

## THE LANDSCAPE DYNAMICS IN PIATRA NEAMT AREA

Liviu Apostol<sup>1</sup>, Dan-Adrian Chelaru<sup>2</sup>

**Key words:** landscape, spatial dynamics, land use change, GIS, Piatra Neamt.

**Abstract.** The great diversity of natural conditions of Piatra Neamt have led to a great complexity of anthropogenic use, which gives a distinctive note to the landscape of the area. In the last century, the city has experienced remarkable changes in the configuration and use of its territory, mainly due to high anthropogenic pressure by different types of land uses, resulting in gradual artificiality of the landscape. The analysis showed the spatio-temporal dynamics of the various components of the geographical landscape mainly using GIS techniques. Also it highlights the defining elements of landscapes found in the study area, making a general typology of them.

### Introduction

Due to favorable natural conditions for human settlements, this area of transition between two major units represented by the Carpathian and Subcarpathian relief was an ancient hearth housing.

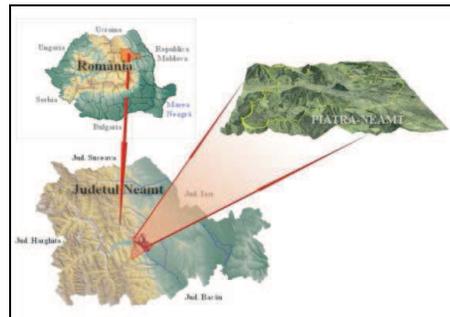


Fig. 1 - Localization of area of study

The emergence and development of the city was favored by the interference of geographical, historical and economic factors, being an obvious "contact area".

<sup>1</sup> Prof. PhD., Alexandru Ioan Cuza University, Iași, apostolliv@yahoo.com

<sup>2</sup> PhD. Student, Alexandru Ioan Cuza University, Iași, dan\_adrian86@yahoo.com

Thus, there is no accident that over this site was grown the ancient settlement of Petrodava.

Geographically, the city location is quite original, the initial built perimeter is sheltered by heights with steep slopes carved into flysch and it expanded to the Bistrita valley and its affluents, especially on terraces, but also in meadows, areas that show optimal urbigene conditions.

Geographical landscape can be defined as a spatial structure expressed by a certain physiognomy, individualized by the interaction of abiotic, biotic and anthropogenic factors, that is valued differently, depending on the perception of each person. (Drăguț, 2000). The main objective of this study is to restore the existing landscape in Piatra Neamt area by the analysis of cartographic documents from different periods of time in order to capture changes in the geographical landscape components.

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

For a better analysis of the phenomenon and for a more complex study GIS techniques were used with the help of the professional software MicroImages TNT mips 7.2.

Because we took into account spatial and temporal dynamics of the landscape was necessary to analyze cartographic materials from different periods of time representative of the phenomenon studied. The main materials used for the achievement of the study are the topographic maps at scale 1:25000, 1986 edition, and ortophotomaps (2006), which led to obtaining the numerical terrain model (MNT) of the studied area, going through several stages. In the analysis we also used statistical data, old photos and bibliographic references.

By combining the MNT with different other vector layers (like human settlements, hydrography, roads, land use, toponyms) will result a number of maps necessary for our analysis: hypsometric map, land use map, the landscape typology map etc. Statistical datas were processed using Excel 2007. Also, for the final version of graphs and maps was used Corel Draw X4 graphics program. Obviously, the main method used in analysis was mapping, but the results can be obtained only by combining it with the direct observation in the field, synthesis, and off course, comparison methods.

### **2. Dynamics of landscape elements in Piatra Neamt area**

**2.1. Changes occurring in the abiotic component of the landscape.** The relief represents a coordinator factor of the landscape. It is the support that other environmental factors (climate, vegetation, water, man) all shape and define the current landscape of the city of Piatra Neamt. The relief of the Piatra Neamt

territory is complex by its type, altitude, slope orientation and slope, original prints of landscapes.

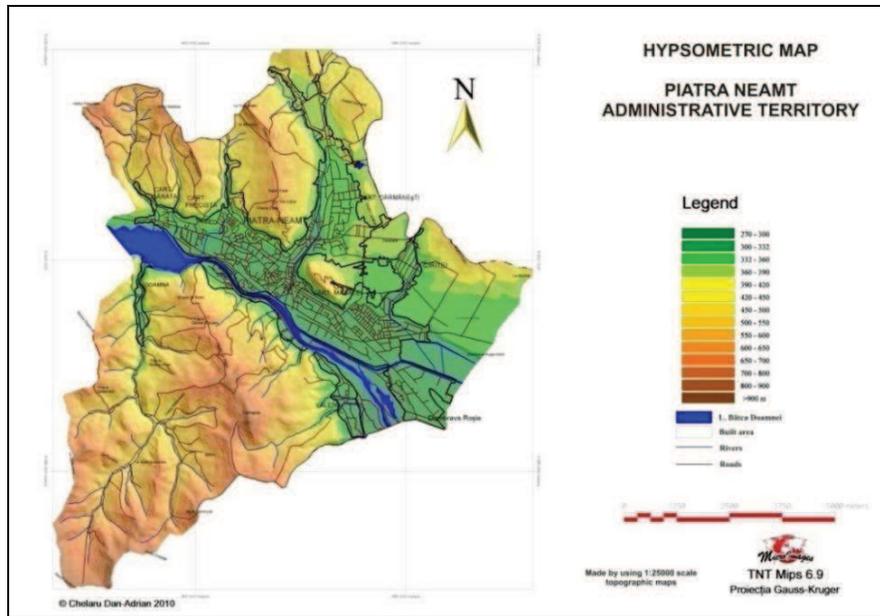


Fig. 2 - The hypsometric map of Piatra Neamț administrative territory

Regarding the macro-relief, it does not show major changes in the last century, represented in cartographic documents. During the analyzed period there is a pretty serious landslide on the south-west of Mount Cozla, which collapsed following torrential rains in 1897 covering the long road and houses in the neighborhood inhabitants of Valea Viei. Also, the landslides on the south-east side of the mountain led to the disappearance of mineral springs, which had made Piatra Neamț a balneary resort. Small-scale landslides can be seen nowadays on the south-eastern side of Cozla, to the Petru Rares street.

The hydrographic network represents an essential component of the geographical landscape, being an active, dynamic and vital life and hence the deployment of human activities.

In the area of study, the main hydrographic component is Bistrita river. In old maps it appears meanders, with many side branches, numerous islands and extensive flood plains and swampy areas which gives a certain restrictiveness in terms of expanding the perimeter of the city built. The latest maps shows

adjustments recorded on Bistrita river by the disappearance of side arms, the islands and many swampy areas due to construction of drainage systems.

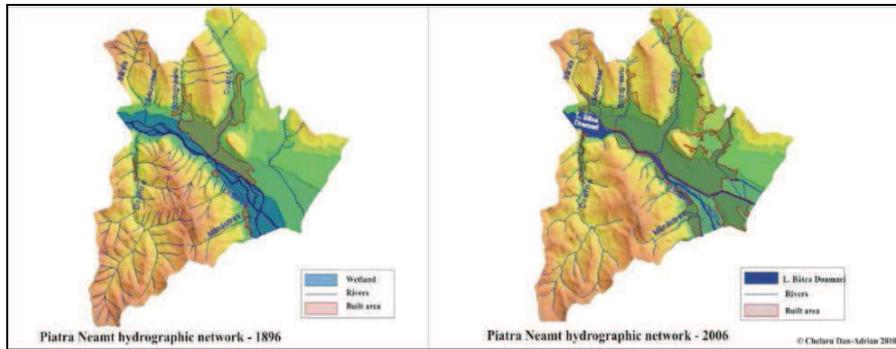


Fig. 3 - Changes of hydrographic network from 1896 to 2006

Bistrita river hydro power stations, which were made since 1960, favored in large extent the urban development in Piatra Neamt.

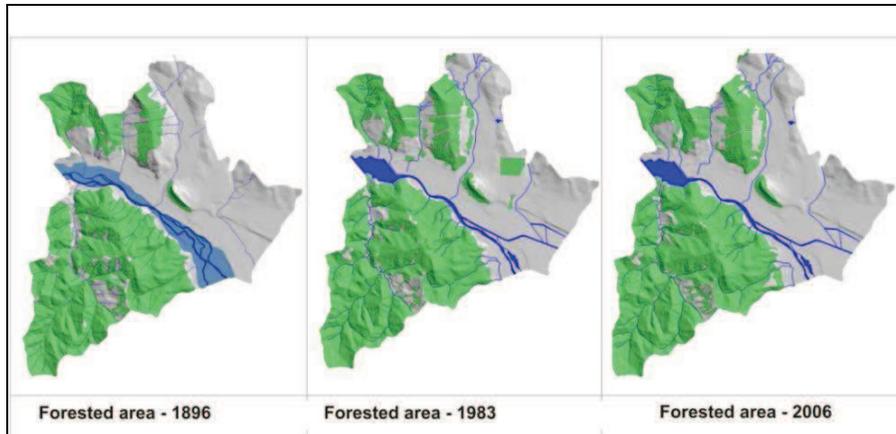


Fig. 4 - Changes in forested areas during the 1896 - 2006 period

**2.2 Changes occurring in the biotic component of landscape.** Vegetation is the main component of the biosphere, that perform the most complex and intense exchanges of matter and energy. Its features define territorial units, functioning as

an indicator of the other components of the landscape (relief, rock, soil, and especially climate).

It is also an extremely sensitive part of the landscape, responding to the slightest variations in environmental factors, recorded and marked by radical feedback response to anthropogenic interventions with multiple consequences on the steady-state landscape. In Piatra Neamț area forest vegetation is prevalent. This type of vegetation acts as a buffer between the agency and the topographic surface modelers, land covered with vegetation, compact soils with normal texture, are well protected against erosion.

Forest area of Piatra Neamț has not changed significantly in the period analyzed, but is noted an increase in forest area Cozla Hill and the Pietricica with 195 ha and 35 ha. However, is observed some small areas and some areas where deforestation has been made especially in Stânișoarei mountains (fig. 4).

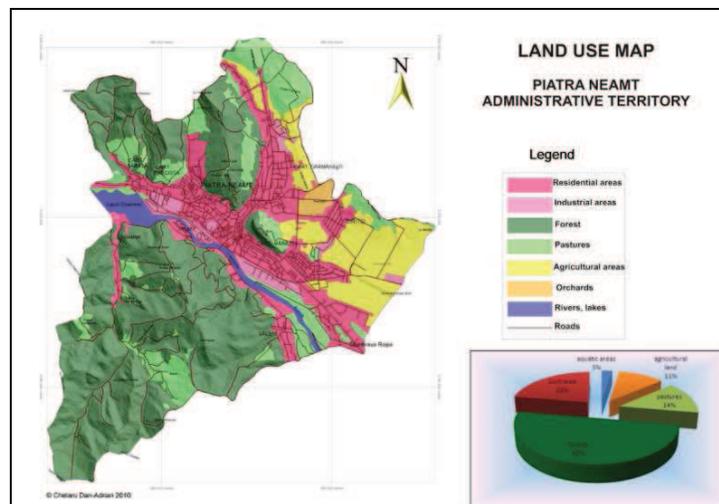


Fig. 5 - The land use map and chart showing the distribution of every field

### 2.3. Changes occurring in the human component of the landscape.

**The current state of land use and recent changes.** Changes in land use and land cover are some of the far-reaching effects of human activities on modern landscapes (Bender et al,2005). The detection and analysis of land-cover and land-use (LCLU) change has been applied successfully in many different countries and ecosystems of the world especially using Geographic Information System (Serra et al., 2008) The knowledge that is acquired can be applied in landscape planning

procedures in order to provide relevant landscape management in the future. Various land cover categories are characterized by the specific internal dynamics of the changes that have been observed. There have been variations in the intensity of these changes over time (Skalo et al, 2010).

The analysis of the chart based on the resulted land use map can show that the largest share of the surface is occupied by forested slopes. Of the total 7700 ha of the city, forested area represents almost half of the surface (3844 ha), followed by the actual built area (1719 ha), pasture (1090 ha) and agricultural land (850 ha). Water surfaces represented by the Bistrita River and its tributaries, but also Bâtea Doamnei Lake occupies a share of only 3%, 196.96 ha (fig.5). Regarding the recent changes occurring in land use the most significant are the expansion of the perimeter of the city built. (Chelaru et Ursu, 2009).

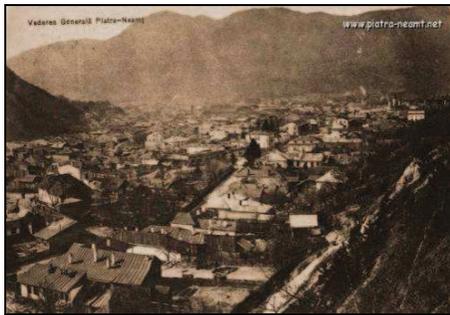


Fig. 6 – Piatra Neamt, 1960

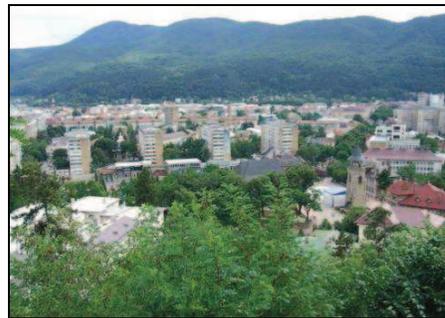


Fig. 7 – Piatra Neamt, 2007

**Changes in urban space.** Concerning the *changes in the spaces designated for residential construction*, until the nineteenth century, the city had a low profile, with the predominance of the ground floor houses, the majority built of less resistant materials (fig. 6). Only in the late nineteenth century buildings have appeared several floors, mostly in the center area of the city. During the second part of the twentieth century we notice a strong tendency to lift vertically, even in outlying neighborhoods (fig. 7). Between 1965-1980, over 65% of new constructions were made in the form of blocks of flats with 5 and 8 levels, leading to the reduction of ground-type housing.

**Changes in the industrial areas (case study – Reconstructia factory).** The transition from a planned economy to a market economy resulted after the fall of communism, imposed a process of industrial restructuring and major structural changes in production volume and closure of large industrial enterprises.

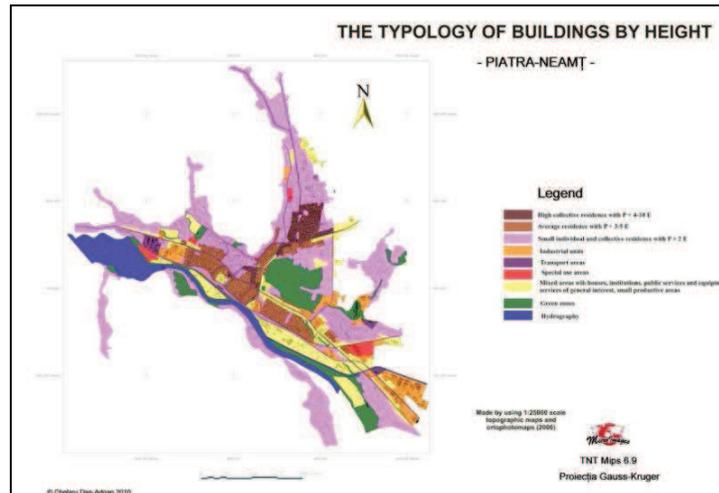


Fig. 8 – The typology of buildings by height in Piatra Neamț



Fig. 9 - Selective images of the former factory buildings (2007)

The increasing demand for building space and the inesthetic aspect that these degraded buildings gives to the landscape required new solutions for recovery of the areas concerned.

Thus, the priority is reinsertion in the economic circuit of former brownfields (eg: former pulp and paper factory "Reconstructia").

Local authorities seek the recovery of 287,000 m<sup>2</sup> of "Reconstructia" by building a residential neighborhood with nearly 40 buildings. The project includes blocks with four and eight floors, supermarkets, two shopping centers, nursery, green spaces, playgrounds, own parking, sports and recreation.



Fig. 10 - Demolition of the old buildings (2009)



Fig. 11 - The present stage of the work (april, 2010)

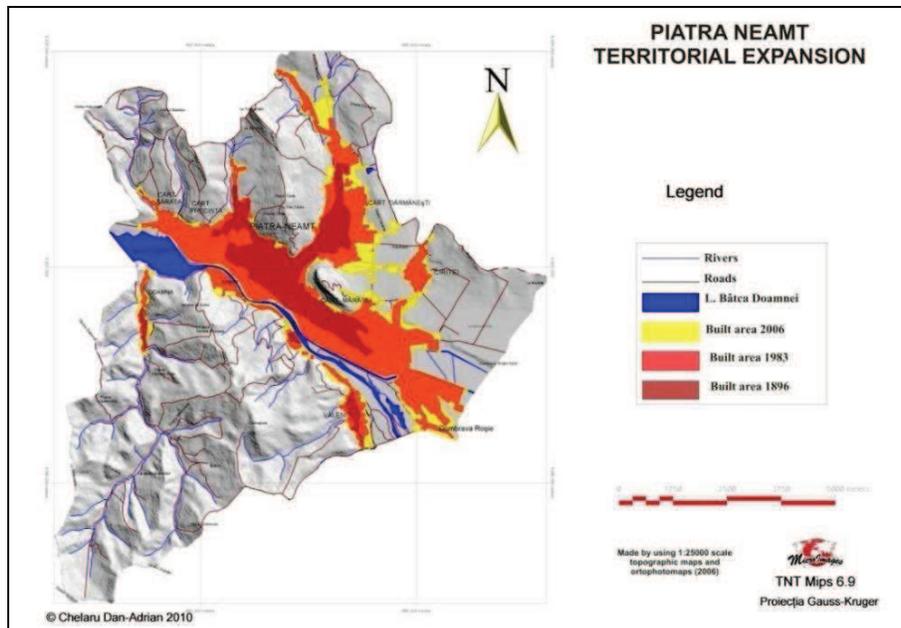


Fig. 12 - Territorial expansion of Piatra Neamt

***Extending the perimeter of the city built.*** Over time, the most interesting changes in land use were those of extending the built perimeter. Thus, the analysis of territorial expansion was reported on two periods: 1896 - 1983 and 1983 - 2006 according to cartographic materials which were available.

Based on this maps, through specific methods, we have calculated the extended areas for each period. Thus, between 1896 - 1983 is found, according to calculations, an expansion of the built perimeter of approximately 787 ha, while from 1983 to 2006 it was an increase of approximately 313 ha. If the first value can be considered normal in the sense that the expansion took place in a 87 years interval, the second value indicates an extremely rapid growth rate for only 22 years.

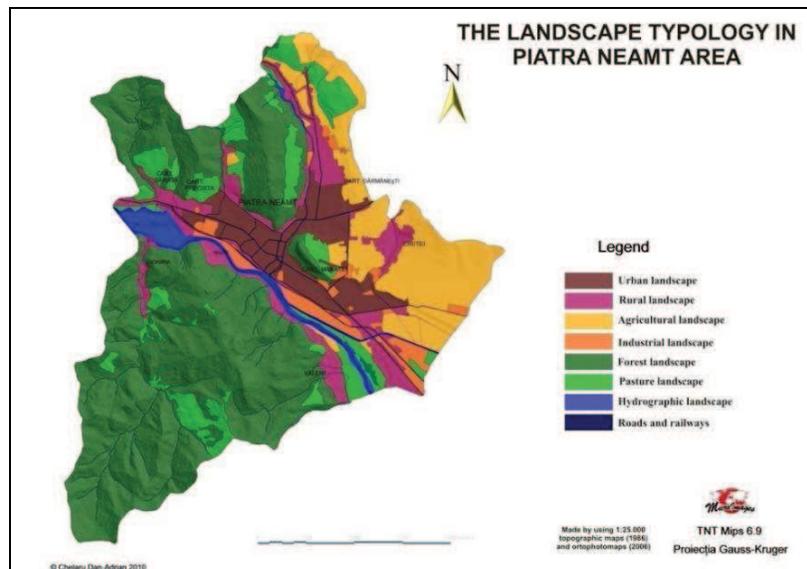


Fig. 13 - The main types of landscape reflected in Piatra Neamț area

The causes of this significant increases we can find during both fall and the subsequent communist regime. Thus, if before 1990 territorial expansion was mainly realized through the rapid process of industrialization, developing some new industrial areas, in the next period, this expansion was due to populations desire for increased comfort indicators, particularly by villa-type buildings that requires space.

**The landscape typology in Piatra Neamț area.** Natural landscapes (human intervention on natural elements are not predominant and not definitive to the landscape character); for example, areas above 500 m absolute altitude, mainly massive Cozla, and Pietricica, Cernegura. There are different types of landscape in which some natural factors are imposed: geomorphological landscape,

hydrographic landscape (hydrographic network, intermittent or permanent lakes), forested landscape (forest - an element of homogeneity), the pastoral landscape.

Humanized landscapes (resulted by human intervention on natural landscapes, through the replacement of natural and native elements, with other natural or modified elements introduced artificially in the geosystem). We can highlight the following types of landscape: agricultural landscapes in the NE of the city; rural landscapes (former municipalities bordering the city were incorporated in the structure, making new neighborhoods: Sarata - west of town, Vânători at east, Văleni, Chindia and Doamna, on the right side of Bistrita, and Ciritei in north-east.

Anthropogenic landscapes (characterized by almost total lack of natural elements in the landscape components); industrial landscapes represents 10% of the built area - industrial units are distributed irregular in the city's territory; urban landscapes represented by the main downtown, Dărmănești and Mărăței neighbourhood, where are located the tallest buildings.

### **Conclusions**

Landscape is a complex notion, dynamic, which differs to the perception of each person. Regarding the abiotic component, on the studied area, water has the most pronounced dynamic character.

The relief is generating the support of landscapes. In the studied area, landforms represent the most stable element, and it is not subject to major changes. Vegetation landscape gives a certain aspect, having an important role in the landscape structure, and is even a criterion for classification of some of them. Regarding the biotic component, in Piatra Neamt forest areas are characterized by major changes. The most dynamic factor of the geographical landscape is the anthropogenic factor, the growing pressure from its ever leads to significant changes in other elements, with obvious changes in landscape physiognomy and default functionality. The analysis can differentiate three major types of landscapes: natural landscapes, humanized landscapes and anthropogenic landscapes, each with many types.

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