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LAND USE CHANGES IN A HISTORIC WINE REGION AND THEIR CONNECTIONS WITH OPTIMAL LAND-USE: A CASE STUDY OF NAGY-EGED HILL, NORTHERN HUNGARY

Anna DOBOS[1], Richárd NAGY[2] & Ádám MOLEK[3]

[1]*Eszterházy Károly College, Department of Environmental Sciences, H-3300 Eger, Leányka út 6., Hungary, e-mail: dobosa@ektf.hu*

[2]*University of Debrecen, Department of Landscape Protection and Environmental Geography, H-4032 Debrecen, Egyetem tér 1., Hungary, e-mail: nagy.richard@science.unideb.hu*

[3]*Eszterházy Károly College, Department of Environmental Sciences, Landscape Research and Nature Conservation Scientific Talent's Workshop, H-3300 Eger, Leányka út 6., Hungary, e-mail: molekadam91@gmail.com*

Abstract: Several parts of the historical wine regions in Hungary are adjacent to foothill areas of mountains of medium height. In the present paper, the land-use changes of Nagy-Eged Hill, characterized by vineyards situated on the highest hill slopes in Hungary, are investigated using the First and Second Military Survey Maps (1782-1785, 1819-1869), topographic maps on scale of 1:10 000 published in 1990, and an aerial survey map made in 2012. This study area has natural conditions favourable for viticulture. There were significant land-use changes here from the 18th century onward. These land-use changes were conditioned by changes of natural conditions, the spreading of the phylloxera disaster, World Wars I. and II. and the modification of social demands. Our aim was to map and describe land-use changes in different historical times and to analyse their effects. It has come to light that 45-60 % of the territory of Nagy-Eged Hill was continously covered by forests. During a thousand years of viticulture here, vineyards appeared in greatest numbers between 1782 and 1785. After that the territory of vineyards decreased and about 90% of vineyards were abolished during the 1888 phylloxera disaster. 17.34% of the study area are vineyards today as a result of re-plantation and vineyard reconstruction. The study area has been affected by intensive soil erosion and land degradation. Nagy-Eged Hill is situated on the boundary of the Bükk National Park, which is why these areas could be integrated into the protected territory and the thousand-year-old viticulture and the landscape values protected under the Nature Conservation and Environmental Management Plan of the Bükk National Park.

Keywords: land-use changes, landscape history, wine region, Nagy-Eged Hill, Northern Hungary

1. INTRODUCTION

There have been significant land-use changes during the last decades in the Hungarian Historic Wine Regions. Vineyards appeared in the formerly abandoned areas and they occupied the areas of forests on the higher parts of hill slopes too. The landscape structure and pattern became more fragmented and the biodiversity of the vineyards increased. Territories under cultivation lie next to the protected national parks. In such territories, the solution of landscape protection management problems and the protection of various natural landscape values and the cultural heritage are important tasks.

An important field of the landscape protection research is the surveying of the spatial and temporal changes of land-use because agricultural territories that have a history of more than 100 years possess valuable cultural heritage and landscape structure elements (Altieri, 2004; Waldhardt et al., 2004). The landscape historical investigation discovering land-use changes can provide information for creating future Landscape Protection or Nature Conservation and Environmental Management Plans (Stohlgren et al., 1997).

As Veldkamp & Fresco (1996) note, land use "is determined by the interaction in space and time of biophysical factors (constraints) such as soils, climate, topography, etc., and human factors like

population, technology, economic conditions, etc."

Land-use changes that appeared during historical times are investigated with respect to population increase, socio-economic development, the changes of agricultural cultivation methods and environmental changes (Latocha, 2009). Land-use changes like deforestation, the increase of agricultural areas and land cover changes can cause land degradation processes. These processes can affect people on a local and global scale too (Foley et al., 2005).

There were significant changes after 1989 and 1990 in the economic system, land-use system (Dezso et al., 2005), landscape management practice and landscape structure in Middle and Eastern European countries that later joined the European Union. Former collectivization and intensive agricultural activity involved large territories and vine-lands. This agricultural cultivation method was replaced by privatization, the increase of the agricultural industry, deforestation and urbanization (Feranec et al., 2000; Cebecauer & Hofierka, 2008; Szilassi et al., 2010).

Many researchers have investigated the effects and consequences of human impact and land-use changes on landscape factors, and the spatial changes of different land-use categories using historical maps, military survey maps and satellite images. They investigate the causes of soil erosion and mass movement formation along with sediment transport problems and the reasons behind the changes of water output and water quality related to land-use changes in different study areas and drainage systems (Bakker et al., 2005; Jordan et al., 2005; Li et al., 2008; Cebecauer & Hofierka, 2008; Tefera & Sterk, 2010; Mugagga et al., 2012; Wijitkosum, 2012; Ristić et al., 2013).

Many research projects have revealed that, compared to the cultivation of other agricultural plants, the cultivation method used in vineyards causes the most intensive soil erosion (Tropeano, 1983; Kosmas et al., 1997). According to the investigations of Martínez-Casasnovas & Sánches-Bosch (2000), most of the damage has been caused by the intensive agricultural cultivation of large areas replacing the traditional agricultural methods. This issue is present all over the world because most vineyards are located in hilly regions and their surface is not covered by vegetation.

Soil degradation processes can develop quickly after land-use or land cover changes (Martinez-Fernandez et al., 1995). The physical and chemical properties of the soil (Dupouey et al., 2002), the amount of organic matters in the soil (Pulleman et al., 2000), soil respiration (Carlisle et al., 2006) and microbiological conditions in the soil (Steenwerth et al., 2002) can all change in consequence of soil degradation.

Numerous small and middle-sized private viticultural farms came into being due to privatization in Central and Eastern European countries in 1989 and in the 1990s. As a result, the area of vine-lands increased and formerly abandoned areas were cultivated again, and new landscape degradation processes occured.

The most outstanding example for the expansion of vineyards is Sonoma County in California where the rate of vineyards has significantly increased since the 'Californian wine boom'. Vineyards have appeared not only along the valleys, but also on higher slopes of hills, which were originally covered by oak forests. New cultivation practice has changed the landscape structure, it has increased soil erosion and made difficult the movement of various species (Merenlender, 2000). Although these tendencies have appeared in Hungary as well, they are of a smaller scale.

In relation to viticulture, terroir research focuses on the landscape mainly because landscape factors determine the unique character of products (wine). This is why the landscape as well as various landscape factors appear in the definition of „*terroir*". According to Vadour (2003), the terroir is a continually changing spatial process, characterised by homogeneous or dominant features with respect to the grape and/or wine. Such features are different forms of the soil, landscape elements and climate in a given place and at a given time, based upon the social and historical tradition and formed by continous technical improvement.

Mauguin et al., (2003) write that the aim of the INAO (*Institut National des Appellations d'Origin)* is to identify and protect the terroirs effects that were created by the geographical conditions. According to their definition, the terroir is a complex system including human factors, production technology and physical environment. Viticulture is frequently influenced by environmental and social factors. INAO aims to protect the unique landscape habitat because it can have an influence on AOC (Appellation Origine Controlle) wines.

According to the definition of the OIV – *Office International de la Vigne et du Vin* – (Resolution OIV/VITI 333/2010, available on OIV webpage): *„Vitivinicultural "terroir" is a concept which refers to an area in which collective knowledge of the interactions between the identifiable physical and biological environment and applied vitivinicultural practices develops, providing distinctive characteristics for the products*

originating from this area."Terroir" includes specific soil, topography, climate, landscape characteristics and biodiversity features."

A survey of data of landscape historical maps makes it possible to gather information about terroirs during the last 200-300 years, which we can use for the planning of sustainable development, Nature Conservation Management Plans, environmental reconstruction and rehabilitation or landscape protection actions. Several specialists have studied historical maps and Military Survey Maps and their environmental and landscape protection aspects in vineyards in the last few years.

Nyizsalovszki & Virók (2001) examined the land-use system and environmental possibilities of Tállya, situated in the Tokaj-Hegyalja region. Bándi & Russu (2005) investigated land-use changes in Fiság Valley between 1980 and 2003. Kiss et al., (2005) examined the spatial distribution and landscape character of vineyards at Nagymaros in the Danube Bend and investigated the socio-economic background of land-use changes as well. Jordan et al., (2005) carried out research on soil erosion and land-use changes in the territory of the Káli Basin next to Lake Balaton. They established that there was a significant connection between soil erosion and land-use changes. At the same time Szilassi et al., (2006) pointed out that vineyards constitute the most characteristic landscape value in the Káli Basin. For this reason their protection as a historical agricultural landscape, and the development of an optimal land-use system to reduce soil erosion, is an important task for long-term environmental management. Sallay et al., (2012) examined land-use changes in the Southern Buda Region and the connection system of land-use and landscape values. Demény & Centeri, (2012) investigated landscape history in the Gödöllő Hills based on Military Survey Maps. Novák & Incze, (2012) and Novák et al., (2013) examined terraced cultivation, its cultural heritage, the systems of stone-heaps, revetment walls and „obala" as the perishing remains of viticulture on Nagy Hill in Tokaj. They studied the various properties of revetment walls, their spatial distribution, terrain slopes, terrain aspects and their altitude above sea level. Based on the results they identified future landscape protection tasks.

In the case of Nagy-Eged Hill, Dékány, (2013) called attention to the landscape history of this territory and to the landscape values and cultural heritage of viticulture. In Historical Wine Regions, better spatial planning and ecosystem management (Tovar et al., 2013) could guarantee more favourable opportunities for the development of vineyards at the edges of the protected areas.

The aim of our article is to reveal land-use changes at Nagy-Eged Hill from the 18th century to date and to point out the processes of soil erosion and landscape degradation in vineyards, so that we could plan optimal land-use systems and a Nature Conservation Management Plan for the area.

2. MATERIALS AND METHODS

The Eger Wine Region is situated in Northern Hungary, along the southern slopes of the Bükk Mountains. There are 6 000 ha vineyards in this 22 160 ha area. The Eger Wine Territory is extended in Northeastern Hungary on the southern slopes of the Bükk Mountains. Nagy-Eged Hill is one of the most representative territories of the thousand-year-old wine growing viniculture here. Nagy-Eged Hill (536m) is situated 2 kilometres towards the northeast of Eger, the centre of Heves County. This hill is bordered by Kis-bajusz and Galagonyás in the west, Kis-Eged Hill in the southwest, Sík Hill and Tó Hill in the south and southeast and Bikk-bérc Hill, Kis-Tiba Hill and Nagy-Tiba Hill in the northeast and north (Fig. 1). Its close connection to viticulture is why it was named Nagy-Eged after St. Egyed, the patron saint of vine-growing (Dékány, 2013).

Nagy-Eged Hill is located on the southwestern edge of the Southern Bükk Mountains. The base rocks in the study area are Triassic and Eocene limestones, overlain by Oligocene marl and clay, Miocene rhyolite tuff and Pleistocene or Holocene slope sediments at the foothills of the hill. Quaternary fluvial sediments were deposited along the stream valley at the southern edge of Nagy-Eged Hill (Pelikán, 2005). The hill has favourable natural conditions, it is a mountainous area of medium height (260-536 m) bordered by the Egri-Bükkalja Foothill Area (older and younger foothills) in the south and west (Dobos, 2002; Vágó & Hegedűs, 2011). It has favourable insolation, soil and slope properties (Nagy et al., 2012) that influence the quantitative and qualitative parameters of the grapes positively (van Leeuwen et al., 2004).

For these reasons Nagy-Eged Hill is a favourable place for viticulture. Rows of vines rise up along the slopes to as high as 500 m above the sea level, thereby deserving the name of „*highest of the vine-lands in Hungary*" (Figs. 2-3). The study area is situated in the buffer-zone of the Bükk National Park, so we had to pay attention not only to agricultural aspects, but also to the interests of nature conservation and landscape protection when working out the Environmental and Nature Conservation Management Plan of this territory.

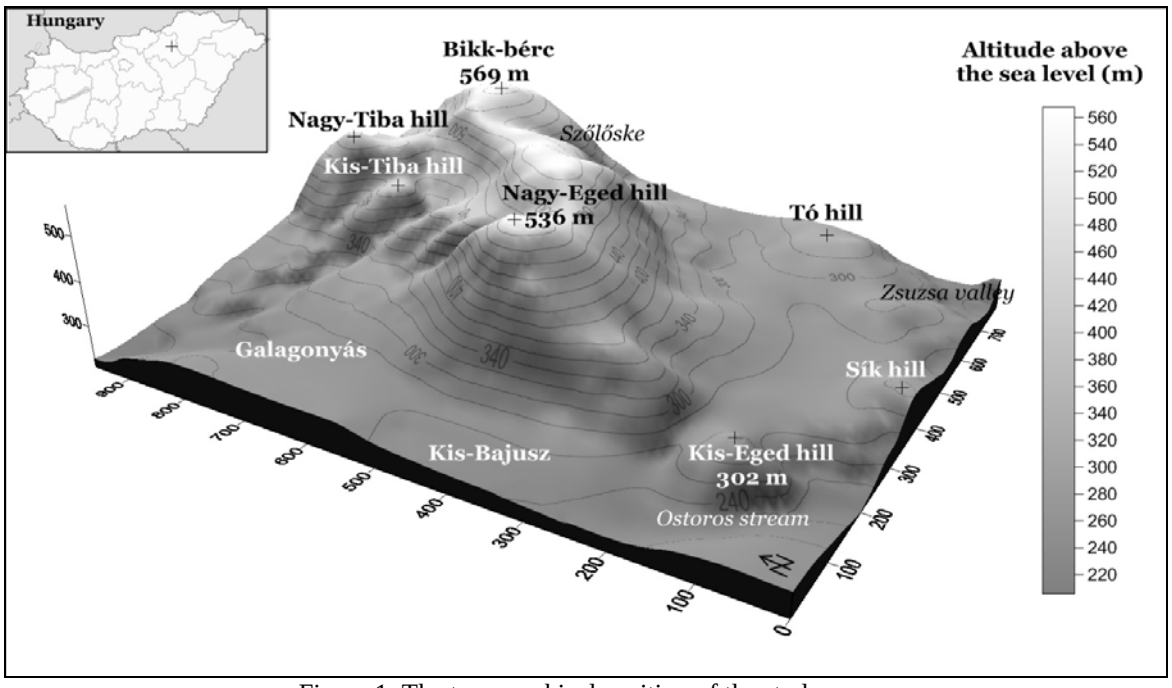

Figure 1. The topographical position of the study area

Figure 2. Vineyards and intensive soil erosion on the southern slopes of the Nagy-Eged Hill

Viticulture on Nagy-Eged Hill, as in other wine territories in foothill areas, has a long tradition. We could trace land-use changes using official topographic maps and military survey maps back to the 18th century. Our research was based on the First Military Survey Map (1782-1785), the Second Military Survey Map (1819-1869), a topographic map in scale of 1:10 000 published in 1990, and the aerial survey map published in 2012. We used the Military Survey Maps published by the National Military History Museum. Maps were digitized, land-use maps were created using main land-use categories (forest, vineyards, arable land, pasture and wetlands) and data and changes were analized. The software tools SURFER 9.0 and Arc.GIS 9.3 were applied for analysing the structure of different maps. The rate of soil erosion and land degradation in the study area was established by grain size and thermal (derivatograph) analysis.

Due to the protected status of Nagy-Eged Hill, the Environmental and Landscape Protection Management Plan of this territory was studied carefully (Sulyok, 2012) and photographs of the main land-use categories were taken during our field trips.

3. RESULTS OF THE INVESTIGATION

Eger was founded in the 10th century and viticulture was probably started on Nagy-Eged Hill during the 11th century, due to the episcopal see founded by King Saint Stephen in 1004. After the Mongol invasion, Walloon settlers established French viticulture methods around the settlement. Wine-growing viniculture became dominant in the area in the 16th century.

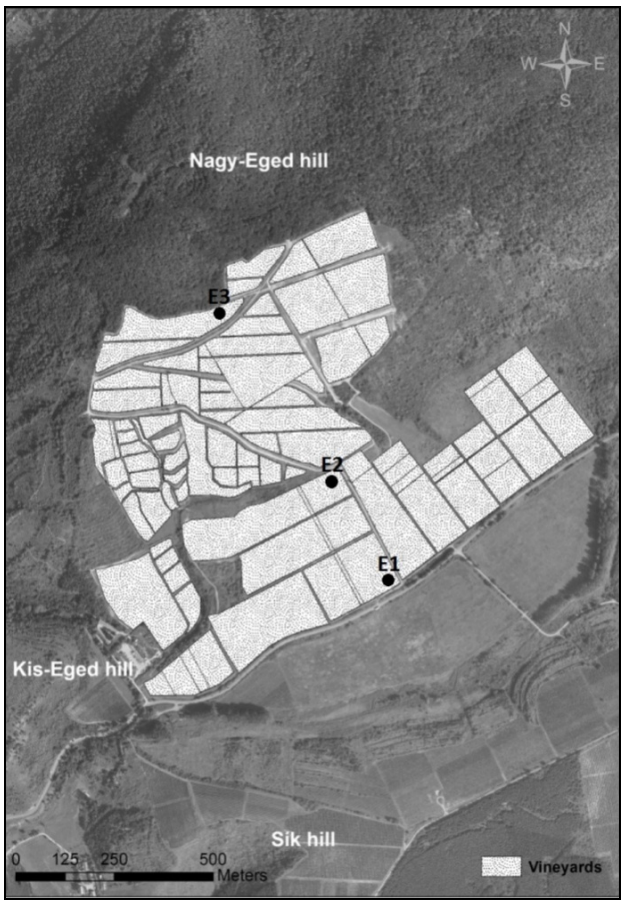

Figure 3. Vineyard block map of the Nagy-Eged Hill with locations of investigated soil profiles

The importance of viticulture decreased after the Turkish invasion in 1596 when the castle of Eger was occupied by the Turkish army, but it never disappeared totally from this territory. Viticulture disappeared, however, from Nagy-Eged Hill and the hill was reforested. The number of inhabitants increased rapidly after the recapture of the town from the Turks and the economy of the settlement became stronger and stronger.

Viticulture revived and grew again and the historical denomination of the vine-lands of Eger originates from the end of the 17th century and the 18th century. Viticulture became regulated at the beginning of the 18th century and the trial judge of Eger coordinated the organization and supervision of local communities.

In our study area, the traces of viticulture can already be seen on the First Military Survey Map published between 1782 and 1785 (Fig. 5). The greates part of Nagy-Eged Hill, Kis-Tiba Hill, Nagy-Tiba Hill and Bikk-bérc Hill were covered by forests in those days. Summit areas were originally covered by *Qurcetum petraea-cerris*, while on the higher slopes of the hill *Corno-Quercetum pubescenti-petraeae* appeared. Specimen of *Quercus petraea*, *Quercus pubescens*, *Quercus cerris* and *Cornus mas* represented the mixed tree stratum. On the lower southern slopes of Nagy-Eged Hill the original vegetation was constituted by *Corno-Quercetum pubescenti-petraeae* or *Ceraso-Quercetum pubescentis* (Kárász, 1991).

The forest covered 49.69% of the whole territory. We can find smaller pastures at the summit areas of hills (1.72%). Viticulture extended primarily over the lower foothill areas and along the valleys (Ostoros Valley) in the 18th century (36.31%). Vine-lands occupied the southeastern slopes and the territory of Szőlőske, which is situated on higher parts of hill slopes. The ratio of meadow was 0.97% while that of arable lands was 0.37% (Fig. 4). Streams and swamps appeared along the Ostoros Stream, the Zsuzsa Stream and a stream that bordered Nagy-Eged Hill in the south (10.94%).

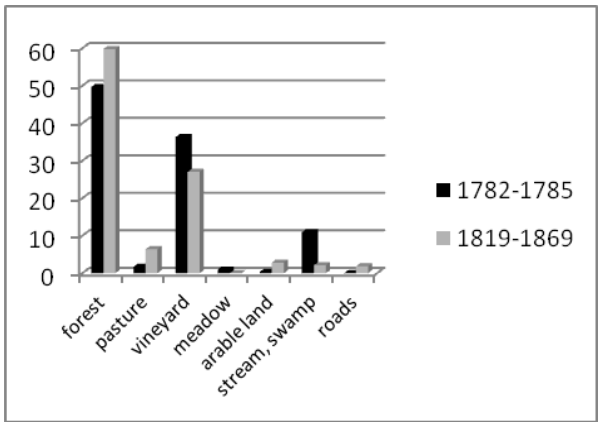

Figure 4. Territorial distribution of different land-use categories on the Nagy-Eged Hill and its surroundings (%) in the period of 1782-1785 and 1819-1869.

The Golden Age of the Eger Wine Territory occured during the 18th and 19th centuries. According to the sources and registers before the phylloxera disaster, there were many types of grapes peroduced around Eger and the vine-lands were mixed in structure.

During the Second Military Survey (1819-1869), an increase of forests and pastures and a decrease of vineyards and wetland areas was observed (Figs. 4-5) compared to former conditions. At the summit of the hills, pastures became more extensive and the original forests conquered new territories as well. Vineyards situated in Szőlőske and on the western side of Nagy-Eged Hill were being destroyed from the beginning of the 19th century and replaced by forests. The ratio of forests increased to 59.79%, while that of pastures increased to 6.38%. The extension of vineyards decreased by 22.56% compared to the First Military Survey Map in the study area. The territory of wetlands also decreased noticeably (2.13%).

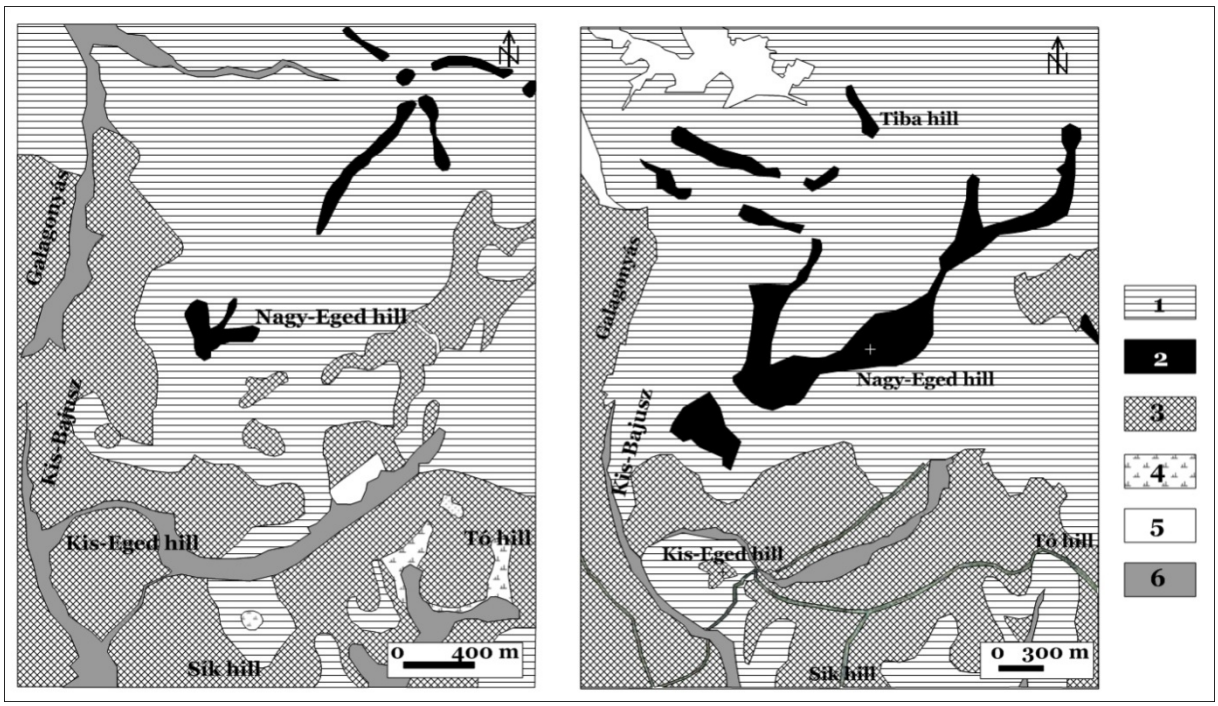

Figure 5. The land-use system in the period of 1782-1785 and 1819-1869 on the Nagy-Eged Hill and its surroundings (after the First and Second Military Survey Maps)
1-forest, 2-pasture, 3-vineyards, 4-meadow, 5-arable land, 6-stream, swamp

The phylloxera disaster appeared in Eger in 1888 and destroyed about 90% of the vineyards (Csutorás & Rácz, 2008). The reconstruction and recultivation of vineyards took 20 years. During the first vineyard reconstruction (1880-1910) after the disaster, different types of grapes were planted into separate fields. Direct producing grape varieties were planted in larger areas because of their higher average yield and low-priced cultivation (Beck, 2003).

Insignificant types of grape were planted during the hard economic period following World War I. due to a lack of capital and labour and a shortage of plant protecting material. The role of white wine increased significantly. Wine growing viniculture became focused on quantity production after World War II. Vineyards were moved down towards the lower areas, the cultivation of which was easier, but which were also less productive. As a result, numerous famous fields were withdrawn from cultivation (for example: Nagy-Eged Hill). In the period of the second Five-Year Plan, vineyards were reconstructed in large areas around Eger. Medium-height and high-cordon training spreaded at that time. Large areas were planted with grape within the framework of the 'Bull's Blood Programme' (the most famous red wine is called „Bull's Blood of Eger") in the period between 1978 and the 1980s.

We can see on the topographic map published in 1990 (Fig. 6) that the original forest vegetation of the study area was reduced to the summit area of Nagy-Eged Hill and its northwestern slopes (41.48%). Forests covered the territory of Bikk-bérc Hill, Kis-Tiba Hill and Nagy-Tiba Hill. The landscape structure became more fragmented and diversified in the surroundings of Nagy-Eged Hill (Fig. 7). Uniform grape fields and strip-like rows of grapes lended a character of diversity to the western foothill areas of Nagy-Eged Hill (9.81%). The western side of Kis-Eged Hill was covered by vineyards and the eastern side was covered by forests (6%).

Vineyards extended towards the younger and lower foothill areas in the southern part of the study area (the southern part of Nagy-Eged Hill, Sík Hill, Tó Hill) where their unique character was interrupted by arable lands, forests and roads. On the southern slopes of Nagy-Eged Hill there were abandoned vineyards (8.83%), meadows (0.4%) and orchards (0.5%). Along the valleys and Holocene fluvial terraces and the area of arable lands increased (9%).

The land-use map of 2012 (Fig. 8) reveals that vineyards, meadows and orchards situated on the southern slopes of Nagy-Eged Hill, abandoned in the 1990s, became cultivated again with the exception of the western edge, and significant vineyard reconstruction took place in this area.

Vineyards extend uphill on the upper parts of the slopes and they appear even along the 500 m above sea level contour line. These slopes are cultivated intensively (17.34%). The strip-like rows

of grapes are the most characteristic cultivation method in the western foothill areas of Nagy-Eged Hill. Larger vine-lands cover the southern surface of Kis-bajusz in the southwestern foreground of the study area. Vineyards cultivated carefully on Sík Hill and Tó Hill are evidence of an advanced grape growing viniculture.

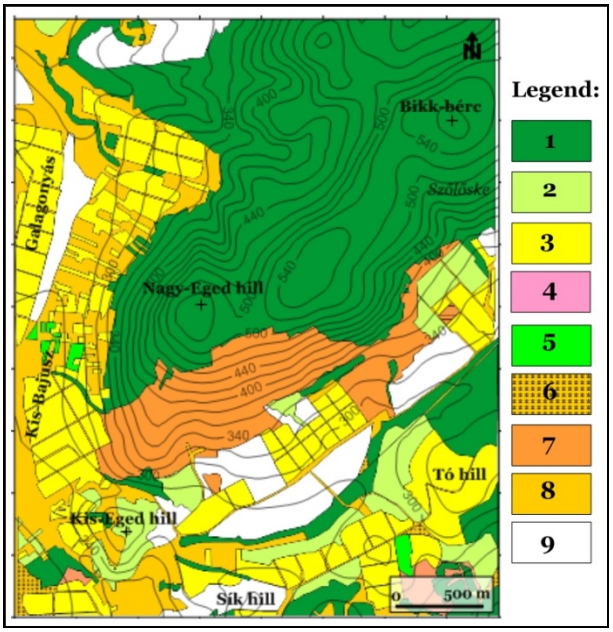

Figure 6. The land-use system on the Nagy-Eged Hill and its surroundings in 1990.
1-forest, 2-younger forest, 3-vineyards, 4-orchard and meadow, 5-orchards, 6-meadow, 7-abandoned vineyards, meadows, orchards, 8-grass land, 9-arable land

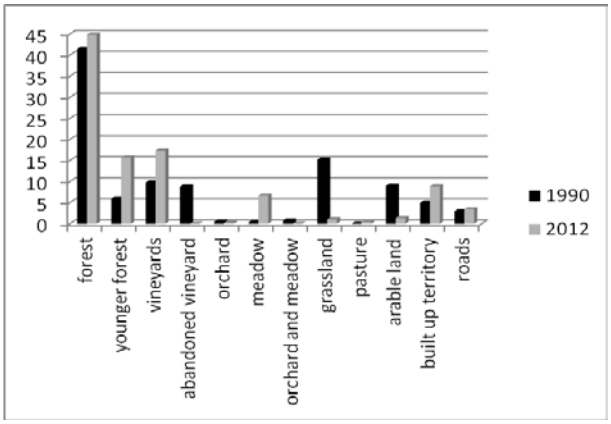

Figure 7. Territorial distribution of different land-use categories on the Nagy-Eged Hill and its surroundings (%) in the period of 1990 and 2012.

Forests were reduced to the summit of Nagy-Eged Hill and its higher, steep slopes (44.86%). Forests cover the territory of Kis-Tiba Hill, Nagy-Tiba Hill and Bikk-bérc Hill, forming part of the protected area of the Bükk National Park. The ratio of forests and younger forests has increased during the last 23 years and the increase of younger forests (15.74%) is especially noticeable in the formerly abandoned vineyards, meadows and orchards on the southern slopes of Nagy-Eged Hill. The territory of orchards decreased (0.22%), while the ratio of meadows increased (6.7%). Arable lands retreated to the alluvium (1.35%).

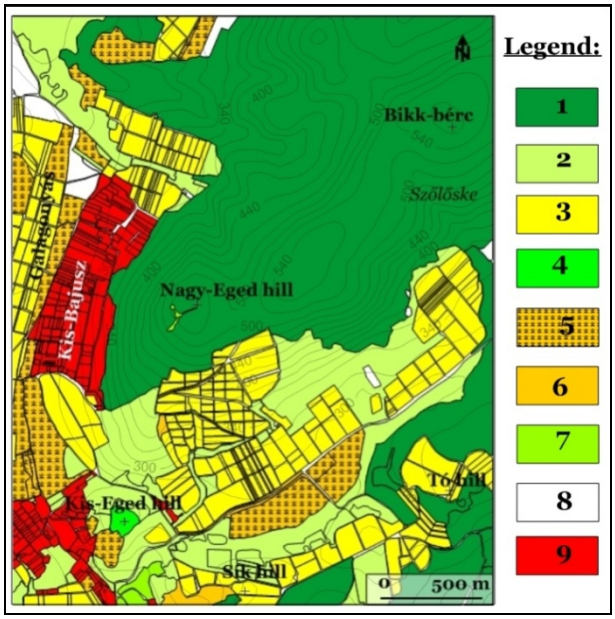

Figure 8. The land-use system on the Nagy-Eged Hill and its surroundings in 2012. (after the aerial survey map published in 2012): 1-forest, 2-younger forest, 3-vineyards, 4-orchard, 5-meadow, 6-grassland, 7-pasture, 8-arable land, 9-built up area)

Nowadays, beside sylviculture, the most widespread land-use category on Nagy-Eged Hill is viticulture. Qualitative viticulture has come to the fore again after the political transformation of 1989 in Hungary; numerous middle- and small-sized wine-houses were founded, providing competition to the large state-owned wine-factory. Some top-quality wine-houses developed quickly in this territory, contributing to an improvement of the quality and appreciation of wines in the Eger Wine Region. As a result of continuous cultivation, landscape and cultural heritage values of viticulture such as different *revetment walls and human-made walls* were also revealed. They lend a special landscape character to this territory and need to be protected for the future.

4. DISCUSSIONS

We have examined the changes of the land-use system on Nagy-Eged Hill from the 18th century to nowadays. We have found that around 45-60% of the whole study area has continously been covered by forests. Viticulture occured in this area in the 11th

century and the largest extension of vineyards was reached in the period between 1782 and 1785. After that the ratio of vineyards decreased gradually and the phylloxera disaster abolished about 90% of the vineyards at the end of the 1880s. At that time the abandoned vineyards, meadows and arable lands reached their greatest spatial extension. The area of vine-lands grew as a result of the new recultivation and reconstruction efforts, which mainly concerned abondoned vineyards, meadows and former arable lands. This expansion did not affect the territory of protected forests. Vineyards have appeared at the 500 m above sea level in the past few years on the southern, steep slopes, which has caused intensive soil erosion there.

Soil erosion on southern slopes of Nagy-Eged Hill has reached such an extent that at 400-500 m above sea level the base rock and its weathered material appear on the surface (Fig. 2).

We have explored changes of soil texture and composition using grain size and thermal analysis. The thermal analysis pointed out the lack of montmorillonite in the upper part of the hill. The montmorillonite could be capable of bonding high amount of water. The opposite effects prevail in case of accumulation areas. The foothill area has deeper clayey horizon, which contains twice more montmorillonite (17-52 %) like the upper part of the slope (15-31%). These changes affect the water supply of the soil, which in turn has disadvantageous effects to the physiological processes of grapevine. Intensive soil erosion that appeared along the southern slopes of Nagy-Eged Hill can be documented by grain size analysis (Fig. 9). We have explored three soil profiles at different positions and heights on the southern slope: E3 – 470 m, E2 – 335 m, E1 – 295 m.

There are coarser and redeposited *periglacial sediments*, like gravels and pebbles (55-56%) at the upper part of the hill (E3 soil profile). The original topsoil was eroded from this territory and the total thickness of soil is 50 cm. The average humus content of the soil is 4.5%. The thickness of the E2 soil profile is 180 cm. At a depth of 0-90 cm, we find some coarser gravel and pebbles (30-43%) and dominant finer sand, silt and clay (70-57%). This character of sediments shows *repeatedly transported sediments*.

At a depth of 90-180 cm, the ratio of gravels and pebbles is above 80% and the ratio of sands is low here. This grain size distribution indicates the weathered material of base rock. The average humus content is 2,4% (0-90 cm) and 0,7% (90-180 cm).

The thickness of the E1 soil profile is 180 cm. At a depth of 0-30 cm, there is a coarser upper soil horizon, where the ratio of gravel and pebble is 54%. This horizon shows *coarser repeatedly transported sediments*, where the gravel and blocks originated from the upper part of slopes. The ratio of finer grains is 46%. There are finer sediments under this horizon, at a depth of 30-90 cm. The ratio of gravel and pebbles is only 5-14%, with a dominance of finer sand, silt and clay (95-86%).

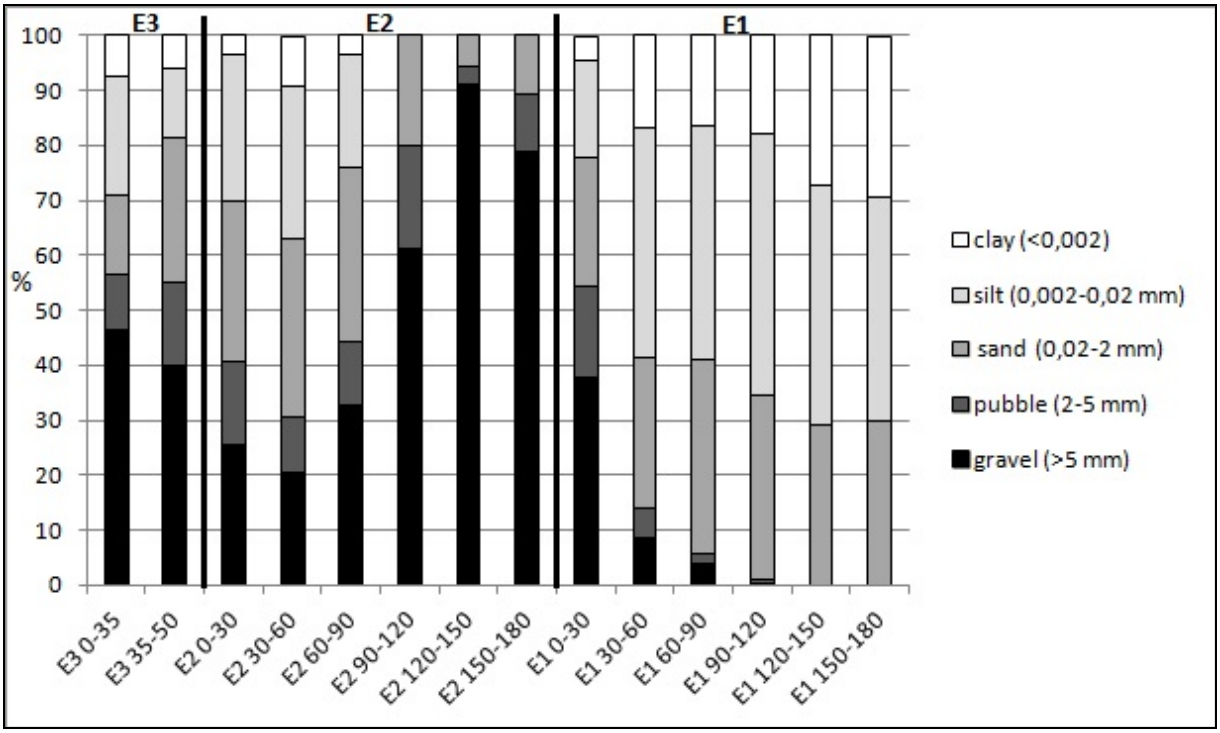

Figure 9. The grain size distribution of investigated soil profiles

The amount of clays is significant (17%) in this material. *There are fine sediments in the lowest horizon of the soil profile* (90-180 cm). The ratio of clay is 18-29%, the ratio of silt is 41-48% and the ratio of sand is 29-33%. The average humus content is 2,067% (0-30 cm), 2,2% (30-90 cm) and 2,0% (90-180 cm). The thickness of the humus horizon is 150 cm.

The investigation of the three soil profiles proves that there is intensive soil erosion on the upper part of the southern slope on Nagy-Eged Hill. The *base rock or weathered base rock* can appear on the surface here today. There are *repeatedly transported and redeposited materials* along the middle part of the slope, while at the lower parts of the slope *an accumulation zone* has developed.

Significant land degradation can be found at 400-500 m above sea level and along erosional valleys that developed on steeper slopes on Nagy-Eged Hill. These areas coincide with the territories of new vineyard reconstructions after the political transformation.

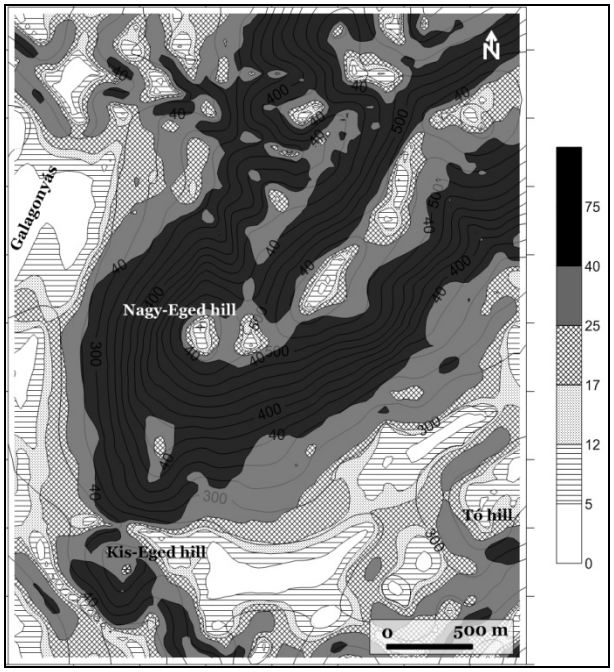

Figure 10. Constructed optimal land-use system based on slope categories of Nagy-Eged Hill and its surroundings: 0-5% - suitable for arable lands, 5,1 -12% - suitable for arable lands, soil erosion possibility, 12,1-17% - the upper level of the large-scale agricultural cultivation, 17,1-25% - suitable for small-scale agricultural cultivation, 25,1-40% - suitable for terraced cultivation and sylviculture, 40,1%- suitable for sylviculture only

This is why, the planning of an optimal land-use system would be beneficial for the study area. In order to do this we have drawn a map of an optimal land-use system based on the different slope categories (Fig. 10) on Nagy-Eged Hill. As we saw in figure 8., the southern, younger foothill areas (Sík Hill, Tó Hill) situated in front of Nagy-Eged Hill and the erosional valleys dissected by Quaternary fluvial terraces can be classified into the 0-25% slope category. These areas are suitable for intensive agricultural cultivation. Terraced cultivation and sylviculture could only be recommended as optimal land-use forms at altitudes between 275 and 375 m above sea level on the southern and southeastern slopes of Nagy-Eged Hill. Sylviculture could be recommended along the steep slopes situated in the 350-500 m altitude range above sea level.

Unfortunatelly, intensive viticulture is practised at present in these areas and, as we have mentioned, it causes intensive soil erosion. The preservation of wooded areas is by all menas justified in these areas, as forests provide the most effective protection against soil erosion.

5. CONCLUSIONS

The land-use system of Nagy-Eged Hill has continously changed and has become more and more fragmented and diversified from the 18th century onwards to nowadays. A proposal for the protection of Nagy-Eged Hill and its Nature Conservation Management Plan (Sulyok, 2012) was produced by the Bükk National Park in 2012 (Fig. 11).

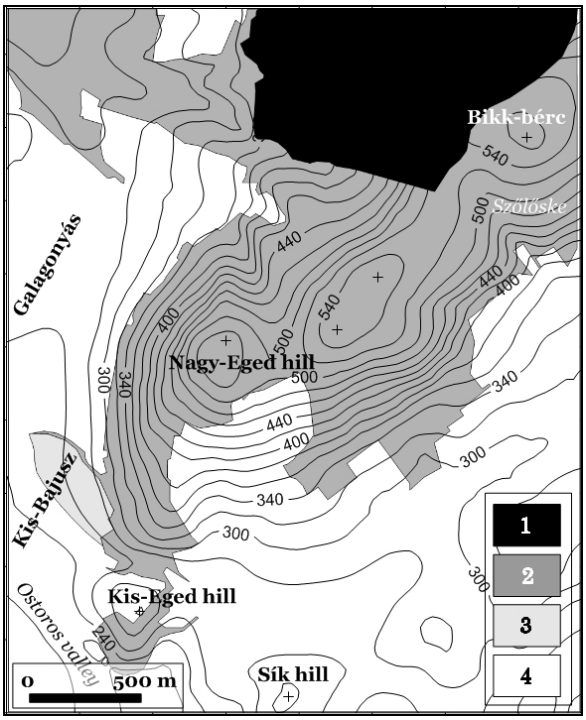

Figure 11. The Proposal for the Nature Conservation zonation system of Nagy-Eged Hill and its surroundings (after Sulyok, 2012): 1 – protected areas, 2 – areas planned for the protection, 3 – divisible areas, 4 – viticulture and arable lands

As can be seen, areas situated north of Bikk-bérc Hill are under protection today. The proposal was aimed at placing Bikk-bérc Hill, Nagy-Eged Hill, Szőlőske and Kis-Eged Hill under protection as well. These areas are covered by forests or younger forests and grassland today.

The designation of areas planned for protection is supported by landscape historical research. Vineyards and arable lands under intensive cultivation were not included in the Nature Conservation Management Plan. These are situated in the buffer zone of the Bükk National Park and for this reason the thousand-year-old system of viticulture and its landscape values and cultural heritage should naturally be taken care of by landscape protection and environmental management actions.

Environmental measures must take into account the transformed landscape conditions as well, since there are already significantly degraded surfaces here. Intensive viticulture is practised along the southern, steeper slopes, which were originally suitable for sylviculture, resulting in significant soil erosion. For this reson it would be important that economic and nature conservation measures should be realized in accordance with landscape conditions on Nagy-Eged Hill.

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