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STUDIES AND RESEARCHES FOR IMPROVEMENT AND PROTECTION, BY FORESTRY WAY, OF THE EMBANKMENTS AFFERENT TO NATIONAL ROAD 17 – TIHUŢA GORGE

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Abstract

This study has as its purpose finding and presentation of the most effective ways of improving and protection of the embankments afferent to national road 17 – Tihuţa Gorge, perimeter situated in Bistriţa-Năsăud and Suceava counties. The main causes leading to the destruction of land are represented on the one hand by natural setting's characteristics of the perimeter: uneven relief with high pitch, heavy textured soil and damp climate, and on the other hand by misuse of land and deforestation. The prerequisite for improving these downgraded lands are restoration of the vegetation and resonable use of it, prerequisite on which the choice of the improving actions and works is based on. The improving actions are: usage restrictions (grazing ban), exploitation rules, perimeter security, the installation of panels, and the improvement works are: phytoimproving measures (afforestation), soil preparation and improvement works (fertilization and amendation works), soil arrange works (draining). Afforestation is the main path to follow in downgraded land contention. The actual surface intended for afforestation from this perimeter Tihuţa-Colibiţa is 80% of downgraded lands from this perimeter.

Key words: *embankment, relief, afforestation, soil, downgraded lands.*

INTRODUCTION

As the deforestations and misuse of land were the causes that led to their destruction, so the re-vegetation and rational use are the basic conditions for the restoration of the degraded lands. In our country there are many regions where the land is in the course of sliding or prone to sliding. On this land the erosion has such an intense activity that, in a relatively short time, their evolution generates torrential formations. (Chiriţă, C., 1977)

The gravitational mass movement is a degradation process which affects the stability of slopes and it is produced by the direct action of the terrestrial gravity, supplemented by the action of the infiltration water. The main link is represented by the phyto-improvement afforestation works with the purpose of protecting, aestheticization and valorification of the degraded land. In most cases, the landslides are caused by top to bottom dipping through water excess of some soil layers characterised by certain composition and alignment.

The present study aims to identify and to implement the most effective methods of improvement and protection of the embankments afferent to national road 17. From the geographical point of view, the analyzed perimeter is located in the Tihuta Pass, its southern part, within Bistrita-Nasaud and Suceava counties.

The perimeter taken into study is part of the slope's morphostructural unit. Regarding the rainfall erosion, the petrographic substrate intervenes both directly and indirectly. The origin of the substrate is represented by loess marl, sandstone and clay-like soil, which indicates a particularly high potential for erosion. On the other hand, the geological substrate is the main natural circumstance that determines the land predisposition to move. Since the substrate is relatively impermeable, having a clay-marl composition, it is very susceptible to the generation of landslides as the water infiltrates into the soil, stagnates over these substrates causing soil dipping which slides under its own weight.

Among the geo-morphological factors, the slope and the inclination have the greatest influence on triggering erosion. The inclined lands, in their entirety, are susceptible to degradation by erosion. One can say that all lands within the improvement perimeter can be considered as being eroded because of slopes. Regarding the rainfall erosion, the precipitous morphological slopes that exceed 60% increase rainwater runoff and on the unprotected portions of vegetation it enhances the erosion process, by increasing its magnitude.

Table 1 Synthesis of the geo-morphological data

Length of perimeter (km)	81
Mean altitude (m)	850
Mean slope (º)	30
Minimum slope (º)	10
Maximum slope (º)	40
General exposition	N-E

Another factor that intervenes in carrying out this process is the exposition of land. Thus, the predominant and sunny general exposition of lands within the perimeter causes a greater predisposition to rainfall erosion because they are subject to more pronounced thermal variations, are dry, support a rare vegetation and they are more intensively exploited from the pastoral point of view. Although the rainwater leakage is reduced, still the depletion of soil is more intense than the shaded expositions.

The improvement perimeter of Tihuţa-Colibiţa is located in the sector of moderate continental climate, corresponding to tablelands. The thermic regime is characterised by: mean annual temperatures of 9,8°C, thermic amplitude of 25,7°C, bioactive period of 279 days and a vegetation period of 186 days. The seasonal variation of mean atmospheric precipitations registers a peak during the summer (273,9 mm), and during winter a minimum value (87,5 mm). During the vegetation period a quantity of 406,8 mm of precipitation is registered. Regarding the wind regime one mentions that, although the area is characterized by a wind regime with moderate winds, still there have been reported higher intensity winds and, exceptionally, even storms.

Following the climate synthesis it results: the climatic conditions in the improvement perimeter of Tihuţa-Colibiţa are favourable to the occurrence of degradation phenomena, as those present in the studied area, namely rainfall erosion and landslides.

This present perimeter is located in the hydrographical basin of Bistriţa river, it has no internal hydrographic network, the hydrographic regime being unbalanced lead to the appearance of runoff gullies formed in dales, result of waviness of slopes and their collapse.

In the Tihuţa-Colibiţa perimeter the following types of soil are met:

Class: undeveloped truncated or arent soils

Soil type: Rendzina

From the vegetation point of view, the perimeter is a part of the region of common beech forests and mixtures of common beech and resinous (*Fagus sylvatica* in combination with *Carex* sp. and *Oxalis*, or *Fagus sylvatica* and *Picea abies* with *Oxalis acetosella* with mull flora).

Instead of the natural vegetation consisting of common beech and spruce forests, due to the deforestation and the overgrazing abusive practice, led to its disappearance and the installation of one that does not provide effective protection of the soil and, sometimes, it does not even exist.

Concerning the rainfall erosion, the vegetation should be a real barrage against soil degradation. The vegetation is the factor that ensures the stability of land, preventing or limiting the mass and rock movement on the slope.

The main objective is to protect the embankments around the present perimeter and the existing stands in this area.

The main concern of the present project is the ratio between the vegetation, as a factor of resistance, and soil erosion, as a process of destruction.

MATERIALS AND METHODS

The land restoration works requires special attention and advertising from the beginning: studies, research, measurements, projects and a good organization.

It is necessary to study in detail all physical, economic and social causes that led to the degradation of these lands. Also, it is necessary to make an inventory of all damaged areas. The lands that compose an improvement perimeter are grouped on hydrographic basins, natural units of which they are part. The inventory is made by simple measurements with different expeditious means. Based on these studies, at first, an activity plan and means to be used are drawn-up. (Florescu, I.I., Nicolescu, V.N., 1996)

The role of the project is to establish in detail the type of works to be performed, where and when to carry them out. Based on project's details, one makes the registration of the works in the annual working-plan and plans in detail the activities to be carried out. Schematically, the ameliorative complex for combating the degradation process and improvement-valorification of degraded lands, includes ameliorative measures and improvement works. The ameliorative measures have an organisational character and concern, on one hand, the degraded lands included in the improvement perimeter, and, on the other hand, the lands surrounding the respective perimeters, which by their position and condition influence the degradation..

In turn, the improvement works have a technical character and relate exclusively to the improvement perimeter. These include technical interventions and intend to improve, protect and value the lands included in the respective perimeters.

In relation to the above mentioned, in the present case, the ameliorative complex of combating the degradation and the improvement–valorification of lands includes the following:

Ameliorative measures: restriction on use (grazing interdiction), operating rules, security of the perimeter, installation of panels, propaganda work carried among population.

All these measures are designed to prevent, expand, intensify or reactivate the degradation processes.

The improvement works are technical interventions carried out exclusively in the improvement perimeter in order to rebuild, protect and valorificate the land.

Improvement works: phytoimproving measures (afforestation), soil preparation and improvement works (fertilization works, amendation works and preparation of soil in patches), soil management plan works (simple and supported terraces, brush head pug, levelling-modelling, drain and drainage).

The core of the ameliorative complex adapted in the present case is represented by the phytoimprovement works, especially by the afforestation works, able to solve most of the problems which arise and find a solution.

All other measures and works, although very important, are still secondary, being designed to support, complete or supplement or the afforestation works. The forest is the only one capable to improve, protect, stable the soil on long-term.

In relation to the previous presented hierarchy, it is however to be noted that afforestation works cannot fulfil their role of fundamental link from the beginning. Thus, after a first stage, with a length of about 5 years, where the main role is fulfilled especially by the management plan works, in the next stage, this role is taken and performed exclusively by the forest.

Regarding the management plan works of the land, which have an important role, sometimes crucial, in the first stage of the improvement-valorification action, they include a variety of works of a special nature, aimed at proper preparing of land for afforestation.

These works depend mainly on both the nature and intensity of degradation and the state of affected lands and they comprise the following categories (for the Tihuța-Colibița perimeter): consolidation works for slopes, ravines, embankments and runoff beds; land slide stabilization works.

RESULTS AND DISCUSSIONS

In designing the ameliorative complex, the purpose is to determine the character and the extension of the interventions so as to achieve an ensemble more efficiently, with minimal cost and location and judicious staggering of the ameliorative complex. The volume and location of the proposed works will be expressed in the following table.

As it can be seen, according to the local particularities and the extension of the degradation processes, each surface requires certain works, each work affecting a smaller or higher percentage of this area.

Table 2 Nature and location of the proposed works

Nr. crt.	Name of work	Location of works	Observations
1	Afforestation works	DN 17 BN-SV	Over all, less than 20% of the gully corridor
2	Fertilization using topsoil	DN 17 BN-SV	Ravines, embankments
3	Preparation of soil in patches	DN 17 BN-SV	Embankments on slopes up to 30%
4	Terrace supported by fences	DN 17 BN-SV	On lands with slopes of 30-70% and 2/3 of the gully corridor
5	Levelling - modelling	DN 17 BN-SV	On half of the sliding land surface
6	Drain and drainage works	DN 17 BN-SV	On the land with excess of water, and about half of the sliding land
7	Enclosure works	DN 17 BN-SV	Where appropriate

The effective area for afforestation from the improvement perimeter represents 80% of the degraded lands within the perimeter. The afforestation is the fundamental way to combat land degradation. Indeed the role of the forest vegetation is critical because it regulates the rainfall leaking, stabilizes, restores, improves, protects and valorificates the lands, being an important, complete and decisive means in combating land degradation. Thus, following the appearance of the forest, the kinetic energy will be reduced by the canopy screen, which will retain some of the precipitations. Also, it will restructure the soil, will actively participate in the genesis of soils (paedogenesis) and because of the litter layers there will be a better infiltration and superficial retention, thus the quantum of rainoff waters will be notably reduced resulting in stopping and restoring the action.

Within the improvement perimeter, one uses massive forest crops, which are the main form of lands' afforestation.

Following the installation of forest crops, they will have a main role of protection and then a production and aesthetic role. The protection role of crops is to protect soils against rainfall erosion and land covered by agricultural crops. In terms of production, by installing the forest crops, it is expected to obtain: firewood, poles, stakes for vineyard, resin, mushrooms and berries. The harvest of the latter should be done with extreme caution, with teams made of few people, with caution not to cause any damage to the perimeter by puddling the land.

The particularities of lands for afforestation determine the silvotechnics of eroded land to be a special technique, which requires a mandatory additional attention when choosing forest species to be used, establishing the formulas and mixing schemes, use of best quality of seedlings, adoption of special ways of working, as well as technical perfection in all aspects.

The key to a successful afforestation activity within the lands affected by degradation is the carefully selection of forest species.

The extreme conditions in which the works are performed cause the elimination of sensitive species or the ones too demanding and does not allow but the installation of cultures composed of resistant and modest forest species, with a high ecological amplitude.

In principle, when choosing the forest species, attention is paid to the stationary conditions and the ecological requirements of forest species, on one hand, and, on the other hand, to the leading role that the forest culture to be installed has to fulfil, namely the protection and support of soil.

Comparing the conditions set by mapping with the ecological requirements of the species given by their ecological records, one can determine for each site type the list of species that can be successfully used in afforestation. Obviously, out of this possible list, one will choose those species that exceptionally satisfy the leading role they have to fulfil, namely fixation and improvement of soil.

Having in view the ecological requirements of the species, and given that the area is located in the common beech and spruce storey, the following species have been chosen for the afforestation of the improvement perimeter: common spruce, European black pine and

acacia and the shrub species: seadbucktorn and bastard indigo.
The afforestation formulas for the site types were determined accordingly to the established formulas principle: 75% acacia, 25% seadbucktorn; 60% European black pine, 40% bastard indigo; 60% common spruce, 40% European black pine; 100% seadbucktorn; 60% common spruce, 40% acacia.
For the lands characterised by moderate erosion and gentile slopes the following formula was adopted: 75% acacia and 25% seadbucktorn, because the vegetation can be reinstalled only here, for the rest of the land a failure being possible due to the unfavourable soil conditions. For the strongly eroded lands with precipitous slopes, one installed the seadbucktorn and the bastard indigo for they rise quickly and it is expected to successfully protect the soil until they reach the close crop.
For the ravines and the natural embankments it is recommended the use of seadbucktorn alone, this shrub being able to stop the degradation of these areas.
For the sub-types represented by very strong and excessively eroded lands, the European black pine and the common spruce is recommended, or the seadbucktorn, these species, especially the seadbucktorn, being able to stop the sliding phenomena, being suitable even for soils with a medium to light texture.
All species, both trees and shrubs, were chosen so as to be compatible with soils with hard texture, specific to common beech and spruce storey.
The afforestation formulas are transposed on the land using some scheme which show the management of species, and for the achievement of sustainable mixtures, they are classified on site types and site sub-types, as it follows: bunches of 100 sqm, mixture of individual trees (due to extreme conditions in terms of degradation) or pure culture. When choosing the species, the following objectives will be taken into consideration: stopping the degradation processes and the improvement of soils; the economic-social interests.
Between these two main objectives, the most important is the first one, namely stopping the degradation processes and the improvement of soils. In order to achieve these objectives, it have been chosen species able to resist and to develop optimum form the ecologically point of view within the existing sites, and out of these species the ones that prove the best abilities to develop, respectively the best wood production.
European black pine – was less used for the improvement of the eroded and sliding lands, but as compared with the Scots pine, it is preferred as it registers a favourable development on soils with light to medium texture, on loess substrates. It grows well in mixtures with hardwood species.
Seadbucktorn - one of the most used shrubs in the afforestation of the degraded lands. This is due to its resistance to the toughest soil conditions. It has a very rich root system. It assimilates nitrogen direct from the atmosphere via its nodosities located on the roots.
It has been widely used in the afforestation of the most difficult categories of eroded and sliding; after 3-5 years of a slower growth, the bushes become stuffed and regenerates from root suckers; after 10-15 years, the land becomes completely covered; it registered good results on sliding lands with the hardest conditions, respectively sliding lands with mass movement with strong and very strong fragmented with marl and marl-clay substrates; it closes the massif after 4-7, when it starts the strong regeneration from root suckers, forming very dense shrubs that strengthens and improves well the soil. It supports very well the potential damages caused by the reactivation of landslides after planting.
Bastard indigo - it is a species that can withstand drought well, behaving very well on lands with warmly summers, affected by drought, on poor sandy or rich soils affected by erosion, fit for the afforestation of sliding lands; sprouts, send out suckers and layers; enriches the soil with nitrogen, making symbiosis with nitrifying bacteria species; it is also appreciated and used as ornamental crops.
For the full success of the forest crops, which install on the land affected by degradation, it is not sufficient only a careful selection of species and their grouping in formulas and mixing schemes, but it is necessary to adopt a proper working technique. Mainly, the technique to be applied so as to install the forest crops must attenuate the excessive conditions and increase the deficient items. Thus, in order to increase

the chances for a successful afforestation on lands with relatively poor soils, the afforestation technique has to remedy these shortcomings, and for this purpose natural fertilizer, mainly organic fertilizer and earth for filling up will be used.
Due to the rough conditions in which the work is carried out, the main working method is planting, made with ordinary best quality seedlings with roots without covering. The afforestation processes are also numerous, depending on the working conditions. Thus, the planting can be done in belt system or in various size pits, depending on the site conditions and nature of seedlings, as it follows: planting in normal pits of 30 x 30 x 30 cm for the units where the preparation of soil in made in patches; planting in enlarged pits of 40 x 40 x 30 cm where other soil preparation is avoided.

CONCLUSIONS

The research carried out in the improvement perimeter of Tihuţa-Colibiţa concentrated on the observation of the behaviour of the afforestation works along the time and their impact on the environment in the studied area. In addition, it has also been studied the degree of fragmentation and the behaviour of runoffs within the perimeter.
The above analysed data allow highlighting the main causes that led to the emergence and development of the degradation phenomena within the studied perimeter.
These cases belong, on one hand, to the natural environment where the analyzed perimeter is located (geological, lithological and geomorphological complexes, climatic, hydrology and vegetation conditions) and, on the other hand, to the social and economic framework (utilities, administration and land use).
As a result of the synthesis of climate, it can be concluded: the climatic conditions within the improvement perimeter of Tihuţa-Colibiţa are favourable to the development of the degradation phenomena, such as those present in the studied area, namely the rainfall erosion and landslides.
The triggering of accelerated rainfall erosion is linked exclusively to the total or partial disappearance of the living soil cover after the intervention and action of some anthropogenic factors. The vegetation is the factor that ensures the stability of the land, preventing or limiting soil and rock mass movements on the slopes.
With a relief background characterised by rough topography with precipitous slopes, a heavy textured soil and a humid climate, the disappearance of the woody corresponding vegetation (structural, compositional and vegetation state) is the triggering causes of the degradation phenomena within the improvement perimeter of Tihuţa-Colibiţa.
Within the Tihuţa-Colibiţa perimeter, were decisive (in the development of the degradation phenomena) the disappearance of woody corresponding vegetation, which amplified the normal processes of runoff and concentration of water on slopes, processes that have led to the appearance of the gullying regressive to paedogenesis.

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REFERENCES

Chiriţă, C., 1977: Romanian soils, Academic Publishing House, Bucharest.
Ciortuz, I., 1981: Silvicultural improvements, Didactic and pedagogic Publishing House, Bucharest.
Traci, C., Costin, E., 1986: Downgraded lands and their harness by natural ways, Agro-Silvicultural Publishing House, Bucharest.
Florescu, Gh., 1994: Afforestation, Publishing House of the University of transilvania, Braşov.
Târziu, D., 1997: Soil and forest sites, Ceres Publishing House, Bucharest.