Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 4, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECOLOGICAL SAFETY OF RURAL AREAS: ECOLOGICAL AND ECONOMIC ASSESSMENT OF LAND USE EFFICIENCY

Anton TRETIAK[1], Nataliia TRETIAK[2], Yurii SKLIAR[3], Yuliia LOBUNKO[4], Andrii MELNICHUK[5]

[1]Institute of Agroecology and Environmental Management of NAAS, 12, Metrologichna Street, Kyiv, Ukraine, 03143, Phone: + 38 044 526-92-21; e-mail: tretyak2@ukr.net
[2]Public Institution «Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine», 60, blvd. Tarasa Shevchenka, Kyiv, Ukraine, 01032, Phone/Fax: +380 44 486 90 48; E-mail: tretiaknatalia@ukr.net
[3]Sumy National Agrarian University, 160 Gerasim Kondratieva Street, Sumy, 40000, Ukraine, Phone/Fax: +38 0542 70-10-12; E-mail: sul_bio@ukr.net
[4]State Agrarian and Engineering University in Podilia, 13, Shevchenko street, Kamianets-Podilskyi, Khmelnytskyi region, 32316, Ukraine; E-mail: maljukkp_777@ukr.net
[5]National University of Life and Environmental Sciences of Ukraine, 15, Heroes of Defense Street, Kyiv, 03041, Ukraine; E-mail: kipit1990@gmail.com

Corresponding author: tretiaknatalia@ukr.net

Abstract

The study proposes an approach to environmental and economic assessment of land use efficiency in the context of environmental safety. The authors believe that the sites with high environmental risk have a direct impact on the development of rural areas, the economy of natural, including land resources and the environment. The significance of the study is that it shows that ensuring the ecological balance of life in the process of organizing land use directly depends on taking into account and preventing dangerous situations from objects with high, medium and low levels of threats (level of increasing the maximum allowable concentration of air emissions, water pollution facilities with agricultural nitrates, industry, defense facilities, etc.). The analysis shows that the ecological balance depends on the structure of land use and the functional use of land. In particular, the authors noted that the greater the share of subtypes of urban land use that has a negative impact on the environment, the higher the degree of danger to human life. Therefore, threats to the ecological instability of land use and, consequently, to the environmental safety of the population within rural areas, where land plots with dangerous objects are located, has to be considered and assessed.

Key words: *ecological stability, anthropogenic load, ecological danger, economic assessment, threats level.*

INTRODUCTION

In the latest economic conditions, for countries with economies in transition, becomes especially relevant a comprehensive analysis of environmental, economic and social efficiency of the organization and the existing structure of land use in accordance with the natural resource potential and needs of the population in the context of environmental security. This is also due to the fact that there is an unhealthy trend in the current environmental situation in rural areas. Such environmental problems include: pollution of water bodies with nitrates from agricultural sources, as well as discharges and emissions of industrial enterprises, transport and utilities; pollution and clogging of the territory with industrial and household waste; the presence of facilities with high environmental hazards, the possibility of environmental accidents and disasters.

To one degree or another, each of these issues requires research to address the important issue of efficient land use in the context of environmental security.

A general study of the use of land and other natural resources in the context of environmental safety, the works of such scientists as O. Budziak [2], G. Obykhod [13], L. Kupinets, O. Zhavnerchyk [10], O. Sakal, A. Kovalenko [17], A. Stepanenko [21],

O. Barriere [1], A.K. Richmond [15], Z. Yang, X. He, M.A. Ashraf [28], M. Zessner, M. Schönhart, J. Parajka, H. Trautvetter, H. Mitter, M. Kirchner, G. Hepp, A.P. Blaschke, B. Strenna, E. Schmid [29]. We will also note the work on the study of strategic adjustment of land use policy in the context of economic and environmental transformation and the adoption of appropriate measures and decisions related to environmental security in the global dimension, namely: U.E. Chigbu, A. Schopf, W.T. de Vries, F. Masum, S. Mabikke, D. Antonio, J. Espinoza [4], Y. Liu, J. Li, Y. Yang [12], T. W. Hertel, U. L. C. Baldos [9], R. De Grenade, L. House-Peters, C. A. Scott, B. Thapa, M. Mills-Novoa, A. Gerlak, K. Verbist [5], in terms of decision-making on environmental safety of agricultural land, are interesting the studies of H. Li, Y. Zhao, F. Zheng [11], X. Qi, Y. Fu, R. Y. Wang, C. N. Ng, H. Dang, Y. He [14]. The influence of land composition on the ecological stability of the territory I. Ryborski, E. Goyke [16]. As for the methods of assessing environmental sustainability and environmental safety in agriculture, such studies were carried out by G. Dudych, L. Dudych [7], A. Tretyak, R. Tretyak, M. Shkvir [25], O. Shkuratov [18]. S. Tian, S. Wang, X. Bai, D. Zhou, G. Luo, Y. Yang, Q. Lu, [22]. The method of assessing the ecological danger of urban land use for the livelihood of the population was considered by A. Tretyak, N. Tretyak, M. Kirov [24], P. Singh, N. Kikon, P. Verma [19]. In general, ecological and economic assessment of the efficiency of agricultural lands was considered by D. Dobryak, O. Shkuratov, T. Yevsyukov, Y. Sklyar [6], O. Furdychko, R. Gulinchuk, I. Samoilova [8], A. Tkach, A. Stepanov, R. Ilyukhin [23].

From the analysis of scientific works, it is established that the problems of the presence of objects with high environmental danger, the possibility of environmental accidents and catastrophes remains a little-studied issue. Given that environmental safety remains one of the main ways to solve / prevent environmental problems, that is why the authors of the article conducted relevant research in this area on rural areas where dangerous objects are located. Namely, through the ecological and economic assessment of land use, this is one of the forms of reflecting the relationship between nature, man and society.

MATERIALS AND METHODS

To assess the impact of land composition and functional land use on environmental and economic efficiency in the context of environmental safety of land use, the proposed system of indicators was used. In particular, the indication of ecological safety of land use is represented by a system of such indicators: coefficient of ecological stability of land use, coefficient of anthropogenic load [16] and the level of ecological danger of land use [24]. The economic efficiency of changes in the structure and regime of land use is well characterized by the value of land use, which is determined by the method of normative monetary valuation of land [3].

The value of the coefficients of assessment of ecological properties of land is calculated using Table 1 [16], where the formula 1 for different composition of land determines the coefficient of ecological stability of land use in the territory ($K_{ек.\ cm.}$) [16].

$$K_{ек.cm.} = \frac{\sum K_{1i} \times P_i}{\sum P_i} \times K_p, \qquad (1)$$

Where K_{1i} – is the coefficient of ecological stability of lands and lands of the *i*-type by functional use;

P_i – area of land and lands of the *i*-th type by functional use;

K_p – coefficient of morphological stability of a relief (K_p = 1.0 – for stable territories and K_p = 0.7 for unstable territories of land uses.

Accordingly, if the obtained value of $K_{ек.\ cm.}$ is less than 0.33, the land use area is ecologically unstable, if it is between 0.34 to 0.50, it belongs to the stable unstable, if it is in the range from 0.51 to 0.66, it passes to the average stability, if it exceeds 0.67, the land use area is ecologically stable.

The coefficient of anthropogenic load ($K_{а.н.}$) (Table 1) reflects the significance of ohuman

activities impact on the environment, including land resources and is calculated by formula 2 [16].

$$K_{a.н.} = \frac{\sum Б_{1i} \times P_i}{\sum P_i}, \quad (2)$$

Where P_{1i} – is the area of *i* land and lands with the appropriate level of anthropogenic load, ha;

$Б_{1i}$ – the score of the corresponding area of *i* land and land with a certain level of anthropogenic load.

Table 1. Coefficient of assessment of ecological properties and degree of anthropogenic load of land for land use

Name of land	$K_{ек.ст.}$	Name of land use	$Б_{а.н.}$
Built-over lands and roads	0.00	Lands of industry, transport, settlements	5
Arable	0.14	Arable	4
Vineyards	0.29	Natural forage lands	4
Forest belts	0.38	Forest belts	2
Fruit orchards	0.43	Perennial plantings	4
Shrubs		Shrubs	2
Homestead gardens	0.50	Micro reserves	1
Hayfields	0.62	Meadow areas	3
Pastures, fallows	0.68	Under water	2
Ponds and swamps of natural origin	0.79	Natural swamps	2
Forests of natural origin	1.00	Forests of natural origin	2

Source: [16].

To calculate the coefficient of ecological stability of land use ($K_{ек.\ ст.}$) and the score of anthropogenic load ($K_{а.н.}$) and taking into account the author's suggestions, land use was taken within the territory of Desnyanskaya united territorial community, where military facilities are located.

Determining the coefficient of ecological stability allows us to assess the ecological safety (danger) of land use by applying the coefficient of ecological danger ($K_{ек.неб}$), which is determined by formula 3 [24]:

$$K_{ек.неб} = 1 - K_{ек.ст.}, \quad (3)$$

The indicator of the characteristics of ecological safety (danger) of land use is the scale, where the critical level of ecological danger of land use is in the range of 1.00-0.67; high level – 0.66–0.51; average level – 0.50-0.34; low level – 0.33–0.00.

Estimation of the value of land use ($B_н$) is determined by formula 4 [3]:

$$B_н = П_з \times P_з \times C_к \times K_м \times K_в \times K_{мц} \times K_i \quad (4)$$

where $П_з$ – land use area, according to the State Land Cadastre, ha;

$P_з$ – rental income per hectare for the relevant category of land;

C_K – term of capitalization;

$K_м$ – a factor that takes into account the location of land. The assessment uses only a coefficient that takes into account regional differences in the formation of rental income and is determined for land for industry, transport, communications, energy, defense and other purposes in accordance with Annex 8 to the Procedure, and for land of other categories is equal to one;

$K_в$ – coefficient that takes into account the type of land use;

$K_{мц}$ – coefficient that takes into account the affiliation of the land to the lands of environmental, health, recreational, historical and cultural purposes;

K_i is the indexation coefficient of the normative monetary valuation of lands.

Given these methods and transformations which took place over recent decades in Ukraine, namely the change in the structure of land use in all categories of land and land ownership, the study proposed to expand the land and land for functional use. It is also proposed to calculate the coefficient of ecological stability and anthropogenic load taking into account the levels of threats, which in turn will improve the methodological approach to assessing the effectiveness of land use in the context of environmental safety. In particular, the author's additions to the level of threats are made on the basis of expert proposals according to the methodology of the World Bank [26; 27]. The essence of which is that a group of experts conducted an environmental

assessment, which takes into account the ratio of the degree of anthropogenic pressure and ecological imbalance and identified three levels of threats (high, medium, small), which are proposed to be used as a reduction factor. In particular, for objects of high level of threats – reduction of land value is 30%; for objects with an average level of threats – reduction of land value – 20%; for objects with a low level of threats – the reduction in the value of land will be – 10%.

RESULTS AND DISCUSSIONS

The use of indicators that characterize the intensity of the process of land use urbanization (structural, process and dynamic) in the system provide an opportunity to identify sources of danger, current problems and critical areas that should be the priority measures to maintain adequate environmental safety and land use capitalization main indicators of quality of life of the population.

There are different approaches to determining these indicators, which differ in the methods aimed at solving various problems that have arisen, as well as to identify the boundaries of environmentally sustainable development of land use in the areas, which has a direct impact on the economy and where the main attention is paid to identifying the degree of change in natural systems, including agricultural and urban land use.

Most studies carry out environmental assessment using landscape and land management analysis of environmental and natural resource potential for different types of economic use, based on generally accepted or proposed own indicators. This allows you to link to specific areas, which to some extent allows you to objectively assess the use of natural resources, to clarify the natural economic potential for long-term development of land use in rural areas, as well as to develop proposals for environmentally sustainable development. However, the application of only a landscape approach to the environmental assessment of land use development of the territory, in the study case, namely in the context of environmental safety of life, is not enough. The presented methodological approaches are based on determining the optimal, actual and minimum land area required to reduce the level of urbanization of the territory and meet the needs of the population.

However, when they are finalized, they can be used for functional zoning in order to establish the regime of use and protection of lands and other natural resources, which has an impact on the greening and capitalization (increase in value) of land use. Because the sustainability of land use depends on the level of development of land and other natural resources, the intensity of land use and the level of existing anthropogenic threats (the level of MPC, nitrate pollution, industry, defense facilities, etc.).

The ratio of the degree of anthropogenic pressure and ecological imbalance shows that the highest scores have industry built-on lands, and arable lands, forests, meadows, pastures and underwater lands play an ecological stabilizing role. That is, the ecological activity of the population is influenced by the presence of forest plantations, water bodies, natural vegetation on the territory of land use. Nevertheless, the typification of land and land by functional use in Ukraine should be clarified depending on the level of threats to hazardous facilities (level of MAC increase, nitrate pollution, industry, defense facilities, etc.), which directly affects the land. That is why, in order to assess the state of environmental safety of the population, the classification of land and land by functional use has been expanded. In particular, separate subtypes of land use with dangerous objects that have a different functional purpose, but are in the appropriate category to distinguish between high, medium and low levels of threats.

Note that in the approach of the World Bank, and in general in the studies of the World Bank and the International Federation of Land Surveyors, the main idea is that an effective system of natural, including agricultural and urban land use should be formed to meet the needs of the population and human-land relations, guaranteeing the security of all

forms of ownership and sustainable land use and natural resources [26; 27].

The scale of the coefficient of environmental stability and the score of anthropogenic load of land and land for functional use with the author's additions are shown in Table 2. Note that the threat level was made on the basis of expert proposals according to the World Bank methodology, given by the authors using the example of military lands, arable land and forest lands.

Table 2. The value of the assessment of the coefficient of ecological stability and the score of anthropogenic load of land and land by functional use in the context of environmental safety

Lands and lands by functional use *	Coefficient of ecological stability of lands and lands, $K_{ек.ст.}$	Anthropogenic load score $Б_{ан.н.}$
Military lands	-0.23	5.00
Military lands with dangerous objects**:		
high level of threats	*-0.30*	*6.50*
medium level of threats	*-0.28*	*6.00*
low level of threats	-0.25	5.50
Land for road transport (under roads):		
with air emissions above the MAC level	-0.1	5
with an acceptable level of MAC	0	4.5
Industry lands:		
with air emissions above the MAC level	-0.1	5
with an acceptable level of MAC	0	4.5
Three- and more-storey residential buildings, other built-on lands, streets, etc.	0	5
One- and two-storey residential estates	0.1	4.5
Arable	*0.14*	*4*
Arable land with dangerous objects**:		
high level of threats	*0.10*	*5.20*
medium level of threats	*0.11*	*4.80*
low level of threats	*0.13*	*4.40*
Linear greenery	0.38	3.5
Orchards	0.43	4
Shrubs	0.43	2
Area greenery (squares, etc.)	0.45	3.5
Land for health purposes	0.5	3
Other lands and lands with insignificant vegetation cover	0.62	3
Haylands	0.62	3
Pastures, fallows	0.68	3
Land under water	0.79	2
Swamps of natural origin	0.83	1
National natural and regional landscape parks	0.85	2.5
Forests of natural origin	0.95	2
Forests of natural origin with dangerous objects**:		
high level of threats	*0,67*	*2,60*
medium level of threats	*0,76*	*2,40*
low level of threats	*0,86*	*2,20*
Forest reserves	1	1

Source: * expanded by authors using sources [16; 26; 29; 24; 25];

** Author's proposals for differentiation of the coefficient of ecological stability and the score of anthropogenic load of lands and lands according to their functional use taking into account the level of threats of dangerous objects are noted.

For a more representative view, the study used land within the territory of the Desnianska united territorial community, where military facilities are located. Characteristics in terms of territories of councils of military lands by land and by functional use are given in Table 3.

Thus, taking into account the differentiated

values for land use, the coefficient of ecological stability of land use in this area ($K_{ек.см.}$) is determined by formula 1. The analysis of the Table 4 shows that when calculating the coefficient of ecological stability of land use taking into account the differentiation associated with With objects of high level of ecological threats, in particular with military objects, such coefficient will change from 0.71 to 0.65, and such land use will already be characterized by average stability.

Table 3. Characteristics of land use of military units in terms of council territories within the Desnianska united territorial community

Land and land for functional use	Desnianska united territorial community				Total
	village Desna	village Koropie	village Kosachivka	village Morynsk	
1. The total land area of military units, ha	21,056	-	-	-	21,056
1.1. under construction	7,421	-	-	-	7,421
of them under housing	*259.5*	-	-	-	*259.5*
1.2. agricultural land (hayfield)	100	-	-	-	100
1.3. forests	13,535	-	-	-	13,535
including for protective, environmental and biological purposes	1,043	-	-	-	1,043
Of the total area within the settlement, ha	296	-	-	-	296

Source: according to the Desnianska united territorial community.

Table 4. Coefficient of ecological stability of land use within the territory of Desnianska united territorial community

Land and land for functional use	Coefficient of ecological stability of lands *Kli*	Area of lands *Pi*	*Kli x Pi*	Coefficient of ecological stability of land use *(К ек.см.)*
1) Calculation of the coefficient of ecological stability without taking into account differentiation:				
Built-on areas and roads	0	7,931.69	0.00	
Arable	0.14	2,897.54	405.66	
Perennial plantings	0.43	30.96	13.31	
Hayfields	0.62	4,631.03	1,750.56	
Pastures	0.68	3,622.26	2,463.14	
Underwater lands and swamps of natural origin	0.79	18,843.23	14,886.15	
Forests of natural origin	0.95	27,470.69	26,097.16	
Total		**65,427.40**	**46,772.32**	**0.71**
2) Calculation of the coefficient of ecological stability taking into account the differentiation:				
Arable	0.14	2,897.54	405.7	
Perennial plantings	0.43	30.96	13.3	
Pastures	0.68	3,622.26	2,463.1	
Military lands: *average level of threats*	-0.28	7161.5	-2,005.2	
Land under roads: *with an acceptable MAC level*	0	154	0.0	
Three- and more-storey residential buildings, other built-on lands and streets	0	259.5	0.0	
One- and two-storey residential buildings	0.1	356.69	35.7	
Hayfields and other lands with little vegetation	0.62	4,531.03	2,809.2	
Hayfields used for military purposes: *average level of threats*	0.5	100.0	50.0	
Land under water	0.79	17,297.9	13,665.4	
Swamps of natural origin	0.83	1,545.3	1,282.6	
Forests of natural origin	0.95	14,978.69	14,229.8	
Forests of natural origin used for military purposes: *average level of threats*	0.76	12,492	9,493.9	
Total		**65,427.4**	**42,443.4**	**0.65**

Source: calculated by the authors according to formula 1, where: 1) using the source [16]; 2) taking into account the author's suggestions.

In connection with the obtained data of the coefficient of ecological stability, the coefficient of ecological danger for the relevant territory of the Desnyansk united territorial community, where military facilities are located, is calculated according to formula 3. This coefficient will be 0.29 and will be characterized by a low level of ecological danger. Taking into account the author's suggestions, respectively, it will be $К_{ек.неб}$ = 0.35 and will be characterized by an average level of danger. These values confirm the importance of highlighting the presence of objects with high environmental risk, in our case, defense lands.

The score of anthropogenic load ($Б_{а.н.}$) reflects the significance of human activities impact on the environment, including land resources of different categories of land. In this case, the scale of the anthropogenic load, taking into account the proposals for the allocation of areas where dangerous objects are located, namely the allocation of limit values will be as follows: if the obtained value is less than 2.5, then the territory has a low degree of anthropogenic load; if it is in the range from 2.51 to 3.50, the average degree of anthropogenic load; if from 3.51 to 4.50, the territory has a high degree of anthropogenic load; if the coefficient is more than 4.51, then the territory has a critical level of anthropogenic load. The calculation of the score of anthropogenic load of land use is given in Table 5.

Table 5. Calculation of the anthropogenic load of land use within the territory of the Desnianska united territorial community

Land and land for functional use	Anthropogenic load score lands, *Бі*	Lands area, *Pi*	*Бі x Pi*	Score of anthropogenic load of land use ($Б_{а.н.}$)
1) Calculation of the anthropogenic load score without taking into account differentiation:				
Built-on areas and roads	5	7,931.69	39,658.45	
Arable	4	2,897.54	11,590.16	
Perennial plantings	4	30.96	123.84	
Hayfields	3	4,631.03	13,893.09	
Pastures	2	3,622.26	7,244.52	
Underwater lands and swamps of natural origin	1	18,843.23	37,686.46	
Forests of natural origin	2	27,470.69	54,941.38	
Total		**65,427.40**	**165,137.9**	**2.52**
2) Calculation of the coefficient of ecological stability taking into account the differentiation:				
Arable	4	2,897.54	11,590.2	
Perennial plantings	5	30.96	154.8	
Pastures	3	3,622.26	10,866.8	
Military lands: *average level of threats*	6	7,161.5	42,969.0	
Land under roads: *with an acceptable MAC level*	4.5	154	693.0	
Three- and more-storey residential buildings, other built-up lands and streets	5	259.5	1,297.5	
One- and two-storey residential buildings	4.5	3,56.69	1,605.1	
Hayfields and other lands with little vegetation	3	4,531.03	13,593.1	
Hayfields used for miitary purposes: *average level of threats*	3.6	100.0	360.0	
Land under water	2	17,297.9	34,595.9	
Swamps of natural origin	1	1,545.3	1,545.3	
Forests of natural origin	2	14,978.69	29,957.4	
Forests of natural origin used for military purposes: *average level of threats*	2.4	12,492.0	29,980.8	
Total		**65,427.4**	**179208.8**	**2.74**

Source: calculated by the authors according to formula 2, where: 1) using the source [16]; 2) taking into account the author's suggestions.

The analysis of the table shows that the score of anthropogenic load without taking into account the proposals indicates the average level of anthropogenic load of the territory ($Б_{а.н.}$ = 2.52). Taking into account the differentiation associated with dangerous objects, in particular defense objects, the score changed from 2.52 to 2.74, and although this score is within the average degree of anthropogenic load, however, it should be noted that the relevant facilities have an impact on the livelihoods of the population of the territory, and the environmental safety of land use is deteriorating. What, in the opinion of the authors should be taken into account when organizing the territory in the context of environmental safety of the population.

Table 6. The value of land within the territory of the Desnianska united territorial community by types of land use

Types (subtypes) of land use and land	Value, UAH / ha	Area, ha	Total value of land, thousand UAH
1) The value of land use without its structuring by land and functional use:			
Agricultural, of which:		7,496	179,904
agricultural enterprises	24,000	528	12,672
citizens	24,000	6,968	167,232
Residential and public buildings, of which:		326	117,360
citizens under construction	360,000	302	108,720
institutions, establishments	360,000	24	8,640
Industry land	233,914	116	27,134
Lands of transport and communication	194,929	185	36,062
Military land	97,464	21,056	2,052,177
Environmental protection	34,627	-	-
Recreational	18,415	31	571
Forestry	2,804	10,365	29,063
Water management	6,197	128	793
Land stock	6,000	25,724	154,344
Total		**65,427**	**2,597,408**
2) Cost taking into account the differentiation by land use regime:			
Agricultural, of which:		7,496	179,904
agricultural enterprises	24,000	528	12,672
citizens	24,000	6,968	167,232
Residential and public buildings, of which:		326	117,360
citizens under construction	360,000	302	108,720
institutions, establishments	360,000	24	8,640
Industry land	233,914	116	27,134
Lands of transport and communication	194,929	185	36,062
Military land, of which:		21,056	1,097,282
hayfields used for military purposes: *average level of threats*	8,042	100	804
under construction: *average level of threats*	144,000	7,421	1,068,624
of them under housing	180,000	259.5	46,710
forestry:		13,535	27,854
forests used for military purposes average level of threats	2,019	12,492	25,221
forests for protective, conservation and biological purposes	2,524	1,043	2,633
Environmental protection	34,627	15,724	544,488
Recreational	18,415	15,159	279,154
Forestry	2,804	5,365	15,043
Water management	6,197		0
Land stock	6,000		0
Total		**65,427**	**2,296,427**

Source: calculated by the authors using sources [3; 20].

Thus, the general analysis of ecological safety (danger) shows that the ecological stability of land use and the level of anthropogenic load depend on the structure of land use and the functional use of land. In particular, the greater the share of land use that has a negative impact on the environment, the higher the degree of danger of land use. Thus, threats to the ecological instability of land use, and consequently the environmental safety of the population within rural areas where land use with hazardous objects is located, should be assessed according to the proposed methodological approach and taking into account the structure and mode of land use.

The level of capitalization (growth of value) of land use is also influenced by the regime of use and protection of land and other natural resources. That is why it is proposed to take into account the proposals for the differentiation of the functional use of land with dangerous objects, in our study with the threats of defense objects. The total value of land in the existing classification of land and land by functional use and author's suggestions for their improvement for land use with hazardous objects is given in Table 6. For agricultural land use, data from the Directory of indicators of the normative monetary value of agricultural land in Ukraine for the corresponding year (hryvnia per hectare) are used [20].

As the comparative analysis of the data of the assessment of the total value of land use within the territory of the Desnianska united territorial community, where the military objects are located, shows that the value of UAH 2,597,408 thousand is not taken into account. Taking into account the differentiation of anthropogenic load on land use associated with dangerous objects, in particular military objects, located on the territory of the Desnyansk united territorial community, it decreases. The cost of land use, taking into account the differentiation by land use regime is 2,296,427 thousand hryvnias. That is, taking into account the anthropogenic load, namely related to the establishment of the regime of land use associated with the threat to the life of the population, the cost decreased by 300,981 thousand hryvnas, and this is natural, because the environmental situation affects the cost of land use.

CONCLUSIONS

In particular, the analysis of this approach shows that the ecological stability of land use, environmental hazard (safety) and the level of anthropogenic pressure depend on the structure of land, land use functions and land use regime. In particular, the greater the share of land use that has a negative impact on the environment, the higher the degree of danger of land use. Thus, the analysis of these calculations shows that the ecological stability of land use within the territory of the Desnianska united territorial community changes when the impact of dangerous objects on it is taken into account. For example, the calculation of the coefficient of ecological stability taking into account the differentiation of lands related to military lands has changed from 0.71 to 0.65, which in turn characterizes the decrease in the stability of land use. Accordingly, the coefficient of ecological danger without taking into account the proposals will be 0.29 and will be characterized by a low level of ecological danger, taking into account the proposals, respectively, it will be 0.35, which will be characterized by an average level of danger. Similarly, the score of anthropogenic load of land use, taking into account the differentiation, changed from 2.52 to 2.74, which characterizes the increase in the level of anthropogenic load of land use of the respective territory. The analysis of the data of the assessment of the economic efficiency of land use related to the threat to the life of the population shows a decrease in the cost of land use by 300,981 thousand hryvnas.

Thus, the proposed approach of ecological and economic assessment of land use efficiency in the context of ecological safety of life allows determining more objectively the level of ecological danger to the population and the monetary valuation of land with dangerous objects. Also, the conducted

ecological and economic assessment allows applying appropriate measures to improve the typification of land and land for functional use with the allocation of areas of objects with high environmental risk.

REFERENCES

[1]Barriere, O., 2017, Human Relationship to the Land from a Legal Perspective as a Human and Environmental Security Challenge. In Environmental Change and Human Security in Africa and the Middle East, pp. 259-304. https://doi.org/10.1007/978-3-319-45648-5_14.

[2]Budzak, O., 2013, Ecological safety of the use of earths and its role in the system of national safety. Visnyk KhNAU, 6: 94-102.

[3]Cabinet of Ministers of Ukraine, 2011, Resolution of the Cabinet of Ministers of Ukraine «On Approving the Methodology of normative monetary valuation of nonagricultural land (except for settlements)», https://zakon.rada.gov.ua/laws/show/1278-2011-%D0%BF#Text, Accessed on 22 September, 2020.

[4]Chigbu, U. E., Schopf, A., de Vries, W. T., Masum, F., Mabikke, S., Antonio, D., Espinoza, J., 2017, Combining Land-Use Planning and Tenure Security: A Tenure Responsive Land-Use Planning Approach for Developing Countries. Journal of Environmental Planning and Management, 60(9): 1622-1639. https://doi.org/10.1080/09640568.2016.1245655.

[5]De Grenade, R., House-Peters, L., Scott, C. A., Thapa, B., Mills-Novoa, M., Gerlak, A., Verbist, K., 2016, The Nexus: Reconsidering Environmental Security and Adaptive Capacity. Current opinion in environmental sustainability, 21(7): 15-21. https://doi.org/10.1016/j.cosust.2016.10.009.

[6]Dobriak, D., Shkuratov, O., Yevsiukov, T., Skliar Yu., 2018, Scientific Basis of Ecological and Economic Study of Land Resources. Balanced nature using, 3: 106-112.

[7]Dudych, H., Dudych, L., 2018, Assessment of the Ecological Sustainability of Agricultural Land Use in the Territorial Structure of Region. Series Management, Economic Engineering in Agriculture and rural development, 18(4): 87-92.

[8]Furdychko, O., Hulinchuk, R., Samoilova, I., 2019, Ecological and Economic Assessment of the Potential of Agricultural Land. Series Management, Economic Engineering in Agriculture and rural development, 19(1): 199-205.

[9]Hertel, T. W., Baldos, U. L. C., 2016, Attaining Food and Environmental Security in an Era of Globalization. Global environmental change, 41: 195-205. https://doi.org/10.1016/j.gloenvcha.2016.10.006.

[10]Kupinets, L., Zhavnerchyk, O., 2016, Ecological Safety of Agricultural Land Use: Theory and Mechanisms of Provision, IPREED NASU, Odessa, Ukraine.

[11]Li, H., Zhao, Y., Zheng, F., 2020, The Framework of an Agricultural Land-Use Decision Support System Based on Ecological Environmental Constraints. Science of The Total Environment, Vol. 717, 137149. https://doi.org/10.1016/j.scitotenv.2020.137149.

[12]Liu, Y., Li, J., Yang, Y., 2018, Strategic Adjustment of Land Use Policy Under the Economic Transformation. Land Use Policy, 74: 5-14. https://doi.org/10.1016/j.landusepol.2017.07.005.

[13]Obikhod, A., 2019, Ecological Safety of Sustainable Development. IEPSR National Academy of Sciences of Ukraine, Kyiv, Ukraine.

[14]Qi, X., Fu, Y., Wang, R. Y., Ng, C. N., Dang, H., He, Y., 2018, Improving the Sustainability of Agricultural Land Use: an Integrated Framework for the Conflict Between Food Security and Environmental Deterioration. Applied Geography, 90: 214-223. https://doi.org/10.1016/j.apgeog.2017.12.009.

[15]Richmond, A. K., 2019, Water, Land, and Governance: Environmental Security in Dense Urban Areas in Sub-Saharan Africa. In The Environment-Conflict Nexus, pp. 91-102. https://doi.org/10.1007/978-3-319-90975-2_6.

[16]Ryborski, I., Gojko E., 1988, Impact of land uses on the sustainability area. Land management in special conditions. Tatranska Lomnica.

[17]Sakal, O., Kovalenko, A., 2017, Environmental Constraints and Rational Opportunities of the Sustainable Development of the Ukrainian Agricultural Sector. Collection of Scientific Articles «University Economic Bulletin», 35(1): 72-81.

[18]Shkuratov, O., 2018, Methodology for Estimation of Ecological Safety in the Agricultural of Ukraine. Series Management, Economic Engineering in Agriculture and rural development, 18(3): 379-389.

[19]Singh, P., Kikon, N. and Verma, P., 2017, Impact of Land Use Change and Urbanization on Urban Heat Island in Lucknow City, Central India. A Remote Sensing Based Estimate. Sustainable Cities and Society, 32: 100-114. https://doi.org/10.1016/j.scs.2017.02.018.

[20]State Service of Ukraine for Geodesy, Cartography and Cadastre, 2020, Handbook of indicators of normative monetary valuation of agricultural lands in Ukraine, https://land.gov.ua/info/dovidnyk-pokaznykiv-normatyvnoi-hroshovoi-otsinky-silskohospodarskykh-uhid-v-ukraini-stanom-na-01-01-2019/, Accessed on 22 January, 2020.

[21]Stepanenko, A., 2018, Integration of Economical and Ecological Policy in the Context of Environmental Safety. Environmental Economics and Sustainable Development, 3-4, pp. 49-55.

[22]Tian, S., Wang, S., Bai, X., Zhou, D., Luo, G., Yang, Y., Lu, Q., 2020, Ecological Security and Health Risk Assessment of Soil Heavy Metals on a Village-Level Scale, Based on Different Land Use Types. Environmental geochemistry and health. https://doi.org/10.1007/s10653-020-00583-6.

[23]Tkach, A., Stepanov, A., Ylyukhyna, R., 1992, Method of determination of ecological and economic efficiency of agricultural production, VNYÉSKH, Moscow, Russia.

[24]Tretiak, A., Tretiak, N., Kirova, M., 2018, Methodical recommendations for assessing the ecological danger of urban land use for the livelihood of the population, Kiev, Ukraine.
[25]Tretiak, A., Tretiak, R., Shkvir, M., 2001, Methodical recommendations for assessing the ecological stability of agricultural landscapes and agricultural land use, Kiev, Ukraine.
[26]USAID, 2012, United States Agency for International Development Project (USAID). Management evaluation module. Kyiv, Ukraine.
[27]World Bank, 1997, Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development. Washington, DC: World Bank.
[28]Yang, Z., He, X., Ashraf, M. A., 2020, Land-use Change in Plateau Lake Basin and its Impact on Urban Ecological Security. Arabian Journal of Geosciences, 13(2): 96. https://doi.org/10.1007/s12517-020-5113-6.
[29]Zessner, M., Schönhart, M., Parajka, J., Trautvetter, H., Mitter, H., Kirchner, M., Hepp, G., Blaschke, A. P., Strenn, B., Schmid, E., 2017, A Novel Integrated Modelling Framework to Assess the Impacts of Climate and Socio-Economic Drivers on Land Use and Water Quality. Science of The Total Environment, 579: 1137–1151. http://dx.doi.org/10.1016/j.scitotenv.2016.11.092.