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ENVIRONMENTAL AND ECONOMIC ASSESSMENT OF THE LAND USE REGULATION EFFECTIVENESS

Oleksandr Harnaha[1], Natalia Savina[1], Volodymyr Hrytsiuk[2]
[1]National University of Water and Environmental Engineering, Institute of Economics and Management, Rivne, Ukraine, [2]National University of Water and Environmental Engineering, Nadsluchansky Institute, Berezne, Ukraine

Abstract. *The article reveals the aspects of environmental and economic assessment of the land use regulation effectiveness. It is emphasized that in order to use land resources rationally and successfully implement scientifically sound farming methods, it is necessary to have holistic and reliable information about land, its productive properties, natural and economic condition. It is noted that the efficiency of land use should have quantitative parameters characterizing each of the aspects directly involved in the process of land use regulation.*

Keywords: land pollution, soil, economic indicators, environmental economics

ŚRODOWISKOWA I EKONOMICZNA OCENA SKUTECZNOŚCI ROZPORZĄDZENIA O UŻYTKOWANIU GRUNTÓW

Streszczenie. *W artykule przedstawiono aspekty środowiskowej i ekonomicznej oceny skuteczności regulacji dotyczących użytkowania gruntów. Podkreśla się, że aby racjonalnie wykorzystywać zasoby ziemi i skutecznie wdrażać naukowo uzasadnione metody gospodarowania, konieczne jest posiadanie całościowej i rzetelnej informacji o ziemi, jej właściwościach produkcyjnych, warunkach przyrodniczych i ekonomicznych. Należy zauważyć, że efektywność użytkowania gruntów powinna mieć parametry ilościowe charakteryzujące każdy z aspektów bezpośrednio zaangażowanych w proces regulacji użytkowania gruntów.*

Słowa kluczowe: zanieczyszczenie gleby, gleba, wskaźniki ekonomiczne, ekonomika środowiska

Introduction

One of the most important principles of land use is the establishment of a scientifically sound relationship between economic and environmental parameters. This is also an important principle of balance and conformity. Land use is a complex integrated economic system that contains many subsystems. In this regard, it is necessary to take into account the degree of human activity impact on the environment and strictly comply with the requirements of ecological balance in each specific land use in the process of land management. In order to use land resources rationally and successfully implement scientifically sound farming practices, it is vital to have complete and reliable information about the land, its productive properties, natural and economic condition. The point is that the lands of different zones, districts, farms and even individual plots, which have their own special spatial conditions, relief, soil cover, vegetation, water regime, geological structure, as well as other natural and climatic resources, vary greatly in terms of their properties and suitability for agricultural production. Therefore, these land properties have a different impact not only on crop yields, but also on production costs, labor productivity, gross product and net income, as well as on the development and implementation of measures aimed at protection of land and related natural resources and surrounding environment.

Ecological and economic aspects of land use development have been holistically studied by the domestic scientists as H. Hutsuliak [5], D. Dobriak [2], A. Tretiak [10], A. Sokhnych [9] and others.

It has been established that if the land is properly cultivated, it increases its fertility and has a beneficial effect on the environment. At the same time, the study of this issue and numerous data show that while in the process of use, land properties haven't been improved, but deteriorated and even destroyed, if the wrong farming methods are used.

In this regard, there are numerous recommendations to improve technological processes in agricultural technology, preparation and application of fertilizers, and the use of complex mechanization in soil and crop cultivation. At the same time, the issues of technical influence on the structural condition of the soil are not sufficiently studied today. Farms located in different natural and climatic zones with completely different soils in terms of fertility and mechanical composition are equipped with practically the same machinery and farming methodology.

1. Systematization of parameters for assessing the effectiveness of land use regulation

The effectiveness of land resources use should have quantitative parameters characterizing each of the aspects directly involved in the process of land use regulation.

The integrated performance indicator contains a generalized assessment of the phenomenon, and assumes the existence of a plurality of indicators that quantitatively reflect different aspects of the processes taking place. So, for example, the criterion of economic efficiency reflects the generalized result of an economic phenomenon on the basis of which evaluation, definition and classification of partial indicators of efficiency are carried out. It is associated with the use of limited resources and the production of consumer goods. Many scientists researching the field of land use divide efficiency into several types: economic and ecological. This indicates the expediency of recognizing the multivariate performance criterion.

The concept of effective land use is very complex and multifaceted and can not be clearly defined. Highlighted in one of its aspects, it can be formulated incorrectly in the sense of the complex meaning of the concept itself. Essence effective land use in agricultural production is formed by two main aspects: economic and ecological.

To define the economic efficiency of land resources use, it is expedient to apply quantitative resource parameters: an indicator of the efficiency of capital investments, resource potential, intensification of agricultural production, etc. At the same time, each of the listed parameters is a complex feature that includes components elaborating it. In particular, the concept of intensification of land resources use in a market economy is inextricably linked with the territorial organization of new forms of management, which, takes into account natural and landscape conditions, as well as forms of ownership established in modern land relations.

Environmental component is important from the point of view of efficiency assessment [7], which in land use is characterized by three main groups of parameters: soil quality criteria, natural landscape conditions, as well as pollution and degradation of land resources.

Based on the analysis and parameters characterizing the economic and ecological components of land use, a set of indicators was formed that will determine the effectiveness of land use development.

A set of parameters for each of the environments (ecological, economic) determines indicators that will be used to assess the effectiveness of land use regulation.

The main indicators in terms of the economic environment include:

- agricultural production growth index;
- agricultural products per capita;
- the amount of capital investment per hectare of agricultural land;
- average monthly nominal wage of full-time employees in agriculture field.

Indicators characterizing the ecological environment include:

- share of agricultural arable land under organic fertilization;
- level of plowing of agricultural lands;
- share of eroded land;
- weighted average humus content.

2. Aggregated indicators

The next step will be defining of aggregated indicators, that is, indicators that are calculated from several separate basic indicators and characterize the state of related group indicators of the economic and ecological environment. We will determine them by the arithmetic mean method (table 1).

Each basic indicator is evaluated on a four-point scale. The highest score is assigned to the indicator that is closest to the benchmark value. The maximum number of points per group is 16.

The integrated indicator is calculated according to the formula of the arithmetic mean among the defined aggregated indicators.

Unlike ecological indicators [1], economic basic indicators belong mainly to positive indicators, the growth of which enhance the development of the ecological and economic system to the reference state.

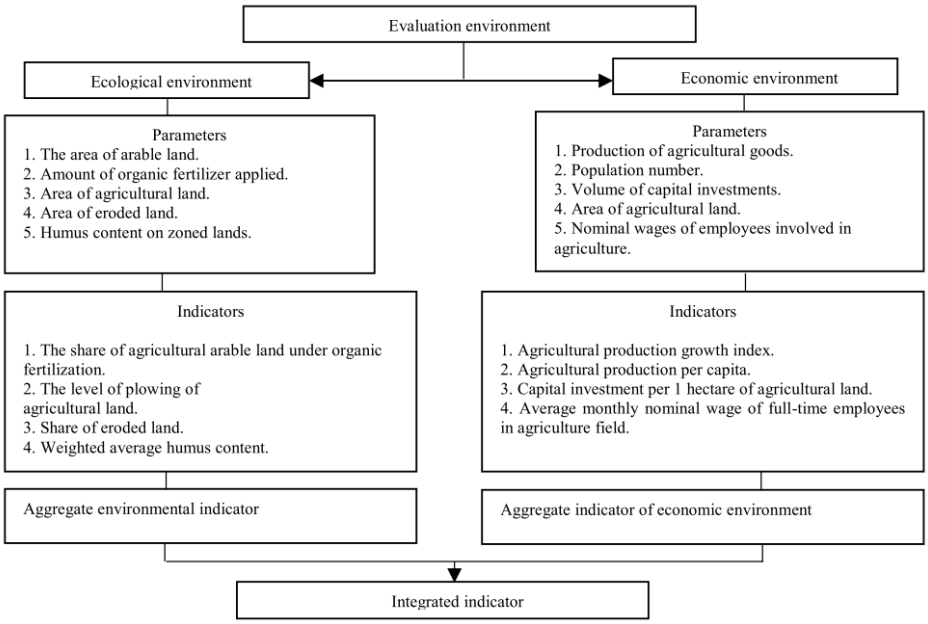

Fig. 1. Systematization of parameters for assessing the effectiveness of land use regulation

Table 1. Calculation of aggregated indicators

No	Aggregate indicator	Basic indicators	Calculation of the aggregate indicator
1	Economic environment	Agricultural production growth index (X_1)	$AIecon. = \frac{X_1 + X_2 + X_3 + X_4}{16}$
		Agricultural production per capita (X_2)	
		The volume of capital investments per 1 ha of agricultural land (X_3)	
		Average monthly nominal wage of full-time employees in agriculture field (X_4)	
2	Ecological environment	Share of agricultural arable land under organic fertilization (U_1)	$AIecol. = \frac{U_1 + U_2 + U_3 + U_4}{16}$
		The level of plowing of agricultural lands (U_2)	
		Share of eroded land (U_3)	
		Weighted average humus content (U_4)	

Table 2. Basic indicators of land use efficiency assessment

No	Group	Indicators	Formula	Conditional notation of parameters
1	2	3	4	5
1	Economic indicators	Agricultural production growth index, %	$Ap = \frac{P\ r.y.}{P\ p.y.} - 100\%$	where *P r.y.* – is agricultural production of the reporting year, in million hryvnias, *P p.y.* – is agricultural production of the previous year, million hryvnias
		Agricultural production per capita, thousand hryvnias	$P_1 = \frac{P\ r.y.}{pop} * 1000$	where *pop* – is the population, million people
		Capital investment per 1 hectare of agricultural land, thousand hryvnias/ha	$KI_{1ha} = \frac{KI_{tot}}{P_a} * 1000$	where KI_{tot} – is amount of capital investments in agriculture, in million hryvnias, P_a – is area of agricultural land, million ha
		Average monthly nominal wage of full-time employees in agriculture field, thousand hryvnias	$P_m = \frac{W}{Q}$	where W – is the wage fund for full-time employees in agriculture, thousand UAH, Q – is the number of full-time employees in agriculture, people.
2	Environmental indicators	Share of agricultural arable land under organic fertilization, %	$O = \frac{A_O}{A_T} * 100\%$	A_O – is the area of agricultural land to which organic fertilizers were applied, thousand hectares, A_T – is the total area of agricultural land, thousand hectares
		The level of plowing of agricultural lands, %	$L_P = \frac{A_T}{A_a} * 100\%$	A_T – is the area of agricultural land, thousand ha, A_a – is the area of tillage
		Share of eroded land, %	$S = \frac{A_E}{A_T} * 100\%$	A_E – is the area of eroded lands, thousand ha
		Weighted average humus content, %	$G_A = \frac{\sum G_i}{N} * 100\%$	$\sum G_i$– is the sum of humus contents by agricultural zones, %, N – is a number of land units according to zonal agricultural distribution

The integrated indicator is calculated according to the formula of the arithmetic mean among the defined aggregated indicators. The basic indicators and the parameters that form them are presented in more detail in table 2.

The developed systematization of the parameters of land use regulation indicates their multifactorial nature, interdependence, multidirectionality in optimization issues, which may involve the development of additional procedures for making management decisions in practical use.

When refining the system of parameters for assessing the effectiveness of land use regulation, we proceeded from the following:

– the achieved level of land use efficiency at a given period of time and the necessary environmental and economic prerequisites create the potential for its improvement;
– the economic efficiency of land use should reflect the real results used in the management process;
– the economic efficiency of land resources use is an integral part of the intensification of agricultural production, including the agricultural reproduction process.

Thus, the aggregate concept of the land use regulation efficiency (*I*) can be analytically presented as a functional dependence of economic (*E*) and environmental indicators (*EI*):

$$I = f(E, EI) \quad (1)$$

The practical application of this functionality to solve the problem of increasing the efficiency of land use can be implemented in the mechanism of state regulation of land use, one of the stages of which is the systematization of ideas on modern directions of increasing the efficiency of land use.

The calculation of the aggregated and integral indicator of the efficiency of land use regulation is in the table 3.

Table 3. Determination of aggregate and integral indicators of the effectiveness of land use regulation in the Rivne region in Ukraine in 2021

No	Indicators	Scores / Values				Actual value	Point	Aggregate indicator
		1	2	3	4			
Economic indicators								
1	Agricultural production growth index, %	<5	5–10	10–20	> 20	2	1	0.438
2	Agricultural production per capita, thousand hryvnias	<10	10–20	20–30	> 30	15.4	2	
3	Capital investment per 1 hectare of agricultural land, thousand hryvnias/ha	0–1	1–2	2–3	> 3	1,2	2	
4	Average monthly nominal wage of full-time employees in agriculture field, thousand hryvnias	0–7	7–10	10–13	> 13	9.5	2	
Environmental indicators								
1	Share of agricultural arable land under organic fertilization, %	0–2	2–5	5–10	>10	11	4	0.813
2	The level of plowing of agricultural land, %	>55	55–45	45–35	<35	33	4	
3	Share of eroded land, %	>60	60–40	40–20	20–0	34.6	3	
4	Weighted average humus content, %	1–2	2–3	3–4	> 4	2,3	2	
Integral indicator of efficiency I = 0.626 (or 62.6%)								

3. Conclusion

The article defines aggregate and integral indicators of the effectiveness of land use regulation in the Rivne region in Ukraine. The aggregate indicators in terms of economic and environmental components were 0.438 and 0.813, respectively. The aggregate environmental indicator is almost 2 times higher than the aggregated economic one, which indicates a better state of the environmental component than the economic one. This was due to the maximum score for such indicators as the share of agricultural arable land under organic fertilizers and the level of plowed agricultural land. The integral indicator was calculated as the arithmetic mean of the aggregated indicators and it is 0.626 or 62.6%.

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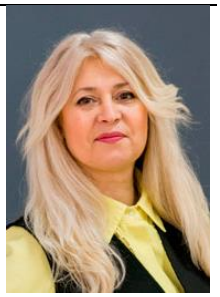
Ph.D. Oleksandr Harnaha
e-mail: o.m.gharnagha@nuwm.edu.ua

Associate professor of the Institute of Economics and Management, National University of Water and Environmental Engineering, Ukraine. Author and co-author of more than 60 scientific papers. Scientific interests are based on the study of the nature use economics, the development of the land market etc.

http://orcid.org/0000-0002-5236-7299

D.Sc. Natalia Savina
e-mail: n.b.savina@nuwm.edu.ua



Doctor of Economics of the Institute of Economics and Management, National University of Water and Environmental Engineering, Ukraine. Author and co-author of more than 100 scientific papers. The author`s research area focuses on the study of economics and management of the national economy.

http://orcid.org/0000-0001-8339-1219

M.Sc. Volodymyr Hrytsiuk
e-mail: v.v.hrytsiuk@nuwm.edu.ua

Senior lecture of the Nadsluchansky Institute, National University of Water and Environmental Engineering, Ukraine.
Scientific interests include the study of nature management aspects, economics of forestry and agriculture etc.

http://orcid.org/0009-0000-2270-0874