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ПРОСТРАНСТВЕННОЕ РАСПРЕДЕЛЕНИЕ ПОВЕРХНОСТНОЙ ЭРОЗИИ В ПРЕДЕЛАХ ГИДРОГРАФИЧЕСКОГО БАССЕЙНА КУБОЛТА

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SPATIAL DISTRIBUTION OF SURFACE EROSION WITHIN THE LIMITS OF THE CUBOLTA HYDROGRAPHIC BASIN

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АННОТАЦИЯ

Текущий уровень накопленной информации о процессе поверхностной эрозии в пределах гидрографического бассейна Куболта позволяет создать полезную базу данных с использованием Географической информационной системы. Для этого необходимо начать с классификации и характеристики видов эрозии, после этого провести оценку опасности и отграничить поверхности с разной степенью опасности эрозии, а также оценку ее последствий и установление приоритетные технические действия. Критерии классификации эрозии практически унифицированы и используется классификация по степени интенсивности процесса. С точки зрения характера интенсивности этого процесса, в пределах гидрографического бассейна Куболта, мы имеем 3 типа территорий, затронутых процессом поверхностной эрозии. Их описание охватывает ряд аспектов, которые впоследствии станут составной частью создаваемой базы данных.

ABSTRACT

The current level of accumulated information regarding the process of surface erosion within the Cubolta hydrographic basin, makes it possible to create a usable database by use of Geographic Information System. For this purpose, it is necessary to begin with classification and characterization of the types of erosion, after this, to assess the risk and delimitate the surfaces with different degrees of risk of erosion, as well as the assessment of its consequences and the establishment of priority technical actions. The erosion classification criteria are practically unified and the classification according to the degree of intensity of the process is used. From the point of view of the nature of the intensity of this process, within the Cubolta hydrographic basin we have 3 types of areas affected by the surface erosion process. Their description covers a number of aspects, which will later become a component part of the created database.

Ключевые слова: геоморфология, геоморфологические процессы, эрозия, классификация, пространственное распространение, водораздел.

Key words: geomorphology, geomorphological processes, erosion, classification, spatial distribution, watershed.

INTRODUCTION

The hydrographic basin of the Cubolta River is located in the northern part of the Republic of Moldova, occupying a total area of 943 km^2. The geological conditions, relief, climate, hydrography, vegetation and above all the anthropic pressure which are characteristic to this region have led to the development of geomorphological processes on quite extensive surfaces. The most important processes that contribute to land degradation within the basin are specific to the entire territory between the Prut and the Dniester and are represented by surface erosion, gully erosion and landslides. For the identification, mapping and analysis of these processes, topographic maps at a scale of 1:25 000, geological maps at a scale of 1:200 000 and orthophoto planes with a resolution of 0.5 m (2007 edition) were used, using the programs MapInfo 9 and ArcGis 9.3, as well as field observations. The spatial distribution of the geomorphological processes reveals their greater predominance in the upper basin and shows a slight decrease in the lower one, the right slope being the most affected.

From a geomorphological point of view, the Cubolta river basin is divided into two geomorphological units, namely the Northern Moldavian Plateau and the Cubolta Plain.

The relief of the Cubolta basin is characterized by altitudes between 85-280 m, with an average altitude of 221 m. The highest altitudes, namely, those that exceed 250 m, are recorded in the upper part of the basin. Altitudes below 100 m are present even in the lower meadow of the Cubolta river basin. According to the hypsometric map, the altitudes are decreasing from the upper part of the basin to the lower part, without registering altitudinal anomalies (Figure 1).

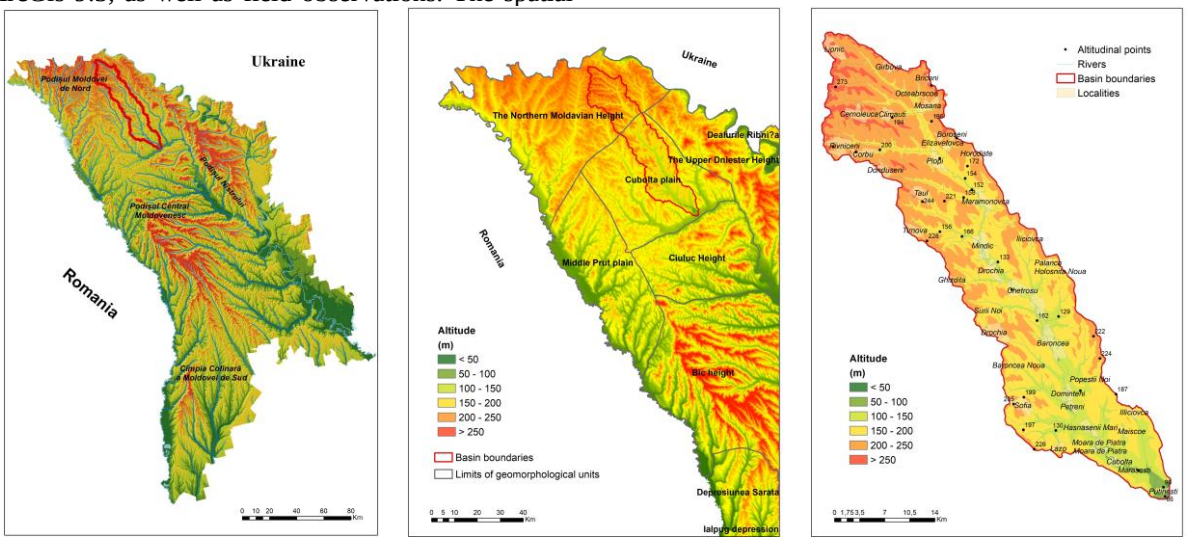

Figure 1. Positioning of the Cubolta basin within the Republic of Moldova

In association with the activity of using natural conditions and resources and planning the space, erosion processes act as geomorphological risk processes, which can bring important damages. However, the degree of risk differs depending on the morphological, morphodynamic and pedological characteristics of the affected surfaces, on the distribution in the territory and the incidence with the various natural and social-economic components of the geographical environment [1, page 38-40].

The negative consequences can have a wide effect: from the degradation of lands located on slopes and occupied with arable land, natural meadows and/or fruit trees (direct negative consequences), to indirect losses (economic losses, negative influences on crop productivity). According to the official data soil productivity decrease by 20% on slightly eroded soils, by 40% on moderately eroded and by 50% on severely eroded soils. Thereby, in the Republic of Moldova weighted average annual harvest losses from eroded lands are: on arable land (431,7 thousand ha) – 27%; on the orchards (1139,6 thousand ha) – 30%; on the pastures (134,4 thousand ha) – 37%.

MATERIALS AND METHODS

Orthophotoplanes (fig. 2, 3) [3] were the initial material for the research, which were supplemented with satellite images [4] necessary to refine the interpretation results. As a result of the interpretation, quantitative indicators of the main elements of the relief and the manifestations of exogenous processes, especially the surface erosion process, were obtained [4]. The use of remote sensing data was supplemented and validated in the field trips. The vectorization (fig. 2) and the visualization of the cartographic data were done using the ArcGIS, MapInfo and Quantum GIS packages. All statistics were calculated using Excel and functions available in ArcTool.

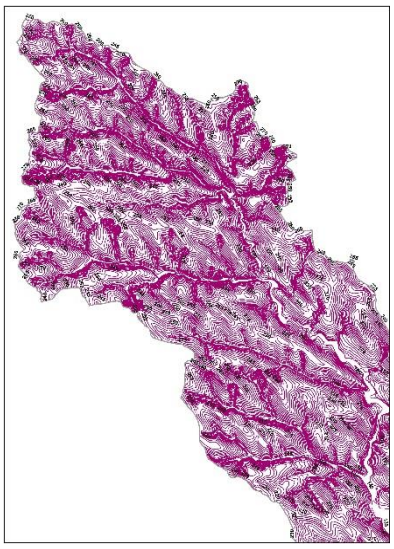

Figure 2. Level curves (scale 1:25 000)

*Figure 3. Orthophotoplane (resolution 0.5*0.5)*

RESULTS AND DISCUSSION

The analysis of the studies of the National Spatial Data Fund, of cartographic materials and orthophoto plans, revealed that 12166.77 ha of land (which constitutes 12.94% of the total area of the basin) are affected by surface erosion (Table 1).

Table 1.

Surface erosion within the Cubolta basin

Erosion classes	Area, ha	Share of the eroded surfaces area, %	Share of the basin area, %
Total basin area	94300,00	--	--
Low eroded	8428,54	69,28	8,97
Moderately eroded	3305,72	27,17	3,52
Highly eroded	432,51	3,55	0,46
Total eroded soils	12166,77	100,00	12,94

Practically, over the entire surface of the basin, a more pronounced spread of weakly and moderately eroded lands is observed, and a greater share of heavily eroded surfaces is recorded in the central part of the basin (Figure 4, 5). Weak erosion, with a share of 8.97% of the total area of the territory, occupies about 8428.54 ha, being followed in descending order by moderate erosion with 3.52% (3305.72 ha) and strong erosion with 0.46% or 432.51 ha (Figure 5).

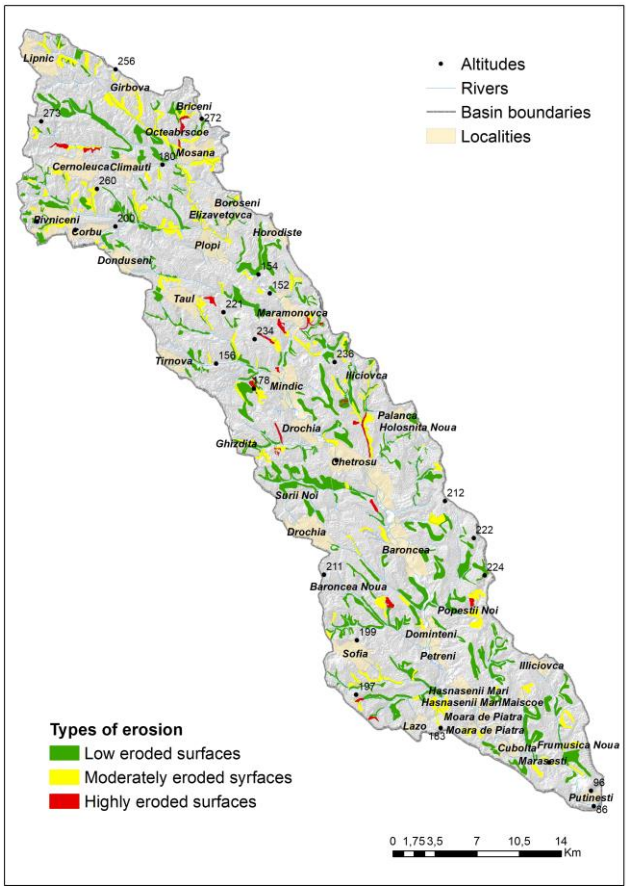

Figure 4. Soil erosion within the Cubolta basin

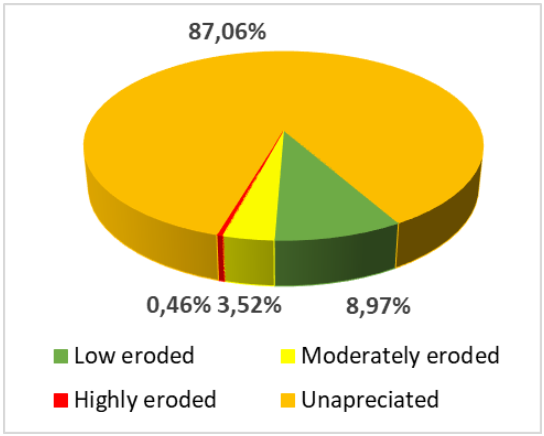

Figure 5. Share of eroded soils within the Cubolta basin

Based on the fact that this process is treated as a geomorphological process, below we will present its spatial distribution on the morphometric characteristics of the relief. Altitude, slope will be taken into consideration.

For the elevation of the relief, the most affected by the surface erosion, are the territories located at altitudes between 150 - 200 m (fig.6). Being followed by the territories located at altitudes of 200 - 250 m and those of 100 - 150 m. lower values are recorded for altitudes of 50 - 100 m and those ≥ 250 m. Zero values represent the altitudinal step < 50 m.

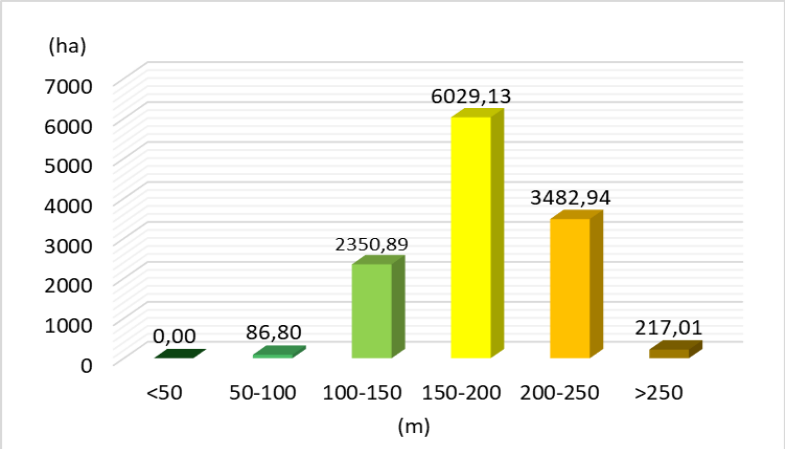

Figure 6. Erosion distribution on altitudinal steps in the Cubolta basin

Figure 7 shows the percentage of erosion classes by altitude category, with the characteristic value of each type of erosion.

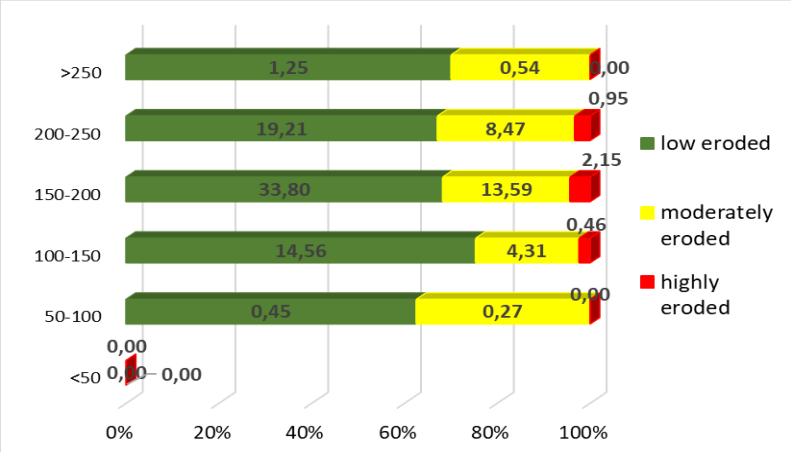

Figure 7. The share of erosion classes by altitude category in the Cubolta basin

According to figure 8, the most eroded surfaces are located on territories with a slope between 2-5° (4672.85 ha), this is probably due to the fact that about 47% of the territory of the basin is characterized by lands with a slope between 2- 5°.

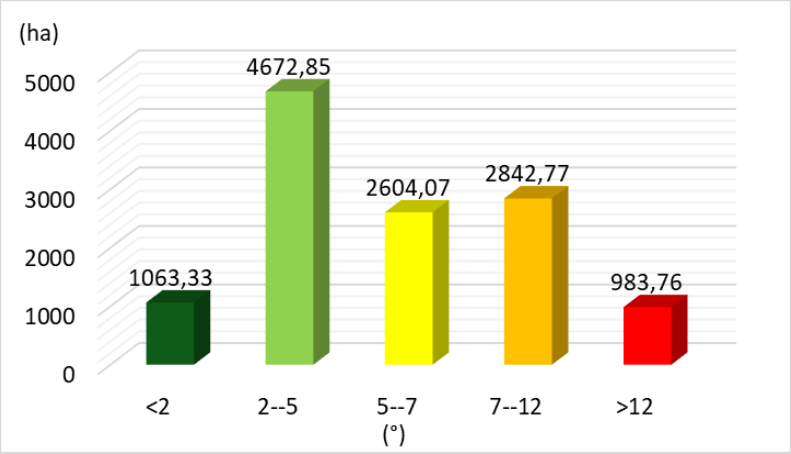

Figure 8. Erosion distribution by slope classes in the Cubolta Basin

The slopes between 5-7° and 7-12° are represented with relatively equal values (2604.07 ha and 2842.77 ha, respectively). Observing figure 9, it is very clear that as the slope increases, the ratio between the erosion classes also begins to change.

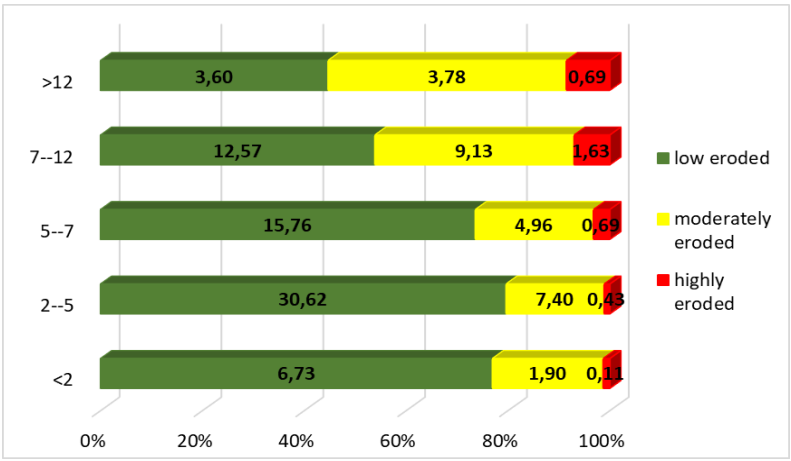

Figure 9. The share of erosion classes by slope category in the Cubolta basin

The surfaces with the class of poorly eroded soils give way and the other two classes of erosion increase. This tells us that the slope has a special role in the development of this process and should not be ignored.

CONCLUSIONS

The spatial distribution of the erosion process on the surface reveals an approximately uniform spread throughout the basin, but after a closer analysis it is

observed that towards the lower part of the basin territories with slightly eroded surfaces predominate.

It was found that about 13% of the total area of the basin is affected by surface erosion, of which about 9% or more than ¾ are slightly eroded soils. Even if the largest areas are occupied by the slightly eroded soils, this does not exclude the fact that in the absence of appropriate development works, all these surfaces will pass into the category of strongly eroded soils.

Knowing the situation with reference to the spatial distribution of this process by classes of slopes and altitude, what is its weight on each class category, we will be able to conclude which surfaces require increased attention in order to carry out works to prevent and combat it.

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