of commodity products per 1 hectare in terms of «without a project» and «with a project» of reclamation plantage plowing of chestnut-solonetz under non irrigated conditions.

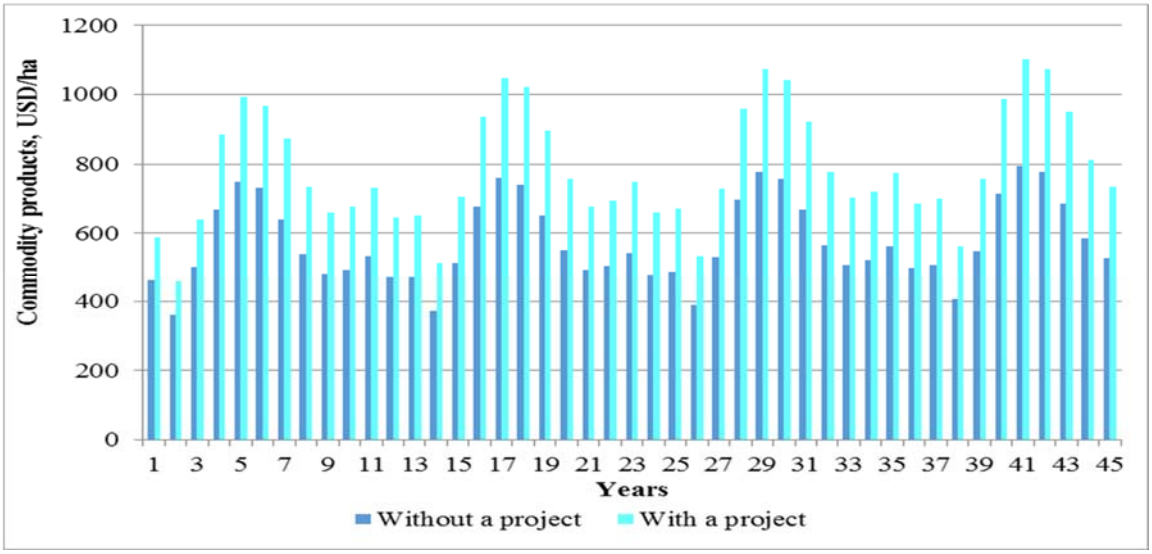
Differences in the formation of profitability indicate the size of additional profits due to reclamation plantage plowing throughout the life cycle of the project and net present value (Figure 2).

Thus, at an average level of profitability of 57.0%, the static payback period of a land reclamation plantage project (cost of 174.2 thousand USD per 100 hectares) by an additional profit is 8.71 years, while the discounted payback period is 9.95 years, which can be considered acceptable both from an economic and a technological point of view. The indicators of net present value (786.9 thousand USD for 45 years) and the profitability index (4.517) also indicate the economic efficiency and feasibility of the project implementation. At the same time, relatively long payback periods point to the need for state financial support for such projects and/or to seek innovative solutions to reduce the cost of meliorative plantage plowing and increase the payback from it.

The results of the study indicate that the use of meliorative plantage plowing of alkaline soils contributes to an increase in the expert monetary valuation of an average of 3636.7 USD/ha or 3.3 times compared to the «without a project» option, as well as an increase in the cost of ecosystem services of soils by an average of 2543.2 USD/ha or 19.5%.

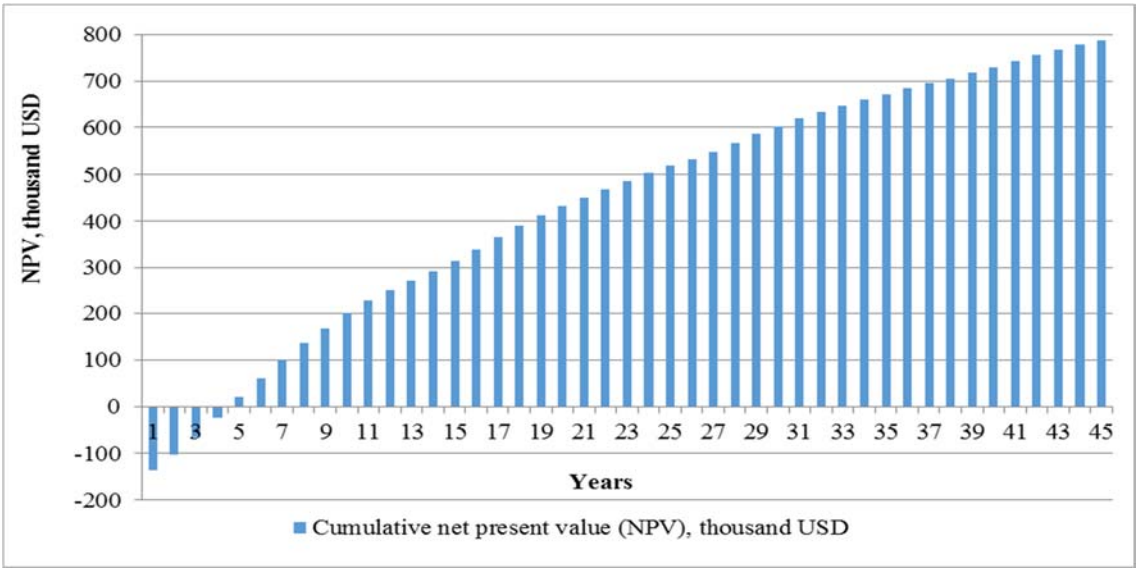
Our results of the economic assessment of soil ecosystem services are consistent with studies by other scientists. For example, the assessment of susceptibility of the ecosystem services of salt-affected soils to reclamation impacts (deep meliorative plowing) demonstrated positive changes in the efficiency of soil ecosystem services, such as the productive capacity, the habitat of species, the storage pool for carbon, and the nitrogen fixation capacity (Balyuk *et al.* 2019).

Figure 1. Forecast of commodity products per 1 hectare in terms of «without a project» and «with a project» of reclamation plantage plowing of chestnut-solonetz under non irrigated conditions



Source: author's research.

Figure 2. Cumulative net present value by the project of reclamation plantage plowing per 100 hectares



Source: author's research.

2.4. Macroeconomic Assessment of the Economic Efficiency of Soil Reclamation Project in Ukraine

At the final stage, we simulated the predictive calculation of potential additional profits from the use of land reclamation plowing in Ukraine on an area of 400 thousand hectares (Table 4).

Table 4. Calculation of potential additional profit from the use of ameliorative plantage plowing in Ukraine (area – 400 thousand hectares), 2018

Indicators	Variants (scenarios/weather conditions)		
	Average (probable)	Minimal (pessimistic)	Maximum (optimistic)
Costs of reclamation plantage plowing, million USD	696.8		
Additional profit per 1 year, million USD	80.0	47.5	121.8
Additional profit per 5 years, million USD	400.0	237.5	609.0
Additional profit per 10 years, million USD	800.0	475.0	1218.0
Additional profit per 45 years, million USD	3600.0	2137.5	5481.0

Source: author's research.

The results of the study under different scenarios (weather conditions) showed that over 45 years by the probable (average) variant potential additional profit is 3600 million USD, and by a pessimistic variant – 2137.5 million USD. At the same time, expenditures on amelioration plantage plowing on an area of 400 thousand hectares make up 696.8 million USD.

Conclusions

The theoretical bases of determination of economic efficiency of land reclamation investment-innovation projects are generalized. Assessment of the economic efficiency of land reclamation projects is based, in particular, on the following conceptual provisions: comparison of options: «with a project» and «without a project», taking into account the life cycle of the project, comprehensive assessment of economic and environmental results, including effects on soils and water resources. As a result of the performed research, the scientific and methodical principles of determining the economic efficiency of land reclamation investment-innovation projects are generalized and formed. The development includes basic conceptual provisions, key methodological approaches, principles, methods, criteria and indicators that will ensure the integrity and unification of the calculation of indicators of this efficiency. Proposed indicators should not be considered as a completed system, as they can be supplemented by others, taking into account the specifics of the functioning of individual enterprises, the existing information base and depending on the tasks. The selection of criteria and indicators of economic efficiency at each stage of the evaluation of the reclamation project and the methods of their calculation are carried out taking into account the purpose of the project implementation, the stage of evaluation, the scale of the assessment and the available information base.

The scientific and applied approaches to the evaluation of economic efficiency were worked out on the example of a concrete reclamation investment and innovation project, which made it possible for a first time, from the standpoint of systemic, situational and interdisciplinary approaches, to carry out a comprehensive assessment of the economic efficiency of the long-term (45 years) project of reclamation plantage plowing of chestnut solonetz under non-irrigated conditions. The results of the study indicate that the use of meliorative plantage plowing of alkaline soils contributes to an increase in the expert monetary valuation of an average of 3636.7 USD/ha or 3.3 times compared to the «without project» option, as well as an increase in the economic value of ecosystem services for soils by an average of 2543.2 USD/ha or 19.5%. At an average profitability of 57.0%, the static payback period of the land reclamation plowing project (cost 174.2 thousand USD per 100 hectares) by an additional profit is 8.71 years, while the discounted payback period is 9.95 years, which can be considered acceptable both from an economic and a technological standpoint. The indicators of the net present value (786.9 thousand USD for 45 years) and the profitability index (4.517) also indicate the economic efficiency and feasibility of the project implementation. At the same time, relatively long payback periods point to the need for state financial support for such projects and/or to seek innovative solutions to reduce the cost of meliorative plantage plowing and increase the payback from it.

Potential consumers of the research results are institutions of different levels of state management of agro-industrial production, in particular, the Ministry of Agrarian Policy and Food of Ukraine, the State Agency for Water Resources of Ukraine, agrarian enterprises when making management decisions on the feasibility of reclamation of innovative investment projects, scientific institutions and institutions of higher education of agrarian profile. The application of the results will increase the economic feasibility and effectiveness of the management decisions on ameliorative innovation and investment projects.

References

[1] Andriichuk, V. H. 2006. *Efficiency of activity of agrarian enterprises: theory, methodology, analysis*. Kyiv, KNEU.

[2] Bahorka, M. 2019. Formation of the ecological-economical management of ecologization of agrarian production. *Agricultural and Resource Economics: International Scientific E-Journal,* 5(1): 5–18.

[3] Balyuk, S. A., Drozd, E. N., Naidenova, O. E. and Nosonenko, A. A. 2019. Assessment of provisioning ecosystem services of irrigated salt-affected soils in Ukraine. *Eurasian Soil Science,* 52(4): 436–447. DOI:https://doi.org/10.1134/S1064229319040045

[4] Baritz, R. 2018. *Voluntary Guidelines for Sustainable Soil Management: Global Action for Healthy Soils*. In: Ginzky H., Dooley E., Heuser I., Kasimbazi E., Markus T., Qin T. (eds) International Yearbook of Soil Law and Policy 2017. Springer, Cham. DOI:https://doi.org/10.1007/978-3-319-68885-5_3

[5] Boiarkina, L. V. 2010. Scientific and practical aspects of the use of the electronic information base of "fertilizers" in the irrigated agriculture of southern Ukraine. *Zroshuvane zemlerobstvo* 53: 231–239. Available at: http://nbuv.gov.ua/UJRN/Zz_2010_53_36

[6] Boiarkina, L.V. 2013. Scientific and practical aspects of the use of the electronic information base "alfalfa forage" in irrigated agriculture in the south of Ukraine. *Zroshuvane zemlerobstvo,* 60: 71–77. Available at: http://nbuv.gov.ua/UJRN/Zz_2013_60_29

[7] Boiarkina, L.V. 2014. Scientific and practical aspects of the use of the program "electronic technological maps of the IIA NAAN" for planning of technologies of cultivation of agricultural crops under irrigation conditions. Irrigated agriculture. *Zroshuvane zemlerobstvo,* 61: 73–78. Available at: http://nbuv.gov.ua/UJRN/Zz_2014_61_27.

[8] Borisenko, V. and Rizhenko,Y. 2017. Determination of expedience of capital investments by the methods of internal norm of profitability and net present value. *Produktyvnist ahropromyslovoho vyrobnytstva,* 29: 18–24. Available at: http://nbuv.gov.ua/UJRN/Pav_2017_29_4.

[9] Dehtiarova, I.B. 2009. *Scientific bases for increasing the efficiency of ecological-economic systems taking into account synergetic effects*. PhD thesis, Sumy.

[10] Demchak, I.M., *et al.* 2015. *Methodological provisions and norms of productivity and consumption of electric power and fuel for irrigation of agricultural crops*. Kyiv, NDI «Ukrahropromproduktyvnist».

[11] Drozd, O. M. 2009. *Agrotransformed soils of Solonetzik Complexes the Dry-Steppe zone of Ukraine*. PhD work, Kharkiv.

[12] Dudoglo, T. 2018. Non-traditional approach to assessment of efficiency of agricultural production. *Agricultural and Resource Economics: International Scientific E-Journal,* 4(1): 60–76.

[13] Heldak, M., Kucher, A., Stacherzak, A. and Kucher, L. 2018. Structural transformations in agriculture in Poland and Ukraine: towards economic sustainability. *Journal of Environmental Management and Tourism* IX, 8(32): 1827–1841. DOI:https://doi.org/10.14505//jemt.v9.8(32).24

[14] Klepikov, A. D. and Antohenko, T. J. 2017. Influence of events of water conservation is on the productivity of farmlands. *Produktyvnist ahropromyslovoho vyrobnytstva,* 29: 57–61. Available at: http://nbuv.gov.ua/UJRN/Pav_2017_29_9

[15] Kokovikhin, S. V. and Boiarkina, L. V. 2011. Scientific and practical aspects of using the "Digitals" computer program to optimize the technologies of growing crops on irrigated lands. *Zroshuvane zemlerobstvo,* 55: 121–129. Available at: http://nbuv.gov.ua/UJRN/Zz_2011_55_19

[16] Kolot, A.M. 2014. Interdisciplinary approach as the dominant factor in the development of economic science and educational activity. *Sotsyalnaia ekonomika,* 1-2: 76–83.

[17] Kononenko, O. 2019. Transformation of land relations regulation mechanism throughout the rural sustainable development context. *Agricultural and Resource Economics: International Scientific E-Journal,* 5(1): 19–36.

[18] Kucher, A. 2019. *Sustainable soil management in the formation of competitiveness of agricultural enterprises*. Plovdiv, Academic publishing house «Talent».

[19] Kucher, A. 2017. Estimation of effectiveness of usage of liquid organic fertilizer in the context of rational land use: a case study of Ukraine. *Przeglad Wschodnioeuropejski,* VIII(2): 95–105.

[20] Kucher, A. V. 2017. Efficiency of organic land use. *Agricultural and Resource Economics: International Scientific E-Journal,* 3(3): 41–62.

[21] Kucher, A. V. and Kucher, L. Yu. 2015. Expert assessment of economic losses caused by soil degradation at agricultural enterprises. *Actual Problems of Economics,* 8: 165–169.

[22] Kucher, A. V., Anisimova, O. V. and Ulko, Ye. M. 2017. *Efficiency of innovations for sustainable soil management: theory, methodology, analysis*. Kharkiv, Publisher Brovin.

[23] Kucher, A. and Anisimova, O. 2016. Theoretical aspects of definition of economic efficiency of application of soil-protecting innovations. *News of agrarian sciences,* 10: 87–91.

[24] Methodical recommendations on the assessment of the efficiency of investment projects for the reclamation of agricultural land. Available at: http://www.alppp.ru/law/okruzhayuschaja-sreda-i-prirodnye-resursy/ispolzovanie-i-ohrana-zemli/10/metodicheskie-rekomendacii-po-ocenke-effektivnosti-investicionnyh-proektov-melioracii- sels.html

[25] Organizational and economic norms of expenses and informational and statistical materials on production of crop production by bioadaptive technologies. 2014. Kyiv, Nilan-LTD.

[26] Parmacli, D., Soroka, L. and Bakhchivanji, L. 2019. Methodical bases of graduation of indicators of efficiency of realized production in agriculture. *Agricultural and Resource Economics: International Scientific E-Journal,* 5(1): 107–121.

[27] Pasichnyk, T. V., Kucher, A. V. and Khirivskyi, R. P. 2016. Efficiency of agricultural enterprises of various organizational and legal forms and the size of land use. *Actual Problems of Economics,* 175(1): 399–405.

[28] Polischuk, K. 2015. Efficiency of biological preparations in the biological agriculture on reclaimed lands of Volyn Polissya. *Agricultural and Resource Economics: International Scientific E-Journal,* 1(1): 38–47.

[29] Pyrohovskaia, H. and Soroko, V. 2017. Economic efficiency of application of lime ameliorants on degraded peat soils. *Agrarian Economics,* 7: 38–46.

[30] Roik, M. V., et al. 2013. *Determination of economic efficiency of technologies, new techniques, inventions and completed scientific developments in crop production*. Vinnytsia, Nilan-LTD.

[31] Rokochynska, N. A., Kozhushko, L. F., Rokochynskyi, A. M. and Dupliak, V. D. 2004. *Temporary recommendations on the economic substantiation of land reclamation projects in the area of drainage reclamation*. Rivne, UDUVHP.

[32] Rokochynska, N. A., Kozhushko, L. F., Rokochynskyi, A. M. and Stasiuk, S. R. 2004. *Temporary recommendations on the economic justification of investments in projects of irrigation systems*. Rivne, UDUVHP.

[33] Rokochynska, N. A., *et al*. 2013. *Temporary recommendations on the assessment of investment projects for the construction and reconstruction of water facilities and reclamation systems.* Rivne, UDUVHP.

[34] Rokochynska, N. A., *et al.* 2010. *Temporary recommendations on optimization of water management of drained lands in projects of construction and reconstruction of water management and reclamation facilities*. Rivne, UDUVHP.

[35] Rokochynska, N. A., *et al*. 2011. *Temporary recommendations on the forecast assessment of water regime and water management technologies for drained lands in projects of the construction and reconstruction of reclamation systems*. Rivne, UDUVHP.

[36] Rokochynskyi, A. M., Frolenkova, N. A. and Koptiuk, R. M. 2013. Investment evaluation of projects for optimization of water regeneration of drained lands taking into account the main factors of influence. *Tavriiskyi naukovyi visnyk,* 83: 216–220. Available at: http://www.tnv-agro.ksauniv.ks.ua/archives/83_2013/43.pdf

[37] Salyha, K. S. 2005. *Efficiency of economic activity of enterprises*. Zaporizhzhia, ZTsNTEI.

[38] Salyha, Ya. S. and Melikhova, T. O. 2012. Principles of construction of indicators of efficiency of the financial security system of the entity. *Visnyk ekonomiky transportu i promyslovosti,* 40: 192–196.

[39] Sinchenko, V., *et al.* 2014. Improving method of determining cost efficiency of scientific research. *Scientific papers of the Institute of Bioenergy Crops and Sugar Beet,* 22: 42–47.

[40] Towhid, O. K. 2018. *Management of Soil Problems.* Springer International Publishing, XX. DOI:https://doi.org/10.1007/978-3-319-75527-4

[41] Ulko, Ye., Kucher, A., Salkova, I. and Priamukhina, N. 2018. Management of soil fertility based on innovative approaches to evaluation of arable land: case of Ukraine. *Journal of Environmental Management and Tourism* IX, 7(31): 1559–1569. DOI:https://doi.org/10.14505//jemt.9.7(31).18

[42] Vargas, R. *et al.* eds 2018. *Handbook for Saline soil management. Eurasian Soil Partnership implementation plan*. Rome, FAO.

[43] Vozhehova, R. A., Balashova, H. S. and Boiarkina, L. V. 2016. Electronic reference base as an element of information provision for the technological process of seed potatoes in irrigated southern Ukraine. *Zroshuvane zemlerobstvo,* 66: 22–26. Available at: http://nbuv.gov.ua/UJRN/Zz_2016_66_7

[44] Vozhehova, R. A., Kokovikhin, S. V., Konashchuk, I. O. and Boiarkina, L. V. 2012. Scientific and practical aspects of introduction of resource-saving innovative projects in irrigated agriculture of southern Ukraine. *Zroshuvane zemlerobstvo,* 58: 24–28. Available at: http://nbuv.gov.ua/UJRN/Zz_2012_58_9

[45] Vozhehova, R. A., Kokovikhin, S. V., Shepel, A. V. and Boiarkina, L. V. 2013. Application of information technologies for estimation of climatic conditions and calculation of water consumption of alfalfa for feed. *Tavriiskyi naukovyi visnyk,* 86: 18–23.

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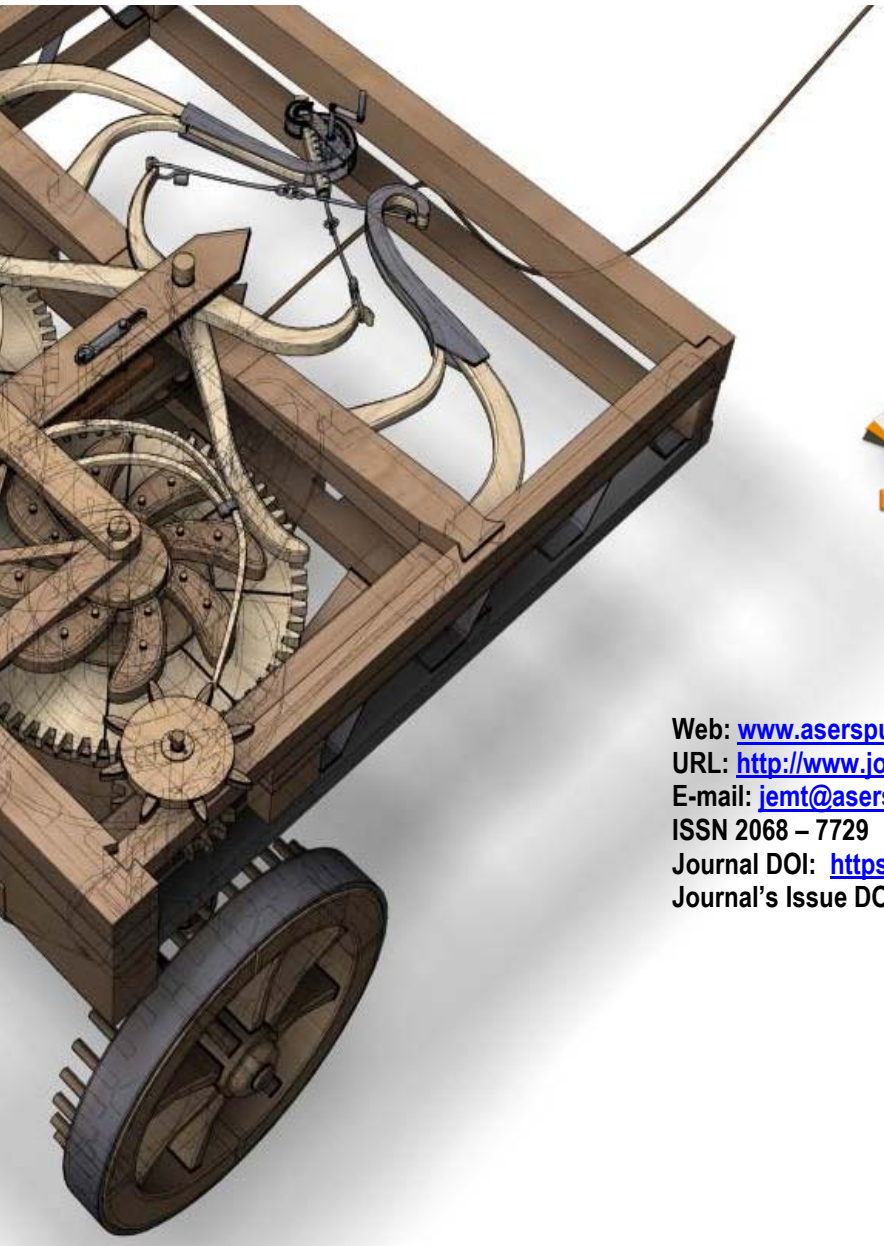

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