

RESEARCH ON THE TECHNICAL EFFICIENCY OF ANTI-EROSION WORKS IN THE IZVORU BERHECIULUI HYDRO-AMELIORATION SYSTEM

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Abstract

This paper presents the evolution after 1990 as well as the current state of some measures and anti-erosion works related to the agricultural land within the hydro-improvement system of Izvoru Berheciului. The surface corresponding to the hydroameliorating system Izvoru Berheciului is about 600 km² and has over 75% sloped fields that occupy the hydrographic basins of Drobotfor and Berheci. The high intensity of the erosion process by water in this area required the execution of several different anti-erosion works in the above-mentioned hydrographic watershed, which considerably slowed the soil degradation, the inundation and the clogging of the depression zones as well as the deterioration of the environment. The best technical efficiency among the management systems was in the forestry works and the anti-erosion hydrotechnical works. The works on slopes for the prevention and control of surface erosion were mostly destroyed by the impact of the application of Law 18. The data obtained highlight the need to revive anti-erosion activities for the conservation of soil production capacity on slopes and the efficient use of land in the reference area.

Key words: soil erosion control, cambic chernozem, moisture content, wetting contour

Research on issues related to the technical efficiency of anti-erosion works applied on land in areas affected by erosion serves to assess the quality of design, execution and operation of works, improve their maintenance and improve the solutions adopted for future development.

The Izvoru Berheciului hydro-amelioration system in Bacău County manages the land improvement works on approximately 600 km², which are included in the Drobotfor, Zeletin, Apa Neagră, Pereschiv and Berheci river basins, which cover 878 km² in Bacău County. From a physical-geographical point of view, the territory of the hydro-improvement system Izvorul Berheciului is part of the Tutovei Hills - subunit of the Moldavian Plateau.

In the area where this hydro-amelioration system works, natural factors and reckless anthropogenic activities have favored the initiation and intensification of soil erosion so that the vast majority of land improvement works here are works to prevent and control erosion processes.

The concerns of the system personnel for restricting erosion within tolerable limits are justified both in order to preserve and restore the production capacity of the soils on the slopes and to protect other components of the environment,

including eliminating the danger of torrential floods.

MATERIAL AND METHOD

The paper was elaborated benefiting from the data kindly provided by the Directorate for Agriculture Bacău, the Territorial Branch of Land Improvements Bacău and the Communal Agricultural Chambers within the system as well as based on detailed studies and observations carried out in the field by the authors. The topographic maps (sc. 1: 50.000; 1: 100.000) and the soil map (sc. 1: 200.000) of the area where the Izvoru Berheciului hydro-amelioration system is located were also used.

RESULTS AND DISCUSSIONS

The relief of the Izvoru Berheciului hydro-amelioration system is individualized by long interfluvial peaks, oriented north-south and separated by a consistently dominant hydrographic network. The heights of the peaks are higher in the north, where the absolute altitudes have values that frequently exceed 400 m and in some places even 500 m (Dealul Doroșanu - 562 m) and lower to the south, up to around 250 m.

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The density of the relief fragmentation is mostly of the territory higher than 1.2, the lower values (between 1.0-1.2) of the relief rhythm being characteristic for the southern part of the area as well as at the source of the Zeletin.

The depth of the fragmentation of the relief generally exceeds 200 m and in the upper sectors of the Berheci, Drobotfor and Zeletin basins the relief amplitude exceeds 300 m.

The map of the slopes highlights in the 5 river basins the dominance of values higher than 15% and those located between 5-15%. *Table 1* shows that 93.5% of the territory has slopes that exceed 5%, the highest percentages (100 and 96.7 respectively) being in the Apa Neagră and Drobotfor basins, areas where slopes greater than 15% also represent percentage values. superior to those in neighboring basins.

From the presented results that the particularities of the relief from the Izvoru Berheciului hydro-amelioration system are very favorable to the erosion processes.

Table 1

Situation of areas by slope categories in the river basins Izvoru Berheciului hydro-amelioration system

River basin	Area (km ²)	Surfaces with slopes					
		< 5 %		5 - 15 %		> 15 %	
		km ²	%	km ²	%	km ²	%
Drobotfor	90	3	3.3	37	41.1	50	55.6
Zeletin	250	20	8	95	38.0	135	54
Apa Neagră	22	-	-	7	31.8	15	68.2
Pereschiv	73	8	11	48	65.8	17	23.2
Berheci	443	26	5.9	213	48.1	204	46
Total	878	57	6.5	400	45.6	421	47.9

The soils that predominate in the researched area are characterized by a low resistance to erosion. From the soil map (*figure 2*) it results that the largest surfaces are occupied by eroded gray soils and erodosols (CN / e / 1; CN / e / 2), eroded brown luvic (podzolic) soils, eroded argillaceous clays and erodisols (BP / e / 1; BP / e / 2), as well as undeveloped or truncated soils, among which erodisols and / or regosols (ER) predominate.

Spontaneous woody vegetation - with the greatest influence on slowing down the processes of soil degradation on the slopes covers only a small area of the researched territory and meadows are dominated by grasslands with grass in most cases degraded. From the group of cultivated plants, the ones that provide the soil with a weak anti-erosion protection predominate on the largest surface.

The evolution of erosion processes in the area is decisively influenced by rainfall. The territorial distribution of precipitation reveals appreciable differences between the average annual quantities (Vaslui - 588 mm; Bacău - 544.3 mm; Găiceana - 441.9 mm; Podu-Turcului - 395

mm). Although the annual values of this climatic element are small, the non-uniformity of the rainfall regime plays the main role in producing runoff and erosion on the slopes and torrential valleys of the Izvoru Berheciului hydro-amelioration system. Most precipitations (60 - 70%) fall in the hot season, usually with the character of showers and the maximum values in 24 hours are around 70 mm for the 10% insurance and exceed 80 mm for the 5% insurance. The uneven rainfall regime, with many torrential precipitations causes in the conditions of geological composition dominated by sands, of the preponderance of soils with high erodibility, of the relief with high slopes and of the poorly represented protective vegetation on most slopes, intense processes of soil washing and floods on hydrographic network exceeding 40 - 60 m³/s, alternating with flows close to zero, characteristic of dry periods.

The high potential for water erosion has required the application of measures and works to protect the slopes and torrential valleys on the territory of the system and to reduce the effects of torrential floods.

The works, applied since 1967, on river basins or at least on the entire surface of some slopes were preceded by the restructuring and relocation of some uses and by the anti-erosion organization of each category of use.

As a result, on more than 95% of the sloping arable land, agricultural work has been carried out along contours and strip farming systems with grassy strips and terraces have been extended to all farms. Along with land improvement specialists, an important contribution in this regard was made by agronomists who practiced anti-erosion cultivation systems, associating them with the whole complex of measures and agrophytotechnical works that characterize the improved cultivation technologies.

Execution of soil works along contours on almost the entire sloping arable land as well as the application of strip cultivation systems, with grassy strips and terraces on about 15,000 ha (mostly arable land) has proven its technical efficiency over time. by gradually reducing runoff while increasing the amount of water infiltrated into the soil, reducing soil losses and fertilizers and reducing flooding in torrential valleys during heavy rains. As a result, the fertility of the soils on the slopes has entered a process of improvement and agricultural production has begun to increase.

It is mentioned that within the Izvoru Berheciului hydro-amelioration system, the anti-erosion works were carried out in stages and on hydrographic basins, priority being given to the

arrangement of the slopes. The Drobotfor river basin was first developed, in the period 1968-1973, followed by the Apa Neagră-Frumușelu basin (1972 - 1975), the Zeletin basin (1974-1976) and after 1976 the Pereschiv and Berheci river basins.

After 45 - 50 years from the commissioning, the technical efficiency of the anti-erosion arrangements applied in the system differs especially depending on the location of the works, their type and their vulnerability to anthropogenic aggression and the interconditioning of natural factors.

Studies and observations carried out in the field allow us to find that the arrangements on the slopes have been, over time, more severely affected, compared to the works in torrential riverbeds and ravines due, in particular, to the faulty application of the Land Law no. 18/1991 (law by which the reconstitution of the right of private property over the lands was carried out), without observing the control requirements of the soil erosion. On the land surfaces that were not affected by the provisions of Law 18 as well as on those on which the application of the Law was made rationally, antierosion culture systems were preserved (*figure 1*).



Figure 1 In Motoseni there are areas where anti-erosion planning works are still properly preserved and exploited

Unchanged maintaining of the locations of the grassy strips and lanes for several years favored the reduction of the general slope of the slopes and the formation of agroterases. Agroterases were also formed on the slopes equipped with bench terraces, by increasing over time the height of the slope. On these lands, simultaneously with the reduction of runoff and erosion, the hydrological regime of the soil was improved and the conditions for mechanized execution of agricultural works were improved. Due to the improper application of the Land Fund Law, the sloping arable land in the Izvoru Berheciului hydro-amelioration system was mostly fragmented into a lot of rectangular plots, located with the long side on the line of the highest slope. Under such conditions, plowing and other agricultural works are carried out on these areas from the hill to the valley and consequently the

erosion is accelerated. Some of these small properties, generally below 1-2 ha, cross terrace slopes, previously executed on arable land (*figure 2*) or in the former vineyards and orchards or are scattered in pasture massifs affected by erosion and landslides (*figure 3*).

The danger of intensifying the soil erosion process on the slopes with arable land is amplified by the fact that in the structure of crops, weeds (especially corn) occupy over 80% of the surface (*figure 4*).



Figure 2 Properties that cross terrace slopes



Figure 3 Agricultural land properties scattered in pasture massifs affected by erosion and landslides

The protective forest plantations established in the Izvoru Berheciului hydro-amelioration system have progressively manifested their efficiency, with the increase of the age of the trees and the consistency of the forest. By retaining increasing volumes of water on the canopy of trees, in the litter layer and in the soil under the forest loosened by tree roots, surface runoff and erosion have been gradually reduced so that it is now estimated that under these plantations, with the age of the trees in the different plots between 25 and 50 years, the soil losses fall within tolerable limits.

Properly applied care works, security and safety permanently ensured to the forested perimeters as well as the rational exploitation of the wood mass by regeneration cuts executed in stages by the Territorial Branch of Land Improvements Bacău (*figure 4*) made the anti-erosion effect of the plantations to be completed with high economic efficiency. The social aspect of the plantations should not be neglected, as they are the only source of firewood for the population in the area.

The transversal hydrotechnical constructions made of concrete and earth have survived very well during the 32-59 years of existence, contributing to the attenuation of floods, the reduction of the solid flow and to the stability of the riverbeds and the adjacent slopes (*figure 5*).



Figure 4 **Forest plantations after regeneration pruning**

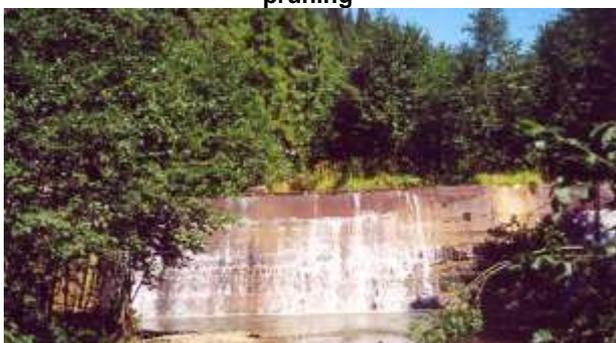


Figure 5 **Concrete dam with the landing formed on the Valea Neagră brook**

The heavy-duty concrete embers, initially made, were later replaced with dams with a flared foundation and filter dams, which are more flexible and have a 30-40% lower concrete consumption.

The dimensions of the overflows allowed the proper functioning of the dams for all floods produced. No transverse work was decommissioned, the energy dissipators worked normally removing the danger of leaking works and the alluvium deposits from landings, which in most cases reached the ridge of the spillway are mostly occupied by forest vegetation.

CONCLUSIONS

1. The orographic, edaphic and climatic conditions on the territory of the Izvoru Berheciului hydro-amelioration system and the reckless anthropic interventions in the natural environment of the area are favorable for the manifestation of water erosion processes with intensity above the tolerable limits on 93.5% of the surface.

2. The replacement of most of the slopes in the river basins that make up the Izvoru Berheciului hydro-amelioration system of anti-erosion cultivation systems with the execution of

agrotechnical works on the highest slope line, as a result of the defective application of the Land Fund Law, contributes to the decommissioning of some anti-erosion arrangements, accelerated erosion and insidious degradation of soil production capacity and environmental quality.

3. Incentive agriculture and the preservation of the local geographical landscape require incentives for owners of sloping agricultural land to apply anti-erosion agrotechnics, restore special degraded anti-erosion work and promote a persuasive policy of civic education in support of care and respect for the quality of the environment.

4. The anti-erosion works with the locations on the inclined surfaces that were not the object of the Land Fund Law or on the lands where the possession was judged, the hydrotechnical construction works on the ravines and torrential valleys as well as the anti-erosion protection forest plantations within the Izvoru Berheciului system good physics and expresses a high technical efficiency which attests that they have been rationally designed, executed correctly and properly maintained.

5. The careful maintenance of the forest plantations of anti-erosion protection and their exploitation through regeneration cuts carried out in stages satisfies both the criteria of technical-ameliorating efficiency and the requirements of the population in the area for the provision of firewood.

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