

SUMMARY

LANDSCAPE ECOLOGICAL RESEARCH IN THE TÁLLYA HALF-BASIN WITH SPECIAL REGARD TO LAND SUITABILITY FOR GRAPE

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1.1 Introduction

The Tokaj Mountains are a traditionally favoured research area of the Department of Applied Landscape Geography of Debrecen University. Within the mountains Tokaj-Hegyalja is of special importance since complex landscape ecological research was performed in the Bodrogkeresztúr Half-basin between 1974 and 1979 under the guidance of Zoltán Pinczés.

Tokaj-Hegyalja, one of the most important Hungarian wine-producing regions, is situated on the pediment of the Tokaj Mountains, a member of the inner Carpathian volcanic range. It has an area of 890 km². Its physical geographical characteristics enabled Tokaj Hegyalja to become the centre of wine-growing in the remained part of the country when the Turkish occupation detached the Szerémség, the previously prominent wine region of Hungary.

The importance of Tokaj Hegyalja in landscape research has not diminished over the last decades, just the opposite, the designation of this cultural landscape of outstanding significance as a UNESCO World Heritage Site in 2002 may provide an additional impulse to the research performed in this area.

After the change of the political regime in Hungary and just before accession to the European Union, the rational regional management and sustainable landuse are of great importance. They are particularly timely issues in Tokaj Hegyalja since it is a world famous region with major anthropogenic impacts for centuries, where a compromise between the intensive landuse and ecological regional management is necessary. In finding the optimal landuse and conserving the diversity of the landscape, the analysis and interpretation of the physical geographical characteristics is of great importance.

At the same time, due to the high agricultural employment, it may be of increasing importance in the future to elaborate and propagate among the local farmers ways of cultivation more adapted to the physical conditions. The need for this research is supported by the fact that landuse problems fundamentally control economical opportunities in the area and thus its population carrying capacity.

1.2 The research area

Tállya and its surroundings are a prominent part of the Tokaj wine region. It was the central settlement of the western margin during the prosperity started in the 16th century. In addition to the extension of vineyards (among settlements of Tokaj Hegyalja, Tállya has the most extended administratively determined vineyard area, 920 hectares in 1873) it excelled in the quality of wine.

When choosing this research area it was considered that the western part of Tokaj Hegyalja is less studied with complex landscape ecological methods and its analysis may provide a good basis for further comparisons with the characteristics of the eastern side.

The other motivation was that Tokaj Hegyalja with Tállya is my birth-place.

2. Aims and methods

2.1 Aims

I tried to continue the traditional research methodology followed the Bodrogkeresztúr Half-basin and to develop it further to meet the requirements of modern landscape ecology.

The aim of my thesis is a complex landscape ecological analysis and interpretation of the Tállya Half-basin and the surrounding mountain margin with special emphasis on the interpretation of the physical geographical characteristics from an agricultural point of view and on the viticulture, the basic economy of the area.

I regarded as an important purpose to promote optimal landuse, primarily the revegetation of abandoned lands, with an excellent opportunity for a more precise analysis and interpretation of the physical geographical features. Since nowadays further major land use changes are to be expected, I think it is very important to influence these changes through underlining of the importance of traditional landscape management by the new scientific results. To establish the appropriate ratio of different landuse methods is a pressing issue as the EU accession calls for the adaptation of new rules.

2.2 Methods

The methods can be classified as follows:

1. The research was started by a detailed analysis of the professional literature.
2. In the course of research various kinds of field work were performed. I have *mapped* landuse, landforms and the blossoming of vine. I have *measured* the changes of the water table, the chemical quality of surface and groundwater, the sugar concentration of grapejuice with refractometer and the natural succession on abandoned land by *phytocenological analysis*. After consultations, 239 auger holes were made in the area.
3. The data from field work were analysed by statistical and GIS methods and were complemented by laboratory analyses
 - The water and soil samples were analysed in the Laboratory of the Geography Department of Debrecen University.
 - The utilized GIS softwares were the Surfer for Windows 6.0, Idrisi for Windows 2.0-t, ArcView GIS 3.2, AutoCAD 14.
 - The statistical interpretations were carried out by SPSS for Windows 9.0 while the simple correlation analyses by Excel 97.

3. Results

The results are listed distinguishing analyses from syntheses.

Results of the analyses

1. Pleistocene geomorphic evolution

- The research of periglacial landform evolution resulted in several new findings. Geomorphic evolution has been influenced in space by lithological contrasts. The pediments were formed on rhyolite tuff. *Gelisolifluction as well as watercourses moved a great mass of material. In some areas of presumed accumulation denudation surfaces have been identified. Thus it is claimed that the Tállya Semibasin was formed by cryoplanation as well as sheet wash but in addition to areal processes channel erosion was also of great importance.*
- I carried out a detailed mapping of cryoplanation features laying emphasis upon the unique circumstances of their development.
- Among the geological objects I have analysed the Pleistocene colluvium by the auger data along 5 catenas. The Pleistocene sediments are rather homogenic in the area of the half-basin, there are no significant differences. Weathering became more intensive during the last interglacial period as it can be seen in the sediments deposited before the last periglacial stage. In the last periglacial stage the effect of fragmentation became predominant. Gelisolifluction was rather intensive mixing weathering products also with paleosols. Since physical and chemical weathering processes were equally intensive the ratio of the different grain size fractions is usually similar.
In the colluvium downslope differences are also detectable. Since at the point of inflexion the bedrock is near to the surface, frost shattering was much more intensive, so coarse material accumulated just below the point of inflexion. Along gentle slopes the ratio of fine fraction, especially that of clay fraction, increases. The material of the samples seems to be finer vertically as well.
- The analysis of the samples provided evidence to the possible existence of a thin loess cover along the gentle slope segments, but later redeposited.
In accumulation areas the ratio of loess fraction is higher in the deeper layers. This indicates a faster removal of the thin loess cover, which cannot appear in higher layers.

2. Soils

- We have deepened 239 auger holes to detect soil thicknesses. Bedrock, type of the soil, soil thickness and angle of slope were identified. The physical and chemical analyses were made on samples collected along 5 catenas (43 samples). In the course of laboratory analyses grain size distribution, humus content, the pH (H₂O, KCl) and CaCO₃ content has been measured. Augering and sampling covered the entire half-basin but concentrated primarily on cultivated areas.
- Some characteristics, especially chemical properties, are different from the typical parameters of the soil type in question, indicating the changes of soil properties partly because of the geological situation (see the loess problem) but mainly due to cultivation (fertilization, liming) for several centuries.
- The thickness of the soil mantle also varies in a rather mosaical pattern reflecting intensive cultivation and the variety of landuses. There is only a weak statistical correlation between the thickness of the soil mantle and the angle of slope.

3. Water

- In the course of research I observed the position of the groundwater table, its changes in space and time, the relationship between these changes and the meteorological factors and the impacts of vine-growing and the local sources of pollution (leaking cesspools) on the chemical properties of surface and groundwater of the settlement. The water level in wells had been monitored monthly over two years (between July 1999 and June 2001). Water

samples were also taken from wells and analysed for nitrate, orthophosphate, chloride and organic matter content in the Physical Geographical Laboratory of the Geography Department of Debrecen University.

- In spite of the short period of the measurement seasonal changes of the water table could have been detected.
- Lithological features also influence changes of the water table in the area.
- The flow of the groundwater in the area shows a rather complicated pattern and cannot be regarded as a completely uniform system partly because of lithological differences (different types of rhyolite tuffs, colluvium). Assuming the appearance of phreatic waters the groundwater can flow in three ways: it may feed direct runoff, it can be stopped by impermeable formations and issue onto the surface or it can infiltrate along the joints and permeable layers to depth. The main direction of runoff will be southwestern, even though it is not continuous. The modifying effect of rock properties appear only locally.
- The chemical quality of groundwater is rather unfavourable, mainly because of the high nitrate content. The water quality of overland flow and sources is satisfactory.

4. Climate

- Following the mosaic pattern of topography the meso- and microclimatic characteristics of the area are also varied.
- The meso- and microclimatic conditions were observed by the analysis of the phenophases of grapevine (blossoming, ripening of berries).
- Both the date of blossoming and the sugar concentration of the grape-juice show significant correlation with the independent variables (altitude above sea level, position of exposure, angle of slope), from which the angle of slope had the greatest impact on the dependent variables.
- In the area studied the zone of altitude of 170–200 m of southern – southwestern exposure and angles of slope above 25° can be regarded as the most favourable from the aspect of grapes blossoming.
- The joint interpretation of maps of sugar concentration of the grape-juice and blossoming delimit the most favourable slopes. They are the same in both cases: southern exposure, slope inclination between 17 and 25° and an altitude between 160 and 200 m.

5. Flora

- In the course of botanic research we analysed the succession processes of abandoned lands. The parcels were grouped into four time categories: A: 1-10, B: 11-20, C: 21-30, D: abandoned for more than 30 years. For the cenological analysis we used squares of 100 m² area. 10 parcels were identified in each group by randomisation from the almost 400 marked ones and within them the squares were analysed. The research has been carried out on three occasions: in April, June and August of 2000.
- The results indicate a mosaic forest-steppe as final association, where a mosaic pattern of oak forest with *Quercus pubescens* and with rich shrub layer and of forest-steppe grassland can be seen. On the regularly burned areas a grass association appears poorer in species, with the dominance of *Stipa*. In other cases, frequently next to the closed oak forest with *Quercus patraea*, spiniferous shrubberies appear forming patches of various size in the former parcel. Sometimes patches of an association with *Prunetum tenellae* also can be seen, but these can presumably be regarded as remains of former *Aceri tatarici* – *Quercetum roboris* associations.

- The botanic research had two main purposes: the analysis of the site properties of abandoned lands and the identification of the natural values worth protection. There are several abandoned land tracts in the area which deserve protection on the basis of their botanic and landscape values but which, at the same time, regarding their physical geographical characteristics, are also suitable for replantation with grape-vine. Thus, further research is needed to decide which areas can be suggested for re-plantation and which require natural protection.

Results of the synthesis

Analysis of the landuse and site properties

- Land use changes were studied in space and time especially with regard to processes which destroyed the traditional zonation of landuse after the phylloxera disease. In the synthesis the impact of the physical geographical conditions on extension of vineyards before 1886 and in 1999 were analysed.
- The role of the individual physical geographical factors in allocating grape-vine plantations has changed over the centuries. Nowadays market requirements induce changes in land ownership and in landuse and consequently in landscape pattern. These processes also lead to economic and social changes. Recently both the vertical structure of landuse and the ratio of its sectors are in change.
- The ratio of abandoned land is steadily decreasing and thus the traditional zonation of landscape management can be re-established rather rapidly, within 10-20 years. In addition, various land uses will be balanced.
- The designation of UNESCO World Heritage Site can help the conservation of the traditional pattern of the landscape and settlements as well as the establishment of the opportunities for further economic and social development.

I hope that my work with analyses and interpretation of the physical geographical characteristics can promote optimal land-use, mainly through the re-plantation of abandoned land tracts with excellent conditions. Since nowadays we have to reckon with new significant changes in land utilization (involved by the accession to the European Union). I regard it very important to provide a scientific base for the re-establishment of traditional landuse in the light of new scientific results.