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THE CRITICAL ENVIRONMENT OF THE SUBCARPATHIAN REGION OF ROMANIA (STATE - OF - THE - ART)

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The Subcarpathian area in Romania lies outside the Carpathian Arc and stretches between the Motru and the Moldova Valleys. The long-lasting impact on the environment has altered some of its components, generating imbaliance. Increased deforestation in some areas, even on step slopes, has amplified erosion, the soil layer has been reduced or washed away altogether; thousands of hectares have been cleared for the exploitation of useful mineral substances; waste dumps have created new landscapes, salt lakes have formed on the site of collapsed salt-domes, crude-oil and gas exploitations are polluting large expanses of soil and vegetation, etc. However, current uses are often in agreement with the natural potential, the landscape presenting an alternation of forests, orchards, pastures and farming lands. The new property relations have led to a changed in landuse , supposedly with significance effects on the quality of the environment of this region which is in a fairly sensitive state of equilibrium.

Key words: critical environment, the Subcarpathians, Romania

INTRODUCTION

The Subcarpathian area in Romania lies outside the Carpathian Arc. It covers 16 330 sq km, and makes the transition from the highlands to the lowlands. The width of the region between the Motru and the Moldova valleys is variable. Being a critical environment, human activities ought to rigorously observe the specific features of the natural landscape, try to adapt to it and strike a balance between production

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functions and the protection of the natural vegetation. The main reasons for it would be the following:

- the local relief is young and it shows a permanent uplifting tendency (averaging 2-3 mm/year);

- there is a mosaic - like geological structure, with deeply folded and faulted strata;

- rocks with very different geomechanical properties - permeable and impermeable and even soluble (salt, gypsum) in some places, alternate over small areas. As a rule, the Mio-Pliocene rocks (marls, clays, sands and gravels) are poorly consolidated and therefore highly prone to erosion on the steep slopes;

- the relief being highly fragmented (4-6 km/sq km), slopes with a greater or lesser declivity prevail by far over the plane surfaces located on interfluves, terraces or in waterplains. The incidence of plane surfaces is greater in the depressions (Subcarpathian Depression of Oltenia, Nişcov and Cracău - Bistriţa depressions, etc.);

- torrential runoff, caused by irregular precipitation and the above-mentioned local conditions, favours the formation and rapid propagation of high floods, which in turn enhance erosion;

- present - day modelling processes (landslides, mudflows, sheet wash, gullies, suffusion, etc.) are very active;

- from ancient times to this day, man has been putting great pressure on the environment.

In the early days, much of the territory was covered by forests and so, despite its steep slopes and thin - profile soils, it was well-protected against sub-aerial erosion. In those days there was little activity, and therefore the environment could not be seriously degraded. In time, however, as we approach our epoch, anthropic pressure has been steadily increasing; cumulating in time, the effect was quite disastrous. Therefore, the present critical condition of the environment is the direct outcome of the natural conditions, of the cultural-historical and socio-political development of the region, of fresh experience acquired in the exploitation of local natural resources by means of new technologies, and last but not least, of the degree of efficiency of the work structured by society along the ages. The present land cover numbers a lot of secondary and derived vegetal associations, some of them of great floristic diversity. The relative equilibrium reached with certain types and degrees of anthropic pressure can easely be disturbed if land management is changed.

What encouraged people to settle in the region from very old times was, besides its natural resources, a fairly mild climate: moderate air temperature (8^{0} - 10^{0} C); quite mild winters, cooler summers, moderate precipitation falls (600-850 mm), low air dynamics, i.e. shelter conditions. In addition, the deep forests and the rough relief have created a shelter against the damages caused by migratory peoples. Archeological diggings have unearthed a number of items dating to the Lower, Middle and Upper Neolithic, the Middle and the Late Bronze Ages, and to the Geto - Dacians. They all bespeak a rich religious and political-administrative life. Even the first medieval capitals of Walachia were set up in the Subcarpathian zone (first at Câmpulung and then at Curtea de Argeş) and subsequently in the contact area with the plain (at Târgovişte).

The prehistorical human communities, as well as the historical ones, had been attracted by the wide range of soil and subsoil resources - farming lands along valley terraces or on the mildly-dipping slopes, easily available water resources, wood for

construction, fire-making or handicraft practices, possibilities to create pastures and hayfields for animal breeding. Used in the beginning for local needs alone, the subsoil resources started being traded.

In the course of time, the relationship between man and nature has acquired a new dimension, in keeping with society's technological advances. The discovery and use of salt, oil, gas, and coal, have inherently concentrated people in the respective areas, which in turn increased the pressure on the environment, sometimes exceeding its carrying capacity.

Taking a comparative look at the average population density in the Subcarpathians, we find that in 1912 it was 79.5 (up to 100-150 inhab/sq km in some areas) as against the all-country value of 53.8 inhab/sq km. That same year many discrepancies appeared within the Subcarpathian zone itself, e.g. 84.6 inhab/sq km in the Curvature area and only 68.3 inhab/sq km in the Subcarpathians of Moldova.

Anthropic pressure in this century alone has been changing very much in terms of population density, reaching in 1985 136 inhab/sq km all over the Subcarpathian Arc, and recording highest values in the Getic Subcarpathians (148.3 inhab/sq km), followed by the Subcarpathians of Moldova (138.7 inhab/sq km) and finally by the Curvature area (125.2 inhab/sq km) (Geografia României, IV) (Fig.1). Thus, concentrating 10 % of Romania's population in a territory with an already very vulnerable environment, which represents only 6.9 % of the country's surface, the region has become the most densely populated zone.

Another indicator of increased anthropic pressure is the density of settlement in an area already short of adequate space for it. Throughout this unit there is an average of 12.2 settlements/100 sq km, as against a national mean of 5.6 settlements. That is more than twice as much. The greatest number of settlements (14.4/100 sq km) occur in the Getic Subcarpathians, with the Moldova Subcarpathians scoring lowest (8/100 sq km).

Such great density of people and settlements had a severe bearing on the landscape. Most of the tightly-packed villages occur on terraces and in depressions, other villages being scattered on the slopes, where homesteads are surrounded by orchards and vineyards, landuse varies according to slope exposition and the very uneven relief. The shortage of arable land has in time generated such phenomena as "swarming" and seasonal moves to the mountain or to neighbouring places in search of work; sometimes, villages from the Curvature area, devoid of arable land, were assigned plots in the lowlands.

About 35-40 % of the Subcarpathian zone is forest land, and only 57% are left for farming. Arable land represents 440 000 ha, i.e. 47 % of the agricultural surface, which means that each person has 0.20 ha, or 0.31 ha if referred to rural population, which is the most numerous (63 %).

The lasting strain imposed on the environment, often beyond its carrying capacity, has in the course of time produced imbalances, critical local situations that require urgent ecological rehabilitation.

The need for cropland, for grazes and hayfields, and for wood (fire-making, building, handicrafts and the processing industry itself) has increasingly reduced forest grounds even on the steep slopes. Profitable as it seemed for immediate reasons, it triggered a series of negative chain effects on the other environmental components. The water regime on the deforested slopes was severely deregulated, runoff and erosion reducing the soil horizon down to its total disappearance. The mean specific discharge of suspended sediment load - an indicator of erosion proceses -

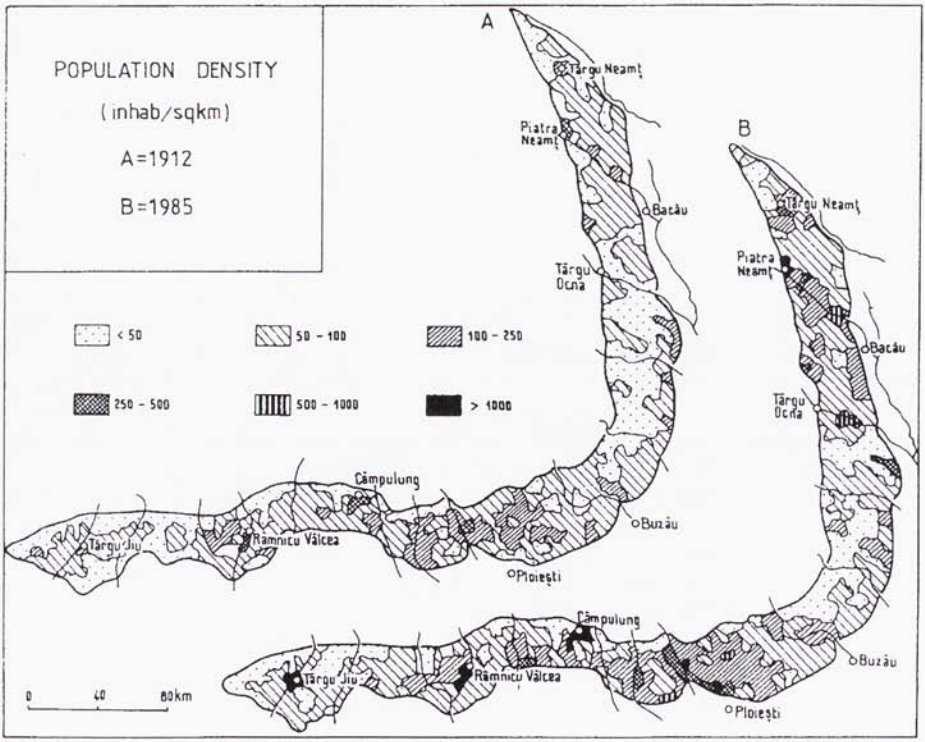

Fig. 1. Evolution of the population density in the Subcarpathians of Romania between 1912 (A) and 1985 (B).

registers the highest values in the Subcarpathians compared to all other parts of the country, usually exceeding 10 t/ha year, with over 25 t/ha year being recorded in the Curvature Subcarpathians. Top values by drainage basin scores the Câlnău (at Potârnicheşti hydrometric station - 55 t/ha year) followed by the Slănic (at Cernăteşti - 39.6 t/ha year).

A map drawn up in the mid-19th century (Satmari 1857) reveals high territorial variations in land use. As early as that time, severely deforested sectors would be found alongside forest-rich grounds. Massive cuts began at the end of the 19th century and in the early 20th, the slopes being populated by hayfields, isolated trees and bushes. Nevertheless, one can still find fairly well afforested areas today, in sectors where the rough relief and the friable rocks discouraged other uses. In an attempt to halt intense erosion caused by excessive past uses (e.g. in the Vrancea, Buzău and Prahova Subcarpathians) some of the last-century deforested plots have been replanted (largely with false acacia and pine, here and there flowering ash and other deciduous species). But even where the forest has been preserved, its structure appears to be deeply altered through repeated fellings (as a rule, management follows a coppice system) and grazing. Structural changes together with the physiological imbalance induced by pollution and a succession of droughty years have generated phenomena of withering, affecting mostly the common oak and durmast stands and the pine plantations.

The steady population growth and the technological progress have led to the

exponential exploitation of the soil and the subsoil resources, to an industrialization drive and increased urbanization. Thousands of hectares have been laid bare to afford the exploitation of mineral substances and building materials. Let us recall the string of coal mines in the Jiu basin, which have created a new landscape viz. the man-built mine dumps. The exploitation of salt-domes has left huge holes inside the earth and open wounds on its surface; frequently, salt lakes which have taken the place of collapsed mines, are used for spa-cures now. Visible traces in the landscape have been left by the quartz sand and diatomite exploitations at Vălenii de Munte and Pătârlagele, respectively. Crude oil and gas drillings (the Subcarpathians of the Prahova, of Buzău and of Gorj) are polluting the soils and the plant cover over vast expanses.

The natural potential is extremely different over small areas. There is an alternation of low slopes with evolved soil (proportionally few, occupying especially the river terraces), of slopes often affected by landslides, on which fertile, evolved intrazonal soils have developed (clinomorphic), and of more or less eroded slopes, with little evolved intrazonal soils (rendzina, pseudorendzina, regosols, lithosols). For example, the last type of slopes covers 45% of the Subcarpathians of Buzău. Halomorphic soils also occur over small areas. A number of detailed investigations, carried out on a representative sample (175 sq km) in the perimeter of Pătârlagele Station, have revealed the mosaic - like distribution of the productive capacity. For example, 28% of the studied area have a good and very good natural potential, 50% are moderately-productive and 22% are poor and very poor (Muică et al. 1981). All in all, the high variability of the natural potential in the Subcarpathians is primarily the consequence of the alternance of slopes modelled in the rock in situ and slopes covered with different deluvial materials affected widely by landslides. Local differences are engendered by the occurrence of terraces, floodplains, alluvia fans, and sliding glacis.

The large population density and an intense economic life are also reflected by a rich network of slope tracks and paths. They discontinue the plant cover, favouring the development of runoff and erosion proceses, frequently ending up in gullying, fact that makes appreciable areas become impracticable, also triggering landsliding. This phenomenon is the more disastrous, the steeper the slope and the more friable the soil.

The current management of the sectors in which the great strain put by human activity has triggered imbalances and a higher or lesser decrease of production potential is widely varied. In broad lines, the following characteristic situations occur:

- the excessive practice of grazing, with large animal effectives being grazed on low-productive grounds, maintains, or even aggravates, imbalances;

- crop-growing has been abandoned; in time, the wounds left by erosion proceses have started healing spontaneously. The bushes, often populating these grounds (most widespread among them are *Crataegus monogyna, Prunus spinosa, Rosa canina, Hippophae rhamnoides, Ligustrum vulgare, Viburnum opulus, V. lantana*), are a sure means of fixing them;

- erosion control works made over the time (gully fixation, forest planting) have been limiting the negative effects, although soil recovery is still underway. In the first stages, it is the herb layer and the undergrowth that are luxuriously growing on the plantations, checking erosion and equilibrating the water balance.

Over much of the Subcarpathian territory, the situation is now under control, with present landuses and the natural potential standing in a good relationship through an

alternation of forests, orchards, pastures and cropland. Even the landslide-affected slopes are adequately used, as orchards associated with hayfields.

A special concern over the past decades has been to create hydrotechnical and water-power installations on the main allochthonous water networks of the Subcarpathian region, typically on the Olt, Argeş, Trotuş and Bistriţa rivers. In addition, the numerous management works made in drainage basins had in view the attenuation of erosion processes. In both cases, however, a series of shortcomings have very much reduced their efficiency.

Thus, the building of storage lakes in an area were sediment load discharge from Subcarpathian tributaries is very high, has led to many devices becoming silted, with useful water volumes decreasing accordingly (Fig. 2). Let us take the case of the Prundu - Piteşti reservoir: as a result of the Doamnei river - carried alluvia, silting rates reached 65% after two years of operation, to top 90% after another two. A similar situation at the Bascov reservoir on the Argeş river, which was silted (74.2%) after three years in operation; subsequently, however, silting rates became lower (11%/year). (Şerban and Teodor 1992).

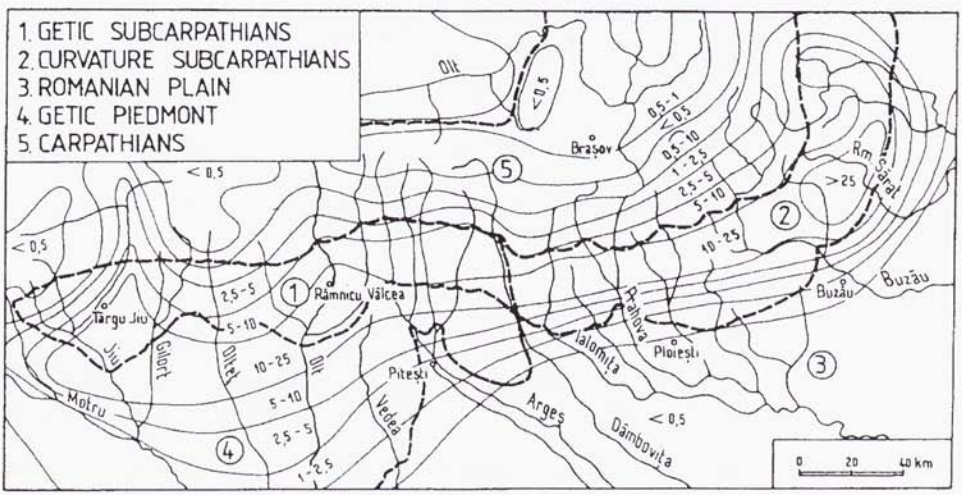

Fig. 2. Specific mean erosion (t/ha/year) in the Getic and the Curvature Subcarpathians compared to the big limitrophe relief units.

Silting on the Argeş and the Olt is decreasing from down - to up - stream. Until 1985, the alluvia carried by Subcarpathian waters had reduced the water volume of the storage lakes on these two rivers by 62 mill m^3 and 22 mill m^3, respectively, out of a total of 654 mill m^3 they have in the Subcarpathians.

The effectiveness of the dams intended to correct torrential flows and attenuate erosion was annulled after a two-or three-year period of operation, they becoming simply longitudinal profile levels. Works began downstream and proceeded up the river, from easy - to - reach places toward the less accessible ones, overlooking the fact that open surface wounds - a major source of alluvia - are located in the source area of gullies and of drainage basins. It would have been advisable to deal first with the alluvia sources and only afterwards have dams built on the longitudinal profile;

they would have stood operational for a longer period of time.

Another important problem of the Subcarpathian drainage network, is the great mobility of channel-beds due to the high alluvia volumes flown down the stream, to the erosion of river banks, and lately (the past few decades) to the ballast pits. Banks are being destroyed primarily by the high floods, at a rate of ca 1 m/year in the Jiu basin and of 2-6 m/year in the Olt basin.

The ballast pits, which supply building enterprises with sand and gravel, are seriously deregulating the discharge regime, at the same time facilitating the formation of sediment load along the rivers. In the Buzău basin, for example, there are 56 such pits supplying annually 2 mill m^3. of ballast. Rivers have a tendency to refill the gap, thereby creating a deficit of circulating sediment in the longitudinal profile downstream the respective pit.

The circulation of channel-bed alluvia changed significantly through changes in the discharge regime after brought about by the building of reservoir lakes in the Subcarpathian zone of the Olt, Argeş, and the Bistriţa, or in the upstream mountainous zone - on the Buzău, Teleajen, and Doftana and in the Motru basin.

In conclusion, the critical environment of the region calls for protection measures to have priority over efficiency criteria, moreover so, as the imbalances produced here can affect large downstream and upstream areas. All in all, this region offers particularly favourable living conditions and good economic opportunities provided uses are carefully considered in keeping with the widely differing potential of the area.

The present changes in the property structure have been showing up in the manner of land use. This can put the precarious environmental balance in serious jeopardy. The consequences are twofold: on the one hand, the interest of the owners to increase the quality of their lands might reduce the number of degraded, uncared for, grazing surfaces crossed by a chaotic network of tracks and paths. According to field observations there is a general tendency to have such tracks and paths closed up to the traffic and to fence in the lands by traditionally efficient means (especially scrub hedges). This could reduce the speed of water flow on slopes and control incipient onset of torrential events. On the other hand, however, there is an obvious tendency of increasing the pressure on slopes by turning former hayfields or orchards into cropland. In the very short run this could produce severe imbalances. Often enough, eager to clear the ground, people would cut off trees or bushes from little consolidated soils, or along relatively stabilized gullies, where such ligneous vegetation acts like a barrier in the way of erosion proceses. Such anthropogeneous tendencies needs be closely watched to see if they do, or do not fit into the requirements for a sustainable development of the Subcarpathian region.

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KRITICKÉ PROSTREDIE SUBKARPATSKEJ OBLASTI RUMUNSKA (SÚČASNÝ STAV)

Subkarpatská oblasť v Rumunsku leží mimo karpatského oblúka a rozprestiera sa medzi dolinami riek Motru a Moldova. Jej špecifické črty si vyžadujú väčšiu opatrnosť zo strany človeka v jeho budúcej činnosti, pretože reliéf je mladý, dvíha sa 2-3 mm ročne, má mozaikovitú geologickú štruktúru s výrazne zvrásnenými a zlomami rozbitými súvrstviami, priepustnými i nepriepustnými, spevnenými i nespevnenými horninami, striedajúcimi sa na malom priestore.

Fragmentácia reliéfu, dosahujúca 4-6 km/km^2, bystrinný charakter odtoku a aktívna súčasná modelácia predstavujú niektoré z ďalších hazardov. Prírodné bohatstvo tejto zóny a jej mierna klíma podmienili skoré osídlenie (od neolitu) tejto oblasti.

V súčasnosti v Subkarpatskej oblasti žije 10% rumunského obyvateľstva, počet sídiel dosahuje 12,2 na 100 km^2 na ploche ktorá predstavuje 6,9% územia krajiny.

Tento dlhotrvajúci nápor na prostredie mal za následok zmeny niektorých jeho zložiek, ktoré spôsobujú nerovnováhu, ako napr. rozširujúce sa odlesňovanie určitých oblastí (dokonca i na príkrych svahoch) zintenzívnilo eróziu, čo vyústilo do redukcie až úplného zmytia pôdnej vrstvy; tisícky hektárov pôdy bolo zabratých pre ťažbu úžitkových nerastov alebo stavebného materiálu, skládky odpadu vytvorili novú tvárnosť krajiny; na miestach prepadnutých soľných dómov vznikli soľné jazerá; drastická ťažba nafty a zemného plynu mala za následok znečistenie veľkej rozlohy pôdy a vegetácie; hydrotechnické zariadenia a vodné elektrárne lokalizované na hlavných subkarpatských tokoch boli silne zanesené prísunom ohromného množstva materiálu transportovaného v suspenzii a riadenie povodí malo malý pozitívny účinok.

Súčasné využívanie je však často v súlade s prírodným potenciálom, s krajinou predstavujúcou striedanie lesov, sadov, pasienkov a polí. Nové vlastnícke vzťahy viedli k zmene vo využívaní zeme a možno predpokladať, že s pozitívnym efektom na kvalitu prostredia tohto regiónu, ktorý sa nachádza v dosť citlivom stave rovnováhy.

Obr. 1. Vývoj hustoty zaľudnenia v Subkarpatskej oblasti Rumunska v rokoch 1912 - 1985.

Obr. 2. Špecifická priemerná erózia (t/ha/rok) v Subkarpatskej oblasti.

Preklad: M. Stankoviansky