ESTIMATION OF LANDSCAPE ANTHROPIC MODIFICATION LEVEL. CASE STUDY: CIULUCURILOR HILLS

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Key words: Ciulucurilor hills, environmental transformation indexes, soil erosion degree.

ABSTRACT:

This paper presents some aspects of assessing the level of anthropogenic landscape modification in the Ciulucurilor Hills by analyzing the degree of soil erosion (Vinogradov, 1998) and the ratio of forests surface to agricultural land and the built area (Manea, 2001; Armas, Manea, 2002). The obtained results by the method of Vinogradov show a ratio of 72.68% of landscapes with high degradation level assigned to disaster and crisis, and, according to the results obtained by the method of Armas and Manea, landscapes with strong and very strong affected ecological balance represent 77.23 %.

1. Introduction

Geographic landscape is a dynamic system whose evolution is determined by interdependence of abiotic, biotic and anthropic factors on the level of Earth's surface with spatial dimensions limited by typological and taxonomical scales that imprint physiological and physiognomic attributes defined by coordinating factors (S. Bănică, 2006). Anthropic activity presents the third component of geographic landscape, the youngest and the most dynamic one, which tends to transform natural landscape. Anthropic activity represents third component of geographic landscape, that tends to transform natural landscape.

In this context, this work's aim is to estimate landscape anthropic modification level in Ciulucurilor Hills on the basis of soils erosion degree analysis (Vinogradov, 1998) and ration between forests area and agricultural terrains area and constructions area (Armas and Manea, 2002).

Study region is Ciulucurilor Hills, takes place in Northern- Central part of the country, being between the regions: at West – Prutul de Mijloc Plains, at North – Cubolta Plains, at East – Dniester Plateau and at South - Codrii de Nord Plateau, being crossed by hydrographic networks of Ciuluc, Solonet, Chiva and Iligaci.

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2. Materials and methods

Two principal data sources, soil map developed by „Nicolae Dimo" Research Institute for Pedology and Agrochemistry, scale 1:200000 (1986) and digitized by Landscapology Laboratory, Institute of Ecology and Geography and digital map of terrains usage elaborated by Land and Cadastre Relations Agency.

Environmental transformation indexes (Itr.e) according to the method proposed by Armas and Manea (2002), represent ratio between forests area and agricultural and constructions areas (Instrumente, Ghiduri si Indicatori..., 2007).

Itr.e = S forest/(S agricultural + S constructions)

According to this approach it is considered that the forest reflects the landscape's natural properties, while agricultural and constructed areas present the factor of environment's anthropic transformation.

Vinogradov, in order to estimate landscapes stability degree, proposed several biotic indicators that consist of three classes of indicators: thematic, spatial and dynamic ones. Thematic indicators include also pedological indicators, among which *soil's erosion degree is*. **(**Б. Виноградов, 1998) .

In order to generate maps of this two indicators' spatial distribution, the thematic layer of land use and soils by erosion degree had been laid over the kilometer grid and then we calculated Itr.e value and eroded soils' proportion for each cell of the given grid. The Obtained values were attributed to centroid points of kilometric grid cells, and then interpolated.

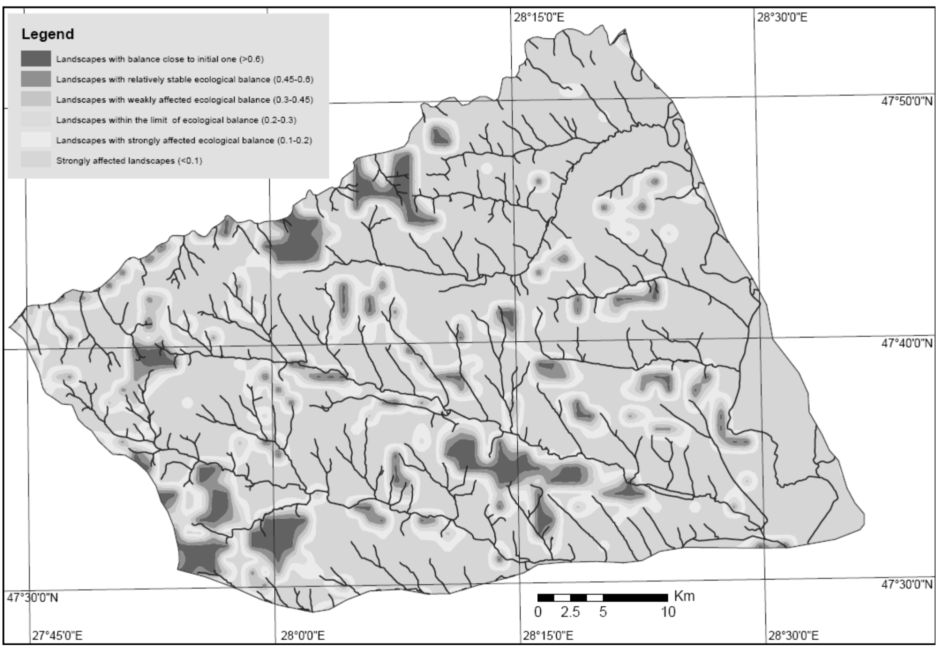

Fig. 1. Geographical landscapes map with different ecological balances.

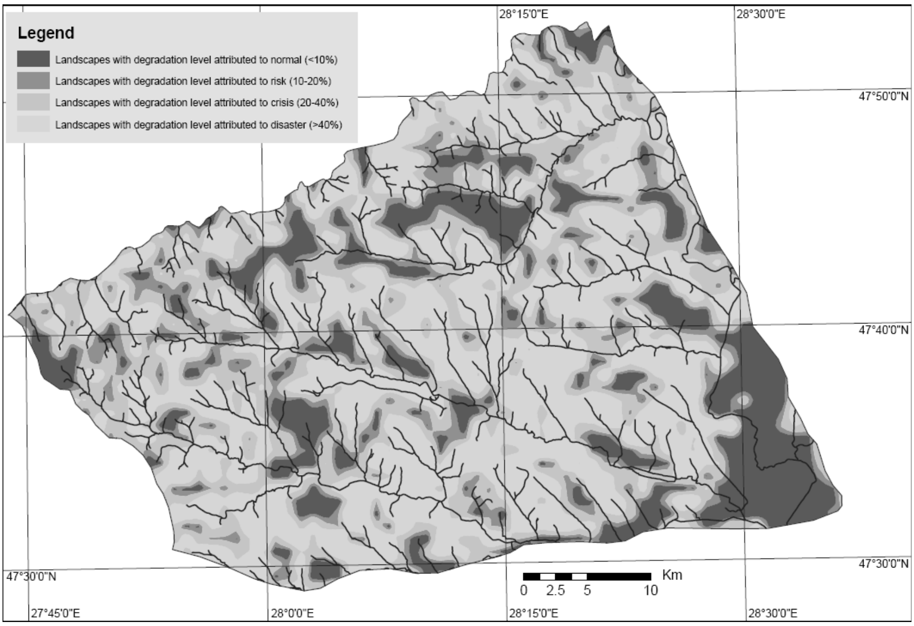

Fig. 2. Geographical landscapes map with different degradation levels.

Obtained rasters were reclassified, in first case, in 6 classes (A.-M. Corpade, 2011, Redimisionarea ecologică şi economică..., 2007), to present geographical landscapes with different ecological balances (figure 1), and in the second case, in 4 classes, which represent geographical landscapes with different degrees of degradation (figure 2).

For spatial distribution analysis of the given landscape, they were correlated with the relief's morphometry (elevation, slope and exposition).

3. Results and discussions

Landscapes ration with strong and very affected ecological balance is equal to 77.23%, and those with relatively stable and close to the initial one is equal to 9.29% (figure 3), which demonstrates that landscapes condition in the given region is instable. The proportion of landscapes with strongly affected ecological balance according to relief's features, decreases with height, and of those with stable balance and close to one, on the contrary, increases with height. (table 1).

The same tangency belongs to the given landscapes weight when related to slopes classification, e.g. together with slope's increase the proportion of heavily affected ecological balance decreases, and proportion of landscapes with relatively stable and close to the initial balance increases. (table 2).

The given tendency of landscapes distribution as a function of terrain's elevation and slope is due to fact that forests are placed mainly on higher terrains and with greater inclination, and the ones with smaller heights and lesser slope's angle are used for agricultural lands and for constructions' placement.

While analyzing landscapes proportion with different ecological balance in correlation with exposition, we can observe that landscapes with ecological balance close to the initial one have the biggest proportion on the slopes with northern and north-western exposition, and the most affected ones on directions of south, south-east and south-west (table 3).

The mode of landscapes distribution according to slopes exposition is determined by the fact that northern slopes are more humid, and therefore more favorable for forest vegetation, and southern ones, on the contrary, are less favorable.

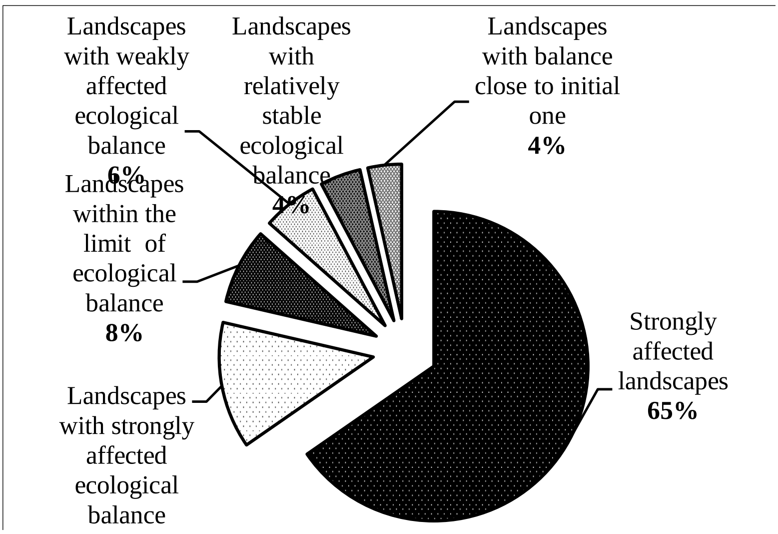

Fig. 3. Proportion of landscapes map with different ecological balances.

Table 1. Proportion of landscapes map with different ecological balances within relief's features framework.

Type landscape	<50	50-100	100-150	150-200	200-250	250-300	>300
Strongly affected landscapes	81.80	76.32	69.31	61.36	47.60	36.89	28.75
Landscapes with strongly affected ecological balance	7.29	11.29	13.58	14.07	13.21	18.26	13.56
Landscapes within the limit of ecological balance	4.50	6.14	7.06	8.73	10.61	15.53	5.94
Landscapes with weakly affected ecological balance	3.66	3.58	4.78	6.37	9.31	12.63	12.20
Landscapes with relatively stable ecological balance	2.16	2.17	3.22	4.68	9.52	9.29	14.47
Landscapes with balance close to initial one	0.58	0.50	2.06	4.79	9.75	7.40	25.08

Table 2. Proportion of landscapes map with different ecological balances within slopes classes.

Type landscape	>2	2-5	5-7	7-15	>15
Strongly affected landscapes	78.86	72.81	63.05	42.60	55.01
Landscapes with strongly affected ecological balance	10.25	12.92	15.04	14.84	10.59
Landscapes within the limit of ecological balance	5.48	6.67	8.90	11.54	6.62
Landscapes with weakly affected ecological balance	3.16	4.04	6.02	10.68	6.88
Landscapes with relatively stable ecological balance	1.49	2.10	4.11	10.50	9.22
Landscapes with balance close to initial one	0.77	1.46	2.87	9.84	11.68

Table 3. Proportion of landscapes map with different ecological balances by slopes' exposition.

Type landscape	Flat	North	North-East	East	South-East	South	South-West	West	North-West
Strongly affected landscapes	79.47	55.36	62.74	66.98	69.00	69.20	69.42	61.76	58.01
Landscapes with strongly affected ecological balance	10.17	12.77	13.68	13.54	14.38	13.81	13.18	12.84	11.69
Landscapes within the limit of ecological balance	5.70	9.64	8.44	7.34	7.26	6.99	7.28	9.05	8.92
Landscapes with weakly affected ecological balance	2.90	8.81	6.11	5.38	4.22	4.83	4.45	6.66	8.17
Landscapes with relatively stable ecological balance	1.40	7.94	5.22	3.76	2.96	2.97	2.85	4.57	6.79
Landscapes with balance close to initial one	0.35	5.48	3.81	2.99	2.19	2.20	2.83	5.12	6.42

The proportion of landscapes with high degradation level more attributed to disaster and crisis is equal to 72.68%, and of those with small degradation level more attributed to risk and normal state is equal to 27.32% (figure 4), which demonstrates that landscapes state in the given region is mostly degraded. The biggest ratio of landscapes with degradation level attributed to normal is registered on the heights of less than 50 meters and more than 300 meters, and of those with degradation level attributed to disaster - on the heights of 100-150 meters, 150-200 meters and 200-250 meters (table 4).

This mode of landscapes distribution as elevation function is determined by the fact that within the heights less than 50 meters soils are less affected by erosion processes and here flood plains soils are prevailing, and terrains with altitudes bigger than 300 meters are less used as arable land. A big proportion of landscapes with degradation level attributed to disaster within the above-mentioned limits is due to fact that here agricultural lands are prevailing, mainly arable ones.

After giving the landscape analysis from the slope's angle point of view, we can observe a growing trend of landscapes with degradation level equal to disaster, together with slope's inclination angle increase, and vice versa in the case of the landscapes with degradation level attributed to normal (table 5).

The given tendency of landscapes distribution is determined by the fact that the slope's inclination increases is always accompanied by eroded soils area's increase.

If we analyze landscapes with different degradation level in correlation with slopes' exposition, we can observe that landscapes with degradation level attributed to disaster have bigger proportion on the northern and north-eastern directions, and of those with degradation level attributed to normal – southern, south-eastern, south-western ones (table 6).

The given mode of landscapes distribution in function of exposition is determined by the fact that northern ones are more humid and more shadowy, and respectively more affected by erosional processes, and Southern ones are drier and respectively less affected by these processes.

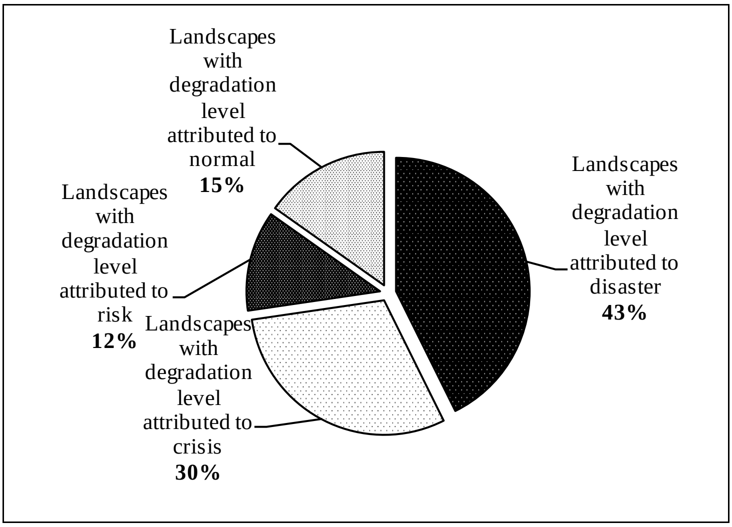

Fig. 4. Proportion of landscapes with different degradation levels.

Table 4. Proportion of landscapes with different degradation levels within relief's features framework.

Type landscape	**<50**	**50-100**	**100-150**	**150-200**	**200-250**	**250-300**	**>300**
Landscapes with degradation level attributed to disaster	8.50	38.46	50.21	41.86	42.52	28.01	11.12
Landscapes with degradation level attributed to crisis	17.35	25.39	29.42	33.93	31.42	33.78	21.71
Landscapes with degradation level attributed to risk	8.68	11.95	10.30	13.75	12.86	18.90	26.37
Landscapes with degradation level attributed to normal	65.46	24.19	10.07	10.46	13.20	19.31	40.81

Table 5. Proportion of landscapes with different degradation levels within slopes classes.

Type landscape	<2	2-5	5-7	7-15	>15
Landscapes with degradation level attributed to disaster	26.89	39.31	48.82	56.22	50.30
Landscapes with degradation level attributed to crisis	28.57	31.87	29.56	27.87	28.22
Landscapes with degradation level attributed to risk	13.17	14.03	11.14	8.63	7.78
Landscapes with degradation level attributed to normal	31.37	14.80	10.48	7.29	13.70

Table 6. Proportion of landscapes with different degradation levels by slopes' exposition.

Type landscape	Flat.	North	North-East	East	South-East	South	South-West	West	North-West
Landscapes with degradation level attributed to disaster	26.13	46.35	45.50	41.46	39.92	42.70	43.39	43.58	42.26
Landscapes with degradation level attributed to crisis	24.99	28.09	30.68	32.03	30.11	29.60	29.27	30.62	30.74
Landscapes with degradation level attributed to risk	10.13	12.60	10.77	12.77	13.06	12.69	11.58	12.64	12.71
Landscapes with degradation level attributed to normal	38.75	12.96	13.05	13.74	16.90	15.01	15.77	13.16	14.29

4. Conclusions

Geographic landscapes in Ciulucurilor Hills are heavily modified anthropically, which was demonstrated by 77.23% proportion of landscapes with strong and very strong affected ecological balance as well as by 72.68% proportion of landscapes with degradation level attributed to disaster and crisis.

Landscapes distribution analysis in correlation to relief's morphometry indicates the fact that together with altitude and slopes inclination angle values increase, the frequency rate of the heavily anthropically modified landscapes is growing in the case of Vinogradov approach and vice versa in the case of Armas and Manea approach. The given contrary is observed also in the case of landscapes distribution on slopes' expositions, and namely: on the Northern slopes frequency rate of heavily anthropically modified landscapes is bigger in the case of the first author's approach and vice versa in the case of last authors.

Thus we can conclude that the increase in the forested areas would improve landscapes state, and deforestation and using those terrains as agricultural, especially arable ones, would lead to increase in erosional processes, contribute to their degradation. Also if antierosional measures intensify on the agricultural terrains with high inclination and altitudes, and northern exposition, it would contribute to landscapes state's stabilization.

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