

TRADITIONAL AGRICULTURAL LANDSCAPES – A MODEL OF DETAILED LAND USE MAPPING

Dagmar ŠTEFUNKOVÁ¹, Jana ŠPULEROVÁ¹, Marta DOBROVODSKÁ¹,
Matej MOJSES², František PETROVIČ³

¹Institute of Landscape Ecology, Slovak Academy of Sciences
Štefánikova 3, 814 99 Bratislava, Slovak Republic; e-mail: dagmar.stefunkova@savba.sk

²Institute of Landscape Ecology, Slovak Academy of Sciences
Akademická 2, 949 01 Nitra, Slovak Republic

³Faculty of Natural Sciences Constantine the Philosopher University in Nitra
Tr. A. Hlinku 1, 949 74 Nitra, Slovak Republic

Keywords: traditional agricultural landscapes (TAL), land use, forms of anthropogenic relief, Slovakia

Abstract: Traditional agricultural landscape structures (TAL) create a mosaic of small-scale arable fields and permanent agricultural cultivations related to the specific regional agrarian culture. Continuity of traditional agricultural utilization was not interrupted in these areas, even during agricultural collectivization. Currently, not only intensive farming, but also increasing urbanization or abandonment threatens the existence of TAL. Research into TAL in Slovakia focused on mapping their distribution and contributing to improvement in the quality of life in rural areas. Herein we present the detailed land use mapping model applied in study areas with preserved TAL. The present state and developmental trends of agricultural landscape and the spatial determination of TAL was demonstrated by detailed land use mapping linked to the 1st and 2nd level of the Corine Land Cover legend (CLC), and by comparison of historical and current land use maps. The largest proportion of extensive farming is maintained in Hriňová, with a significant 15% share of small-block fields and 25% heterogeneous agricultural areas. We also created a set of indicators through which the incidence of TAL in the field could be confirmed, or refuted. Based on the presence of land use elements and according to TAL national classification scheme, the 9 TAL types were determined in these study areas, where their overall share of the total agricultural land area varies from 11% to 50%.

Introduction

Traditional landscapes have a long history which has evolved slowly, taking centuries to form the characteristic structure and reflecting a harmonious integration of biotic, abiotic and cultural elements (ANTROP 2005). These areas represent regions with specific combinations of natural and cultural diversity with high visual quality and public preferences (ŠTEFUNKOVÁ and CEBECAUER 2006, ARRIAZA et al. 2004, TEMPESTA 2010). Cultural landscapes indicating traditional land use and culture are displayed in the Landscape Atlas of the Slovak republic (PODOLÁK et al. 2002). This describes the traditional meadow-pasture landscapes, landscapes with traditional dispersed settlements, historical landscapes with small farm buildings or water mills, and historical landscapes of mixed types. These latter features include folk architecture, cultural mosaics and traditional mining landscapes. All these landscape types maintain the history of our human society and create an important basis of the cultural and natural heritage of the territory of Slovakia. Substantial parts of traditional landscapes create the agricultural landscape. This appears as a mosaic of small-scale arable fields and permanent agricultural cultivations depending on the specific regional agrarian culture. Based on land use elements, the following classes of traditional agrarian landscape (TAL) have been distinguished (ŠPULEROVÁ et

al. 2011): (1) TAL with Dispersed Settlements; (2) TAL of Vineyards; (3) TAL of Arable-Land, Grasslands and Orchards; (4) TAL of Arable-Land and Grasslands. Agriculture was a crucial part of production forces in Slovakia from neolithic revolution eras up to 1950s. During that period the Slovak countryside formed part of pre-industrial societies, characterized by considerable stability (SLAVKOVSKÝ 2009). It was impossible to increase agricultural production during that period due to high fragmentation of agricultural land and the lack of technological underdevelopment (DEMO et. al. 2001). Mainly mountainous areas remained unaffected by the industrial revolution with new agricultural technologies and land reforms instituted in Europe primarily from the 18th until the early 20th century. Existing land structure was derived from initial division of feudal land ownership (DEMO et. al. 2001, GOJDA 2000, LUKNIŠ 1977). Great changes in the agricultural land structure and agricultural land property took place in Slovakia and other European post-socialist countries (OLAH et al. 2009, GERARD et al., 2010, LIPSKÝ et. al. 2006), and consequent threat to its heterogeneity, biodiversity and heritage emanated from the collectivization and socialization processes of agriculture (GELENCSÉR et al. 2012). These mainly occurred following the 2nd World War between the 1950's and 1980's. The regions, where TAL is still preserved generate specific and unique landscape images especially in sloping areas where terraced and enclosed landscapes were created over a long period. These creations closely resemble traditional agricultural landscapes in the Mediterranean area (PETANIDOU et al. 2008, AGNOLLETI 2011, CULLOTTA and BARBERA 2011), and in other parts of Europe (PETIT et al. 2012, RIEZNER 2008, SMRDEL 2010). Small remnants of TAL are surrounded by intensive farmland or forest and these are becoming rare and highly valuable. Therefore research activities now focus on analysis of state-of-the-art of TAL, their role in biodiversity, the pressures and threats to TAL and on concentrated efforts to preserve their value.

Herein, we present a model of land use mapping in areas with preserved traditional agricultural landscapes and this forms the basis for determining their current enlargement and for evaluating their biodiversity and cultural-historical value. While land cover is defined as the physical material on the earth's surface consisting of natural and modified (cultivated) and artificial objects, land use describes society's utilization of land (FERANEC and OŘAHEL 2001; FISHER et al. 2005). While urbanized artificial surfaces or intensively used agricultural areas such as arable land, permanent crops fit the definition of land cover, these terms also indicate their land use and their social function (FERANEC et al. 2007).

In the highly fragmented agricultural patterns, typical of traditional agricultural landscape, significant changes are not observable by conventional remote sensing approaches to land change measurement (ELLIS et al. 2006). Therefore specific procedures are applied to map cultural and natural heritage, currently threatened by urbanization and abandonment. The procedures included fine-scale mapping based on aggregation data such as historical records, field mapping of individual plots, cadastral records together with multiple level approaches defining land system – land cover – land use, forms of anthropogenic relief, management system, cultural heritage feauters and vegetation (CULLOTTA and BARBERA 2011, ELLIS et al. 2009, KIZOS et al. 2010, SUPUKA et al. 2011).

Forms of anthropogenic relief in traditional agrarian landscape are an important part of the cultural heritage and at the same time a source of biodiversity. They were formed over many centuries to improve the relief-soil quality of agricultural land and contain specific features as a result of local agrarian culture and specific natural conditions. Consequently

they form part of the land-shaping system. Recently, they have been studied, evaluated and classified in publications by AGNOLETTI (2010), RIEZNER (2007), KIZOS et al. (2010), CHARTIN et al. (2011), DOBROVODSKÁ and ŠTEFUNKOVÁ (1996) and others.

Within the Slovakia TAL inventory, the following forms of anthropogenic relief were distinguished (DOBROVODSKÁ et al. 2010): (1) Terrace slopes, (2) Step balks (low step boundary of plot covered by grass or bushes); (3) Solitary heaps, (4) Lengthwise mounds (earthy or stone walls on the plot boundary); (5) Unconsolidated walls (dry stone retaining walls, supported the vineyard terraces); (6) Mounds or heaps formed on terrace slopes. As shown by some studies, forms of anthropogenic relief in TAL areas constitute in addition to irreplaceable landscape image and also specific habitats of high biodiversity on agricultural parcels borders (RUŽIČKOVÁ et al. 1999).

The use of detailed and specialized mapping methods allows creation of a database for application in further research of TAL biodiversity and cultural and historical value. In this paper we present the mapping procedures for the inventory of traditional agricultural landscapes.

Study area

An example of detailed TAL land use mapping is presented in study areas where the original agricultural plot division with typical forms of anthropogenic relief is still significantly preserved, and to some extent traditional farming is maintained.

The study areas whose allocation is identical with cadastral units are situated in the Western Carpathians Mountains in different regions of Slovakia, and they contain three different types of landscape with preserved TAL (Figure 1.).

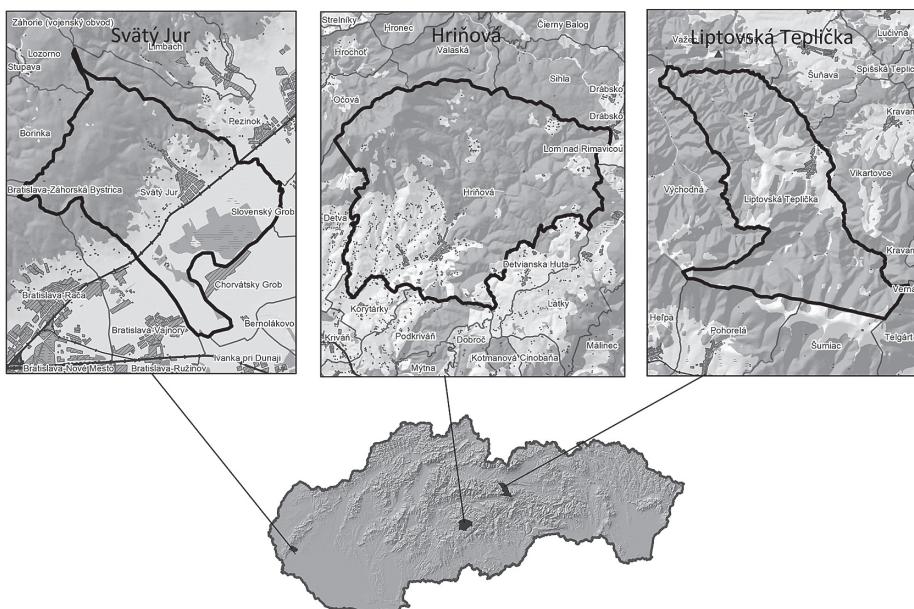


Figure 1. Situation of study areas (cadastral units) within Slovak territory
1. ábra A vizsgált terület (kataszteri egység) elhelyezkedése Szlovákián belül

The Svätý Jur study area has a viticulture-arable landscape with forest and preserved fragments of traditional vineyards. It is situated at the interface of the foothill relief of the Little Carpathians Mts. and the Danube plane, with the central compact settlement being the historical town of Svätý Jur (Figure 2.). It is located in western Slovakia, 15 km from the Bratislava capital. The study area lies at an altitude varying from 126 to 514 m and it covers 3,987 ha, with 1,015 ha agricultural land. The area was settled in the 9th century with wine growing in this territory dating from the Roman settlement era. Here, the advanced technology in wine growing and wine trading were strongly influenced by German colonists settling Svätý Jur before 1200 AD. Terraces on steep slopes were created over several centuries; prevailingly on crystalline subsoil with cambisols and rankers. These illustrate traditional wine growing practices. Following establishment of an agricultural cooperative in 1950, most of the traditional vineyard land was completely changed between 1970 and 1980 to new, larger vineyard terraces. Thus, the greatest portion of the traditional small-structured vineyard landscape was destroyed.



Figure 2. The Svätý Jur study area (Photo: Štefunková)
2. ábra A Svätý Jur vizsgálati terület (Fotó: Štefunková)

The Hriňová study area is a sub-mountainous arable grassland landscape with dispersed settlement (Figure 3.). It is situated in central Slovakia on the Poľana mountain massif which, at 490–1,458 m altitude, ranks amongst the largest extinct volcanoes in Europe. The central settlement is Hriňová township – 15 km from the district town Detva. The area covers 12,640 ha, of which 2,975 ha is agricultural land. The oldest artefacts which provide evidence of the Poľana territory settlement emanate from the Bronze Age. The area was inhabited in the period of “kopaničiarska” colonization before the beginning of the 19th century. The landscape forms a mosaic of forests, meadows and arable land on prevailingly granodiorite and biotite diorite, and to a lesser extent on volcanic subsoil with cambisols. There was no land consolidation implemented here during the socialist period.



Figure 3. The Hriňová study area (Photo: Mojses)
3. ábra A Hriňová vizsgálati terület (Fotó: Mojses)

The Liptovská Teplička study area comprises mountainous arable grassland landscape with traditional agriculture (Figure 4.).



Figure 4. The Liptovská Teplička study area (Photo: Špulerová)
4. ábra A Liptovská Teplička vizsgálati terület (Fotó: Špulerová)

The area is 9,868 ha, of which 1,313 ha is agricultural land. It is located in the northern part of Slovakia at an altitude of 846–1,429 m on the margin of the Low Tatra Mountains. The terraced fields of arable land are still preserved, and these mostly lie on a carbonate pad with rendzinas and cambisols. The area was colonized in the 17th century by Walachian law and agricultural collectivization occurred in 1975 during the socialist period. Land consolidation and balks and hedges removal were instituted in areas most suitable for crop planting, and the original land structure is preserved in steeply sloped areas.

Materials and methods

The research of current landscape structure was based on the concept of land use hierarchically linked to the 1st and 3rd levels of the Corine Land Cover (CLC) nomenclature (FERANEC and OťAHEL 2001, 2008).

In order to standardize outputs of land use mapping and to set clear boundaries between land-cover and land use concepts, we defined a hierarchical distinction between our land use legend and the CLC legend group of agricultural elements.

Detailed mapping levels require the larger scales of 1:5,000 and 1:10,000. These allow description of agricultural landscape elements on the basis of intensity of cultivation which normally manifests itself as consolidated large-block or fragmented small-block land structure. In order to better appreciate the current state of the agricultural landscape and its history we mapped the abandonment of individual plots with a minimum size over 0.1 ha, and for vineyards also the occurrence of pin vineyards, where traditional technology of wine grape training on wooden stakes is still preserved.

TAL sites comprised areas with preserved continuity of agricultural use, and their distribution in the study areas was identified based on the comparison of present and historical maps reflecting the state of land use in the following three time horizons:

- the middle of 19th century – period from the Austro-Hungarian Monarchy
- the middle of the 20th century before socialist collectivisation
- the present (2011) reflects the landscape changes during socialist collectivisation (1950–1980), postsocialist restitution and agriculture transformation (1990–2000).

It was also necessary to distinguish between small fragmented agrarian structures with historical continuity and those arising from 1990 to 2010 following the collapse of socialism and the restoration of private land ownership. The occurrence of TAL sites was confirmed in the field, using four indicators where at least one of the following characters was present:

- preserved small-scale plot division
- primary land use unchanged during the agricultural collectivization of the socialist period,
- preserved original forms of anthropogenic relief and
- preserved features of traditional extensive agricultural technology.

Forms of anthropogenic relief in the TAL sites were mapped and classified in terms of nationwide classification (DOBROVODSKÁ et al. 2010).

Land use and TAL type maps were created using the GIS ArcGIS 9.2 software programme. Digitization of spatial data was performed manually using the “on screen” method based on the visual interpretation of maps and aerial photos in the ArcView GIS environment. Historical land use from the middle of the 19th century was processed from maps of II. military mapping (1846 – Liptovská Teplička, 1847 – Hriňová, 1838 – Svätý Jur) at a scale of 1: 28,800. The maps contain the information on the land use categories of arable land, grassland, woodland, built-up residential areas and manufacturing and transport sites.

Historical land use from the middle of 20-th century was processed from orthorectified monochrome aerial photos from 1949, and topographic maps from 1956 in the scale of 1:25,000 were used as an additional database (© Topographic Institute, Banská Bystrica, Slovakia).

The present land use was generated by orthophotos in the scale of 1:5,000 – (Orthophoto © Geodis Slovakia 2003, Aerial photography and digital orthophoto © Eurosense, s.r.o., Slovakia, 2003), and by QuickBird high-resolution satellite imagery (©DigitalGlobe 2011), and verified by field mapping. Basic maps of Slovakia in the scale of 1:10,000 (1992–1993), and current cadastral maps were used to support spatial allocation of land use elements.

Results

Current state of agricultural land use in the study areas

The extent and structure of mapped agricultural land use elements in the study areas reflect the impact of historical and current socio-economic conditions on the natural landscape potential. In 2010, there were total of 33 agricultural land use types identified in the study areas of Svätý Jur (SJ), Hriňová (HR) and Liptovská Teplička (LT) (Table 1.).

The greatest extent of large-block fields in the three study areas, covering 61% of the total agricultural area and 52% of vineyards, was recorded in the Svätý Jur area (Figure 5.). These agricultural ecosystems have been strongly affected by human impact, with the agricultural cooperative engaging in intensive farming since 1950. However, the relatively high 7% proportion of abandoned large-block vineyards reflects a decline in intensive winegrowing in this traditional wine region.

Compared with Svätý Jur, grasslands predominate in Hriňová at 59% and also at Liptovská Teplička with 92%. The relatively high 32% of intensely managed permanent grassland is in Liptovská Teplička where this is controlled by the agricultural cooperative. The largest proportion of extensive farming is maintained in Hriňová, with a significant 15% share of small-block fields and 25% heterogeneous agricultural areas. These percentages reflect the absence of agricultural cooperative establishment in Hriňová.

On the other hand, extensive farming is closely correlated with abandonment. A significant proportion of abandoned agricultural land is situated in Hriňová (17%), while smaller percentages were recorded in Liptovská Teplička (7%) and Svätý Jur (10%).

The greatest variety of land use types in heterogeneous agricultural areas and all land use types mapped in agricultural elements were recorded in Svätý Jur (Table 1.). This highlights that Svätý Jur has the highest diversity of natural conditions of the three study areas.

Table 1. The area of agricultural land use types in the cadastral areas:

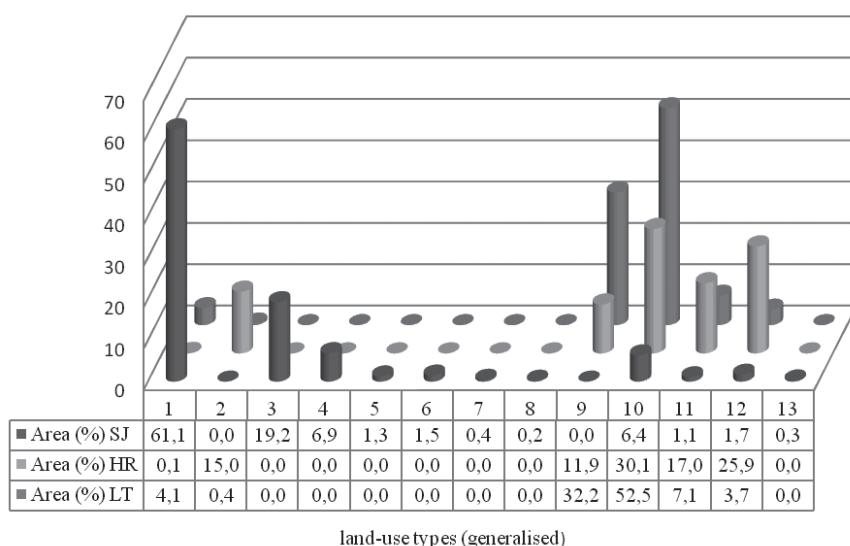
Svätý Jur (SJ), Hriňová (HR) and Liptovská Teplička (LT)
1. táblázat A mezőgazdasági tájtípusok kiterjedés a kataszteri területeken:
 Svätý Jur (SJ), Hriňová (HR) and Liptovská Teplička (LT)

<i>AGRICULTURAL LAND-USE TYPES IN CADASTRAL AREAS (Legend is hierarchically linked to level 2 – level 3 of the CLC project legend)</i>	<i>Area SJ (ha)</i>	<i>Area HR (ha)</i>	<i>Area LT (ha)</i>
2.1. ARABLE LAND			
2.1.1. Non-irrigated arable land			
Large block fields (incurred during the collectivisation of agriculture)	620.47	3.04	54.00
Small block fields	-	445.09	4.96
2.2. PERMANENT CROPS	-	-	-
2.2.1. Vineyards	-	-	-
Large block vineyards (incurred during the collectivisation of agriculture)	70.11	-	-
Large block vineyards temporarily under fallow	195.28	-	-
Small block wire vineyards	11.88	-	-
Small block pin vineyards	0.55	-	-
Small block mixed vineyards	0.42	-	-
Small block wire vineyards temporarily under fallow	10.84	-	-
Small block pin vineyards temporarily under fallow	2.62	-	-
Small block mixed vineyards temporarily under fallow	1.47	-	-
2.2.2. Fruit trees and berry plantations	-	-	-
Extensive fruit orchards	0.53	1.71	-
Extensive chestnut orchards	3.92	-	-
Fruit orchards temporarily under fallow	0.66	-	-
Chestnut orchards temporarily under fallow	1.58	-	-
2.3. PASTURES	-	-	-
2.3.1. Pastures	-	-	-
Intensive meadows	-	253.71	196.75
Extensive meadows (including rarely mown fallow land with less than 20 % shrub overgrowth)	64.56	742.88	276.75
Intensive pastures	-	98.81	225.55
Extensive pastures	-	153.1	412.41
Meadows temporarily under fallow	10.65	224.96	36.48
Pastures temporarily under fallow	-	280.1	56.89

2.4. HETEROGENEOUS AGRICULTURAL AREAS		-	-	-
2.4.2. Complex cultivation patterns (less than 20 % natural woody vegetation)		-	-	-
Arable land, grassland and vineyards	2.23	-	-	
Arable land and vineyards	0.29	-	-	
Arable land and orchards	-	0.66	-	
Arable land, grassland and orchards	4.39	1.51	-	
Arable land, orchards and vineyards	0.19	-	-	
Arable land, orchards, vineyards and fruit shrubs	1.14	-	-	
Grassland and arable land	-	766.11	49.17	
Grassland and vineyards	2.03	-	-	
Grassland and orchards	0.59	2.61	-	
Grassland, orchards and vineyards	6.11	-	-	
2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation		-	-	-
Grassland and vineyards (20–40 % trees and shrubs)	0.94	-	-	
Orchards and vineyards (20–40 % trees and shrubs)	1.38	-	-	
Arable land, orchards, and vineyards (20–40 % trees and shrubs)	0.63	-	-	

Figure 5. The proportion of agricultural land use types in the total agricultural area of Svätý Jur (SJ), Hriňová (HR) and Liptovská Teplička (LT)

5. ábra A mezőgazdasági tájhasználati típusok részaránya Svätý Jur (SJ), Hriňová (HR) és Liptovská Teplička (LT) mezőgazdasági területein belül



Legend:

Generalised land use types: 1 - large block fields, 2 - small block fields, 3 - large block vineyards, 4 - large block vineyards temporarily under fallow, 5 - small block vineyards, 6 - small block vineyards temporarily under fallow, 7 - extensive fruit and chesnut orchards, 8 - fruit and chesnut orchards temporarily under fallow, 9 - intensive grassland, 10 - extensive grassland, 11 - grassland temporarily under fallow, 12 - heterogeneous agricultural areas with less than 20% NWV, 13 - heterogeneous agricultural areas with 20–40% NWV (NWV – nonforest woody vegetation)

Identification and classification of traditional agricultural landscapes in the study areas

Establishment of the spatial determination of TAL areas was based on the comparison of historical and current land use maps of the study areas, and on use of the mapping key in the field mapping process.

The largest percentage of TAL in agricultural land was recorded in the Hriňová cadastre, where the most extensive farming tradition of all study areas has been preserved (Table 2.).

Table 2. The proportion of traditional agricultural landscapes in the study areas
2. táblázat A hagyományos mezőgazdasági tájak részaránya a vizsgált területeken

Pilot area	TALS area (ha)	TALS share on total size of agricultural land (%)
<i>Svätý Jur</i>	113.0	11.12
<i>Liptovská Teplička</i>	275.6	20.97
<i>Hriňová</i>	1517.0	50.99

Farmers in the Hriňová study area were organized in the Association of self-employed farmers before and during the communist era, and this situation continues today. A relatively high proportion of TAL was recorded in Liptovská Teplička, where the agricultural cooperative manages not only consolidated land, but also grassed terraced fields of TAL areas. These activities are supported by agro-environmental schemes which help to maintain TAL and support grassland biodiversity through grass mowing. The smallest proportion of TAL in *Svätý Jur* compared to other areas is due to the intensive agricultural land consolidation instituted during the communist era. Significant changes in the structure of agricultural land were carried out here. Narrow-striped terraced vineyards oriented mostly along the fall line were converted into a large terraces oriented laterally (Figure 6. and 7.). Following land restitution, many land owners have become more interested in selling their land for building purposes rather than maintaining traditional farming.

Figure 6. The Svätý Jur study area in 1945 – typical landscape pattern formed by traditional vine growing for many centuries
© Topographic Institute, Banská bystrica, Slovakia

6. ábra A Svätý Jur terület 1945-ben – tipikus tájmintázat, amelyet a több évszázados szőlőtermesztés alakított ki (© Topographic Institute, Banská bystrica, Szlovákia)

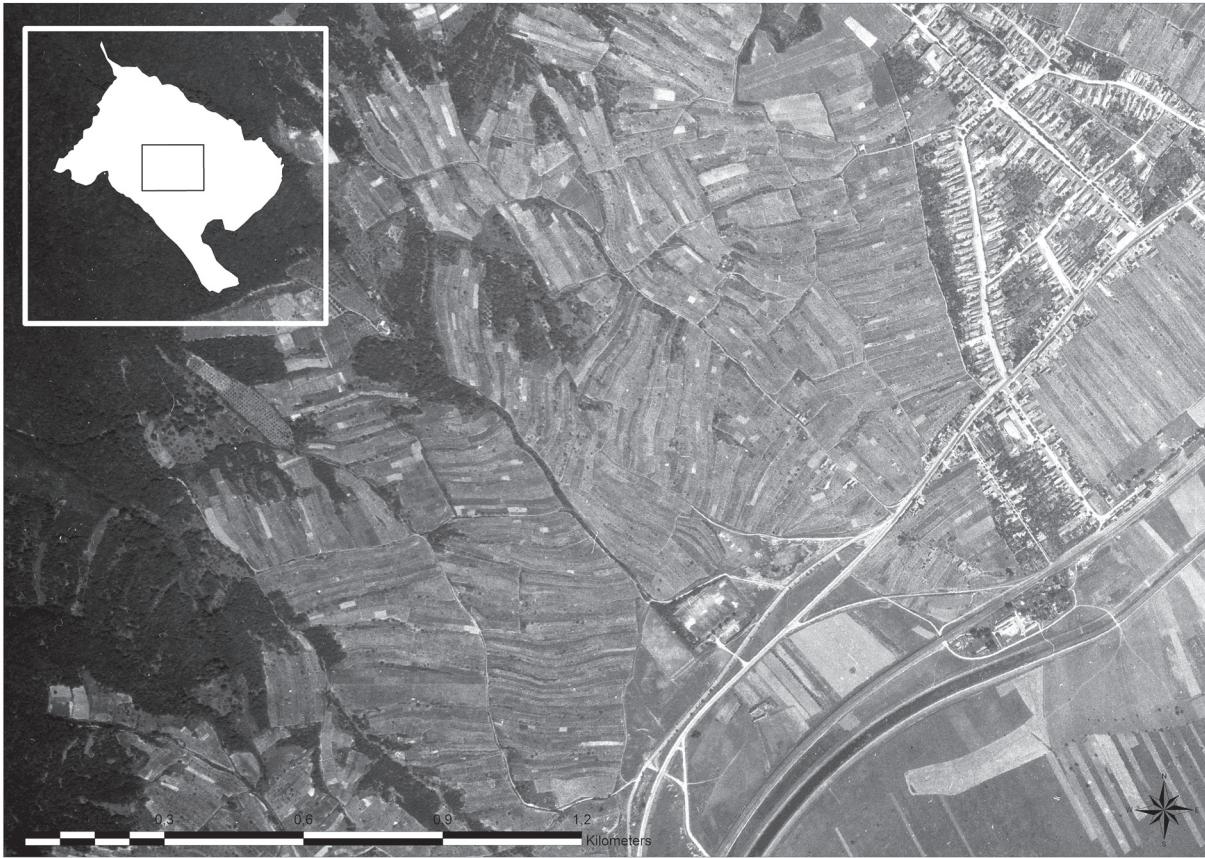


Figure 7. The Svätý Jur study area in 2003 – landscape structure reflects the significant changes in agriculture during the communist era (Orthophoto © Geodis Slovakia 2003, Aerial photography and digital orthophoto © Eurosense, s.r.o., Slovakia, 2003)

7. ábra A Svätý Jur vizsgálati terület 2003-ban – a tájszerkezet a kommunista időszak alatt a mezőgazdaságban bekövetkező szignifikáns változásokat mutatja (Orthophoto © Geodis Szlovákia 2003, Aerial photography and digital orthophoto © Eurosense, s.r.o., Szlovákia, 2003)



Most TAL sites are located on steep slopes (over 12%), on shallow and skeletal soils. This reflects the presence of different forms of anthropogenic relief, formed over many centuries which remain preserved today. The terrace slopes were created during long-term land cultivation of arable fields on steep slopes and these mainly occur in Liptovská Teplička study area. They create natural habitats covered by grass or bushes. Step balks situated on moderate slopes are characteristic features of Hriňová study area (Figure 8.). Solitary heaps and lengthwise mounds were formed by cultivation of arable land and removal of the skeleton on the borders or in the centre of the plots. These occur in all three cadastres. Unconsolidated walls were built from stones to form supporting walls for vineyard terraces and these are characteristic in Svatý Jur (Figure 9). Slope mounds and heaps formed on terraces were rarely found in Liptovská Teplička and Hriňová study areas.



Figure 8. Step balks situated on moderate slopes are characteristic features of Hriňová study area
(Photo: Mojes)

8. ábra A mérsékelt lejtőn elhelyezkedő lépcsőzetes mezsgye a hriňová-i mintaterület jellegzetessége
(Fotó: Mojes)



Figure 9. Unconsolidated walls were built from stones to form supporting walls for vineyard terraces and these are characteristic in Svatý Jur (Photo: Štefunková)

9. ábra A szőlő-teraszok megerősítésére szolgáló, kötőanyag nélküli köfalak a Svatý Jur mintaterület jellegzetességei (Fotó: Štefunková)

Forms of anthropogenic relief were established to improve relief soil quality for cultivated land, through creation of erosion control measures. Even when the intensity of land use changed, and most of the former arable fields were transformed to grassland, TAL with forms of anthropogenic relief provides additional ecosystem services for society. Here, they play an important role in water retention and soil erosion prevention which are increasingly important in times of climate change.

Based on the presence of the land use elements and according to the national classification scheme of TAL (ŠPULEROVÁ et al. 2011), the following 6 TAL types were determined:

Traditional agricultural landscape with dispersed settlements (1)

- Traditional agricultural landscape with dispersed settlements of dominant grassland (code 102); where grasslands predominated and, orchards and arable land were also present. This type of mosaic is the most frequent in dispersed settlement in the Hriňová study area.
- Traditional agricultural landscape with dispersed settlements with a mosaic of grasslands and arable land (code 103); where no present land use types dominate (Figure 10.). This TAL type occasionally occurred around dispersed settlements in the Hriňová study area.



Figure 10. Traditional agricultural landscape with dispersed settlements, a mosaic of grasslands and arable land; where no present land use types dominate

10. ábra Hagyományos agrártájak szétszórt településekkel, füves mozaikokkal és szántókkal, ahol egyik jelenlegi tájhasználat sem dominál

- Traditional agricultural landscape with dispersed settlements with a mosaic of orchards, grasslands and arable land (code 104); this was also occasionally observed in the Hriňová study area.

Traditional agricultural landscape of vineyards (2)

- Traditional vineyard agricultural landscape with dominant vineyards and other land use forms without buildings (code 220); or with buildings (code 221). This TAL type is only found close to the Svatý Jur settlement. A significant proportion of abandoned vineyards are found in mosaics without buildings. TAL subtypes with buildings are used for recreation or temporary housing (Figure 11.). Many plots are fenced and used as decorative and productive gardens.
- Traditional vineyard agricultural landscape with differing non-dominant land use forms without buildings (code 230); or with buildings (code 231). These are present only in Svatý Jur, where they are quite dominant. Their structure is created by small-block vineyards, grasslands, orchards and arable land with a significant proportion of natural vegetation.

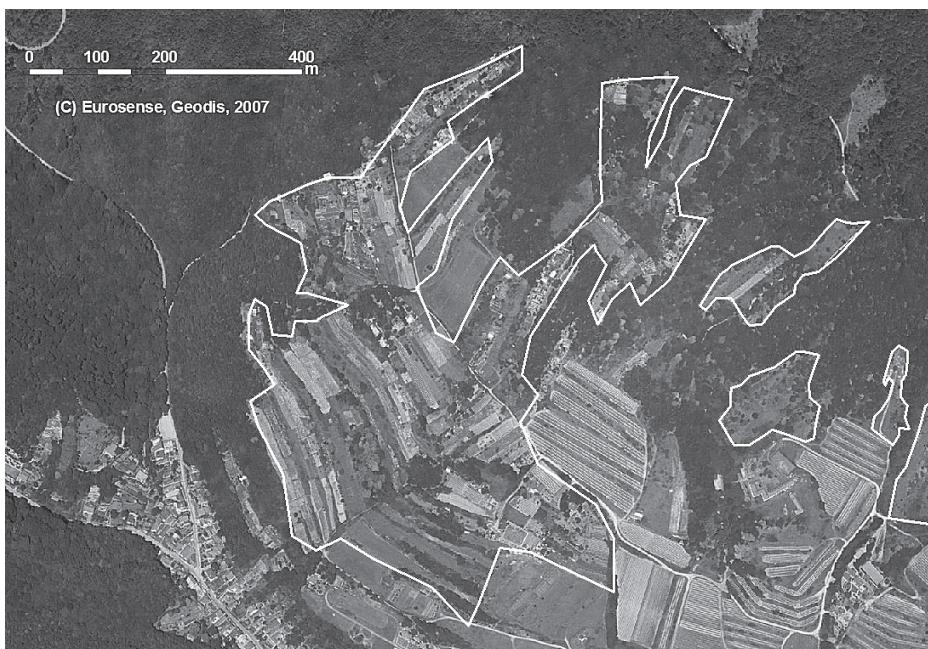


Figure 11. Traditional vineyard agricultural landscape with dominant vineyards and other land use forms with buildings

11. ábra Hagyományos agrártáj szőlő dominanciával és egyéb tájhasználati formák épületekkel

Traditional agricultural landscape of arable-land and grasslands (4)

- Traditional agricultural landscape of arable-land and grasslands with dominant grasslands with differing percentages of arable land (code 402). These are found in the Hriňová and Liptovská Teplička study areas.
- Traditional agricultural landscape of arable-land and grasslands with a mosaic of grasslands and arable land (code 403) This TAL type was identified in the Hriňová and Liptovská Teplička study areas.
- Traditional agricultural landscapes of arable land and grasslands with grasslands only (code 404), other types of land use are not present. These TAL types was also identified in the Hriňová and Liptovská Teplička study areas, and constitute former terraced fields or former mosaics of fields and grasslands, currently changed to grasslands (Figure 12.).



Figure 12. Traditional agricultural landscapes of arable land and grasslands only (code 404), other types of land use are not present

12. ábra Hagyományos agrártájak szántóval és fűves területek kizárolag gyepekkel (404-es kód), más tájhasználat nincs jelen

Conclusions and discussion

The detailed structure of agricultural land use in selected study areas of TAL in Slovakia was mapped using specialized methodology. The spatial distribution and detailed classification of agricultural land use is crucial in this type of research, and this contribution demonstrates methodologies and outputs of detailed inventory of the current landscape structure based on the concept of land use hierarchically linked to the 1st and 3rd levels of CLC (FERANEC and OŽAHEL 2001, 2008). This allowed comparison of present and historical land use and identification of sites where TAL were preserved.

Investigation of the landscape structure in terms of landscape diversity shows that level of projection of landscape structures is significant. The agricultural mosaics significantly increase landscape diversity and this fact can be missed, if mosaics are delineated as one polygon. The highest diversity of land use was observed in Svätý Jur, where the diversity of natural conditions is the highest of all three study areas and the conditions for agricultural management are also the most favourable.

Focusing on present and historical land use from the three time horizons of 1938, 1949 and 2010, large-block fields and vineyards in Svätý Jur and intensely managed permanent grassland in Liptovská Teplička documented strong land use changes during

agricultural collectivization. In general, new landscapes are considered less diverse and less coherent than the traditional ones (VAN EETVELDE and ANTROP 2004). In comparison with other rural areas in Slovakia, the presence of TAL is quite significant, from 11% in Svätý Jur to 50% in Hriňová. These can be singled out as outstanding cultural landscapes. They were identified based on the landscape pattern, typical in its preserved small-scale plot division and presence of forms of anthropogenic relief, and also based on preserved traditional extensive agricultural technologies.

Traditional extensive management is closely related to abandonment, as it was observed in all three pilot study areas. Detailed elaboration of the legend highlights the intensity of use. Landscape categories such as extensive chestnut orchards, extensive meadows and pastures and complex cultivation patterns with less than 20% natural woody vegetation indicate extensive use. Landscape categories such as large block vineyards, small block wire vineyards and orchards, all temporarily under fallow, highlight landscape abandonment. The most significant trend in abandonment in three study areas was apparent in Hriňová. Results herein substantiate findings in other parts of Europe which demonstrate that abandonment and forest re-growth is largely restricted to; (1) land with grass and scrub vegetation and agricultural land with groups of trees at mid to high altitudes, steep slopes, stony ground and a low temperature, and (2) regions with immigration and part-time farms (GELLRICH et al. 2007). All these features are dominant in our study areas.

This is now essential to preserve existing fragments of TAL, because they have irreplaceable ecological, cultural and historical value and local owner interest in TAL management has been steadily declining. If we wish to preserve TAL for future generations, it is essential to fully understand their value and to disseminate this knowledge to third parties. Local stakeholders are currently becoming increasingly involved in activities aimed at furthering their knowledge of values associated with TAL and their required management. According to sociological surveys, the local stakeholders acknowledge these ecological, cultural and historical values and theirs benefits. In particular, they appreciate the natural value connected with biodiversity and clean air and water sources, in addition to the value of preserving their architecture and folk arts and traditions. With respect to economic values, they perceive possibilities for tourism development and the production of local agricultural crops (BARÁNKOVÁ et al. 2011). The research results and agricultural landscape evaluation herein support future development possibilities and the protection of our outstanding agricultural landscapes.

Acknowledgments

This contribution was prepared within the grant project of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences No. 2/0051/11 "Significance and ecosystem services of historical structures of agricultural landscapes" and project of the Slovak Research and Development Agency No. APVV-0669-11 "Atlas of landscape archetypes of Slovakia".

References

AGNOLETTI, M. (ed.) 2010: Historical rural landscapes. For a National Register. Ministerio Delle Politiche Agricole Alimentari E Forestali, Editori Laterza.

AGNOLETTI, M., CARGNELLO, G., GARDIN, L., SANTORO, A., BAZZONI, P., SANSONE, L., PEZZA, L., BELFIORE, N. 2011: Traditional landscape and rural development: comparative study in three terraced areas in northern, central and southern Italy to evaluate the efficacy of GAEC standard 4.4 of cross compliance. *Italian Journal of Agronomy* 6(1):e16. 121–139.

ANTROP, M. 2005: Why landscapes of the past are important for the future. *Landsc. Urban Plann.* 70: 21–34.

ARRIAZA, M., CANAS-ORTEGA, J. F., CANAS-MADUENO, J. A., RUIZ-AVILES, P. 2004: Assessing the visual quality of rural landscapes. *Landscape and Urban Planning* 69: 115–125.

BARÁNKOVÁ, Z., DOBROVODSKÁ, M., ŠTEFUNKOVÁ, D., BABICOVÁ, D., MOYZEOVÁ, M., PETROVIĆ, F. 2011: Participation of local people on identifying the landscape values and future development in historical agricultural landscapes. *Ekológia (Bratislava) International Journal of the Biosphere*, 30(2): 216–228.

CULLOTTA, S., BARBERA, G. 2011: Mapping traditional cultural landscapes in the Mediterranean area using a combined multidisciplinary approach: Method and application to Mount Etna (Sicily; Italy). *Landscape and Urban Planning* 100: 98–108.

DEMO, M. (ed.) 2001: History of Agriculture in Slovakia. Slovak Agricultural University, Nitra (in Slovak)

DOBROVODSKÁ, M., ŠPULEROVÁ, J., ŠTEFUNKOVÁ, D. 2010: Research and maintainance of biodiversity in historical structures in the agricultural landscape of Slovakia. In: BARANČOKOVÁ, M., KRAJČI, J., KOLLÁR, J., BELČÁKOVÁ, I. (eds.): *Landscape ecology-methods, applications and interdisciplinary approach*, Institute of landscape ecology SAS, Bratislava 131–140.

DOBROVODSKÁ, M., ŠTEFUNKOVÁ, D. 1996: Historické poľnohospodárske formy angropogénneho reliéfu v oračinovo-lúčno-pasienkarskej a vinohradníckej krajine. *Acta Enviro. Univ. Comen.*, Bratislava 7, 85–91. (in Slovak)

ELLIS, E. C., NEERCHAL, N., PENG, K., XIAO, S. H., WANG, H., YAN, Z., LI, S. C., WU, J. X., JIAO, J. G., OUYANG, H., CHENG, X., YANG, L. Z. 2009: Estimating long-term changes in China's village landscapes. *Ecosystems* 12(2): 279–297.

ELLIS, E. C., WANG, H., XIAO, H. S., PENG, K., LIU, X. P., LI, S. C., OUYANG, H., CHENG, X., YANG, L. Z. 2006: Measuring long-term ecological changes in densely populated landscapes using current and historical high resolution imagery. *Remote Sens. Environ.* 100: 457–473.

FERANEC, J., HAZEU, G., CHRISTENSEN, S., JAFFRAIN, G. 2007: Corine land cover change detection in Europe (case studies of the Netherlands and Slovakia). *Land Use Policy* 24(1): 234–247.

FERANEC, J., OťAHEĽ, J. 2001: Land cover of Slovakia, Veda, Bratislava.

FERANEC, J., OťAHEĽ, J. 2008: Land cover changes in Slovakia in the period 1970–2000. *Geografický časopis* 60(2): 113–128. (in Slovak)

FISHER, P. F., COMBER, A. J., WADSWORTH, R. A. 2005: Land use and Land cover: Contradiction or Complement. In: FISHER, P., UNWIN, D. (ed.) *Re-Presenting GIS*. Chichester: Wiley, pp. 85–98.

GELENCSÉR, G., VONA, M., CENTERI, Cs. 2012: Loosing agricultural heritage in rural landscapes – a case study in koppány valley area, Hungary. *European Countryside* 2: 134–146.

GELLRICH, M., BAUR, P., KOCH, B., ZIMMERMANN, N. E. 2007: Agricultural land abandonment and natural forest re-growth in the Swiss mountains: A spatially explicit economic analysis. *Agriculture Ecosystems & Environment* 118(1–4): 93–108.

GERARD, F., PETIT, S., SMITH, G., THOMSON, A., BROWN, N., MANCHESTER, S., WADSWORTH, R., BUGAR, G., HALADA, L., BEZÁK, P., BOLTIZIAR, M., DE BADTS, E., HALABUK, A., MOJSES, M., PETROVIC, F., GREGOR, M., HAZEU, G., MÜCHER, C. A., WACHOWICZ, M., HUITI, H., TUOMINEN, S., KÖHLER, R., OLSCHOFSKY, K., ZIESE, H., KOLAR, J., SUSTERA, J., LUQUE, S., PINO, J., PONS, X., RODA, F., ROSCHER, M., FERANEC, J. 2010: Land cover change in Europe between 1950 and 2000 determined employing aerial photography. *Progress in Physical Geography* 34: 183–205.

GOJDA, M. 2000: Archeologie krajiny, Academia Praha. (in Czech)

HOWLEY, P., DONOGHUE, C. O., HYNES, S. 2012: Exploring public preferences for traditional farming landscapes. *Landscape and Urban Planning* 104: 66–74.

CHARTIN, C., BOURENNANE, H., SALVADOR-BLANES, S., HINSCHBERGER, F., MACAIRE, J. J. 2011: Classification and mapping of anthropogenic landforms on cultivated hillslopes using DEMs and soil thickness data — Example from the SW Parisian Basin, France. *Geomorphology* 135: 8–20.

KIZOS, T., DALAKA, A., PETANIDOU, T. 2010: Farmers' attitudes and landscape change: evidence from the abandonment of terraced cultivations on Lesvos, Greece. *Agric Hum Values* 27:199–212.

LIPSKÝ, Z. 1995: The changing face of the Czech rural landscape. *Landscape and Urban Planning* 31(1–3): 39–45.

LUKNIŠ, M. 1977: *Geografia krajiny Jura pri Bratislave*. Univerzita Komenského v Bratislave. Bratislava (in Slovak)

OLAH, B., BOLTIŽIAR, M., GALLAY, I. 2009: Transformation of the slovak cultural landscape since the 18th cent. and its recent trends. *Journal of Landscape Ecology* 2(2): 41–55.

PETANIDOU, T., KIZOS, T., SOULAKELLIS, N. 2008: Socioeconomic Dimensions of Changes in the Agricultural Landscape of the Mediterranean Basin: A Case Study of the Abandonment of Cultivation Terraces on Nisyros Island, Greece. *Environmental Management* 41: 250–266.

PETIT, C., KONOLD, W., HÖCHTL, F. 2012: Historic terraced vineyards: Impressive witnesses of vernacular architecture. *Landscape History* 33(1): 5–28.

PODOLÁK, J., KLINDA, J., HRNČIAROVÁ, T., IZAKOVÍČOVÁ, Z., LICHARD, P., MARÁKY, P., MEŠŠA, M., ZEROLA, J. 2002: Traditional way of land use and traditional culture. In: *Landscape Atlas of the Slovak Republic*; 1st. ed., Bratislava: Ministry of Environment of the Slovak Republic; Banská Bystrica: Slovak Environmental Agency, pp. 139

RIEZNER, J. 2008: Strip semibocage: The landscape character type of the Jeseník area. *Geografický Ústav, Přírodovědecká Fakulta MU*. In: *Geografie-Sborník CGS*. (Geografie-Sborník CGS, 113(2): 173–182.

RIEZNER, J. 2007: Agrární formy reliéfu ve Zlatohorské vrchovině. *Geomorphologia Slovaca et Bohemica* 7: 50–55. (in Czech)

RUŽIČKOVÁ, H., DOBROVODSKÁ, N., VALACHOVIC, M. 1999: Landscape-ecological evaluation of vegetation in relation to the forms of anthropogenic relief in the cadastre of the Liptovská Teplička Village, the Nízke Tatry Mts. *Ekológia* Bratislava 18: 381–400.

SLAVKOVSKÝ, P. 2009: Vanishing world. Traditional agrarian culture of Slovaks in Central and Southern Europe. Veda publishing, Bratislava (in Slovak)

SMRDEL, H.K. 2010: Cultural terraces in Slovenian regions. *Dela* 34, 39–60.

SUPUKA, J., VEREŠOVÁ, ŠINKA, K. 2011: Development of vineyards landscape structure with regard to historical and cultural values. *Ecology* 30(2): 229–238.

ŠPULEROVÁ, J., DOBROVODSKÁ, M. 2010: Significance of landscape diversity of historical agricultural landscape structures on the example of Liptovská Teplička study area. In: NOVÁČEK, P., HUBA, M. (ed.) *Udržitelný rozvoj - stav a perspektivy v roce 2010*, Univerzita Palackého v Olomouci, Olomouc, 241–251.

ŠPULEROVÁ, J., DOBROVODSKÁ, M., ŠTEFUNKOVÁ, D. 2011: Survey of historical structures of agricultural landscape in Slovakia. In: *Living Landscape. The European Landscape Convention in research perspective*. 18–19 Oct., Florence. Conference Materials. Vol. II. Short Communications, pp. 88–92.

ŠTEFUNKOVÁ, D., CEBECAUER, T. 2006: Visibility analysis as a part of landscape visual quality assessment. *Ekológia* (Bratislava): International Journal of the Biosphere, 25(suppl 1): 229–239.

TEMPESTA, T. 2010: The perception of agrarian historical landscapes: A study of the Veneto plain in Italy. *Landscape and Urban Planning* 97: 258–272.

VAN EETVELDE, V., ANTROP, M. 2004: Analyzing structural and functional changes of traditional landscapes – two examples from Southern France. *Landscape and Urban Planning* 67(1–4): 79–95.

HAGYOMÁNYOS MEZŐGAZDASÁGI TÁJAK –
EGY RÉSZLETES TÁJHASZNÁLAT-TÉRKÉPEZŐ MODELL

D. ŠTEFUNKOVÁ¹, J. ŠPULEROVÁ¹, M. DOBROVODSKÁ¹, M. MOJSES², F. PETROVIČ³

¹Tájékoncianiai Intézet, Szlovák Tudományos Akadémia
Štefánikova 3, 814 99 Bratislava, Szlovák Köztársaság; e-mail: dagmar.stefunkova@savba.sk

²Tájékoncianiai Intézet, Szlovák Tudományos Akadémia
Akademická 2, 949 01 Nyitra, Szlovák Köztársaság

³Nyitrai Constantine the Philosopher Egyetem, Természettudományi Kar
Tr. A. Hlinku 1, 949 74 Nyitra, Szlovák Köztársaság

Kulcsszavak: hagyományos mezőgazdasági tájak, tájhasználat, antropogén domborzati formák, Szlovákia

A hagyományos mezőgazdasági tájszerkezetek (HMT) mozaikos kisméretű szántóföldeket és állandó, speciális regionális agrárkultúrához kapcsolódó mezőgazdasági művelési formákat alkotnak. A hagyományos mezőgazdasági használat folytonossága még a mezőgazdaság termelőszövetkezetekbe történő szervezése során sem szakadt meg ezeken a területeken. Jelenleg nem csak az intenzív gazdálkodás, de a növekvő városiasodás és a területek elhagyása is veszélyezteti a HMT-ket. A HMT-kre vonatkozó szlovákiai kutatás a kiterjedéstük térképezésére és a vidéki élet minőségének javítására fókusztált. Jelenleg a megőrzött HMT-kkel rendelkező vizsgálati terület tájhasználati részletes térképezésének modellje kerül bemutatásra. A mezőgazdasági tájak jelenlegi helyzetének és fejlődésének trendje és a HMT-k területi meghatározása került bemutatásra az első és második szintű Corine Land Cover (CLC) jelmagyarázat segítségével készült részletes tájhasználat térképezés használatával és a történelmi és jelenlegi tájhasználat térképek összehasonlításával. Az extenzív gazdálkodás Hriňová területén volt a legnagyobb arányú, ebből 15% kisparcellás, 25% heterogén mezőgazdasági terület volt. Létrehoztunk egy indikátor csomagot is, amely segítségével a HMT-k előfordulása egy területen bizonyítható vagy sem. A tájhasználati elemek előfordulása és a HMT nemzeti osztályozási séma alapján 9 HMT típus került meghatározásra a vizsgált területeken, ahol részarányuk az összes mezőgazdasági területekből 11% és 50% között változott.