LIMITATIVE FACTORS OF AGRICULTURAL LANDS FROM THE ADMINISTRATIVE TERRITORY OF RADUCANENI, IASI COUNTY

Oprea RADU[1], Daniel CUREA[2], Minodora AILENEI (RADU) [1]

e-mail: opricaradu@yahoo.com

Abstract

Land quality index is based not only on soil fertility, which is undoubtedly the most important factor, but also on climatic factors, landscape and hydrology. The administrative unit used in this study comes under the category of temperate climate, with a multi-annual temperature average of 9.4°C and a multi-annual rainfall average of 572.4 mm. The relief is typically hilly with altitudes ranging from 26 m in Jijia Plain and 414 m in Crasnita Hill. The hydrographical network is relatively dense, with the temporary stagnation of water in hollow areas and is part of the hydrographic basin of the middle River Pruth, the main rivers that drain the studied area being Jijia, Bohotin and Cozia. The analysis of the geomorphologic indicators concerning land gradient, landslides, deep erosion (gullies), as well as of the pedological indicators regarding organic matter content, soil reaction, soil texture, gleying/stagnogleying, salinization and alkalization, revealed that the soils in the area under survey are severely degraded. The productive capacity of the soil on the mapped area of 6624 ha is affected by surface erosion (58.04%), landslide (14.62%), gleying (32.20%), stagnogleying (0.59%), salinization and alkalization up to 23.75% of the surveyed area.

Key words: agricultural land evaluation, gleying, stagnogleying, erosion, landslide

The rational exploitation of soil resources requires an intimate knowledge of soil properties, but also of the features of all the environmental factors.

Fertility is the most important soil characteristic and it is defined by the whole set of physical, chemical and biological features that provide plants their nutrients during the vegetation period.

Soil fertility is affected more or less by one or more restrictions caused by natural factors and/or anthropogenic agricultural and industrial activities, which may often act synergically in a negative way (Lukianas A. *et al*, 2006; Hornbuckle J.W. *et al*, 2007; Burja C. *et al*, 2013). Their harmful influences are reflected in the deterioration of soil characteristics and functions, i.e. their bioproductive ability, with consequences on the quality of agricultural products and food security.

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 (Hera Cr., 2008).

The harmful effect of soil quality as a consequence of the negative influence of the factors regarding the climate, relief, hydrology, soil characteristics has been assessed under various intensities over 7.5 million ha of arable land, which represents around 80% of the arable surface of Romania (Dumitru M. *et al*, 2006).

MATERIALS AND METHODS

The territory of Raducaneni is, administratively, part of Iasi county, located in the south-eastern part of it, (*figure 1*), and geologically, it is part of the broader area of Platforma Moldoveneasca.

According to the Land Title and Survey Office from Iasi, the total surface area of the studied territory is of 8739 ha, out of which 6539 ha represents agricultural land and 2200 ha, non-agricultural land. Agricultural land represents 75% of the total surface area of the territorial and administrative division and it is made up of 3863 ha arable land, 956 ha meadows, 840 ha grasslands, 582 ha vineyards and 298 ha orchards.

The pedological study executed by the Office of Pedological and Agrochemical Studies

[1] *"*Ion Ionescu de la Brad*"* University of Agricultural Sciences and Veterinary Medicine, Iasi
[2] O.S.P.A., Iasi

from Iasi, in 2017, was carried out on a surface of 6624 ha, making up 6539 ha agricultural land and 85 ha of unproductive land.

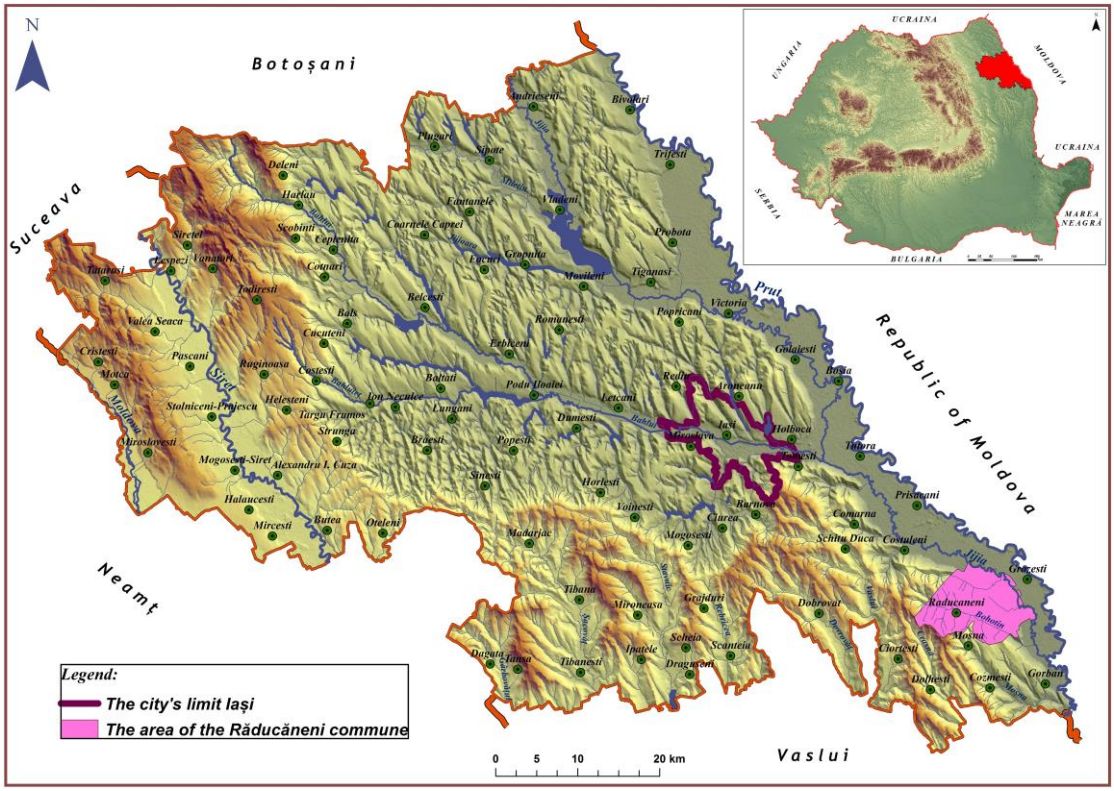

Figure 1 **Geographical and administrative position of Raducaneni commune**

The geomorphological features and processes of Raducaneni commune were identified both through traditional research methods (observations and field measurements, geomorphological mapping, statistical and mathematical processing, analysis, synthesis) and modern methods based 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.

RESULTS AND DISCUSSIONS

The pedo-climatic and geomorphological constraint in use of the Raducaneni commune lands requires thorough research of the soil fertility status and identification of the main limiting factors of the agricultural production in order to establish necessary agropedoameliorative measures for the proper implementation of the Code of Good Agricultural Practice.

Out of the multitude of environmental conditions, evaluation marks of farmland regarding natural conditions take into account the most important factors, namely: climate, topography, hydrology and soil.

a) Climate

The climate of the studied area is temperate-continental, partially excessive, characterized by cold winters and low temperatures, relatively elevated humidity and high frequency of temperature inversions, with high temperatures and reduced humidity in the summertime.

The masses of continental polar air are frequent all along the year and sometimes, there are extreme temperatures and dampness in the air, caused by the break-in of tropical air from the south and arctic air from the north.

The multiannual average temperature is 9.4°C, and the multiannual average rainfall is 572.4 mm. Rainfall distribution is uneven, with the highest registered quantity in June; there are times when agricultural crops get damaged, because of water shortage, as well as times of excessive humidity. During the hot season, it rains very heavily, especially during summer, when there are showers of extreme intensity, which favor surface soil erosion.

b) Landscape

The overall morphology of Raducaneni territory is specific to the Central Moldovenesc Plateau, since it is made up of plateaus, inter-river heights and relatively deep and asymmetric

valleys, completed by the Prut meadow in the east.

Altitudes are comprised between 26 m in Jijia Lowland and 414 m in Crasnita Hill. The region with altitudes under 100 m is the largest – 40.60% of the studied surface (8739 ha) and occupies the common meadow Prut-Jijia, middle-inferior sections of the bottom of the main local valleys, as well as the inferior slopes of these valleys. 54.77% of the surface can be found at altitudes comprised between 100-300 m, and the rest of 4.63%, at altitudes of over 300 m(*figure 2*).

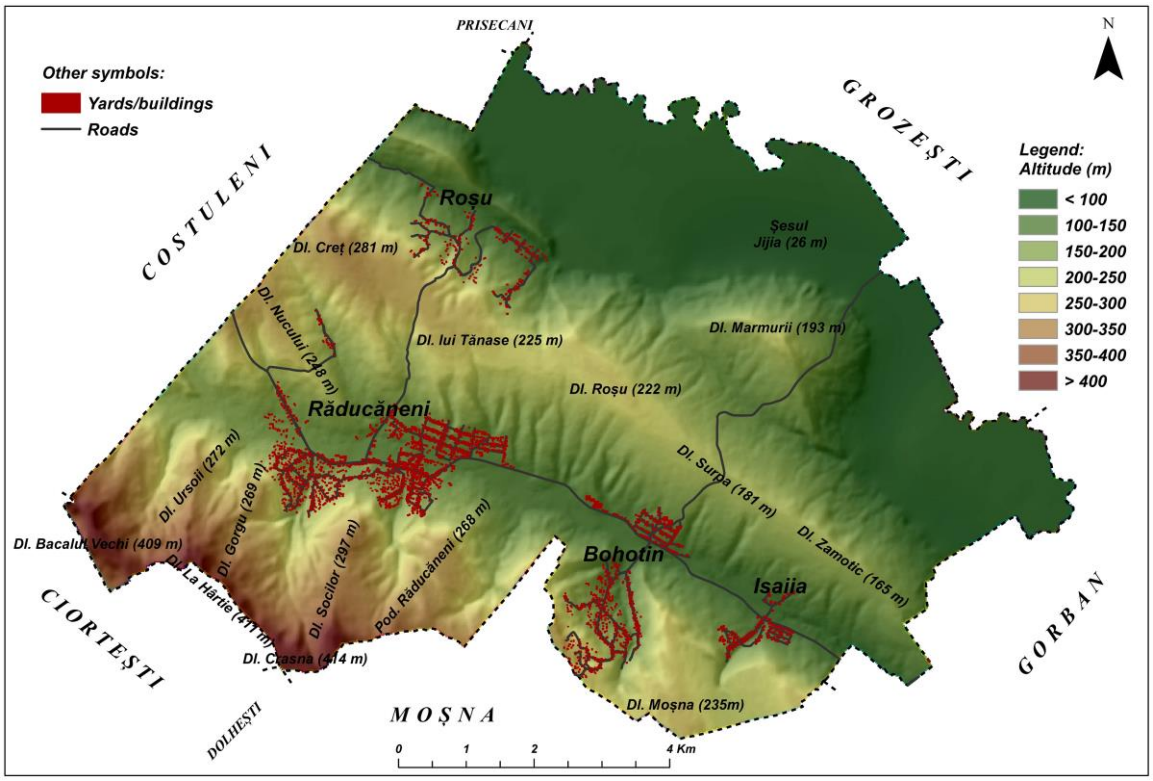

Figure 2 **Altitude distribution**

The landscape has an important role in determining the quality of the agricultural lands, taking into consideration the pitch angle of land surface with influence in differentiating between surface and deep erosion, landslides, valley-bottom aggradation etc.

In *figure 3*, there is the highest proportion – 28.82% (2519 ha) of the surface area, which belongs to the class of slopes smaller than 5%, spread on the common lowland Prut-Jijia, Bohotin lowland, narrow valleys of Cozia and Ochiului, plateaus and inclined stairs of the slopes.

In order of proportion, here come the classes of slopes according to their pitch angle: 10-15% (2166 ha – 24.79%), 5-10% (1802 ha – 20.62%), 15-20% (1387 ha – 15.87%), 20-25% (635 ha – 7.27%) and bigger than 25% (230 ha – 2.63%).

The high inclination of the land (>25%) is emphasized on the slope map by two lanes – the first one is well-defined and it is located on the right slope of Bohotin, in the west of Raducaneni, Bohotin and Isaiia. The second land has a reduced development and occurs as a slipping ledge on the hills of Bacalul Vechi, La Hartie and Crasnita.

The Basarabian lithological structure, specific to Moldavian Central Plateau, the relief made of a series of hills and hillocks, as well as the temperate continental climate and human activity are some of natural and anthropogenic factors contributing to 14.62% of the area be mapped pedologically, 968.66 ha, respectively, and be affected by landslides (*figure 4*).

Types of slides:

- stabilized landslides – 447.04 ha, representing 46.15% of surface affected by landslides;
- semi-active landslides – 414.76 ha – 42.82%;
- active landslides – 106.86 ha – 11.03%.

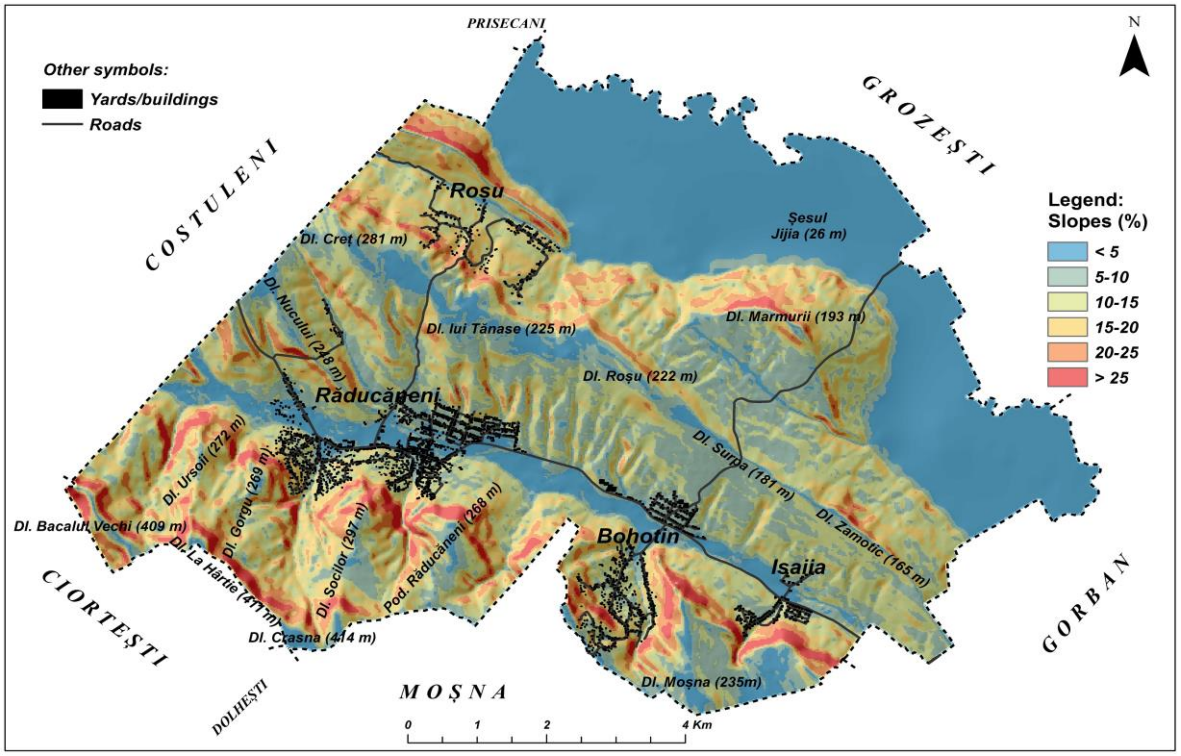

Figure 3 **Field declivity chart**

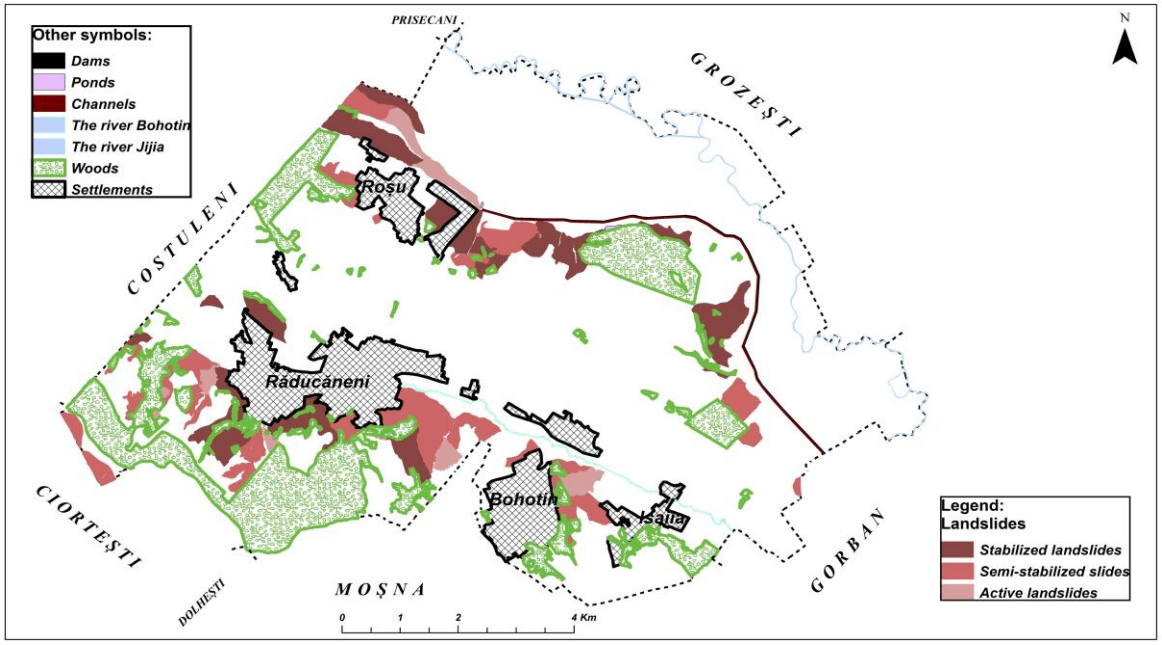

Figure 4 **Territorial distribution of landslides**

c) Hydrology

Hydrologically, the territory of Raducaneni belongs to the middle catchment of Prut, since the main rivers which drain the studied area are Jijia, Bohotin and Cozia.

Jijia river drains the eastern extremity of the territory, over a length of 19.700 km and has a medium slope of 1.4‰, also emphasized in the accentuated meander of the river.

Bohotin river drains the central-southern part, on the NV-SE direction. The most important tributaries are on the right side - Pietrele, Bazguta, Pagubosul, Hemeiosul, Chiriloaia and Isaiia – and are known for heavy rainfalls, are eroded in the upper course, with big drainage slopes and reduced water catchment.

d) Soil

From the evaluation of the pedo-geomorphological features of the land, it results a list of restrictive factors of production, which bring about a series of restrictions in their agricultural use. The restrictions refer both to the

existing conditions, which diminish the harvest, and to the damage risk causing the same effects.

Soil fertility from Raducaneni is affected by the following restrictive factors: surface erosion, deep erosion, landslides, gleization, stagno-gleization, salinization and alkalization.

Surface erosion intensity is directly proportional to the degree of inclination and shape of slopes, their length and surface, being influenced also by the petrographic composition, use of land, vegetation cover etc.

In Raducaneni village, erosion area occupies 3844.40 hectares, which is 58.04% of the mapped pedologic 6624 ha, out of which 1563.41 ha are affected by slow erosion, 1488.38 ha by moderate erosion, 135.54 ha by strong erosion, 579.42 ha by very strong erosion and 77.65 ha by excessive erosion (*figure 5*).

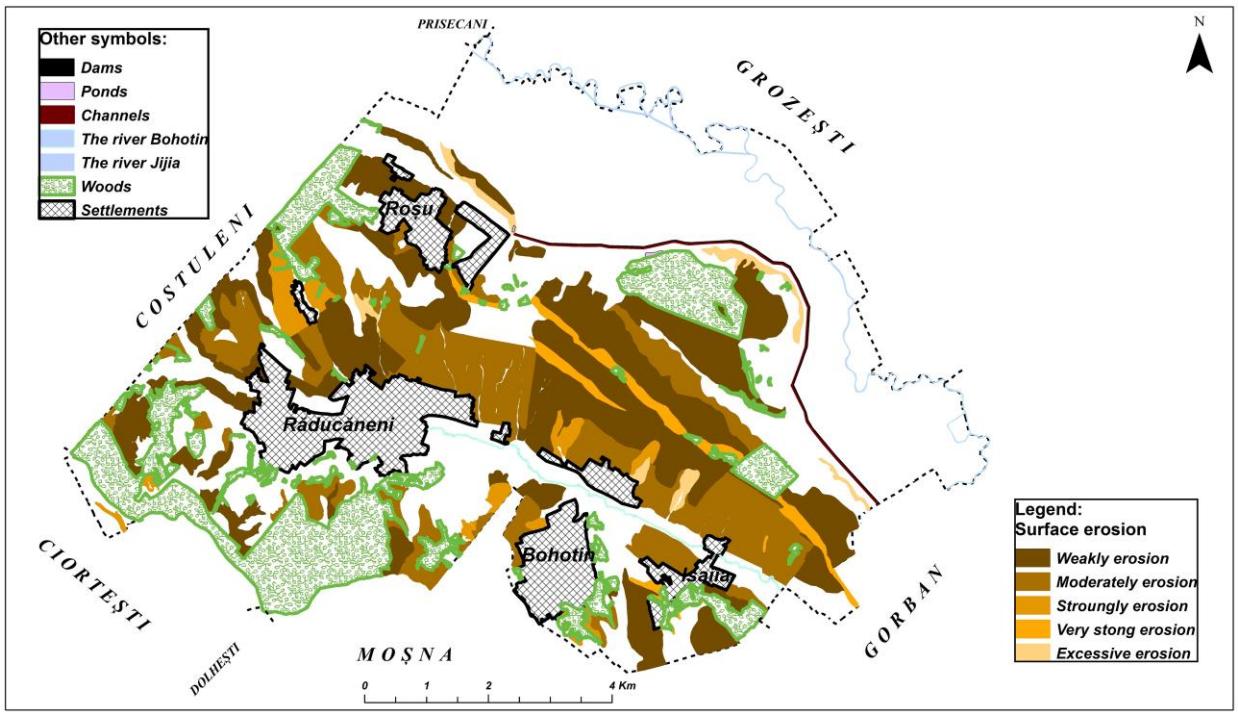

Figure 5 **Surface erosion distribution**

The presence of groundwater at a critical depth, in the conditions of a slightly immersed minor gully, extremely meandered and of a slightly permeable lithological substrate, caused groundwater-related humidity excess (*figure 6*) in 32.20% (2133.04 ha) of the pedologically mapped surface.

The intensity of phreatic water excess is, as follows:

- weak excess – 320.71 ha, 15.03% of mapped area, respectively;
- moderate excess – 1019.28 ha, 47.79%, respectively;
- strong excess – 646.58 ha, 30.31%, respectively;
- excessive phreatic excess – 146.47 ha, 6.87%, respectively.

Poor total porosity, low permeability and soil compaction are few of soil deficiencies caused by the presence of clay-rich horizons, so that 0.59% (39.44 ha) of mapped pedologic surfaces show a moderate stagnogleyzation.

Saliferous river depositions are responsible of the mineralization of groundwater located at shallow depth, which causes a salinization and alkalization in the lower horizons of the soils, more accentuated in the upper horizons, during summertime.

Salinization and alkalization affect a surface of 1573.12 ha, representing 23.75% of the pedologically mapped surface and it can be found in the common lowland Prut-Jijia and Bohotin lowland.

The intensity of salinization is, as follows:

- weak salinization – 52.14 ha;
- moderate salinization – 801.41 ha;
- strong salinization – 242.84 ha.

The intensity of alkalization is, as follows:

- weak alkalization – 771.71 ha;
- moderate alkalization – 102.32 ha;
- strong alkalization – 26.30 ha.

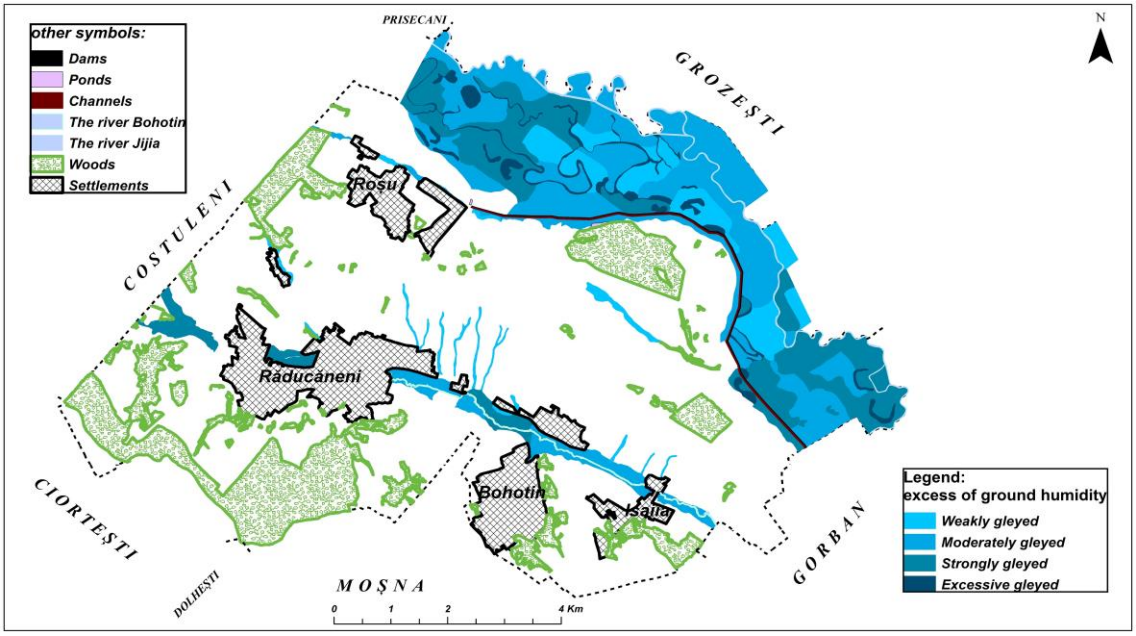

Figure 6 **Gleization distribution**

CONCLUSIONS

The land of Raducaneni is included, in terms of climate, in the temperate area, with a multiannual average temperature of 9.4°C and multiannual average rainfalls of 572.4 mm. These have a spatial distribution, directly connected to landscape configuration.

The landscape is typical hilly, with altitudes comprised between 26 m and 414 m and slopes of 10-15% over 25% of the surface of the commune, slopes of 15-20% over 16%, slopes of 20-25% over 7% and slopes bigger than 25% over 3% of the surface of the studied area.

Landslides were found on a surface of 969 ha, namely 15% of the mapped surface, out of which 415 are semi-active slides and 107 ha represent active slides.

The hydrographic network is relatively dense and belongs to the middle catchment of Prut River, and the main river draining the studied area are Jijia, Bohotin and Cozia.

Surface erosion affects 3844 ha, which amounts for 58% of the pedologically mapped surface of 6624 ha, out of which 136 ha display an increased erosion, 579 ha an extremely increased erosion and 78 ha an excessive erosion.

The pedo-climatic and geomorphological conditions have caused the manifestation of soil gleizations, salinization and alkalization on the land of Raducaneni. Gleizations affect 2133 ha, which amounts for 32% of the mapped surface, out of which 647 ha display a powerful gleization and 146 ha, excessive gleization. Salinization and alkalization are visible on 1573 ha, which represents 24% of the pedologically mapped surface.

REFERENCES

Burja C., Burja V., 2013 – *Sustainable development of rural areas: A challenge for Romania*. Environmental Engineering and Mangement Journal, 14 (8), 861-871.

Dumitru M. și colab., 2008 – *Evoluția principalilor parametri de monitoring al solurilor și terenurilor agricole.* Publicațiile SNRSS, editura Solness, Timișoara.

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

Hornbuckle J.W., Christen E.W., Faulkner R.D., 2007 – *Evaluating a multi-level subsurface drainage system for improved drainage water quality, Agricultural*. Water Managemnet, 89(3), 208-216.

Lukianas A, Vaikasas S, Malisauskas A., 2006 – *Water management tasks in the summer polders of the Nemunas Lowland*. Irrigation and Drainage 55(2), 145-156.