Pedological Aspects of Utilization Possibilities of the Tihany Peninsula

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Introduction

The Tihany peninsula belongs to the Lake Balaton recreation area subregion (Figure 1). Literature evaluating the subregion and the region (Transdanubian Hills) show this area to be rich in natural values, agricultural and cultural, historical traditions (MAROSI & SZILÁRD, 1975; ÁDÁM et al., 1987-1988; MAROSI & SOMOGYI, 1990). Though the tradition of agriculture is strong, this region was the first protected area in Hungary (KENYERES, 1952).

Based on the natural and social characteristics and the land use of the Tihany peninsula three factors have primary importance: agricultural production, nature conservation and tourism. These factors often contradict each other. Based on soil analyses, the interests of agriculture and nature conservation can be confronted.

According to VÁRALLYAY (1994a, b), sustainable land use and agriculture is based on soil data. Soil is the most important conditionally renewable natural resource, which integrates and transforms other natural resources, gives place to biomass production; is a storing media of temperature, nutrients and water, a natural filter; high capacity buffer, and important gene reservoir. HARRACH (1987, 1993) – dealing with the connection between soil evaluation, agriculture and nature conservation – expands the function of soils with the following features: component of biotopes and archives of the Earth and cultural history. Soil use planning, adjusted to the characteristics of the site, considers the cultivation of farmland, the conservation of the traditional landscape and the conservation of soils and their ecological functions. BRADY (1990) emphasizes the various possibilities of using soil maps. In his opinion soil data are suitable for planning agricultural production, land evaluation and land use.

LÁNG (1995) emphasized the importance of founding the system of Environmentally Sensitive Areas. The basic objective is to develop a harmonic rela-

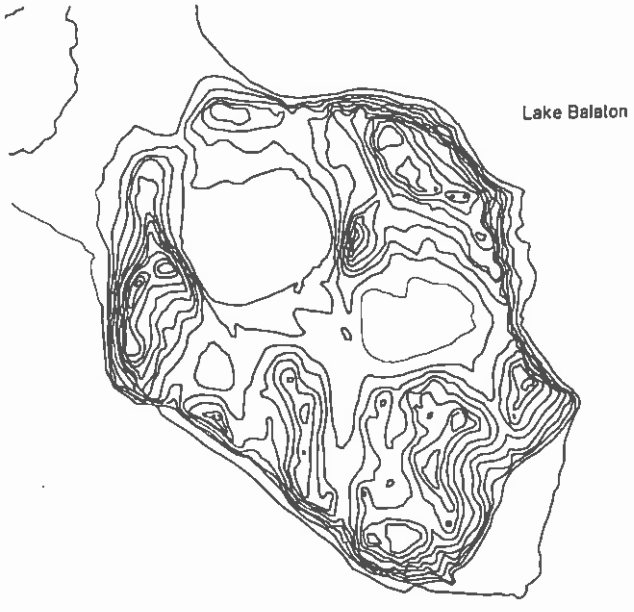

Figure 1
The map of the Tihany peninsula with contour lines

tionship between agriculture and nature conservation. The European Union initiates that environment-friendly agriculture should be subsidized. Regulated agricultural production and increased nature conservation give new tasks and functions to the population of the regions regulated in the mentioned way. The role of agriculture is extended to the conservation of farmland and biodiversity and prevention of environmental contamination (HARRACH, 1994). Based on the findings of several authors (SUKOPP et al., 1978; STEINRÜCKEN & HARRACH, 1984; KUNZMANN et al., 1985) the biodiversity of soils unsuitable for cultivation (have extreme water regime or shallow tilt) is higher than others, considering both natural vegetation and weeds. By excluding soils unsuitable for production, results can be achieved in nature conservation, as there is an inverse proportion between the agricultural value and environmental importance of soils, taking into account growing field crops (HARRACH, 1973). Agriculture adapted to soil characteristics and functions not only supports sustainability but gives directives for determining and conserving natural reserves.

Survey of land suitable for agricultural production is primarily based on exploring and analyzing the features limiting soil fertility and inducing soil degradation (FAO, 1976; DENT, 1978; SCHREIRER & ZULKIFLI, 1983; JONES & THOMASSON, 1987; PUENTES, 1987). Factors inducing soil degradation and impeding soil fertility in Hungary are as follows: high sand content, acidity, salt accumulation, salt accumulation in deeper horizons, high clay content, wetland

formation, erosion and hard rock near the surface (SZABOLCS & VÁRALLYAY, 1978, 1980).

Considering the above-mentioned views we decided not to categorize soils of the chosen regions for evaluation but select lands unsuitable for cultivation by the factors impeding agricultural production.

Materials and Methods

Information collection and mapping started in 1994. The soil analyzing process can be divided into three parts: the reconstruction phase, the field survey and laboratory tests, and the evaluation of data (BARCZI et al., 1995).

The location of sampling sites was determined with the help of former soil, topographic, geological and vegetation maps completed by points marked on air photos and field experiences. 350 points were chosen. Soil profiles were taken according to the standards from points where botanical evaluation also took place (BARANYAI, 1989). Samples were taken from each horizon and were analyzed according to the standards (BUZÁS, 1988, 1993). Analyses primarily concentrated on general soil characteristics and nutrient supply (organic matter, pH, total salt, clay and sand content, Al-P_2O_5, Al-K_2O, upper limit of plasticity according to Arany).

After preparing the maps data processing was carried out with mathematical-statistical methods (Cluster-analysis, distribution diagrams) and the maps and data were analyzed simultaneously. Among the GIS (Geographical Information Systems) (BURROUGH, 1982; MAUSBACH & REYBOLD, 1987; RAO et al., 1991) softwares in use, the ARCINFO and AUTOCAD were applied in this work. Soil types were determined according to the Hungarian classification (STEFANOVITS, 1992). Statistical analysis was performed according to SVÁB (1967).

Results

The most important soil forming factors on the Tihany peninsula turned out to be parent material, dry weather with lack of precipitation and the high water table. The Tihany peninsula is located on the border of the forest and steppe zone. The soils of this area are chernozem type and brown forest soils with patches of stony soils. Hard basaltic tuff as parent material determines soil formation on the belt of hills along the edge of the peninsula. Hydromorphic soils occur on the central part and the neck of the peninsula near to the lakes or temporary ponds (External and Internal Lake, Rátai-csáva). Drier soils with deeper horizons are located on more or less flat areas on the remaining parts. If soil types are projected to the 3 dimensional topographic map it can be observed that stony soils are located on the hill belt and the lakes are surrounded

by hydromorphic soils like rings (Figure 2). According to topographic maps the Diósi-meadows near to Aszófő are located on the low lying area between the hills of Balaton-highlands and higher lying areas of the Tihany peninsula. Here the high water table has the greater importance in soil genesis as the land is often covered with water. On higher topographic position with higher slope angle the soils are drier but they are subjected more to erosion and have less deep solum. Stony soils (solid rock is near to the surface) were found on the small plateau. Due to erosion and mechanical cultivation stony soils and colluvial deposit soils are abundant. The material of the hills is the result of former local volcanic activity. There are mixed colluvial soils at the bottom of the slopes both on the northern and southern side.

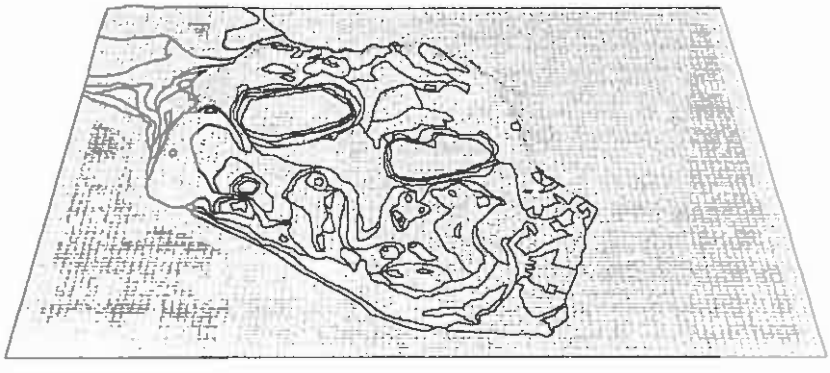

Figure 2
The 3 dimensional map with border lines of the soil types

Soils are located in belts around the External and Internal Lake caused by the basin effect. The closer we get to the lake the water table is more nearer to the surface. There is a similar phenomena southeast from the lake at the Rátai-csáva. The area is surrounded by shallow (10-40 cm deep) soil formed on tuff.

There are chernozem brown forest soils east of the belt of shallow soils and on a great patch south of the External Lake, on the central area of the peninsula, which is under farming as it is the most valuable soil from the agricultural point of view.

The most patched part of the peninsula is the Geyser Basin. The peaked tops of the geysers are covered by stony soils, rendzinas occur on the area among them and colluvial deposit soils can be found in the zone of accumulation. The small rock outcrops and stony soils covering them could not be presented on the map.

To sum up, the proportion of soils covering the area is presented in Table 1.

As it was presented in the Introduction, there are eight factors that prevent agricultural utilization (in this case grape or crop production) of land in Hungary. All factors are based on an extremity in one soil characteristic, such

Table 1

The percentage of soils covering the surface in the studied area (Tihany peninsula) (with FAO soil types)

Soil type	%
Anthropogenic soils, urban area	12.09
Stony and rocky soils (Leptosols)	33.88
Brown forest soils (Cambisols)	13.04
Meadow soils (Vertisols)	11.28
Peaty, alluvial, colluvial deposit soils (Fluvisols, Gleysols & Histosols)	26.81
Open water surface, lake	2.90

as high sand and clay contents are extremities in texture. Salinization on the top or deeper horizons and acidity are extremities in salt content or pH, wetland formation shows extreme moisture regime. Hard rock on the surface can be correlated with shallow horizons and erosion susceptibility.

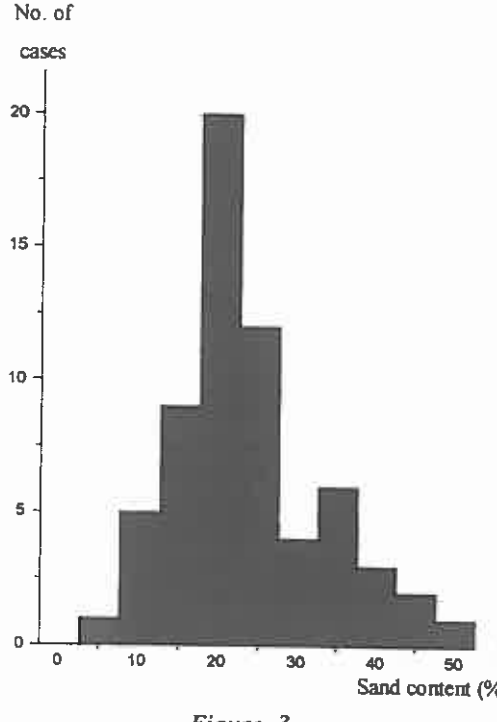

Figure 3
Sand content distribution diagram of soils of the studied area (Tihany peninsula) (%)

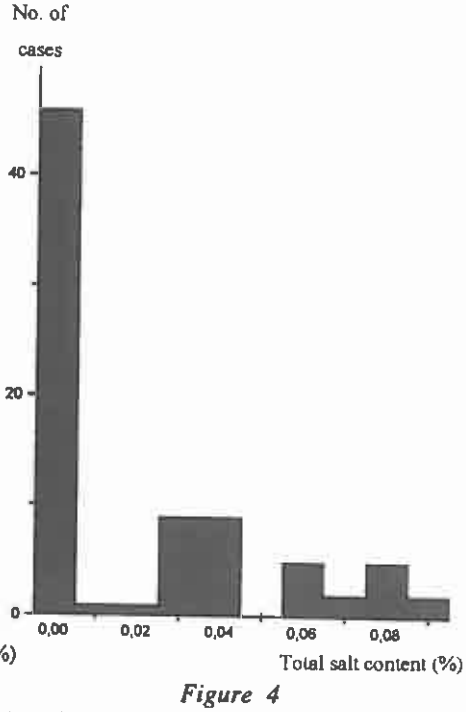

Figure 4
Total salt content distribution diagram of soils of the studied area (Tihany peninsula) (%)

17 soil profiles were opened and sampling took place on 63 locations, so samples from 80 locations were analyzed. The most important soil properties were examined, like texture, pH, nutrient content, etc. and emphasis was laid on tests related to factors limiting soil fertility. First the homogeneity of the soil types was tested by comparing properties with Cluster-analysis. Then normal distribution diagrams were drawn from the results of the tests to determine the scale of extremities in the soil cover of the area.

There were no extreme values in pH, clay content and sand content (Figure 3), so these features are not characteristic of the soils of the Tihany peninsula.

There are more extreme values and higher distribution in total salt content that indicates extremities in salt content, but the measured values are below the limit value of salinization (0.1%) (Figure 4).

Based on these results high clay and sand content, salinity, and acidity can be excluded from the factors preventing agricultural production in the examined area. Although extreme water regime, shallow solum (Figure 5), slope and erosion susceptibility are significant fertility limiting factors in the soil mantle.

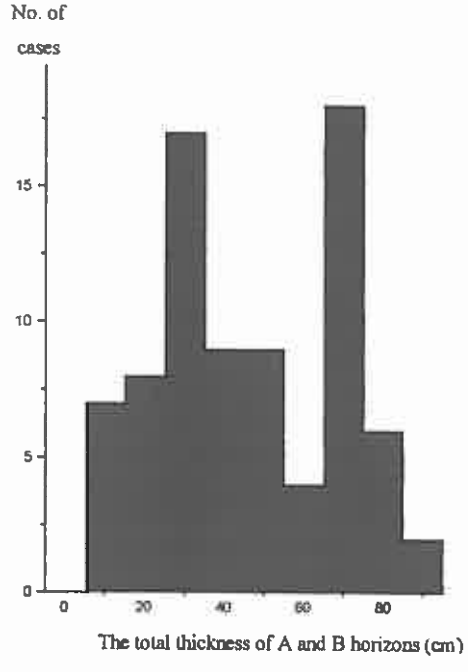

Figure 5
The distribution diagram of the total thickness of A and B horizons (cm)

Using the percentage of the soil types (see Table 1) factors preventing agricultural utilization, such as shallow solum, erosion susceptibility, waterlogging, can be determined. In order to present the preventing factors on a map, these features have to be drawn (Figure 6).

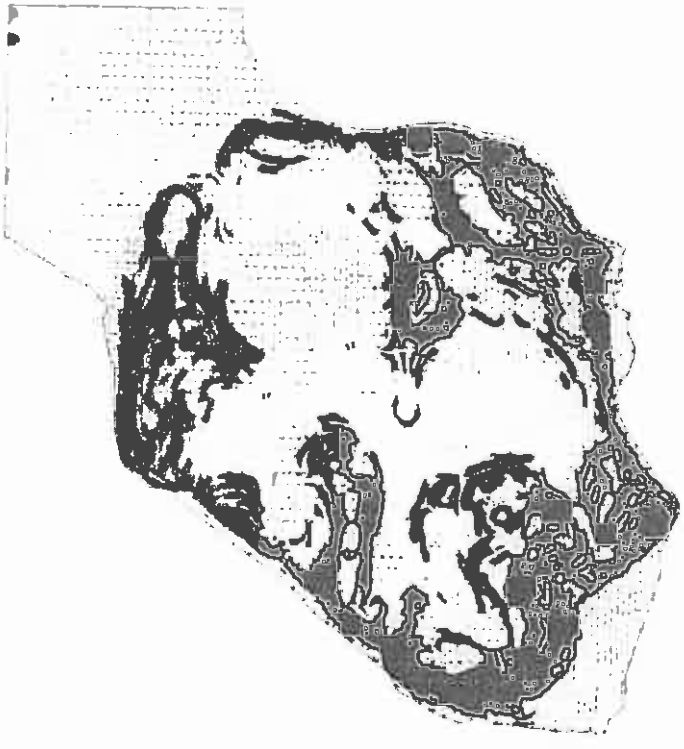

Figure 6
Lands unsuitable for agricultural utilization
Grey-coloured areas: unsuitable because of erosion susceptibility, *horizontally striped areas*: shallow solum, *vertically striped areas*: waterlogging

Waterlogged territories are located on the shoreline, in the area of the lakes, and the neck of the peninsula. Shallow solum and steep slopes, causing erosion susceptibility, are characteristic of several parts, they primarily occur in the hilly belt and on the basaltic tuff saturated with silicic acid or lime of the Geyser Basin. Steep slopes occur in the belt of hills and are less important on the geyser cones. These areas are unsuitable for farming (grape and crop production). The map shows that only a limited area is suitable for agricultural utilization.

There are no limiting factors on the area covered by chernozem brown forest soils with slight slope angle in the center of the peninsula. The area north of the

Rátai-csáva can also be utilized. However, forest soils developed on the hillslopes with slight slope angle could have been suitable for agricultural production, but these areas have forest vegetation. We would like to emphasize that the purpose of this work was not the recommendation of agricultural utilization of land, but the elimination of the unsuitable areas.

Potentially suitable areas were not determined, because this kind of strictness must be in accordance with nature conservation.

Summary

As the first step of the work, soil field survey was carried out. Analyzing maps and laboratory data, it was found that agricultural production cannot be successful on lands with waterlogging or shallow solum. Soils with these properties were mapped and were excluded from agricultural production on a summary map.

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