

SOIL FERTILITY ASSESSMENT IN A CASE STUDY IN HUNGARY

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Introduction

The wild plants accommodate to the soil conditions themselves but the plants which are produced by us are grown on different soil types and soil conditions. So it is important to know which soil type can grow arable crops with the best success. (Fekete, 1958) The specific land use allows that the plant production should be profitable in the way of sustainability of fertility on croplands. (Birkás, 2001) Soils have been described for many years in terms of the proportions of particles of different sizes that they contain. This basis of characterization soils developed because particle size is an obvious characteristic related to soil behavior and plant response. (Black, 1967) The main goal of this study was to evaluate crop lands on an objective basis and to create land use classes with the help of the evaluated values. Land evaluation helps the correct planning of agronomic land use very much. This study introduces how you can evaluate the soil fertility through the potential agronomic production. The method determines the production potential of agricultural lands in a quantitative way.

Methods

Case study area is located in the middle regions of Hungary in Balaton Highland (Kővágóörs), including 28 soil subtypes. The most important soil property from the point of view of the soil fertility is the genetic soil type. This is the property which expresses the process in the soils in the most realistic way. We used the soil subtype to assess soil fertility. These soil units are the basis of the evaluation. The digital soil maps serve for the visualization of the soil units. The evaluation applies large scale (M=1:10 000) digital soil maps and includes land evaluation algorithms to assess the production potential of agricultural parcels. But it is not the only way to display the soil properties. There are many other cartograms (humus, texture, pH, etc.) to collect and visualize almost the all soil properties. For example: Soils are mapped generally on the basis of physical characteristics which the surveyors can recognize by visual inspection. Many of the important chemical and biological properties are reflected by the physical properties of the soil. Furthermore, the physical properties of soils determine their productive capacity. (Thompson, 1957) It is well-known, that besides the soil fertility other factors also influence the yield volume on a specific soil. Such a factor is the technological level of production. Technological levels may differ greatly from farm to farm. So you can get the real idea of the fertility of a given soil type only by collecting the long term average farming data from a great number of farms on the same soil type. The average of this data will be the fertility of the particular soil type at a specific agro-technological level. The database of land evaluation analyses was the national plot-level soil, fertilization and yield databases from 5 years, 80000 cultivated fields each year, containing yield, fertilization and soil information for each plot. The information of the database can be classified in three major groups:

- Basic data (location, size, sloping, exposure, meteorological area etc.)
- Soil analysis data (SA) (pH, texture, humus, N, P, K)
- Plot registry data (plant, succession, yields, fertilizer application)

Analyses of soil unit representation on maps in relation to productivity indices were carried out on the basis of the above mentioned national databases. First of all we had to calculate the basic point during the evaluation process. This point was calculated on the basis of the average yield of a specific plant. The average yields of the plants were normalizing to a 100 indexes scale. It is convenient to assign the value 100 to the most fertile soil types and value 1 to the least fertile soil types. So there is a wide scale to express or rather to assess the different fertility levels of the different soil types. To assess the soil fertility correctly you have to take into consideration the other factors which influence the soil fertility. We took into account the texture, the humus content and the CaCO_3 content of the soils. We calculated the average yields again but not on the basis of the soil subtype but the new fertility-groups. Those groups were created like a category-system which merges the soil subtypes into groups according to their plant specific fertility. The group creating was worked out on the basis of average yield of crops by HCA (Hierarchical Cluster Analysis) statistical method. (SPSS, 2000; Sváb, 1981) The soil subtype was aggregated to 10 groups. There were several groups which contained only one or two soil subtypes. With this object we made additional contractions according to the average yield and the evolution (hydromorphic or brown forest soil formations) of the given soil subtype. In that way 6 main fertility-groups were calculated. Those fertility-groups would be the basis of the evaluation process away because we could calculate more effective and more realistic fertility values on that way.

Results and discussion

It is convenient to assign the value 100 to the most fertile soil types and value 1 to the least fertile soil types. So there is a wide scale to express or rather to assess the different fertility levels of the different soil types. In addition to providing productivity information based on yield and soil analyses, the sample area database was built for GIS development purposes (to assist land use planning). So we could represent the different soil fertility through the different evaluated values. Three classes of soil fertility were aggregated which are showed on map in three different colors. The darkest color represents the most fertile area on the field according to specific plant (Figure 1).

Figure 1. The fertility of crop fields on the case study area (Kövágóörs) according to the different plants.

a, winter wheat

b, maize

c, sunflower



We can separate well the areas where you can produce the best success.

Conclusions

We can refine that evaluation method if we use the information of other soil type as well as the other plants for the evaluation process; those data are available in the national production database. New GIS applications offer different opportunity to collect and analyze many other soil properties as well. By use of those tools we can take account almost all processes which influence the soil fertility. A new land evaluation system that is displayed with available tools of information technology (Internet, GIS, database managers etc.) offers new possibilities that allow the harmonization of agricultural production and environmental management on a higher level.

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