PEDO-GEOMORPHOLOGICAL FACTORS LIMITING SOIL FERTILITY IN MĂDÂRJAC COMMUNE, IAŞI COUNTY

Oprea RADU[1], Daniel CUREA[2,3]

e-mail: opricaradu@yahoo.com

Abstract

The edaphic cover is an essential constituent of the environment, as well as a natural resource with multiple uses for mankind. Soil quality is affected to a smaller or larger extent by one or more restrictions. Their harmful influences materialize in soil features and functions deterioration, which affects their bioproductive capacity, with consequences on agricultural produce quality and food safety. These restrictions are caused either by natural factors, or by agricultural and industrial anthropic actions, which may have a synergic yet negative effect, leading to soil quality decrease and even soil function annihilation. The following main soil degradation factors were identified in Mădârjac Commune: gleying, stagnogleying, surface erosion, landslide and gully. The pedo-geomorphological study conducted revealed strong-excessive gleying in 6%, mild gleying in 20%, moderate-strong stagnogleying in 22%, mild stagnogleying in 43%, excessive surface erosion in 8%, moderate-strong erosion in 48%, mild erosion in 15%, and landslide and gully in 45% of the whole charted area of 1369 ha.

Key words: gleying, stagnogleying, erosion, landslide, gully

In its capacity of primary natural resource for agriculture, the soil is a basic constituent of the continuity and prosperity of rural inhabitants, and hence of the prosperity of the entire nation, which compels us to preserve and make the best use of this natural capital. Soils are the most valuable wealth, the most precious asset, which needs to be known and acknowledged, preserved and used at its real potential (Acad. Cristian HERA, 2008).

MATERIAL AND METHOD

From the administrative point of view, Mădârjac Commune is in Iasi County, being located about 50-60 km south-east of Iasi City, and from the geographic point of view, it lies in the north of the Central Moldavian Plateau.

The total area of Mădârjac territorial and administrative unit is 5263 ha, of which 1329 ha make up the agricultural area and 3934 ha the non-agricultural area. Please note that the forests take up 3736 ha, i.e. 71% of the whole territorial unit. Mădârjac Commune lies in a hilly and plateau area, in the middle of a woody massif of over 15,000 ha. It actually looks more like a big clearing surrounded by woods. Only its south-western border consists of a one-kilometer long woodless opening to Bojila Village, on the road going to Ţibana Commune.

The climate here is temperate, though a little harsher, specific to woody areas, with a mean annual temperature of 8.3°C and average annual precipitations of 531 mm with uneven distribution.

Most of the commune, i.e. 76% of it, has altitudes ranging from 200 to 350 m, the highest altitude being 415 m, and the lowest 171 m. The lands with slopes superior to 15% make up about 1580 ha, i.e. 30% of the whole area of the commune.

The hydrographic network is relatively dense, as over 90% of the commune land is included in the Sacovăţ River basin. A specific characteristic of its hydrographic network is the irregularity of the streams and the occurrence of transient pools in the low-lying areas in the major beds. The ground water is located at depths exceeding 10 m in the high lands, at 2-4 m in the Sacovăţ Meadow and 0.8-1.5 m in microdepressions.

The pedological study included field and office operations, such as soil profiles, soil specimen sampling, analysis and interpretation.

The geomorphological specificity of Mădârjac Commune was determined by traditional research methods (field observations and measurements), as well as by modern methods relying on GIS software. The cartographic material was collected by using the TNTmips v.6.9 and ArcGIS v.10.1 programs. An important stage in spatial modeling was the development of the Digital Terrain Model (DTM), by the vectorization of the contour lines on the topographic plans at a 1:25 000 scale. Thematic maps were created based on vectorized contour line processing.

[1] University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad " Iasi
[2] Office for Pedological and Agrochemical Studies, Iasi
[3] Faculty of Geography and Geology, "Alexandru Ioan Cuza" University of Iasi

RESULTS AND DISCUSSIONS

The pedo-geomorphologic study conducted in Mădârjac Commune revealed the following factors limiting soil productivity: gleying, stagnogleying, surface erosion, landslide and gully.

Sacovăţ Valley becomes considerably larger after achieving confluence with Pietrosul Brook, and takes on the appearance of a meadow until it leaves the territory of Mădârjac Commune. It is covered by a layer of medium-texture alluvial materials in which the brook progressively dug its bed. This high-lying and better drained land is rarely affected by floods. It has excessive groundwater areas corresponding to some deserted river meanders.

Areas with different degrees of excessive groundwater were also detected on the lower courses of the left tributary streams of Sacovăţ River, namely Pietros, Pietroasa, Ponoarele, where we may speak of actual alluvial-colluvial valleys scattered with pools in the low-lying and poorly drained sectors almost all year round.

Groundwater is the main pedo-genetic factor in the lowland of Sacovăţ River and its tributary streams, which contributes to alluvial soil formation. Groundwater occurring at critical depths, in a rather poorly dug minor bed and hardly permeable lithological substrate, caused poor gleying on an area of 238 ha (17%) of the charted area, in the higher and more properly drained areas of the lowland. In the lower areas of the lowland with groundwater close to the surface, it caused strong gleying on 93 ha (7%), and in microdepressions, with groundwater occurring at less than 1 m; excessive gleying occurred on 43 ha (3%), gleysols being the representative soils (*figure 1*).

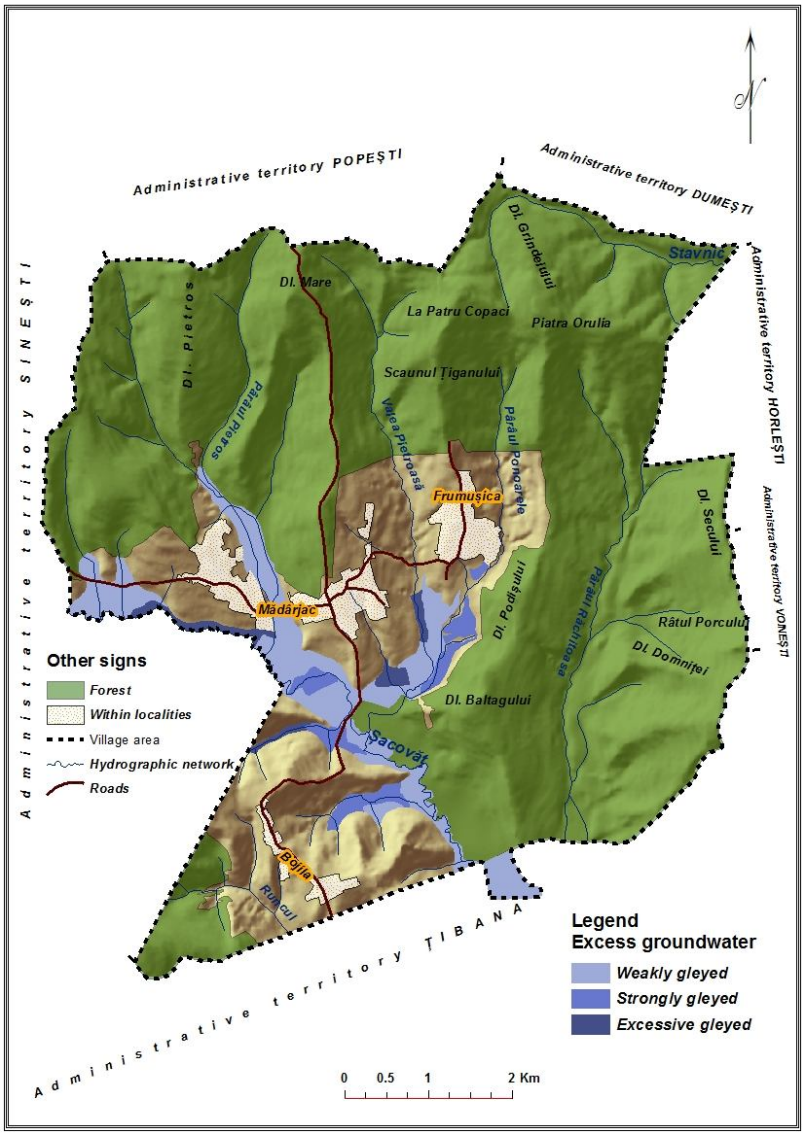

Figure 1 **Soil gleying intensity distribution**

On the surveyed area, excessive soil humidity, total poor porosity, low permeability and soil settlement are some of the soil deficiencies caused by the occurrence of horizons enriched with clay by the pedogenetic elluviation and illuviation process. Thus, 43% (584 ha) of the pedologically charted area exhibits poor stagnogleying and 22% (302 ha) exhibits moderate-strong stagnogleying (*figure 2*).

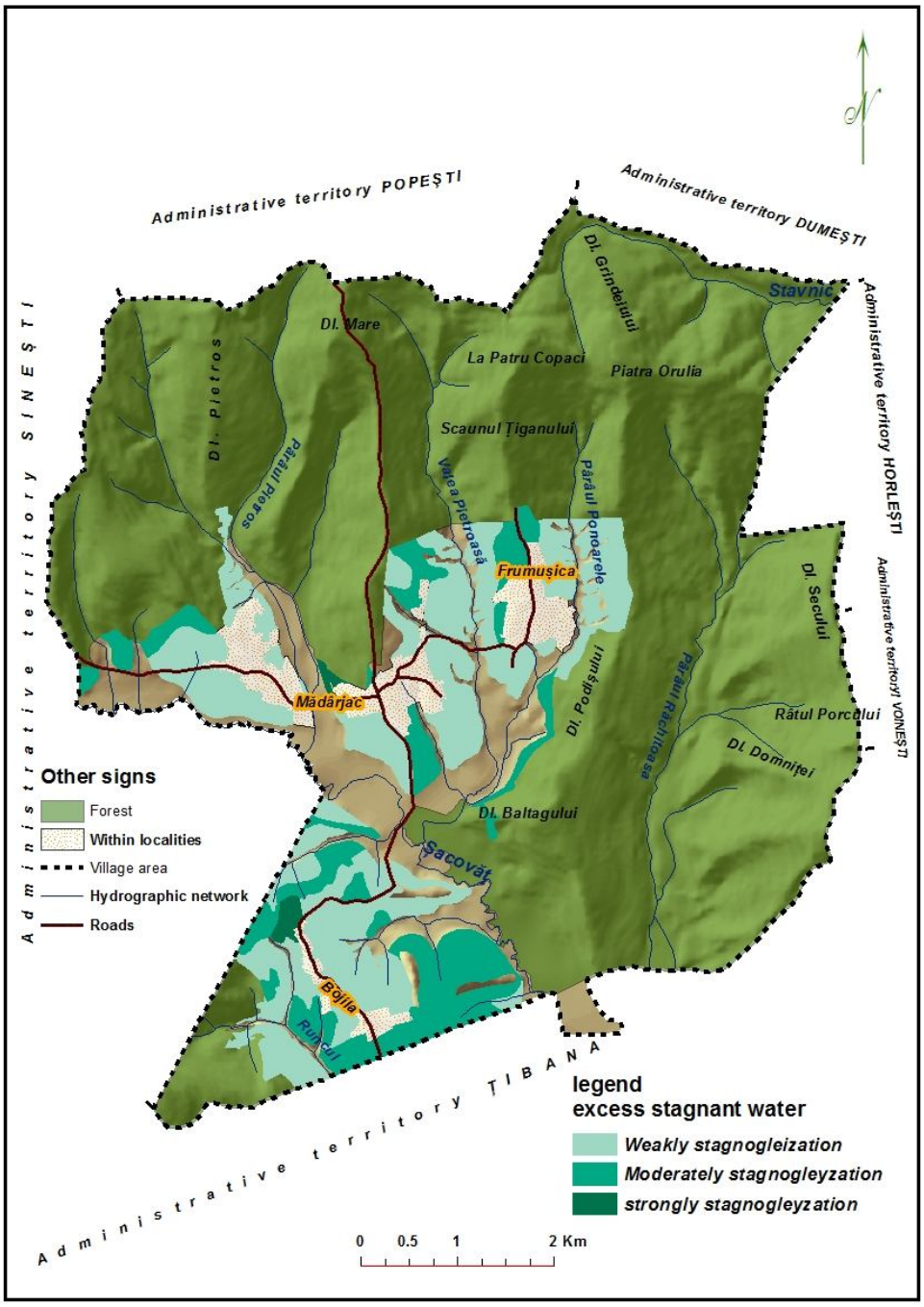

Figure 2 **Soil stagnogleying intensity distribution**

The extent of the surface erosion and its development stage are proportional to the slope gradient, length and surface, being also influenced by the petrographic structure, land use, vegetation cover, etc. (*figure 3*).

The local geomorphology characterized by short and steep slopes, which play the role of faces of cuesta, greatly affected by landslide, causes moderate-strong surface erosion in about 653 ha (48%) of the pedologically charted land. The preponderance of luvisols, which have poor erosion resistance, associated with mild-moderate

slopes, located on the back sides of the damaged cuestas, causes mild erosion in about 210 ha (15%) of land. Landslide cliffs, active landslides and erosive anthrosols are pedo-geomorphologic components affected by excessive erosion and make up 109 ha, i.e. 8% of the pedologically charted area.

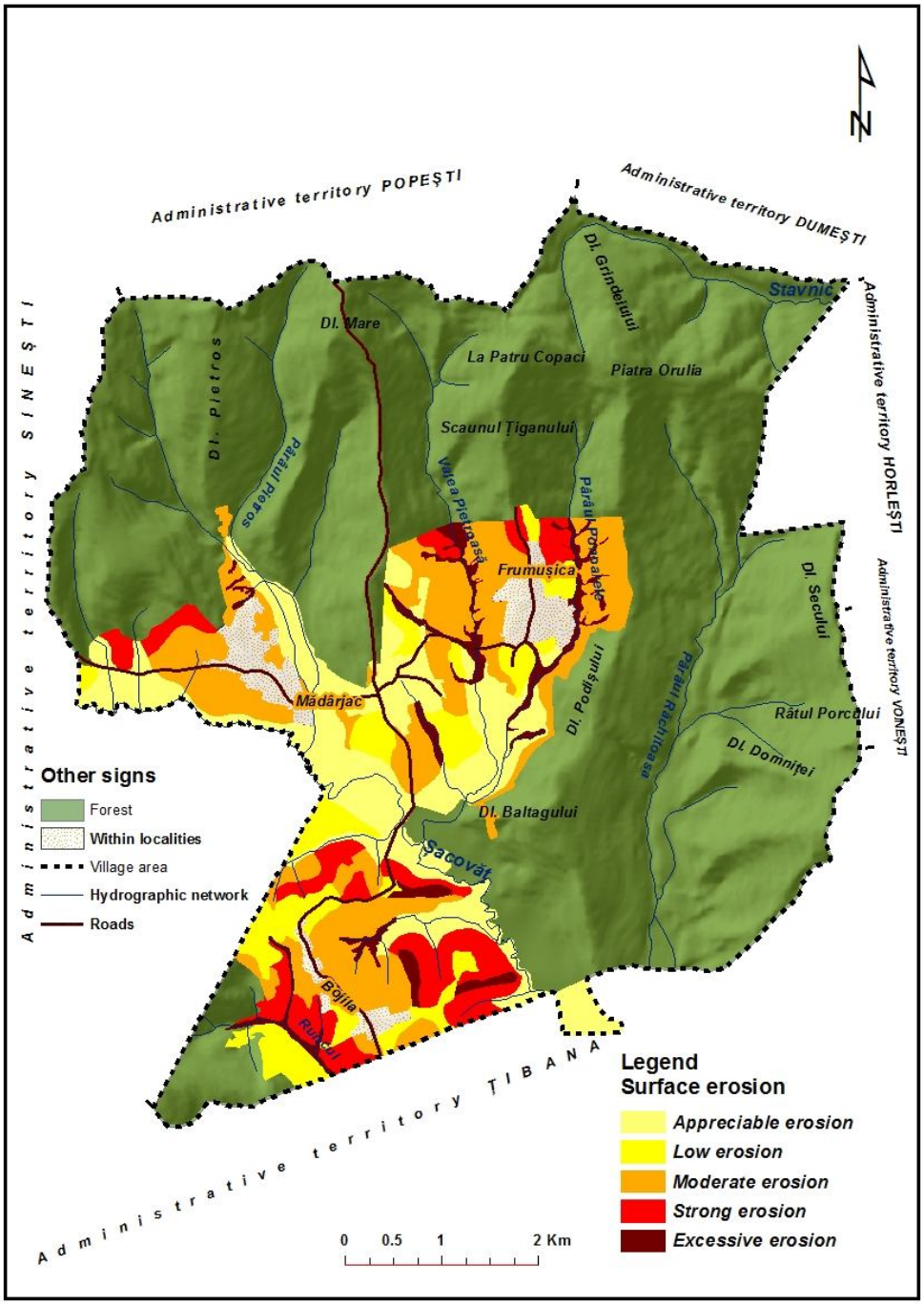

Figure 3 **Map of erosion degrees**

The lowlands of the main brooks, narrow valleys and interfluves plateau crests make up 29% (397 ha) of the pedologically charted area the erosion of which could not be determined.

The Bessarabian lithological structure, specific to the Central Moldavian Plateau, the relief consisting of many hills and knobs separated by deep valleys and having a more chilly and heavy rainfall climate, and human intervention are some of the natural and anthropic factors that caused landslide and gully on 613 ha of land, i.e. on 45% of the whole pedologically charted area (*figure 4*). Figure 4 shows that, although 374 ha of land are affected by stabilized landslides, there still

is a considerable area confronted with active (91 ha) and semi-active (58 ha) landslides. Active landslides occur especially in the south extremity of Mădârjac territorial and administrative unit, on lands with slope gradients exceeding 15% (*figure 5*).

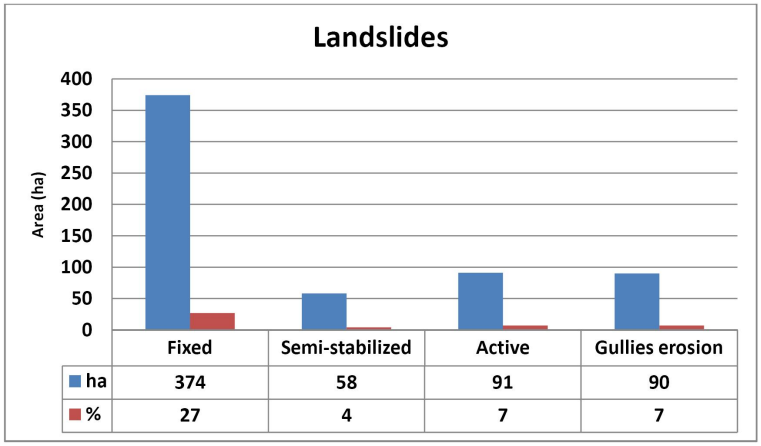

Figure 4 **Extent of landslide and gully**

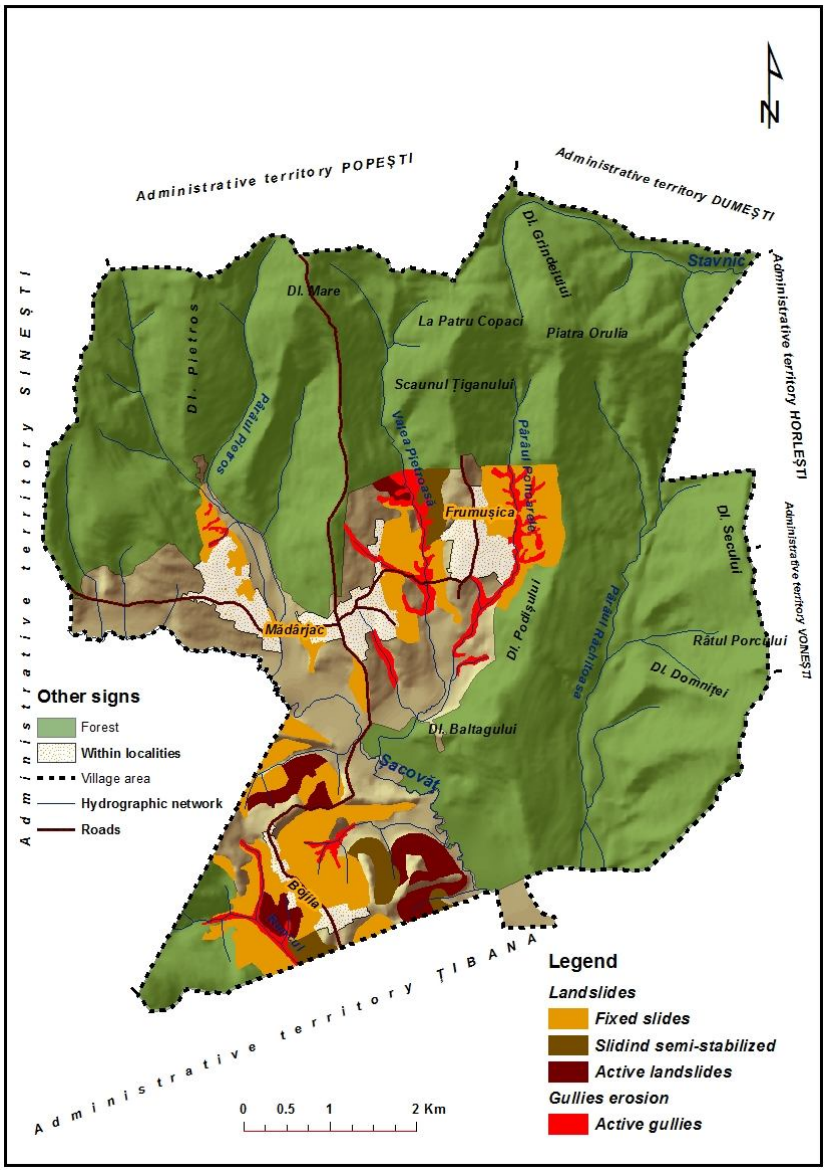

Figure 5 **Territorial landslide and gully distribution**

CONCLUSIONS

The pedo-climatic and geomorphologic conditions specific to the surveyed 1369 ha area caused mild gleying in 17%, strong gleying in 7% and excessive gleying in 3% of the pedologically charted area. Also, 43% of the surveyed area is characterized by mild stagnogleying and 22% of it by moderate-strong stagnogleying.

The high land slope gradient, slope length and area, petrographic structure and inappropriate land use increased surface erosion, and therefore about 56% of the charted area is affected by moderate, strong and excessive erosion.

Natural and anthropic factors contributed to the occurrence of landslide and gully in about 45% of the whole land. Despite the 374 ha of land with stabilized landslide, we find it alarming that 91 ha are affected by active landslide, 58 ha by semi-active landslide and 90 ha by gully.

Among the solutions that we suggest for the improvement and preservation of this land we could enumerate rational and proper use of the land, excessive humidity control, application of anti-erosion measures and works, as well as landslide prevention and control.

REFERENCES

Băcăuanu V., et al., 1980 - *Podișul Moldovei*. Editura Științifică și Enciclopedică, București.

Coteţ P., 1973 - *Geomorfologia României*. Editura tehnică, București.

Dumitru M. et al., 2008 - *Evoluția principalilor parametri de monitoring al solurilor și terenurilor agricole.* Publicațiile SNRSS, editura Solness, Timişoara.

Hera Cr., 2008 - *Mesajul Academiei de Ştiințe Agricole și Silvice "Gheorghe Ionescu-Şişeşti" la aniversarea a 100 de ani de Știința Solului în România.* Publicațiile SNRSS, editura Solness, Timişoara.

Ioniță I., 2000 - *Relieful de cueste din Podişul Moldovei.* Editura Corson, Iaşi.

Ţărău D., **2003** - *Cartarea și bonitarea solurilor*. Editura Solness, Timişoara.