

AGRICULTURAL LAND QUALITY IN ION NECULCE COMMUNE, IAȘI COUNTY

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Abstract

Fertility is the most important soil characteristic and is defined by all its physical, chemical and biological features, which provide the plants with the necessary amounts of nutrients during their vegetation. Land generally has a natural fertility formed during the soil genesis process and an artificial fertility which is the result of human intervention, in the natural soil evolution, by breeding improvement measures. Agricultural land quality is determined by land quality and productivity assessment, according to which agricultural land in Romania is classified in five quality categories. Land quality and productivity assessment is conducted on land areas as homogeneous as possible from the viewpoint of its environmental conditions and vegetation factors. In the Ion Neculce administrative-territorial unit, the 76 simple soil units and 14 complex soil units identified, belonging to the Protisoils, Cernisoils, Luvisoils, Hydriisoils, Salsodisoils and Antrisoils classes, were included, depending on their slope and exposure, in elementary land units, which resulted in 340 simple ecologically homogeneous territories and 91 complex ones. Relying on the land quality and productivity assessment grades calculated for the 431 ecologically homogeneous territories, we decided that the surveyed land belonged to the arable use category, i.e. to II, III, IV and V quality classes. 48% of the total mapped area of 6338 ha belongs to the lower quality classes, namely IV and V, 39% to the III quality class and only 13% to the higher II 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 viewpoint, the Ion Neculce Commune territory belongs to Iași County,

whereas geographically, it is located on the southern border of the Jijia Hilly Plain, where the latter meets the Iașilor Flank, which determined the complexity of the natural factors and their numerous combinations.

The Ion Neculce Commune includes the Ion Neculce, Războieni, Gănești, Buznea and Prigoreni villages and is located to the west of the county, about 40 km from Iași City (*figure 1*).

The total area of the Ion Neculce administrative territorial unit is 7148 ha, of which 6300 ha of agricultural land and 848 ha of non-agricultural land. In its turn, the agricultural land is made up of 3988 ha of arable land, 1801 ha of grazing land, 377 ha of grass land, 94 ha of vineyards and 40 ha of orchards, whereas the non-agricultural land comprises 456 ha of forests, 187 ha of waters, 91 ha of communication means, 76 ha of courtyards with buildings and 38 ha of non-productive and degraded land.

The soil survey conducted by O.S.P.A. Iași was carried out on 6338 ha, which include both agricultural and non-agricultural land in the commune. The geomorphological features and processes of Ion Neculce commune were identified both through traditional research methods (observations and field measurements, geomorphological mapping, statistical and mathematical processing, analysis, synthesis) and

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modern methods based on GIS software. 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.

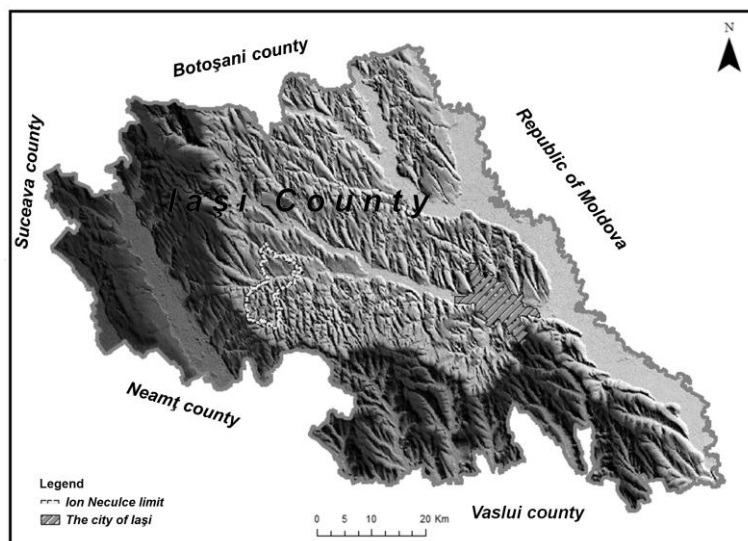


Figure 1 Geographical and Administrative Location of Ion Neculce Commune

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 DISCUSSION

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

On the 6338 ha mapped area in the Ion Neculce administrative territorial unit, we identified 76 simple soil units and 14 complex soil units belonging to the following soil classes: 69.45% Chernisoils, 14.04% Antrisoils, 9.91% Protisoils, 3.40% Luvisols, 1.92% Hydrisoils and 1.28% Salsodisoils (*figure 2*). Chernozems make up 69.12% of all the soils, phaeozems 0.33%, anthrosols and technosols 14.04%, alluvial soils 9.91%, preluvosols 2.23%, luvosols 1.17%, gleysols 1.92%, solonchaks 0.13% and solonetztes 1.15% of the entire mapped area.

The simple US 1-US 14 soil units are of the alluvial soil type of the Protisoils class, US 17-US 56 and US 62 of the chernozem type and US 57-US 60 of the phaeozem type of the Chernisoils class, US 61, US 63 of the preluvosol type and US 64 of the luvosol type of the Luvisols class, US 65-US 67 gleysol of the Hydrisoils class, US 68 of the solonchaks type and US 69-US 72 of the solonetztes type of the Salsodisoils class, US 73-US

76 of the anthrosol type and US 15-US 16 of the technosol type of the Antrisoils class.

The complex US 701-US 703 units are soil combinations occurring in narrow valleys, US 704-US 706 occur in the stabilized landslides area, US 707-US 709 in the semi-active landslides area, US 710, US 711 in the active landslides area, US 712 in the borrow pit area and US 713, US 714 are to be found in the gullies area.

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.

As concerns the land gradient in the Ion Neculce Commune (*figure 3*), 2078.45 ha have slope gradients below 5%, 1569.25 ha slope gradients ranging from 5 to 10%, 1451.79 ha slope gradients ranging from 10 to 15%, 1197.60 ha slope gradients ranging from 15 to 20%, 672.48 ha slope gradients ranging from 20 to 25% and 178.17 ha slope gradients exceeding 25%.

In the surveyed area, the shady versants with N-NE exposure (*figure 4*), which take up an area of 2208 ha, i.e. 31% of the total surface area of the commune, are predominant. The semi-shady (E-NV) versants rank second, with an area of 1552 ha (22%), the sunny (S-SV) versants take up 1851 ha (26%) and the semi-sunny (V-SE) versants take up 1537 ha (21%).

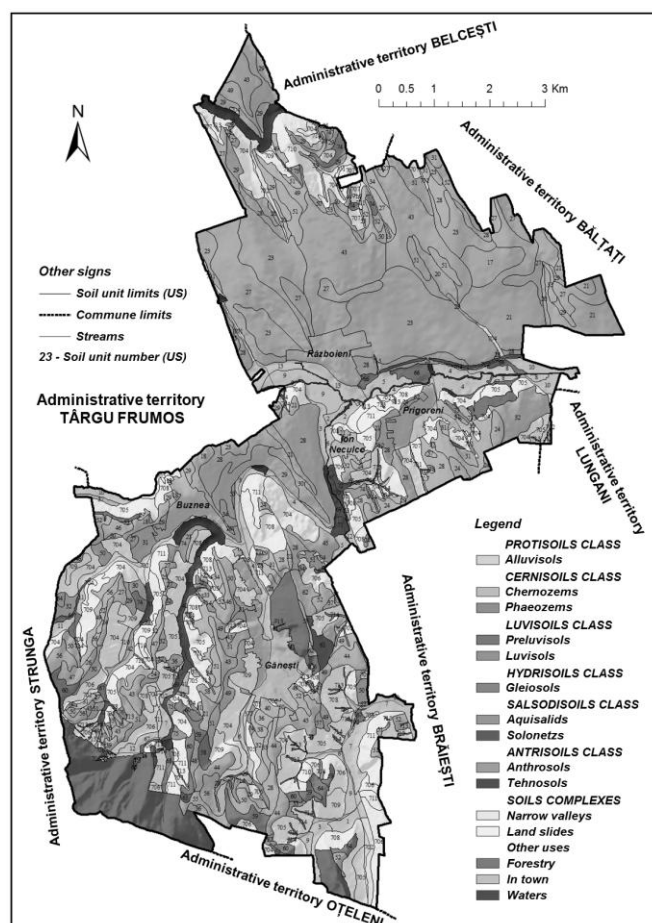


Figure 2 Soil Units Map (SU)

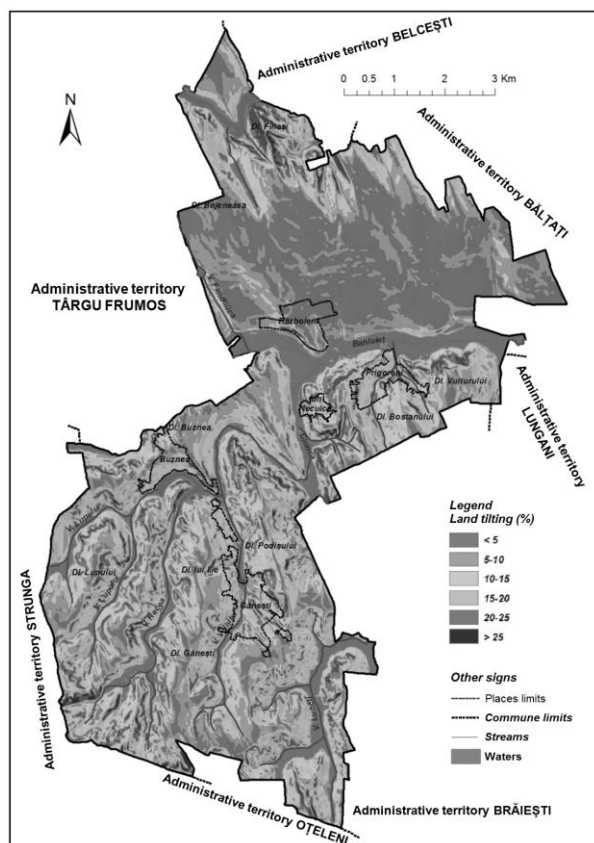


Figure 3 Land Gradient Map

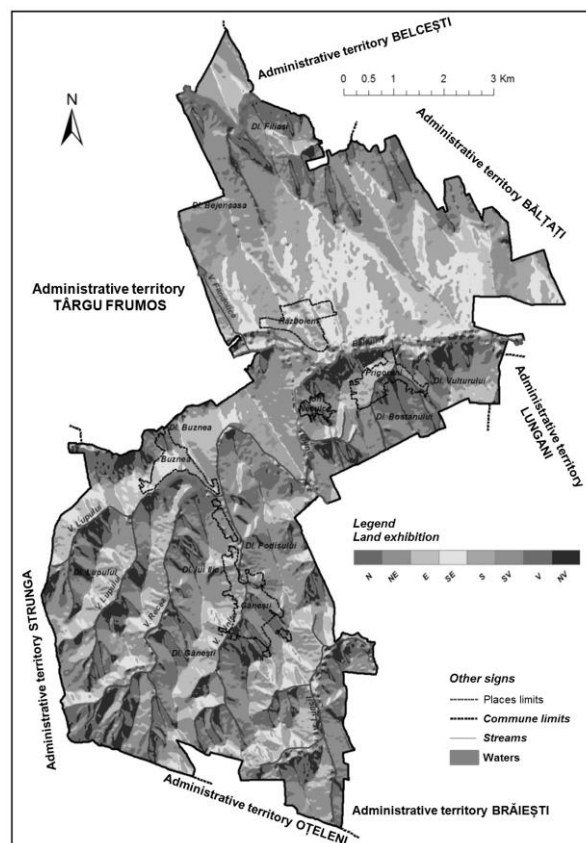


Figure 4 Land Exposure Map

As a consequence of this fragmentation of the field, resulting in 431 ecologically homogeneous territories (TEOs), of which 340 are simple TEOs and 91 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.

Land gradient is an important indicator when establishing the land quality and productivity grades. Its presence diminishes the favourability of those areas by soil erosion and soil properties impairment.

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 1075 ha, representing 17% of the soil mapped surface (6338 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 (418 ha), active landslides (265 ha) and gully erosion occupying 71 ha, namely 12% of the soil mapped surface are completely contraindicated for agricultural plants culture.

Salinization and alkalization are important indicators which diminish the quality of the agricultural land in the Ion Neculce Commune, due to the fact that a large area is affected, more precisely 1664 ha, i.e. about 26% of the mapped area, by penalizing crops at mild intensity by land quality and productivity assessment coefficients of 0.7-0.9, at moderate intensity by 0.4-0.7, at strong intensity by 0.1-0.3 and at excessive intensity by coefficients of 0.1.

The mild gleying affecting 208 ha (23%) of the mapped area does not penalize the 8 crops (wheat, barley, maize, sunflower, potato, sugar beet, soy and peas/beans), which are considered when establishing the arable land quality and productivity grade, yet the moderate gleying occurring on 224 ha (25%), the strong gleying affecting 359 ha (40%) and the excessive gleying present on 103 ha (12%) penalize the abovementioned crops by 0.1-0.3 points, as gleying, and especially excessive gleying, is an unfavourable characteristic.

The land quality and productivity assessment grade in natural conditions, on crops, was calculated by multiplying by 100 the product of the coefficients of the 17 indicators, which are directly involved in the establishment of the land quality and productivity grade.

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

The arable land quality and productivity grade was calculated with the observance of the regulations in force, as the arithmetic mean of the grades of the 8 most frequent crops: wheat, barley, maize, sunflower, potato, sugar beet, soy and peas/beans.

Based on the obtained bonitation grades, the result is that the mapped surface of 6338 ha of the Ion Neculce territorial and administrative division, of Iași county, frames within the II-nd, III-rd, IV-th and V-th quality classes, for the arable usage category (*figure 5*).

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.

Thus, we found that 48% of the mapped soils exhibit very severe and extremely severe agricultural production limiting factors and that they belonged to the 4th and 5th quality classes, which means a rather high percentage of poorly and very poorly fertile soils.

Good and moderately good arable soils make up 52% of the mapped area and they are included in the 2nd and 3rd quality classes.

The land included in the 2nd quality class (61 - 80 points) takes up 841 ha (13% of the mapped area); these are fertile and deep soils, with moderate or moderate-fine texture, with good or middle-reduced permeability, which are barely affected by degradation phenomena (salinization, erosion, excessive humidity, etc.), located on flat

or slightly sloping land, in temperature and precipitations conditions which are favourable for crops.

These soils are to be found on the left versant of the Bahluiet River, north of Războieni, on the interfluvial plateau peaks south of Buznea and Gănești, i.e. with slopes below 5% or with slight slopes ranging from 5 to 10%, on cambic chernozems or non-eroded or mildly eroded surface limestone chernozems.

The indicators involved in establishing the land quality and productivity assessment grade with coefficients ranging from 0.8 to 0.9 are of climatic, geomorphologic and hydrogeologic nature, such as temperature and precipitations, mild land gradient and water table depth exceeding 5 m.

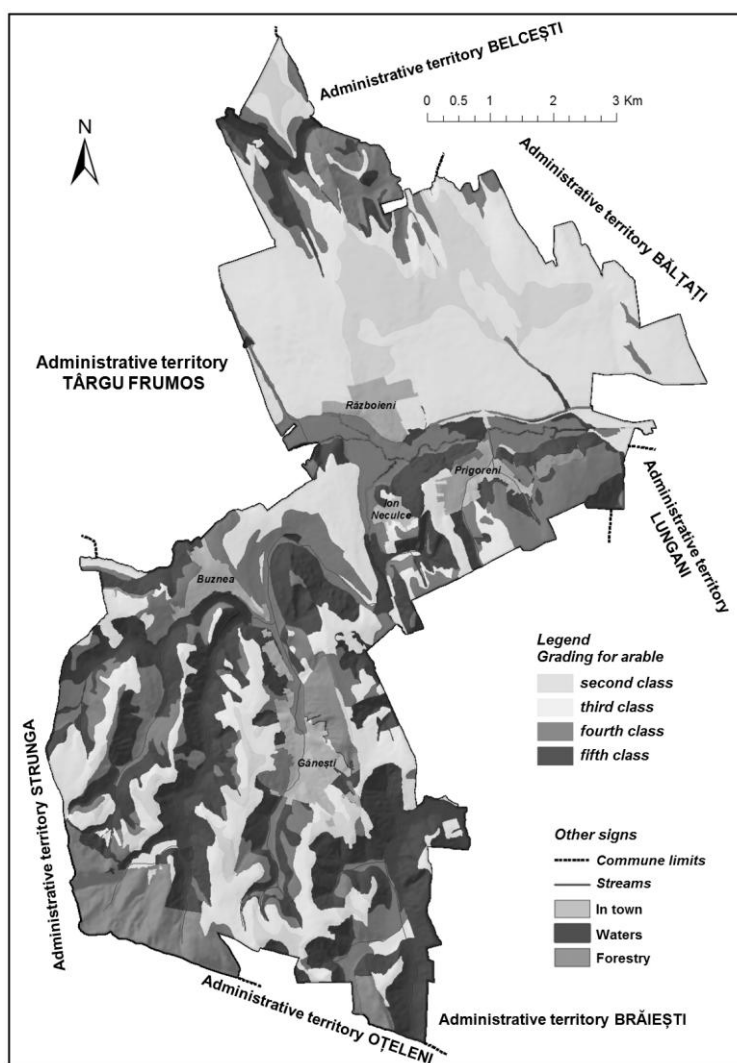


Figure 5 Map of Arable Land Quality Classes

The land included in the 3rd quality class (41 - 60 points) takes up 2460 ha, i.e. the highest percentage (39%) of the mapped area, and includes moderately fertile, deep or moderately deep soils, with moderate, moderate-coarse or fine texture, which are moderately affected by degradation phenomena (salinization, acidification, erosion, excessive humidity, etc.), located on flat or moderately sloping land, in temperature and precipitations conditions which are moderately favourable for crops.

The soils included in this class occur on the mildly sloping interfluvial peaks, on versants with slopes of up to 15%; the biggest area is found on the Bahluiet River terrace on the left versant, on proxicalcaric, cambic and regraded cambic chernozems.

The indicators establishing the land quality and productivity assessment grade with coefficients of 0.7-0.9 with temperature and precipitations, water table depth of over 5 m, land slope and poor humus reserve.

The land included in the 4th quality class (21 - 40 points) takes up 1268 ha (20%), being mildly fertile, often skeletal or with hard rock, at small depth, with variable (coarse to fine) texture, strongly affected by degradation phenomena (salinization, acidification, erosion, active landslides, excessive humidity, etc.), located in climatic conditions which are barely favourable for agricultural crops.

The soils included in this class are distributed especially in stabilized landslides with high gradients of 15-25%, with low humus content, with strong and even excessive surface erosion, with loamy/loamy-clayey/clayey structure.

The land included in the 5th quality class (1 - 20 points) takes up a large area, i.e. 1769 ha (28%), and includes very poorly fertile land, which are improper for arable uses, very strongly affected by degradation phenomena (erosion, excessive humidity, etc.).

Active or partially stabilized landslides, salinized and alkalized soils, gullies, narrow valleys with excessive water table supply, small depression areas with strongly mineralized water table located close to the surface, are occupied by soils in this class which are strongly degraded by excessive surface erosion, excessive gleying, very low humus content for active landslide soils and gullies, strongly alkaline reaction, particularly affected by salinization and alkalization.

CONCLUSIONS

On the 6338 ha mapped area in the Ion Neculce Commune, we identified 76 simple soil units and 14 complex soil units belonging to the Chernisols, Antrisol, Protisol, Luvisol, Hydriisol and Salsodisol classes.

Chernozems make up 69.12% of all the soils, phaeozems 0.33%, anthrosols and technosols 14.04%, alluvial soils 9.91%, preluvosols 2.23%, luvisols 1.17%, gleysols 1.92%, solonchaks 0.13% and solonchaks 1.15% of the entire mapped area.

Strong fragmentation of land has led to delimitation within soil units of 431 environmentally homogenous territories (EHT), out of which 340 simple and 91 complex EHTs that have been used for calculating the land quality evaluation mark for use and crop under natural conditions.

Given the pedo-geomorphologic conditions in the surveyed area, the land quality and

productivity indicators, which are a major drawback when establishing the grades on types of uses and crops, are land gradient, landslide, gleying, salinization and alkalization.

For the arable use category, the surveyed land belongs to the 2nd, 3rd, 4th and 5th quality classes. The largest area, 2460 ha (39%), is included in the 3rd quality class, 1268 ha (20%) and 1769 ha (28%) in the 4th and 5th quality classes, respectively, which are lower quality classes, and only 841 ha (13%) are included in the 2nd 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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LAND QUALITY AND PRODUCTIVITY ASSESSMENT DATABASE CONCERNING THE AGRICULTURAL LAND OF ION NECULCE COMMUNE, IAȘI COUNTY

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Abstract

Agricultural land quality and productivity assessment relies both on soil fertility, which is undoubtedly the most important factor, and on climate, relief and hydrology factors. Soil quality is affected to a higher or lesser extent by one or more restrictions determined either by natural factors, or by agricultural and industrial anthropogenic actions, which may have a negative synergistic influence, the effect of which is a decrease in soil quality and even the abolition of its functions. This paper tackles the soil mapping surveys and the climate, relief and hydrology conditions in the Ion Neculce administrative-territorial unit, Iași County. From the climate point of view, the surveyed unit belongs to the temperate climate, with an average annual temperature of 9.5°C and average annual precipitations of 502 mm, which fall unevenly. The relief is mostly hilly, the biggest area of 6108 ha is located at altitudes ranging between 100 and 200 m, whereas 114 ha at altitudes ranging between 200 and 300 m. The water system is relatively dense and belongs to the Bahluiet river basin, a characteristic being the intermittent watercourses and the presence of temporary ponds in the depression areas. The productive capacity of the soil on the mapped area of 6338 ha is affected by surface erosion (53.35%), landslide (27.74%), gullies (1.12%), gleying (14.11%), stagnogleying (0.56%) and salinization and alkalization up to 26.25% of the surveyed area. The Ion Neculce Commune soils belong to the Chernisols (69.45%), Antrisol (14.04%), Protisol (9.91%), Luvisols (3.40%), Hydrisols (1.92%) and Salsodisols (1.28%) classes.

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 (Hera C., 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).

MATERIAL AND METHOD

From an administrative viewpoint, the Ion Neculce Commune territory belongs to Iași County, whereas geographically, it is located on the southern border of the Jijia Hilly Plain, where the latter meets the Iașilor Flank, which determined the complexity of the natural factors and their numerous combinations.

The Ion Neculce Commune is located to the west of the county, about 40 km from Iași City and includes the following villages: Ion Neculce, Războieni, Gănești, Buznea and Prigoreni (*fig. 1*).

The total area of the Ion Neculce administrative territorial unit is 7148 ha, of which 6300 ha of agricultural land and 848 ha of non-agricultural land.

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