

ASSESSMENT OF HUMAN IMPACT ON ENVIRONMENTAL QUALITY OF METROPOLITAN AREAS. CASE STUDY – CRAIOVA METROPOLITAN AREA

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Abstract. The paper is concerned with the establishing a methodology for the analysis of landscape transformation in metropolitan areas due to human activities such as agriculture and industry (oil extraction industry) through the application of a set of indicators meant to assess the landscape transformations. Human pressure on the environment is evaluated through the use of agricultural land, the index of naturalness of modified landscape, index of naturalness and landscape transformation index. The results are calculated for the metropolitan area of Craiova in order to assess the environmental quality. This type of evaluation can be evaluated by local authorities for urban planning in the perspective of urban sprawl and development.

Keywords: Craiova metropolitan area, environment, landscape, indicators, human pressure.

Rezumat. Evaluarea impactului activităților umane asupra calității mediului din zonele metropolitane. Studiu de caz – Aria metropolitană Craiova. Lucrarea de față propune o metodologie de analiză a transformării peisajului în ariile metropolitane sub impactul activităților umane cum ar fi agricultura și industria (extracția petrolului), prin aplicarea unui set de indicatori mențiți să evalueze transformarea peisajului. Presiunea umană asupra mediului este evaluată prin utilizarea terenului agricol, indicele de naturalitate și indicele de transformare a peisajului. Rezultatele au fost calculate pentru aria metropolitană Craiova în scopul evaluării calității mediului. Acest tip de evaluare poate fi valorificat de către autoritățile locale pentru planificarea urbană în perspectiva dezvoltării zonei metropolitane.

Cuvinte cheie: arie metropolitană Craiova, mediu, peisaj, indicatori, presiune umană.

INTRODUCTION

The metropolitan area of a city represents a critical space where land-use conflicts can contribute to the degradation of environmental quality. There are to be mentioned studies of PĂTROESCU et al., 2009 regarding metropolitan area of Bucharest, PĂTRU-STUPARIU (2012) with the structural modeling and functional landscapes but also ANTROP (2004) with the urbanization process in Europe and Landscape changes, BOTEQUILHA LEITAO & AHERN (2002) with landscape ecological concepts and metrics in sustainable landscape planning. There must be mentioned that standardized indexes for the assessment of the environmental quality were mainly used for landscape changes analysis within non metropolitan areas, such as landscape transformation in managed forested areas (LÖFMAN & KOUKI, 2001).

STUDY AREA

The present paper is a case-study of Craiova metropolitan area, which is situated in the south-western part of Romania and which is one of the most important metropolitan areas in the South-Western Region of Oltenia. It has been settled by the association of Craiova municipality with 21 administrative units and two towns namely, Segarcea and Filași, since 2008 (MARINESCU, 2006). The metropolitan area of Craiova has a total area of 149,862 hectares, which represents almost 20% of the total area of the county (Fig. 1). The metropolitan area is constituted by the association of voluntarily partnership between the great urban areas and urban and rural settlements, which developed multiple purpose cooperation relationships (Fig. 2).

MATERIALS AND METHODS

Agriculture (cereals, crop plants for industrial end uses and vegetable crops) and industry represent the most important sources for land use conflicts and environmental pollution. They have a direct negative impact on landscapes quality through the degradation or even destruction of natural ecosystems (MUNTEAN, 2005). The scientific research is based on statistical data for Dolj County (INSSE. RO 2014).

It was calculated the **human pressure on environment (P)** by taking into account the type of use of agricultural land. The way lands are used can induce a specific environmental pressure. For its calculation there has been used the formulae used by FAO.

$$P = S/N [1]$$

where

P = human pressure (ha/ inh.);

S = analyzed surface (ha);

N = number of inhabitants within the analyzed perimeter (inh.);

There was also calculated the **index of naturalness of modified landscape (Nat)** by the use of the following formulae:

$$\text{Nat} = (F + M)/S \times 100 \text{ [2]}$$

where

Nat = index of naturalness

F = forested surface

M = surface of meadows

S = total surface

Environmental transformation index (Etr) was used for the first time by Maruszczak in 1988 in Poland and applied by Pietrzak in 1998 for the evaluation of the human impact on the pre-Carpathian landscape from Poland, as the ratio between forest, meadows and built surface.

$$\text{Etr} = F+M/B \text{ [3]}$$

Where:

Etr = environmental transformation index

F = forested surface

M = surface of meadows

B = built area

Absolute Naturalness Index (Nabs) was the last to be analyzed. It is the ratio between forested surface and total surface of the territorial unit of reference.

$$\text{N abs} = F/S \text{ [4]}$$

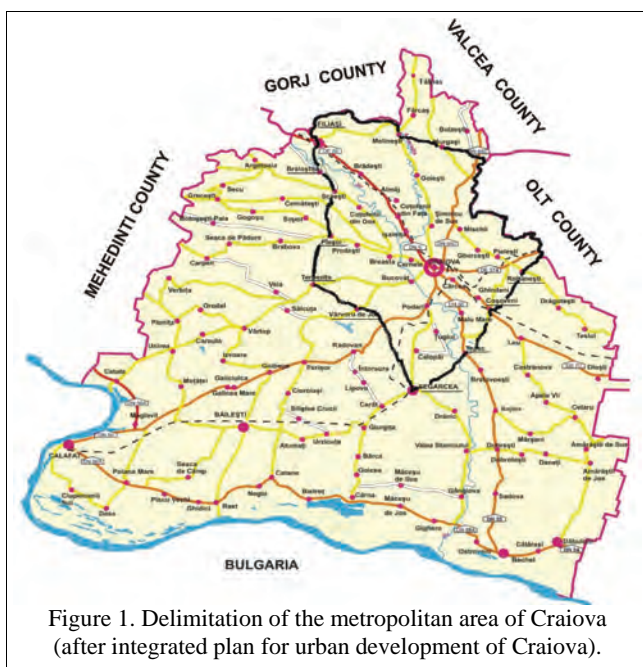


Figure 1. Delimitation of the metropolitan area of Craiova (after integrated plan for urban development of Craiova).

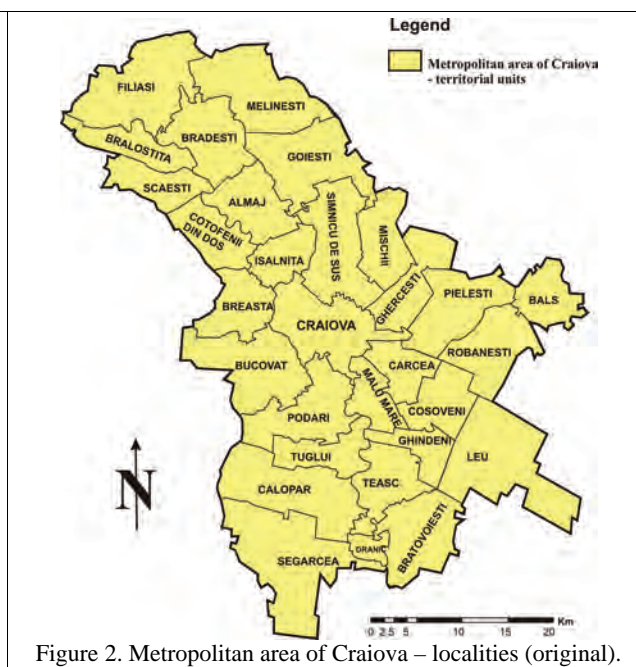


Figure 2. Metropolitan area of Craiova – localities (original).

RESULTS AND DISSCUSIONS

Adaptation of **human pressure on environment (P)** index to the metropolitan area of Craiova points out a significantly increase of human pressure on the environment through the agricultural use of lands. These types of changes are influenced by a range of factors such as:

- numerical growth of the population
- the increase of agricultural surface by including flooded areas from the alluvial plain of the Jiu or sandy lands in the agricultural circuit, through the plantation of adapted agricultural crops such as vineyards, tobacco, melons, etc.;

The calculated values reveal that the administrative units situated in the eastern part of the metropolitan area (Mischii, Ghercești) present values of the human pressure index over the average (1.7 ha/inh. – 2.1 ha/inh.) (Fig. 3). One main cause of these high values may be generated by the human pressure on agricultural surface, with a small percent of land per capita (PĂTROESCU, 2000). Another cause is food industry (mill-bakery), due to extended surfaces planted with wheat and rye (Ghercești) and maize (Mischii).

The maximum values are recorded for Ghercești commune (2.8 ha/inh.) and the minimal value for Ișalnița Commune (0.3 ha/inh.). In Romania, the average value of the index is 0.68 ha/inh., while the county average ranges between 0.5 and 1.4 ha/inh. (PĂTROESCU, 1983). The first category (0.5- 1.0 ha/inh.) indicates territories classified to the limit of environmental equilibrium of natural elements of landscape (Fig. 4).

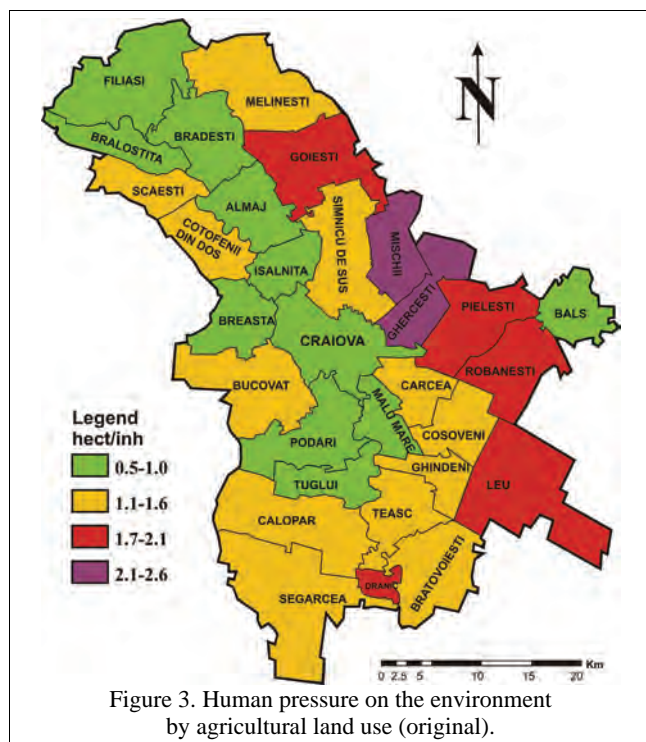


Figure 3. Human pressure on the environment by agricultural land use (original).

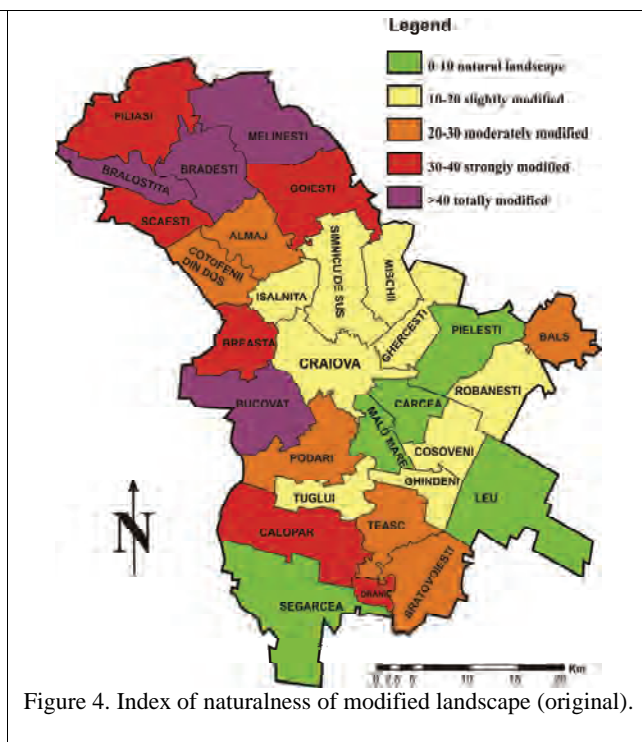


Figure 4. Index of naturalness of modified landscape (original).

The second category (1.1-1.6 ha/inh.) indicates rural moderate landscape modifications and feebly modified landscapes, which are characterized by an alternance of cultivated surfaces and different land use (built surface, forest patches). Values of 1.7-2.1 ha/inh. indicate strongly modified surfaces, which are exclusively used for agriculture with scarce forest patches. Last category (2.1-2.6 ha/inh) indicates most strongly modified landscapes with areas used exclusively for agricultural purpose.

The index of naturalness of the landscape indicates the extent of human intervention within a territorial unit. It has been applied to the study and indicated mixed areas of natural landscapes (Segarcea, Leu) but also completely modified landscapes (Melinești, Brădești) (Fig. 4).

The environmental transformation index reflects the environment transformation degree, in this case the metropolitan area of Craiova (Figs. 5; 6).

Totally affected landscape is recorded in the communes situated in the eastern and south-eastern parts. The maximum value is recorded at Cârcea, which confronts in the present with an increasing demand for plots of land for the development of residential buildings and economic purpose.

The main urban expansion is recorded eastward and south-eastward. Westward expansion is limited by the existence of the natural barrier of the Jiu River. Another cause of totally affected landscape is due to the reduced surface of forests (Segarcea, Leu), which records far below 100 hectares, as compared to the other communes such as Bucovăț, Melinești, which own large forested areas (over 2000 ha).

Values less than 1 indicate a strong anthropization, while values greater than 1 indicate the dominance of the natural elements (PĂTRU-STUPARIU, 2012). The last analyzed indicator is the index of naturalness, which represents the ratio between the forest area and total area; to be mentioned in this indicator, it is reported the presence of forest in the study area, and not the natural state of forest.

Adaptation of this to the analyzed space presents obvious failure on the proportion of forests; there are areas with a very strongly affected landscape: Craiova and the majority of communes situated in its proximity (Cârcea, Ișalnița, Podari). The main cause of this situation is the presence of anthropogenic elements (Fig. 6).

Another cause, designated as the main problem in the analyzed area, is from the perspective of natural area, the very small percentage of the forest area (11.5 % of total surface), well below the national (28.3%) and regional (29.5 %) average (SDES Dolj, 2014), which emphasizes the risk of climate change and desertification, especially in the south of the county, where there are very strongly affected landscape respectively at the limit of ecological equilibrium (Podari, Țui, Teasc communes with a predominant agricultural land use). Places with a deficit of forested areas (<10%) are: Segarcea, Leu, Ghercești (under 100 ha each one), which has a strong agricultural profile.

By contrast, large forested areas are found in the hilly area of the metropolitan area: Calopăr, Bucovăț, Melinești, with values recording slightly affected landscape, respectively landscape with relative established ecological equilibrium (here, forest area covers more than 2000 ha.).

The Forestry Department Craiova proceeds programs of afforestation yearly, on almost 400 hectares of full afforestation and 200 hectares by natural regeneration; also at the county level there are plans for arrangement of about 500 ha of forest plantations to protect forest land and settlements.

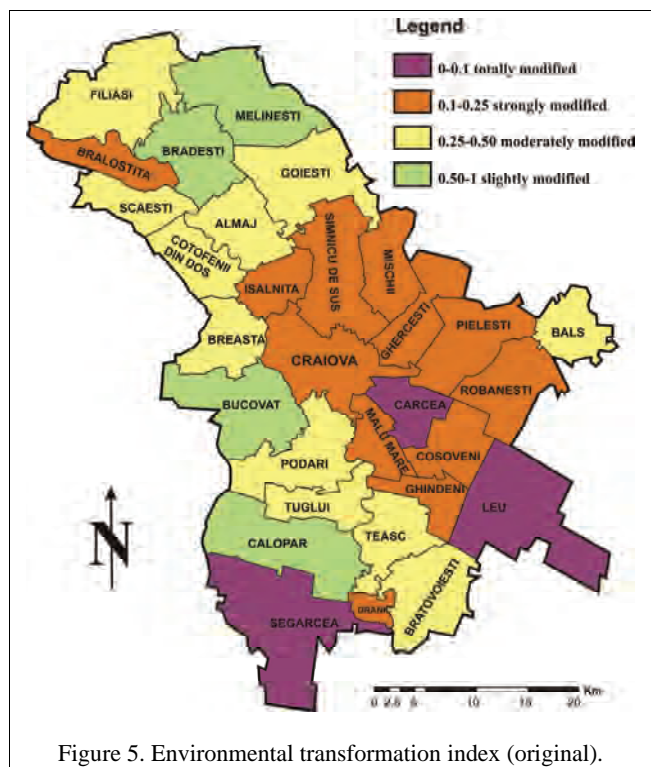


Figure 5. Environmental transformation index (original).

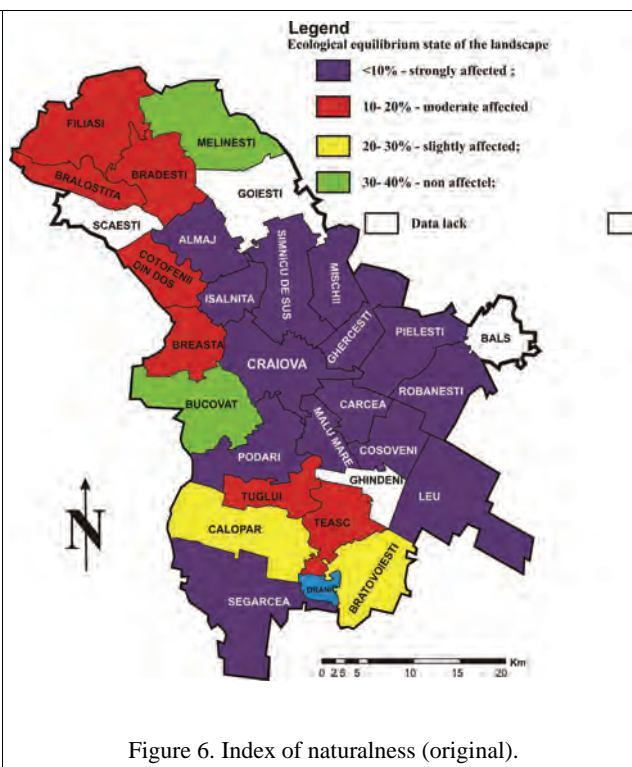


Figure 6. Index of naturalness (original).

CONCLUSIONS

Over time, the analyzed landscape confronted with a number of changes: economic, demographic, and especially ecological, imposed by the society development, changes which mostly had negative effects on the environment.

The landscapes analysis of the metropolitan area Craiova by the use of environmental assessment indices allowed us to identify strongly affected landscape and totally affected landscape largely present within the analyzed perimeter. Thus, there were indicated “hotspots” in this regard, such as: the northern zone of the metropolitan area characterized by strongly and totally modified landscapes. The main cause was industrial and industry, with direct effect on natural ecosystem.

Another strongly affected environment is in the eastern and south-eastern parts of the analysed area. In this area, urban expansion with its implications was the main unleash factor. By contrast, in the western and north-western part of the metropolitan area, the main cause is the natural barrier of urban spreading left to the Jiu River.

For a more detailed analysis of the projection of human activities in the quality of the environmental state of the metropolitan area of Craiova, we suggest additional indicators for assessing the natural landscape transformation: the general index capitalization of agricultural land, use intensity (CSI) and density of population.

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