# AGROPEDOAMELIORATIVE STUDY OF AN REPRESENTATIVE AREAL, LOCATED IN THE POLOCIN BASIN, TUTOVEI HILLS

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**Abstract**

The research objectives were aimed at highlighting the possibility of higher recovery potential fertilization slopes, which have suffered from inappropriate and aggressive human interference in the last quarter of the century which favoured the acceleration of erosion and activation of landslides, with negative impact on agro potential of farmland on the slopes in the studied area.
Given the multitude and variety of degradation processes in the investigated area and the predominant slopes between 5-15%, we recommend implementing measures and improvement works to prevent and control soil erosion.
Also, avoiding deepening degradation of the soils on slopes imposed identifying solutions to determine erosion diminishing and to prevent landslides on the slopes in the area.

**Key words**: soil, slope land, erosion, fertility, ameliorative.

The "Drageşti - Tataraşti" area is located in the Southern county of Bacau, in the east of the Siret River, in the Polocin Basin, in the South - West of the Tutovei Hills.
The researched area is 555.60 hectares. The whole area belongs to the administrative territorial unit Tataraşti and is accessed via communal roads DC 99A, DC 99C, DC 100 and county road DJ252C, which in turn connects with the main cities and towns in the perimeter through national roads DN 11A (Oneşti - Bârlad), DN2F (Bacau - Vaslui) and DN2/European-E85 (Bucharest - Siret).

The area is dominated by a multitude of meadows and slopes with gradients within the range 5-25%, frequently with marl-clay lithology, which were added by torrential rainfall in the warm seasons, and improper human intervention, by practicing agro-technical works from hill to valley, with weed predominance in the structure of crops and overgrazing. All this accelerated land degradation, particularly erosion and landslides, something which inevitably led to deteriorating productive capacity of the land area.
Within this paper, we've highlighted the need to find solutions that can lead to improving the current state of affairs in the territory.

## MATERIAL AND METHOD

To achieve the researched topic, the data were obtained from the study of topographic maps (sc.1:5.000, 1:10.000 and 1:25.000) and soil (sc. 1:10.000) of Tataraşti village, Bacau county, information regarding the evolution and works for antierosional agriculture, accessible through the archives and databases of the Pedological and Agrochemical Institute Bacau (OSPA) and from the Local Agency for Land Reclamation Bacau (ANIF) and from the findings which the author have made in the field on the slope processes and prevention of soil erosion.

## RESULTS AND DISCUSSION

The landscape is varied, derived from the geological structure and monoclinic pattern of the hilly region. As such, the area has a hilly cuesta fragmentation relief. The area is located primarily on a cuesta reverse, located between the Ezerei and Polocin valleys. The brow cuesta from Souththern Tataraşti village is poorly expressed (Micului Coast). The height difference is 163 m of altitude in perimeter to 135 m absolute altitude at the confluence of the streams with Polocin and Ezerei and 298 m in the Comorilor Hill. The structure of the slopes reflects habitat groups of mesorelief and its features. In the territory we find slopes of all kind of categories (*table 1*).

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Table 1

**Slope classes present in the studied territory**

| Slope classes (%) | Land types | Area | |
|---|---|---|---|
| | | hectares | % |
| 0 – 2 | Horizontally | 8.7 | 1.57 |
| 2 – 5 | Very Weak sloping | 94.8 | 17.07 |
| 5 – 10 | Weak Sloping | 181.5 | 32.67 |
| 10 – 15 | Weak - Moderately sloping | 132.1 | 23.76 |
| 15 – 20 | Moderately sloping | 52.0 | 9.36 |
| 20 – 25 | Moderate - Heavily tilted | 47.0 | 8.46 |
| 25 – 35 | Heavily tilted | 11.1 | 2.00 |
| 35 – 50 | Very - Heavily tilted | 6.1 | 1.10 |
| 50 – 100 | Extremely heavily tilted | 22.3 | 4.01 |
| TOTAL | | 555.60 | 100% |

It appears, due to reversible cuesta mentioned, that prevailing land with slopes less than 15%, 75.07% of the extensive surface and overall 81.36% of the surface is subject to a serious risk of erosion.

Lithologically, the area consists of clay deposits – marl and sands. Over these Pre-Quaternary rocks, there are, in recent deposits, a coating of territory, consisting in clay-clay loam, home colluvium - wind (loess) delluvium-colluvium and low-eluvium (residual deposit). The bottoms of the valleys are rhythmic accumulated alluvium deposits-colluvium soils buried. The sloping surfaces on the back of cuesta consist predominantly (85%) of loess and slopes consisting predominantly of clays or clay – clay loam. The slope of Micului Coast in the South of the area is a brow cuesta, "unveiling" layers clay - marl. In conclusion, 95% of the surface area, and underlying parent materials are clay (grain size, which is the type clay – clay loam).

The basin area falls in the Siret basin, Polocin sub-basin. As a practical location, the studied area overlaps the Ezerei Creek, with its tributary on the right - Tataraşti and Mațcani Valley creek with its tributary on the right - Giurgeni Valley.

Areal weights of the two sub-basins is about equal. The North-West corner of the area (below 10%) exception, being oriented either to stream basin Repede, either to Drageşti basin. Mațcani creek and its alluvial plain is not included in the studied perimeter. Streams of the perimeter (Ezerei, Tataraşti and Giurgeni) have very low flow rates (~2 l/s), draining the sources of their basins. Rain debts grow strongly, depending on the volume and intensity of the rainfall. We noticed the strong character of the Ezerei torrential valley.

Hydrogeologically, the area is characterized by the pedophreatic clear predominance level of over 5 m depth. Only about 17% of the perimeter (94 ha) plants or soils are influenced by intake water system. On the valley floor Ezerei, at the confluence with Tataraşti Valley, there appears an area with excess groundwater intake (7.5 ha). The phreatic level is about 3 – 5 m depth and it is distributed on lower slopes with colluvial processes (74 ha). Fluvisols flood occur on the bottoms of valleys located (10.8 ha) and moderate frequency - rare.

Climatically, the area is located in the pedo-geo-climatic moderately warm semi-humid zone. The average annual temperature is about 9,3 $^0$C and average annual rainfall of 530 mm.

Hydroclimatically, the annual deficit balance is poor. The annual number of days without frost is 190.

The maximum rainfall occurs, on average, in early summer. Rainfalls during May 1 to August 31 are on average 275 mm, which is 52% of the annual average.

Frequent droughts occur in April, August and September. In the area, heavy rains are common. In some cases, such as the latest recorded on 5 and 6 September 2007 (Galațeanu M., 2007), the effects of rainfall on lands with basic tillage done, were very strong and the whole arable layer stripped completely near Drageşti village.

Vegetation: the area has a steppe character. Only North-West of Comorilor Hill area is located in the forest floor. The forest in the vicinity of this hill is made up of oak, field maple, maples, elms and hornbeams.

Anthropogenic influence is reflected in the perimeter by:

- The occurrence of a specific micro-relief (embankments, excavations, loam pits, Field terraces ~ 10% of the perimeter);
- Accelerated erosion of the perimeter is a general phenomenon, caused by the operation disorganized as arable land. Status deep erosion is the result of uncontrolled exploitation and inappropriate land at risk of erosion in the area. In this regard, there is the mention that the perimeter does not have soil erosion control facilities;
- Plow sole perimeter appears on 153 hectares, sloping land;
- Acidification of soils due to unilateral fertilization with mineral fertilizers on 58 hectares.

Soils in the area, following studies, highlight as eight types (*table 2*). It may be noted that specific types of soil slopes (regosols and anthrosols) are the most extensive.

Table 2
**Soil classes present in the Drageşti – Tataraşti area**

| Soil type | Area | |
|---|---|---|
| | hectares | % |
| Fluvisols | 10.80 | 1.94 |
| Chernozems | 16.80 | 3.02 |
| Eutric Cambisols | 63.10 | 11.35 |
| Anthrosols (Erosive) | 68.20 | 12.28 |
| Phaeozems | 48.50 | 8.73 |
| Luvisols | 15.50 | 2.79 |
| Hapludalfs | 233.50 | 42.03 |
| Regosols | 99.20 | 17.86 |
| TOTAL | 555.60 | 100.00 |

The soil texture is loamy on 92% of the perimeter (511.2 ha). 8% of the surface texture is clayey-loam (24 ha), loamy-sandy (15 ha) or sandy-loam (5.4 ha).

Soil reaction (*table 3*) is determined by many factors, especially erosion and landslide.

Reaction of the acid is strong, the amount of hydrolytic acidity is less than 70% $V_{AH}$ on 58.1 ha, which means 10.44% of the total surface.

Table 3
**Status soil reaction in the studied area**

| Soil reaction types | Area | |
|---|---|---|
| | hectares | % |
| Weak Alkaline | 164.00 | 29.52 |
| Neutrals | 26.00 | 4.68 |
| Weak Acid | 180.00 | 32.39 |
| Moderately Acid | 127.50 | 22.95 |
| Strong Acid | 58.10 | 10.46 |
| TOTAL | 555.60 | 100.00 |

In the progress of landslides and erosion, we mention the presence of weak vertices processes in an area of 18 hectares of land on the Micului Coast in the area of contact between the surface sloping to reverse cuesta southern forehead represented by this coast.

Secondary settlement or plow soles appears on 153 ha (27.54% of the area).

The average content of $CaCO_3$ on 0 – 50 cm depth, are over 8% on 65 ha (ie 11.70% of the total area).

Depth carbonate accumulative horizon ($C_{CA}$) under 100 cm, appears on 285 ha (51.30%).

The emergence of the material surface by less favorable textures on 44 ha, meaning 7.92% of the area studied are the type loamy sand textures, clayey-loam and loamy-sandy that are in the current phase in the horizon medium surface of the soils. The permeability is small and medium on 86.34% of the area (table 4).

Soil porosity (tab. 4) to layer up to 75 cm depth is smaller in only 50.3 ha (9.05%).

Gleyied soil occurs about 20 ha restrictive, which represents 3.6% of the perimeter.

Soil moisture deficit is restrictive (and very large) about 90 ha (16.2%).

Alkalizing is weak and it appears insular on an area highlighted in the Ezer Valley, on a regosol soil type textural contrast and with the contribution of the coastal groundwater and springs. The land also have active landslides.

Soils with low humus reserve (*table 4*), and horizon thickness (table 4) below 10 cm are expanded nearly 90% of the surface. The situation is a reflection of erosion, siltation and land use arable (both duration and intensity) and more less pedo-genetic processes.

Table 4
**The main characteristics of the soils in the area Drageşti – Tataraşti**

| Soil feature<br><br>Soil deposit (ha) | Total porosity (<75 cm depth) | Permeability | Humus horizon thickness (<10 cm depth) | Humus deposit |
|---|---|---|---|---|
| Great | 164.8 | 75.9 | 66.4 | 32.0 |
| Middleweight | 340.5 | 427.1 | 390.5 | 19.1 |
| Lesser | 50.3 | 34.3 | 15.1 | 357.5 |
| Very small | - | 18.3 | 83.6 | 93.0 |
| Extremely small | - | - | - | 54.0 |
| TOTAL | 555.60 (100%) | | | |

The structure of agricultural land use categories (table 5) is dominated by arable land (83.71% of the area), followed by meadows (9.52%) and vine fruit-plantations (3.48%). A high percentage (2.79%) is distributed to land at an advanced stage of degradation slope processes.

Table 5
**The use of the land from the investigated perimeter**

| Category use | Area | |
|---|---|---|
| | hectares | % |
| Arable | 465.10 | 83.71 |
| Pastures | 52.90 | 9.52 |
| Vineyards | 16.70 | 3.01 |
| Orchards | 2.60 | 0.47 |
| Forest | 2.80 | 0.50 |
| Unproductive | 15.50 | 2.79 |
| TOTAL | 555.60 | 100.00 |

*Soil degradation processes*

The slopes and landforms are copying main degradation soil molds. The latter are essentially accelerated geomorphological processes in the context of land use in time. As such, the main kinds of land degradation are the following:

Surface soil erosion - is the largest expansion degradation and affects 477.3 ha (tab. 6). The situation reflects both the normal ratio between land degradation, geomorphological processes and anthropogenic state of acceleration of the process. Erosion affects 85.92% of the surface area. This high percentage is explained both by land as arable (83.71% of the area) and the

organization and work of inappropriate land slope, the biggest part of the history of exploitation of those lands, but also by facilitating erosion of natural background (long hills and loamy texture). The perimeter area affected by erosion is clearly dominated by low intensity of erosion (53.07% of the area) in the current phase.

Table 6

**The intensity of soil degradation by erosion processes in the studied area**

| Intensity of erosion | Area | |
|---|---|---|
| | hectares | % |
| Weak | 253.30 | 53.07 |
| Moderate | 140.40 | 29.41 |
| Strong | 20.60 | 4.32 |
| Very strong | 8.70 | 1.82 |
| Excessive | 54.30 | 1138 |
| TOTAL | 477.30 | 100.00 |

One can notice that surface erosion tends to expand the perimeter on the slopes as well of 2-5%, on very long lines on the reverse slope of the cuesta.

Depth soil erosion - manifests itself on an area of 395.5 ha, so that 71.20% of the perimeter has deep erosion formations of various intensities (table 7). The explanation for this wide area of damage is the same as for surface erosion: operation as arable 83.71% of the perimeter, long slopes and texture of clayey-clay-sandy. Weaker is the dominant intensity (on gutters 77.52% of the total surface formations by deep erosion).

Table 7

**Deep erosion forms present in the perimeter**

| Type of erosion | Density of erosion | Area | |
|---|---|---|---|
| | | hectares | % |
| Rill | Lesser | 237.70 | 60.10 |
| Rill | Average | 68.90 | 17.42 |
| Advanced rill | Little | 39.30 | 9.94 |
| Advanced rill | Average | 14.10 | 3.57 |
| Advanced rill | Large | 2.90 | 0.73 |
| Gully | Little | 8.50 | 2.26 |
| Gully | Average | 1.80 | 0.46 |
| Ravine | Large | 22.30 | 5.64 |
| TOTAL | | 395.50 | 100.00 |

A reflection of the state of activation of deep erosion is the situation from the Ezerei Valley, which was a strong aggravate bed (ravine bottom of the valley), two thirds of its length. Upstream of the confluence with the Tataraşti small tight valley, the deepened reactivation was so strong that it triggered hillside complex processes: collapses and landslides, with the emergence of badland sectors type, upstream of the village;

Therefore, gullies appear on an area of 66.6 ha (16.96% of the total area affected by depth erosion), and gutters on 306.6 hectares (77.52% of the total area affected by depth erosion).

Active ravines are expanded on 22.3 ha (5.64% of the total area affected by depth erosion).

Landslides, a process of degradation, undergo a process of deepening and development of the valleys in the area and therefore their weight in perimeter is most reduced, these manifesting themselves in 138.1 hectares (24.86% of the habitat). Training and landslides reactivation of the perimeter (table 8) is closely linked to the deepening valleys and then widening sunken beds on a background litho-hydro-geology favorable movement of masses of rocks on the slope.

Table 8

**The intensity of the landslides in the studied area**

| Formations | Types | Area | |
|---|---|---|---|
| | | hectares | % |
| Furrows | Stabilized | 4.10 | 2.97 |
| Waves | Stabilized | 59.00 | 42.72 |
| Waves | Semi Stabilized | 13.70 | 9.92 |
| Footsteps | Stabilized | 16.20 | 11.73 |
| Footsteps | Semi Stabilized | 9.30 | 6.73 |
| Mound | Semi Stabilized | 7.40 | 5.36 |
| Crumbling | Semi Stabilized | 6.10 | 4.42 |
| Crumbling | Active | 22.30 | 16.15 |
| TOTAL | | 138.10 | 100.00 |

Landslides in the narrow sense are of several types: stabilized on 79.30 ha (57.42% of the area affected by landslides) and semi-stabilized on 36.5% (26.43%). The above mentioned areas were excluded subsidence, which, strictly speaking, are not really slides. Subsidence occurs on 28.4 ha (16.15%), of which 22.3 ha active.

There are three areas of development landslides:

*Area 1* - Giurgeni, the wider area, developed on the right side of the middle Mațcani Valley. It is an area with slides consisting in waves and footsteps. Reactivation occurred as a result of the deepening Giurgeni ravine. The area is spread over 65.8 hectares, of which the reactivation on 11.2 ha (17.02% of total).

*Area 2* – The Ezerei Valley is developed upstream of the confluence Tataraşti. It is a narrow area, held along the creek Ezer, notably the right valley, linked to the structure of litho - hydro - geological area. The form of the landslides is diverse: footsteps, waves and mounds. Reactivation landslides occurred in this area by immersion. The area is spread over 31 hectares, of which the reactivation on 19.2 ha (61.6%). In fact, this area with active landslides is the most fragmented and unstable area of sliding landslide.

*Area 3* - Micului Coast is the lowest, as expansion, at the current phase, landslides are stabilized and aunder the form of waves or

furrows. The surface of this area is of 8.1 hectares active subsidence occurs on ravines in the perimeter of the bottom of the valley, being ordered by the share occupied as follows: the Ezer Valley, the Tataraşti Valley and the Giurgeni Valley. These collapses are complex, affecting slopes just adjacent to the confluence with Tataraştii Ezer and downstream subsidence strictly bottom of the valley, affecting the alluvial plain.

Cloggings – are produced on 40 ha (7.20% of the total), of which weak-moderate (deposited layer thickness is under 25 cm), 64% of the area being affected by the process.

The cloggings mentioned are weak and appear on the lower slopes, the slope saddles and trade downstream areas with high erosion and gullies. On the valley bottoms, strong cloggings occur.

*Improvement requirements*

The main measures and improvement works necessary are works meant to prevent soil erosion and control it:

- Basin Ezer anti-erosion works and the right valley slope Mațcani, located between Blageşti and building of the former state farms Tataraşti (side overlaps on the eastern side of Comorilor Hills and Ezerei and Basin Ravine Giurgeni);

- Fitting of ravines and valleys of torrents of Ezer, Tataraşti and Giurgeni.

Also, it is considered necessary the timely completion of the drainage, leveling capital, regularization of rivers (including the drainage system), spring intake, drainage (a small area of 2 ha).

In particular it must prevent and control landslides, including subsidence.

At the agropedoameliorative level, a first radical fertilization is (necessary humus soil reserve and phosphorus content is low) anti-erosional culture system organization drainage area, the establishment of plantations for protection, deep loosening and amendment limestone (with slightly lower share).

Particular attention will be given to protective plantations, especially afforestation, urgently needed in the area.

## CONCLUSIONS

The area proposed for improvement is complex through its features. There are a series of degradations, which seriously affect land in the studied area (surface erosion 85.92%, 71.20% on deep erosion, landslides on 24.86% and 7.20% on clogging of the territory).

The hilly landscape consists of cuesta fragmented relief. The predominant slopes are between 5-25%, something that represents 74.25% of the surface area. Soils are dominated by preluvisolic with poorly differentiated textures, followed by regosols and erosive soils. A percentage of 92% of the habitat has a loamy texture.

The total porosity of the soil is on 61% of middle and low surface, the only 9%. Permeability is average and 86.34% lower on the perimeter. Reserve humus is low on 90.80% of the territory.

Given the aforementioned synthesis, studying the area in terms of soil degradation, caused by erosion in the broad sense, which may put at risk the very backbone of the dwellings that make up human settlements in the perimeter, this study is topical.

The agropedoameliorative study of the agricultural land in terms of natural and anthropogenic factors which contribute to the degradation of soils on slopes enables the enunciation of solutions for preserving soil fertility and the environment.

Implementation of the 18/1991 law, by reconstituting the old locations of properties caused excessive fragmentation of land through demarcation of their long side towards the hill – valley, inhospitable soil conservation aspect. Besides this, subsistence farming practised and / or ignorance of the common people made it grow steadily, year after year, corn, crop plants which raised to a large extent the degree of water erosion and other slope processes.

However, we believe that the reunification of certain areas of farmland in various forms, one could meet an adequate agrotechnics in order to restraint erosion in the tolerabkle limits and make some special arrangements work again in order to fight and control soil erosion, or possibly extend them by accessing European funds.

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