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LIMITATION OF THE PRODUCTION CAPACITY OF AGRICULTURAL LAND IN RADUCANENI COMMUNE, IASI COUNTY

Oprea RADU[1], Daniel CUREA[2]

[1]"Ion Ionescu de la Brad" University of Life Science Iasi, 3 Mihail Sadoveanu Alley, Iasi, Romania
[2]OJSPA, 3 Dumbrava Rosie Street, Iasi, Romania

Corresponding author email: opricaradu@yahoo.com

Abstract

The efficient exploitation of agricultural lands and the obtaining of high productions depend on the biological material and the applied technology and, to a large extent, on the factors of environment, soil, climate, relief and hydrology. Soil fertility is affected to a greater or lesser extent by one or more restrictions, caused by natural factors and / or anthropogenic agricultural and industrial actions, which can often act in a negative way in a negative way. Research has shown that soil fertility in the Raducaneni territorial administrative unit is affected by the following limiting factors: surface erosion, deep erosion, landslides, gleyzation, stagnogleyzation, salinization and alkalization. If on the sloping lands the significant restrictive factors are the soil erosion and landslides, on the flat lands, from the River Jijia Meadow, the productive capacity of the agricultural lands is strongly diminished by gleyzation, salinization and alkalization.

Key words*: limiting factors, soil erosion, gleyzation, salinization, arable land.*

INTRODUCTION

The production capacity of agricultural lands is influenced by the complex of environmental conditions (soil, climate, relief, hydrology) and by the anthropic factors that intervene by modifying some natural factors or some properties of the plants.

The evaluation of agricultural lands represents a complex action of research and quantitative appreciation of the main conditions that determine the growth and fruiting of plants, to establish the degree of favorability of these conditions for each agricultural use.

Land valuation is not the same as soil quality assessment. Soil quality assessment is the process of assessing the ability of a soil to function. Due to the different soil functions, simply measuring an individual soil parameter is not enough (De La Rosa D., 2003).

In conditions of intensive land use, maintaining soil and land quality is a major challenge for increasing crop productivity.

Assessment of soil and land quality indicators is necessary to assess the state of degradation and changing trends of different land use and management interventions (Ray SK et al., 2014; Dumanski and Pieri, 2000; Bindraban et al., 2000).

MATERIALS AND METHODS

From a physical-geographical point of view, the administrative territory of Raducaneni is located about 40 km southeast of Iasi municipality (Figure 1), and from a geological point of view it is part of the wide area of the Moldavian Platform, from whose sedimentary cover erosion has uncovered Bessarabian formations (Middle Sarmatian), Chersonian (Upper Sarmatian) and Meotian, which has a slight inclination of approx. 7-8 m/km in the NNV-SSE direction (Ionesi et al., 2005; Jeanrenaud and Saraiman, 1995).

Raducaneni commune has a total area of 8739 ha, of which 6539 ha are agricultural land and 2200 ha are non-agricultural land. The agricultural area represents 75% of the total area of the territorial administrative unit and consists of 3863 ha of arable land, 956 ha of pastures, 840 ha of hayfields, 582 ha of vineyards and 298 ha of orchards. The mapped area is 6624 ha, consisting of 6539 ha of agricultural land and 85 ha of non-productive land.

The peculiarities and geomorphological processes in the territory of Raducaneni commune have been identified both by traditional research methods (field observations

and measurements, geomorphological mapping, statistical-mathematical processing, analysis, synthesis), as well as by modern methods based on GIS software.

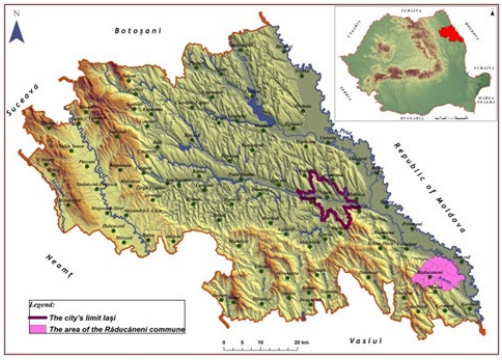

Figure 1. Geographical and administrative location of Raducaneni commune

The cartographic materials were obtained using TNTmips v.6.9 and QGIS, and the statistical processing was performed with Microsoft Office Excel 2007. An important step in spatial modeling was the realization of the Numerical Terrain Model (MNT) by vectorizing contours and elevations on topographic planes at a scale of 1: 5000.

Based on them, thematic maps were prepared regarding geomorphology, hypsometry, terrain slope, surface erosion, etc.

Climate maps were deduced by interpolation based on data covering the period 1950-2000 (Hijmans et al., 2005).

RESULTS AND DISCUSSIONS

Raducaneni commune is located in the eastern part of the Moldavian Plateau, more precisely on the northeastern branch of the Central Moldavian Plateau, in the Comarna-Raducaneni Hills subunit. The altitudes decrease, in general, from SW to NE, being between 414 m in Crasnita Hill and 26 m in Jijiei Plain (Figure 2).

According to the share of areas by hypsometric classes, the area with an altitude of less than 100 m has a share of 40.60%, of the surface of the communal territory of 8739 ha.

This area is located in the Prut-Jijia common meadow, on the middle-lower sections of the bottom of the main local valleys, as well as on the lower slopes of these valleys.

Overall, 54.77% of the surface of Raducaneni commune is at an altitude between 100 m and 300 m, and only 4.63% of the commune surface has altitudes over 300 m.

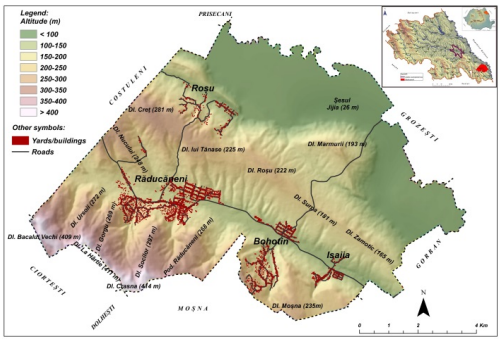

Figure 2. Altitude distribution

The main types of genetic relief in the studied area are those specific to the Central Moldavian Plateau, respectively: the lithological structural relief, the sculptural relief in general monoclinal structure and the river accumulation relief (Figure 3).

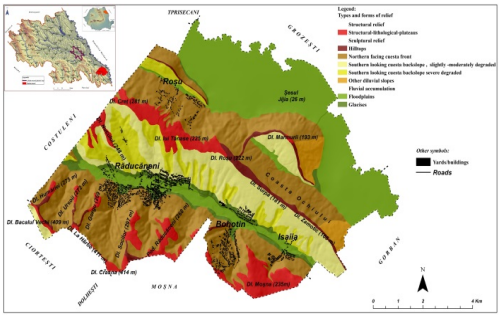

Figure 3. Geomorphological map of Raducaneni territory

The structural relief, restricted on 776 ha (8.88%) occupies the last place, subordinated to the sculptural relief and the fluvial relief of accumulation and is imposed by structural-lithological plateaus.

The sculptural relief (fluvio-denudational topography) in general monoclinal structure is the predominant genetic type as a distribution in the area of Raducaneni commune, because it occupies an area of 5281 ha, which represents 60.43% of the total area.

It is imposed by two specific forms, namely: sculptural interfluvial peaks and deluvial slopes. The interfluvial peaks have a small share, of only 2.31% (202 ha) of the total area.

On the other hand, the deluvial slopes represent the predominant form of local relief extending on 5079 ha, which represents 58.12% of the total surface of the studied administrative territory and plays the role of cuesta fronts (35.47%) and back slopes (20.35%).
The accumulation relief occupies the second place by weight, of 30.69% (2682 ha) and is represented by the common flood-plain Prut-Jijia, the flood-plain meadow of Bohotin and the alluvial-colluvial-proluvial glaciers.
The climate is temperate continental with shades of accentuated excessiveness, characterized by cold winters, relatively high humidity and high frequency of temperature inversions, and in summer the temperatures are high and the humidity low.
The masses of continental polar air are frequent all year round and sometimes there are extreme values of temperature and humidity of the air, caused by the penetration of tropical air from the south and arctic air from the north.
The average multiannual temperatures are between 8.2-10.2°C, increasing from the west of the territory to the east, being in correlation with the distribution of altitudes (Figure 4).

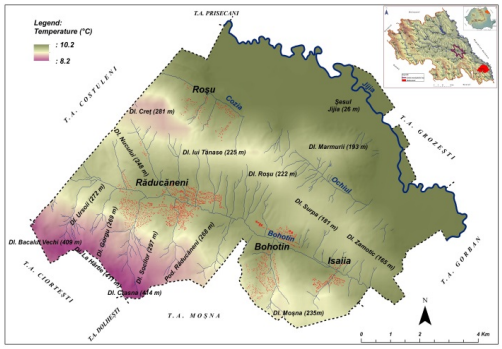

Figure 4. Temperature distribution

Also, the precipitations are correlated with the altitudes, the multiannual average values being between 532-612 mm (Figure 5).
The precipitation regime is uneven, during the year there are periods when the agricultural crops suffer due to the water deficit, as well as periods with excess humidity. The highest amount of precipitation is recorded in June. In the hot season, the precipitations have a pronounced torrential character, when there are showers of a special intensity, which favors the surface erosion of the soil.

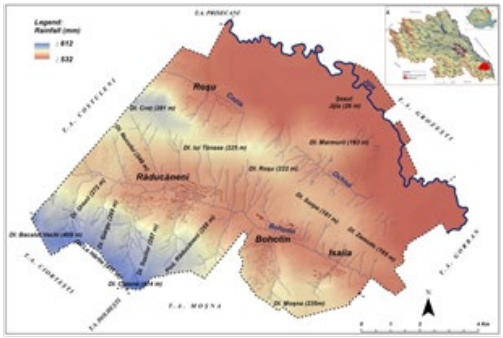

Figure 5. Rainfall distribution

From a hydrographic point of view, the territory of the commune belongs to the middle basin of the Prut, the main rivers being Jijia, Bohotin and Cozia.
The Jijia River drains the eastern extremity of the territory on a length of 19.7 km, with a strongly meandered riverbed due to the small slope, on average 1.4‰.
The Bohotin River drains the central-southern part in the NW-SE direction. Its main tributaries, on the right side, have a torrential character, strongly ravaged in the upper course, with large drainage slopes and a small receiving basin.
Following the mapping of the surface of 6624 ha, according to the Romanian Soil Taxonomy System (SRTS, 2012), 70 simple soil units and 6 complex soil units from the classes Protisols, Cernisols, Luvisols, Hydrisols and Antrisols were identified (Figure 6). These include six soil types and over thirty subtypes, divided into lower level categories based on physico-chemical and agro-productive properties.

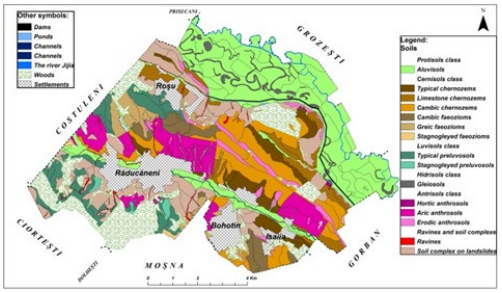

Figure 6. Distribution of soil types

The Cernisols class is the most widespread, comprising 1862 ha of chernozems and 515 ha of phaeozioms, representing 36% of the pedologically studied area. Protisols,

represented by aluvisols, are found on 2066 ha (31%). Next, the Antrisols class, with 1359 ha anthroposols, ranks third in weight, 21%, followed by the Luvisols class (677 ha preluvosols) 10% and the Hydrosols class has a weight of 2% (145 ha gleiosols).
The land fund is the expression of the natural conditions of the territory and forms the basis of economic and social activities in agriculture and forestry. It has undergone many changes as a result of socio-economic activities and a change in the legal framework of land.
In general, the distribution of uses is in accordance with the nature of the local pedo-climatic and pedo-geomorphological conditions (meadows, plateaus, interfluvial peaks, slopes, etc.) which allowed the agricultural lands and, within them, the arable lands to have the highest weight (Figure 7).

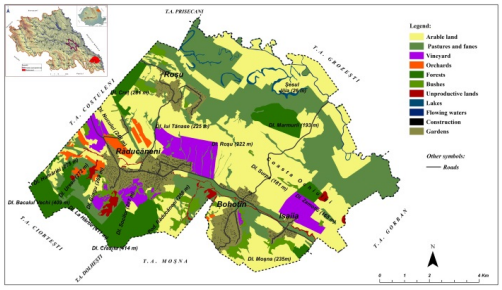

Figure 7. Distribution of use categories

Thus, out of the total area of 8739 ha of Raducaneni commune, 75% represent lands with agricultural use, of which the arable lands have the highest share, respectively 59%, followed by pastures with 15% and at a short distance hayfields with 13%, then vineyards with 9% and lastly orchards with 4%.
From the evaluation of the pedo-geomorphological properties of the lands results a series of limiting factors of the production that determine a series of restrictions in their agricultural use.
The restrictions refer both to the existing conditions, which diminish the harvests, and to the danger of the appearance, through exploitation, of some degradations with the same effects.
The relief by the degree of inclination of the land surface contributes to the differentiation of the surface and depth erosion, the triggering of landslides, the pleasing bottom of the valleys, etc.
The analysis of the slope inclination shows that a large area is relatively flat, spread over the common Prut-Jijia plain, the Bohotin plain, the narrow valleys of Cozia and Ochiului, the plateaus and the slopes on the slopes (Figure 8).
The surface of 2519 ha has slopes less than 5%, 1802 ha slopes between 5-10%, 2166 ha slopes of 10-15%, 1387 ha slopes of 15-20%, 635 ha slopes of 20-25%, and the surface of 230 ha has a slope greater than 25%.

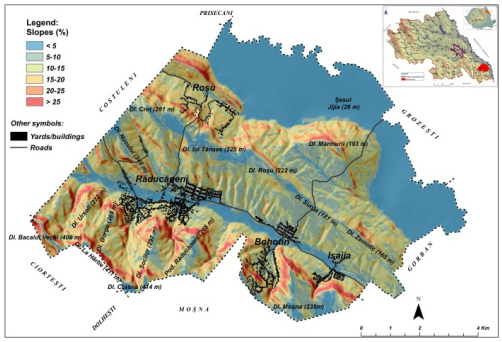

Figure 8. Land slope distribution

As the arable land has a large share in the agricultural area of the commune, 59% (3863 ha), Figure 9 shows its classification by slope classes.

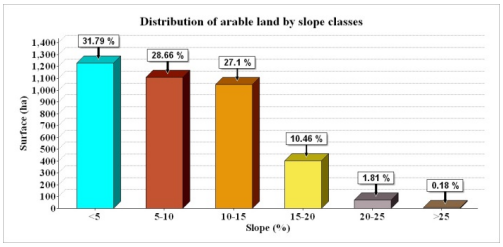

Figure 9. Distribution of arable land by slope classes

The surface of 2335 ha (60.45% of the arable land) has a slope of less than 10% and 1047 ha have a slope between 10-15%. In the slope range of 15-20% there are 404 ha and over 20% are exploited as arable 77 ha.
The intensity of the surface erosion is directly proportional to the degree of inclination and the shape of the slopes, their length and surface, being also influenced by the petrographic composition, the way of using the land, the vegetation cover, etc.

Surface erosion affects 3844 ha, which represents 58% of the pedologically mapped area. 1563 ha is affected by light erosion, 1488 ha by moderate erosion, 136 ha by strong erosion, 579 ha by very strong erosion and 78 ha by excessive erosion (Figure 10).

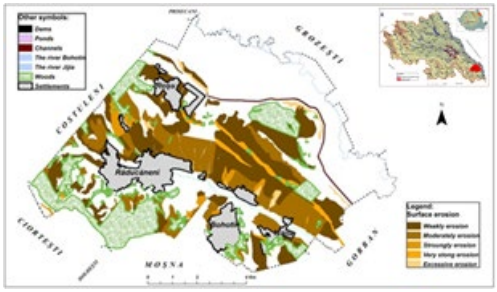

Figure 10. Distribution of surface erosion

Also, the relief, the lithological structure specific to the Central Moldavian Plateau and the anthropic activity led to the manifestation of landslides on 969 ha, of which 447 ha stabilized, 415 semi-active landslides and 107 ha active landslides.

Salinization and alkalization significantly diminish the production capacity of agricultural lands within the Raducaneni commune, being found in the common Prut-Jijia plain and the Bohotin plain.

Salivary fluvial deposits are responsible for the mineralization of groundwater located at shallow depths, which causes salinization and alkalization in the lower soil horizons, more pronounced in the upper horizons during the summer.

Salinization and alkalization affect an area of 1573 ha, which is about 24% of the pedologically mapped area. The surface affected by salinization is 1096 ha, of which 52 ha with poor salinization, 801 ha moderate and 243 ha strongly salinized (Figure 11).

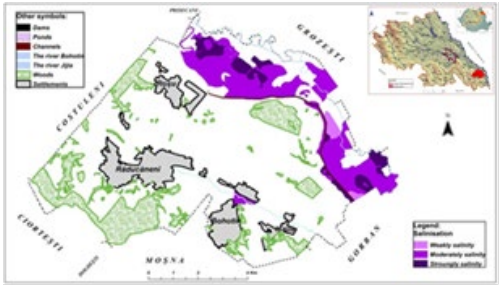

Figure 11. Distribution of soil salinization

The alkalization is manifested on 900 ha of which 771 ha with low intensity, 102 ha moderate and 27 ha strongly alkalized (Figure 12).

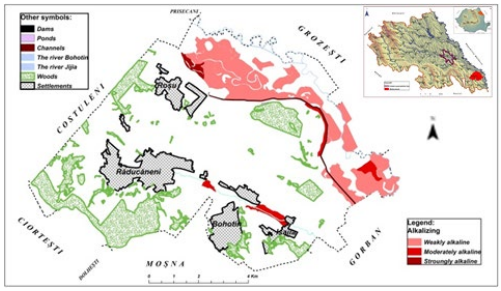

Figure 12. Distribution of soil alkalization

Of the arable land, within the commune, 396 ha are exploited on soils with moderate-strong salinization / alkalization (Figure 13).

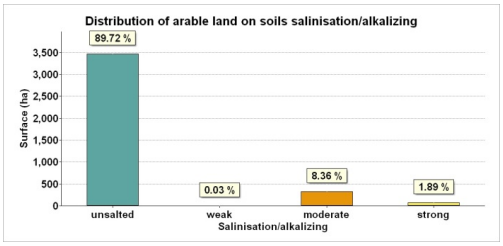

Figure 13. The share of salinization/alkalization on arable land

The presence of the groundwater level at critical depth in the conditions of a weakly deep, strongly meandering minor bed and of a weakly permeable lithological substrate determined that 2133 ha to present excess of phreatic humidity (Figure 14).

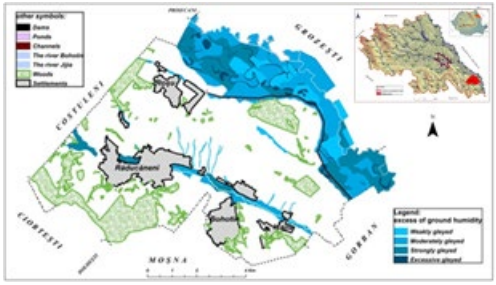

Figure 14. Distribution of gleyzation

Weak gleyed is manifested on 321 ha, moderate on 1019 ha, on 647 ha the soils are strongly gleyzation and 146 ha show excessive gleyzation.

Out of the surface of 3863 ha with arable use, on 240 ha there is weak gleyzation, on 503 ha moderate gleyzation and on 251 ha there is strong and excessive gleyzation (Figure 15).

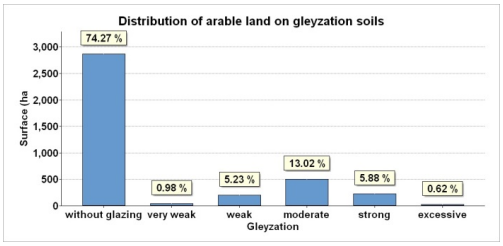

Figure 15. The share of gleyzation on arable land

The influence of the limiting factors on the production capacity of agricultural lands within Raducaneni commune, is highlighted by the low value, 40 rating points out of a maximum of 100, of the weighted average mark obtained for the total mapped area of 6624 ha, for use arable regardless of current use.

CONCLUSIONS

The overall morphography of the territory of Raducaneni commune is typical of the Central Moldavian Plateau, being formed by plateaus, interfluvial peaks and relatively deep, asymmetrical valleys, completed to the east by the Prut meadow.

Of the total surface of the territory, about 49% has a slope of less than 10%, 25% of the surface falls within the slope range 10-15%, 16% within the range 15-20% and 10% of the surface has a slope over 20% . Over 12% of the arable land area has a slope of more than 15%.

Soils of the class Cernisols (36%), Protisols (31%), Antrisols (21%), Luvisols (10%) and Hydrisols (2%) were identified on the mapped surface.

The main limiting factors of the production capacity of the agricultural lands within the Raducaneni commune are: surface erosion, salinization/alkalization and soil gleyzation.

Surface erosion affects 3844 ha of which 136 ha with strong erosion, 579 ha with very strong erosion and 78 ha with excessive erosion.

On the mapped surface, the salinization is manifested on 1096 ha, of which, on 801 ha it has a moderate intensity and on a strong 243 ha. The alkalization is manifested on 900 ha of which, with moderate intensity on 102 ha and on 27 ha strong manifestation.

On arable land, salinization and alkalization are moderate and strong on 396 ha, which represents 10% of the total arable land.

Excessive groundwater affects a total area of 2133 ha, of which 647 ha are heavily gleyzation and 146 ha are excessively gleyed.

On arable lands was identified the gleyzation on about 1000 ha, of which on 503 ha it is manifested moderately and on 251 ha it is manifested strongly and excessively.

In order to limit the production losses within the Raducaneni commune, it is recommended the exploitation on merged surfaces in order to apply the agro-improvement works and the advanced agricultural technologies.

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