UNIVERSITY "BABEŞ - BOLYAI" CLUJ NAPOCA

FACULTY OF GEOGRAPHY

DOCTORAL SCHOOL OF GEOGRAPHY

PhD THESIS

THE DYNAMICS AND FUNCTIONS OF THE GEOGRAPHIC LANDSCAPE IN THE CERNA RIVER BASIN (HUNEDOARA COUNTY)

- summary -

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Content

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Introduction

The work brings to the attention of the hydrographical basin of Cerna (Hunedoara County), located at the contact of two major divisions of the Carpathians (Meridional and Occidental). The subject of this study is landscape, a notion used in geography to describe the physical and functional features of a territorial complex. The chosen unit of study was the river basin, as it has clear boundaries and a complex way of organizing. The study of geographic landscape involved: the analysis of the characteristics of the geographic space, the impact of the humanization process on the organization and functionality of the geographic landscape and landscape dynamics as a result of changing the geographic, social and economic factors; Identifying and describing types of landscapes; Presenting strategies, implemented or possible, for the protection and preservation of landscape and landscape diversity.

Chapter 1. Theoretical and methodological considerations

1. 1. The concept of landscape

The landscape is a concept with multiple and complex meanings, depending on context and user training. Thus, the landscape refers to an objective reality, but also to its perception, which is subjective; also it can refer to an administrative territory (*pays, landschaft, landschap*) or is regarded as a resource. As a consequence, the landscape study is not always clearly defined, the science of the landscape including all the disciplines involved in its research.

In geography, A. Hommeyer (1805) used the term landscape (landschaft), with the appearance of a land. The first definitions (Rosenkranz, S. Passarge, L. S. Berg) focused on natural landscape physiognomy and content. O. Schlüter, C. Sauer consider society as the main agent in the transformation of the landscape and uses the term cultural landscape to name the landscape created by man. The European Landscape Convention defines it as "an area / region, perceived by humans, the character of which derives from the action and interaction of natural and / or human factors."

The landscape is the materialization of relationships and interactions between the components of the environment in any territory. Its main features are: uniqueness, homogeneity, dynamic character and physiognomy. Landscape features depend on the virtually limitless possibilities of combining the component elements, the coordinating role of certain elements and / or relationships between them. Identifying and studying mutual relationships between physico-geographic factors, biological processes, economic and social relations led to the individualisation of landscape ecology (C. Troll).

Geography has taken on the notion of landscape, often using the term geographic landscape, to describe the physiological and functional features of a territorial complex. Landscape analysis has gone through several stages: in the first descriptive studies, the emphasis is on physiognomy; then the analysis of the landscape components is the central element, and then the analysis of the relationships established between its components; the applied geography emphasizes the quantitative analysis of the landscape, which aims to optimize the landscape.

The landscape is composed of ecological potential (i. e. petrographic substrate, terrain, climate, water), biological exploitation (i. e. plant and animal associations, soil), and anthropic use (i. e. a certain way of social and economic exploitation of space). The landscape must be

considered a complex unit, more than the sum of its components. Natural features and usage patterns determine landscape dynamics.

The landscape offers multiple possibilities for capitalization and can meet multiple requirements of use in society. Each landscape performs certain functions (economic, ecological and social) in accordance with its natural potential. Anthropic intervention in natural landscapes gave rise to other landscapes with new functions.

The combination of the elements will highlight a particular landscape feature, facilitating the typological classification of landscapes. The type of landscape brings together landscapes that share genesis and certain structural and physiological features. Classification of landscapes is done according to their genesis, distinguishing natural landscapes and anthropic landscapes; they are differentiated by the dominant factor: terrain, vegetation, water, human activity.

The landscape presents itself as a hierarchical structure of territorial units, based on the unity of the landscape, and more stages with increasing degree of complexity (Christian și Stewart, Solînțev, Bertrand, Soceava).

1. 2. Hydrographic basin as a geographic system

The river basin is the defining element of a river and determines the general character of the river and its main features. The configuration and evolution of the hydrographic basin depend on the relationships between matter (water), energy (solar radiation) and characteristics of the active surface (altitude, geological constitution, vegetation cover and soil). The hydrographic study offers the possibility of a unitary understanding of terrain development, and allows for more accurate models and quantification.

1. 3. Methodology of research of the geographic landscape in the Cerna basin

The analysis of the landscape components and their interactions aimed at highlighting the effects of the socio-economic development of the region on the physiognomy and functionality of the geographic landscape. The methodology used (principles - spatiality, causality, integration and history; methods - inductive, deductive, observation, bibliographic documentation, analysis, synthesis, cartographic, GIS etc.; means - description, explanation, comparison, classification, hierarchy, etc.) allowed to emphasize the decisive role of the geographic environment in profiling the industrial function of the basin and its resilience to the subsequent transformations materialized in new functions of the geographic landscape.

1. 4. The history of the geographical knowledge of the Cerna basin

The Cerna Basin has been the subject of numerous studies, which focused on all its components, materialized in the comprehensive studies of terrain units or the research of their components, without an analysis of the basin as a whole.

Chapter 2. Cerna basin - morphological and hydrographic unit

2. 1. The geographical location of the Cerna basin

The Cerna River Basin is located in the central-western part of Romania, in the contact region of the Southern and Western Carpathians. It is located in the middle part of the Mureş River basin and it lays almost entirely on the territory of Hunedoara County. The basin overlaps the central and northeastern part of the Poiana Rusca Mountains and the north-western compartment of the Haţeg-Orăştie Depression, called Hunedoara Hills, the boundary being marked by the contact between the crystalline mountainous area and the sedimentary formations belonging to the hilly area.

2. 2. Paleogeographic evolution of the Cerna basin

The Poiana Rusca Mountains formed during three tectonic-magmatic cycles. In the Prebaikal and Hercinic cycles the crystalline schists were metamorphosed, and during the Alpine cycle (Austrian, Mediterranean and Laramic movements) the structure of the mountainous area was completed, by the formation and elevation of the Cretaceous formations, processes accompanied by the formation and activation of numerous fractures. The Haţeg – Orăștie Depression is a graben that has formed following the movements in the Laramic phase; the sedimentation process, interrupted by the emergence phases, took place until Pliocen.

2.3. Cerna basin - hydrographic unit

The surface of the basin is 727 km^2, and has an elongated shape. The average altitude of the basin is 647 m, the average slope is 16,04 m / km and the average width is 9,96 km. Cerna, the largest river of Poiana Rusca Mountains, has a length of 73 km. It springs from the Rusca Peak at an altitude of 980 m and flows into Mureş, near the village of Sântuhalm, at 184 m altitude. The river basin is asymmetric, with the left slope occupying almost three quarters of the basin's surface. The main tributaries are received on the left: Bordul, Valea Preajba, Valea de Pietre, Vălăriţa, Govăjdia, Zlaşti, Peștiş, Cristur and Valea Ursului, and among the tributaries on the right side are Negoiu and Lingina. The length of the hydrographic network is 1,268 km. The average slope of the main course is 10.90 m / km, and the coefficient of sinuosity is 1.62.

The hydrographic network density is 1.74 km / km^2. The Horton-Strahler classification revealed six orders of magnitude, order 6 belonging to Cerna, downstream of Negoiu's confluence.

Chapter 3. The Cerna Basin - a landscape unit

3. 1. Structure of the geographic landscape

The Poiana Rusca Mountains are made up exclusively of crystalline schists, plus the sedimentary rocks in the Rusca Montana Basin; in Haţeg - Orăştie Depression there is a set of sedimentary deposits, Badenian and Sarmatian deposits having a wide development.

The Poiana Rusca Mountains host important underground resources: iron, lead, zinc, copper, talcum and marble. In Hunedoara Hills (Hăşdat), sand is being exploited.

The basin terrain shows a difference of 1,171 m, between Rusca tip, near the Cerna springs (1,355 m), and the confluence with Mureş (184 m). The altimetric steps are marked by a great variation, most of them being between 600 and 1,000 m. On the crystalline rocks, the interfluvials are wide and elongated while the slopes are steep and rocky; the valleys are heavily deepened, with gorges: Govăjdia, Nădrab, Sohodol, Zlaşti. On conglomerates and sandstone the interfluvials are sharp in the form of ridges, and the slopes are very fragmented; on marls and clays there are mass movements; on pebbles and sands, the terrain is represented by wide and fragmented interfluves and by slopes highly fragmented by torrential erosion. Faults systems surrounding the Poiana Rusca Mountains give them the horst character. Terraces are very well developed in Hunedoara Hills. Cerna terraces are asymmetrically developed, fragmented and uneven. The terrace bridges on the left are heavily fragmented, while the terraces on the right have weakly fragmented bridges; the tops of the terraces are affected by torrential erosion. The floodplain of the Cerna River is wide, 4-5 km, in the Hunedoara basin, and narrower, up to 2 km, in the Peştiş-Sântuhalm sector; it presents areas of compaction and depression and is parasitised by slurry cones and glacis. The terraces and floodplains of Cerna affluents show a reduced development. The anthropic terrain has a significant presence: the quarries at Ghelari, Teliuc, Vadu Dobrii, Cerişor, Lelese, Zlaşti, Alun, the tailings ponds and the dumps at Ghelari, Teliuc and Hunedoara; in Ţinutul Pădurenilor, the plowing fields contributed to the forming of the terrain by leveling into agricultural terraces.

The average annual temperature is below 10 ° C in the hilly area and between 3 ° C and 4 ° C in the high mountain range. Precipitation is abundant in the mountains (1,000-1,200 mm), while in the hilly region the values are lower (500-700 mm). The regional particularities

determine a series of specific topoclimates, which are generally divided: the high, mountainous hills, the main valleys, the depression basins, the Lake Cinciş, the hillside, the floodplain and the urban area.

The hydrographic network consists of low-flow rivers: 2,915 m³ / s at Toplita and 3,413 m³ / s at Teliuc on Cerna river , and 1,172 m³ / s at Teliucu Superior on Govăjdia river. The highest average flow rates correspond to spring when more than one-third of annual flow is achieved; fall is noticeable by the lowest flow values. Maximum flows occur in the period from March to May, and the minimum ones occur in autumn and winter. Lake Cinciş-Cerna, with an area of 261 ha and a volume of 43,000,000 m³, was built on the middle course of Cerna.

The forest vegetation comprises the subrange of the sessile oak and sessile oak blends forests , the beech and beech and coniferous forests, and the subzone of the submesophilous-thermophilous oak forests. Mountain meadows were formed on the site of beech forests and mixed beech and coniferous forrests, and the hillside was formed on the site of the quercine forests.

On the background of cambisols and luvisols a wide variety of soils are grafted under specific conditions of terrain or rock: lithosols, regosols, alluvial soils, anthrosols, phaeosioms, rendzinas, vertosols, gleysoils, stagnosols, erodosols.

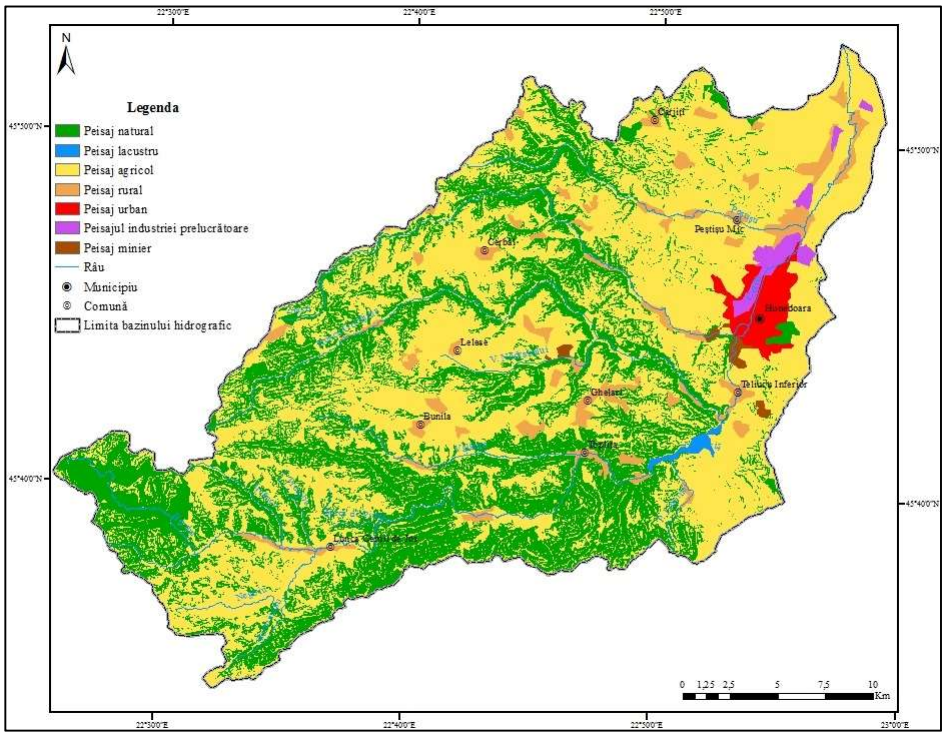
According to the 2011 census, the population in the Cerna basin was 72,804 inhabitants. The population is concentrated in the lower parts of the basin, 90.09% up to the altitude of 300 m. The population structure shows an aging population, a feminisation trend, and a decrease of the active population.

The number of human settlements is 64, of which one urban settlement with a rank of municipality, Hunedoara, 11 suburbs of Hunedoara, Deva and Simeria, and 52 rural settlements which are organized in 11 communes.

Representative economic activities are the industrial ones: the exploitation of construction rocks, steel, machine building, equipments, metalworking, woodworking, building materials, clothing and knitwear, footwear, bakery products.

3. 2. Typology of geographic landscape

The landscape classification must take into account the origin, separating two large classes of landscape (natural and anthropic), which are further classified according to the criteria: terrain, vegetation, water, human activity. The identification and delimitation of landscape types are based on a complete analysis of elements in the environmental system it reflects.



Map of landscapes in the Cerna basin

Geographic landscapes imposed by terrain

A. Interfluvial landscape

a. *The landscape of the high mountain summits* is specific in the south of the Cerna basin, on the interfluves separating it from the Bistra, Rusca and Dobra basins. The terrain has a massive look; the interfluvials are prolonged, smooth or broadly branched, being individualized by deep valleys (Cerna, Vălăriţa, Govăjdia). Mixed beech and coniferous forests are interrupted by meadows. The anthropic intervention is discreet (grazing and seasonal tourism), manifesting itself only on the vegetal cover.

The landscape of the high mountain summits (Lunca Cernii de Jos commune)

b. The landscapes of the anthropically transformed peaks characterize the interfluviations where the intensity of the anthropic intervention varies from moderate to very strong. *The landscape of the humanized mountain peaks* is characteristic at altitudes of 600-900 m, on the interfluves forming the watercourses separating the basins of the Cerna affluents. The terrain has heavy shapes, with narrower, rounded and fragmented interfluves, separated by

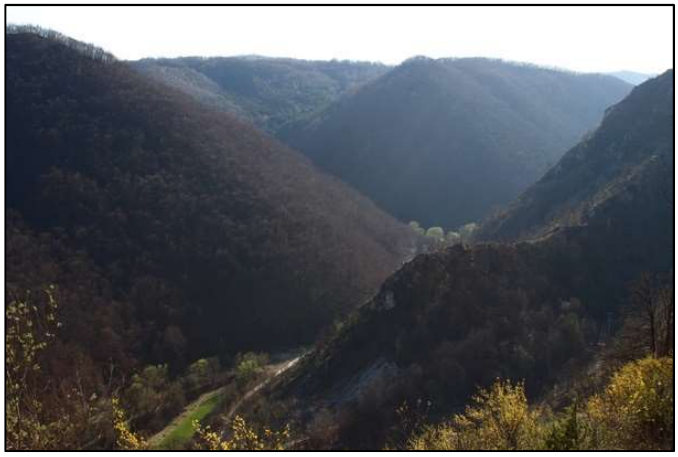
The landscape of the mountain peaks in Ţinutul Pădurenilor (Cerbăl commune)

deep valleys: Runcu, Zlaşti, Cerna, Sohodol, Peştiş. The interfluvials, largely deforested, are occupied by the villages' hearths (Cerbăl, Poieniţa Tomii, Ghelari, Lelese, Muncelu Mic) and agricultural estates or quarries for the exploitation of the underground resources (Ghelari, Lelese, Muncelu Mic). *The landscape of humanized hillocks* characterizes the set of interfluves with altitudes between 300 m and 550 m; wide and smooth interfluves, with remnants of erosion and numerous structural changes, are occupied by arable lands and secondary meadows.

The landscape of Calan Hills (village of Peştişu Mare, Hunedoara)

B. Landscape of the slopes

a. *Landscapes of mountain slopes*. Rocky slopes with large and very large slopes are developed on the crystalline schists (Cheile Cernei) or on limestone and crystalline dolomites (valleys Govăjdia, Sohodol, Zlaşti). On stretched areas, the soil cover and the vegetal layer are missing, leaving the crystalline rocks exposed. The human settlements (Muncelul Mic, Cerbăl, Alun), capitalize on the slopes with southern exposure, as well as the agricultural lands, represented mainly by pastures and hayfields.



The landscape of the mountain slopes (Nădrab Valley, Lelese commune)

b. *Landscapes of hillsides*. In the south and west of the hillside, the slopes have a higher inclination compared to the slopes in the east and north, which are less inclined. The slopes are

affected by landslides. It is distinguished by agricultural use, like pasture and hayfields on the higher inclination hills, and orchards and even vineyards on those with low inclination.

Landscape of the slopes of Cârjiți - Nandru Hills (Cârjiți commune)

C. The depression landscapes characterize the depression basins developed along the large valleys (Cerna, Vălăriţa, Runcu, Zlaşti).

a. *The landscape of the intramountain depression basins* is characterized by a varied terrain: low lying surfaces with the appearance of fields, floodplains, terraces, glaciers and secondary peaks; the terraces and floodplains have a higher development only within the larger basins (Lunca Cernii - Negoiu and Hăşdău - Dăbâca). The human settlements are numerous (Lunca Cernii, Negoiu, Hăşdău, Dăbâca, Topliţa, Cernişoara Florese, Runcu Mare, Govăjdia, Groş), and the agricultural areas (arable land, pasture and hayfields) are large.

The landscape of the Lunca Cernii - Negoiu Depression (Lunca Cernii de Jos commune)

b. *The landscape of the Cerna Depression* characterizes the area between the confluence with the Zlaşti brook and the spill in Mureş, to which it opens wide; it is divided into two sectors: the Hunedoara basin and the Pestiș-Sântuhalm basin. The Hunedoara basin has a highly transformed terrain due to industrial and urban development. Floodplains and terraces are mainly covered by civil and industrial buildings, deposits and heaps, and less by arable land and secondary meadows. The city developed on the right side of Cerna, while on the left, alongside the old city, the industrial platform expanded.

The landscape of the Cerna Depression

D. *The landscapes of the terraces and floodplains* are characteristic of the lower basin of Cerna. Lower terraces are used as arable land and hayfields, and upper ones as arable land, pasture and construction land; the tops of the terraces are used for fruit growing. The floodplain have been heavily transformed due to the presence of numerous human settlements and the development of the industry. The unoccupied sectors of civil and industrial construction are used as arable land, for vegetable farming and for pasture.

The landscape of river terraces (village of Sântandrei, Simeria)

The landscape of the floodplain (village of Sântandrei, Simeria)

Geographic landscapes imposed by vegetation

A. *The landscape of mixed beech and coniferous forests* is characteristic of regions located at altitudes above 800-900 m; forests, made of beech, associated with fir or spruce, or both, are interrupted by meadows.

The landscape of mixed beech and coniferous forests

B. *The landscape of beech forests* characterizes regions with altitudes between 600 m and 800-900 m. The forests consist predominantly of beech; on stretched surfaces, the forests are intercalated with secondary meadows.

The landscape of beech forests

The landscape of quercine forests

C. *The landscape of quercine forests* is specific at altitudes under 600 m. The forests, consiting mainly of sessile oak, alongside ash, cherry, field maple, small-leaved linden, are compact only on hilly peaks or on the high inclination slopes.

D. *The meadows landscape* includes, at over 600 m altitude, the *Agrostis tenuis* and *Festuca rubra* mountain meadows, formed on the site of beech forests and mixed beech and coniferous forests. Under 600 m the landscape consists of *Agrostis tenuis* meadows, together with mesophiles and xeromezophiles species that formed on the place of the quercine forests.

The landscape of mountain meadows

The landscape of hilly meadows

Geographic landscapes imposed by anthropogenic intervention

A. *Rural landscapes* are the product of the interrelations between man and nature, marking the transition from the natural landscape to the landscape transformed by anthropogenic intervention, the features of physical-geographic and anthropogenic components being the effects of the socio-economic activities taking place within them. The concentrated villages, located on

The landscape of the concentrated villages (village Cinciş-Cerna, Teliucu Inferior commune)

Landscape of scattered villages (Hăşdău village, Toplita commune)

the interfluves in the mountain area and in the inferior area of Cerna, are characterized by the accentuated assembling of the habitat elements; the scattered villages, located along the valleys and showing an elongation tendency, are defined by the groups of households dispersed in the territory. The agro-pastoral use generates a mosaic landscape with cultivated lands, pastures and hayfields, and even forest areas, which can be divided into landscape subtypes, differentiated according to the specifics of agricultural activities: the landscape with agroterraces, the pastoral landscape, the landscape of the meadows, the complex agricultural landscape.

The landscape of agricultural terraces (Cerbăl commune)

Pastoral landscape, Hunedoara Hills

The landscape of the meadows (Lunca Cernii de Jos commune)

Complex agricultural landscape (Mănerău village, Peştişu Mic commune)

B. *The anthropic landscape Cinciş* is distinguished by the aquatic surface, the concrete dam behind which the accumulation has been achieved, and the use of the territory around it. On the right bank, anthropic intervention was more intense; the tourist facilities, the pastures and the cultivated lands are distinguishable. The left bank has been less transformed, being well forested and lacking tourist facilities.

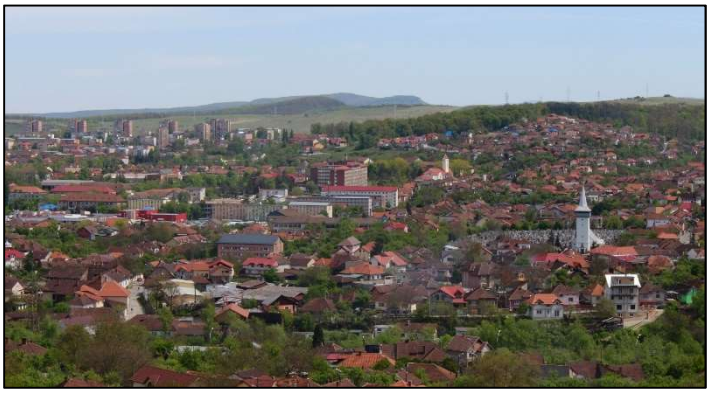
The Cinciş-Cerna dam

Lake Cinciş. The right bank

Lake Cinciş. The left bank

Hunedoara. The Corvin Castle and the city

C. *The landscape of Hunedoara municipality* bears its historical development. Based on the strong steel industry, the city has continued to develop until 1990. The urban landscape typology is based on the heterogeneity of the city's territorial structure as a result of various social and economic functions (residential, administrative, commercial, industrial, etc.), respectively the functional areas, their architecture and aesthetics generating clearly individualized assemblies. In the structure of the city, the largest areas are occupied by the industrial and storage area, and the residential area.



Hunedoara. The residential area

D. Industrial landscapes

a. *The landscape of the mining industry* is highlighted by quarries, tailings dumps, tailings ponds (Ghelari, Teliuc, Muncelu Mic, Crăciuneasa, Zlaşti, Alun), industrial or public buildings. Industrial waste has a large share, occupying areas from the forestry or agricultural fund.

Quarry Teliuc

Teliuc tailings pond

b. *The landscape of the steel industry*. The distinctive notes of the siderurgical industry scenery in Hunedora were given by the furnaces, the coke ovens, the massive steelworks and mills, the raw material deposits, the slag heap. A characteristic feature was the red color of the atmosphere, the consequence of the smoke emanations and other noxes resulting from technological processes, with a desolating effect. The industrial landscape is complemented by a dense network of communication ways: roads, railways, high voltage lines, large pipelines.

Combinatul Siderurgic Hunedoara, 1966 (Source: www.panoramio.com)

Combinatul Siderurgic Hunedoara, 1974 (Source: www.panoramio.com)

Hunedoara Industrial Park
(Source: www.replicahd.ro)

3. 3. Functions of the landscape

Habitat function. There are 37 settlements in the Poiana Rusca Mountains, and 26 in Hunedoara Hills (including Hunedoara). The villages in Poiana Ruscă Mountains are small and very small; more of the medium-sized villages are located in Hunedoara Hills. Hunedoara falls within the category of medium urban settlements (50,000-100,000 inhabitants). The density of the settlements is 8.80 settlements / 100 km^2.

Agricultural function. Agricultural lands occupy just over a third of the area. The main agricultural activity is livestock breeding (sheep, pigs, cattle) supported by the considerable areas occupied by meadows, used as pastures and hayfields, and forage plant crops. Plant culture (wheat and rye, corn for grains, potatoes and vegetables) is more developed in the lower part of the Cerna basin, capitalizing on the arable land in the hilly area.

Industrial function. In the Cerna basin there are companies from the mining industry (Talc-Dolomită Hunedoara), steel industry (ArcelorMittal Hunedoara), the metal construction and metal products industry (Mecanica Sider, Recom Sid, DAR Dräxlmaier Automotive in Hunedoara, Mecanica "Poiana Rusca" Teliuc, Eurosport DHS Deva), construction materials industry (Silvadez Hunedoara, Macon Deva). The light industry is present through clothing and footwear producing companies, and the food industry is present through bread and canning factories.

Recreation and leisure. The main tourist attractions are the anthropic ones: the ethnographic resources (Ținutul Pădurenilor), the architectural elements (the Corvin Castle, the St. Nicholas Orthodox Church in Hunedoara, the Reformed Church Hunedoara, the Orthodox Church in Ghelari, the St. Nicholas Church in Vălari,Topliţa); the blast furnace from Govăjdia (Ghelari commune) and Lake Cinciş. The main accommodation and leisure facilities are concentrated in Hunedoara and on the shores of Lake Cinciș; rural pensions contribute to the diversification of tourism activities (rural tourism).

Protection function. The Natural Reserves of Cheile Cernei, Codrii seculari de pe Valea Dobrișoarei sau Prisloapei, Pădurea Bejan and Pădurea Chizid were included in the category of "Reserves and Monuments of Nature". The first three also have Natura 2000 protected natural area status in Romania, with habitat types and animal species being protected.

Chapter 4. The dynamics of the landscape in the Cerna Basin

4.1. Paleodinamics and the current dynamics of the terrain

The terrain was formed during the tectonic movements belonging to the prealpine and alpine cycles, which resulted in the uplift of the crystalline-mesozoic unit and the Haţeg sedimentation basin. The modeling of the Poiana Rusca Mountains materialized in the formation of the leveling surfaces: Poeni (Danian-Paleogen) at 900-1,000 m altitude, corresponding to the main ridge Padeş - Rusca - Cioaca Strigoanei; Pădureni (Upper Miocene) at 600-800 m altitude in the upper basins of the rivers; Deva (Lower Pliocene) at 400-500 m

altitude. In the hills of Hunedoara, the underwater modeling resulted in the formation of piedmont leveling surfaces: Ciulpăz-Măgura (Upper Miocene) at 520-560 m altitude, the passage between the hilly area and the mountain and Cinciş (Pliocene-Quaternary) at altitude of 400-450 m. In Pleistocen, the periglacial modeling took the place of the fluvial modeling, and in Holocene the terrain modeling is carried out under the coordination of the hydrographic network.

The floral composition has changed in neogen and quaternary and has been finalized in holocene. During the glacial phases, arctic-alpine and subarctic grass and shrubs formations predominated, and the interglacial phases favored the development of spruce, oak, elm, ash, hornbeam and hazel woods. Holocene was characterized by a significant vegetation dynamic, consequent to climatic changes; during this period the man's influence on vegetation begins to occur, materialized in the regression of the forest formations and the extension of the meadows.

The current modeling of the unit is achieved by the action of a wide range of geomorphological processes: permanent (deep and lateral erosion), periodic (erosion in the surface) and accidental (crumblings, landslides, solifluctions).

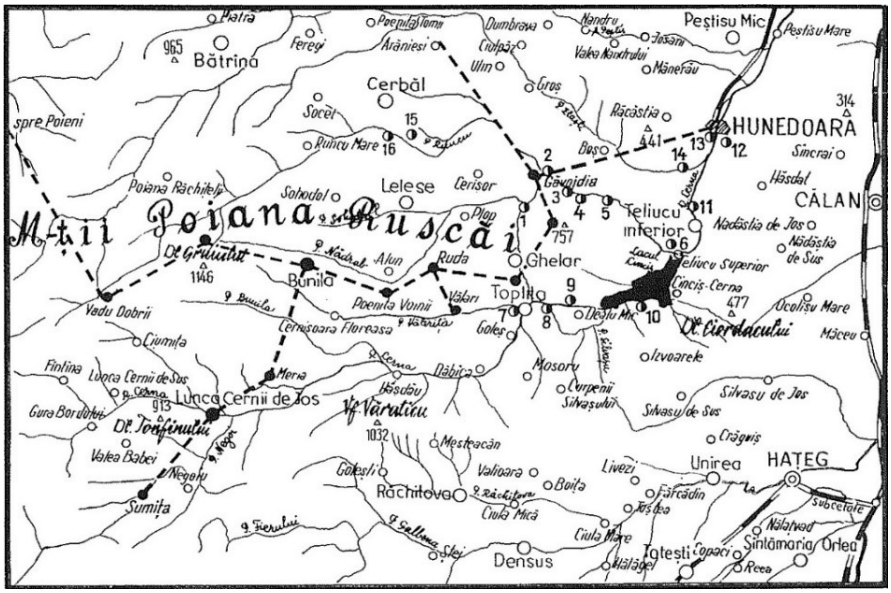
4.2. Dynamics induced by the humanization process

The population of the basin grew up to 1989, after which the number of inhabitants began to decrease. Hunedoara's population grew up to 1989, the largest jump occurred during the industrialization period. Since 1990 the number of inhabitants has started to decline. In the rural area, the number of inhabitants increased until 1910, after which a regressive dynamic was established; still there were also growing periods (industrialization period).

The settlement system has been formed and consolidated in a long time. The number of human settlements increased until 1966, when there were 70 settlements. At present, the system of human settlements in the Cerna basin comprises of 64 settlements, one municipality (Hunedoara) and 63 villages.

The exploitation and processing of iron took place without interruption in the Iron Age. The main mining operations were at Ghelari and Teliuc. In the seventeenth century, five large workshops were known: Plosca, Baia Noua, Topliţa,

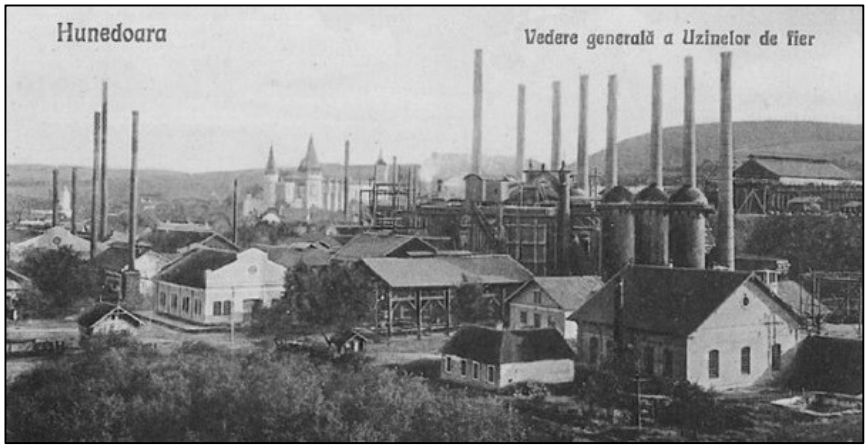
Quarry Ghelari



Workshops to extract and process the iron around Hunedoara: 1 – Nădrab; 2 – Govăjdia; 3 – Limpertul superior; 4 – Limpertul inferior; 5 – Baia de Coase; 6 – Plosca; 7, 8 – Toplița; 9 – Fanci; 10 – Cerna; 11 – Teliucu Inferior; 12 – Perintei; 13 – Banie; 14 – Zlașți; 15 – Runc superior; 16 – Runc inferior *(Source*: Chindler *et al.*, 1974*)*

Nădrab, Limpert. In the eighteenth century, blacksmith trade had a much larger development, running 13 extraction and ironmaking workshops. The era of modern iron metallurgy on the Hunedoara area begins on July 13, 1781, when the Toplița furnace prepares the first batch. The Govăjdia furnace was put into operation in April 1813; it functioned until 1924.

The Govăjdia furnance (Source: Monografia Județului Hunedoara)



Uzinele de Fier Hunedoara, 1924 (Source: www.adevarul.ro)

The construction of the Hunedoara plant started in August 1882. The development of the plant was carried out in several stages, the process ending in general in the 70s of the last century. Combinatul Siderurgic Hunedoara was organized in seven factories: Coke-Chemical, Furnace-Agglomeration, Refractory Steel

Mills, Laminates, Siderurgical Repairs and Replacements, Energy Production, Transport and Distribution, Rail Transport.

Furnace no. 6, 1954 (Source: www.panoramio.com)

Martin steel plant no. 2, 1958
(Source: www.panoramio.com)

Rolling mill unit, 1970
(Source: www.panoramio.com)

The variety of the underground resources, in parallel with the needs of the growing industry, led to the opening of mines and quarries for their extraction: dolomite at Crăciuneasa, Teliuc and Zlaşti, talcum at Cerişor and Lelese, marble at Alun, copper ore at Muncelu Mic. Within the basin there were also units of the construction materials, wood, light, and food industries.

After 1989, the industry in the Cerna basin underwent a restructuring process, which led to the reshaping of the iron and steel industry, the closure of the mining operations, the modernization of some industrial enterprises, the emergence of new activities, and the diversification of the industrial profile of the region.

Corvin Castle and industrial platform, 2006
(Source: www.primariahd.ro)

Corvin Castle and industrial platform, 2017

The impact of the industrialization process on the geographic landscape consists in changing its components (terrain, hydrography, vegetation, land use) and pollution of air, water, vegetation, soils.

The actions of changing the land use are millennary, increasing with the increase in population, and technological progress. The period of intense use and transformation of the land fund begins in the 13th-14th centuries, as a result of the increase in the number of inhabitants and human settlements; the exploitation and processing of iron ores have led to important changes in the way the land fund is used.

4. 3. Dynamic classification of geographic landscapes

The landscapes in the equilibrium characterize the isolated areas of the Cerna basin, mountain peaks with compact forest areas alternating with natural meadows. *The landscapes in the disequilibrium* are widespread in most of the Cerna basin as a result of intense and long-lasting anthropogenic intervention: the mountain peaks occupied by numerous human settlements and agricultural lands; the steep slopes with active geomorphological processes (erosion, sinking) and the predominance of non-productive land (rocks, boulders, gravels); depression basins, with human settlements, agricultural land and active geomorphological processes; interfluvial and hilly slopes with agricultural land and affected by geomorphological processes. *The highly artificialised landscapes* correspond to very strongly transformed areas:

Cerna's depression (being affected by urbanization and the development of the iron and steel industry) and the Teliuc-Ghelari and Muncelu Mic areas (as a result of the exploitation and processing of iron and polymetallic ores).

Chapter 5. Cerna river basin in the context of sustainable development policy

Sustainable development of a territory requires an exhaustive analysis of its structure and functionality. The purpose of this analysis is to identify the more active or less active components, so that the anthropic exploitation impacts as little as possible the rhythm and the sense of the normal evolution of its natural potential. Landscape diagnosis is the prerequisite for formulating forecasts and prognoses related to landscape development: organizational and spatial planning actions in order to maintain current functions or to create new functions.

5. 1. Indicators for the assessment of the quality of the geographical landscape in the Cerna basin

The quality of landscapes can be expressed using elementary landscape assessment indicators: human pressure indicators, landscape nature indicator, and environmental transformation indicator.

In conclusion, the environment and the geographic landscape in the Cerna basin are subject to increasing anthropogenic pressure; the forests somewhat maintain the balance of the environment and are a determinant element of the geographic landscape.

5. 2. Territorial policies for reconstruction of the geographic landscape

References to landscape are made in environmental and land-use legislation. At regional and local level, objectives have been formulated for rural and urban development, environmental protection and tourism development.

5. 3. Regeneration of landscapes in the Cerna Basin

For sustainable rural development have been adopted a series of measures for professional reorientation of the population, development of agriculture and diversification of non-agricultural economic activities, modernization of villages, respecting specific traditions and architecture, extension of services of all kinds, regeneration of artisan activities, promoting cultural heritage, local traditions and customs, with effects on the structure, dynamics and functions of rural landscapes.

In the Cerna basin were established the protected natural areas: Cheile Cernei (mixed type reserve), Codrii seculari de pe Valea Dobrișoarei sau Prisloapei and Pădurea Bejan (forest reserves), and Pădurea Chizid (botanical reserve); Cheile Cernei, Pădurea Bejan and Ținutul Pădurenilor were included in the list of sites Natura 2000 in Romania.

The development of the tourism sector is based on the overall landscape quality: the sunny slopes of the broad peaks, the extensive forests and the steep slopes of the valleys. The reduced presence of natural resources (Cheile Cernei, caves) is compensated by the anthropic resources (the Corvin Castle, ethnological folklore area Ținutul Pădurenilor, Govăjdia's old blast furnace, churches, museums, archaeological sites, lake and recreation center Cinciş). Sustainable tourism development aims at protecting the natural, social and cultural heritage, as well as meeting the needs of tourists and local communities.

Conclusions

The geographic landscape of the Cerna basin is the result of the collaboration between natural and anthropic factors. The relationships between the two categories of factors have changed over time, with the landscape being constantly transformed and diversified.

The diversity of landscapes confirms the contact character of the Cerna basin (the contact between the Southern Carpathians and the Western Carpathians), but also the variety of natural and human potential. The landscape mosaic is due to the individualization of geographic units with different characters (Poiana Rusca Mountains and Hunedoara Hills, subdivision of Haţeg – Orăştie Depression).

The natural potential has certain specific features: the terrain of the mountainous area is characterized by medium and low altitudes, broad and smooth interfluves, deep and narrow valleys; in the hilly unit prevails the more sluggish slopes, and the floodplains and terraces occupy large areas; the geomorphological processes have a low intensity; the dense hydrographic network, is formed, however, from small rivers; vast forests and meadows; natural resources (iron ores, building rocks, wood), and offers multiple possibilities for capitalizing, creating the premises of a multifunctional space, suitable to satisfy multiple needs of the inhabitants.

The population has exploited the natural potential of the basin, which has been transformed and organized according to its own needs. The particularities of the humanization process are: the exploitation and processing of iron ores, the activity with long traditions, was

the coordinating factor of economic and social development; population and agricultural use of mountain peaks, the main farming activity being animal husbandry; massive deforestation for the extension of settlements, agricultural and industrial land, or communication networks.

The dynamics of the geographic landscape was analyzed by highlighting the changes in land use, determined by the numerical evolution of the population and the basin industrialization. The increase in the number of inhabitants has resulted in the expansion of human settlements, roads, and agricultural land. The industrialization process has boosted the expansion of occupied land (industrial and civil) and the communications network by removing large areas from the natural and agricultural use to quarries, storage areas of raw materials, products and waste resulting from technological processes; industrialization has also led labor migration from agriculture to industry, which has led to even less land use for agriculture.

1989 marks the beginning of the demographic and economic decline of the Cerna basin: the number of inhabitants begins to decline, demographic structures change, by the aging and feminisation of the population and the economic dependence ratio and by the growth of the inactive population share; the reorganization and reshaping programs of the industry have led to the closure of mining operations and the reduction of siderurgical activity. As a result, agricultural land and industrial land are abandoned or given another use: the natural vegetation is reinstated, marking a slight increase in the forest fund, aquatic surfaces are formed, and are occupied by new constructions.

The anthropic pressure on natural landscapes had the effect of transforming them. The geographical landscape in the Cerna basin bears the mark of human intervention, dominating the cultural landscapes: rural landscapes, urban landscape and industrial landscapes. Rural landscapes, as a result of housing and the rural economy, include the landscapes of rural settlements whose characteristics are conditioned by the activities and agricultural landscapes, which are characterized by their complexity and variety, determined by the mosaic of the agricultural areas and by some specific elements of the farming activities. The urban landscape is the result of the transformation of Hunedoara, determined by the dynamics of the steel industry; the urban landscape is characterized by the architecture and aesthetics of the functional areas, especially the residential area. The industrial landscape is distinguished by the landscapes generated by the exploitation and processing of natural resources, especially iron ore, activities that allow the individualization of the mining landscape and the landscape of the manufacturing industry. The industrial landscape is complemented by networks of transport and suplly of power, raw materials, water.

The natural (quasi-natural) landscapes, although occupying significant areas in the Cerna basin, appear either in its isolated regions (high peaks) or in those with limited possibilities for capitalization (the steep slopes), being better represented in the mountainous area, where forest areas and natural meadows are preserved, or as unproductive landscapes (rocky slopes).

The landscape of the Cerna basin is a resource that can contribute to the economic development of the region through tourism, in the context of the modest agricultural potential and the decline of industrial activities. The development of tourism implies an increase in the value of the tourist potential of the Cerna basin, by arranging thematic routes that include less known objectives, by promoting the traditional products, the cultural-artistic and sporting events. Growing interest in tourism, rural cooperation within GAL Țara Hațegului – Ținutul Pădurenilor, which facilitates access to funds for village modernization, rural economic activities and communication routes, private investment in tourism infrastructure, represents opportunities for tourism development in the region. Unsatisfactory promotion and insufficient capitalization of tourism potential, poor infrastructure, especially accessibility, are the main problems in the tourism development of the Cerna basin, also accentuated by the economic stagnation of the region, the decline in living standards and the demographic decline.

Tourism development requires the involvement of authorities in taking measures to: diversify and promote tourist offer, preserve and capitalize protected natural areas and cultural values of national interest, improve access and touristic infrastructure, encourage and support the private initiative in this area.

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