

ASSESSING THE DEGREE OF ANTROPOGENIC PRESSURE ON LANDSCAPES. STUDY CASE - NORTHERN CODRII PLATEAU

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Abstract: Ce travail représente les aspects sur l'appréciation des niveaux de pression humaine on paysage géographique de la région Codrilor du Nord. Pour cet étude ont été sélectionné et utilisé plusieurs indicateurs de base d'évaluation du paysage: l'indicateur de naturalité, l'indicateur de la transformation de l'environnement, l'indicateur de pression humaine par des terres agricoles, par des terres non agricoles et des forêts. Le calcul de ces indicateurs nous nous donnons des informations quantifiables qui nous permet d'exprimer et prévoir les changements qui se produisent dans l'environnement. En limite de plateau Codrilor du Nord la pression anthropique on paysage est en croissance continue et contribuer de cette manière aux changements de physionomie et de fonctionnalité du paysage. Faire un aperçu générale des indicateurs de base du paysage analysé, nous concluons que les paysages géographiques à l'intérieur d'unités administratives du limites de Codrilor du Nord ont affecté l'équilibre écologique. Nous notons que dans le central et méridional part sont les grandes valeurs de fragmentation du relief, la fréquence grande du glissements de terrain limite l'activités agricoles, ici sont présents les paysages avec l'équilibre écologique relativement stable. Toutefois, dans le nord et en particulier dans l'est de zone d'étude les terres agricoles détenir une part importante au détriment du paysages forestiers.

Keywords: *Northern Codrii Plateau, anthropogenic pressure, degree of ecological stability of land.*

1. Introduction

The concept of landscape emerged many years ago, being used initially in the arts' field. In the geographical literature it was introduced by A.von Humboldt in early nineteenth century, leading over time to a science of geographic landscapes.

Over time, the different geographical schools have advanced several definitions of the landscape, defined as “a piece of space, resulting from the interaction in time between the initial physical environment, the biological exploitation and people's actions. The integration of the interacting elements was completed with the historical dimension, the scale of human life, the organization and development of the society” [1].

Thus, the human factor is the third component of the geographical landscape, however the most dynamic, inducing the most visible changes to the landscape and tending to transform more and more the natural landscape.

In this context, the aim of this study is to assess the degree of anthropogenic pressure on the landscapes in the territorial-administrative units (communes) within the limits of Northern Codrii Plateau, starting from the analysis of the main indicators of landscape assessment. We consider it necessary both from the theoretical point of view and from the

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perspective of its practical implications, taking into consideration the advanced degree of human intervention on the landscape of the area.

The area of study - Northern Codrii Plateau - is a subregion of Codrii Plateau, comprising the central-northern part of the Republic of Moldova and has a particular morphological structure in comparison to the rest of the region. At the same time, it is a region with most active sliding processes. Spatially, this area is delimited by Northern Ciulucurilor Hills, Dniester Plateau in the east, Eastern Codri and Western Codri in the south and Middle Prut Plain in the west. Northern Codrii Plateau is crossed by Cula and Raut rivers, as well as by the upper course of Ikel river.

2. Materials and methods

A way of expressing the human intervention dimension in a territorial unit is the calculation of some elementary indicators regarding the landscape assessment, which represent quantitative values obtained from the various ratios of statistical data.

In the context of the extremely recent typology and terminology Cassattella & Peano (2011), the term of indices, frequently used in the studies in the field (index of naturalness, indices of human pressure, index of environmental transformation) were considered as inadequate. Thus, they were renamed as elementary indicators of landscape assessment. This grouping and renaming is based on the fact that they provide scarce information on the landscape analysis, without outlining the path of such a study of landscape assessment [1].

Due to the characteristics of the study region, in order to determine the level of artificialisation, we selected the following indicators as being most representative: the indicator of naturalness, the indicator of environmental transformation and the indicator of human pressure through agricultural, non-agricultural and forestry use of the territory.

The indicator of naturalness I_{nat}

The Indicator of naturalness is given by the ratio between the forest area and the total area of the territorial unit:

$$I_{nat} = S_{forest} / S_{total}.$$

Alternatively, the indicator may be expressed as a percentage by multiplying the value obtained from the above formula with 100.

Dumitrascu (2005) adjusts this index to the forest steppe area [2].

$$I_{nat} = (S_{forest} + S_{grassland}) / S_{total} \times 100$$

Taking into account the fact that the Northern Codrii Plateau is in the forest-steppe vegetation, in order to calculate this indicator we also took into account the grassland areas and forest areas, so that the results obtained should be more conclusive.

It should be noted that this indicator is reported, in fact, to the presence of forest in the study area and not the natural state of the forest, an aspect which is difficult to assess.

The indicator of environmental transformation I_{tre}

This indicator generally reflects the relationship between natural and anthropogenic surfaces. The manner in which the natural and anthropogenic areas are defined is essential in order to define precisely this indicator.

Initially, this indicator was calculated as the ratio between forests and grasslands on the one hand, and the built area on the other.

$$I_{tre} = S_{(forests + grassland)} / S_{built}$$

The idea which led to the use of this indicator (suggested by the Polish school Maruszczak 1988, and Pietrzak 1998, in order to assess the human impact) focuses on the reality that forest and grassland reflect the naturalness of the landscape, while built surfaces are the factor of environment transformation [3].

In this context, depending on the specificities of the analysed area, the next calculation formula developed by Dumitrascu (2006) was proposed:

$I_{tre} = (S_{forest} + S_{grassland} + S_{underwater}) / (S_{built} + S_{arable\ land} + S_{vineyards} + S_{orchards})$, where S_{built} is the surface represented by constructions, roads and railways.

Therefore, this indicator can be adjusted according to the strongest intervention in the landscape (agriculture, built areas), being an indicator of land occupancy and not of its use.

The human pressure through land use and occupancy represents a set of indicators that reflect or appreciate the intensity of the impact of human activities on the environment, an impact exerted by different ways of land use and occupancy. "The human pressure on the environment through land use is greater when the share of agricultural land per capita is higher"[4].

The formula applied by F.A.O. is:

$$P_{class} = S_{class}(ha) / N(loc.), \text{ where}$$

P_{class} = human pressure through a certain class of land use and occupancy;

S_{class} = area occupied by the selected class;

N = number of inhabitants.

This indicator should not be understood as the pressure exerted by a number of people on a certain class of land use and occupancy (in the density of the population). It indicates the number of acres of a particular category of land per inhabitant, reflecting the way people exercise pressure on the environment through the respective category.

For that area of study we calculated the indicators of human pressure through agricultural lands, human pressure through non - agricultural lands and the human pressure through forests [1].

3. Results and discussion

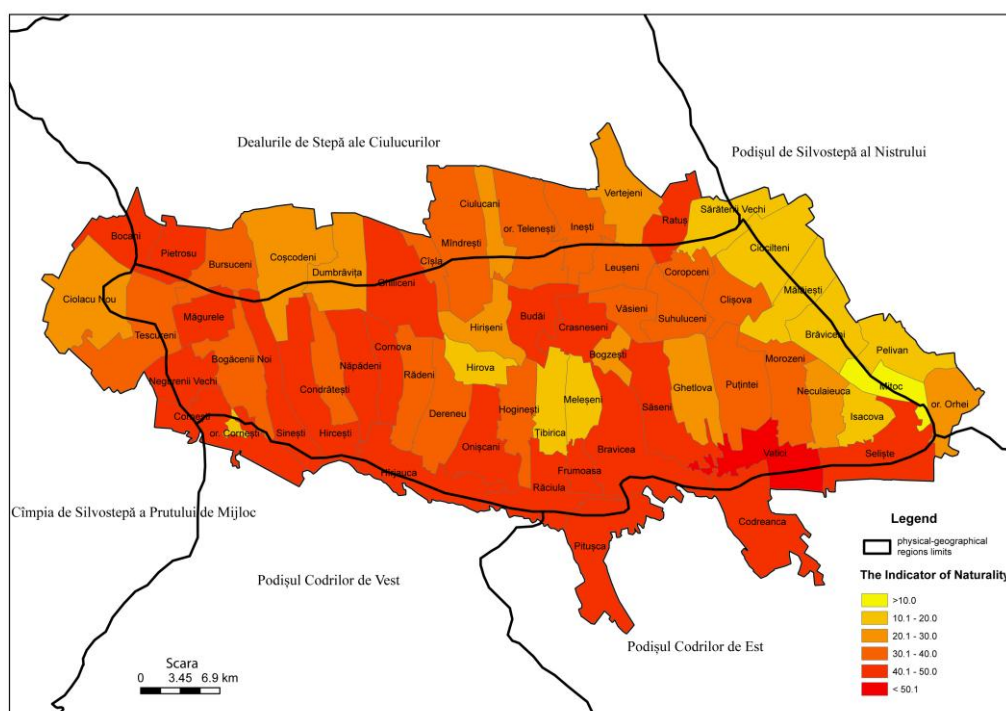
By means of the indicator of naturalness we can estimate the naturalness of the landscape. According to the share of forests and grasslands in the administrative - territorial units (communities) we identify six types of landscapes (Fig. 1), classified according to the degree of damage to the ecosystem balance [5].

The indicator of naturalness calculated for the communes in the study area records significant spatial variations of values (Fig. 1), due to the multitude of landscape types present in the area of Northern Codrii Plateau.

Thus, the indicator values of less than 10 show that the natural landscape was strongly affected by human activity, strongly transformed by it. Such values are recorded only in Mitoc locality.

The category of strongly affected ecological balance landscapes (with Naturalness Indicator values of 10-20) includes 10 administrative - territorial units, most of them in the eastern part of the study region (Malaiesti, Braviceni, Pelivan, Hirova), with extensive arable land at the expense of forests.

In the group of the landscapes situated at the limit of the ecological balance there are 10 of the administrative - territorial units of the region, communities that have experienced large deforestations.



The category of landscapes with a weak ecological balance, affected by anthropogenic intervention, with values of the Naturalness Indicator between 30 and 40, comprises 18 administrative - territorial units, especially large areas of forests and multiannual plantations.

The administrative-territorial units in the southern part of the region distinguish themselves by landscapes with a relatively stable ecological balance, the values of the indicator of naturalness being between 40 and 50. and landscapes with an ecological balance close to the original one, the value of the indicator exceeding 50 (Vatici) commune), a fact which is due to the presence here of a highly fragmented landscape, heavily affected by erosion processes and landslides, in which forest lands have a wide area.

The value of the indicator of environmental transformation (Figure 2) is considered to be higher when areas considered natural dominate over areas considered anthropogenic. Values below 0.01 indicate a strong human intervention, while values exceeding 0.61 indicate the prevalence of the natural element. It is the case of the landscapes with an ecological balance that is weakly affected, relatively stable or close to the initial one, the value of the indicator exceeding 0.61. It applies to some of the settlements in the region (about 30), located mainly in the southern and central part of the study area. Among them, there are the municipalities of Vatici, Seliste, Frumoasa, Hirjauca, Napadeni, Hircesti, in the case of which this indicator exceeds the value of 2, showing a clear dominance of the natural element. Values of the environmental transformation indicator of less than 0.60 are typical of 32 municipalities in the region, with a strongly affected balance in which anthropogenic surfaces dominate over natural areas.

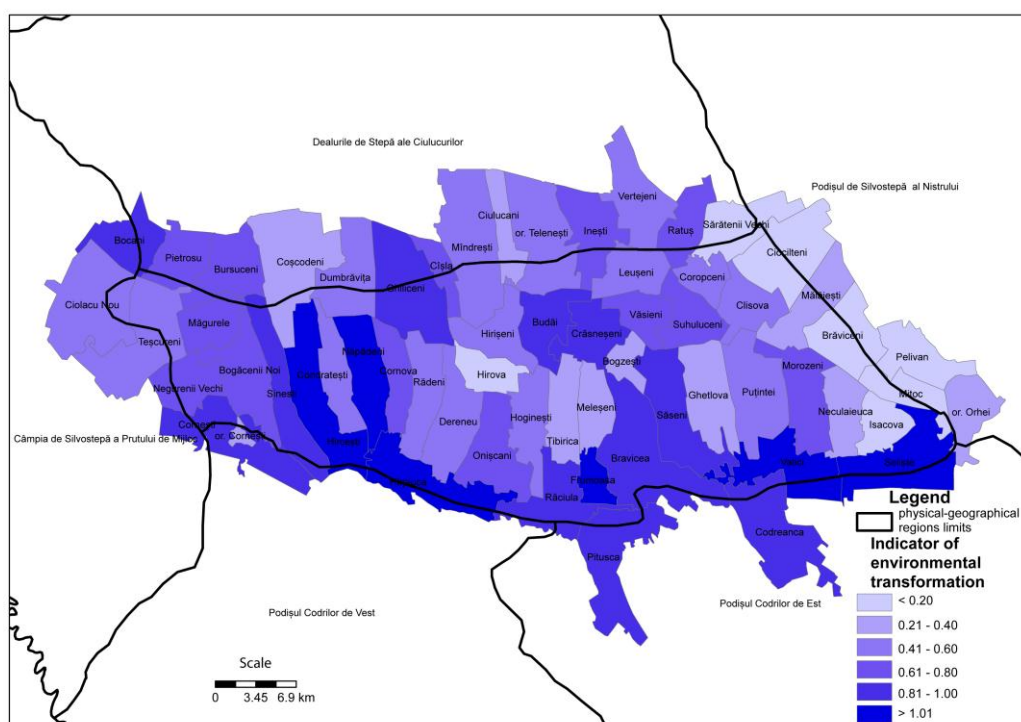


Figure 2. Spatial distribution of Environmental Transformation Indicator values

A classification of the human pressure through agricultural land use was proposed by FAO/UNESCO in La Carte mondiale des sols (1964), being divided into four types of regions according to the values of the Pa indicator.

- territories at the limit of keeping a relative balance of the natural components of the landscape (<0.40 ha / inhabitant.).
- rural landscapes moderately balanced and very weakly unbalanced (0.41 to 1.00 ha / inhabitant.), characterized by an alternation of cultivated areas and areas with other uses (built area, clumps of forest).
- strongly unbalanced rural landscapes (1.01 to 2.00 ha / inhabitant), characterized by an exclusivity of crops and rarely preserved forest clumps.
- very strongly unbalanced rural landscapes (> 2.00 ha / inhabitant), including areas with an intensive agriculture.

For Northern Codrii Plateau this indicator was calculated and spatialized (Figure 3) at the commune level. The lowest values (<0.40 ha / person.) correspond to territories situated at the limit of relative balance of landscape natural components (12 communes). At the other extreme, there are the rural landscapes which are strongly and very strongly unbalanced, with values of the indicator exceeding 1 ha / inhabitant and characterized by an exclusivity of agricultural crops, forest clumps being rarely preserved. It mainly comprises the localities in the west of the region (Ciocănești, Tescureni, Coscodeni). We consider that this situation requires further explanations because plantations, pastures and meadows were calculated by being assigned to agricultural areas, too. It is true that they have expanded at the expense of forests, but they can still be classified as natural ecosystems used by man and thus, they do not reflect a serious imbalance. The category of non-agricultural land includes constructions and waters (Fig. 4). The values of the indicator of human pressure through agricultural areas varies

within the study area from 0.1 ha / inhabitant in the centre part to 0.5 ha / inhabitant in the west, which is mainly due to pressure through construction.

According to F.A.O., the limit for environmental balance preservation is of 0.3 ha forest / inhabitant. The distribution of the values of this indicator (Figure 5) reveals that in most settlements of the area this limit value is maintained. However, there are also places in which the value of the indicator of the pressure through forest areas is below the allowable limit.

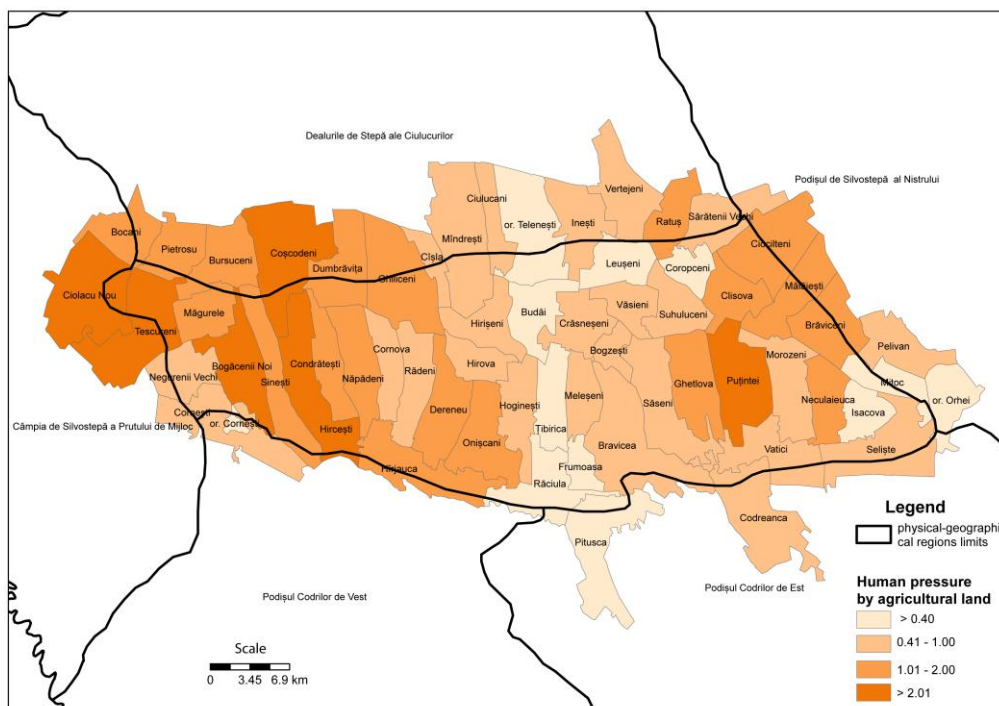


Figure 3. Spatial distribution of Human Pressure Indicator values through agricultural lands

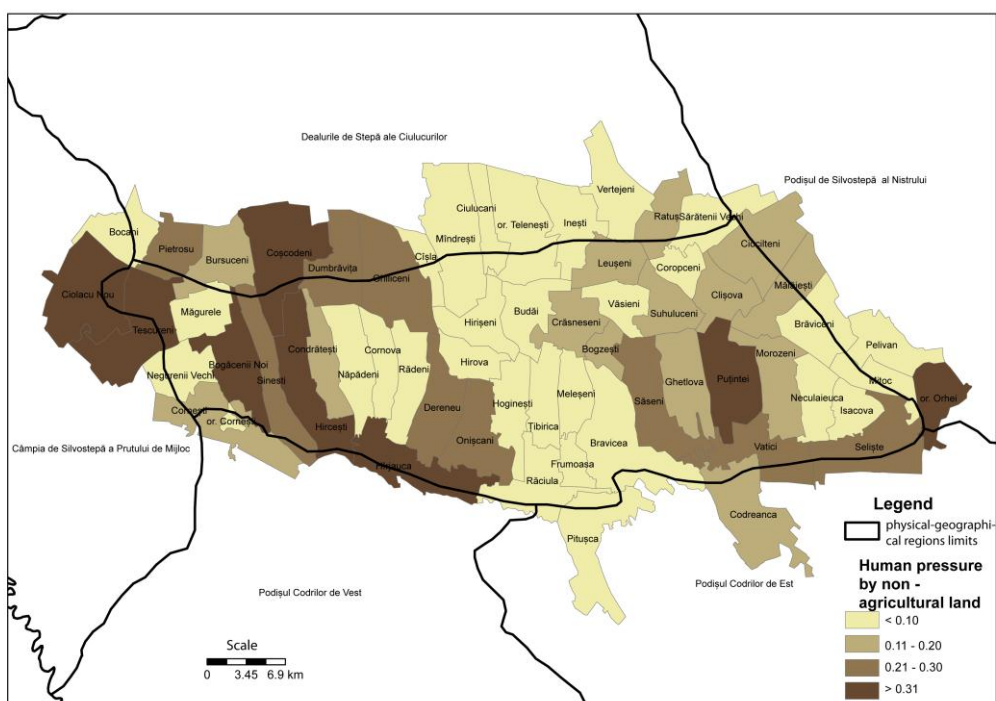


Figure 4. Spatial distribution of Human Pressure Indicator values through non-agricultural land

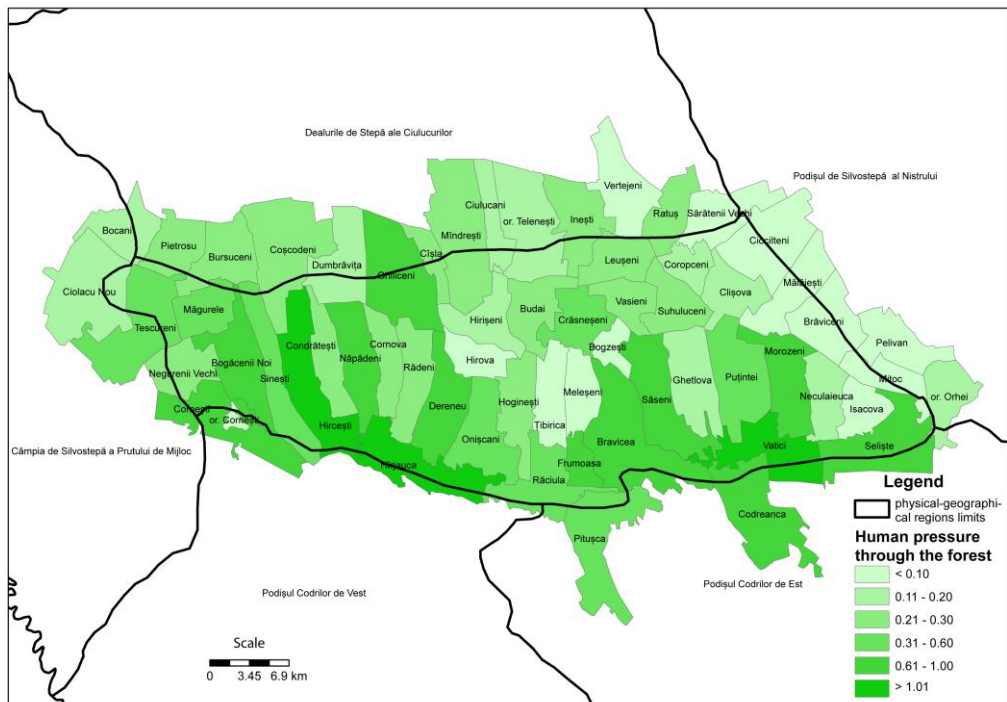


Figure 5. Spatial distribution of Human Pressure Indicator values through forest lands

4. Conclusions

Thus, assessing the human impact on the environment can be achieved by using indicators which quantify the information and help us express and foresee the changes which occur in the environment. They may provide a link between the categories of environmental impact and socio-economic activities, but they can also warn us on possible environmental problems caused by human activities.

Within the limits of Northern Codrîi Plateau, anthropogenic pressure on the landscape is constantly increasing, contributing to changes in the physiognomy and functionality of the landscape. By having made an overall analysis of the elementary indicators of landscape assessment, we can conclude that the geographical landscapes within the administrative units in Northern Codrîi have got an affected ecological balance.

We notice that in the central and southern part the high values of the relief fragmentation and the large frequency of landslides limit agricultural activities generating landscapes with a relatively stable ecological balance. However, in the north and especially in the east of the study area agricultural lands have a significant share, to the detriment of the forest ones.

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