DATABASE OF AGRICULTURAL LAND QUALITY INDEX IN DRĂGUȘENI VILLAGE, IAȘI COUNTY

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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 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 lesser or greater extent by one or several restrictions determined either by natural factors, or by anthropical agricultural and industrial activities. The latter can act synergically, in a negative sense, resulting in a decreased soil quality and even in annulling their functions. The administrative unit used in this study comes under the category of temperate climate, with a multi-annual temperature average of 9.0°C and a multi-annual rainfall average of 560 mm. The landscape is typically hilly with altitudes of up to 310 meters. The hydrographic network is part of the lower basin of the Stavnicul river. It is relatively dense, characterized by intermittent watercourses and temporary pools in depression areas. The productive capacity of the soil on the agricultural land of 1729 ha, which constitutes the object of this study, is affected by surface erosion (48.66%), landslide (26.84%), gleization (12.19%), stagnogleyzation (5.89%) and salinization in 9.10%. The soils in Drăgușeni commune belong to the classes of Cernisols (65.07%), Luvisols (10.41%), Protisols (9.89%), Antrisols (7.40%) and Hydrisols (7.23%).

Keywords: 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.

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).

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. and collab., 2006).

MATERIAL AND METHOD

From an administrative point of view, the area of Drăgușeni belongs to Iași county and, geographically, it is part of Central Moldavian Plateau. The village of Drăgușeni, founded in 2004, by separating itself from the area of Șcheia town, made of Drăgușeni and Frenciugi villages, it is situated at about 35 km from Iași municipality, in the southern part of Iași County at the border with Vaslui County (*figura 1*).

The total area of Drăgușeni territorial administrative unit is of 2325 ha, out of which 1992 ha unincorporated and 333 ha residential land. Based on O.C.P.I. Department of Iași, the unincorporated land of the village includes 1678 ha of farmland 314 ha non-farmland land.

Soil survey was carried out by O.S.P.A. Iași in 2009 on the area of 1729 ha.

The geomorphological features and processes of Drăgușeni 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.

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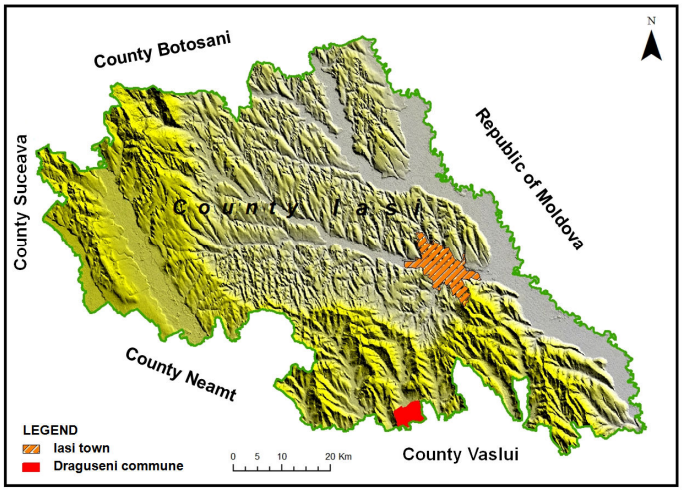

Figure 1 **Physical-geographical positioning of Drăgușeni commune**

RESULTS AND DISCUSSIONS

The pedo-climatic and geomorphological constraint in use of the Drăgușeni 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

To describe the climate of the area of Drăgușeni village, climate data from WorldClim – Global Climate Data „*Free climate data for ecological modeling and GIS*" (Hijmans et. al., 2005) have been used, and from Iași Weather Station.

The village has the temperate continental climate, joining the climate of the hilly Moldavian plateau, with forest influences in the northern part and steppe in the south.

The average yearly air temperature is 9.0°C, 9.5°C being recorded on the Stavnic plain, as well as on lower slopes up to the altitude of 200-250 m, from where it drops slightly to 8.5°C on peaks higher than 300 m (*figura 2*).

Also, the average annual temperature is between 8-9°C in the north of the village and between 9-10°C in the south.

Average multiannual rainfall is 560 mm and its spatial distribution closely follows the configuration of landscape, more abundant, with values of 574 mm, are spread over high peaks and, as we descend to Stavnic plain, rainfall has a slightly decreased values of about 547 mm (*figura 3*). Rainfall distribution is uneven; the highest rainfall was recorded in June, with periods when crops suffer from water scarcity and periods of excess moisture. During the warm season, rainfall has a strong torrential nature, especially in summer, when high intensity showers are recorded, favoring surface soil erosion.

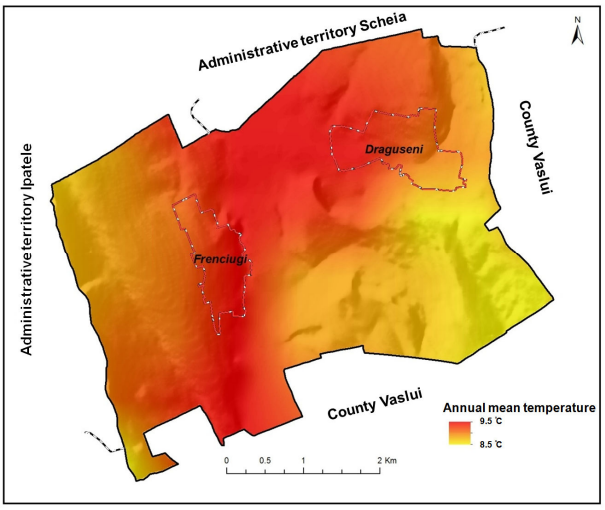

Figure 2 **Average yearly temperature map**

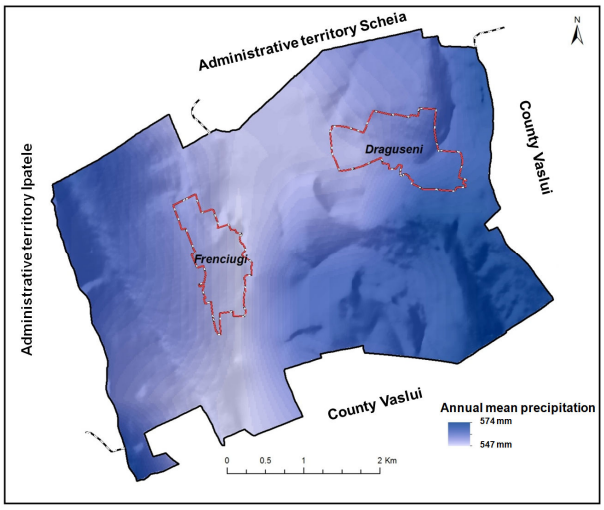

Figure 3 **Average multiannual rainfall map**

b) Landscape

The landscape is typically hilly with altitudes of up to 310 meters. The altitude has a decrease in western (300-310 m) and eastern (280 m) frames of the village, both in the NS direction and towards the center of the village, crossed by Stavnic plain, where altitudes fall below 150 m. On the Southwestern frame of the village, a Basarabian erosion marker is required, the Frenciugi Hill with altitude of elevation of 310 m, from where it decreases towards south (*figura 4*).

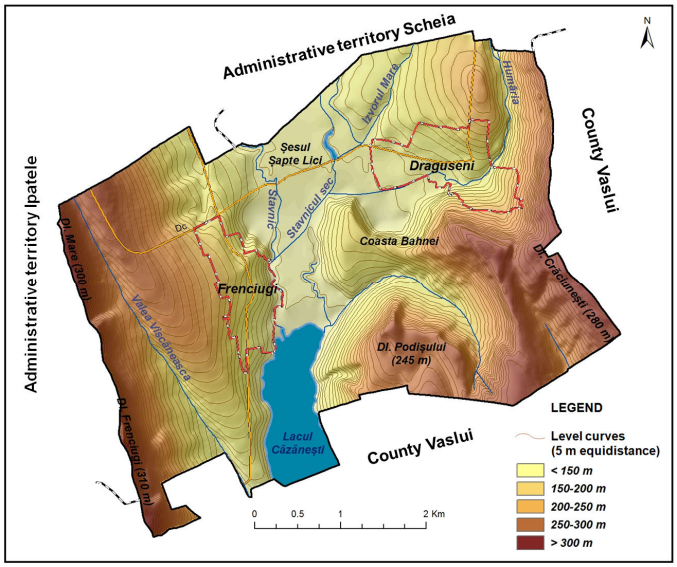

Figure 4 **Altitudinal distribution of map**

Sculptural relief (river-denudational) having the general monoclinal structure is the main type of relief found on the territory of Drăguşeni followed by the accumulative relief.

Closely linked to the evolution of the valley adjacent to Stavnic, it is monoclinal to Moldavian plateau, mostly carved, 89% of the area (1957 ha) is located at altitudes below 250 m and only 11% (249 ha) at an altitude of 250 m (Figura 5).

The landscape has a major influence on agricultural land evaluation marks by the degree of inclination of the ground surface. In terms of slopes, Stavnic lowland, narrow valleys and plateau peaks have slopes lower than 5% (615 ha), while the highly-upper part of slopes, occupied mostly by landslides, displayed over 20% (222 ha). The middle and lower part of slopes, from 150 m to 250 m has slopes between 5-20% over an area of 1369 ha (*figura 6*).

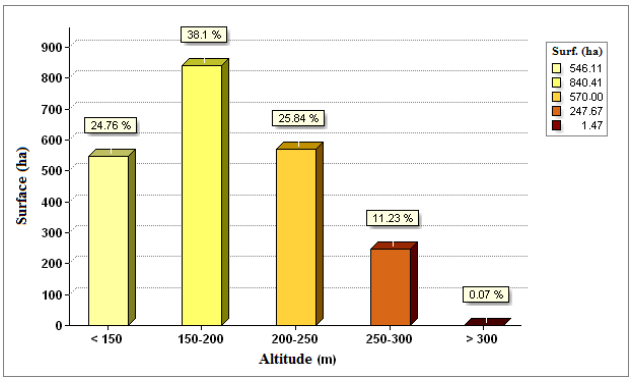

Figure 5 **Share altitudes**

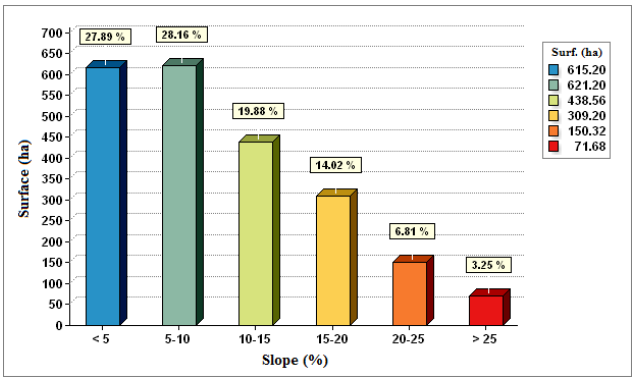

Figure 6 **Share slopes**

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 26.84% of the area be mapped pedologically, 464 ha, respectively, and be affected by landslides (*figura 7*).

Types of slides:

- stabilized landslides – 453.54 ha, representing 97.75% of surface affected by landslides;
- semi-active landslides – 8.00 ha – 1.72%;
- active landslides – 2.46 ha – 0.53%.

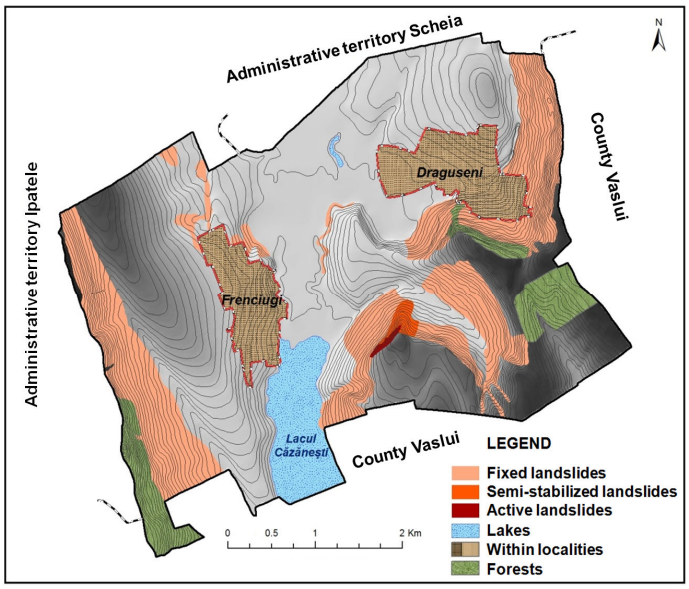

Figure 7 **Territorial distribution of landslides**

c) Hydrology

From a hydrographic perspective, the territory of Drăguşeni village belongs to the lower basin of Stavnic from the middle basin of Bârlad river (*figura 8*). Stavnic feeds mainly from rainfall and snow falling into the pluvial-nival and moderate underground type of feed.

The territory of Drăgușeni village is also drained by Valea Vâscănească, Stavnicul Sec, Izvorul Mare, Humăria creeks and headwaters of Crăciuneşti stream.

High waters occur in early spring when more than 36% of the annual volume is transported. Floods are most frequent during summer and depend on torrential rains. Low water period is quite long, starting from late summer to early spring.

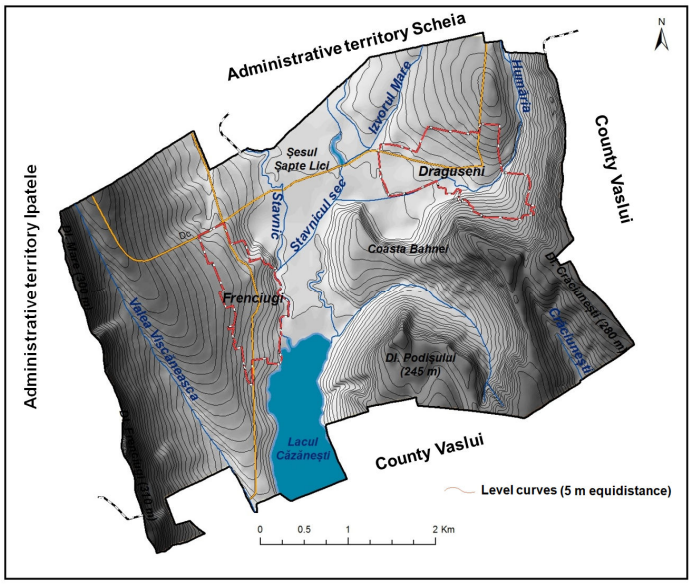

Figure 8 **Hydrographic map of the village Drăgușeni**

Stavnic creek with irregular bed floods in spring or as a result of torrential rains the surrounding areas, usually, in areas of tributary streams detachment where a broad plain of about 2 km has appeared.

Groundwater is closely related to physico-geographical and geological conditions. From this point of view, we can distinguish groundwater in eluvial materials on inter-rivers located at various depths and that contribute to a small degree to the formation of leakage to rivers, groundwater in diluvio-colluvial deposits participating more in river feeding and groundwater in fluvial materials located at different depths, in some places causing soil gleyzation and in other places swamps.

d) Soil

Soil fertility in the village of Drăguşeni is affected by the following limiting factors: surface erosion, gleyzation, stagnogleyzation and salinisation.

The alternation of rocks, monoclinic structure composed of clay and slightly loose sand made erosion fairly easy to install, affecting limestone and sandstone from the upper part.

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 Drăguşeni village, erosion area occupies 841.29 hectares, which is 48.66% of the mapped pedologic 1729 ha, out of which 627.60 ha are affected by slow erosion, 106.18 ha by moderate erosion, 46.06 ha by strong erosion and 61.45 ha by excessive erosion (Figura 9).

The presence of groundwater level at critical depth in case of a weakly deepened minor bed and a weakly permeable lithologic sublayer completed with the presence of Căzăneşti accumulation lake caused for 12.19% (210.84 ha) of the pedologically mapped area display an excess of phreatic moisture (*figura 10*).

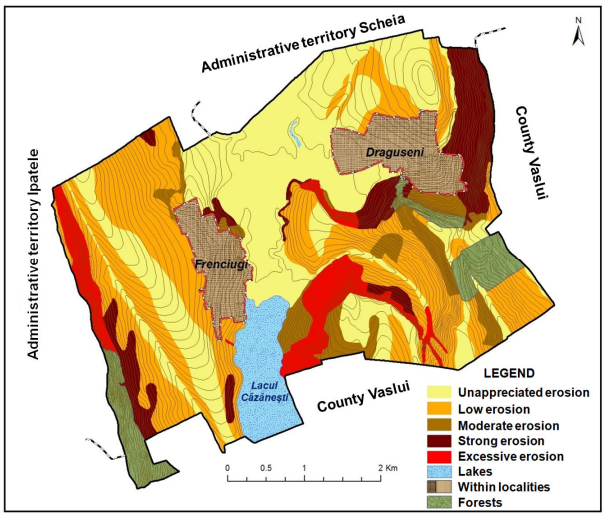

Figure 9 **The distribution of surface erosion**

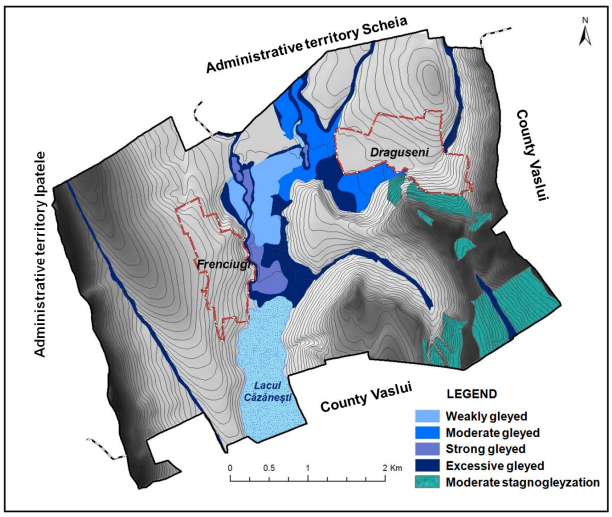

Figure 10 **Soil gleying and stagnogleying distribution**

The intensity of phreatic water excess is, as follows:

- weak excess – 50.00 ha, 3% of mapped area, respectively;
- moderate excess – 70.00 ha, 4%, respectively;
- strong excess – 23.00 ha, 1%, respectively;
- excessive phreatic excess – 68.00 ha, 4%, respectively.

Poor total porosity, low permeability and soil compaction are few of soil deficiencies caused by the presence of clay-rich horizons, so that 5.89% (101.84 ha) of mapped pedologic surfaces show a moderate stagnogleyzation.

Salt fluvial deposits are responsible for phreatic water mineralization located at low depth, which causes light salinization of soils in lower horizons, deeper, however, even in superior horizons during summer.

Salinisation affects an area of 157.30 ha, representing 9.10% of the mapped pedologic surface, being encountered mainly on Stavnic plain and also on narrow valleys draining the area.

Soil inventory of the territorial administrative unit Drăguşeni was made based on the Romanian System of Soil Taxonomy (RSST) in 2012.

On the area of 1729 ha, 23 ground units of simple soil and 6 units of complex units from the following classes have been identified: Protisols, Cernisols, Luvisols, Hydrisols and Antrisols.

Soils from the class Cernisols, occupy the largest surface of 1125 ha which represents 65.07%, Luvisols occupy 180 ha (10.41%), Protisols class occupy 171 ha (9.89%), Antrisols class 128 ha (7.40%) and Hydrisols are found on a surface of 125 ha representing 7.23% of the total mapped surface.

To assess soil classification, the classification was completed with ecological issues by recording edaphic parameters, degradation risks and also by grouping soil units by pedoclimatic micro-zones, namely, by including the thermo-hydric criteria into soil classification.

CONCLUSIONS

From an administrative perspective, the territory of Drăgușeni village belongs to Iași county and, geographically, it is part of the Central Moldavian Plateau, a physico-geographical subunit of Plateau of Moldavian Plateau.

The village has the temperate continental climate, joining the climate of the hilly Moldavian plateau, with forest influences in the northern part and steppe in the south.

The average yearly air temperature is 9.0^{o}C and the average multiannual rainfall is of 560 mm, with a spatial distribution in direct correlation with landscape configuration.

The landscape is typically hilly with altitudes of up to 310 meters, the largest surface of 1411 ha (64%) is located from altitudes between 150-250 m, 249 ha (11%) to altitudes of over 250 m and 546 ha (25%) at altitudes lower than 150 m.

Land has slopes lower than 10% on a surface of 1236 ha (56%), slopes between 10-20% on 748 ha (34%) and slopes higher than 20% on a surface of 222 ha (10%).

Landslides were identified on a surface of 464 ha, 27% of mapped land, respectively, out of which, 454 ha are stabilized landslides and 10 ha are semi-active and active landslides.

The hydrographic network is relatively dense and belongs to the lower basin of Stavnic from the middle basin of Bârlad river, fed mainly from rainfall and snow falling into the pluvial-nival and moderate underground type of feed.

Surface erosion was recorded on 841 ha representing 49% of pedologically mapped surface of 1729 ha, out of which, 628 ha are affected by slow erosion, 106 ha by moderate erosion, 46 ha by strong erosion and 61 ha by excessive erosion.

Pedo-climatic and geomorphological conditions determined weak gleization on 3% (50 ha), moderate gleization on 4% (70 ha), strong-excessive gleization on 5% (91 ha), stagnogleization on 6% (102 ha) and salinisation on 9% (157 ha), out of pedologic mapped area.

Soils found on the territory of Drăgușeni village belong to the following classes: Cernisols on 1125 ha (65.07%), Luvisols on 180 ha (10.41%), Protisols on 171 ha (9.89%), Antrisols on 128 ha (7.40%) and Hydrisols on 125 ha (7.23%), aut of total mapped surface.

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