

## THE ECOLOGICAL STATE'S EVALUATION AND THE REDUCING OF THE ANTHROPOGENIC IMPACT IN THE RURAL AREA

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**Key words:** ecological situation, anthropogenic impact, land use, ecological balance, ecological risk.

**Abstract.** This work is dedicated to the investigations and evaluations of the ecological situation in the Republic of Moldova's rural areas. The anthropogenic impact's level over agro landscape was calculated and evaluated on the basis of the parameters of the ecological risk's factors – naturals and anthropogenic; at the same time, the ecological stability's coefficient of various areas was determined according to the quotas of different land categories and their way of using. The investigation works show that the ecological risk over the territory mainly depends on major indicators – relief, ravine intensity, the hydrographical network's density, the tillage and forestation degree, lands stabilizing the environment, the land's degree of development, the ecological dangerous objects placement, the anthropogenic impact's level. The ecological situation will also be directly influenced by animal and human wastage t/km<sup>2</sup>, which are formed and stocked on several areas. The detailed analysis for the Republic of Moldova's localities indicates a big variability of the indexes which will determine the ecological situation and the anthropogenic impact's level over some areas. The improvement of the territory's stability can be achieved by decreasing the arable land and the tree plantations - viticulture quota, by increasing the areas with hay, grass land, sylvan areas, lakes and plashes, and by decreasing the anthropogenic impact and by applying anti erosion measures on slopes.

### Introduction

The environment's problems investigation and evaluation for rural localities, including the evaluation of the anthropogenic impact's level are being focused on some priorities: the population's and territory's ecological safety, the rational and lasting use of natural resources - water, air, soil, subsoil, biodiversity, division development by applying the measures of protection of the environment - institutional, engineering systems, legislative background, cooperation, recommendations, decisions on state, district and community level.

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The ecological security is one of the important components of the general security which efficiently and plenary contributes to the development of the country, districts, communes. The difficult conditions, which follow the transition to the Republic of Moldova's market economy, have a big impact on the environment components, generating the ecological equilibrium derangement, the ecosystems' deterioration and the aggravation of the natural resources' situation. The ecological security is the environment's state, in which the total causes and consequences of the anthropogenic activities exclude or minimize the modifications of the immediate or further degradation of the ecosystems of the environment and the negative impact's exclusion on population's health. (The National Program of Ensuring the Republic of Moldova's Ecological Security, 2007).

The objective of ecological security in the communes is to identify their ecological situation, by applying different methods, by implementing techno-organizational measures, and maintaining a stable environment for the rural areas, or even restoring the damaged components of the ecosystems. There are various mechanisms of ensuring the ecological security, but we must focus on the activities in the communes. For ensuring the localities' ecological security and lasting development, it is necessary to be aware of the ecological situation and to evaluate the impact of the anthropic activities on the environment, to stabilize and to protect natural systems, to preserve the environment's quality, applying the ecological incorporated monitoring, as well as taking the right economical and administrative decisions, according to the situation.

### **1. Materials and methods**

The research purpose was the evaluation of the ecological situation and the resources quality in the rural area, by applying various methods, mechanisms, and important protection measures to different activities. An essential role belongs to the evaluation of the ecological stability's degree of the territory compared to the actual and future anthropogenic impact. In this paper, we will talk in more detail about the methodological part of calculating and evaluating the ecological situation in the rural area and evaluating the anthropogenic impact's level for concrete conditions (Method according to I. Jitin, L. Procova, 2002). In the next papers, we will present the ecological situation's evaluation and the resources' quality, including the aquatic ones, the quality of the fountains of the rural areas, which are the most vulnerable and directly depend on the anthropogenic impact's level and the particularities of the factors generating him. The ecological evaluation can become more complex by a detailed examination of the natural resources' situation and the environment factors (land, climatic, aquatic, underground and biological resources). The anthropogenic impact is represented by the economical activities.

Tab. 1 - The ecological risk's factors in the use of ecosystem

Factors	The factor's value	Index
<b>A- Naturals</b>		
Use of the territory, (%)	>90	1,0
	90 – 81	0,9
	80 – 71	0,7
	70 – 60	0,5
	<60	0,3
Territory's ploughing, (%)	>75	1,0
	75 – 66	0,9
	65 – 56	0,8
	55 – 45	0,7
	<45	0,5
Territory's forestation, (%)	<10	1,0
	10 – 20	0,9
	21 – 30	0,7
	31 – 40	0,5
	>40	0,3
Lands with slopes>2 <sup>0</sup> (%)	>40	1,0
	40 – 31	0,9
	30 – 21	0,8
	20 – 10	0,7
	<10	0,5
The hydrographical network's density, km/km <sup>2</sup>	>2,5	1,0
	2,5 – 1,0	0,9
	0,9 – 0,7	0,8
	0,6 – 0,3	0,6
	<0,3	0,4
Assets stabilizing the environment, (%)	<25	1,0
	25 – 35	0,9
	36 – 50	0,7
	51 – 70	0,5
	>70	0,3
<b>B – Anthropogenic</b>		
Population's density, people/km <sup>2</sup>	>200	1,0
	200 – 150	0,9
	149 – 101	0,8
	100 – 50	0,7
	<50	0,5
The concentration degree of the animal livestock, conventional	>200	1,0
	200 – 161	0,8
	160 – 126	0,6
	125 – 100	0,4

heads/100 ha agricultural assets	<100	0,2
Use of pesticides, kg/ha per year	>5,0	1,0
	5,0 – 3,1	0,8
	3,0 – 1,6	0,6
	1,5 – 0,5	0,4
	<0,5	0,2
Mineral fertilizers, kg/ha active substance per 1 year	>400	1,0
	400 – 301	0,9
	300 – 201	0,7
	200 – 100	0,5
	<100	0,3
Organic fertilizers, t/ha per 1 year	<2,0	1,0
	2,0 – 2,4	0,9
	4,1 – 6,0	0,8
	6,1 – 8,0	0,7
	>8,0	0,5
Placement of ecologically dangerous objects (EDO)	1,0 – 0,91	1,0
	0,9 – 0,81	0,9
	0,8 – 0,51	0,7
	0,5 – 0,20	0,5
	<2,0	0,2

The brief effect of the factors' influence has been calculated according to the formula:

1. Effect of the natural factors (En):

$$En = \frac{100(K1 \times K2 \times K3 \dots Kn)}{n}$$

where:

En – effect of the natural factors; K1, K2, K3...Kn – factors' indexes;  
n - number of factors taken into account.

2. Effect of the anthropogenic factors (Ea):

$$Ea = \frac{100(K1 \times K2 \times K3 \dots Kn)}{n}$$

where:

Ea – Effect of the natural factors; K1, K2, K3...Kn – factors' indexes;  
n - number of factors taken into account.

3. The ecological danger (Pe) has been calculated according to the following formula:

$$Pe = En - Ea$$

The evaluation of the ecological danger (level of the anthropogenic impact) over the agro landscape according to table 3.

Tab. 2 - The coefficients of the ecologically dangerous objects' placement

Factors	Points
1. Placement on the hydrographic basin's territory	
a) on the water poise	0,1
b) on the slope	0,3
c) downstream (river's valley)	0,9
2. Placement according to the areas	
a) outside the protection area, green area and other areas	0,2
b) in the protected part of the area	0,8
c) in the locality's immediate neighbourhood	1,0
3. Placement according to other protected territories	
a) outside the buffer areas	1,0
b) inside these areas	0,5
c) inside the protection areas	0,9

The brief effect of the factors' influence has been calculated according to the formula:

1). Effect of the natural factors ( $E_n$ ):

$$E_n = \frac{100(K_1 \times K_2 \times K_3 \dots K_n)}{n}$$

where:

$E_n$  – effect of the natural factors;  $K_1, K_2, K_3 \dots K_n$  – factors' indexes;

n - number of factors taken into account.

2).Effect of the anthropogenic factors (Ea):

$$Ea = \frac{100(K1 \times K2 \times K3 \dots Kn)}{n}$$

where:

Ea – Effect of the natural factors; K1, K2, K3...Kn – factors' indexes;

n - number of factors taken into account.

3) The ecological danger (Pe) has been calculated according to the following formula:

$$Pe = En - Ea$$

The evaluation of the ecological danger (level of the anthropogenic impact) over the agro landscape according to table 3.

Tab. 3 - The level of anthropogenic impact on agro landscape

Ecological danger	Level of anthropogenic impact
-10	Very dangerous
-10 - +5	Critical
5 - 15	Significant
> 15	Allowable

The ecological situation of several communes and localities of the Republic of Moldova's has been evaluated.

## 2. Results and discussions

The investigations show that the ecological risk for the territory depends on mega indexes – relief, ravening intensity, the hydrographic network's density, ploughing degree, forestation degree, assets stabilizing the environment, the degree of the territory's use, the placement of the ecologically dangerous objects and the level of the anthropogenic impact.

The development of the stressed ecological situations depends on the density and the characteristic of the hydrographic network, which influence the territory's predisposition to erosion and also to the raising of the phreatic waters' level and to the pollution of the water sources, as well as the quantity of animal and human waste t/km<sup>2</sup> formed and stocked on certain areas. The detailed analysis for the

Republic of Moldova's localities indicates a big variability of the indexes which will generate the ecological situation and the anthropogenic impact's level on certain territories.

Tab. 4 - The characteristic of the geomorphologic regions' relief of the Republic of Moldova

№	Name	Altitude, m			Average length	Slopes			
		Max	Prevalent	Min		Surface, %			
						0-2 <sup>0</sup>	2-8 <sup>0</sup>	6-10 <sup>0</sup>	>10 <sup>0</sup>
1	Northern Moldova Plateau	311	220-240	54	800	47	35	12	6
2	Northern Moldova Plain	340	160-200	40	850	50	38	9	3
3	Prenistrian hills	347	180-240	30	1000	40	40	14	6
4	Middle Nistru Plain	274	160-220	30	250	45	35	10	10
5	Central Codri Plateau	430	200-320	27	1000	25	35	25	15
6	Southern Moldova Plateau	280	120-180	20	1100	45	35	15	5
7	Tigheci hills	301	160-290	30	900	30	42	20	8
8	The inferior Nistru Plain	198	20-80	5	200	80	15	5	0

The indexes of the natural components' groups on the Republic of Moldova's territory are pretty varied and they are mostly dependent and different for the geomorphologic districts, especially according to the slopes' situation and the territory's hydrographic situation. This will differently affect the drinking water's quality.

According to the Land Register Office of the Republic of Moldova (2008), 75,6 % of the country's total area is occupied by agricultural lands, 64,6% of which are subject to intense works.

The natural ecosystems and the recreation elements are about 15%. In the category of lands on which intense works are made, arable lands have the biggest percentage, occupying 81,7 % of the area and 18,3 % belong to multi annual plantations.

Tab. 5 – The comparative analysis of the ploughing and forestation degree and the index of the ecological balance for the localities of the Riscani district, 2008

№	Locality	G ploughing		G forestation		I ecological balance		K of ecological stability	
		%	evaluation	%	evaluation	%	evaluation	K	evaluation
1	Riscani	High	68.9	Extremely low	1.6	Low	19.2	0.14	Ecologically unstable
2	Costești	Average	43.5	Low	11.1	Low	11.5	0.30	Ecologically unstable
3	Alexandruști	High	71.9	Extremely low	3.4	Average	22.2	0.17	Ecologically unstable
4	Alniș	High	76.7	Extremely low	1.3	Low	18.5	0.15	Ecologically unstable
5	Boroșeni Noi	High	61.8	Average	15.7	High	32.7	0.22	Ecologically unstable
6	Erniște	Average	55.6	Extremely low	1.5	High	32.0	0.17	Ecologically unstable
7	Corlăteni	High	79.9	Extremely low	1.8	Low	13.3	0.13	Ecologically unstable
8	Dumitroare Nouă	High	77.6	Extremely low	0.97	Low	11.73	0.13	Ecologically unstable
9	Galățeni	High	69.5	Extremely low	3.25	Average	23.9	0.16	Ecologically unstable
10	Grănci	High	75.7	Extremely low	1.9	Low	17.8	0.15	Ecologically unstable
11	Hilani	High	66.1	Extremely low	3.5	Average	25.6	0.18	Ecologically unstable
12	Horodște	High	71.2	Extremely low	4.7	Average	20.6	0.17	Ecologically unstable
13	Mălinoșroce	High	65.5	Low	13.0	Average	29.1	0.20	Ecologically unstable
14	Mihăileni	High	75.8	Extremely low	2.9	Low	19.2	0.16	Ecologically unstable
15	Năroeni	High	61.8	Low	13.4	Very high	52.6	0.22	Ecologically unstable
16	Perșeni	Average	55.8	High	29.8	High	38.7	0.25	Ecologically unstable
17	Pirjota	High	63.4	Low	10.9	Average	29.3	0.23	Ecologically unstable
18	Pocimboșuți	High	65.8	Extremely low	4.8	Average	28.3	0.20	Ecologically unstable
19	Pocimboșeni	High	67.2	Extremely low	6.5	Average	26.0	0.18	Ecologically unstable
20	Răcăria	High	69.9	Extremely low	3.3	Average	24.3	0.18	Ecologically unstable
21	Recea	High	76.2	Extremely low	2.6	Low	18.0	0.15	Ecologically unstable
22	Șumna	High	71.3	Extremely low	4.4	Average	21.8	0.13	Ecologically unstable
23	Șugrăeni	High	79.0	Extremely low	4.7	Low	14.8	0.14	Ecologically unstable
24	Șurzeni	High	66.9	Extremely low	2.5	Average	26.4	0.18	Ecologically unstable
25	Sătebani	Average	58.5	Average	20.0	High	34.2	0.23	Ecologically unstable
26	Vădețuți	High	72.4	Extremely low	4.4	Low	19.5	0.16	Ecologically unstable
27	Vîratic	High	74.3	Extremely low	2.1	Low	14.4	0.14	Ecologically unstable
28	Zăiceni	High	79.1	Extremely low	1.3	Low	14.6	0.17	Ecologically unstable
<b>Total Per Riscani district</b>		<b>High</b>	<b>68.6</b>	<b>Extremely low</b>	<b>Extremely low</b>	<b>Average</b>	<b>23.6</b>	<b>0.17</b>	<b>Ecologically unstable</b>



In general, the indexes of the group of natural components on the territory of the Republic of Moldova are quite varied, mostly dependent and different for the geomorphologic districts (tab.4), especially according to the slopes' situation and the territory' hydrography.

The Republic of Moldova's territory has hills and plains and the plateaus occupy mostly the central part, little inclined from north-west to south-east, that increases the danger of polluting the waters with nutrients. The relief's altitudes vary between 5 m (Giurgiulesti) and 429 m (Balanesti). There are 8 geomorphologic units highlighted on the Republic of Moldova's territory, which mostly influence the waters' pollution and the manifestation degree of polluting sources' transportation in the water sources.

According to the hydro geological estimations, the hydrographic network's average density ( $\text{km}/\text{km}^2$ ) in the Republic of Moldova is 0,48; the Danubian basin-0,67; Prut - 0,94; Ciugur - 0,69; Ialpug - 0,43, Camenca - 0,58; Lunga - 0,43; Sarata - 0,42; Larga - 0,5; Draghiste - 0,62.

The evaluation of the territory's ecological situation shows a critical and significant level of the anthropogenic impact for most of the Republic of Moldova's localities, even without placing ecologically dangerous objects in the hydrographic basins and in other protected areas. Otherwise, the anthropogenic impact's level becomes critical and very dangerous.

For example, in the commune Vasileuti, Riscani district, the territory's utilization exceeds 90 %, the ploughing degree is of 72,6 %, the forestation degree is very low - 3,3 %, the assets stabilizing the environment are 20,3 %. At the actual level of the agriculture's chemisation - applying the pesticides under 0,5 kg/ha annually, mineral fertilizers <100 kg per ha, active substance, organic fertilizers under 2 tones per ha annually, the estimated anthropogenic impact's level is of 7,8 % and it is significant. When placing just one ecologically dangerous object, the situation becomes critical and very dangerous.

The ecological situation of village Sadovoe, Glodeni district, is characterized by a high degree of utilization of the territory (86 %), ploughing degree (62,2 %), the forestation degree is very low (1,91%), assets stabilizing the environment - 14%. The effect of the natural factors is 10,8. The estimated anthropogenic factors are 0,02. The estimated ecological danger is 10,78. The anthropogenic impact's level is significant, being influenced mostly by the low rate of the territory's forestation and its high degree of utilization, as well as by the specific of the relief.

### **Conclusions**

The investigation of the environment problems of the rural areas is based on the priority of the ecological security's priority of the population, of the territory and the rational use of the natural resources - water, air, soil, subsoil, biodiversity.

The objective of the ecological security in the actual communes is to be acquainted with their ecological situation by examining and evaluating the situation, applying various methods and protection measures.

The localities ecological security and their lasting development include the knowledge of their ecological situation and the evaluation of the anthropic activities' impact on the environment, the stabilization and the protection of the natural systems, the conservation of the environment factors' quality, as well as the integrate ecological monitoring.

The protection of the environment in the rural areas must be based on the rational use of the resources, on the avoidance of unbalance between agricultural activity and environment and on the decrease of the anthropogenic impact.

The fast tracing of the critical levels of the factors modification and of the registered localities, will make it possible to take urgent measures, regarding the unfavorable tendencies' settlement, by introducing the necessary modifications in the lands' quota of some land assets.

The placement of some objects that are hostile to the environment in the communes requires the preliminary ecological evaluation of the territory and the comparative examination with other reference objects.

Most of the Republic of Moldova's localities are ecologically instable and the anthropogenic impact's level over the agro landscape is significant or critical.

The territory's stability's improvement can be reached by reducing the arable lands and tree lands quota, by increasing the areas with hay fields, grasslands, forest areas, lakes and marshes, by decreasing the anthropogenic impact and by applying antierosional measures for the sloping lands.

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