THE QUALITY OF AGRICULTURAL LANDS IN DRĂGUȘENI COMMUNE, IAȘI COUNTY

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Abstract

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. All lands enjoy natural fertility, which originates in the soil genesis process, as well as artificial fertility, which is the result of human intervention in the natural soil evolution consisting of agricultural improvement measures. Agricultural land quality is determined by assessment, according to which, in Romania, agricultural land belongs to five quality classes differentiated based on their assessment grades. The assessment study is conducted on various agricultural lands, which should be as homogeneous as possible from the viewpoint of their environmental factors and vegetation factors. In the territorial-administrative unit of Drăguşeni, the 23 simple land units and the 6 complex land units identified, belonging to the Protisols, Cernisols, Luvisols, Hydrisols and Antrisols classes, were divided according to slope and exhibition in elementary land units, resulting in 90 ecologically homogeneous territories (TEOs), of which 45 are simple TEOs and 45 are complex TEOs. Based on the evaluation carried out for the 90 ecologically homogeneous territories, the territory studied fits into the 2nd, 3rd, 4th and 5th quality classes of arable land. From the total area of 1729 ha covered, the largest surface of 631 ha (36.50%) comes into the 3rd quality class. The surface of 534 ha (30.88%) and 161 ha (9.31%), respectively, belong to the lower quality classes, namely the 4th and 5th. Finally, the surface of 403 ha (23.31%) is included in the 2nd, upper quality class.

Keywords: agricultural land quality assessment, ecologically homogeneous land, soil units

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. 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.

Teaci D. et al. (1985), defines agricultural land quality assessment as the "complex operation of thorough knowledge of plant growth and fructification conditions and the determination of the favorability of these conditions for each use and crop, by means of a system of technical indices and assessment grades."

The value of crops and the net cadastre revenue, for long periods of time, may be determined scientifically by cadastre assessment methods applied to agricultural land, thus preventing the undesirable consequences of approximations relying on uncertain data.

MATERIAL AND METHOD

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

The total area of Drăguşeni territorial administrative unit is of 2325 ha, out of which 1992 ha unincorporated and 333 ha residential land, based on O.C.P.I.

Based on O.C.P.I. Department of Iaşi, in 2009, the structure of unincorporated land use of the village was as follows: arable land 1144 ha, grassland 402 ha, meadows 126 ha, vineyards 6 ha, woods 114 ha, waters 129 ha, roads 18 ha, buildings 2 ha and unproductive land 51 ha. Mapped area is 1729 of ha, being made of agricultural and unproductive land.

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The geomorphological features and processes of Drăguşeni 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.

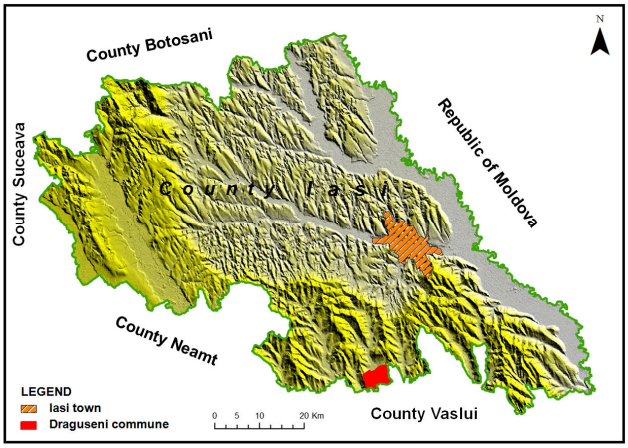

Figure 1 **Physical-geographical positioning of Drăguşeni commune**

The assessment of the evaluation coefficients on different intensity degrees of the soil degradation factors, the evaluation and arrangement of the fields according to quality classes, for arable usage, were performed according to the "Methodology for Drafting the Soil Studies" part II, I.C.P.A. Bucharest-1987, by using BDUST software, version 9.5.

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

Since the production capacity of the fields modifies under the influence of the natural factors, but mostly because of the human intervention, the evaluation must be updated on a permanent basis.

A basic requirement for the performance of agricultural land quality assessment works is the existence and use of pedological maps.

Based on the soil mapping of the agricultural land in Drăguşeni territorial and administrative division, there are 23 simple soil units and 6 complex soil units (composed of 12 simple soil units), belonging to the following soil classes: Protisols, Cernisols, Luvisols, Hydrisols and Antrisols (*figure 2*).

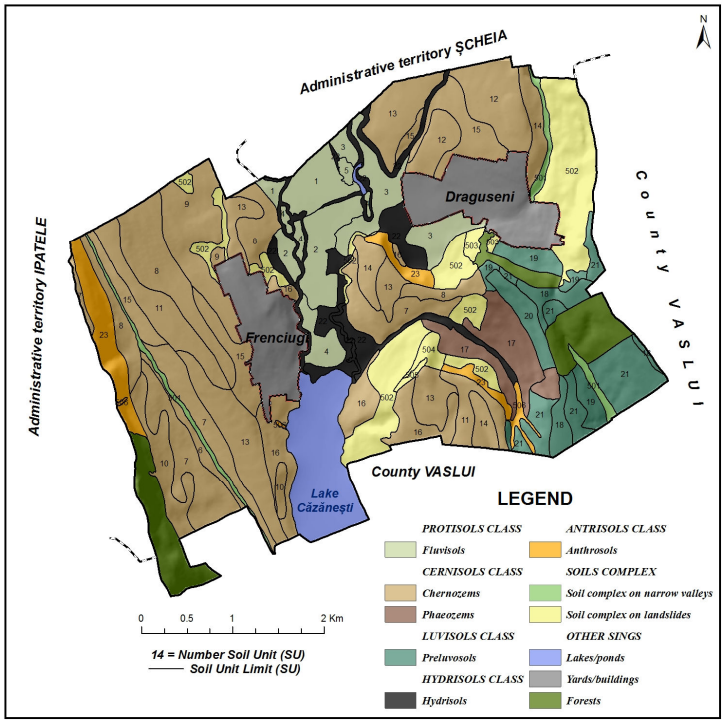

Figure 2 **Map of soil units (SU)**

Simple soil units US 1-US 5 are of fluvisols type from the Protisols class, US 6-US 16 are of chernozems type and US 17 of phaeozems type from Cernisols class, US 18-US 21 of preluvosols from Luvisols, US 22 hydrosols from Hydrisols class and US 23 of anthrosols from Antrisols class.

US 501 complex soil unit found in narrow valleys, in some areas with bank breaks is represented by 60% hydrosols and 40% chernozems. In areas of stabilized landslides, US 502 soil unit was identified represented by 75% chernozems and 25% anthrosols, respectively, and US 503 soil unit composed phaeozems 30% and preluvosols 70%. US 504 is identified in the area of semi-active landslides made of 70% chernozem and 30% anthrosols, US 505 is identified in the active landslides area made of 20% chernozems and 80% anthrosols and US 506 of anthrosols type was identified on gully erosion.

The identified soil units were divided, according to the cliff and view, into elementary field units, homogenous from the perspective of all the soil and field features, called ecological homogeneous territories (TEO's). The ecological homogeneous territory represents the basic unit for which the bonitation grades, the quality classes, the favorability classes, the reliability classes, etc. are calculated, based on the indicators.

Regarding land slopes, Stavnic lowland, narrow valleys and plateau peaks have slopes under 5%, while the upper part of slopes occupied mainly by landslides are over 20%. The middle and lower part of slopes with altitudes between 150 m and 250 m have slopes between 5-20% (*figure 3*).

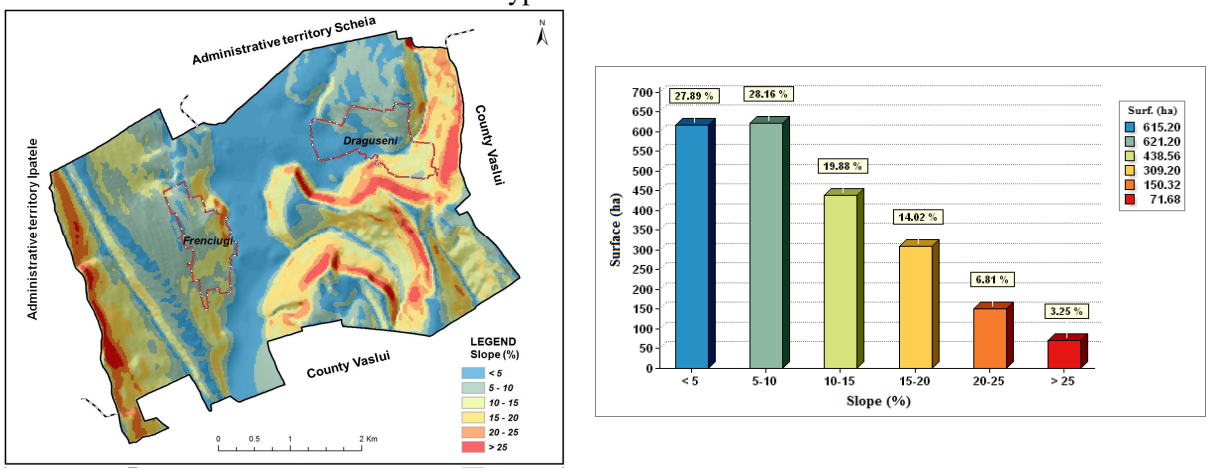

Figure 3 **Field declivity chart and slopes weight**

It was also found that about 2/3 of surface (1236 ha) has a slope lower than 10%, surface of 439 ha has a slope between 10-15%, 309 ha have slopes between 15-20% and 222 ha over 20%.

Land positioning is important in the process of pedogenesis due to differences in rainfall and heat that result in specific features of soils. Therefore, on sunny slopes (S-SV) and semi-sunny (V-SE) that receive a larger quantity of solar radiations and, therefore, are more heated and dry, soils have a thinner profile than soils on shaded slopes (N-NE) and semi-shaded (E-NV). On studied area, shaded slopes (N-NE) have a share of 28% (620 ha), semi-shaded (E-NV) 19% (423 ha), sunny slopes (S-SV) occupy 29% (645 ha), and semi-sunny slopes (V-SE) spread over 24% (518 ha) of the surface of Drăguşeni village (*figure 4*).

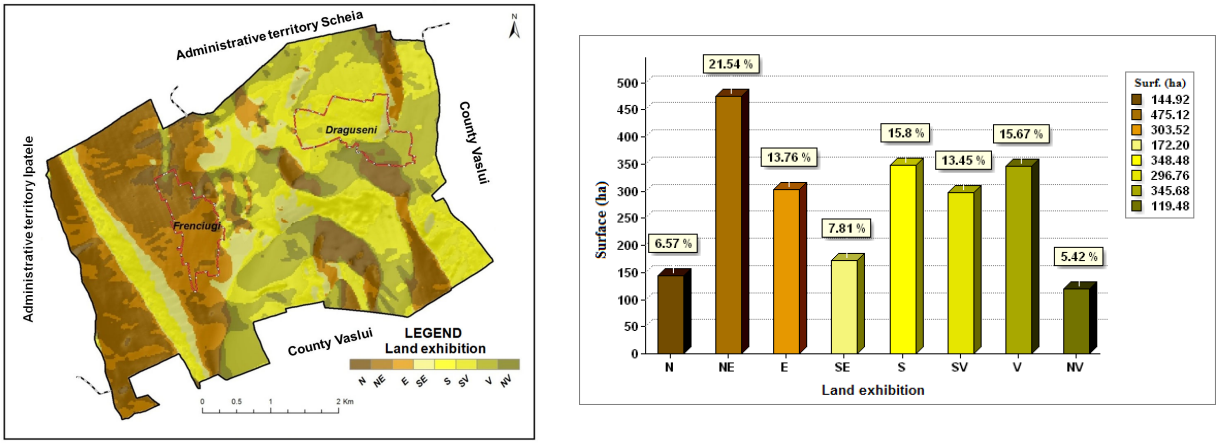

Figure 4 **- Field view chart and weight**

As a consequence of this fragmentation of the field, resulting in 90 ecologically homogeneous territories (TEOs), of which 45 are simple TEOs and 45 are complex TEOs., at the level of which we performed the computing of the bonitation grades, according to cultures and usages, for natural conditions, on the studied territory there being no arrangement and amelioration work of the fields. For that purpose, we extracted the coefficients corresponding to the bonitation indicators in the Methodology for Drafting the Soil Studies- part II, drafted by the I.C.P.A. Bucharest, in 1987, Annexes 3-2,…, 3-18.

Gleyzation is one of the indicators affecting the productive capacity of land in the Drăguşeni village. Weak gleyzation is found on 50 ha (3%), out of pedologically mapped surface, does not affect the 8 crops (wheat, barley, corn, sunflower, potato, sugar beet, soy and peas/beans) that are considered in giving the evaluation marks for arable use and moderate gleyzation on 70 ha (4%), strong gleyzation on 23 ha (1%) and excessive on 68 ha (4%), affects the above mentioned crops by 0.1-0.3 points, being a negative feature especially the excessive gleyzation.

Salinization is a limiting factor that appears together with gleyzation on land of Stavnic plateau affecting crops with quality coefficients of 0.7-0.9, even of low intensity on soil surface.

Field declivity is another important indicator in determining the bonitation grades of the fields in Drăguşeni village, the presence of these declivities diminishes the favorability of the respective surfaces, favoring soil erosion, affecting other properties of the soil.

By analyzing the bonitation coefficients for the declivity of the field, according to the Bonitation Methodology of the Agricultural Fields, we can notice that they vary within very large limits, according to the declivity. Therefore, for the declivities up to 10%, the annual plants which can be bred and the vegetables are slightly penalized with 0.1 points, while straw cereals bear well this declivity of the fields. Once with plants growth, the eight cultures taken into account become more and more sensitive to the declivity of the fields, so that the declivities of more than 25% are penalized with 0.7-0.9 points.

Moreover, landslides presence penalizes the cultures according to the type and intensity of the sliding phenomena. The stabilized landslides occupying a surface of 454 ha, representing 26% of the soil mapped surface (1729 ha), can be successfully used for the straw cereals culture by enforcing the appropriate agricultural soil ameliorative works, penalizing them with 0.2 points only, but these are less recommended for the potato and sugar beet cultures, penalized with 0.4 points.

The fields affected by semi-active, active landslides and gully erosion occupying 18 ha, namely 1% of the soil mapped surface are completely contraindicated for agricultural plants culture.

The bonitation grade for natural conditions, according to usages and cultures, was achieved by multiplying by 100 the product of the coefficients of the 17 indicators, which participate in a direct manner in the determination of the bonitation grade.

$$\mathbf{Y = (x_1 \cdot x_2 \cdot x_3 \cdot ... \cdot x_{17}) \cdot 100}$$

where: Y – is the bonitation grade, according to the usage or culture;

x_1, x_2, x_3, ..., x_{17} – represent the coefficients for the bonitation indicators.

At the soil units' level, the bonitation grade was computed as weighted average of the bonitation grades corresponding to the ecological homogeneous territories comprised.

Based on the obtained bonitation grades, the result is that the mapped surface of 1729 ha of the Drăguşeni territorial and administrative division, of Iaşi county, frames within the II-nd, III-rd, IV-th and V-th quality classes, for the arable usage category (*figure 5*).

II class land quality (61-80 points) occupy a surface of 403 ha and represent 23.31% of mapped surface. These are fertile, deep soils, having a medium or mid-fine texture, with good or medium permeability that are weakly affected by degradation phenomena (salinization, erosion, excessive moisture, etc.) found on flat surface or slightly inclined under favorable temperature and rainfall conditions for crops.

These areas are found to the north of residential land of Drăguşeni on the peak of interfluves plateau, therefore, these have slopes under 5% or slight slopes of 5-10% on cambic uneroded or slightly eroded chernozems on the surface of V and NV in Frenciugi, on the slightly inclined peak of interfluves with slopes of up to 10%, on uneroded proxicalcaric or slightly eroded chernozems on the surface. Also, these are also found on Stavnic higher plateau, batigleic mollic proxicalcaric fluvisols, therefore, with a slight gleyzation in the soil depth.

Indicators used in giving land quality evaluation marks with coefficients between 0.8 and 0.9 are of climate, geomorphologic and hydrogeological nature such as: temperature and rainfall, low inclination of land and groundwater depth of over 5 m.

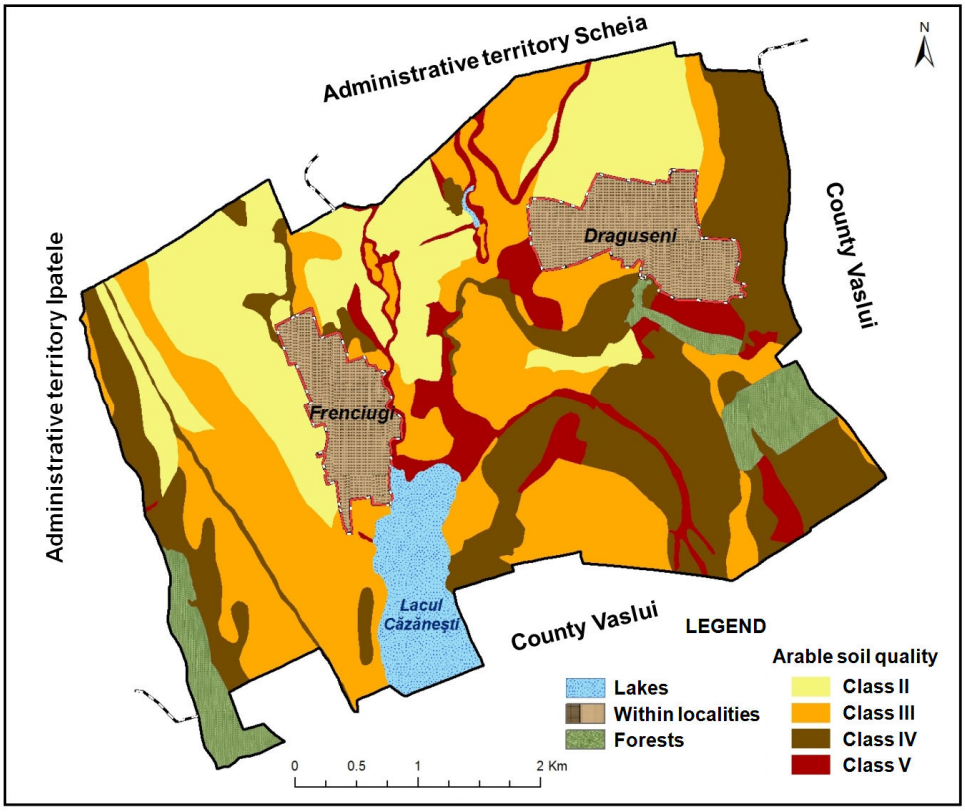

Figure 5 **Distribution of arable land quality classes**

Class III land quality (41-60 points) occupies 631 ha (36.50%) and includes medium fertile soils, deep and moderately deep, with medium texture, roughly-medium or fine, moderately affected by degradation (salinization, acidification, erosion, excess moisture, etc.), this is found on flat or medium inclined surfaces under moderately favorable temperature and rainfall conditions for crops.

Land of this class are spread whether on peaks of interfluves plateau or on slopes of up to 15%, on proxicalcaric cambic or cambic degraded chernozems and on Stavnic plateau, on weakly gleyzed or weakly salinized fluvisols.

Indicators used in giving land quality evaluation marks with coefficients between 0.7-0.9 are temperature, rainfall, weak salinization, phreatic water depth of over 5 m (except the plateau), land slope and weak reserve in hummus.

Class IV land (21-40 points) occupy 534 ha (30.88%) are weakly fertile soils, often skeletal or having rough rock at low depth, with varied texture (rough to fine), highly affected by degradation phenomena (salinization, acidification, erosion, active, landslides, excess moisture, etc.) found in less favorable conditions for agricultural crops.

Land is distributed mainly on stabilized landslides with steep slopes between 15-25%, with low humus content, even with strong and excessive erosion on surface, with clay/argile texture.

Class V land (1-20 points) occupies 161 ha, 9.31% of totally mapped surface and includes weakly fertile land, improper for arable use, heavily affected by degradation phenomena (erosion, excess moisture, etc.)

Active landslides, gully erosion, narrow valleys with excessive groundwater, microdepressive areas of Stavnic plateau with shallow groundwater belong to this class, land is heavily degraded by excessive erosion in the area, excessive gleyzation, strongly alkaline reaction and low content of humus for soils of active landslides and gully erosion.

Table 1 presents the bonitation grades and the quality classes, for the arable usage, on the 23 simple soil units and the 6 complex soil units.

The analysis of table 1 shows that US 1, US 2 soil units of Protisols class, US 8, US 9, US 12 and US 15 soils of Cernisols belong to class II, in which highest marks for land quality have been given to arable use land.

To class V of land quality belong US 19 of Luvisols and US 22 of Hydrisols class, as well as soil complexes from semi-stabilized landslides (US 504), active landslides (US 505) and gully erosion (US 506) where has been recorded the lowest evaluation mark of land quality.

Low quality of farmland of Drăguşeni village is shown by the average weighted mark of 44.91 on the total mapped area of 1729 ha that includes this area into class III quality.

Table 1

The bonitation grades and the quality classes, according to soil units, for arable usage

Nr. crt.	US	Surf. (ha)	The bonitation grad	The quality class	Nr. crt.	US	Surf. (ha)	The bonitation grad	The quality class
1	1	35	78	II	16	16	81	45	III
2	2	45	74	II	17	17	72	35	IV
3	3	62	49	III	18	18	31	52	III
4	4	25	45	III	19	19	35	19	V
5	5	4	28	IV	20	20	22	30	IV
6	6	12	56	III	21	21	86	30	IV
7	7	139	52	III	22	22	107	15	V
8	8	114	65	II	23	23	65	23	IV
9	9	65	66	II	24	501	30	22	IV
10	10	43	35	IV	25	502	204	25	IV
11	11	74	56	III	26	503	8	25	IV
12	12	68	70	II	27	504	9	14	V
13	13	156	56	III	28	505	3	14	V
14	14	51	50	III	29	506	7	14	V
15	15	76	66	II					

CONCLUSIONS

23 de units of simple soil and 6 units of complex soil from Protisols, Cernisols, Luvisols, Hydrisols and Antrisols classes have been identified in Drăguşeni village. Chernozems and phaeozems occupy 65% preluvosols 11%, fluvisols 10%, hydrosols 7% and anthrosols 7% of areas,

Strong fragmentation of land has led to delimitation within soil units of 90 environmentally homogenous territories (EHT), out of which 45 simple and 45 complex EHTs that have been used for calculating the land quality evaluation mark for use and crop sunder natural conditions.

Under pedo-geomorphologic conditions in the studied area, land quality indicators that strongly affect the evaluation marks for land use and crops are: land inclination, landslides, gleyzation and salinization.

The mapped area of 1729 ha falls for land use into II, III, IV and V classes of quality. The largest area of 631 ha (36.50%) falls into III class of quality, 534 ha (30.88%) fall into the III category and to IV and V lower quality classes, 161 ha (9.31%), respectively and 403 ha (23.31%) to II higher quality class.

Soil, climate, landscape and hydrologic conditions require an efficient use of land, implementation of modern crops technologies, use of adequate agricultural machinery and higher quality biological material. Also, it is recommended that land shall be exploited by using crops that obtained high quality marks and also these shall contribute to prevention and fight against soil erosion and landslides.

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