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LANDSCAPE ALTERATIONS INDUCED BY ANTHROPIZATION IN THE BARCĂU COAL BASIN

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Résumé: ***Modifications du paysage par l'anthropisation dans le bassin charbonnier de Barcău.*** Le bassin hydrographique de Barcău de Nord-Ouest de la Roumanie est un espace bien peuplé des anciens temps où se trouvent de nombreux habitats ruraux et un seul centre urbain (Marghita). Dans son secteur charbonnier, les composants favorables qui ont conduisent aux modifications majeures et à l'anthropisation du paysage sont représentés par des ressources naturelles (roches de constructions, minérales, forêts, terrains agricoles), des ressources des eaux et les voies de communications. Pour apprécier le degré d'anthropisation, de la pression humain sur l'environnement et sur le paysage, on a utilisé certains indicateurs (le niveau de chargement humain, le caractère temporel de celui-ci et le type spatial de l'anthropisation). Les effets de la pression humaine atteinte le degré de la naturalité du paysage, l'équilibre des composants naturels et anthropiques, les coûts pour l'environnement etc. L'action des processus anthropiques dans le bassin charbonnier de Barcău a crée quelques paysages anthropogènes (paysage agricole, industriel - minier, urbain et rural).

Mots - clés : bassin charbonnier, anthropisation, naturalité, pression humaine

1. Preamble

On the whole, the Barcău drainage basin at the northwest of Romania is an area well inhabited from ancient times, with numerous small and medium sized settlements and only one town (Marghita). The evolution of this geographic area is governed by natural laws disturbed by anthropic intervention especially after the coal and oil resources have been discovered and exploited.

In this coal sector of the basin, the components favourable to major modifications of landscape and its anthropization, are the natural resources (construction rock, minerals, forests and crop fields), water resources and lines of communication. Among the subsoil resources, lignite and bituminous sands were under exploitation until not very long ago. The pontian coals were being exploited all over the area, at Zăuan, Cosniciu, Ip, Suplacu de Barcău, Popeşti, Voivozi, Derna, Budoi in mines and quarries and were used, in proportion of 80% at the Oradea thermo-electric power station and for briquetting in the plants Voivozi and Varviz.

The forests, much reduced in surface, are still in exploitation along the contact with the mountain frame of Plopiş (29.9%) and the crop fields cover as much as 16,189 hectares (61.2%). In addition, the water supply for the population and its activities is quite scarce (0.83%). Also the thermal and hyper-thermal springs (Pădurea Neagră, Zăuan) or drillings (Derna) are worth mentioning.

As for the lines of communication, the coal basin is cut by numerous county and subsidiary roads (a total length of 43.2 km) and a 12 km long railway sector. The components with some restrictions of human activities (directly involved in fading the

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impact on landscape) are being represented by morphometric parameters of the relief (declivity, fragmentation degree, relief energy, slope processes), which restrains the expansion of building activities and also the floods on the Barcău River and its tributaries.

2. Indicators of the anthropization degree and pressure on landscape

As to appreciate the anthropization degree and the human pressure on the environment and landscape, we used some indicators like the level of human load, its temporal character and the spacial type of anthropization (I. Ianos, 2000).

If we consider *the temporal character of anthropization,* we can find a continuous anthropization due to geographical conditions favorable to the evolution of human settlements in this area sincce ancient times, fact proved by archaeological diggings and historical documentation (I. Berindei, Gr. P. Pop, 1972). For example the diggings performen by the archaeologists of the Tarii Crisurilor Museum have revealed neolitic tools and other neolytic artefacts. Several old standing fortresses, like the dacian ones (Marca, Voivozi, Sacalasău Nou and Şinteu) and after the Roman Conquest in 105-106 AD the north and west of the country (including the mentioned fortresses) were inhabited by the free dacians. On this teritory there are many old settlements with different functions.

The level of human load is estimated by population density knowing that a high value indicates an increased pressure upon space and environment factors. At present, the settlements network in the Barcău coal basin consists of four communes (Popeşti, Suplacu de Barcău, Derna and Ip) with 22 belonging villages.

In the Barcău coal basin, the population average density is high for the rural society (82 inhabitants /sq km) due to the exploitation of the existent natural resources. For the communes, the situation is as follows: Derna: 64 inhab/sqkm; Ip: 68 inhab/sq km; Popeşti: 86 inhab/sqkm; Suplacu de Barcău: 111 inhab /sq km (in the year 2001) (fig.1).

The extension of economic activities and their type is an element correlated with the population degree of an area. Economic activities may be violent, giving radical changes (draining, deforestations, surface mining exploitations), moderate, with re-adaptation of the environment to the new conditions, or they can be insignificant for its evolution. In the Barcău coal basin, at the beginning of its population, economic activities didn't have a significant impact on the natural environment. But, as they grew in time, towards modern and contemporary times, the impact became violent all over the Barcău drainage basin, as great areas were deforested for crop fields, and later, lignite mines and quarries appeared. As for the space alignment, some areas of concentrated exploitation of subsoil resources have been identified:

- the coal area in the Nuşfalău Depression, with lignite exploitations in mines (Ip, Zăuan) and in quarries (Cosniciu de Jos and Marca);
- the coal area in the Bistrei basin, with lignite exploitations in mines at Voivozi, Varviz, Vărzari, Borumlaca, Valea Cerului and in quarries at Budoi;
- the coal and bituminous sands at Budoi-Derna, with exploitations in the mine fields Derna-Becaşteu and Budoi.

However, today by closing all mines and almost all lignite quarries, by ecologic recuperation of the lands bearing lignite quarries (R. Linc, Nistor, St., 2008), human pressure became moderate, so that landscape and environment factors can slowly readapt to the new conditions.

As for *the spatial type of anthropization,* this area shows a punctual anthropization around mine exploitations and a scattered anthropization all over the Barcău coal area.

The effects of the manifested human pressure, affects the natural degree of the landscape, the balance between natural and human components, the environment costs etc (Maria Pătroescu et all. 2001).

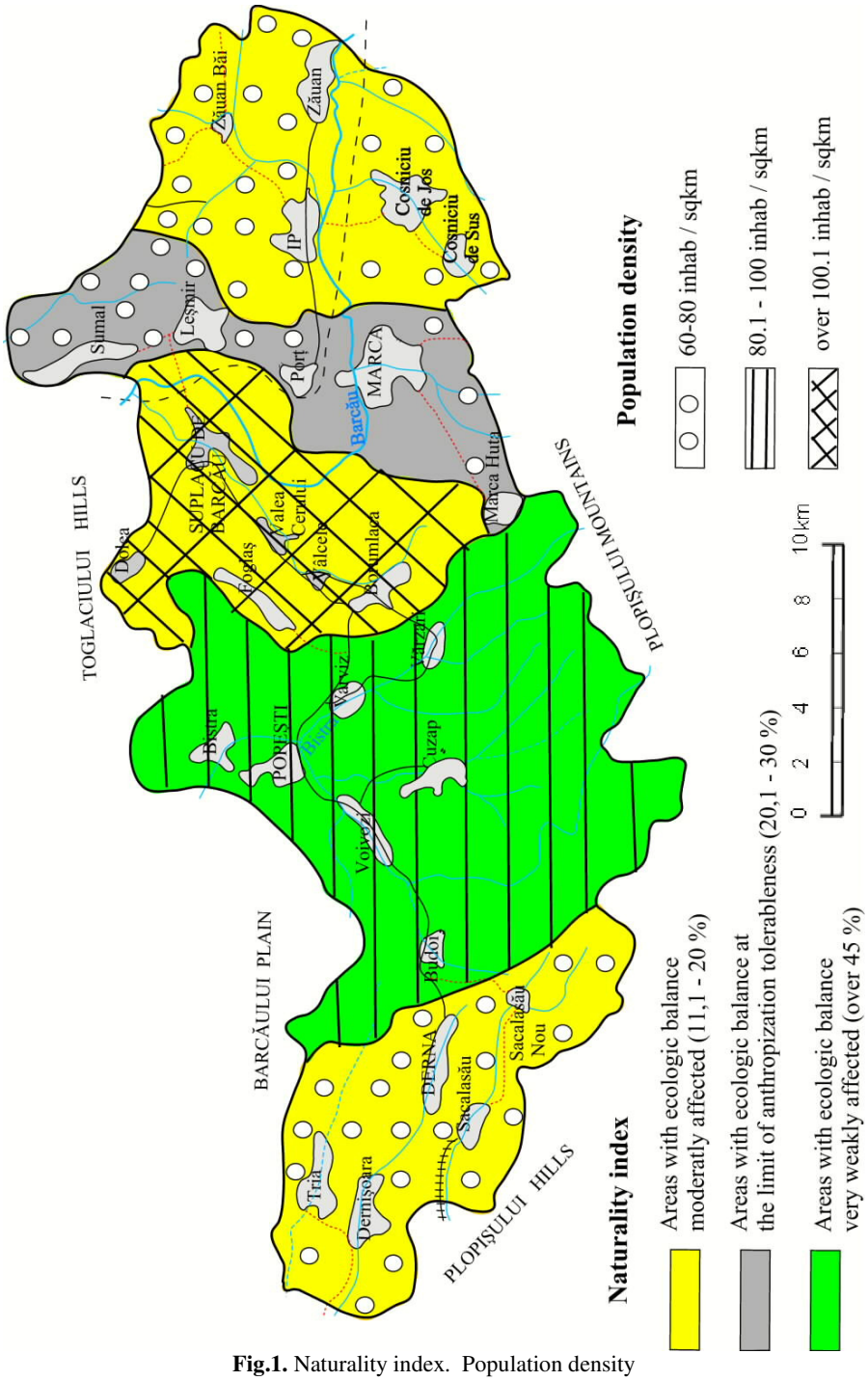

Fig.1. Naturality index. Population density

The "naturality" index (N. I. = forest surface/ total surface * 100, expressed in percents) synthesizes other two indicators (*human pressure through arable and human pressure through forestry).*

For the entire Barcău coal area the "naturality" index is **30%.** As for the commune level, it has the following values: **22%** Derna, **12%** Ip, **50%** Popesti, **13%** Suplacu de Barcău. Those values bring the communes Ip and Suplacu de Barcău to the category of territories with an ecologic balance strongly affected and Derna in the category of territories with an ecologic balance at the limit of antropization tolerable ness. Popeşti commune only presents a better situation as it is included in the category of territories with an ecologic balance, mildly affected because it stretches onto the mountain frame where forests still exist (fig. 1).

3. Types of landscapes

In the Barcău coal basin, until the vigorous human intervention, there was a rich deciduous forests landscape, dominated by quercinea. Once with the appearance of man and settlements, great modifications of the natural landscapes began with deforestations on large areas, expansion of crop fields, exploitation of subsoil resources, development and expansion of settlements and their infrastructure, development of some industrial branches, building of communication lines, pollution of the environment factors (fig.2).

Among the activities mentioned above, the greatest landscape alterations in these areas were given by the activities of sub-terrain exploitation and in micro-quarries of lignite and bituminous sand.

The result of these activities are vugs in the Earth shell, artificial subsidence of the geomorphologic surfaces (dumps, dirt levees etc.), substratum squeeze, local deepening of the terrestrial shell, anthropic re-bedding of materials, transport and redistribution of materials from the upper part of the earth shell.

The anthropic accumulation relief is a result of the storage of the material coming from excavation works and it is represented by the dumps. Because of the intensity of mining activity, dumps are a characteristic of the relief. By their storage place, dumps can be: exterior (located at a distance from the quarries) and interior (inside the quarry). The dimensions of the dumps are given by the uncovered blank material, for example in the quarry of Budoi Tunel, during 1991-1997, a volume of 1,745,000 m^3 blank material was removed and in the quarry Budoi Sat, in the same period, a volume of 1,049,000. Unlike the exterior dumps, relative stable geomorphologically, the interior dumps have some particular aspects like the permanent storage of blank material, without observing technical standards which leads to a chaotic aspect of the dumps. (R. Linc, Nistor, St., 2000). It gives a favorable setting for a continuous emergence of slow geomorphologic processes that do not however leave a strong mark on the dumps because of the permanent storage of the blank.

The action of the anthropic processes in the Barcăului Basin had as a result the creation of some anthropogenous landscapes, like the following ones (Ribana Linc, Dorina Ilieş, 2000):

- *the agricultural landscape* as a result of the agricultural activity that brings to the transformation of the natural landscape by fallowing and deforestation so that the existent natural vegetation is almost entirely removed, except on small areas. Natural vegetation, represented by forests, occupies now 19.7% of the basin area, especially on the mountain area. The agricultural landscape is defined by extended cereal crops, vines and orchards, but the expansion of crop fields on slopes, inaccurate land processing practices and inadequate plants, brought to disturbances of their morphodynamic balance by activating the actual shaping processes (superficial sliding, surface streaming, stream flow erosion).

- *the industrial-mining landscape* with its distinct feature given by the anthropic relief, as a result of anthropic shaping. The excavation anthropic relief is represented by the lignite quarries (Budoi- Sat, Budoi- Tunel, Varviz, etc.), and the accumulation relief consists of the dumps, with dimensions given by the volume of the blank material dislocated. The exploitation of those resources brought to the accelerated development of some processes, among which, the land slides at the top and within the quarries and deep erosion, favour the development of ravination. The old exterior dumps are gradually introduced in the agricultural circuit as long as the blank is stored in other perimeters. It is worth mentioning that at present, in the Bistra coal basin, the ecological rehabilitation works are in progress.

- *urban and rural landscape* – the result of the development of settlements network. In this type of landscape, the function of the settlements could be another indicator of anthropic pressure, because the industrial function, even in the rural environment, has a great impact on the landscape, added also the agricultural function. From this point of view, in the Barcăului coal basin, former industrial settlements come out: Popeşti, Voivozi, Derna Budoi Sat, but now this function is almost gone, once that coal exploitations stopped.

As a result of the hydrologic improvement works started in 1834, the Barcău River was embanked on a length of about 29 km, as to prevent the almost yearly floods. Flood problems still exist in the sectors: Marca and Suplacu de Barcău. After the improvement works were completed, the natural landscape of the riverbanks and meadows was modified and in addition marshy soils and salting occurred.

Natural factors, along with anthropic ones, had a major role in shaping the basin landscape.

The main natural factors which contributed and still do, to the alteration of the landscape, are mainly the external agents: precipitation, wind, frost-defrost etc.

Precipitation. Rainfall contribute most the alteration of landscape, both because of erosion effect, streams, floods, alluvial fans, land slides etc. and of river overflow, the rock transport and sedimentation effects In the last years, during rich rainfall periods, the Barcău River overflew its banks several times, producing most important flood effects. At the contact between the Plopiş Mountains and the Pannonian Plain, also because of the rich precipitation, the waters collected by the torrent valleys in the area Suplac-Tătăruş produced important damages, striping and deepening the terrestrial crust along the valleys. Another effect of rich precipitation in the hilly areas is the occurrence of massive land slide, damaging crop fields, vineyards, orchards even endangering households. Even though man has diminished the effect of those phenomena, they cannot be totally eliminated and go on with their shaping effect.

The wind. By its action and as an external agent, wind together with other agents (precipitation etc.) shape the terrestrial crust by decomposition, transport and sedimentation but in this region its action is less characteristic.

Frost-defrost. This phenomenon contributes in the first place to the decomposition of rock, soil etc., and can bring to land slides especially in the areas where forests had been exploited. However, in this area, it had no visible effects.

The occurrence of these geomorphologic processes is also determined by the undermining of the slope base once the quarry started working. Unlike the natural relief in the contact area of the Silvaniei Depression, the relief created by the exploitation of lignite has an accelerated dynamic, which will finally also lead to a natural shaping of that slope.

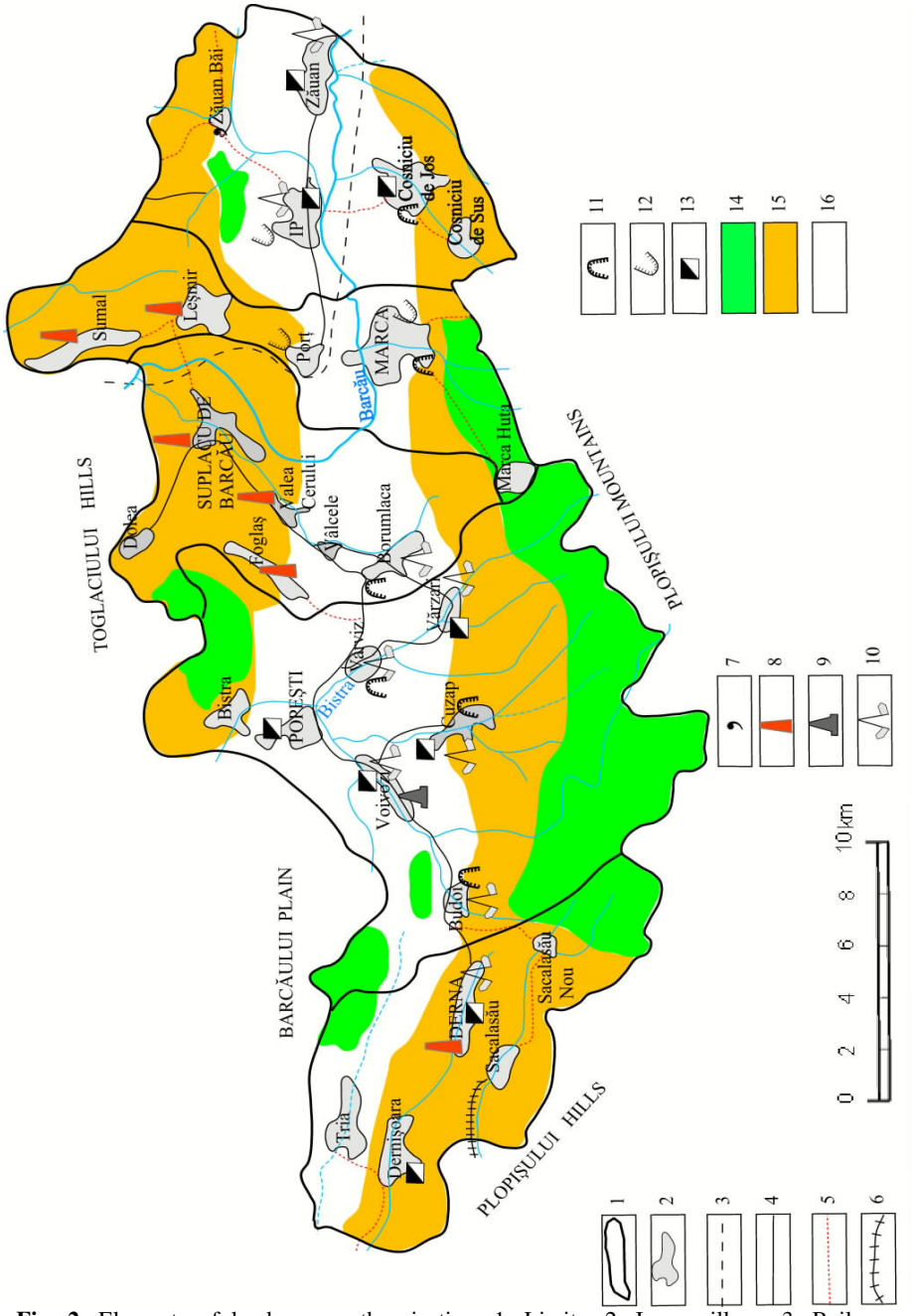

Fig. 2. Elements of landscape anthropization. 1. Limits; 2. Inner village; 3. Railway; 4. Modernized road; 5. Unmodernized road; 6. Levee; 7. (Thermo) mineral spring; 8. Oil wells; 9. Disaffected thermoelectric plant; 10. Disaffected mine; 11. Coal quarry; 12. Stone quarry; 13. Small industrial plants; 14. Forests; 15. Meadows; 16. Plough land

Even if the technical exploitation standards are respected, the actual geomorphologic processes (slides, declines, collapses) are more ample because of the geological particularities and in addition the climatic ones.

Among the actual geomorphologic processes, the most representative are landslides, which in the quarries of Budoi are present both in the interior and at the top of them. The ones in the interior of quarries are determined by the permanent modification of the local base level represented by the levels of coal exploitation.

The landslides at the top of the quarries have a regressive character unlike the other category and are better individualized.

Collapses are also present and they occur partly because of the inobservance of the morphometric standards in building the safety levels of the general ramp.

Ravination is another geomorphologic process present within the mine exploitations perimeter and it occurs mainly at the top and at the base of the quarries. In the quarries, the ravination is not present because they are active and the necessary amount of time for their evolution does not exist.

From the natural landscapes to the anthropized ones, several types of landscape are structured, like the balanced derived landscapes, anthropized derived landscape with a progressive balanced evolution, sporadically degraded landscapes.

Balanced derived landscapes are more extended towards the mountain frame of the Barcău Basin where the features of the geographic landscape are rather natural and the evolution of the forest geo-system has almost the same conditions like the ones existent before human involvement, even though human activity has produced some temporary, small scale alterations. Forest landscape is the exponent of this type of landscape.

Anthropized derived landscapes are characteristic to those parts of the basin where natural processes are massively replaced by the artificial ones. The occurrence and evolution of this type of landscape is the result of a demographic positive evolution correlated with the local growth of industrial and agricultural activities. From this point of view in Suplacu de Barcău we can notice the semi-urban landscape, with industrial plants and other economic activities, which have an obvious impact on the quality of the landscape. The agricultural landscape can also be included in this type of landscapes.

Degraded landscapes occur in the places where certain human activities affect profoundly the different components of the geo-system. The areas that bear anthropic degradation in the Barcău Basin are linked to the subsoil resources exploitation.

4. Conclusions

In the Barcău coal basin the alteration of natural landscape started once with the occurrence of human element that has induced a phenomenon of anthropization more and more aggressive and accelerated, along with social, economical and technical advancement. This was realized by extracting important quantities of resources from the environment (minerals, construction rocks, forests, fresh water etc.) and by implants of foreign elements (settlements, lines of communication, industrial sites). The interference between human activities and the natural environment has as a result its accentuated anthropization.

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