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# HISTORICAL LAND USE AND ANTHROPOGENIC FEATURES: A CASE STUDY FROM NAGYMAROS

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**Összefoglalás** – A tanulmányban egy körülbelül 0,15 km$^2$ kiterjedésű, korábban szőlővel borított, mára már részben visszaerdősült területet vizsgáltunk. A Kapu-hegyen elhelyezkedő mintaterületen viszonylag nagy méretű, épségben maradt kősorok, árkok és teraszok találhatók. A 18. század végén a terület délkeleti kitettségű, meredek hegyoldala döntően szőlőművelés alatt állt egészen 19. század végéig, de a terület művelése – részben megváltozott területhasználat mellett – gyakorlatilag az 1950-es évekig folytatódott. A hosszú időn keresztül folyt intenzív művelés és az erózió elleni védekezés az eredeti talaj szerkezetét erősen átalakította. Terepi vizsgálataink során bizonyos törvényszerűségek megállapításával s párhuzamok keresésével olyan kérdésekre próbálunk választ találni, mint például: mikor és miért kerültek oda s meddig voltak használatban a területen található kősorok, árkok és teraszok, illetve hogy az egykori intenzív használat nyomai milyen mértékben követhetők a jelenlegi felszínen és a talaj fizikai szerkezetében.

**Summary** – In this study, an approximately 0.15 km$^2$ representative study area of former vineyards, now partly reforested, is the subject of investigation. The area of the Kapu Hill is characterised by a system of relatively large and intact stone hedges, ditches as well as well-preserved traces of man-made stone and earth terraces. In the late 18th century this steep slope of southeastern exposure was predominantly covered by vineyards and thus, it was subject to severe erosion roughly until the late 19th century, but – with changed land use – in some extent until the 1950s. Due to intensive vine cultivation as well as effective protection techniques soil structure was strongly modified. In the course of our investigation we try to find out the main characteristics and probable regularities in the set of abandonned man-made features, seeking for the answer of such questions as when and why these stone hedges, ditches and terraces became part of the landscape and in what extent intensive land use left its marks on the present soil and surface of the study area.

*Key words*: hill vineyards, changed land use, historical soil protection, man-made features

## THE STUDY AREA

The study area (between 340 and 220 m above sea level) is located northeast to the town of Nagymaros in the former '*promontoria*' (hill vineyards) area, on an 18-22° slope of the Kapu Hill with south-southeastern exposure, turning towards the Danube, under the plateau of the Gubacsi-hálás (360 m), at the boundaries of the Danube-Ipoly National Park (*Fig. 1*). It is surrounded by oak forest from the upper part of the slope, while a long supporting wall and a road close it down at the lower end, separating the study area from the today extensively utilized zone of cottage houses (former vineyards). At the two sides chestnut and oak forests are located. In between, our sample area of abandonned terraces,

long stone hedges and stone-bedded ditches is mainly characterised by forest steppe and shrubby vegetation.

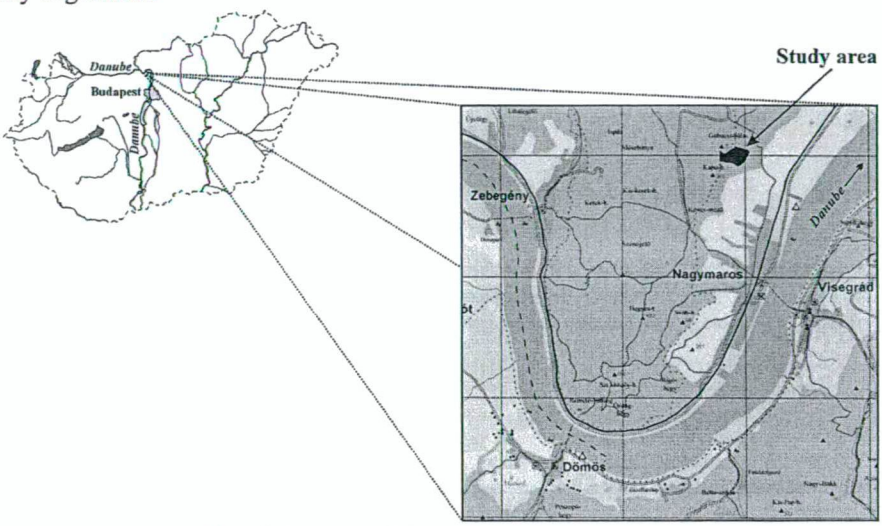


*Fig. 1* Location of the study area in Nagymaros

The bedrock of the hillslope is Miocene andesite and andesite agglomerate, typical for the Börzsöny Hills, but in the eroded head part of the valley, located south-southwest, limestone as well can be found in patches (only in detrital form). Terraces of natural origin, namely fluvial Danube terraces, also appear in the study area (*Pécsi*, 1991. 36-47). The characteristic soil cover is the strongly eroded brown forest soil with clay illuviation, in plateau position black erubase soils, in the environment of the bare bedrock stony soils can be found, while black rendsinas also appear on limestone patches. The volcanic bedrock debris and the thin brown forest soil with clay illuviation as well as the black erubase and stony soils are acceptable for traditional vine cultivation, which needs a minimum soil depth of 30-40 cm, and another 1-3 m-deep permeable layer where roots can absorb nutriments (e.g. *Boros*, 1996. 10).

The study area is significant not only because of its terraces and long stone hedges, but also because it is located in a 'transitional' area: between the mostly forested upper-hill zone and the main areas of continous, traditional cultivation (fruits, arable, meadows, etc.) in the pediment area. Due to its distance from the historic centre (less than one hour on foot), the steepness of its slopes, the relatively high altitude as well as the favourable exposure, the study area is quite likely to be cultivated in periods of economic expansions. However, such an area always needs higher investment both in terms of labour and money, though presumably a better-quality wine can be produced as a result, especially compared to some less-favourable lands of the former Visegrád estate Nagymaros belonged to (e.g. vineyards of Visegrád, on the other side of the Danube). Beyond the risks mentioned above, another negative effect could be soil erosion in general.

Thus, the present examination has two main aims: one aim is to detect the former land use (cultivation types, techniques) with its *in situ* remains and some past structures still retraceable in the study area. Another aim is to provide a detailed field survey of the study area, utilizing the already-known information of previous land use, cultivation forms and some main characteristics of vegetation. In connection, among many others, it is an

important question when, why and how man-made terraces, stone hedges and ditches were created, for how long these features were in use, and when, why and how they were finally abandonned. In order to find the adequate answers, beyond field examination of soil structure analysis and dendrochronological study, we used contemporary written documents, maps and some currently-published works of local history research as well as parallels, namely the results of geographical, botanical and ethnographical, historio-etnographical research of other areas mainly carried out in Hungary.

## IMPORTANCE OF ABANDONNED TERRACES

The application of terraces in the more effective utilization and soil protection of hilly areas, namely in cereal as well as in vine- and fruit production was much more wide-spread in the last millenium until the late 19th century than it is today. In the international (especially the oversea) research is mostly concentrated on South-America, partly on the Asian subtropical areas and the European Mediterraneum (see e.g. *Spencer and Hale,* 1961; *Denevan,* 2001. 133-211; etc.; for Asia see e.g. *Xing-guang and Lin,* 1991; for European example see e.g. *Bell and Boardman,* 1992; *Rackham and Moody,* 1996; *Dotterweich et al.*, 2003; *Dunjó et al.*, 2003; etc.).

In Hungary, the largest number of terraces, still traceable, were built in connection with ploughing and vine (or fruit) cultivation. Among the research in connection with abandonned terraces, formerly used as ploughlands, one has to emphasize the importance of the works of Gyula Nováki. He studied the area of Nagybörzsöny and Bernecebaráti (Börzsöny Hills, north to Nagymaros), where abandonned ploughlands with long stone terraces were found, dated to a period prior to the 18th century (*Nováki,* 1975). Another investigation took place at the deserted late medieval settlement of Sarvaly (close to Sümeg, Western Hungary) as well as near Tamási in Tolna county, South-Hungary (*Nováki,* 1984). Moreover, historio-ethnographic research was carried out in the Hegyköz area (Northeast-Hungary) and the Palóc lands, in North Hungary (e.g. *Hoffmann,* 1956. 541, 543, 550, 554; *Balassa,* 2000. 57).

While terraces connected to ploughing activity are mainly characterised by few, but long (several 10 m) terraces, such intensive cultivations on steep slopes as vine are generally more connected to shorter terraces, although sometimes long terraces can also be connected to vine cultivation. Most of the abandonned terraces of former vine cultivation all around the country are said to be dated back to the 18th-19th centuries, but some of the features might be built already in the 17th century or even earlier (see e.g. *Balassa,* 1991. 76, 92-93. etc.). Application of terraces on steep slopes were wide-spread in vine cultivation until the late 19th century. As a branch of anthropogenic geomorphology, in Hungary mainly geographers studied the anthropogenic features and the extent of human impact occurred, among others, in (former) hill vineyards with terraces and other man-made features. A good conclusion of these works, especially for South and Southwest Hungary, were carried out by *Erdősi* (1984), referring to, for example, the wine regions of Szekszárd as well as the Villány and Mecsek Hills.

From our present viewpoint, historical parallels also have special importance. The most well-investigated example is Tokaj-Hegyalja: the preparatory works, namely the formation of stone hedges, land boundaries, terraces, ditches – at least from the early 17th century – were carried out by specialised skilled workers of German origin, living in the

village of Mecenzéf in Northeastern Hungary (*Balassa*, 1959; *Balassa*, 1991. 83-87). The maintenance works, however, were mainly done by less skilled workers whom were either paid or they did it as an obligatory work (*Hőgye*, 1986. 188, 195, 216; *Boros*, 1996. 108-109). In the 17th-18th centuries the 'preparation' works, carried out before and continued during vine cultivation, were important and necessary parts of the effective utilization of the area for wine production. These works included, for example, the building of stone terraces, the 'de-stonification' of the (future) area of vine cultivation, preparation and cleaning of ditches, carriage of earth and dung as well as the creation of land-boundaries on steep southern slopes (*Balassa*, 1991. 76-94). The latest in the 17th century, cleaning of ditches (applied especially against the mass erosion work of downpours and cloud bursts) and repairing hedges and terraces in the areas under intensive vine cultivation were systematically controlled by the local official bodies through laws in the Tokaj-Hegyalja wine region (*Balassa*, 1991. 76-78). Balassa in his work clearly connects the above-mentioned anthropogenic features to the traditional ways of soil protection. Similar type of anthropogenic features (stone hedges, terraces, ditches) of the Balaton Uplands (Central Transdanubia), the Mátra Hills, the environs of Eger (both in North-Hungary) and the hills around Budapest as well as the areas of Szekszárd or Pécs and the Villány Hills (all in South-Hungary), formerly connected to vine cultivation now mainly stay abandonned, are in many cases still visible in forests or in areas under the process of reforestation (see e.g. *Baráth*, 1963; *Ádám*, 1975; *Bodnár*, 1987; *Nyizsalovszki*, 2001; *Szilassi*, 2003. etc.).

In the area of Nagymaros, abandonned stone and earth terraces of former vine and cereal production can be found in some of the mainly reforested hilly slopes of southern exposure, the latter observed by *Nováki* (1975. 76). The appearance of short terraces as well as other features such as stone hedges or (stone-bedded) ditches were strongly, nevertheless, dependent on former land use: presumably, in this area they were mainly connected to intensive vine cultivation.

## FORMER LAND USE OF THE STUDY AREA

The strongly transformed southern slopes of the former '*promontoria*' in Nagymaros were subject to severe erosion during a longer time of intensive cultivation. These relatively steep (18-22° or even more) slopes of favourable exposure in the Danube Bend, except for the top regions and plateaux, almost everywhere were under cultivation. The main period of (vine) cultivation in Nagymaros can be dated presumably from the 14th to the early 16th and then particularly to the 18-19th centuries (see *Kiss et al.*, 2005). With the application of contemporary maps and images, the land-use changes of the area can be detected in more detail from the second half of the 18th century. Only indirect evidence is available before, referring to the general landscape changes of the areas belonging to Nagymaros (see *Kiss et al.*, 2005).

In the 18th century, most of the manorial vineyards in Nagymaros were located underneath our study area, at the same hill (*Magyar*, 1998. 108, 112). From the earliest maps available from the 18th century, both the estate map (1787-1805; see *Fig. 2*) and the First Military Survey (1784 – HMT, Coll. XII. Sec. 17) suggest that the study area – except for some of the highest, northern parts – was predominantly covered by vineyards at that time. As we could already see, exactly in these decades the Nagymaros wines had a steady market in the Upper-Hungarian mining areas, namely in Selmecbánya (today Banská

Štiavnica in Slovakia; *Magyar*, 1998. 145; see also *Kiss et al.*, 2005). The same was the case in 1856 when, according to the cadaster map and conscription, the study area was part of the vineyard-zone of Nagymaros (OSZK-TK, Bv 1455/1/1-2).

*Fig. 2* The study area on the detailed map of the Visegrád-estate, dated to 1787-1805 – MOL, S11. 207/b (original: *ca.* M 1:5760)

On the maps of the Third Military Survey (1872-73 – HMT 4862/3), the sample area is still mainly covered by vinestocks and trees scatttered around; trees seem to be predominant especially in the higher parts of the study area. In the mid-19th century, the Lator-valley, located in the direct neighbourhood of the study area, was mentioned: here around that time vine cultivation was predominant (*Pesty*, 1986. 227). According to the land-consolidation map of 1885-1887, the study area still belonged to the category of 'Vineyards under the town' (MOL, S 11. 832/a). By 1923, on othe other hand, the study area was mainly covered by meadows, trees scattered and partly vineyards and some orchard in the lower sections (1923 – HMT 4862/3).

Approximately similar is the case in the early 1950s when maps still show some cultivated lands of vineyards and orchards in the lower, smaller sections while the more extensive, upper sections are characterised by lines of trees and meadows. The aerial photos taken in 1951, 1962, 1970 and 1987, as well as the new Military Surveys of the 1950s, 1970s and 1980s (HMT – L-34-002-D-b), show a gradual increase of uncultivated lands in the study area. In this sense, the aerial photo of 1951 has special importance: past land boundary structures can be detected probably the most in this case (see *Fig. 3*).

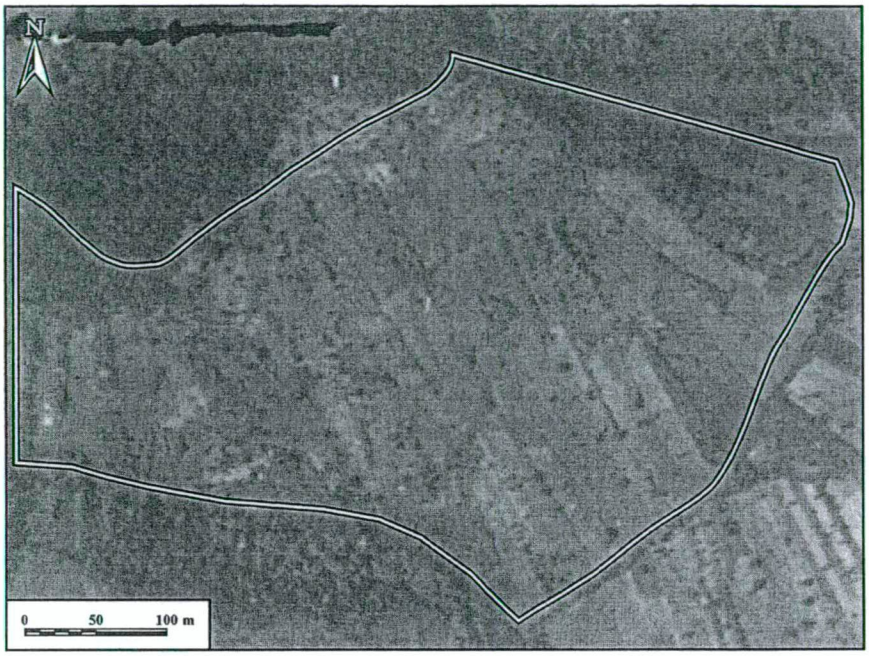


*Fig. 3* The study area on the aerial photo taken in 1951 – HMT, L-34-2-D-b (original: *ca.* M 1:20,000)

Another information for the appearance of the today-existing wooden vegetation (thus, when the management of the area ceased to exist) also suggests that the final abandonment of the area did not occur at once but it was the result of a longer process: while the intensive cultivation of the higher and the northern areas decreased first, some of the lowest parts were under cultivation probably even in the 1960s (see e.g. the aerial photo of 1962 – HMT, L-34-2-D-b). According to the dendrochronological survey, based on samples mainly taken from older trees of the species *Quercus petraea L.*, the average age of oak trees was around 44 years (oldest on a terrace: 58). After the age and location of the oldest trees (beyond 50 years each) we can presume that in the upper section of our study area the appearance of 'natural' wooded vegetation in larger number probably started already around the end of the 1940s, beginning of the 1950s.

A '*terminus ante quem*' date can also be provided with the help of approximately a dozen broken roof tiles found at small cube-like places (rectangular 'holes' in stone hedges – probable storage places) both in the middle and the northeastern (lower further) end of the sample area. Their description '*BERGMANN MIHÁLY NAGY-MAROS*' suggests that it was made in the local brick-factory, worked between 1882 and 1945 (*Fischer*, 2005. 8). These roof tiles were presumably produced in a later phase of the factory, thus in the first half of the 20th century, but definitely before 1945 when the factory was finaly closed down.

## POSSIBLE CONNECTIONS BETWEEN PRESENT SURFACE CONDITIONS AND PAST LAND USE

Both on the slope and in plateau position – in more or less original morphological situation – the maximum soil-depth is 40 cm, but generally this depth is not more than 25-

30 cm. During the Ice Ages the most important geomorphic proccess might have been the weathering caused by frost, gelisolifluction and debris-creep, which traces can be found at the study area even today in the form of earth-terrace-like features. Thus, based on the form itself, in some cases it is not possible to state clearly whether the actual feature is natural or a heavily eroded former man-made terrace. Due to this problem, only the clearly man-made terraces were measured and included in this article. Near the bare stones lying at the surface of the upper section crioplanation debris, and on this debris the traces of fossil landslides can be detected. Due to the steepness of the slope the solifluction and the slow movement of the andesite debris is active even today, which can be proved by the appearance of several warped trees of the area.

The higher, larger section of the study area can be characterised by meadow vegetation with patches of forested parts, while the lower areas, especially to the south, southwest (where vine cultivation was given up at last) mainly shrubby-scrubby vegetation is predominant. However, the vegetation of the lower areas is quite mixed: the shrubby area is sometimes mixed with forest-steppe at the lower end, while it is almost entirely replaced by young dense woodland towards the northeast. Although the predominant tree species of the area is oak (*Quercus petraea L.*), some other types such as walnut, chestnut, cherry and several other, wild fruit trees are mixed into. While walnut is a typical tree of vineyards, the latter tree of Mediterranean origin presumably came from the chestnut forests nearby, both representative for the area, since until the end of the 19th century some of the main products of the settlement were grapes, wine, chestnut and walnut (see e.g. *Döbrössy*, 2004. 67). The appearance of cherries can also be connected not only to the formerly (early 20th century) significant fruit production of the settlement, but also a possible later land use type of that particular site.

In general, the landscape of the study area shows close parallels to one of the last phases of succession (forest-steppe meadow) typical for former vineyards abandonned several decades before. This level of succession is described by *Baráth* (1963. 346), referring to an area of roughly similar phyisical conditions, located relatively close to Nagymaros (near Budapest). His results were in good agreement with the ones carried out in the abandonned vineyards of the Tokaj-Hegyalja region (e.g. *Nyizsalovszki and Virók,* 2001). However, unlike other former vineyards, the almost entire lack of any trace of vinestocks (we found only two stocks in the lower and the central parts) in our study area is quite striking. One probable reason is that in most parts of the study area vine cultivation could have been given up a hundred, hundred and twenty years ago or even earlier. On the other hand, it is also probable that after vine cultivation was given up in some parts of the study area, remaining vinestocks were at least partly removed since other utilization types (pasture, fruit production) appeared. Zoltán Baráth also emphasised the significance of latter land use in the areas of former vineyards, in connection with the possible directions of vegetation-development (*Baráth*, 1963. 342).

Forestification has most probably started from the oak forest above and around the study area as well as from the older tree lines along the boundaries (see *Fig. 3*) – partly located on stone hedges. In case of the latter ones it is presumable that trees on stone hedges and at boundaries were left even during cultivation on purpose: some ethnographic parallels show that these trees could be regularly cut for, for example, firewood (*Baráth*, 1963. 345). The idea of a conscious 'management' can be supported by the fact that in our study area mainly the old coppice of oak trees can be found on the stone hedges which can be marked as tree-lines on the aerial photo of 1951 (see *Fig. 3*). The other development direction, described by *Baráth* (1963. 344), the abundance of grassy vegetation can be also

detected in the study area. The possible deeper connections and further parallels can be discussed only after a more detailed botanical survey of the study area.

## TERRACES, STONE HEDGES AND DITCHES

In order to provide a more clear overview, the man-made features of the study area had to be mapped in detail. Due to the steepness of slopes and other problems (very uneven surface, dense vegetation etc.), measurements were carried out by a hand GPS of 5-10 m mean error. For further correction of data, we applied the 'traditional method' of measurements (e.g. compass, tape-measure and angle gauge). Results of measurements are indicated on *Fig. 4*. Additionally, we compared our results to the aerial photo taken in 1951, where due to the still-ongoing cultivation, some main structures of land divisions are still visible (*Fig. 3*).

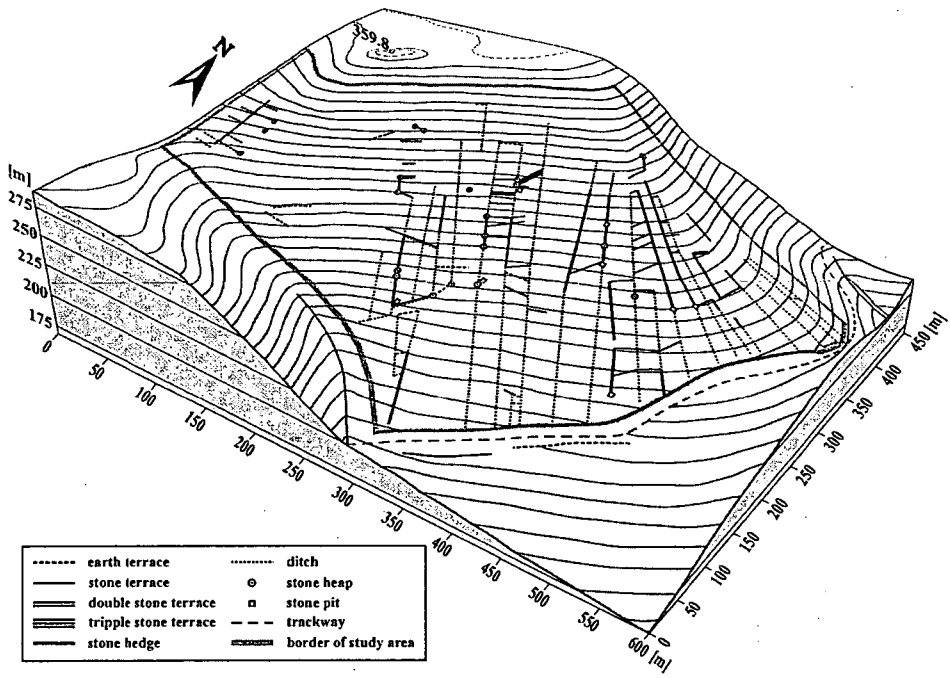


*Fig. 4* The 3D model of the study area and the anthropogenic features detected

Located in the study area, the width of anthropogenic, partly stone (*Fig. 5a*) and partly earth (*Fig. 5b*) terraces is rarely more than 10-15 m, while their height changes between 3 and 0.5 m. Some of the terraces (also counted here as stone terrace) show a transitional form: only the two edges, usually along ditches are strengthened by stones. At first site, the location of terraces is not systematic, although they are clearly connected to a former parcel-system: smaller units attached to stone-hedges and/or stone-bedded ditches more in one-one line or alone can be recognised (*Fig. 4*). Terraces of better condition can be found mainly in the central and lower parts of the study area where vine cultivation was given up only in the last phase of abandonment.

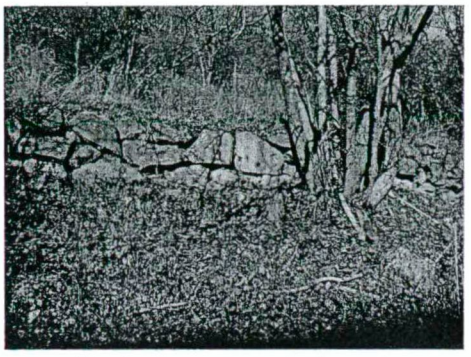

*Fig. 5a* Stone terrace in the study area

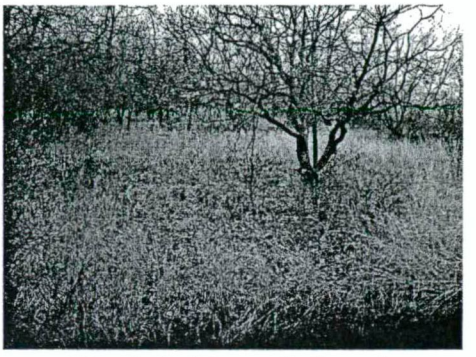

*Fig. 5b* Earth terrace in the study area

The primary function of both the earth and stone terraces could be to increase protection against soil erosion and probably also to decrease other negative effects such as the steepness of slope; on the other hand, some of the rather massive stone terraces could as well have a boundary function (between the lands of two different owners). Other interesting speciality of many terraces is the inclination of the terrace level towards the ditches and stone hedges. It seems that the original formation of the terrace level had this characteristic feature: namely that the terrace level in this way slowly led the water towards the ditch. Beyond the well-definable terraces, within the boundaries of former parcels, one can find earth terrace-like features in the majority of the study area. Even if these features in many cases show similarities to the former terraced vineyards, described by *Baráth* (1963), due to the above-mentioned natural conditions of the area, we indicated only the terraces of clear anthropogenic origin and in this investigation doubtful cases were left out of *Fig. 4*.

The so-called (both stone-bedded or earth) pseudo-terraces of the area should also be mentioned: these man-made terrace-like features are attached to former paths and small 'tilted' roads (see *Fig. 4*), which – connected to other paths or ditches – in many cases presumably had a draining function as well. Moreover, our study area was surrounded by two (wagon)roads (see *Fig. 2*) where smaller paths led to: while the southwestern one, based on its appearance, really deserves the name of a (stone) pseudo-terrace (only 10-20 cm high), the other – attached to the road closing the study area from the southeast – with its sometimes 2 meter high, long stone walls of several ten meters appear (and is structured) like a real terrace.

In the study area, around 1.5-2 m (maximum 4 m) tall and some ten meters long, stone hedges were detected (*Fig. 6a*); however, not all the stone hedges are accompanied by terraces. Additionally, some smaller and larger stone-heaps (1.5 to 4 m height) were found. According to the distribution of stone hedges, we can divide the study area into two parts: the first, considerably smaller one with two hedges and large stone-piles or heaps is located in the most upperly northwestern part, while the other, larger one with the rest of the stone hedges and most of the terraces can be found considerably lower to the south-southeast (see *Fig. 4*).

Detected either as a separate feature or as a continuation as well as a parallel line of some stone hedges, man-made – both earth and stone-bedded – ditches can be found, mainly along the former boundary lines of separate parcels. The present traces of ditches in some cases are characterised by almost straight lines of trees, possible to be traced back to 10-15 m or even longer (*Fig. 4* and *6b*). The origin of stone hedges, traditionally called as

'*obola*,' is presumably strongly connected to the intensive cultivation of a stony area. The stone debris coming out of the ground (before or) during cultivation was presumably thrown to the edges of the parcel (e.g. *Hoffmann*, 1956; *Baráth*, 1963; etc.). The large size of some stone hedges suggests an older origin, and thus there is a possibility that stone hedges of the study area were started forming already in the time of the estate map, namely in the late 18th century or before. Although the stone of the hedges came mainly from the cultivated ground, they must have had a function to confine the boundaries. Ditches presumably led the water of intensive precipitation events from the steep slope and the terraces in order to avoid, or to decrease mass erosion and the development of gullies. While most of the ditches are perpendicular to the slopes, some of them – in many cases connected to pseudo-terraces (see above) – are still today altering the water towards the already-existing gullies or the small valley nearby. Moreover, the size of particular (stone-bedded) ditches might suggest that beyond the above-mentioned function, some of them could have been used as walking paths as well. On the other hand, based on the size and formation of some of the ditches we can presume that not all of the ditches were made to be used as paths: many of them had the single function of leading the water down from the land.

*Fig. 6a* Stone hedge in the study area

*Fig. 6b* A former ditch with trees

After mapping the study area, we received a quite complicated picture as a result: many of the traces mapped are well-connectable to the former parcel-boundaries visible on the aerial photo of 1951, some of the main structures, especially the rough framework of the area is also compareable to the estate map of 1787-1809 and the cadaster map of 1886 (see *Figs. 2-4*). It has to be highlighted, however, that our map of man-made features is restricted to those still clearly visible in the landscape; these features are on the other hand only the fragments of a past structures which more or less unevenly remained from the levels of originally well-structured landscape, in continous transition.

## CHANGED SOIL STRUCTURE AND ANTHROPOGENIC TERRACES

The former '*promontoria*' zone of Nagymaros and thus, the study area itself belongs to the strongly eroded areas where more than 70% of the original surface layer is eroded (MNA, 80). The average soil depth in the study area is not more than 40 cm: around 40 cm the borer clashed into an impermeable andesite-debris. The physical characteristics of this 30-40 cm upper soil-layer is clay with 10-20 % stone content. It was possible only in some cases to determine genetic layers. This means that there is practically no intact, natural soil

profile in the study area, but only resected brown forest soil with clay illuviation where redeposited B-layers appear in the profiles. Consequently, the research carried out at Nagybörzsöny, only some kilometers north to Nagymaros, provides good parallels to our investigations: in the study area of Gyula Nováki, the depth of soil cover reached 40-45 cm only in the strips of the former plough zone, but in the other parts of the area, he counted with only a thin (20-30 cm), redeposited soil (*Nováki*, 1975. 56-58).

The morphology of stone and earth terraces, remained in definable condition, is rather uniform: generally we can find relatively horizontal surface only in a 50-100 cm-wide strip above the upper margin of the terrace (hereafter terrace level). Over the terrace level, after a short, concave transition, the presumably original surfaces can be found down to the bottom of the next terrace (in case there is another one above) with approximately the same angle as that of the natural slope (*Fig. 7*). Since 40 cm or even a bit deeper profiles appeared only at the terrace level and the slope transition, it seems to be proved that terraces were not wider even at the time of their formation, and thus, the narrowness of the terraces is not caused by later earth infilling from the upper sections. Terraces with more than 1 m width are very rarely appear, and they predominantly occur at the stone wall or closing stone terrace located at the lower end of the study area, near the road. Here the average soil depth was sometimes 1.5 m.

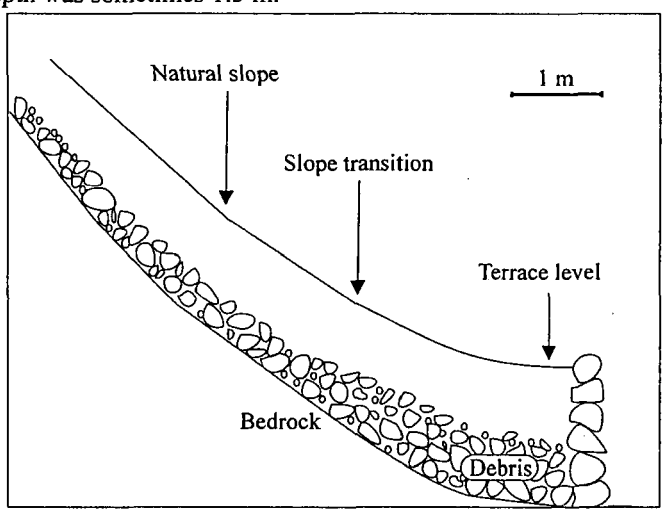


*Fig. 7* A simplified structure of terrace-profiles in the study area

The soil depth of terrace levels is altering between 40 and 100 cm, while this depth gradually decreases to 25-40 cm at the slope transition (*Fig. 7*). This structure shows certain similarities to the results of soil sampling (yet unpublished), carried out at some abandonned man-made terraces at Balatonszepezd (Balaton Uplands) in 2002 and 2003: terraces were rather narrow and soil depth was approximately the same (both on slopes and terraces) as that of the ones in Nagymaros. The around 40 cm soil depth can be significant from a cultivation point of view: in case of the traditional vine cultivation techniques the 'active' soil depth of cultivation primarily affected the most upperly 40 cm of the soil (e.g. *Gál*, 2004. 125-128).

Soils of the study area, depending on their genetic layers, can be divided into two groups:

1. In profiles with an average depth of 40-60 cm, genetic layers very rarely can be distinguished, from the surface to the decayed debris homogenous brown forest soil with clay illuviation B-layer were detected. Based on the almost-horizontal morphological situation, significant erosion cannot be detected, and thus, the examined homogenous profiles provided us with the proof that the terrace surfaces received a rather homogenous soil cover (namely, artificial infilling). The basis of the shalllow fertile soil layer is not identical with the top of the original decayed C-layer, but shows that behind the artificially-created stone walls (of the stone terraces) the embankment was carried out applying stone debris and only the upper few 10 cm were filled up with a fertile soil layer (*Fig. 7*).

2. The 60-100 cm deep fertile layers are generally well-distinguished into A- and B-layers. Between the two layers difference can be detected only in the percentage of humus content. Since these all were found on the terraces (terrace levels), we had to give up the theory that the this profile shows an undisturbedly developed genetic soil type; the development of the layers is presumably the result of a deeper or an older embankment. The thicker infilling leads to a much more balanced water and heat economy, which results faster humus development, and thus, a naturally-looking soil profile can develope already within a few hundreds of years. Should we face with terrace-sequences of a much older generation, this can even more generate the possibility of the development of clear genetic soil layers.

The advanced development of soil profile, namely the appearance and clear division of A and B layers of terrace-soils – similar to the large size of stone hedges as well as the structural parallel sin the location of the parcells – mentioned above suggest an older embankment, which mainly could happen a few centuries ago. In addition, this could be an explanation for two other unusual facts that the width of stone terraces rarely exceeds more than 1 m while their soil depth does not significantly differ from the surrounding slope with no terraces. Thus, the lower section of the terrace was filled up with stone debris and then beyond this debris layer the terrace was infilled with a thin soil layer. In this case, therefore, the primary function of terraces was on one hand not only to increase soil depth but rather to preserve the stability of the slope against soil erosion and the formation of gullies. The other function, however, might be connected to vine cultivation: in the 19th century, an adviced method of garden vine cultivation on clay soils was to fill the future vineyard with stone debris or sand and then cover it with some fertilized mixture of the original clay soil where vinestock was planted afterwards (see e.g. *Parragh*, 1860. 79).

## CONCLUSION

In the late 18th century, vine cultivation was predominant in the study area. After severe decrease of vine cultivation by the early 20th century, other, less intensive land-use types were invented in the majority of the study area; vine cultivation remained important only in the lower sections. Final abandonment of the area mainly occurred from the early 1950s. Nevertheless, it did not happen at once, but rather gradually, and mainly ended up by the 1960s.

Presumably, stone hedges, terraces and ditches are partly the traces of former land divisions. Terraces and ditches – among other functions – took an active, essential part of protection against severe soil erosion. Although no direct data refers to the age of anthropogenic features in the study area, it seems rather likely that from the beginnings of

the (latest) intensive vine cultivation period of the study area, namely from at least the late 18th century, protection and thus certain preparatory works against rapid and irreversible soil erosion were needed. The mapped system of hedges and ditches is presumably a fragment of an old system of boundary lines, since the lines of these objects are in good agreement with the boundary lines marked by trees, still visible in the early 1950s. This structure, however, in its main characteristics can be traced back to the boundary lines depicted on the late 18th-century detailed map of the study area. Moreover, the development of the physical soil structure suggests an early origin of terraces, which structures were mainly connected to the traces of structures characterised by stone hedges and ditches. Thus, the age of terraces cannot be separated from that of the hedges and ditches, and in this sense, for the formation of the described structure, we suggest an early (19th or probably even 18th century) origin.

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