

REHABILITATION AND MODERNIZATION OF SOIL EROSION CONTROL WORKS IN IZVORU BERHECIULUI CATCHMENT

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Abstract

The research on the technical efficiency of the soil erosion control works applied on the lands in the areas affected by erosion serves to assess the quality of the design, execution and operation of the works, to improve their maintenance and to improve the solutions adopted for future development. The area and the intensity of the manifestation of the soil degradation processes encountered in the studied area determine damages by diminishing the agricultural surface and crop losses. The analysis carried out in the territory highlights the fact that on these lands it is necessary to intervene urgently in order to diminish within acceptable limits the manifestations of the degradation processes. In order to increase the effectiveness of the soil erosion control works, it is considered necessary to repair and modernize the existing works - received and taken over by the National Agency for Land Improvements Bacau - over time as well as their completion with new ones. The negative impact in case of non-performance of the proposed works consists in maintaining the current system of practicing an empirical agrotechnics on a random structure of agricultural crops with negative effects on the economy of the area, soil conservation, environmental protection and life quality.

Key words: slope lands, torrential rains, soil erosion control, crop yields, environment quality

Erosion causes changes in soil properties, contributes to reduced agricultural production, causes difficulties in the exploitation of agricultural land, worsens the water supply of springs and rivers and endangers the accumulation routes and human settlements (Bucur D., 2016; Xiong M. *et al*, 2018).

Reduced soil fertility by erosion results in low yields on eroded sloping land. It is known that the smallest crops are obtained in our country in counties that have large areas of sloping land (Ioniță I. *et al*, 2015). The results obtained in our country and abroad in connection with the productions obtained on the eroded lands lead to the formulation of the following. Yields crop decreases without exception in all crops as the horizon of humus accumulation has been eroded (Mahbulul A, 2018). Once complete erosion of the humus accumulation horizon, production depends on the thickness of the humus accumulation horizon formed on account of the lower horizons brought up to date by erosion, as well as on the properties of these horizons (Gao J. *et al*, 2017). When the erosion has reached the bedrock, the production is related to the properties of the rock (Pedro V.G. *et al*, 2019).

What is characteristic of eroded soils, regardless of the agrotechnical methods used, is the uncertainty of production from one year to another, all depending on the distribution of rainfall (Chen Z. *et al*, 2019). This is especially true in the steppe and forest-steppe regions (Makaya N. *et al*, 2019) In these regions, tillage can help to accumulate water in the soil (Smetanová Anna *et al*, 2019).

The main purpose of the work is to inventory and analyze the technical efficiency of soil erosion control works. Based on the assessment of the physical condition of the works, recommendations were made regarding the rehabilitation of the degraded ones. New works have been proposed to maintain soil losses through erosion at tolerable values.

MATERIAL AND METHOD

For the realization of the project were used topographic plans at a scale of 1: 5,000 and orthophoto plans made in 1970, 2005, 2009 and 2012.

The data necessary to assess the technical efficiency of the anti-erosion measures and works, the way of exploiting the agricultural lands both in terms of use and exploitation were taken from the discussions with the specialists from the

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agricultural chambers and those from the Izvorul Berheciului hydro-improvement system, but also with the farmers in the area.

The processing of data entered on plans and orthophotos as well as those taken from the field were analyzed, studied and interpreted in the laboratory.

Finally, it was prepared for the final material containing proposals for the rational use of land, including in terms of use categories, assortment of cultivated plants and measures and works to ensure the conservation of soil fertility and the environment as a whole.

RESULTS AND DISCUSSIONS

At present, given the importance of land improvement works in terms of quality of life, water, environment, the decisive role of these works in the social and economic development of society, it is necessary to carry out extensive investment works in the context of the emergence of new technologies, less energy consuming and environmentally friendly.

The current context, generated by the COVID-19 pandemic crisis, has affected, like the other branches of our country's economy, the activity of land improvements.

First of all, affecting the food security of the population through the limitations brought to the process of vegetal and animal production.

The health crisis imposes strict rules on staff in charge of operating the systems, which prevents the operational and timely conduct of seasonal operations.

At the same time, it involves the use of a certain staff structure that is affected as little as possible by the pandemic crisis, including a differentiated and sometimes reduced work schedule, including by age categories.

The use of protective equipment limits the efficiency and efficiency of the working personnel causing discomfort in the production process. Communication is also less easy.

The productions in the area are below the agricultural potential in areas that are pedologically favorable and that recommend agricultural crops in stable lands and with the pedological horizon A as consistent as possible and rich in organic matter.

Currently, the lands affected by erosion present in different degrees of manifestation, deep erosion, landslides, excess moisture, as well as torrential processes reduce the possibility of practicing a superior agrotechnics, an optimal structure of agricultural land uses, fragmenting arable land on which practices mechanized agriculture as well as issues related to damage caused to some peasant households; soil losses

above the permissible limit of 6 t / ha / year; existing degradation with an adverse impact on the ecology of the area and currently affected by degradation processes.

The works for soil erosion control under the administration of ANIF - Bacau Territorial Land Improvement Branch, in the Berheci river basin, include a set of works carried out in two stages, the first during 1976-1979 and the second, with completion works during 1982-1984, with the main purpose of combating surface and deep erosion, regularizing runoff on slopes and restoring in the agricultural circuit of marshy lands in lowland areas.

After about 43 years of operation, the existing landscaping works present a differentiated technical and functional state in terms of their structural integrity, stability and functional role in ensuring the maintenance of surface soil erosion within acceptable parameters, prevention of deep erosion, elimination excess surface moisture and avoidance of damage to other socio-economic objectives.

At the same time, the marginal channels to the technological connecting roads, which were generally reinforced with concrete walls, suffered serious damage by destroying and dislocating the concrete wall from the site, with the reduction or even disappearance of the drainage section.

All the evacuation channels are clogged, more strongly, with percentages between 60% and 90% of the surface of the section, those of the earth biologically consolidated by grassing.

At the same time, on appreciable lengths, the drainage sections of the escape channels are invaded by woody vegetation, generally naturally installed shrubs.

- The collection - discharge channels are clogged in a proportion of 70 - 90% of the surface of the cross section, being practically permanently decommissioned.

- The catchments of the springs, present the catchment chambers as well as the degraded discharges, strong clogging of the adjacent chambers and drains, two of them being taken out of operation.

Ground dams and forced slopes generally have an unsatisfactory state of their earthworks, especially on the downstream slopes where there are intense erosion phenomena with runoff, landslides, subsidence and subsidence due to runoff over the canopy and adjacent area and affecting their structural integrity.

The overflows at the earth dams show damage, caused by their undersizing, which caused the earth to wash under the consolidations on the

slopes, leading to the suspension and cracking of the wall.

Protective forest plantations, due to their calamity in dry years, especially in the first years until reaching the state of massif, but especially the negative intervention of the anthropogenic factor through grazing and illegal logging, show degradation and destruction on areas between 10% and 60 % of the total plantation area.

1. The positive effect predicted by the realization of the investment works

The influence of land improvement works on the entire biotope and adjacent ecosystems can be defined as particularly beneficial, especially in the current climate context, when major changes in fundamental components (thermal and rainfall) dictate a much broader approach to environmental degradation surrounding.

The National Recovery and Resilience Program is the answer to these natural and anthropogenic challenges. In addition, the non-adaptation to the new environmental conditions will generate other types of disadvantages that are difficult to predict at present. In the context in which the alternation of extreme meteorological phenomena (major hydrological events followed by long periods of hydrological and pedological drought) tends to become the main climatic feature on temperate continental areas to which agriculture must adapt and the support provided by land improvement arrangements.

An additional cause that favored the degradation of agricultural lands in the area is the high intensity of rains in the conditions of intensified climatic aggression and higher frequency of recent hydrological events, the degradation processes encountered intensifying over time, having as an immediate consequence of the irreversible loss of agricultural land at the base of the slippery slopes or in the existing river network.

The achievement of the investment objective is aimed at:

- the increase of agricultural productions by introducing in the economic circuit some additional values resulting from the capitalization of the productions on the market, the stabilization of the prices and contributions to the establishment of the stock exchange of agricultural products;

- the conservation of fertile soils and the increase of agricultural yields over a foreseeable time horizon of fifty years;

- avoiding the clogging of the country's hydrographic network and the accumulation lakes with sediments produced on the slopes and in the torrential network;

- protection of the country's critical infrastructures as defined by government emergency ordinance (GEO) 98/2010;

- spontaneous merging of agricultural lands and the establishment of large, profitable farms by setting up organizations / federations;

- stable jobs during the execution, in operation, the overall development of the areas bordering the canal;

- avoiding soil degradation by practicing superior agrotechnics and adopting a correct crop structure;

- socio-economic development of the area by increasing animal production, the emergence and development of small local food-specific industry.

2. Modernization, completion, efficiency, extension works

Considering the long operation interval as well as the current physical condition, it is considered absolutely necessary to intervene in the objectives listed in table 1.

In order to increase the soil erosion control efficiency, the behavior of the existing works was analyzed, based on which the need for the following new works was established:

- extension of protection plantations with anti-erosion role (willow, willow, mojdrean, acacia, sea buckthorn, rosehip, energy willow).

- risberme, energy disipator in raw / broken stone;

- Concrete dams and sills.

The total estimated value of the investment, determined on the basis of the existing costs in similar works and the projected execution quantities, is eur 24652449 including VAT.

3. Peculiarities of the proposed location for the achievement of the investment objective

From an administrative point of view, the works to combat soil erosion existing in the Berheci river basin, with a total area of 28106 ha, are located in the eastern part of the county, on the territory of Filipeni, Izvorul Berheciului, Oncești, Vultureni, Dealu Morii, Găiceana, Parincea, Glăvănești and Podu Turcului.

The length orientation of the Berheci river basin is approximately north-south, with a considerable length of 54.0 km, compared to the average width of about 10.1 km.

From upstream to downstream, within it are located the localities Izvoru Berheciului, Oncești, Filipeni, Vultureni, Dealu Morii, Găiceana, N-V, Parincea, S-E Glăvănești and Podu Turcului, the last three with small areas.

Table 1

The physical and value centralizer of the proposed works

Object name	Quantity	Unit price	Value without VAT (euro)
Modernisation works			
Concrete dam and sills Leading walls Energy dissipator Get rid of the rocks	59 pieces	60000	3540000
Cassette and tubular bridges	350 pieces	20000	7000000
Exhaust channels made of stone masonry Hydrotechnical works on drainage channels - concrete falls	115 km	16100	1851500
Grassed channels	15.3 km	10900	166661
Forced slopes - fast concrete channels	3.34 km	15100	50434
Intercepting drainage for collecting seep areas	15 buc	1600	24000
Plastic drains	13.5 km	10900	151946
Drains inspection chamber	19 buc	500	9500
Secondary operating roads	373 km	1900	708700
Consolidation of operating roads	10 km	20000	200000
Marginal channels to exploitation roads	8.68 km	8100	70308
Marginal channel hydrotechnical works (calming chambers, falls, reinforcement sleepers, channel head spurs)	50 pieces	10500	525000
Systematization of runoff from slopes - grassed channels, sloping channels, falls on channels	45 pieces	8500	382500
Proposed new works			
Anti-erosion protection plantations (willow, acacia)	500 ha	3800	1900000
Earth dams	10 pieces	70000	700000
Concrete dams	5 pieces	60000	300000
Grassed channels Concrete falls on canals	50 pieces	8500	425000
Secondary operating roads (on the direction of the contour lines)	100 km	2500	250000
Plastic drains	25 km	12900	272500
Leveling, modeling, uniformity in continuous planes	150 ha	300	45000
Cassette and tubular bridges	80 pieces	20000	1600000

From a hydrographic point of view, it is located in the upper basin of the river Berheci, arrangement code 454:

- to the North - BH Tutova
- to the East - BH Zeletin
- to the South - border with Vrancea county.
- to the West - BH Polocin and Racatau.

The connection with the county center is made by DN 11A Adjud - Podu Turcului in the southern part of the basin, or on the north side by DN 241 Bacau - Podu Turcului.

There are no permanent sources of pollution in the studied area.

The plateau area represented by the Bârlad Plateau, with the Tutovei Hills subunit.

It is crossed from N to S by the Berheci brook with a length of about 66 km.

The neighboring villages have a good technical and municipal network, being able to ensure the connection of the future construction site to the existing utilities.

In the location area there are no municipal networks that would require relocation / protection, no servitude obligations and no constructive conditioning.

4. Brief description of the proposed investment objective, from a technical and functional point of view

The proposed works aim to reduce the effects of the phenomena of agricultural land degradation in the studied area and to give an

economic value to the lands that have become non-agricultural through the action of these phenomena.

The proposed layout includes:

1. Works for the soil erosion control arrangement of the territory and the regularization of the runoffs on the slopes:

- redevelopment of the network of anti-erosion technological roads;
- rearrangement of the evacuation channels, the marginal channels at the network of anti-erosion technological roads;
- rearrangement of tubular and chiseled bridges;

2 Works for the arrangement of the torrential network

- redevelopment of earth dams;
- rearrangement of forced slopes;
- redevelopment of concrete dams and sills;
- rehabilitation of drainage channels in the ravines.

3. Soil erosion control with wood plantations.

It is planned to rehabilitate the existing wood plantations made for the biological consolidation of excessively eroded lands, ravines, heavily disturbed areas, steep slopes, ruptures, collapses, active landslides, lands that could no longer receive an agricultural use and which in case of rains torrential or normal ones continue to erode.

The proposed works must address the causes of land degradation processes, removing as far as possible the effects of these causes.

The specific functional requirements are:

- increasing the degree of mechanization of agricultural works on sloping lands, with their realization, only on the level curve;
- achieving an economical and safe circulation of agricultural equipment in all areas of the perimeter;
- regularization of runoff on slopes by reducing the intensity of surface runoff, significant reduction of surface soil erosion, respectively soil losses, bringing them within acceptable limits;
- as a result, the important effect will be the gradual increase of agricultural production per unit area;
- strong decrease of the intensity of manifestation of the negative phenomena of landslides and deep erosion, ensuring a forest use on important non-productive land surfaces;
- improving ecological and environmental conditions.

In the case of the proposed investment, it is necessary to develop a Technical Expertise that

will be performed in accordance with the provisions of government decision H.G. no. 907/2016, and which will be an integral part of the Documentation for the Approval of Intervention Works (DALI). Based on the expertise report, in which at least two solutions are presented, the necessary interventions will be recommended to ensure the requirements of the quality requirements (Law no. 10/1995).

CONCLUSIONS

The main goal of the land rehabilitation projects in the Berheci river basin was to combat soil erosion, regularize drainage on the slopes, and restore the agricultural circuit of the marshy regions from the lowland areas.

After nearly 43 years of operation, existing amenajare works have taken on a technical and functional appearance that is distinguished by structural integrity, stability, and operational role in ensuring the maintenance of acceptable surface erosions, the prevention of deep erosions, the elimination of excessive surface moisture, and the avoidance of other social-economic objectives.

In order to increase antierozional efficiency, a model of behavior in the exploitation of existing works was examined, on the basis of which the need for rehabilitating existing works as well as new works was determined.

The proposed projects aim to mitigate the negative effects of agricultural land degradation in the study region as well as to provide economic value for land that cannot be farmed.

It is planned to rehabilitate existing forest protection plantations that were created for the biological consolidation of excessively eroded lands, ravines, heavily disturbed areas, steep slopes, ruptures, collapses, active landslides, lands that could no longer be used for agriculture and that continue to erode in the event of torrential or normal rains.

The entire estimated value of the investment, including VAT, is eur 24652449, based on existing expenses in similar works and predicted execution quantities.

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