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ANALYSIS OF THE EFFICIENCY OF THE USE OF LAND RESOURCES WITHIN THE BOUNDARIES OF THE KODYM TERRITORIAL COMMUNITY OF THE PODIL DISTRICT OF THE ODESSA REGION

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Abstract. *Agricultural lands, as the most important element of national wealth and living conditions of society, within the Kodyma TG occupy 67.01% of the total area, which fully satisfies the needs of agricultural production of the community. However, the associated high degree of plowing leads to large-scale erosion processes and disrupts the general ecological balance in the area. The main way to preserve the ecological balance of the territory should be the transformation of plowed, degraded and low-productive arable lands into pastures, hayfields and afforestation of eroded slopes. Such*

transformation is also one of the ways to increase the area of forest land. Calculations were made of such indicators as agricultural development of the territory, plowing of the territory and plowing of agricultural lands. It was established that the area of agricultural lands occupies 65.4% of the territory of the Kodyma TG, and the TG belongs to the second group in terms of the degree of agricultural development. Agricultural lands have a fairly high level of plowing - 82.9% and are environmentally unstable. According to the results of calculations, it was found that the indicators of ecological stability of land use and the level of anthropogenic load are 0.4 and 3.89, respectively, and correspond to the assessment of the territory as weakly stable, with an increased level of anthropogenic load.

Keywords: *land resources, agricultural development, ecological stability, anthropogenic load.*

Formulation of the problem. According to the Law of Ukraine "On Land Protection", "land resources are the total natural resource of the land surface as a spatial basis for settlement and economic activity, the main means of production in agriculture and forestry" [1]. Rational use of the available land potential is the basis for ensuring the necessary level of national food security, which is especially important in the context of existing geopolitical challenges and macroeconomic risks. The key component of the entire mechanism for the use of land resources is state policy, which should be aimed at ensuring productivity, environmental safety and rational use of the country's land resources. The structure of state policy uses both socio-economic and administrative-legal instruments aimed at maximizing the efficiency of land resource use [2]. The development of land relations in Ukraine has led to changes in land management. The redistribution of land as the main national wealth of our state has exacerbated the economic and environmental problems of agricultural land use. Ukrainian agricultural producers must ensure effective competition, produce environmentally friendly products, focus on the

global market and identify the need to improve the ecological and economic management of land resources. Land resources are vital for our existence, as they provide us with food, shelter and many other basic necessities. However, as the world's population continues to grow, the demand for land resources has also increased, leading to their overuse and degradation. Therefore, it is important to use land resources with careful planning to ensure their sustainable use for future generations [2, 3].

Analysis of recent research and publications. Important importance in considering the problem of effective use of land resources was given by domestic scientists [3-10].

Outstanding scientists Tretyak A.M., Tretyak V.M., Tretyak N.A. [4] “investigated the institutional environment of organizational structures of land resources management and land use to identify negative factors of ineffectiveness of land relations regulation and land use administration”.

Bagin M. [5] “substantiated the theoretical and methodological principles of assessing the efficiency of agricultural land use and established promising directions for the use of agricultural land”.

Begal I.I. [6] “analyzed the impact of transformational changes in the administrative system on the features of land resources management and land use”.

In the work of Lazareva O.V. "the indicators characterizing the yield of agricultural crops and their gross harvest, the degree of land use, the sown areas of agricultural lands, the level of land use, and production per capita were studied" [7].

The previously developed theoretical and methodological principles allow us to approach the study of land use efficiency based on the assessment of the state of land within individual territorial communities, which is an urgent task at the present stage.

The purpose of the research in this article is to assess the efficiency of land resource use within the Kodyma TG of the Podilsk district of the Odessa region.

Research materials and methods. The research was conducted on land use materials of the Kodyma TG of the Podilsk district of the Odessa region.

“The calculation of the state of land use was carried out using such an indicator as agricultural development of the territory according to formula 1 [2]:

$$\text{Ос} = \frac{S_{cr}}{S_3} \cdot 100, \qquad (1)$$

where *Oc* – agricultural development of the territory, %;

S_{cr} – area of agricultural land, thousand hectares;

S_3 – total land area, thousand hectares".

“The plowability of the territory characterizes the specific weight of arable land in the total land use area and is determined by formula 2 [2]:

$$\text{Крт} = \frac{S_\text{Р}}{S_3} \cdot 100, \qquad (2)$$

where K_{PT} – plowed territory, %;

S_P – площі ріллі, тис. га;

S_3 – arable land, thousand hectares".

“The plowability of agricultural land characterizes the specific weight of arable land in the total area of agricultural land and is calculated by formula 3 [2]:

$$\text{К}pcr = \frac{S_\text{Р}}{S_{cr}} \cdot 100, \qquad (3)$$

where *Kpcr* - plowed agricultural land, %;

Sp – arable land, thousand hectares";

S_{cr} – area of agricultural land, thousand hectares".

“The assessment of the ecological state of agricultural lands by the composition and ratio of land was carried out by determining the degree of violation of the ecological

balance between arable lands as the main destabilizing factor of agricultural landscapes and the set of natural landscape components that perform an ecologically stabilizing function [8, 9] according to formulas 4 and 5:

$$\text{P} = \frac{S_{\text{P}}}{S_{\text{P}}+S_{\text{ECУ}}} \cdot 100, \qquad (4)$$

where *P* – specific weight of arable land in the group of lands P+ECУ, %;

Sp – arable land, hectares;

S_{ECY} – the sum of natural components, hectares.

$$\text{ECУ} = \frac{S_{\text{ECУ}}}{S_{\text{P}}+S_{\text{ECУ}}}, \qquad (5)$$

where ECУ – specific weight of ecologically stabilizing lands in the group of lands P+ECУ, %".

The degree of ecological imbalance in agricultural landscapes was calculated using the ratio P+ESU and assessed on a five-point scale [8, 9] (Table 1).

1. Scale for assessing the ecological state of agricultural landscapes by land ratio

Ecotype of the territory	Specific weight in the land group P+ECУ, %		Agroecological condition of the territory	Assessment, point
	P	ECУ		
0	<20	>80	optimal	1
I	21-36	64-80	good	2
II	37-55	45-63	satisfactory	3
III	56-70	30-44	unsatisfactory	4
IV	>70	<30	critical	5

Source: based on data [8, 9].

The assessment of ecological stability and anthropogenic load on the territory was carried out according to the methodological recommendations for assessing the ecological stability of agricultural landscapes and agricultural land use by A.M. Tretyak [2, 10].

“The ecological stability coefficient is calculated by formula 6:

$$К_{ес} = \frac{\sum S_i K_i}{\sum S_i} \cdot K_{р}, \qquad (6)$$

where *Кес* – coefficient of ecological stability of the territory;

Кі – coefficient of ecological properties of the land of the i-type;

Si – land area i-type, hectares;

K_P – coefficient of morphological stability of the terrain (*Кр* = 1,0 – for stable areas і *Кр* = 0,7 for unstable areas)".

"The anthropogenic load coefficient Kan is determined by formula 7:

$$К_{ан} = \frac{\sum S_{і} Б_{і}}{S_{і}} \qquad (7)$$

where *Кан* – coefficient of anthropogenic load;

Si– land area i-type, hectares;

Бі – ball of anthropogenic load (from 1 to 5)».

The assessment of ecological stability and anthropogenic load depending on the Kes and Kan of individual lands is given in Table 2 [2].

2. Assessment of the ecological state of the territory according to the Kes and Kan indicators

Environmental sustainability factor, *Кес*	Environmental status	Anthropogenic load factor, *Кан*	Level of anthropogenic load
≤0,33	ecologically unstable	4,1−5,0	high
0,34−0,50	weakly stable	3,1−4,0	elevated
0,51−0,66	moderately stable	2,1−3,0	average
≥0,67	ecologically stable	1,0−2,0	low

Source: based on data [2].

Research results and their discussion. Kodyma TG of Podilsk district of Odesa region is located in the extreme north-west of Odesa region in the southern forest-steppe part of Podilsk upland. The territorial community borders on the Baltic TG in the east, on the Podilsk TG in the south, on the Republic of Moldova in the west, and on the Vinnytsia region in the north.

The land fund area of Kodyma TG is 81649.60 hectares, or 2.34% of the total area of Odessa region.

According to Art. 19 of the Land Code of Ukraine [11] the land fund of Kodyma TG consists of the following categories of land (Fig. 1):

- agricultural land - 54710.13 hectares (67.01%);
- residential and public development lands – 7617.20 ha (9.33%);
- nature conservation lands – 3200.86 ha (3.92%);
- forestry lands – 13728.15 ha (16.81%);
- water fund lands – 494.30 ha (0.61%);
- industrial, transport, communications, energy, defense, and other lands 1898.96 ha (2.33%).

Agricultural lands consist of agricultural and non-agricultural lands.

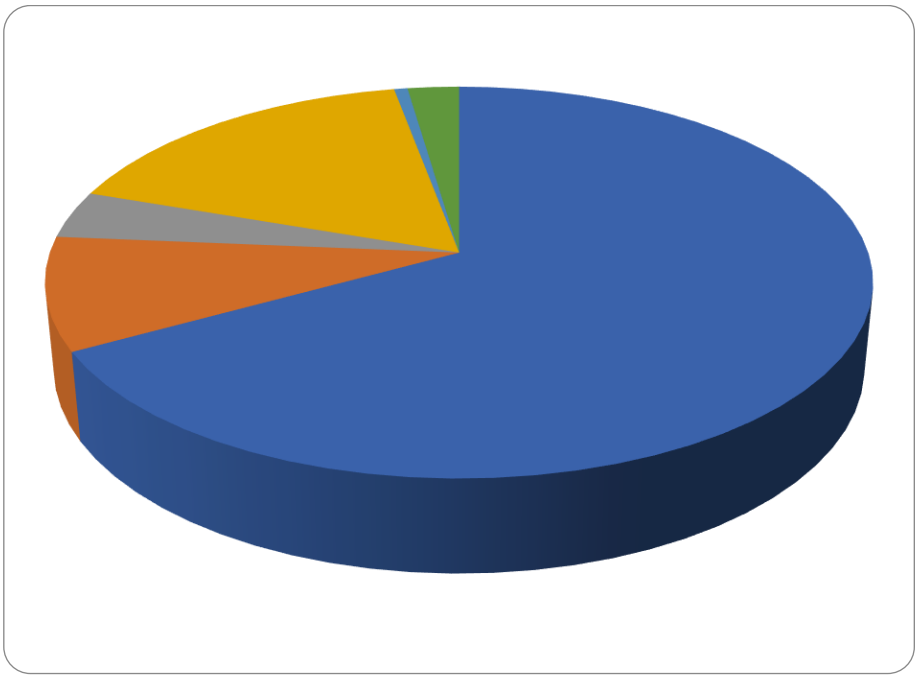

Fig. 1. Distribution of the land fund of Kodymsk TG by land categories.

The agricultural lands of the community are 53,385.20 hectares, of which:

- arable land – 44,230.23 hectares;
- orchards – 1,782.58 hectares;
- other perennial plantings – 758.72 hectares;
- hayfields – 648.09 hectares;
- pastures – 5,631.72 hectares;
- conservation – 333.86 hectares.
- Non-agricultural lands of the community are 1,323.9 hectares, of which:
- land under farm buildings and yards – 656.19 hectares;
- land under farm roads and tracks – 664.71 hectares.

The entire territory of the community is conditionally divided into three groups according to the degree of agricultural development of the land: I - <60%, II - 61-80% and III - >80% [2]. The lands of the community belong to the second group according to the

degree of agricultural development: the specific weight of the area of agricultural land is 65.4%.

The territory under agricultural land has a fairly high level of plowing - 82.9% and is environmentally unstable. The high level of plowing of the land indirectly indicates the presence of fertile soils and, as a result, intensive agricultural production.

Calculations showed that the share of arable land in the group of lands P+ESU (P) and the share of ecologically stabilizing lands in the group of lands P+ESU are 63% and 37%, respectively, the ecological state of the agricultural lands of the community in terms of the ratio of the main types of lands belongs to the III ecotype (Table 1) and is assessed as unsatisfactory, i.e. a reduction in the share of natural complexes in the structure of lands and indicates the transition of agricultural landscapes to the category of unstable. In such a situation, it is necessary to take urgent measures to change the component composition of degraded agricultural landscapes.

The calculation of the coefficient of ecological stability of land use Kes was performed using the values Ki (coefficient of ecological properties of lands of the i-type, Si (area of lands of the i-type, ha) and KR (coefficient of morphological stability of the relief, [2, 10]) within the territory of the Kodymsk territorial community (Table 3). Thus, based on the ratio of the area of land and lands with functional use, it was established that the coefficient of ecological stability of land use Kes for the studied territory is 0.4 (Table 3). This indicates that this territory is characterized by weak stability (Table 2).

Further, the calculation of the coefficient of anthropogenic load of land use within the territory of the community was carried out (Table 4). The calculations used the values of the score of anthropogenic load of lands and lands and land area according to [2, 10]. The coefficient of anthropogenic load is 3.89, which indicates an increased level of anthropogenic load (Table 2).

3. Coefficient of ecological stability of land use within the Kodymsk territorial community

Land plots and land according to functional use	Coefficient of ecological stability of lands and lands, *Ki*	Land area, *Si*	*Ki* × *Si*	Coefficient of ecological stability, *Kec*
Built-up areas and roads	0,00	1320,9	0,00	
Arable land	0,14	44230,23	6192,23	
Orchards, perennial plantings	0,43	2541,3	1092,76	
haymakers	0,62	648,09	401,82	
Pastures	0,68	5631,72	3829,57	
Ponds and marshes	0,79	488,09	385,59	
Forests, reserves	1,00	16571,72	16571,72	
Total		71432,05	28473,69	0,4

Source: developed by the author Serbov M. based on land use materials of the Kodymsk TG as of 2020.

In the Kodyma TG, the soil cover is represented mainly by dark gray podzolized and regraded soils, dark gray podzolized heavy loamy slightly washed out and podzolized chernozems regraded heavy loamy medium washed out (17.42%, 8.83% of the community area).

Table 5 shows the list of eroded soils of the Kodyma TG Podilsk district Odesa region.

Analysis of the steepness of the slopes of the district with agricultural soil groups showed that weakly eroded soils on the territory of the community make up 2255.13 hectares (2.76%); medium-eroded soils – 13455.70 hectares (16.48%) and strongly eroded soils – 6,491.30 hectares (7.95%). Basically, the degree of erosion depends on the steepness of the slopes. The trend is observed - the greater the slope (>5º) - the greater the soil erosion.

4. Коефіцієнт антропогенного навантаження в межах Кодимської територіальної громади

Land plots and land according to functional use	Ball of anthropogenic load of soils and lands, *Бі*	Land area, *Si*	*Бі* × *Si*	The coefficient of anthropogenic load, *Кан*
Built-up areas and roads	5	1320,9	0,00	
Arable land	4	44230,23	221151,15	
Orchards, perennial plantings	4	2541,3	10165,2	
haymakers	3	648,09	1944,27	
Pastures	2	5631,72	11263,44	
Ponds and marshes	1	488,09	488,09	
Forests, reserves	2	16571,72	33143,44	
Total		71432,05	278155,54	3,89

Source: developed by the author Liashenko G. based on land use materials of the Kodymsk TG as of 2020.

5. List of eroded soils of the Kodyma TG Podilsk district Odesa region

Area, hectares	Degree of soil erosion, ha/% (of the total area of the community)		
	Medium washed	Strongly washed	Faintly washed out
81649,60	13455,7	6491,3	2255,13
	16,48	7,95	2,76

Source: compiled by the author Danilova N. based on land use materials of the Kodymsk TG as of 2020.

The area of land with a steepness of 0-3 ° is – 39382.96 hectares, which is 48.23% of the total area of the community. The area of land with a steepness of 3-5 ° is 9650.63 hectares, 11.81% of the total area of the community. The area of land with a steepness of 5-7 ° is 17005.68 hectares, 20.83% of the total area of the community. The steepness of slopes from 7-10 ° occupies the territory of 12972.2 hectares, 15.89% of the total area of

the community, the area of land with a steepness of more than 10 ° is 13553.97 hectares, 16.60% of the total area of the community (Table 6).

6. The steepness of the slopes of the Kodyma TG of the Podilsk district of the Odesa region

Total, hectares	including, hectares							
	0-1	1-2	2-3	3-5	5-7	7-10	10-15	water
81649,60	14406,08	12770,70	12206,18	9650,63	17005,68	12972,21	13553,97	3151,38

Source: compiled by the author Volvach O. based on land use materials of the Kodymsk TG as of 2020.

Among the agricultural lands in Kodyma TG, arable land is most often washed away, the total area of which occupies 44230.23 hectares, which is 80.84% of the entire land fund of the community. And it is erosion processes that annually turn significant areas into degraded soils. Due to the high level of intensity of agricultural production, the level of soil fertility loss increases. According to Table 7, the loss of the fertile soil layer due to erosion processes on arable land in the unprotected territory of Kodyma TG is 455702.19 tons per year.

7. Information on the loss of the fertile soil layer in the unprotected territory of Kodyma TG Podilsk district Odessa region

Total hectares	Total ton	Total across the community	
		hectares	ton
34723,71	731882,89	20039,85	455702,19

Source: compiled by the author Nikitin P. based on land use materials of the Kodymsk TG as of 2020.

Effective protection of lands from water and wind erosion and their rational use and protection, optimization of the structure of agricultural landscapes makes it possible to introduce a contour-strip system of land use. On agricultural lands, these requirements are met by a soil protection system of agriculture with a contour-ameliorative organization of the territory [12]. The basis of this system of agriculture is the differentiated use of arable lands in territories with a potential high risk of erosion processes and taking into account soil and landscape factors. This situation is implemented by dividing arable lands into agro-technological groups.

Lands of the I agro-technological group form full-profile and slightly degraded soils on plateaus and slopes up to 3 °, which can be used for placing grain-steam-rowed crop rotations and growing crops using intensive technologies. The group includes wide watershed plateaus with a slope of 0-1 °, single-slope slopes of a simple form with a slope of 1-2 °, single-slope slopes of a complex form (1-3 °), the bottoms of narrow shallow beams (slopes of 0-1 °).

Lands of the II agrotechnological group form - slopes of 3-5 ° with weakly and moderately degraded soils, which are used with the application of biological principles of agriculture for growing continuous crops and perennial grasses, i.e. grain-grass or grass-grain crop rotations. The group includes narrow erosion-dangerous plateaus of 0-1 °, single-slope slopes of a simple form of 3-5 °, slopes of a complex form with angular slopes of 3-5 °, single-slope slopes of a simple form of 5-7 °.

Lands of agro-technological group III form highly degraded soils subject to removal from cultivation by meadows or defoliation. The group includes single-slope slopes of complex shape (slopes 5-7 °), single-slope slopes of simple shape (slopes 7-10 °).

Lands of agro-technological group IV form alluvial swamp soils of river floodplains used in fodder crop rotations. The main task of the land management scheme of agricultural enterprises is to organize the use of arable land plots on the basis of scientifically substantiated crop rotations.

A study of agro-technological groups of soils in the community showed that the total area of agro-technological groups of lands throughout the community is 49370.01 hectares (60.47% of the total area of agricultural lands of the community), of which:

- universal group – 22183.51 hectares (27.17% of the total area of agricultural lands of the community);

- soil protection group – 23332.91 hectares (28.58% of the total area of agricultural lands of the community);

- conservation group – 3853.59 hectares (4.72% of the total area of agricultural lands of the community);

- hydromorphic groups – none.

Thus, the main group on the territory of the Kodyma TG is the soil protection group - the use of anti-erosion tillage, the design of field-protective and drainage-regulating forest belts.

Conclusions. Thus, the general analysis shows that the ecological stability of land use (0.4) and the level of anthropogenic load (3.89) depend on the functional use of land and the structure of land use, and the greater the share of land use that has a negative impact on the environment, the higher the degree of land use hazard. In the future, this will make it possible to predict the possible results of the use of these lands, and will also make it possible to identify negative and positive trends in the development of agriculture in the region. To prevent the increase in erosion processes and preserve soil fertility, it is first necessary to determine the suitability of agricultural lands for their use in agriculture. After that, degraded and low-productive lands should be removed from arable land and transferred to temporary conservation or permanent conservation, hayfields, nature conservation or recreational areas and afforestation), thus significantly increasing the area of fodder lands and the area of areas under forest plantations, respectively, the area of plowing will decrease, which in turn will reduce the manifestation of erosion. In order to revive the culture of agriculture in accordance with agro-technological groups, for the

implementation of crop rotation, it is necessary to develop land management projects that provide ecological and economic justification for crop rotation and land management, in which the conditions for land cultivation are specified.

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АНАЛІЗ ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ ЗЕМЕЛЬНИХ РЕСУРСІВ В МЕЖАХ КОДИМСЬКОЇ ТЕРИТОРІАЛЬНОЇ ГРОМАДИ ПОДІЛЬСЬКОГО РАЙОНУ ОДЕСЬКОЇ ОБЛАСТІ

Анотація. *Сільськогосподарські землі, як найважливіший елемент національного багатства та умов життєдіяльності суспільства, в межах Кодимської ТГ займають 67,01 % загальної площі, що повністю задовольняє потреби сільськогосподарського виробництва громади. Проте пов'язаний з цим високий ступінь розораності призводить до масштабних процесів ерозії та порушує загальну екологічну рівновагу на місцевості. Основним способом збереження екологічної рівноваги території має бути трансформація розораних, деградованих і малопродуктивних орних угідь у пасовища, сіножаті та заліснення еродованих схилів. Така трансформація також є одним із шляхів збільшення площі земель лісового фонду. Було проведено розрахунки таких показників, як сільськогосподарське освоєння території, розораність території та розораність сільськогосподарських угідь. Встановлено, що площі сільськогосподарських земель займають 65,4 % території Кодимської ТГ, а ТГ належить до другої групи за ступенем сільськогосподарського освоєння. Сільськогосподарські угіддя мають достатньо високий рівень розораності – 82,9% і є екологічно нестійкими. За результатами розрахунків виявлено, що показники екологічної стабільності землекористування і рівня антропогенного навантаження становлять відповідно 0,4 і 3,89 і відповідають оцінці території як слабко стабільній, з підвищеним рівнем антропогенного навантаження.*

Ключові слова: *земельні ресурси, сільськогосподарська освоєність, екологічна стабільність, антропогенне навантаження.*