CHARACTERISTICS OF THE DEGRADATION OF AGRICULTURAL SURFACES IN THE SOUTHERN BĂRĂGAN PLAIN, THROUGH RAIN-EROSION PROCESSES

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Abstract. ***Characteristics of the degradation of agricultural surfaces in the southern Bărăgan Plain, through rain-erosion processes.*** The Southern Bărăgan Plain is a geographical unit where the rainfall processes have a moderate action, even reduced in some places, taking into account the low rainfall as well as the morphology and morphometers of the relief. These processes have an impact on man and human activities, primarily through the action they have on land on which intensive agriculture is practiced or even on inhabited areas.

Keywords: rainfall, erosion, degraded land, precipitation

1. INTRODUCTION

From the lithological, morphographic and morphometric conditions of this relief unit and their interaction with climatic factors has resulted the rainfall relief that developed and is represented by forms with a degree of frequency and development appropriate to morphogenetic conditions (Achim, F., 2013) .

The morphogenesis of the pluvial relief has as modelling agent *the water from precipitation*. The action of this agent can be achieved depending on some factors, with influence on rainfall modelling, existing at the level of this plain unit (Achim, F., 2015).

We include and analyse in this study, those forms of relief created by the processes of: *rain-erosion, areolar erosion, diffuse flow and concentrated flow.*

2. DATA AND METHODS

The identification and typification of this genetic type of relief resulted from the field observations and the consultation of the theoretical aspects that genetically analyse the relief, as a need for the correct framing of the existing relief forms. We consider the fluvio-pluvial relief as a genetic category framed

by the fluvial relief on the one hand and the pluvio-denudational relief on the other hand, being specific to a stage in which the relief forms evolve from the pluvio-denudational relief to the fluvial relief.

During the studies, a series of specialized principles were applied, namely (Achim, F., 2021):

- the principle of general research, on the entire surface of remote sensing images and maps;
- the principle of logical or selective research;
- the principle of quantitative analysis;
- the principle of qualitative analysis;
- the principle of evolutionary and chronological analysis;
- the principle of the relationship and dynamics of the elements on the ground.

As a special note of the study, spectral indices were used, these being parameters for quantitative and qualitative evaluation, on some elements of the environment, which are transposed on the satellite image. The values of the indices can be calculated, through specific formulas in which data of some measurable elements are introduced with the help of remote sensing sensors and by laboratory methods, or can even result from the direct exploitation of images (Reteșan - Floca, Diana, 2003).

Indices can be represented by certain signs, most often in the form of joining letters, which are acronyms of titles, expressions, etc. Indices often have well-developed calculation formulas and are proven by the results obtained during the use of images.

An example of their use is that of the soil cover index (BSI), following the erosion processes that the land surfaces have but also for establishing the differentiations that appear within the soil classes.

$$BSI = \frac{(Xred - Xswir) - (Xnir + Xblue)}{(Xred - Xswir) + (Xnir + Xblue)}$$

Xswir = value of short infrared waves.
Xnir = value of near-infrared waves;
Xred = value of red band waves;
Xblue = the value of the blue band waves.

3. RESULTS AND DISCUTIONS

The forms of rain relief on the surface of the South Bărăgan Plain are:
- the relief forms created by the process of areolar erosion (undulations, micro-depression surfaces located on the field or slopes, etc.);
- little developed valleys (vâlcele), made by the geomorphological process of diffuse flow;
- little developed valleys (vâlcele), made by the geomorphological process of concentrated flow;
- little developed valleys (vâlcele), made by the geomorphological process of concentrated flow and linear erosion;
- as a result of all these processes of pluvial erosion we meet the pluvial relief of accumulation (colluvio-proluvial strips).

The factors with a role in the process of rain relief formation and evolution in the South Bărăgan Plain can be divided into: *restrictive factors and favourable factors.*

Restrictive factors.

- against the background of a small altitudinal difference, it resulted, at the level of the whole unit, *a low relief energy* and *very low slopes*. Therefore the water flow rate is very low and the transport of sediments is reduced. It is observed, in the case of smooth surfaces with very small slopes, that in the situation of high rainfalls, the water has a tendency to puddle, the drainage being made on short distances to the surface of some cenotes;
- *the poor development of the valley network*. The density of the hydrographic network at the level of the entire unit is 0.17 km/km^2, and the spatial distribution is uneven, the central-eastern part of the plain being devoid of valleys (including endorheic surfaces);
- due to *the lithological constitution of the surface deposits* and *the development of the soil layer*, a large part of the precipitation water infiltrates easily, so that in case of light or average quantitative rains, the rain processes do not occur;
- *the reduced amount of annual atmospheric precipitations* (between 462.1 mm in Feteşti and 561.6 mm in Fundulea) (Bogdan, Octavia 1980);
- *agricultural works*, which level the microforms built by the drainage of water from precipitation, from one rain to another (on the other hand, the same works, favour the rainfall processes).

Favourable factors for the development of rain relief.

- *the lack of a cohesive vegetal carpet*, especially the low presence of forests. Here it should be emphasized on one hand that the natural steppe vegetation has been, for the most part of the plain, replaced by crop vegetation (which does not protect the soil as well), and on the other hand the seasonal nature of the vegetation (more than 6 months, the land being bare of vegetation);
- the existence of *dry periods*, which, due to the lack of water, weaken the cohesion of the soil particles, *followed by torrential rains* in the form of showers, the resulting water cloth transporting, to the lower parts, these dislocated soil particles;
- the appearance, on the background of the multiannual precipitation deficit, of some *periods with long lasting rains* and especially the increase of the amount of precipitations in the second part or at the end of the rainy period. Such rains sometimes occur in autumn or spring and very rarely in summer. In June and September 2005, there were such rains, with surface erosion affecting agricultural crops (for example, in the case of maize, in June, the plants were sometimes uprooted or covered with material transported by water from a short distance);
- *strong winds* produced against the background of dry periods, especially in the hot season, which displaces, disperses and transports dust particles. These in the place where they are deposited form a mass (thin layer) without cohesion, which will be easily washed by rainwater. The wind deposits the sediments taken over, especially in sheltered places located on valleys, ravines, slopes, etc., places where they are easily washed away by rainwater;
- *low temperatures*, which produce soil frost (freeze), allow the wind to detach and transport soil particles;
- *the snow layer*, deposited unevenly, with a greater thickness in the lower areas of land and valleys, causes the resulting water to erode the topographic surface on which it is located and especially when deposited on the slopes of some valleys are formed in their place small ditches. The production of precipitation in liquid form, in the conditions of the existence of the snow layer on the ground, greatly favours this process;
- *agricultural works* such as ploughing, hoeing, harvesting crops, but also land improvement works (such as: *construction of irrigation canals, digging ditches for the installation of irrigation water pipes*, etc.) greatly weaken the cohesion of surface deposits (Gâştescu , P., 1971). It is known from practice and literature the negative role of ploughing performed perpendicular to the slope. However, in the South Bărăgan Plain, they are

frequently practiced, "motivated" by properties with small areas in the form of narrow strips arranged perpendicular to the slope, but also by the poor level of knowledge of those who practice these works;
- also related to *agriculture*, it must be said that many of the agricultural crops consist of *weed plants*, which have a low density (corn, sunflower, vegetables, etc.) and during the rains, the land is exposed to surface washing, these crops protecting l just wind. Also, in the summer after the harvest of straw cereals, the lands remain exposed to the wind that transports in the form of dust large quantities of materials that settle;
- anthropic works that consist in the opening of some earth quarries on the slopes of some valleys or those within some surfaces with uneven appearances, on the background of the existence of some forms of suffusion and settlement, near the localities. In this sense, it is observed the existence near each locality, regardless of the size, of some spaces from where "yellow earth" (loess) is extracted for constructions and the maintenance of constructions, the houses being predominantly built of resorts once every few years to "gluing", in fact consolidating the walls on the outside and plugging the cracks. The extraction of the material is done by excavating at the base of higher portions, or where there are no such forms, pits are dug near the village. On the support of this opening, made by man, the precipitation waters act through erosion, creating forms of pluvial relief. In the valleys, where dams have been built, much of the material is made up of earth, extracted from nearby slopes. As the valley slope has a certain degree of inclination, the rain erosion is quite active, resulting in relief forms such as ravines and torrential organisms. In some cases, in the ninth decade, canals were dug on the plain surface for drainage, and the slopes of these canals were not sealed with concrete slabs. After about 10 years, in the conditions of a poor maintenance of this type of canals, and the removal of the concrete slabs, the rain erosion acted on the slopes, resulting in extended ravines of up to 10 meters in the field. We mention that in those spaces, this type of canal was dug by man with a depth of about 4 m (eg in the northeast of Vâlcelele).

The relief forms, made by the process of areolar erosion, from the content of the South Bărăgan Plain. The water, resulting from precipitation, acts on the plain surfaces, either in the form of concentrated water or in the form of a cloth with surface runoff.

Where due to the relief configuration, the water does not concentrate but flows in the form of a canvas, the modelling of the field surface is done through the geomorphological process of areolar erosion (Sorocovschi, V., 2016).

This geomorphological process consists in transporting the fine material from the surfaces located in a slightly higher position to the lower surfaces. The maximum transport of sedimentary material is made during quantitatively rich rains (showers), which occur either after dry periods or at the end of rainy periods.

Due to the very small slopes, the water drainage is generally done at a very low speed, only on some parts, depending on the slope, it increases. The transported material is not in large quantities, and as a result of this process, the forms of accumulation and very little those of erosion are more easily observed (Sorocovschi, V., 2017).

Areolar erosion leads to the creation of relief microforms through vertical development but with a much greater horizontal extension, such as the *small undulations* of the slopes, *the extension of cenotes*, etc. The accumulation of sediments occurs in the micro-depression and valley spaces and we find it in the form of sediment accumulations in the cenotes (the culture plants are buried, with sediments on thicknesses from a few cm to tens of cm).

Related to the problem of defining these relief forms, it is quite difficult, at least within this relief unit, because rainwater erodes the land on small thicknesses, the resulting erosion forms being difficult to see due to the small vertical dimensions. The fact that on the surface of the plain there is a developed soil horizon, shows us that the areolar erosion acts weakly. Of course, the forms of accumulation are easier to observe, especially after rains, because they occupy much smaller areas and are made of materials transported by water from large areas. A first consequence of surface erosion is soil erosion, followed by clogging of riverbeds in the region.

Being a geomorphological process preceding the runoff, the long action of areolar erosion leads to the increase of the possibility of the appearance of such forms (Surdeanu, V., 1998). Areolar erosion is more intense near valleys, cliffs and in the northern part of the South Bărăgan Plain, where surface deposits are less consolidated due to the high content of sand of wind origin that these deposits have.

Small valleys with diffuse water flow. They are found in the form of portions ("corridors") where the water of heavy rainfall falling on a larger area of the field flows to the lower parts. They are in the form of shallow valleys (1-1.5 m) and several tens of meters wide with lengths of hundreds of meters or even over a kilometer. In the transversal profile it does not present a lower space (of the type of a trough) through which to drain the water, this being done at the level of the whole valley in a diffuse form.

These valleys have a generally uniform distribution on the surface of this plain. Being closely related to the inclination of the relief, where this parameter has a higher value, their density also increases. Also, the northern

part of the plain, occupied by superficial wind deposits that have a weaker cohesion, is more affected by this relief.

Where the density of the cenotes is higher, the surface runoff of water from a cenote, located at a slightly higher altitude, to a cenote located below, is done mainly through this type of ravine.

Small valleys with concentrated water flow. They are found where the drainage of precipitation water has managed to create by erosion valley spaces smaller in size but deeper than those of the diffuse but narrower streams, which ensure a faster flow of water. Leakage and medium intensity rains are also recorded during these floods. In the transverse profile, the ravine does not have a trough, but the profile shape is more curved than in the diffuse erosion valleys.

On the surface of the South Bărăgan plain, the distribution of these relief forms is not uniform. Thus, they are rarely found on the smooth surfaces of the field, but more often they are found near and on the slopes of the valleys. Also at the head of the Danube terraces, the space near and at the head of the field is affected by small valleys. In the space located inside the plain, the existence of some streams of concentrated flow is related to the development of some cenotes and at the same time they make the connection between cenotes. Detailed observations have shown us that these ravines can be included in river basins, such as the situation of the Jegălia basin, where the network of valleys extends into the field, reaching by branching tributary valleys of this type.

Valleys dug by geomorphological processes of concentrated flow with intensification of linear erosion. They are the result of a longer period of erosion exerted by fallen water during precipitation. They resulted from the evolution of the valleys formed by concentrated runoff, by more intense erosion. Compared to the previously analysed valleys, they are different in that in their transversal profile there is a trough, which shows runoff in almost all situations with average or more voluminous precipitation. Although, on the surface of the South Bărăgan Plain, they have variable dimensions with lengths between a few hundred meters and a few kilometres, most often they have dimensions between 500 m and 2 km. The width of the valleys is between 50 and about 500 m.

According to the position he occupies within the South Bărăgan Plain, it stands out:

- the valleys located in the vicinity of the hydrographic network;
- ravines located nearby and on steep spaces;
- ravines located in the field.

In the first situation, the valleys are included in the hydrographic network in the form of tributaries of various orders. These ravines are the most numerous, being characterized by a high slope, have a torrential flow of water, have depths sometimes of a few meters, are narrow and at the confluence with

river valleys have a cross profile better expressed morphologically (Rădoane, Maria, Rădoane, N., Ichim, I., Surdeanu, V., 1999). They are found in all river basins, with the observation that within the Jegălia river basin are some of the longest valleys of this type.

In the places where important steep spaces meet (the terrace fronts of the Danube, the steep plain towards the Danube terraces and the border river valleys) these valleys have a high frequency (Gâştescu, P., Zăvoianu, I., Ţuchiu, Elena, 2012). They fragment the relief form over which they are located, ensuring the drainage of water, and at the lower part they sometimes have sediment deposits in the form of pseudo-manure cones. Although they are more developed in width than the ravines within the hydrographic network, they are deeper in relation to the level of the relief forms within which they are located, reaching differences in level even greater than 5 m (eg. north of Radu Voda). These ravines have a higher density on the space of the steep field from the first terrace of the Danube, the sector between Călăraşii Vechi and Movila cu Coadă. In the same way, the Ialomiţean steep slope of the plain, to the east of Sudiţi locality, is fragmented by such wolves.

These ravines are found on the surface of the plain and outside the hydrographic network. They are characterized morphometrically by larger dimensions. Their construction was based on the long action of rainwater, simultaneously with some processes of compaction-suffusion, an aspect observed from their location near and in connection with the existence of gulls, tablelands or cenotes (Surdeanu, V., Rădoane Maria, Rădoane, N., 2003). They drain several such forms, ensuring in situations with rich rainfall, the transport of water. Often their trough was arranged anthropically by deepening or digging canals covered with concrete slabs that prevent the puddle of water and the temporary rise of the groundwater level.

4. CONCLUSIONS

Due to a weak presence of the hydrographic network, the water resulting from the fall of precipitations, on the surface of the plain, is evacuated through a network of less developed valleys, which completes the hydrographic network within the existing basins. When this amount of fallen water is concentrated in a larger volume, it begins to act on the relief, through small or large geomorphological processes.

The mode of action of the water from precipitations concentrated on the topographic surface, on the plain of South Bărăgan, presents particularities given by the overall configuration of the relief. It is observed that in the conditions of the existence of a large plain surface (3520.4 km^2), during the precipitation, a large amount of water reaches the topographic surface, which

must be evacuated by drainage. The problem, posed by this plain unit, in the process of water evacuation, is induced by the very low slope, a morphometric parameter that leads to a low speed of water flow, with the tendency to puddle. Contrary to this aspect, there is the lithological constitution and the properties of the surface deposits and the soil layer, which allow the infiltration of a large amount of water (more than 90%), which allows the studied relief unit not to surface. or one with excess moisture, during and near rainy periods.

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