Criteria for determining the ecologo-economic and economic efficiency of agricultural land use and for ensuring its sustainable development

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Abstract. Against the background of present-day market relations, agriculture is gradually evolving into agricultural land use, whose sustainable development must be effective in terms of both economy and ecology while providing opportunities to integrate environmental policies into Russia's strategy for socio-economic reforms. One issue has gained considerable relevance in this regard, i.e. the need to substantiate and improve the criteria for determining the ecologo-economic and economic efficiency of agricultural land use and for ensuring its sustainable development in the Republic of Crimea. The article examines the theoretical and methodological framework of agricultural land use, its essence, criteria and system of indicators. Scientific views of economists are given regarding the definition of the term "efficiency" that are part of the notion of criteria for assessing agrarian land use. These include the financial result owing to the use of natural resources in agricultural production activities; changes in ecology due to soil fertility and environmental health; and the ability to deal with seasonal variations of agricultural output related to agricultural specificities. An analysis was made of Russian researchers' approaches to assessment of criteria for determining the ecologo-economic and economic efficiency of agricultural production. A relevance tree was drawn to represent the strategic objectives for ensuring the sustainable development of agricultural land use and a study was made of the different components of this relevance tree. The authors suggested a formula for calculating the ecologo-economic and economic efficiency (EEE) of the sustainable development of agricultural land use, which updates and enriches the methodological framework for its definition, exposed by the authors in economics literature. This formula takes into account the aggregate capital (AC), value-based human capital, increased gross value added as well as the impact of agricultural land use on the state of natural resources (land and water) and the environment. The suggested methodological approach was used as a basic set of criteria for determining the ecologo-economic and economic efficiency of the sustainable development of agricultural land use, which could enhance its sustainable development and contribute to environment conservation in agricultural entities of various types of ownership in the Republic of Crimea (see Annex for details). **Keywords:** criterion; economic efficiency of agricultural production; ecological efficiency of agricultural land use; economic efficiency of agricultural land use.

1. Introduction

In today's innovative development, Russian agriculture is gradually evolving into agricultural land use, whose sustainable development must be effective in terms of both economy and ecology. This is why current issues concerning the environment and the sustainable development of agricultural land use in general and, particularly, in the Crimea, are becoming increasing relevant and show a need to seek solutions for ensuring and enhancing it by fostering a rational, sustainable and caring attitude towards natural resources and by maintaining environmental balance.

At the present stage of market relations, agricultural development and a deepening environmental crisis in Russia have had a negative impact on the environment and soil fertility, aggravating the challenge of their recovery. Consequently, in the agricultural sector

of economy, the sustainable development of agricultural land use should provide opportunities for integrating environmental policies into Russia's strategy for socio-economic reforms, which is related to the reliable criteria-based assessment of its economic and ecological efficiency affected by many indicators under investigation in this study.

Criteria for assessing ecologo-economic and economicl efficiency in agricultural land use need to be laid down to ensure its sustainable development. It should be highlighted that both Russian and international researchers have contributed to the study, on one hand, of the theoretical, methodological and practical aspects of the ecological and economic efficiency assessment and, on the other, of the economic system's impacts on the environment. A significant contribution to research in these areas was made by O. F. Balatsky, I. K. Bystryakov, O. O. Veklich, B. M. Danilishin, S. I. Doroguntsev, N. V. Karayeva, L. G. Melnik and Ye. V. Khlobystov, among others.

Modern economic researchers propose different definitions of the ecologo-economic and economi efficiency criterion. As an example, V. L. Dikan and A. G. Deyneka consider that the criterion means maximizing environmental benefits while keeping agricultural land use expenses to a minimum. In their opinion, the ecological and economic benefit results from the development of production, i.e. it inherently acts as a variety of the economic benefit while having a social dimension.

This interpretation seems to be correct, since this is a question of assessing the most ecologically efficient measures taken to preserve natural resources and the environment. This criterion, however, is not so good for assessing the production results of agricultural land use.

Furthermore, these researchers' developments do not reflect the impacts of various factors on the production efficiency criterion taking into consideration the impact of agricultural land use on the state of natural resources (land and water) and on the environment.

Therefore, this controversial issue needs to be addressed by elaborating a theoretical framework to determine the ecologo-economic and economic efficiency criteria in terms of agricultural land use, which is the purpose of this paper.

The present research aims to substantiate the criteria for determining the ecological and economic efficiency of the sustainable development of agricultural land use as the integral economic performance of agricultural production. It will also take into consideration the impact of agriculture on the environment and soil fertility with a view to ensure sustainable agricultural land use, which will contribute to the integration of environmental policies into Russia's strategy for socio-economic reforms in the agricultural sector of the national economy, given that ecology and economy are inextricably linked to each other.

2. Methods

The research methods adopted in this paper include analysis of research literature on the criteria for determining the ecologo-economic and economic efficiency of the sustainable development of agricultural land use.

A critical analysis was made of the substance of economic efficiency reflecting the performance of agricultural enterprises, while an ecologo-economic analysis reflected various aspects of the use of natural resource (land, water and biological resources) as environmental factors to be preserved and restored. Besides, economic sustainability depends on the oscillatory nature of the agricultural production process influenced by weather patterns and climate.

Other methodological tools adopted in the present research include the dialectic, systematic, economic, mathematical and comparative approaches used to enhance the sustainable development of agricultural land use.

The aim of the research was to carry out a critical analysis of different approaches to assessing the results and expenses, on which depends the performance of enterprises and the state of the environment in the agricultural sector of Russian economy. The results were used to draw a relevance tree showing the objectives of the criteria-based assessment of the ecological and economic efficiency of the sustainable development of agricultural land use. Additions and amendments were also made to the relevant calculation formulas.

3. Results

The main objective of any agricultural enterprise is to maximize production and profits by making natural resource users exert continuous influence on the environment.

Besides, external factors or *externalia* often emerge in agricultural production and manifest themselves in the constant impact which natural resource users make on the environment and soil fertility and which need to be taken into account.

The substance of the economic and ecologo-economic efficiency of agricultural production is expressed through specific criteria and indicators.

In theory, the substance of each of the following notions – a) economic efficiency of agricultural production, b) ecologo-economic efficiency of agricultural land use and c) economic sustainability of agriculture – differs in terms of content and is reflected in the system of indicators and in ways to calculate them.

Consequently, the criteria-based assessment of the ecologo-economic efficient development of stable and sustainable agricultural land use reflects both the obtained financial result and ecological changes in soil fertility and the environment as well as the ability to overcome specific seasonal fluctuations in production processes. It is, therefore, necessary to analyze the theoretical and methodological combinations of the three efficiency modes integrated into the notion of criteria-based assessment.

A criterion (from Ancient Greek *kriterion*, “a means of judging”) is a peculiarity, a basis for or a measure of evaluation used to assess the efficiency or lack thereof of production. Generally speaking, it refers to maximum effects gained from every unit of invested public effort or minimum of expense of public effort per impact unit. For some producers, profit maximization is the benchmark of their economic performance, since it represents the major purpose of production in a market economy. Therefore, specific indicators are important to quantify economic efficiency.

According to Wikipedia [1], there are logic criteria of trueness (by form) and empirical or experimental one and criteria-based assessment and the criteria-based comprehensive approach cover an entire set of indicators.

According to S. M. Kontsevaya and G. F. Shurmina, “economic efficiency is a theoretical and practical basis for managerial decision-making reflecting economic relations in respect of the outcome-expense ratio that results from this process. Differences in assessments, obtained results and incurred expenses produces an effect providing insights into what an enterprise will obtain by using managerial means, methods and tools. This result can be presented in two ways: as a difference between the cumulative effect and cumulative expenses or as a difference between cumulative effects and current expenses only” [2, pp. 28-29].

Given stable resource potential and reduced material and labor inputs, the increase in agricultural production depends on increased economic efficiency of agriculture [3].

In this context, the criteria-based assessment of the ecologo-economic efficiency of the sustainable development of agricultural land use can be represented as a relevance tree (Fig. 1).

Building on the views of Russian and international economic researchers, the authors conducted a consecutive analysis of the different components of this relevance tree, discussed below.

American researchers McConnell and Brue [4] suggest that productive efficiency is related to a rational and appropriate use of resources and to their amount: the more resources are used; the more products can be produced and the more profit/efficiency one can get.

Heine states that "efficiency is always related to the resulting value-cost ratio" [5, p. 170].

Palynin highlights that "production is considered efficient only when production outcomes outweigh materialized and direct labor costs, i.e. when the so-called added value is achieved" [6, p. 34].

Eklund [7] observes that economic efficiency characterizes the production of the required quantity of goods by using a specific quantity of resources. This definition, however, does not echo investments and the result.

Ukhalevich [8, p. 82] points out that consumers' interests affect economic efficiency and, as a result, efficiency must reflect the interests of consumers.

According to Stelmashchyuk [9], the structure of production and of needs are related to its efficiency and to the quality of products, works and services. Pavlishchyuk, a stalwart supporter of this concept, [10] believes that production efficiency must be inextricably linked to the quality of the products and services.

Many Russian economic researchers put forward the hypothesis about efficiency back in the 1970s and 1980s. This hypothesis is based on the following relationship: costs – cost saving – cost recovery – growth in profits. However, it does not reflect the impact of other factors on production efficiency.

Consequently, in order to determine the economic efficiency of agricultural production, it would be appropriate to adopt a system of indicators which reflect not only impact measurement, but also all kinds of production resources in use and weather conditions. The economic nature of these indicators shows a great diversity and is not always comparable.

Based on the above, there are two ways to calculate economic efficiency indicators: 1) by dividing the result by the sum of resources or costs or 2) by determining the difference between the result and the cost of obtaining it.

At the present stage of economic development, economic theory has provided a clear rationale for the role and importance of the aggregate capital for any production entity.

In our view, the economic efficiency of any enterprise's performance can be calculated as per Formula 1:

$$E = \frac{\Delta P}{\Delta AC}, \quad (1)$$

Where E is the economic benefit, in rubles;

ΔP, growth in profits, in rubles;

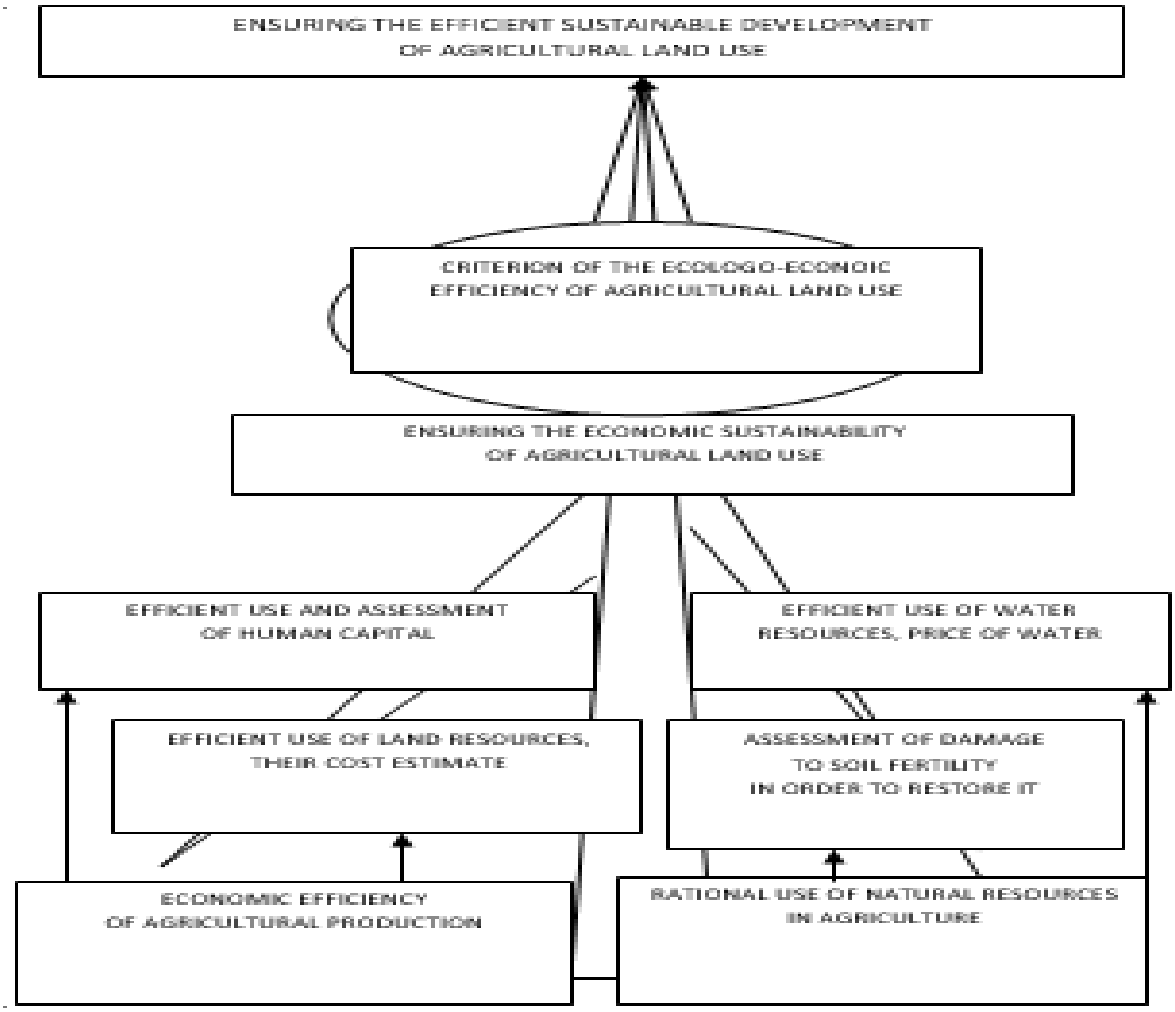

Fig. 1. Relevance tree for a criteria-based assessment of the ecologo-economic efficiency of the sustainable development of agricultural land use

**Source: Drawn by the authors.*

ΔAC, growth in the aggregate capital, in rubles.

When expanded, Formula 1 will be as follows:

$$E = \frac{(P_b - P_a)}{(AC_b - AC_a)}, \quad (2)$$

Where P_b и P_a are profits obtained before and after the growth of capital, in rubles;

AC_b и AC_a are the aggregate capital before and after the growth, in rubles [11, p. 14].

It is, however, advisable to expand Formula 1, since the aggregate capital (AC) comprises fixed and current assets (including biological assets), human capital, valuation of land before and after the growth of capital and valuation of water before and after the growth of capital.

In this case, the above formula will be as follows (Formula 2):

$$E = \frac{P_a}{HC_{gc} + FA_{gc} + CA_{gc} + L_{gc} + W_a} - \frac{P_b}{HC_b + FA_b + CA_b + L_{vb} + W_b}, \quad (3)$$

Where HC_b и HC_{gc} are human capital before and after the growth of capital, in rubles;
FA_b and FA_{gc}, fixed assets before and after the growth of capital, in rubles;
CA_b and CA_{gc}, current assets before and after the growth of capital, in rubles;
L_{vb} and L_{gc}, valuation of land before and after the growth of capital, in rubles;
W_b and W_a, valuation of water before and after the growth of capital, in rubles.

Importantly, the indicator for the growth of capital does not fully reflect the efficiency of regional economy, since State revenues, budget replenishment and the income of the population have not been taken into consideration here. This is why the growth of gross value added (GVA), rather than the growth of profits, will most fully reflect economic production efficiency, as the gross value added includes State revenues, the income of the population and business profits.

In this case, the formula for calculating the economic production efficiency of a country or a region can be as follows:

$$E = \frac{GVA_{gc}}{HC_{gc} + FA_{gc} + CA_{gc} + L_{gc} + W_a} - \frac{GVA_b}{HC_b + FA_b + CA_b + L_{vb} + W_b}, \quad (4)$$

Where GVA_b and GVA_{gc} are the gross value added before and after the growth of the aggregate capital, in rubles.

Formulas 3 and 4 include another major indicator, i.e. valuation of human capital, which is calculated based on investments in human capital.

Modern economic researchers propose different definitions of the ecologo-economic and economic efficiency criterion. As an example, V. L. Dikan and A. G. Deyneka [12] consider that the criterion means maximizing environmental benefits while keeping agricultural land use expenses to a minimum. In their opinion, the ecological and economic benefit results from the development of production, i.e. it inherently acts as a variety of the economic benefit while having a social dimension.

This interpretation seems to be correct, since this is a question of assessing the most ecologically efficient measures taken to preserve natural resources and the environment. This criterion, however, is not so good for assessing the production results of agricultural land use due to the fact that the main objective of any agricultural enterprise is to maximize production and profits by making natural resource users exert continuous influence on the environment.

Melnik [13] attributed this to the fact that the system of economic indicators comprises resources such as direct and past labor, while the environment does not. In agriculture, the adopted economic indicators include only the initial effect of measures undertaken and compare costs and results without considering environmental impacts.

Undervaluation of environmental factors and low environmental awareness favorably affects economic production efficiency.

In our opinion, ecologo-economic efficiency is an economic result obtained from agricultural production, taking into account the impact of agricultural land use on natural resources, i.e. land and water, and on the environment.

In this regard, Doroguntsev and Mukhovikov [14] highlight the urgent need to consider the impact of production on the agro-ecological condition of land resources. This view should be accepted, given that this indicator reflects the efficient use of material and

human resources in the production process, along with costs of environmental decontamination or pollution prevention resulting from agricultural activities.

Bobylev [15, 16] believes that ecologo-economic efficiency in agriculture is subject to many factors affecting the state of natural resources. These include the technological sophistication of production with regard to soil fertility and reclamation as well as the phytosanitary quality of soils; the optimal structure of farmland, cropland and agricultural landscape; the ratio between rotations of soil-improving and soil-destructive crops and crop rotation seasons; applied soil protection activities such as forest improvement, counter-erosion and engineering reclamation; compensation for depletion of nutrients due to intensive agricultural practices; integrated efforts to protect plants and animals by using agro-biological means; the extent and optimization of the machines' impact on the soil during soil treatment; the use of irrigated land taking into consideration the ratio between the water supplied and water consumption by agricultural crops; the condition of the reclamation system (facilities and entities); rational use of natural forage lands; construction and operation of treatment plants, fertilizer and manure warehouses, among others; condition of agricultural livestock and agro-chemical services; and compliance with the recommendations (tentatively) developed by agricultural production technology.

In our view, this list of twenty-three indicators reflecting the environmental impact of agricultural production is important and needs to be taken into consideration without, however, being a criteria of ecologo-economic efficiency.

Veklich [17, 18] considers that the main criterion of the ecologo-economic efficiency of agricultural production are efforts to meet public demand for production while optimizing production costs and preserving the environment. In our opinion this criterion makes it possibly to give a synchronous assessment of the production process in terms of meeting public demand for agricultural products without exceeding the maximum permissible use of the environment, taking into account achieved economic benefits or losses.

The most popular criterion for determining production efficiency is a net profit which is, in fact, nothing but an economic category. At the same time, it cannot give a true estimate of how fertilizers, pesticides and other nutrients affect the environment. In other words, this criterion does not consider environmental consequences, which can be both positive and negative. Importantly, there is no universally recognized method for calculating these environmental consequences and keeping records on ecologo-economic efficiency is a relatively recent procedure in agriculture.

Karayeva [19] suggests that calculations of ecologo-economic benefits or damage should provide a basis for determining the ecologo-economic efficiency of agricultural production.

Ecologo-economic damage refers to losses incurred during the agricultural production process due to human influences on the condition of natural resources (land and water) and the environment and their compensation. To calculate ecologo-economic damage, a compensation approach is adopted, based on the valuation of expenditures required to prevent or repair damage inflicted to the environment during agricultural activities. Additionally, the cost of lost agricultural products is calculated. These expenditures are determined according to the cost of pollution prevention, which includes, on one hand, calculations of capital investment in the design, construction and development of facilities, entities, equipment and technologies with a view to prevent or reduce damage to the environment and, on the other hand, recurrent costs conducive to effective agricultural production.

The authors consider that the ecologo-economic benefit is a variety of the economic benefit that can be defined as the difference between production outputs and production costs, adjusted to the value of ecologo-economic damage. It should be calculated by

comparing the agricultural output over a certain period of time. Specifically, a comparison is made between gross and final output as well as production costs. Deterioration of qualitative environmental indicators due to the environmentally illiterate production process management should also be taken into consideration, as well as its direct and indirect harm.

To increase the ecologo-economic benefit and identify its stocks in agricultural production, specific information is needed, which can be obtained from a number of activities such as an analysis of real ecologo-economic efficiency in order to devise projections and business plans for enterprises, industrial complexes, farms and more. These activities also include the development of comprehensive programs designed to make use of scientific and technical achievements and to devise and appraise technical, organizational and other activities. Attention should be given to the fact that there are two different types of the ecology-economic benefit, the actual one and the expected one. The former refers to the benefit observed in the relevant sector over a specific period of time and calculated by comparing the actual indicators related to economic activity while considering the environmental damage to the enterprise due to the environmentally unstable agricultural production management. The expected effect is determined by a thorough analysis of expenditures, outcomes and incurred damage. These indicators are necessary to develop future-oriented activities such as forecasts and agricultural development plans for a region, a sector, an agricultural enterprise and its departments as well as technic, organizational and other activities.

In finding the best option for achieving desired production figures, in terms of both economy and ecology, at the lowest possible cost, the comparative ecologo-economic efficiency should be determined by comparing the indicators for absolute efficiency and ecologo-economic damage.

In determining the ecologo-economic efficiency of plant production, specificities of agricultural land use are to be taken into consideration, along with specific land uses. The fact is that, throughout the economic reform's implementation, the elimination of the crop rotation system and of one-crop wheat production in addition to insufficient organic and mineral fertilization have led to a sharp drop in soil fertility, which should be seen as environmental damage [20].

Golub [21] suggests to calculate the economic benefit (ECON) and the environmental benefit (ENV) through the soil fertility benefit (Fert.) according to Formula 5:

$$ENV = ECON + Fert. \quad (5)$$

The already mentioned Formula 6 is used to determine the economic benefit:

$$ECON = YP - C = NI, \quad (6)$$

where:
Y is yield, dt/ha;
P is the sale price of 1 dt, in rubles;
C are costs, in rubles/ha;
NI is the net income, in rubles.

Furthermore, Golub believes that the soil fertility benefit is due changes in humus content, which accurately reflects the trend in changing soil fertility. At the same time, an increase or a decrease in the net income depends on the cost of the additional production received or lost, thus adjusting the dimension of ecologo-economic efficiency.

A textbook on economic theory [22] suggests to define ecologo-economic efficiency (E) at the present stage of Russia's development as the economic efficiency and land use efficiency of an economic entity according to Formula 7

$$E = E_0 - (A + B + C), \quad (7)$$

where E_0 is the overall economic benefit of an economic entity, in rubles;
A is the cost of nature-conservation programs, in rubles;
B are losses arising from damage to the natural environment, in rubles;
C is the cost of natural resources, in rubles.

Importantly, Formula 7 does not divulge the nature of the A, B and C indicators, given that the total sum of natural resources (land and water) exceeds the economic benefit of an economic entity, which makes Formula 7 unacceptable.

Ivatanova [23] proposes to environmentalize the traditional value figures and to create strong incentives to ensure environmentally friendly economic activities. At the same time, Ivatanova believes that the overall criterion of the ecologo-economic benefit in terms of land use will result, at the enterprise, in social cost savings of the environmental resources (SCer) involved in the land use process. This indicator is compared to the performance standard and comprises the overall cost savings of the environmental resources involved in the land use process and of costs of environment protection and environmental restoration.

Relevant calculations are made according to Formula 8:

$$SCe = SCer + SCenv, \quad (8)$$

where

SCer are social costs of the environmental resources involved in the land use process (justified by the public interest), in rubles;

SCenv are social costs of environment protection and environmental restoration of acceptable quality, in rubles.

What makes the suggested calculation method interesting is its environmental dimension. This method, however, does not reflect the production process itself, whose growth is due to the minimization of resources consumption, including the environment resources.

Nevertheless, Ivatanova [23] considers that it is possible to generalize the assessment of the ecologo-economic efficiency of land use by calculating the indicator for natural capital cost-effectivness (Cce) while respecting environment-related limitations. Ivatanova suggests to calculate this indicator as a ratio of the total sum of profits from production and commercialization of products, taking into consideration socially necessary environmental costs, to the cost of natural capital involved in the production process, taking into consideration the cost of environmental resources. It is suggested to adopt Formula 9:

$$C_{ce} = \frac{\sum_{t=1}^{T}\sum_{i=1}^{n}[(P_{e\ it} - FP_{e_{it}}) \times X_{it} - H_{it} - Tpf_{\ it}]}{Nc(e)}, \quad (9)$$

where:
t is the index of year;
T is a given period, in years;

i is the index of a recoverable resource;
n is the quantity of resources, in tons;
Pe_{it}, FP_e are the price and the first price of the realization of products, in rubles;
Tpf_{it} are taxes, payments and fines related to natural resources, in rubles;
Nc is the price of natural capital, in rubles.

This indicator reflects more accurately the ecologo-economic efficiency of production.

In evaluating this approach, however, it is noteworthy that not only natural capital participates in creating production and the final benefit. This formula does not include the logistic means, both fixed and circulating, and human capital. Importantly, only a combination of the resources (natural resources, logistic means and human capital) involved in the production process can give an ecologo-economic benefit.

Bondarenko [24] believes that economic efficiency in agro-business largely depends on the rational use of agro-ecological resource potential and, above all, on land resources and soil fertility. In other terms, resources such as direct and past labor are part of the system of economic measurement, while natural resources are not.

4. Discussion

In the current system of economic activities, humanity borrows from nature, so to say. Information about the ecological damage from production processes is not reflected in the financial outcome of economic activities. This is why the absence of information about the extent of ecological damage to the environment distorts the real economic efficiency and does not encourage agricultural enterprises to shift to ecologically safe agricultural technologies.

Roshchina [25, p. 80] states that, today, increased destruction of agricultural ecosystems, reduced soil fertility and environmental pollution all over the world leads to more serious environmental problems and stands in the way of both the sustainable economic development of regions and competitiveness of national economies.

Therefore, the authors think that all forms of damage caused to natural resources and the environment during the agricultural process should be taken into consideration.

The above critical analysis of the views on ecologo-economic efficiency leads to the following conclusions:

1. The criterion of the ecologo-economic efficiency of agricultural land use must reflect agricultural production outcomes, taking into account their environmental impact on natural resources.

2. Agricultural production results from the impact exerted on natural resources (land, animals, plants, etc.) by human labor and its means of production. At the same time, in terms of pricing, workforce is assessed as human capital that uses, in the production process, the combined fixed and current assets in relation to natural resources (land, animals, plants, etc.). The latter are evaluated at their market value at the time of purchase or according to a monetary evaluation at the preliminary price in case of exchange transactions.

Based on the above, the authors suggest Formulas 10 and 11 to calculate the ecologo-economic efficiency (EEE) of the sustainable development of agricultural land use:

$$EEE_1 = \frac{I_2 - ED_2}{HC_2 + FA_2 + CA_2 + MENR_2 + W_2} - \frac{I_1 - ED_1}{HC_1 + FA_1 + CA_1 + MENR_1 + W_1} \quad (10)$$

$$EEE_2 = \frac{GVA_2 - ED_2}{HC_2 + FA_2 + CA_2 + MENR_2 + W_2} - \frac{GVA_1 - ED_1}{HC_1 + FA_1 + CA_1 + MENR_1 + W_1} \quad (11)$$

where:

I_1 and I_2 are income from agricultural activities for the first and second years being compared, in rubles;

GVA_1 and GVA_2 are the region's gross value added of the first and second years being compared, in rubles;

HC_1 and HC_2 are the human capital of the first and second years being compared, in rubles;

FA_1 and FA_2 are the fixed assets of the first and second years being compared, in rubles;

CA_1 and CA_2 are the current assets of the first and second years being compared, in rubles;

$MENR_1$ and $MENR_2$ is the monetary evaluation of natural resources (land, animals, plants, etc.) for the first and second year being compared, in rubles;

W_1 and W_2 is the cost of water consumption for the first and second year being compared, in rubles;

ED_1 and ED_2 is environmental damage for the first and second years being compared, in rubles.

It should be clarified that, in the first case, ecologo-economic efficiency is determined by an increase in profits to the changed potential minus damage. This is the best option for specific enterprises, farms and enterprise groups. Official Handbooks of Statistics for the Crimea (in our case) point to profit margins before taxation and, therefore, the gross value added is best to use as an efficiency indicator, since it includes the profits, the total income to the budget and the salary of workers. This is a highly interesting and importance efficiency indicator.

Savin points out that "the efficiency of a productive organization is a multi-criteria notion. The principle of efficiency underlies the assessment of any system and its modifications, while the choice of an appropriate criterion of efficiency depends on the organization's operation, purpose and strategy, which are reasons for modifications" [26].

Calculations of the ecologo-economic efficiency of agricultural land use in the Crimea according to Formula 11 showed that the gross value added for 2015 grew 184.2% compared to 2005, while its production capacity dropped 19.4% due to the decreasing costs of natural resources (farmland by 1.7% and water resources by 24.7%); the monetary evaluation of farmland was down 0.8% resulting in environmental damage. In 2005, the 1,000-rouble potential produced 4.8 rubles, whereas it produced only 2.6 rubles in 2015. Overall efficiency declined sharply, although agricultural efficiency did grow.

Natural resources, i.e. land, biological assets and water, that are used in agricultural production lose part of their initial cost in the production process and require rehabilitation measures.

5. Conclusion

Based on the research on the above-mentioned current methods used to assess the criteria for identifying the ecologo-economic and economic efficiency of agricultural production, a relevance tree was drawn to establish the strategic objectives for ensuring the sustainable development of agricultural land and an analysis of its components was carried out. Furthermore, the authors suggested a formula to calculate ecologo-economic efficiency which seems to make a more reasonable and precise assessment of it.

Our approach is based on the following. In identifying the ecologo-economic efficiency of agricultural production, the main challenge is to substantiate the specificities of agricultural land use in general and in specific contexts. In finding the best option for achieving desired production figures, in terms of both economy and ecology, at the lowest

possible cost, the comparative ecologo-economic efficiency should be determined by comparing the indicators for absolute efficiency and ecologo-economic damage.

The criterion of the ecologo-economic efficiency of agricultural land use is a growth in profits compared to the preceding profit period (for enterprises, firms and other business entities) or the gross value (for sectors or regions) per productive capacity, i.e. the sum of fixed and current assets, human capital and the cost of natural resources being used.

In our view, ecologo-economic efficiency is the economic result of agricultural production, taking into consideration the impact of agricultural land use on natural resources (land and water) and the environment.

An analysis of the Crimea's agricultural land use confirms that the growing economic efficiency of agriculture for the period 2000-2015 is accompanied by the deterioration of natural resources (land and water). The monetary evaluation of farmland has equally decreased, echoing the incurred environmental damage.

The suggested formula for calculating the ecologo-economic efficiency (EEE) of the sustainable development of agricultural land use updates and enriches the methodological basis of its definition, exposed by the authors in their research work. It is expected to foster the development of economic relations in the agricultural land use of the Republic of Crimea with a view to ensure its sustainable development and to preserve the environment.

Research shows that the sustainable development of agricultural land use with due regard for environmental issues is only possible by promoting an integrated approach to dealing with major challenges facing Russia's agricultural sector. These include the focus on the biological and environmental aspects of agricultural processes; the differentiated use of natural, labor and other resources; and the development of highly productive and environmentally sustainable agro-systems.

The suggested methodological approach can be used as a basic tool for determining the ecologo-economic and economic efficiency of the sustainable development of agricultural land use including all efficiency indicators. The aim is to identify its real dimension and production reserves in agricultural production and to respond to one of its major challenges, i.e. optimization of its structure. The latter takes into account the return level fostering the sustainable development and preservation of the environment in agricultural entities of various forms of ownership in general and in the Republic of Crimea, in particular (see Annex for details).

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Notes: The Annex includes a report on the use of propositions based on the following: a research study by Yu. V. Roshchina: Association of the Crimean Farmers and Landowners of 17 January 2014, No. 11; Belogorsk District State Administration in the Republic of Crimea of 11 December 2013, No 8495/01-6; and Nizhnegorsk District State Administration in the Republic of Crimea of 24 December 2013, No. 15-09-1256.

6. ACKNOWLEDGEMENTS

This study was carried out without any financial support. The authors made an equal contribution to the study.