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DIFFERENTIATED CHANGES OF DRAINAGE IN THE BASINS OF THE CIULUC AND CULA RIVERS IN THE 20TH CENTURY

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Abstract. In the content of the article reflects a comparative analysis of the evolution of drainage in two basins: the Ciuluc and Cula rivers in Moldova. Modifications of morphometric differences are caused by the impact of the environment factors in these basins agricultural regime react primarily the structure and apparent density of the soil.. These cause the soil porosity, therefore, pore space is a comprising index of physical change processes showing certain dependencies on the impact upon soil. In case of conventional agricultural soil working systems, based on ploughing, the physical degradation processes (compaction. dismantling) have major ratios and lead to the constitution of a faulty pore space in soil, which affects the processes of reproducing the chernozems type of pedogenesis. The alternative (conservative) tillage systems diminish the stratification, reduce soil profile stratification and ensure the stability as well as the continuity of pore space. During the whole year, the optimal conditions for ecosystem functioning and reproduction of soil type chernozem soil formation are created.

Evolution of river basins is a result of interactions between the regime of matter and energy flows entering and moving beyond them, and the resistance of surface topography. The basins characterization in the second half of the twentieth century, along with traditional parameters, includes the morphometric elements of these geographic systems through the studies effectuated by R. Horton (1945), A. Strahler (1952), S. Schumm (1956) V. Filosofov (1959), M. Rjaniţân (1960), A. Scheidegger (1965), I. Zavoianu (1978), M. Маккaveev (1987), I. Simonov (1985), I. Covaliciuc (1995, 1997), etc.

As objects of geographical research served the hydrographic networks and the basins of Ciuluc and Cula rivers, including all the torrents, ravines and river beds up to the confluence with Raut river, reflected on topographical maps at 1:100.000 scale that characterize the years 1913 and 1986. The volume of study includes network and watershed mapping of different directions, according to Horton-

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Strahler ranking system, achieving the creation of a database of measurements and morphometry characterization of these basins in comparison with Horton's laws (I. Codreanu, 2005).

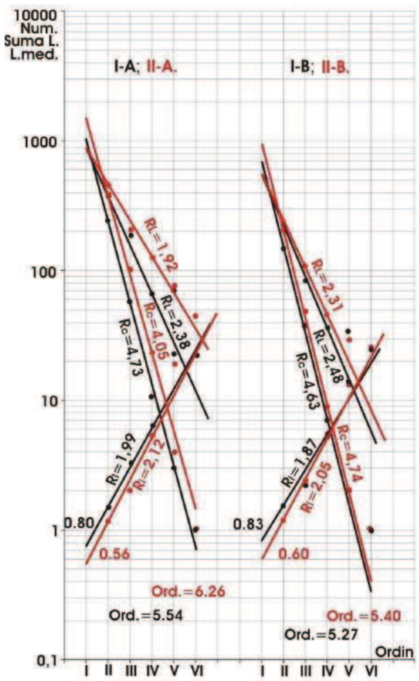

Fig.1 - Morphometric model of the drainage for rivers: A - Ciuluc; B - Cula. (between 1913-1986)

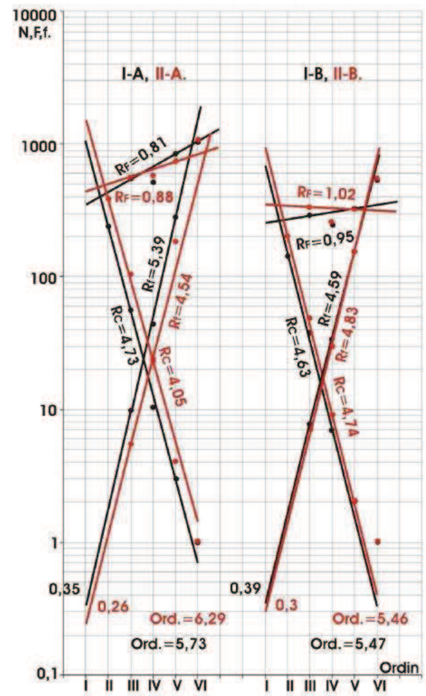

Fig.2 - Morphometric model of the basin area drainage between 1913-1986: A - Ciuluc; B - Cula

Therefore, to track trends of change in morphometric parameters from the Ciuluc and Cula rivers for almost a century, were superimposed on the same logarithmic scale both obtained values for drainage patterns from 1913, and those obtained in the 1986 year. (fig. 1 A and B).

For Ciuluc River (fig. 1 A) was realized a proportionate increase in the number of segments of rivers and a movement to the right, as confirmed by the state laws of number lines, almost parallel. A space movement, but with a smaller distance for the same right, is witnessed for Cula River (fig.1, B).

For Ciuluc River, the summed length achieved a significant increase with increasing order size, while the average lengths resulted in a lower growth rates with decreasing trend toward approaching the upper lot. The same morphometric parameters of the models of the Cula River have suffered slight changes. For example, the summed lengths of the lower rates of both phases are almost equal, and only slow growth with a tendency towards higher rates. The law of the average length shows a particular position, a move that highlights the line in opposite directions, crossing to the right of 1913 year. In this case we find a clear decrease in the average lengths determined for the lower orders (Ciuluc: from 0.80 km to 0.56 km Cula: from 0.83 km to 0.60 km) and a very small increase for higher orders. Calculations have showed changes of the order of magnitude of the river during this time. Thus, if this value was 5.54 for Ciuluc, by the 1986 year it was 6.26, and respectively Cula rose from 5.27 to 5.40.

In order to follow trends over time and space evolution of morphometric parameters characterizing the surface of drainage basin in increasing sequence, of Ciuluc and Cula basins for almost a century, were represented in the same logarithmic scale as the determined values for model drainage in 1913, as well as those obtained for 1986 (fig. 2, A and B). Thus, being analyzed these sizes; we can draw the following conclusions:

1. In the morphometric model characterizing Ciuluc river (fig. 2, A), we see a movement to the right of the system at the end of the 20^{th} century (II-A) in comparison with that from its beginning (I-A). The situation is determined both by the emergence of new lower order basins, predominantly in the area of origin, as well as a proportional redistribution of areas to the higher orders, which also eventually led to an increase of the whole system for about a century. Those related are confirmed both by the right that defines the law of summed up areas, with a tendency to decrease in geometric progression, as the right that defines the low of middle areas. The latter, although we demonstrated a reduction in the average area required for the apparition of basins of the first order from 0.35 km^2 to 0.26 km^2, during the time shows a growing trend more evident in proportion to the average surface increasing the size of orders.

A specific situation is found analyzing the morphometric model of the Cula River basin (fig. 2, I-B and II-B), which highlights the evolution of the system in time and space. The emergence of not very large basins of first order, for a century increased the sum of orders lower surfaces with geometric progression downward trend that they represent. This situation is confirmed by law surface environments, factual and right that shows a more modest reduction of the surface necessary for basins apparition on the first order from 0.39 km^2 to 0.30 km^2, while the higher orders associated with the reduction in area, even to decrease the value of achieving the basin of 5.47 in 1913 to 5.46 by 1986. The specific reaction of the studied basin is determined by environmental factors which maintain a relative balance system. A proof is the fact that the first order basins have not occurred in the area of origin, but predominantly in the watershed area of higher orders, which did not allow making changes according to the ranking system applied.

Researches conducted on the basis of hydrographic networks and basins till now have not used mathematical methods which would allow quantitative assessment of the environmental factors that define their individuality. The interaction of variables that characterize the basins' individuality requires a backlash against the system that actually depends on the strength of the topographic surface opposite to the action of external agents.

In international practice are known examples of basins research depending on some separate factors. Thus, in some cases the basins, especially those with outstanding sizes, are investigated in terms of climate and tectonic conditions (Симонова Т., 1992), including dependence on geology and human impact (Ковальчук И., Волос С ., Холодько Л., 1992; Ковальчук И., 1995; Курбанова Т., 1996, etc.). They also conducted extensive studies on the formation of Ialomita Basin drainage network in the spectrum of interaction of environmental factors and morphometric elements (I. Zavoianu, 1978).

Analysis of morphometric indices characterizing Ciuluc River drainage highlights a differentiated reaction system as a result of environmental conditions. Thus, for a century Ciuluc Basin has accumulated 147 second-order segments, with a reduction of 0.41 km length of their average, and their respective surfaces, with 0.71 km^2. By calculation was determined that the basin has accumulated 424 first-order segments, with a reduction of 0.24 km of them, and the related areas of 0.09 km^2. The plateau on which has developed this basin is fragmented by wide valleys, with asymmetrical slopes, fragmented by ravines and bumpy. River's slopes are small in both cases, with values between 2.5 and 2.7, with slope angles of 2-6^0. One of the important factors that determined the essential differences in changes in this area is the lithological one. Thus, linear erosion in the basin is enhanced by the presence of clays and only on narrow interfluves are present alternations of sands and clays of the same age.

If you look at smaller basins of Ciuluc (I. Codreanu, 2005), it is noted that most segments have occurred in the river basins of origin Ciuluc Mic and Mijlociu, which can be explained by their oval shape. The smallest changes took place in Ciuluc Mare, which has a pronounced elongated shape. Many of the new segments were formed on the slopes directly related beds order IV and V.

A certain role in these changes is the amount of precipitation from the 20th century. In these basins, rainfall is lower in comparison with that of the basins of the Nistru and Codri Tablelands. Soils are predominantly clay-loam texture, and the forest area increased slightly in both cases. As in other cases we examined, we cannot consider important the role of tectonic factor, because the slow lifting currently makes up only +2 +4 mm / year.

At the same time in the Ciuluc River basin human impact has increased, confirmed by the massive expansion of agricultural land that at the end of last century made up 75-90% of the total area. In the structure of agricultural land dominates arable land, and in agricultural cultures dominates grain and hoes. Forests and natural grassland areas are very rare. The morphology of river beds was changed, still in the 60s of last century. These works were carried out in order to extend agricultural land on account of natural areas.

Cula River Basin shows a slower response of the drainage system to the influence of erosion processes, accumulating for a century only 52 second order segments, reducing the average length with 0.34 km and average drainage area with 0.37 km^2, a fact confirmed by the insignificant increase of the order of magnitude of the basin from 5.27 to 5.4. The calculation method determined that this basin has accumulated only 262 first-order segments, reducing the average length with 0.23 km and the average drainage area with 0.09 km^2.

At the first view the high energy plateau in this basin, deep valleys, alternations of sand and clay, would have to make the appearance of a greater number of river segments, with major changes of the lengths and areas. In fact almost all the new segments are points of confluence with upper and lower orders in the area of origin, which has not increased the size of the order of Horton-Strahler classification system. These factors have a higher amount of precipitation, in comparison with other basins investigated in this study, and again the role of tectonic movements of lifting the minimum values only 4 mm / year.

However, in this basin we find the highest degree of forest cover (10.80%), although the forest areas in the twentieth century were reduced with 3.20%. Relatively higher degree of forest cover, lower recovery (70-85% of the basin surface), high share of grassland areas and multi-plant, as well as the presence of clays and sands on narrow interfluves of Superior Miocen reduced the intensity of erosion processes and formation of new segments of rivers.

The presence on the southern interfluve of a variety of gray forest soils and sandy loamy texture decreased erosion processes, unlike the northern interfluve, where clay and clay-textured soils have contributed in some degree to the formation of new segments of the river. The slope of river beds has high values, which confirms the ratio of slopes equal to 3.10, this increasing in Sarmatian clays.

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