

TRANSFORMATION OF LANDSCAPE IN THE CERNA BASIN

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ABSTRACT - The landscape is a sensitive component of the environment, an indicator of its state. At the same time, it is an important component of the natural and cultural heritage, so that the protection and preservation of the landscape are essential elements of planning development at local and regional level. The Cerna basin landscape has experienced an intense anthropogenic pressure, causing change and even degradation. This study aims to identify the factors modifying the landscape, to assess its quality, as well as to identify the actions required for adequate protection, managing and planning of the landscape.

Keywords: landscape, human pressure, industrial activities, land use, sustainable development

INTRODUCTION

The transformation of the landscape results in reduced landscape diversity, loss of identity and its character, changing processes and functions in the landscape; new landscapes appear which replace traditional landscapes. Landscape analysis aims to identify the factors responsible for its structure, dynamics and current functions. It aims to assess the landscape and evaluate its equilibrium, which is a result of interactions between its components. The stability of the landscape is dependent on the manner in which its components react to modifying factors, both natural and anthropogenic. Landscape diagnosis is prerequisite to developing forecasts of its further growth. The fundamental aim of the forecast is the devising of objectives and proposals for a sustainable use of the landscape, decisively contributing to the sustainable development of the area by organizing and planning. The purpose of planning is to create, preserve, improve and restore landscapes in accordance with environmental principles.

The area of study is the basin of Cerna, located in west-central Romania, where the Southern Carpathians meet the Western Carpathians, in the middle of the Mureș basin. The Cerna basin partially overlaps the central and north-east of the Poiana Ruscă Mountains and the northwestern compartment of Hațeg Depression, Hunedoara Hills (Figure 1). The environment and plentiful resources have attracted a large population, whose social and economic life has played a decisive role in transforming the landscape.

MATERIALS AND METHODS

Information was collected by studying the references, maps and satellite images, but also through field observations.

This study also included processing of data from the National Institute of Statistics (statistical databases, TEMPO Online), which served as the source for the determination of elementary indicators used to assess the landscape. On this basis, a more realistic image of the landscape and its development trend has been obtained.

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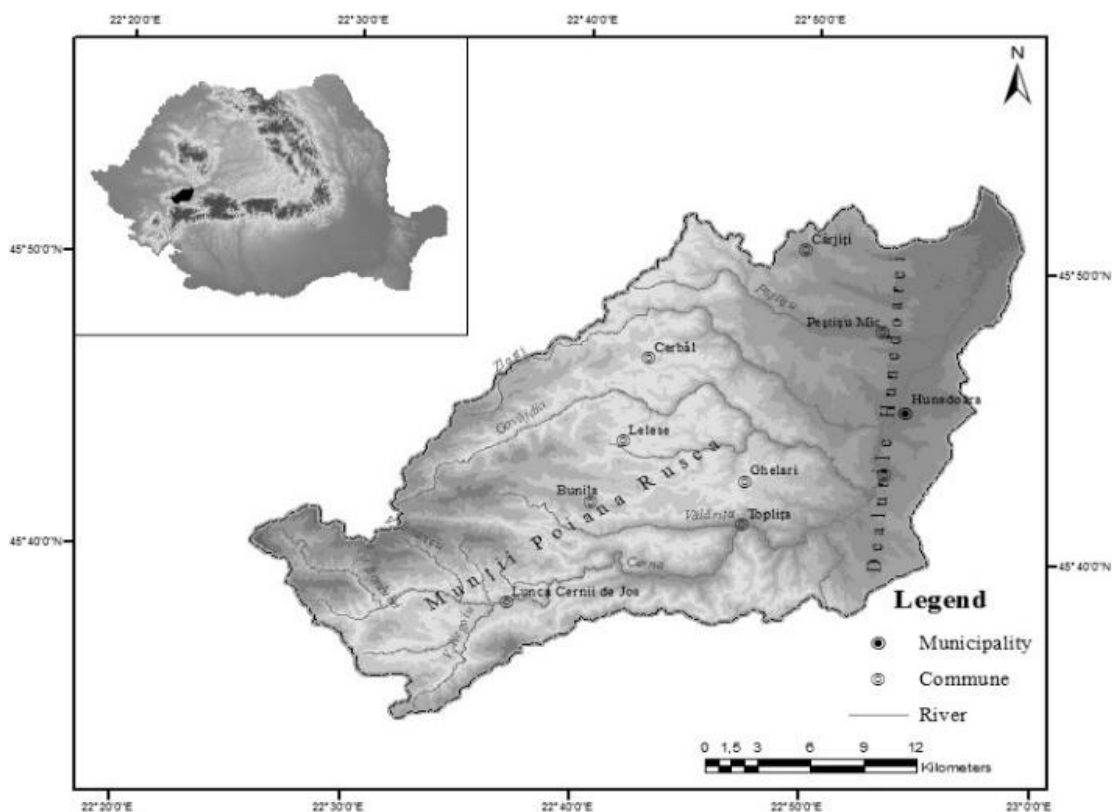


Figure 1. Cerna basin

ANTHROPOGENIC INTERVENTION ON THE LANDSCAPE

Anthropogenic intervention, manifested over a long time and with growing intensity, is expressed by human pressure, the effects of industrial activities and land use change.

Human pressure by the type of use and occupation of land can be evaluated by the magnitude of the effect of human activities on the environment, as a result of various modes of land use (Figure 2), indicating the size of the area of a certain category of land, or class of use, per inhabitant (Pătru-Stupariu, 2011, p. 111). “The higher the share of agricultural lands per capita, the greater is the human pressure on the environment through the use of the land” (Pătroescu cited by Pătru-Stupariu, 2011, p. 111).

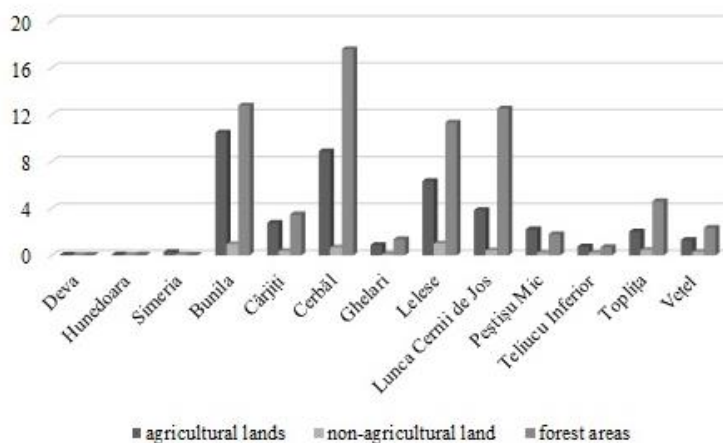


Figure 2. Human pressure by category of land use in 2012

Source: National Institute of Statistics

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Human pressure by agricultural lands is small in Cerna basin. Agricultural area per capita is small, and agricultural lands have a low share of the land fund. Agricultural lands are represented in particular by pastures and hayfields, which can be classified as natural ecosystems used by humans.

Human pressure through non-agricultural land (roads and railways, courtyards and buildings, and unproductive lands) is growing, both in Cerna basin as a whole and in each administrative unit contained within its boundaries, mainly due to pressure by construction.

Human pressure through the forest area exceeds the 0.3 ha forest/capita limit (Geografia României I, 1983, p. 556) for maintaining environmental balance, so it can be considered that the environment is in balance. However, in the urbanized areas the values are below this limit while in the rural areas the limit is exceeded. In the mountain area, the great expanse of forest areas and the small number of residents give very high values for this indicator.

The effects of industrial activities on the landscape include the alteration of its components (relief, hydrography and vegetation) and the pollution of air, water, vegetation and soils. The most significant changes of the geographical landscape were caused by the mining and processing of iron ores.

Mining generated the most representative forms of anthropogenic landscape by establishing open pits and deposits of tailings, as well as triggering or accelerating geomorphological processes (collapses, subsidence and landslides) in the perimeters of underground mines, waste dumps and tailings ponds. The relief above the underground mines was distorted by collapses due to the operation methods that have created large underground voids.

The waste dumps resulting from exploitation and processing of resources (iron ores, complex ores, dolomite, marble) covers an area of approximately 40 ha at Ghelari, Teliuc, Muncelu Mic, and Zlaști. Tailings ponds, located at Valea Podului, cover a total area of 18.6 ha, at Teliuc and Ghelari (Duma, 1998, pp. 315-320). Slag resulting from steel processes is stored in Hunedoara, in a landfill with a surface of 70 ha; the old stockpile of land with an area of 9.30 ha is also located within the city (Figure 3).

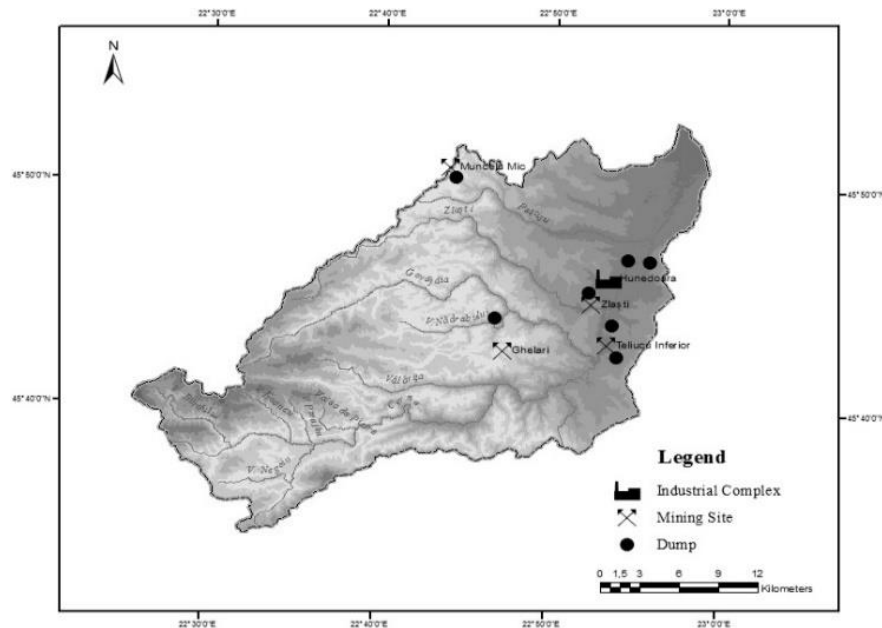


Figure 3. *Industrial sites in the Cerna Basin*

The landscape has also been altered by industrial buildings for machinery, production lines, administration buildings, warehouses for storage of raw materials and finished products.

The hydrographic network has been disrupted by industrial waste, as well geomorphological processes. Hydro-technical facilities on the rivers Runc, Zlaști, and Cerna (Cinciș Lake) were developed to assure the adequate water supply. Massive deforestations have been carried out in order

to produce the charcoal needed for the processing of iron ores, thus entire forests were consumed by the forges in the eighteenth and nineteenth centuries. Switching to coke use in the steel industry in 1895 has reduced the pace of deforestation, which nevertheless continued driven by the needs of the population and industrial processing.

Vegetation was removed from extended surfaces to make room for waste dumps or quarries. Soils were covered with waste or were removed.

Deforested lands have been replaced by farmland and secondary grasslands, with mesophile and xerophile plants in the areas of Cinciș, Groș, Ghelari, Teliuc, Boș, Zlaști (Popa, 1997, p. 103). Deforestation also influenced the spread of animals living in the forest. Clearing the forest changed the conditions of pedogenesis, which is reflected in the morphology and characteristics of different types of soils.

Another aspect of the industrialization process is the action of pollutants generated by industrial activity. The vegetation is affected by dust deposition on leaves, which slows down the development of biomass; trees are thin and grass is meager, which in turn favors erosion. Secondary grasslands, less productive, are used as pastures and hayfields. Soil quality is significantly affected by industrial waste or household waste deposits.

The change in land use and landscape was caused by agricultural use, which began in the Neolithic and continued with increased intensity to this day. This change was also driven by the establishment of industrial plants and their subsequent expansion.

The forest vegetation was removed on increasingly large areas to allow expansion of arable land, pastures and hayfields.

Since the middle of last century, the area of cultivated land has decreased, while the area for pasture and hayfields has increased and, most notably, the area covered by civil and industrial construction and forests has significantly increased (Figure 4).

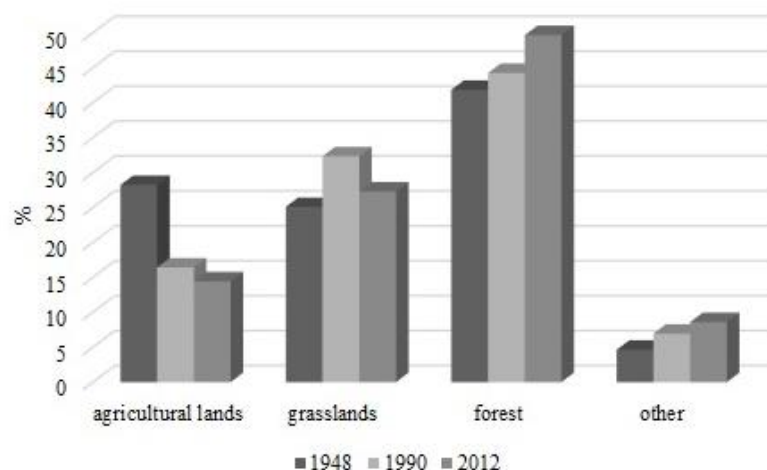


Figure 4. Change in land use from 1948 to 2012

Source: National Institute of Statistics

The land improvement efforts, which generate microforms, and reforestation with spruce and fir carried out in the upper basin, have also caused changes in the landscape.

INDICATORS FOR ASSESSING THE QUALITY OF THE LANDSCAPE

The quality of landscapes can be expressed using elementary indicators such as the naturality indicator and the environmental transformation indicator.

The naturality indicator describes the presence of forest areas in the territory and is calculated as the ratio between the forest area and the total area. This allows the categorization of landscapes as

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follows: close to the original ecological balance (over 0.60); relatively stable ecological balance (0.45 to 0.60); weakly affected ecological balance (0.30 to 0.45); poor ecological balance (0.20-0.30); severely affected ecological balance (0.10-0.20); and very severely affected ecological balance (under 0.10) (Pătru-Stupariu, 2011, pp. 108-109).

The Cerna basin landscape is in a relatively stable ecological balance, with forests covering half the territory. Significant differences between urban (Deva, Hunedoara, Simeria, Călan, Hațeg) and rural areas are, however, present (Figure 5).

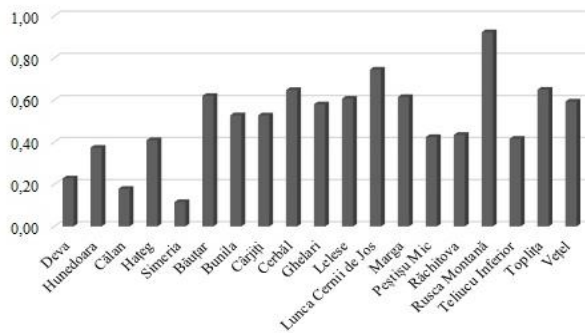


Figure 5. The naturality indicator in 2012
Source: National Institute of Statistics

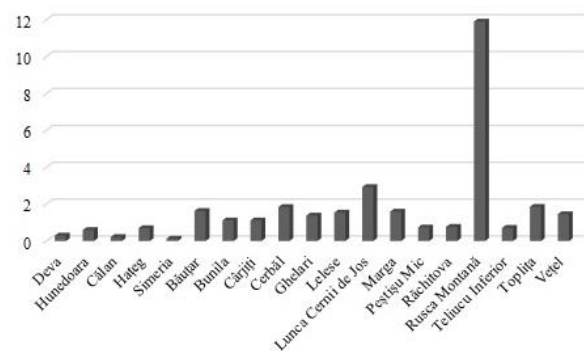


Figure 6. The environmental transformation indicator in 2012
Source: National Institute of Statistics

The *environmental transformation indicator* describes the relation between natural areas and areas transformed by human intervention; it is determined as the ratio between the forest areas (which expresses the naturality of the landscape), and farmed and built areas (expressing human impact) in the territory. Values less than 1 indicate a strong transformation, while higher values indicate the dominance of the natural elements; values close to 1 show a delicate balance (Pătru-Stupariu, 2011, pp. 115-118).

According to this indicator, the observed unit is in a delicate balance, as showed also by the analysis of the administrative-territorial units (Figure 6).

THE LANDSCAPE AND SUSTAINABLE DEVELOPMENT

The accelerated transformation of landscapes, and the public desire to enjoy quality landscapes, require the implementation of policies at both the local and regional level, recognizing the value of the landscape as a key ecological, environmental, social and cultural element. Contemporary society has to aim to repair landscapes disturbed by previous human intervention.

Sustainable development of a territory requires a thorough analysis of its structure and functionality. The purpose of this analysis is to identify the most active components as well as less active, so human intervention would minimally disturb the pace and direction of the evolution of the natural potential of the territory.

Development plans at regional and local level (2007) cause a number of changes in the structure, dynamics and function of landscapes in Cerna basin, which is subject to man-made transformation of the soil cover, vegetation, topography, and hydrographical network.

1. Rehabilitation of industrial sites

The closure, conservation and rehabilitation of abandoned industrial sites after reducing or closing industrial activities (mining, metallurgy, tailings ponds, tailings and slag dumps) are included in the landscaping plans. Remodelling the space occupied by mining and processing infrastructure aims to re-establish the balance of the area.

The closing of underground mines and conservation resorted to flooding of the mine galleries (hydraulic backfilling), followed by sealing the gates. Water levels and quality are monitored for

environmental impact assessment. At Teliuc, quarries were flooded to form a pit lake, generating a specific landscape and new habitats.

The rehabilitation of the dumps and tailing ponds involve reshaping works (currently in progress on the pond no. 1 Valea Cărbunelui and ponds no. 2 and 3 Valea Podului in Teliuc) and covering with new vegetation. Some of the dumps and ponds were preserved before the termination of mining activities, as they reached the designed capacity (Mate, 2014, pp. 35-37).

Blast furnaces and abandoned facilities have been demolished and levelling of the anthropogenic relief was performed in mining areas and the metallurgic site. Land decontamination procedures were performed in order to improve the quality of the soil and groundwater.

The slag dump in Hunedoara has been exploited and utilized for road construction or recovery of useful substances.

Some industrial facilities, such as the old furnace Govăjdie and the hydro-technical Cinciș-Cerna facility have been integrated into the tourist circuit, which may be a solution for other rehabilitated industrial sites.

2. Sustainable Rural Development

The rural area has undergone profound changes, especially in the second half of the twentieth century, by reduction of the number of inhabitants and the stake of the population employed in agriculture and forestry, and by decrease of the share of agriculture based income, amid unprecedented urbanization and industrialization.

In order to attain a sustainable development in the rural settlements within Cerna basin, measures such as retraining the population, agricultural development and diversification of non-agricultural activities, modernization of villages incorporating traditions and specific architecture, implementation of services of all kinds, revival of the crafting activities, as well as promotion of cultural heritage, traditions and local customs, were adopted. These measures affected also the structure, dynamics and functions of rural landscapes (CDP, Hunedoara).

Sustainable farming helps to preserve the environment, to protect the biodiversity and the landscape, being an important factor in the improvement of rural areas. The development of forestry, tourism, and small and medium enterprises, as well as supporting traditional crafts, contribute to the economic development of rural settlements, helping to protect the natural and cultural heritage.

3. Landscape protection and conservation

The Cerna basin includes, in whole or in part, three protected areas as stated in Annex 1 of *Law no. 5/2000 on the Approval of the National Landscaping Section III - Protected Areas*. These protected areas are Cerna Gorge (a composite reserve), Chizid Forest (botanical reserve) and Bejan Forest (forest reserve).

In Annex 3 of the same law, Corvin Castle, St. Nicholas Church (Hunedoara) and Old Govăjdie Furnace (Ghelari commune) were declared as cultural heritage sites of national interest. Some of the administrative-territorial units (the communes of Cârjiți, Pestisu Mic, Teliucu Inferior, Toplița) also contain cultural values and historical monuments of national importance.

The extension of protected areas and their inclusion in the Natura 2000 network of sites in Romania is also noteworthy. For example, the reserves of Cerna Gorge and Bejan Forest have been included in the list of sites of community importance under Annex 1 of *Order no. 1964/2007 Regarding the Creation of the Protected Area of Sites of Community Importance as Part of The Natura 2000 European Ecological Network in Romania*.

The Presidential Commission for Built Heritage and Historical and Natural Sites (2009) proposed the inclusion of the area the Land of Hașeg - the Land of Zarand - Hunedoara, which preserves naturally and culturally distinct landscapes, into the World Heritage List of cultural Romanian landscapes with universal value. Corvin Castle and St. Nicholas Church were mentioned as well.

Landscape preservation and maintenance of its natural characteristics, in response to the damage produced by the human intervention, are objectives of the Environmental Protection Agency

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Hunedoara, and are stated in the *Local Action Plan for Environmental Protection* (2012). This document identified the high priority environmental issues and strategies were developed to correlate the economic development with environmental and landscape protection issues.

4. Tourism

The main characteristic that leads to the development of the tourism sector is the overall quality of the landscape, the mountain area featuring unique landscape beauty: the sunlit glades on broad peaks, the vast forests and the steep valleys slopes. The shortage of natural resources (Cerna Gorge, caves) is counterbalanced by the abundance of human resources (Corvin Castle, the old furnace at Govăjdie, churches, museums, archaeological sites, Cinciș Lake and leisure facilities, and the ethno-folkloric area of the District of Pădureni).

Sustainable tourism development aims at protecting the natural, social and cultural heritage, as well as meeting the needs of tourists and local communities. Ecotourism and rural tourism best meet these requirements, by both economic development and environmental protection. Ecotourism and rural tourism rely heavily on the quality of the landscapes that complement tourism services (accommodation, recreation).

Ecotourism highlights the natural resources and biodiversity of the environment, focusing on conservation, education, responsibility and active involvement of the local community. At the same time, ecotourism infrastructure does not involve the same type of investment as classic tourism. The Cerna Basin has the advantage of the natural capital: vast forests, species of large carnivores (bear, wolf, lynx), as well as authentic local traditions. Ecotourism development involves implementing tourist services of high quality, thematic educational programs and other outdoor activities. An example of this is the cultural tourism project *Welcome to Romania. Ecotourism itineraries between spirituality and legend*, a Romanian-Italian partnership (CDP, 2007, p. 34).

Rural tourism capitalizes on the rustic qualities of a well-preserved rural area and the hospitality of the native population. Tourism in rural areas highlights the unspoiled nature, the traditions and customs, and the practiced activities. Its aim is to raise living standards in rural areas and to preserve the inherited culture. Local projects and the growing number of tourist guesthouses demonstrate the awareness regarding this type of tourism.

Tourism provides employment, generates revenue for local budgets, thus contributing to the sustainable development of the region.

CONCLUSIONS

The transformation of the landscape in the Cerna Basin was due to human pressure on the environment, industrialization and modification of the land use.

The Cerna Basin environment and landscape are under increasing human pressure, with obvious differences between mountain and hilly areas, and between urban and rural areas. Forests, which cover more than half of the area, maintain the environmental balance and are a defining element of the landscape in the examined area.

Development plans, both regional and local, target the protection, management and landscape planning issues. Strategic directions defined to achieve these goals are the rural development, environmental protection and tourism development.

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