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GEOMORPHOLOGICAL PROCESSES WITHIN THE LARGA CATCHMENT

Tatiana Popusoi[12], Petru Bunduc[1]

Abstract. The Larga catchment is located in the south-west of the Republic of Moldova, being part in the physical-geographical unit of Tigheci hills and the total area of the basin is 14688 ha. The main degradation processes are represented mainly by erosion surface, gully erosion and landslides. Using GIS technologies have been identified, mapped and evaluated all geomorphological processes within the Larga catchment. The shape and dimensions of gullies and their spatial difference are conditioned by lithological characteristics of the morphologic substrate, climatic conditions, but most important part accounting for the relief is morphometric variables.

Keywords: Larga catchment, Tigheci Hills, geomorphological processes, gullies, sheet erosion, landslides

1. Introduction

The Larga catchment is located in the south-west of the Republic of Moldova, being part in the physical-geographical unit of Tigheci Hills (fig.1). The total length of the river is 32.3 km and the total area of the basin is 14688 ha.

In geological terms, the surface deposits belong to the upper Sarmatian (Chersonian and Meotian) Pliocene, Pleistocene and Quaternary formations. Lithologic deposits are represented mostly by sands and clays, leading in particular, to the occurrence and manifestation of the erosion and mass movement processes.

The relief of Larga basin is characterized by low altitudes (100-300m), with a mean value of 145 m. The minimum and maximum values are of 10, respectively 303 m, at the confluence with Prut River and in Lărguța Hill. Slope declivity values oscillate between 0o and 35o, with a mean of 5o which indicates that the basin is situated in a region favorable for agricultural terrain use. Larga basin is situated in the geomorphological unit of Tigheci Hills, with a certain specificity of relief fragmentation materialized in an obvious asymmetry. If the right side of the basin is represented by cuesta dip slopes with low declivities and altitudes that do not exceed 220 m, the left slopes are made of strongly fragmented cuesta escarpments, with altitudes that reach up to 300 m.

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The morphology of relief of Larga catchment is due to the action of external factors, while internal factors play a subordinate role. For this reason, the fluvio-denudational relief represented by interfluvial peaks and deluvial slopes, covering about 90 % of the total.

Given its position in the south-western part of Moldova, Larga catchment is characterized by a temperate continental climate with obvious nuances of excessiveness. The mean annual temperature ranges between 9,9˚C and 10,2˚C and the mean rainfall is about 525 mm in one year, with a frequent deviation between 512,2 and 535,1 mm. Climatic conditions influence the groundwater aquifers that have only minor reserves

The land degradation in Larga catchment is mainly represented by sheet erosion processes (with a generalized distribution), gully erosion and landslides. Sheet erosion develops in all places where there is a small slope that can allow water runoff through diffuse processes. The agricultural lands situated on slopes greater than 5%, are the most exposed areas to this process (Hârjoabă, 1968, Moţoc, 1963), which is less noticeable and difficult to be assessed, but which evolves gradually and causes the loss of surface fertile soil horizon. Gully erosion is the most characteristic geomorphological process, both by the occupied area and by the resulting effects (consequences of functional, structural, landscape order), even if, overall, this process does not exceed the amount of soil losses, caused by sheet erosion. The development of landslides in the studied area is at a small scale, being especially favored by the Meotian sandy-clay substrate, intercrossed at the slopes' level.

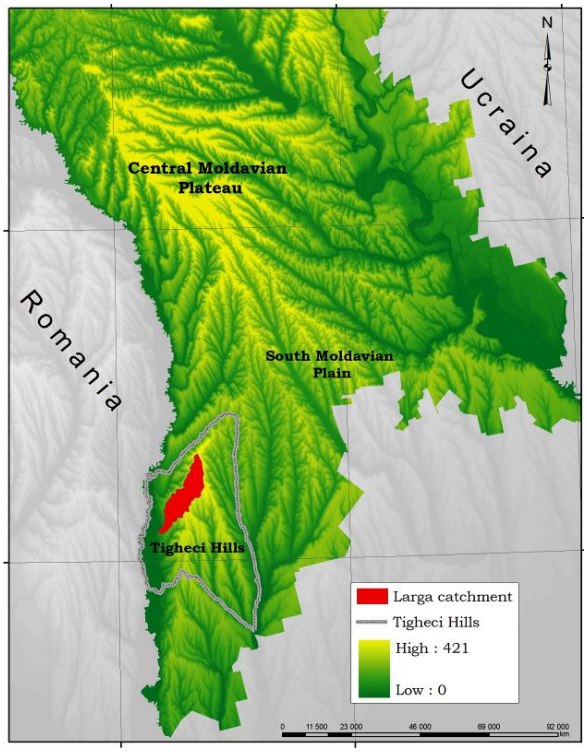

Figure 1: The geographic location of Larga catchment

Materials and methods

The study was based using G.I.S techniques for morphometric and morphographical analysis through Map Info 9 and ArcGis 9.3. software. For the assesment geomorphological processes were purchased and used topographic map, (in scale 1:25 000 and 1:5000), based on which were obtained Digital Terrain Model (DEM) and a series of thematic maps useful in understanding and interpreting local features of relief. Also have been used soil maps (in scale 1:10 000) efferent communal territories of Larga catchment and orthophotos (with 0,5 x 0,5 m resolution, 2007 edition)

In the Larga catchment, soil erosion was estimated by processing the data from soil studies for localities Larguta, Haragis, Cirpesti, Lingura, Tartaul, Plopi, Ciobalaccia, Cucoara, Chircani, Rumeantev and Gotesti conducted by the Institute for Soil Science, Agrochemistry and Soil Protection „N. Dimo" I.P.A.P.S., Chisinau. Classification criteria were correlated with those of the I.C.P.A.-1986 (MESP, 1987).

Results and discussion

Geomorphological processes are defined as concrete forms of manifestation of modeling agents (lithology, relief, climate, hydrography, vegetation and especially of human intervention) and lead to soil degradation on extremely large surfaces.

Surface erosion is considered a pedo-geomorphological developed on all lands with a small slope as that may allow a diffuse leakage (Niacşu, 2012). The favorable conditions for surface erosion represents first of all soil friability, lack of vegetation cover, slope and torrents of rain.

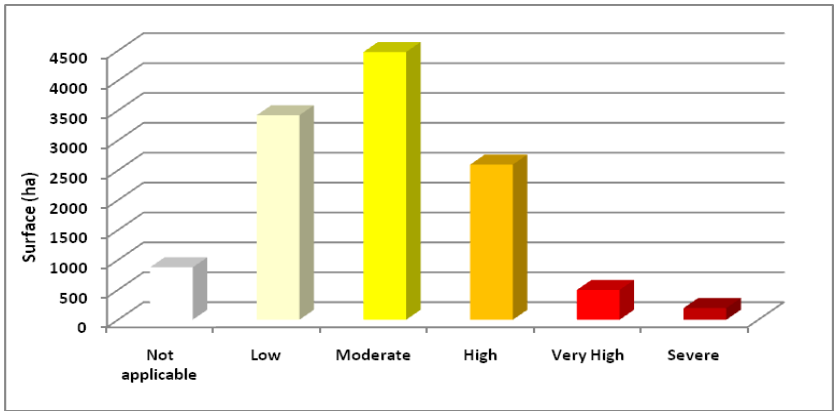

Figure 2: The area of soil erosion on intensity classes
(after processing pedological studies at scale 1:10 000, by IPASP)

The pedological studies (fig. 2) show that in the study area about 4500 ha (37.11% of total surface) are affected by moderate erosion, on 3421,32 ha (28,35%) prevail low erosion and 2595.15 ha (21.50%) are highly eroded. The lands with very high and severe erosion are more widespread on cuesta fronts, representing about 6 % of the study area (694,91 ha), while terrains not affected by erosion hold a total of 876,65 ha (7,26%). The highest erosion is observed in the middle third of the slopes and the detached materials are redistributed in the lower third of slopes. Morphologically, this process is reflected in the formation of a slight convexity or, more clearly, within the existing crops which are much better developed compared to the middle third of the slopes, due to the additional contribution of humus transported along slopes. On terrains used for the grazing, covered with herbaceous vegetation, the intensity of erosion is reduced, but on the cuesta fronts, where overgrazing occurs, the lack of vegetation leads to excessive erosion rates.

The most characteristic geomorphologic process in Larga catchment is the gully erosion, resulting in a serious range of consequences on large areas, even if, overall, this process does not exceed the amount of sheet erosion. Based on the orthophotoplans (2007) there were identified 141 forms of gully erosion (131 valley-side gullies, 10 valley-bottom gullies) with the indication that there were selected only those gullies whose active surface, exceeds 50 m2 (fig. 3).

Valley-side gullies are represented by small catchments usually discontinuous, with a linear longitudinal profile (fig. 4 and fig. 5). They are developed on the slopes with a total area of 64,67 ha. Many of these gullies were formed by „emphasizing of incisions made along the lines of old roads that cut the slopes with a high gradient”(Niacşu, 2012). Frequently this

gullies occur alone, without major ramifications, but when their density increases can form a microrelief such as „badlands" one on the right side of Ciubuclia or on the left side of Tartaul.

Valley-bottom gullies appear in a number much lower than side gullies but the forms are much more developed and spectacular. Such gullies were formed in the valleys and hold an area of 104.88 m. Most valley-bottom gullies are located on the right side of the Larga catchment occupying impressive surfaces and length (fig.6 and fig. 7).

In the Larga catchment the total length of gullies is 54,03 km. Approximately 70,92 % (100 gullies) of total gullies hold the length between 100-500 m, about 11,35 % of gullies have a length of between 500-1000 m. The gullies with the length below 100 m occupy 10,64 % and the lowest rate of 7, 09% hold longer than 1000 m.

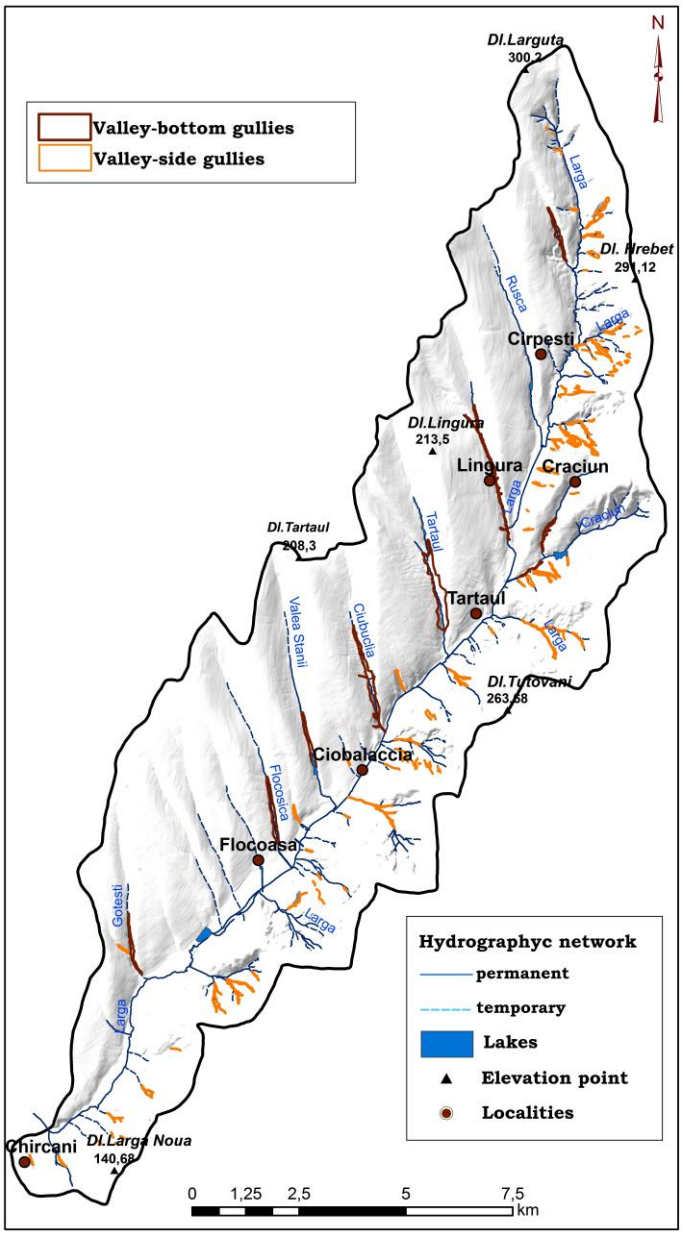

Figure 3: Distribution of gullies in Larga catchment

Figure 4: Valley-side gullies on the left side of Larga catchmet

Figure 5: Valley-side gullies on the left side of Larga catchmet (4.11.2011)

Figure 6 Valley-bottom gully in the Ciubuclia catchment

Figure 7 Valley-bottom gully in the Ciubuclia catchment (14.05.2012)

Usually the highest density of gullies is in the upper and middle sectors of the catchment due predominantly sandy lithology. The average of these processes is 0,36 km/km^2, relatively low value compared with Tigheci hills, which is 1.22 km/km^2.

Instead the average number of gullies is 0,95 gullies/km2, frequency higher than in the Tigheci hills (0,83 gullies/km2). Bilinkis et al. (1978) identified a much larger number of gullies on an area of 1 km2 within Ciobalaccia village that is the 1.5-2.0 gullies/km2. Analyzing the territory of Ciobalaccia village and number of gullies on topographic plans (1986 edition) and the ortophotos (2007 edition), it was found that the frequency of gullies in 1986 was 0,69 gullies/km2 to 0,5 gullies/km2 in 2007.

In the '70 -80 years were made a series of antierosional works, especially by flatting gullies, and a large part of the area affected by these processes was transferred to Forestry Fund for afforestation.

Currently, the forested gullies were considerably reduced mainly on the left side of the basin, south-east of the Ciobalaccia village due to deforestation abusive, using these lands as pasture.

The landslides, besides surface and gullies erosion, complete the set of geomorphological processes in the Larga catchment.

In view of genesis and created microrelief, the landslides can be divided into:

- Complex landslides (Step-like landslides and wave-like landslides);
- Landslide amphitheatre (local name: hârtop)

The complex landslides develop on slopes with varied geological deposits and a high energy of relief, where was installed valley side gullies thus favoring deluvial sliding reactivation. The step-like landslides appear on the cuesta front where the left side of the basin usually, represents reactivation of old forms of landslides. On the sliding steps due to rainfall or snowmelt, are formed small semi-permanent lakes, of which area does not exceed 50m2. The wave-like landslides have large depths and the resulted microforms are caused by obstacles which slowed down suddenly the moving material. The landslide amphitheatres are bounded by a semicircular main scarp and the entire deluvium (landslide body) converges towards the axis of the small catchment (fig. 8).

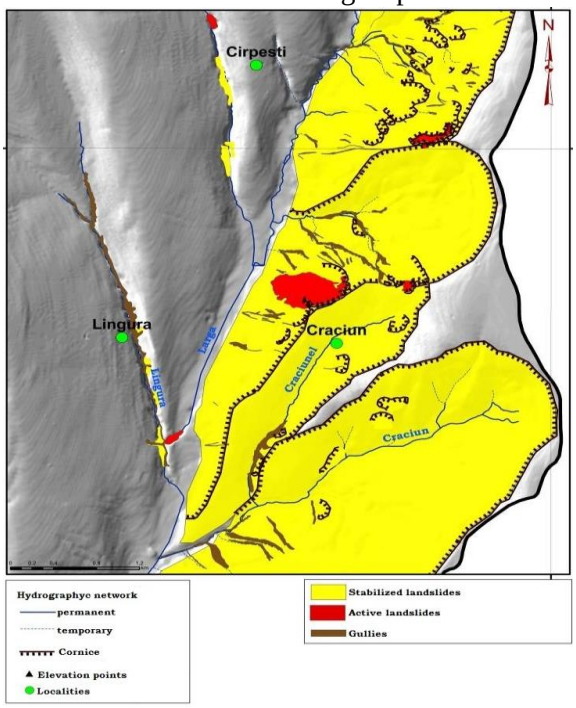

Figure 8: The landslides amphitheatre in the Larga catchment

In the Larga catchment, the landslide amphitheatres were developed only on the left side, with areas from 60 ha to 700 ha, causing the development of other geomorphological processes. Two types of landslide amphitheatres can be separated, simple and complex, depending on the rate of landscape dissection.

However, an encouraging fact is that the most sliding amphitheatres are partially forested, presenting today some balance in terms of development and triggering other processes of land degradation.

Conclusion

The Larga catchment has an area of 146.8 km2 and among the present geomorphological processes, the surface erosion has the highest spatial extension and manifests with different intensities on about 70 % of the whole territory. On cuesta backslopes, the intensity of erosion is low, but on the fronts, with slopes over 15o, there are present areas without vegetation which may lead to excessive high erosion rates. Gully erosion represents one of the most characteristic geomorphological processes for Tigheci Hills, implicitly for the basin of Larga, being identified a number of 141 gullies, out of which 131 are valley-side gullies and only 10 valley-bottom gullies. Gravitational mass movements include first of all landslide, with the most severe consequences regarding terrain degradation and use. The spatial repartition of the surfaces affected by landslides brings out their extension

mainly on the left side of the basin (cuesta scarp) and much more reduced on the right one, which functions as a dip slope.

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