POTENTIAL EFFECTS OF LAND USE CHANGE AROUND THE INNER LAKE IN TIHANY, HUNGARY – EXAMINATION OF GEOLOGY, PEDOLOGY AND PLANT COVER/LAND USE INTERRELATIONS

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Abstract: land use changes are sources for a series of problems but they can be solutions as well. In a nature conservation area it can reduce and increase biodiversity, however in the Tihany Peninsula nature conservationists try to protect the present natural environment. Human induced landscape changes gained the peninsula the first landscape protection district status of the country. Geological background, microclimatic conditions, given soil heritage, plant cover and land use plays an important role in the life of the peninsula. We wish to give an example how human induced activities might affect the valuable natural environment in a way that threatens the aim of the protection.

Keywords: soil, nutrients, grazing, land use change

Introduction

Taking into account the most influencing soil formation factor, the human activity, we can state that soil is a non-renewable natural resource (Várallyay, 2007). Human activities (e.g. deforestation, over-intensified arable farming, animal husbandry and grazing, introduction of invasive plant species) can cause soil compaction, soil erosion (Jakab 2006, Centeri and Császár, 2003), nutrient loss and damage to local plant and animal populations (Csontos and Tamás, 2006; Deák and Keveiné, 2006). Geology-pedology relation is examined in very specific cases, mostly during soil ecology researches and connected with the weathering of the rocks. Researches on relation between plant and soil are more often and less specific (Halbritter et al, 2003; Penksza et al., 2005; Nagy and Penksza, 2006). Soil tillage changes soil properties rapidly (Birkás et al., 2005) however on the examined area soil has not been tilled recently. Land use changes (Máté, 2007; Szabó et al, 2007; Malatinszky, 2004; Malatinszky and Penksza, 2004) are the most common agents of land degradation. The most dangerous case is when forests are removed and replaced by arable land. It is not as damaging but includes potential problems when forests are changed into grassland. In this case overgrazing is a serious problem.

Materials and methods

The Tihany Peninsula was the first Landscape Protection District in Hungary. From 1997 it has been a part of the Balaton Upland National Park and does not exist separately as landscape protection district.

There were three lakes situated on the peninsula. Now we can find two lakes with water surface all year round. The Outer Lake is a strictly protected nature conservation area. Both lakes has its own watershed inside the peninsula, no water flows in from outside

and neither they have connection with the water level of Lake Balaton, in what the peninsula is situated. The Inner Lake a fishing lake, situated close to Tihany village. There is a parking lot and a restaurant on the shore of the lake.
The area of the Inner Lake is 28.2 ha, its average depth is 1.5 m. The bottom of the lake is silty on the southern and covered with marl on the northern part. The lake is a natural crater lake. The climate is Sub-Mediterranean.
The Inner Lake was originally framed by a reed zone, almost all around its shores. The lake suffered serious damage when plant eating species were introduced to the lake. Nearly all the reed was gone. The rehabilitation of the lake started about a decade ago, now we can see some reed zone between the lake and the village.
For soil analyses we used the Pürckhauer type soil core sampler (Finnern, 1994). Six sampling point and a sample slope were chosen (Figure 1.) for pedological examination. A soil profile was opened and described on the western side of the lake.

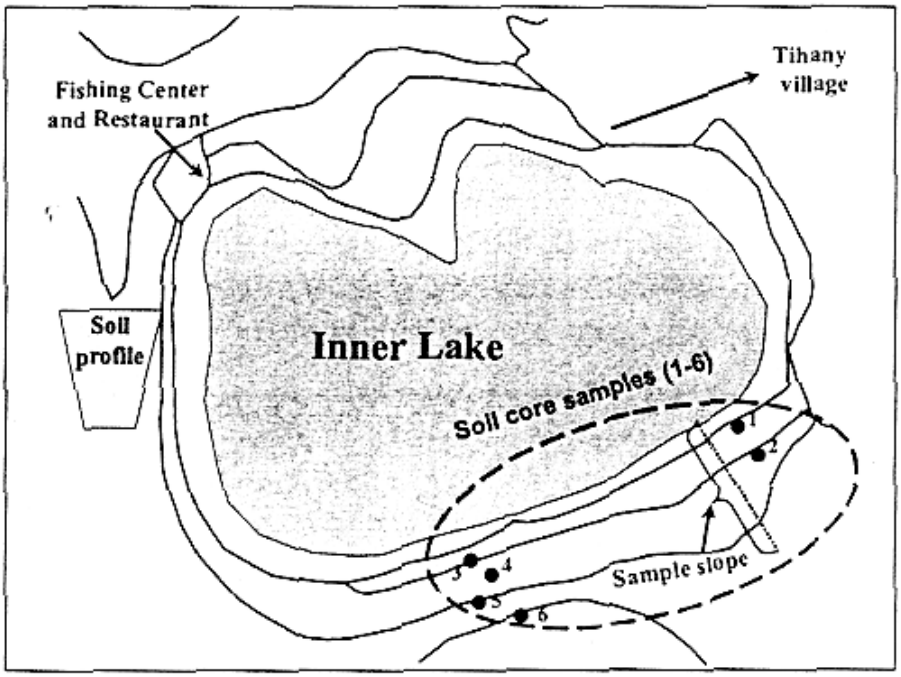

Figure 1. Overview map of the examined area, Tihany Peninsula, Hungary

Soil laboratory analyses were done by the description of Buzás (1993). Comparison of soil type distribution was done by the soil map of Góczán (1970) and Barczi (1995)

Results and discussion

The peat accumulation around the lake is not very strong since it as handled as a fishing lake and there are a lot of human activity on the shores, especially trampling has a serious effect on the soils. However, in the northern part of the lake, where there is more reed cover, we can find some peaty meadow soil. Following the shores of the lake, there is a very narrow stripe of raw Fluvisol with some spots where we could find some young peaty layers (peaty meadow spots). After the Fluvisol there is a gravel road creates a ring around the lake. The road is surrounded by and was created on Vertisol. Coenological examinations found extreme plant associations indicating salt in the soil, especially on the shores. Further away from the lake there are Vertisols with some

Chernozem effects on higher ground. On the southern side, this changes into Chernozem soils that bear some vertic properties, too. These soils carry vertic properties in their clayey loam texture and dark colour, their structure is crumby with some calcic coat in the springtime. The parent material towards the lake is swampy clay and powder like Pleistocene slope material.
We compared two analyses of soil maps (prepared by Góczán, 1970 and Barczi, 1995). The comparison was done for soil types that occur around the Inner Lake (Table 1).

Table 1. Area of soil types in the percentage of the area of the peninsula in 1970 and 1995

Soil types	Area (%)		Soil types	Area (%)	
	1970	1995		1970	1995
Anthrosols, built in areas	2.83	12.09	Histic Vertisol	8.76	2.78
Meadow Chernozem	1.90	5.55	Vertic Chernozem	1.58	2.24
Typical Vertisol	6.22	5.27	Vertic Histosol	1.23	4.87
Fluvic Vertisol	-	0.46	Fluvisol (with fresh soil material)	-	2.82

During the field experiment soil was found highly compacted. Soil profile laboratory examination proved that grazing is not a principle form of land use around the soil profile (Table 2.) since the phosphorus content was very low.

Table 2. Laboratory results of the A horizon of the examined soil profile

Depth of the profile (cm)	Color (Munsell)	pH(KCl)	$CaCO_3$ (%)	SOM* (%)	AL-P_2O_5 (ppm)	AL-K_2O (ppm)
65	10YR 3/3	6.1	1	5.9	18	275

**SOM = Soil Organic Matter*

The $CaCO_3$ content was very low that was reflected in the pH, too. It was unexpected that K_2O content was normal since phosphorus was very low in the profile. The soil texture of the examined soil profile was clayey loam. Slope angle was 5%. The amount of total salt content was zero. Compared to the 1995 examinations, results of laboratory examinations of soil samples from 2007 (Table 3.) show big differences. We chose a sample slope on the southern part of the lake (Figure 1).

Table 3. Results of soil samples from 2007

Sample	pH (KCl))	$CaCO_3$ (%)	SOM %	AL-P_2O_5 (ppm)	AL-K_2O (ppm)
Upper third of the slope	7.27	37.29	14.40	163.5	706.2
Upper third of the slope	7.07	8.95	8.84	686.0	1200.7

**SOM = Soil Organic Matter*

A herd of the Hungarian Grey Cattle was introduced to the area in the year 2000. It result a much higher nutrient content compared to the 1995 examinations. We compared the upper and lower parts of the slopes. It is obvious that grazing causes trampling, that – as can be seen in the present example – can increase compaction, surface runoff and nutrient loss. In the lower third of the slope P_2O_5 content is 4.2 and K_2O content is 1.7

times higher than on the upper third of the slope. $CaCO_3$ content shows that erosion reached the parent material, causing mix up of the lime content.

Conclusions

Soils have undergone several changes on the peninsula. The introduced Hungarian Grey cattle herd caused trampling, increasing soil compaction, soil structure degradation and nutrient loss that can be further threat to the ecosystem of the lake. Water pollution can reach a level that must be handled thus influence the fishing and recreation activity of the tourists.

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