EVALUATION OF SOIL PHYSICAL QUALITY USING SIMPLE INDICATORS

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Since the characteristics of the indicators used to evaluate soil quality should be sensibility to changes in management, but also stability to modifications not related to management, robustness, relevance, analytic validity and cost effectiveness, we tried to evaluate soil physical state using simple parameters that comply with the requirements (indices related mainly to texture, and also pedotransfer functions related to soil compaction, crusting, porosity).

In the study area, the results showed that most of the soils are sandy loams and loams, weakly light - weakly compacted. This aspect is a hopeful one, since it indicates a poor soil compaction. In the case of total porosity, the largest part of the soils has medium and large values of this parameter. In the analysis of structure degradation has been used the crusting index, the largest part of the analyzed profiles being characterized by low values. Most of the soils have high or very high water capacities, due to their sand content and large porosity.

***Key words**: soil physical quality, simple indicators, evaluation.*

Physical quality of agricultural soils refers mainly to soil resilience and water dynamics and storage in the root zone. An agricultural soil of a good quality is one that is resistant enough so as to maintain a good structure, to resist erosion and compacting, yet weak enough so as to allow an easy rooting and the proliferation of soil fauna and flora. A good physical quality soil has also characteristics of fluids transmission and storage that permit optimum proportions of water, dissolved nutrients and air [8].

Soil's physical state represents a complex of physical features and regimes applied for the evaluation of soils as space for root development, water storage, system with functions of filter and buffer [6].

To appreciate soil physical quality, which cannot be evaluated as a sole entity, are used quantitative indices that may be determined / measured in field or laboratory. Jigău (2003) separates these indices into several groups, according to their role in assuring soil functionality in the ecosystems: intrinsic, indices defining structural – aggregation state; indices for the characterization of the compaction state; hydrophysical indices; hydrologic indices; aeration indices; trafficability and workability indices; self-loosening indices; indices for determining soil's relation with heat.

The determinations of physical characteristics may serve in certain situations as soil quality indicators. According to the situation, other measurements regarding physical and hydrophysical properties may serve in obtaining soil quality indicators.

MATERIALS AND METHODS

The analysis has been conducted on a sample area from Tutovei Hills, more precisely in Horoiata basin, situated in the central – southeastern part of the region (*fig. 1*). The position of the study area in the eastern part of Romania has a special importance in determining different soil properties that condition their quality. The geographic position determines first of all the climate, one of the main soil forming factors, that at its turn influences directly or indirectly the other. Thus, in the conditions of a specific (sandy) geology, of characteristic landforms and geomorphologic processes, and under the influence of excessive continental climatic conditions, the soils formed will have a regional – local specificity of their quality.

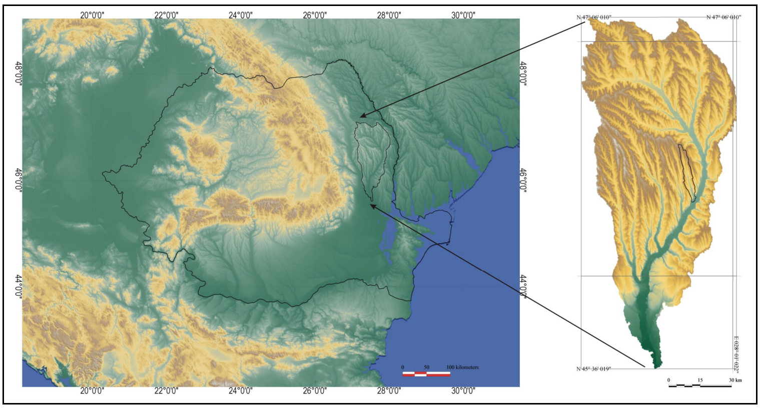

Figure 1 **Study area and the position of the sampled profiles**

The objective of the study was to attempt an analysis of the soil physical quality from this area with the help only of simple indicators. The soil surveys conducted in Romania do not include expensive analyses such as determinations of aggregate stability or water properties, so the qualitative parameters of physical nature have to be estimated. As the initial analyses data are few, the multiple estimations with the help of formulas and pedotransfer functions may lead to the occurrence of significant errors. From another perspective, is known the fact that simple indicators such as texture (together with the organic matter content) may offer very useful information regarding different physical aspects of soils. Thus the analysis and spatialization of simpler parameters linked to different soil physical properties may be of a real help in the planning of different agricultural activities.

The data used in this study have been taken from soil surveys conducted by OSPA Vaslui, from previous studies but also from our own sampling. For the estimation of other parameters than those measured have been used different PTFs.

Thus, the most important parameters analyzed have been texture, total porosity, crusting index, and parameters referring to water availability in soil. A part of these have been interpolated with the help of kriging functions.

The spatial modeling was conducted by testing the performances of ordinary and universal kriging (with 1st degree polynomial trend derived at global or local level). The exponential semivariograms have been used in all cases.

RESULTS AND DISCUSSIONS

The first aspects analyzed were those regarding soil texture. According to the Romanian textural classification, almost half of the area's soils enter the sandy loams category, aspect perfectly correlated to the region's parent materials. Then follow the loamy (25%) and loamy clayey (20%) soils, much reduced proportions being detained by clayey (5% - met mostly in the lower basin) or sandy soils (mainly Erodosols, in which case is brought to surface a lower horizon or even the parent material).

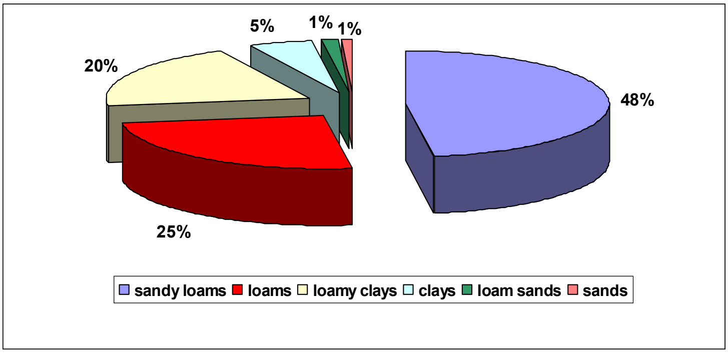

Figure 2 **The percentage of the textural classes for the upper horizons**

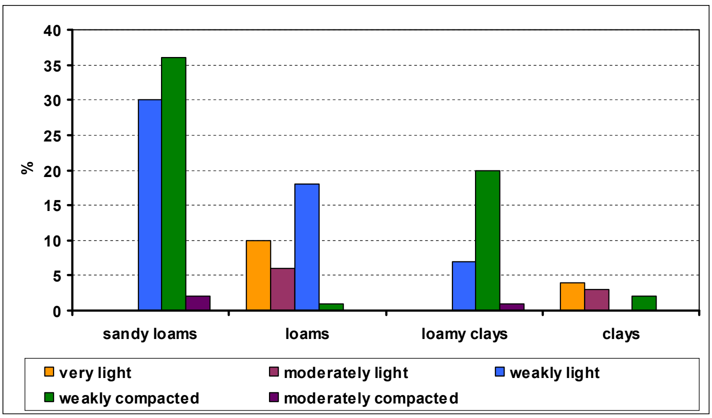

Figure 3 **The proportions of the bulk density classes**

Bulk density is a common measure for compaction or total porosity. Still, the relationships between bulk density and plant growth are depending and on other soil properties (pores' distribution, organic matter, texture).

If we apply Canarache's [3] bulk density characterization scheme, we observe that the largest part of the area's soils enter the category of the light – weakly compacted ones. Higher percentages of the very and moderately light soils are met only for the loamy and clayey textures, the other compaction states being weakly represented. This is an encouraging aspect, because it indicates a good compaction state in the upper part of the soils.

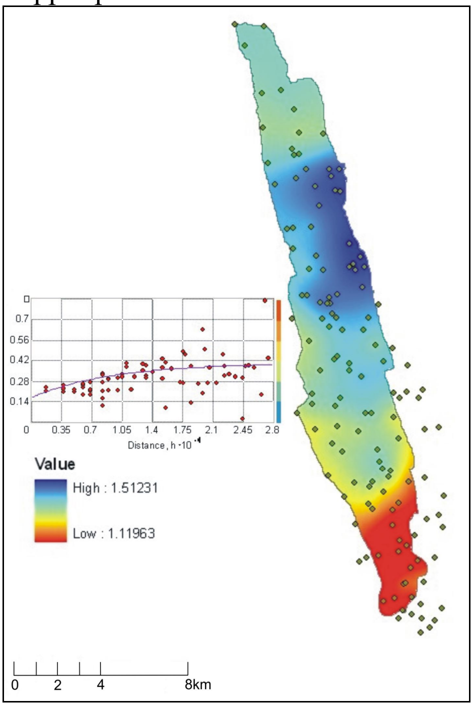

Figure 4 **Example of spatial interpolation of soil properties (bulk density)**

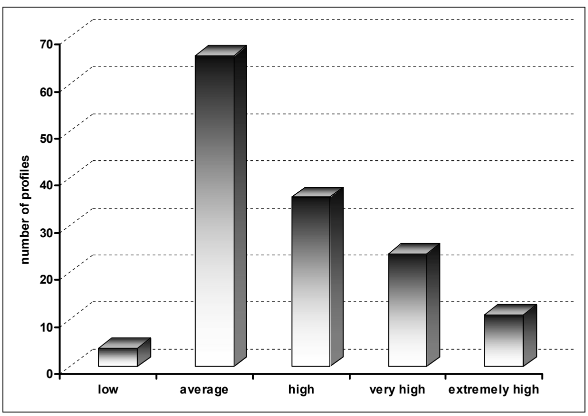

Figure 5 **Proportions of the total porosity classes**

In the case of total porosity, according to Canarache's [3] classification the largest part of the soils from Horoiata basin have average and high values of this parameter. In a second class enter soil of very and extremely high porosities, situation concordant with the sandy geology of the region. Porosity values are correlated with those of the mainly loamy texture.

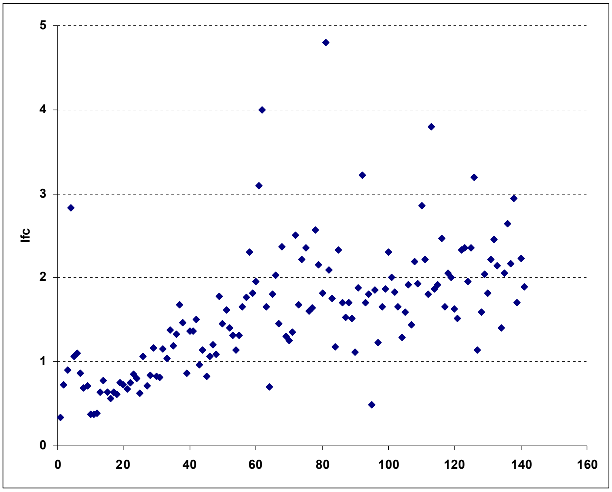

Figure 6 **Dispersion of the crusting index values**

Not having data of the aggregate stability type, in the analysis of structural degradation can be used the crusting index. If the value of 2 is the lower limit from which soils are predisposed to structural degradation, we see (*fig. 6*) that most of the profiles are characterized by lower values. Very few are the soils that exceed the value of 3 of this index, these being those with high bulk densities.

In what regards available water capacity (AWC) (*fig. 7*), the values indicate a good soil quality, most of them having high or very high capacities. This implies the storage of large quantities of water, but in some cases a poor retention due to the sandy component of the texture.

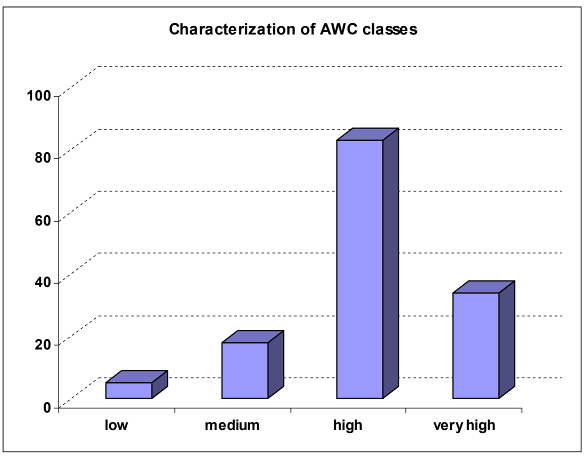

Figure 7 **Available water capacity classes**

CONCLUSIONS

During the last decades complex assessment method for soil quality have been developed in literature. Many times, these methods imply complex, costly and hard to understand (mainly for farmers) indices. The use of simple indices as those presented above may be an option for the characterization of soil (physical) quality, more easily understandable for the practitioners in the field, and more easily computable due to the availability of the data needed. Another aspect that recommends such simple indicators is their meaning, which exceeds the simple measurement, most of them being highly correlated with other physical or chemical soil properties.

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