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ASSESSMENT OF THE ECOLOGICAL SUSTAINABILITY OF AGRICULTURAL LAND USE IN THE TERRITORIAL STRUCTURE OF REGION

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Abstract

The article is devoted improves method of the assessment of the ecological sustainability of agricultural land use in the territorial structure of region. Approbation of this method was carried out on the example of the districts of the Lviv region, located in the western part of Ukraine. The analysis of ecological parameters and modern structure of lands of the territory of Lviv region is presented. Based on the analysis of the coefficients of ecological sustainability of agricultural land use, three groups of districts have been identified, depending on the level of this indicator: stable, average sustainability, low sustainability. Using correlation-regression analysis, we established the relationship between ecological parameters of the organization of the territory and humus content, as well as the normative-monetary valuation of land, using the example of Lviv region districts. The proposed method for assessing the ecological sustainability use can be an integral part of the ecological passport of the territory, which makes it possible to consider the environmental factors that have resulted in the result of the assessment in combination and interdependence. The application of the proposed methodology makes it possible to choose the best variant of the organization of land use in agrosphere, which will increase the efficiency of production, as well as optimization of natural ecosystems.

Key words: *method, assessment, ecological sustainability, agricultural, land use*

INTRODUCTION

An important direction of land policy of any country is to provide ecological balanced using of land in agrosphere. However, today the peculiarity of domestic market relations is that in the activity of a significant part of agrarian enterprises in the process of land use, the main attention is paid to the socio-economic orientation, while environmental problems are of secondary importance. This causes a violation of the ecological balance and the balance between the economic activity of society and the natural environment. Therefore, the importance of the environmental component in the system sustainable use of land in agrosphere every year becomes more and more important. At the same time, the territorial structure and the ecological imbalance of the land fund, significantly impair the effectiveness of the use and protection of soil, as well as its natural ability to heal itself, leads to depletion of species diversity of flora and fauna in landscapes.

Optimization of agricultural land use involves the normalization of its size, legal status, the achievement of appropriate economic parameters, regulation of landscape and environmental aspects. In turn, environmental aspects are represented by specific qualitative and quantitative indexs, in particular the level of ecological stability of the territory. Therefore, today it is important to research the state of land resources, the peculiarities of their transformation in the territorial structure of the region, as well as the assessment of the ecological sustainability of territory in agricultural.

Ecological features of land in agrosphere occurred in the works of many experts, including D. Dobriak, Y. Dorosh, G. Gutsulyak, O. Kanash, A. Martin, M. Stupen, O. Shkuratov, A. Tretyak, S.Volkov and others. In particular, the representative of the School of Agro-Ecological Economics O. Shkuratov [11] suggests the ecological prerequisites for land use optimization with using the index of environmental nonconformity of existing use.

O. Kanash [5; 6] considering an approach that, in his opinion, "will help to establish the real environmental situation, making the design on the organization of land and crop rotation should perform appropriate calculations, using an algorithm". Despite the comprehensive study of the mentioned scientific directions, the exacerbation of environmental problems associated with the imbalance of land use led to the need to find ways to study the theoretical and methodological foundations for assessing the ecological state of territorial structures.

Thus, the specific imperatives of the formation of ecological sustainable land use can effectively control the use and protection of land and increase their productivity.

MATERIALS AND METHODS

An assessment of the ecological sustainability of agricultural land use was made on the example of the districts of the Lviv region located in the western part of Ukraine. The territory occupied by the Lviv region is interesting in terms of relief and climatic conditions, since it is located in various natural-economic zones (forest-steppe, polissya, mountain, foothill). The agricultural development of the territory of the Lviv region during the last years remains in the range of 60%, while the cultivation of the territory of individual districts ranges from 25% in the Skolivskyi district to 79% – in Sambirskyi.

To determine «the ecological norms of the level of sustainability of land use in the territorial structure, S. Volkov's methodology was applied to the ecological stability of the territories» [14] taking into account the specifics of the landscape structure of the territory of the Lviv region on the basis of certain specifications of the coefficients of ecological stability for various types of agricultural and other lands specified by the author (Table 1).

In particular, we propose to specify the coefficients of ecological sustainability of land use for three types of territory. In particular, in our opinion, open land without vegetation is less stable compared to arable land, therefore we propose to reduce this index to 0.05. At the same time, perennial plants have many features characteristic of natural forests, so this indicator S.Volkov providing total value 0,43 diminish the value of this type of land. Given our previous calculations, factor ecological sustainability perennial plants should be at 0.72. The same calculations were made for the type of land - pasture, as a result, the coefficient of their ecological sustainability is equal to 0.85.

Table 1. Assessment of ecological properties of lands

Indexes	The coefficients of ecological sustainability of land under the method of S. Volkov	Author's coefficients of ecolodgical sustainability of land
Built-up area	0.00	0.00
Open lands without plant cover	0.14	0.05
Arable	0.14	0.14
Perennial plantings	0.43	0.72
Hayfields	0.62	0.62
Pastures	0.68	0.85
Earth Water Fund	0.79	0.79
Forests	1.00	1.00

Source: formed by the author on the basis of data [14].

In this case, the overall coefficient of ecological sustainability of land using in agricultural, which characterizes the level of intensity of use of the territory of the region (I_{es}) can be calculated by the formula:

$$I_{es} \frac{\sum I_з \times LA_з}{\sum LA_з}, \quad (1)$$

where I_i – the coefficient of ecological stability of the land of the *i*-th species;
LA_i – the area of the land of the *i*-th species.

Based on the results of the calculation, the level of ecological sustainability is represented by the corresponding gradation (Table 2).

The proposed methodology for assessing the ecological sustainability use can be an integral part of the ecological passport of the territory, which makes it possible to consider in combination and interdependence the ecological factors that have caused the result of the assessment.

Table 2. Grading scale of the coefficient of ecological sustainability of land use in agricultural

The level of ecological sustainability	The magnitude of the coefficient of ecological sustainability
Unsteady	< 0.33
Low sustainability	0.33–0.50
Average sustainability	0.51–0.66
Stable	> 0.66

Source: author's development taking into account the S. Volkov method [14].

RESULTS AND DISCUSSIONS

At present, the organization of land using of agrarian enterprises should be based on fundamentally new scientific, methodological and methodological provisions. Thus, the system of measures for the territorial organization and arrangement represents the method of forming agrolandscapes, and the agrolandscape itself should be considered as the material basis for the existence of an ecosystem, with the creation of conditions for ensuring optimal environmental regimes [1; 3].

Solving the problems of organizing agricultural land use and preserving the ecological framework of natural complexes are considered as the main measures to increase the efficiency of agro-industrial systems. One of the main problems of the organization of land in agrosphere is not fully the adequacy of the existing farming system to natural conditions, the imbalance of reproduction processes. These factors have led to the need to clarify the existing farming systems, taking into consideration the agrolandscape structure and modern economic circumstances.

With ecological optimization, on the basis of the criteria of the land parcels, it is imperative to foresee an exception from the intensive use those lands which, due to their modal properties, can not ensure the stability of land use [2; 4; 7]. Under ecological optimization of the structure of land is to be understood as a set of measures to find the optimal variant of the organization of use and protection of soil at the level of the rural (village) council for the purpose of their use in an ecologically safe mode [12, 15].

In territorial terms, the definition of the appropriate natural equilibrium is a dynamic balance of various ecological subsystems that provides elemental diversity and component optimum that preserve the ecological system in the state of potential self-healing to the zonal natural or natural-human type, to which an adapted district economy has been adapted.

The maintenance of natural equilibrium is achieved in two main ways: functional and territorial. The functional direction is achieved by a set of measures for rationalization of land use at the expense of stable agricultural lands, and the territorial is based on the system-balance method of full and partial conservation of a part of territorial complexes. The conservation of natural areas, the optimal proportional ratio of arable land, forests and forage lands, from studies by a number of scientists [13], contribute to increasing the stability and productivity of agrolandscapes and the stability of natural systems in general.

An analysis of the current structure of land and boundary ecological parameters makes it possible to conclude that a high degree of plowing in the territory of most studied regions of Lviv region (Table 3). Distribution of land resources for economic use of them today has no comprehensive environmental and economic justification. Along with the forms of management has changed the composition and structure of agricultural land. About 60% of the total land area is involved in economic use, which far exceeds the permissible limits. In recent years, there has been a tendency to decrease this share, although the indicator of economic use of the territories is still much higher than the similar indicator of the developed countries of the world. For example, in Europe, the share of arable land is on average 30-35%, while in the Lviv region this figure has reached 59%. Negative is the fact that a large area of arable land became possible due to deforestation and the transfer of pastures to their composition.

Based on the above data, we can talk about a significant differentiation of the territory as about the presence of various land use structures, as well as about the presence of various arable land areas, and, as a result, an objective need arises to develop special

strategic programs that take into account the specifics of the area and necessarily take into account these conditions production [8-10].

Table 3. The structures of land using and ecological parameters of Lviv region, 2016

District	Land area, ha									Normative monetary valuation of agricultural lands, ths. UAH	Average weighted humus content, %
	Territory in general	Arable	Hayfields	Pastures	Perennial plantings	Forest	Constructed land	Open lands without plant cover	Earth Water Fund		
Brodivskyi	113,601	42,340	11,295	12,204	1,070	40,005	4,286	928	1,473	17,621	2.8
Buskyi	83,291	36,006	10,365	9,768	606	20,594	3,781	155	2,016	17,966	2.6
Horodotskyi	71,214	36,856	6,062	10,652	1,645	9,441	3,193	639	2,726	11,180	2.6
Drohobytskyi	118,887	37,189	10,980	14,061	1,293	47,643	4,646	1,151	1,924	6,038	2.7
Zhydachivskyi	96,980	44,197	10,206	12,343	918	19,337	6,116	887	2,976	14,278	2.6
Zhovkivskyi	126,415	56,472	11,087	15,305	1,720	32,566	5,467	909	2,889	13,065	2.6
Zolochivskyi	107,202	46,151	15,088	10,927	1,372	26,183	4,147	2,017	1,317	19,362	3.5
Kam`ianka-Buzkyi	85,007	40,136	8,065	10,263	1,035	17,841	4,909	189	2,569	14,662	2.5
Mykolaivskyi	66,315	22,510	7,031	9,573	642	18,705	4,591	765	2,498	9,290	2.4
Mostyskyi	83,127	45,005	4,466	10,555	1,212	16,797	3,898	157	1,037	12,969	2.2
Peremyshlianskyi	90,413	37,854	6,569	12,044	1,145	28,722	2,796	418	865	10,225	2.2
Pustomytivskyi	92,415	47,661	7,888	10,054	1,891	16,467	6,277	389	1,788	16,825	2.6
Radekhivskyi	111,619	49,792	9,559	13,808	474	30,559	5,510	362	1,555	16,120	3.6
Sambirskyi	91,618	44,715	12,826	13,343	1,114	12,003	4,118	1,080	2,419	11,669	2.8
Skolivskyi	146,521	12,903	13,299	10,014	177	104,864	3,080	1,064	1,120	3,736	3.0
Sokalskyi	153,136	63,669	21,614	18,327	1,371	36,000	7,029	728	4,398	18,153	2.0
Starosambirskyi	122,561	38,331	3,979	13,941	1,496	57,373	4,017	1,732	1,692	5,496	1.9
Stryiskyi	79,631	31,742	5,664	7,952	656	24,815	3,298	3,477	2,027	8,504	2.2
Turkivskyi	118,764	21,768	5,563	17,049	211	68,002	3,899	1,035	1,237	3,281	3.0
Yavorivskyi	151,836	35,769	5,830	23,437	1,410	61,645	9,246	10,905	3,594	6,355	1.6

Source: author's calculations

Research existing in the Lviv region of stability of ecosystems, which shows not in favor of that land is adapted to the environment.

Table 4. Characteristics of the ecological state of land use in the Lviv region by district

District	I_{es}	The level of ecological sustainability
Brodivskyi	0.57	Average sustainability
Buskyi	0.51	Average sustainability
Horodotskyi	0.43	Low sustainability
Drohobytskyi	0.62	Average sustainability
Zhydachivskyi	0.47	Low sustainability
Zhovkivskyi	0.51	Average sustainability
Zolochivskyi	0.50	Low sustainability
Kam`ianka-Buzkyi	0.47	Low sustainability
Mykolaivskyi	0.56	Average sustainability
Mostyskyi	0.44	Low sustainability
Peremyshlianskyi	0.55	Average sustainability
Pustomytivskyi	0.43	Low sustainability
Radekhivskyi	0.51	Average sustainability
Sambirskyi	0.44	Low sustainability
Skolivskyi	0.85	Stable
Sokalskyi	0.51	Average sustainability
Starosambirskyi	0.65	Average sustainability
Stryiskyi	0.52	Average sustainability
Turkivskyi	0.76	Stable
Yavorivsky	0.62	Average sustainability

Source: author's calculations.

Based on the information provided, we were able to adequately characterize the degree of ecological sustainability of agricultural land using in agrosphere the example of Lviv region districts (Table 4).

On the basis of the analysis of coefficient data, the following groups of areas are allocated, depending on the level of ecological sustainability of agricultural land use:

1.Stable: Turkivskyi, Skolivskyi.

2.Average sustainability: Brodivskyi, Buskyi, Drohobytskyi, Zhovkivskyi, Mykolayivskyi, Peremyshlyanskyi, Radekhivskyi, Sokalskyi, Starosabirskyi, Stryyskyi, Yavorivskyi.

3.Low sustainability: Horodotskyi, Zhydachivskyi, Zolochivskyi, Kamyanka-Buzkyi, Mostyskyi, Pustomytivskyi, Sambirskyi.

The average and low level of constancy of the territory of Ukraine and its regions is a result of human impact on nature, which is the reason for the transformation of ecologically stabilizing lands into open lands with low levels of stability. Two regions of Lviv region belong to a group of ecologically stable agricultural land use, due to the fact that they are mountainous regions and in which agriculture is at a low level of development.

Using correlation-regression analysis, we established the relationship between ecological parameters of the organization of the territory and humus content, as well as the normative-monetary valuation of land, using the example of Lviv region districts (data of 2016), which is described by linear equations. The assessment of the correlation coefficients confirms that the ecological constancy of land using in agrosphere in no way affects the content of humus (Table 5).

Table 5. The significance of the coefficients of regression of the impact of ecological sustainability of land using in agrosphere on humus content and land valuation

Indexes	Correlation coefficient (R)
Humus content	0,05
Normative-monetary assessment of agricultural land	-0,72

Source: author's calculations.

At the same time, there is a strong link between the ecological constancy of the territory and the same inversion, which indicates that the higher the level of ecological sustainability, the lower will be the normative-monetary valuation of land. This is due to the fact that the normative-monetary valuation of agricultural land depends on the productivity of crops and the efficiency of production.

CONCLUSIONS

An assessment of the ecological sustainability of land using in the territorial structure of the region has once again highlighted the dilemma of the alternative choice of the economic development of the agrarian sector or preservation of the natural environment. According to the results of the analysis, it is determined that the normative-monetary valuation of agricultural lands depends on the level of agricultural production through the increase of sown areas. Using these indicators allows to control and, if necessary, adjust the land use structure.

The method of calculating the ecological stability of natural zones, makes it possible, in the presence of only data on the area of land to get remote, but remotely correct data on the constancy of territories. Certainly, this analysis does not allow to draw conclusions about the productivity of specific plots, but gives an idea of the territorial differentiation of agricultural land uses of the Lviv region and is the basis for further research in this direction.

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