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HISTORICAL TERRACES – CURRENT SITUATION AND FUTURE PERSPECTIVES FOR OPTIMAL LAND USE MANAGEMENT: THE CASE STUDY OF ČIERNY BALOG

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ABSTRACT

Historical structures of the agricultural landscapes (HSAL) result from interactions among natural and human factors within a geographic area. The paper is focused on HSAL consisting of arable land and grassland with the typical occurrence of terraces. This type was found in 23 localities, covering 23.85% of the agricultural land in the cadastral district of Čierny Balog (Slovakia). HSAL were classified into 8 categories (according to their land cover composition, and current land uses); 40% of HSAL was cultivated actively. Generally, we proposed incentives focusing on preservation of landscape character, including protection of habitats on terraces and removing non-forest woody vegetation covering the HSAL.

Keywords: traditional landscape, sustainable farming, remote sensing data, landscape character

TERRAZZAMENTI STORICI – LA SITUAZIONE ATTUALE E LE PROSPETTIVE FUTURE PER UNA GESTIONE DEL TERRITORIO OTTIMALE: IL CASO STUDIO DI ČIERNY BALOG

SINTESI

Le strutture storiche di paesaggi agricoli (SSPA) derivano dalle interazioni tra fattori naturali e umani all'interno di un'area geografica. Il contributo si incentra sulle SSPA costituite da terreni arabili e da quelli prativi con la tipica presenza di terrazzamenti. Questo tipo di SSPA figura in 23 località e copre il 23,85 % dei terreni agricoli nel comune catastale di Čierny Balog (Slovacchia). Le SSPA sono state classificate in 8 categorie (in base alla relativa composizione della copertura del suolo e gli attuali usi dello stesso); il 40 % delle SSPA risultavano coltivate attivamente. In linea generale, abbiamo proposto incentivi orientati alla conservazione del carattere del paesaggio, tra cui la protezione degli habitat sui terrazzamenti e la rimozione di vegetazione legnosa non boschiva che copre le SSPA.

Parole chiave: paesaggio tradizionale, agricoltura sostenibile, dati telerilevati, carattere del paesaggio

INTRODUCTION

Farming shapes the ecology and outer appearances of the rural environment to the point where, in many countries, the farmed landscape has a cultural value that rivals or exceeds its economic significance (Jackson, 2013). In old agricultural landscapes, both the cultural aspects and the natural elements are essential in the holistic assessment of the landscape characteristics (Markuszewska, 2017, 103). The long-term interactions of environmental factors with activities of residents reflects in a form of landscape patterns (Kopidura, 2017, 872), which also applies to terraces. Terraces were established primarily during the Wallachian colonization from the 14th to the 16th century in Slovakia (Stankoviansky, 2003, 91). In some regions, they were built up from the 17th to the 19th century (Slámová et al., 2017).

Agricultural terraces with traditional land use older than 50 years are valuable historical relics of agricultural landscape (Jančura et al., 2010). Terraces are representative features of cultural landscapes (Slamova et al., 2013), and witnesses of technological wisdom and economic evolution of a particular historical period (Špulerová et al., 2017, 101). Terraces are found in all types of traditional cultural landscapes in Slovakia. These types are classified in the Landscape Atlas of the Slovak Republic (Podolák et al., 2002, 139): traditional meadow-pastoral landscapes, landscapes with traditional scattered settlements and landscapes with traditional vineyards (Figure 1) and typically occur in archetypes of traditional agricultural landscape or in archetypes of vineyards and orchards (Hreško et al., 2015).

Historical structures of the agricultural landscapes (HSAL) are result of interactions among natural and human factors within a geographic area. They occupy predominantly mountainous and sub-mountainous regions of Slovakia (Špulerová et al., 2016). They are divided into several types which are classified at national level. The article focused on HSAL characterized by mosaic of ploughland, meadows and extensively used pastures altering with non-forest woody vegetation. Terraces typically occur in this type of HSAL (Špulerová et al., 2016).

Before land consolidation reforms carried out in the period 1950–1970 in Slovakia, agricultural landscape had been very heterogeneous. Ploughland on terraces and narrow fields on steep slopes were typical. The period of Communism influenced significantly the land cover transformation in Slovakia (Lieskovský et al., 2014). Traditionally managed agricultural landscapes, which once covered more than half of the Slovakia territory, were transformed into large-scale fields (Lieskovský et al., 2014, 867). Terraces protected the soil from erosion processes on slopes; however, these terraces were destroyed to achieve extensive areas with arable land. As a consequence, the accelerated erosion

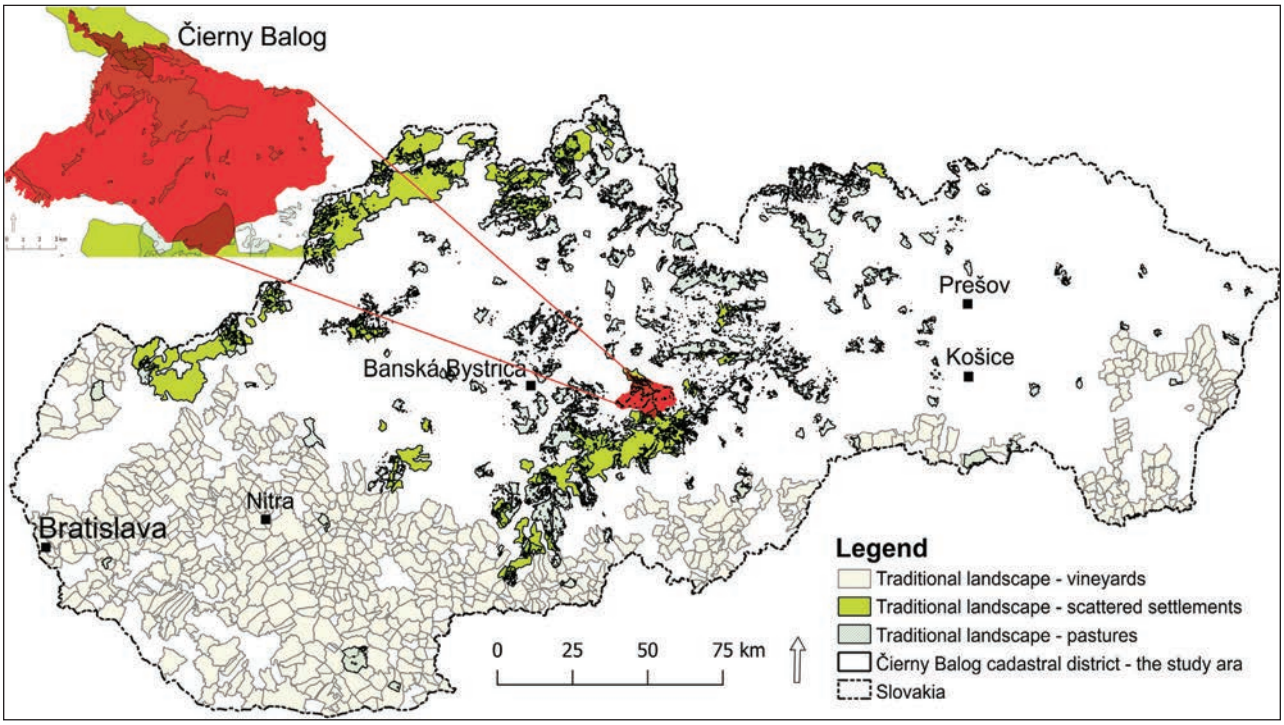

Figure 1: Types of traditional cultural landscapes (Podolák et al., 2002, 139) encompassing agricultural terraces (Source: Authors, 2018).

Figure 2: Large-scale ploughland in the foreground established during Communist Regime and historical agricultural terraces on steeper slopes in the vicinity of the Odorica Farm in the background (Source: Authors, 2018).

degraded soils on steeper slopes. Finally, badly eroded land was covered with non-forest woody vegetation or by grasslands (Chrastina, 2009, 206.)

The result of agricultural landscape transformations is documented in Figure 2, on the example of the Odorica Farm (the farm that joined the project ERASMUS 2016-1-SK01-KA202-022502; FEAL: multifunctional Farming for the sustainability of European Agricultural Landscapes). The farm performs multifunctional agriculture and provides adequate maintenance to the nearby terraces and large-scale ploughlands spread all around the farm. Extensive ploughlands result from land consolidation reforms carried out during Communist regime.

After the Velvet Revolution in 1989, terraces were abandoned and naturally destroyed in many regions of Slovakia (Slámová et al., 2017). The current socio-economic situation and demographic decline resulted into the continued abandonment of terraces (Lieskovský et al., 2015). Only fragments of traditional agricultural landscapes have survived in the countryside (Lieskovský et al., 2014). Locally, terraces occur in hilly terrains of lowlands and they are well preserved mainly in sub-mountainous agricultural landscapes being presented in the case study from the cadastral district of Čierny Balog.

On the other hand, historical terraces are often covered with non-forest woody vegetation and these vegetation formations constitute forest ecosystems in many sub-mountainous and mountainous regions in Slovakia (for instance the cadastral district of Horný Tisovník) (Slámová et al., 2017). This reforestation process has buried a valuable rural patrimony also in many other European regions (Pardini & Gispert, 2012, 7). Spontaneous vegetation has spread significantly mainly over hilly agricultural regions in the Eastern block of former Communist-controlled states of Europe; as Demény & Centeri (2008) documented in the Gődőllő Hillside region in Hungary or Ažman Momirski & Kladnik (2015) observed in the Brkini Hills in Slovenia.

THE STUDY AREA

Land Use Transitions in the Case Study of Čierny Balog

The cadastral district of Čierny Balog is located in the Slovenské Rudohorie Mountains in the area of the Balocké Vrchy Mountains formed by crystalline and Mesozoic rocks of the Veporidy geological unit (The State Geological Institute of Dionýz Štúr, 2017). The cadastral district of Čierny Balog corresponds with the water catchment area of Čierny Hron. Climate is moderately cold and very wet (Lapin et al., 2002).

Archaeological findings confirmed mining of gold in secondary fluvial deposits in the early Bronze Age (Bátora, 2009, 196). Ancient natural forests were cut down during Wallachian (since the 15th century) and German (since the 16th century) colonization phases and late medieval settlements were founded here. Nowadays, Čierny Balog consists of 13 settlements; the oldest one (Krám) was established in 1607 (Kováčik, 2007). Wood processing and pastoralism were main economic activities which contributed to gradual deforestation of the study area. Establishment of agricultural terraces and their dating is unclear. We assume that they were built up gradually as the population expanded and the establishment of the local agri-forestry economy became a key point for everyday survival of inhabitants in harsh natural conditions.

Earlier, water energy had been used for wood transportation. Pronounced explosion of the local population was associated with the Industrial Revolution in the 19th century when in 1836 a serfdom was abolished (Kováčik, 2007). Demand for wood increased and a narrow-gauge forestry railway was built up in a total length of 131.98 km. Today it is protected as a technical monument and attracts many tourists. Archival sources mentioned old mines (1845) where iron of low quality was mined and processed in an iron smelter in the nearby village of Hronec (Kováčik, 2007).

A Role of Terraces in Optimal Land Use Management

Terraces shall be maintained and preserved in the countryside and the following criteria were selected to support the importance of their preservation:

- Ecological and biological: The intensification of agriculture during the period 1950–1970 in Slovakia caused destruction of terraces (Chrastina, 2009, 206) and biodiversity was reduced (Bezak & Halada, 2010). The overall pattern analysis exhibited a shift from traditional and dispersed agriculture to large-scale and intensive practices (Faulkner et al., 2003, 120). Agricultural terraces represent places of refuges for species that can spontaneously succeed in fallow fields (Machová & Kubát, 2014, 319).
- Cultural, historical and aesthetic: agricultural landscape with historical structures with traditional or nature-friendly farming practices is an important part of our cultural heritage (Špulerová et al., 2016, 123). Maintaining traditional features by agricultural activities in the countryside and adopting sustainable farming approaches are imperative tools. Combining historical identity and sustainability is a big challenge for our society (Larcher et al., 2017, 339). Due to the historical and aesthetic significance, terraces are important for agriculture and tourism; however, they also pose challenges for the land conservation and management (Stanchi et al., 2012, 90).
- Environmental – protecting soil from erosion and slowing down the surface water runoff: Terraces are implemented to protect soil from erosion (Mazdak et al., 2006). Their irreplaceable role in erosion prevention is expected also when reforestation appears on agricultural land. Their insufficient maintenance can induce intensive erosion processes (Centeri et al., 2008). Terraces slow down the surface water runoff from the river basin. Thus, they prevent the river flat from floods which were common here and damaged village in the past (Blahušiaková & Matoušková, 2012).
- Environmental – improving soil attributes: Terraces occur predominantly in sub-mountainous agricultural landscapes in Slovakia and cambisols are common in these regions. Cambisols occur typically in forests on moderate and steep slopes and they are moderately or heavily skeletal (Vilček, 2007). Approximately 47% of agricultural soils in Slovakia have a prevailing rocky fraction (Hraško & Bedrna, 1988). Slámová et al. (2015) confirmed that local inhabitants have improved the soil conditions on terraces, primarily by removing the rocky fractions. Terraces had an optimal slope grade for arable soils (planes or gentle slopes with little to no risk of water based erosion) in comparison with natural terrain often exceeding the critical slope of 12°.

Considering the criteria, the main goal of the research was formulated: the identification of HSAL with terraces using data gathered through remote sensing technologies, public web map services and the field survey and the classification according to their land cover composition, intensity and character of their land use. Proposed remediation and revitalization incentives could be implemented in the territorial planning documentation of the Čierny Balog municipality.

METHODOLOGY

Technologies and Datasets

Geostatistical analyses were processed in QGIS Lyon 2.12.2 (QGIS is a free and open-source cross-platform desktop geographic information system) and the coordinate reference system S-JTSK East North (Greenwich) (ESRI code 102067) was applied. Public online maps were accessed by a QGIS client of the web map services (WMS) from Geoportal (2016) databases: ZBGIS and ortophotomaps (2010). ZBGIS is the geometric basis of the national infrastructure for geospatial information. It is maintained by the Geodesy Cartography and Cadastre Authority of the Slovak Republic (under the Act no. 215/1995 Coll. on geodesy and cartography, section 2, § 14).

The following vector layers were elaborated from public online maps:

- Forests and watercourses were vectorized from ZBGIS maps (Geoportal, 2016).
- The urbanized territory of the village and the cadastral district boundaries were vectorised from the real estate cadastre maps (Geodesy, Cartography and Cadastre Authority of Slovak Republic – GCCA SR, 2016). The urbanized territory was delimited according to the act on Territorial Planning and Building Order, No. 50/1976 Coll., as amended by later regulations.
- Historical infrastructure including roads, railways, and settlements (including haylofts and chalets) was vectorized from the II. military topographic maps (1810–1869) (a scale of 1 : 28,800) and military topographic maps from 1952–1957 (a scale of 1 : 25,000) (Slovak Environmental Agency, 2016). Historical data refer to a historical phase when the countryside was exploited more intensively due to progressively developing the Industrial Revolution during the 19th century.

HSAL with occurrence of terraces were vectorised from ortophotomaps (2010). Historical ortophotomap of the whole Slovakia was acquired using available archive aerial photography from years 1949 and 2010. The ground sample distance was 0.5 m. Further information about the ortophotomap, it's accuracy and other details are available e.g. in Kardoš et al. (2017). Areas of HSAL with terraces were overlaid by land parcels of cadastral maps (GCCA SR, 2016) and the existence of terraces within HSAL was confirmed through the field survey, as well.

A hillshade raster map which is derivative of digital model of relief (DMR) (Geoportal, 2016) was used in the background of vector maps.

HSAL with terraces were classified into 8 categories and following criteria were used:

- Current land use according to the situation from ortophotomaps (2010) (arable land, meadows, pastures, non-forest woody vegetation) and the field survey. HSAL include a mosaic of small-scale arable fields, original meadows and pastures, small wetlands and other land uses; terraces are usually linked to plot boundaries with non-forest woody vegetation (Hreško et al., 2015; Špulerová et al., 2016).
- A distance between a hamlet and cultivated land with terraces is an important factor influencing possibilities of their current management and preservation in agricultural landscapes as well (Lieskovský et al. 2015).
- Current management activities characterise terraces as extensively / intensively used according to the land use situation in ortophotomaps (2010) which were updated during the detailed field survey in 2016. Agnoletti et al. (2015) found out in the case study from the Mediterranean region, that terraces can occur both in areas of utilized agricultural land use and in forests and semi-natural areas. Therefore, appropriate intensity of terraces management is necessary for their preservation in agricultural landscape. Once, the agricultural activity tends to decrease, terraces are overgrown with shrubs and trees and they would be converted to the forested land.

The Field Survey

Mapping of HSAL was carried out in June 2016. These areas were surveyed by global navigation satellite system (GNSS) positioning device (Garmin 60csx) in 2012. Photodocumentation of HSAL was carried out from different localities, thus representing different categories of HSAL in the study area. Terraces were observed in all localities.

Classification of HSAL with Terraces and their Land Use Intensity

Land uses – forested land, agricultural land and urbanized (built up) areas – were vectorized in the cadastral district.

Terraces arose spontaneously as a result of long-term ploughing of linear parcels on milder slopes or they were built intentionally on steeper slopes to prevent soil erosion and movement of sediments downslope during the storm situations (Stankoviansky & Barka, 2007). A terrace field is the most frequent landform that developed after the contour ploughing (Stankoviansky, 2001, 106). Terraces were present more or less in all categories of HSAL which were identified in ortophotomaps (2010), vectorised and verified in the field (2016).

We classified HSAL according to their land cover compositions and current land uses (active and extensive) into 8 categories (Figure 3): Terraces covered

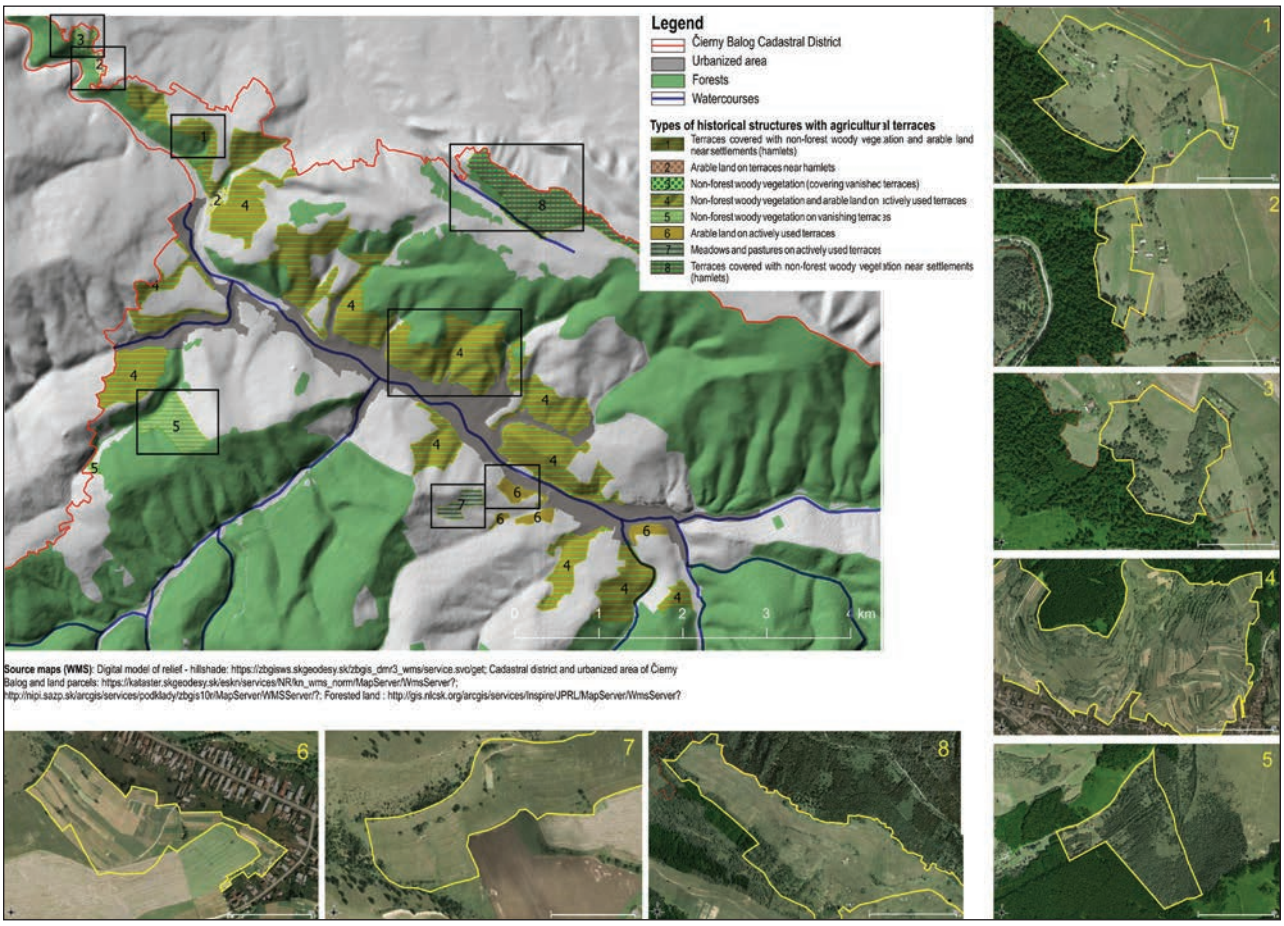

Figure 3: Types of historical structures of the agricultural landscape with terraces visualised in ortophotomaps (2010; Source: Authors, 2018).

with non-forest woody vegetation, arable land on actively used terraces near hamlets (1); Arable land on terraces near hamlets (2); Non-forest woody vegetation (covering vanished terraces) (3); Non-forest woody vegetation and arable land on actively used terraces (4); Non-forest woody vegetation on vanishing terraces (5); Arable land on actively used terraces (6); Meadows and pastures on actively used terraces (7); Non-forest woody vegetation on extensive terraces near hamlets (8).

Proposals of Future Land Use Management of HSAL with Terraces

While the Act no. 543/2002 Coll. on Nature and Landscape Protection, as amended by later regulations defines exactly what "nature conservation" means, the meaning of the "landscape conservation" is specified vaguely. The landscape maintenance shall be understood primarily as a conceptual process of planning preservation activities, not to be only a static conservation activity as explicitly states the law (Jančura et al., 2010). We applied three possible incentives maintaining HSAL: prevention (PRE), protection (PRO) and remediation (RE).

In the first stage we proposed the transformation to forested land for all agricultural parcels that exhibited more than 50 % coverage of successive non-forest woody vegetation because these have not been recognized as HSAL (Špulerová & Štefunková, 2009). Agricultural land parcels with the character of forest stands can be evaluated according to the Food and Agriculture Organization of The United Nations (FAO) (2015) definition, where a forest is mentioned as a forest-ridden area with trees higher than 5 m and a canopy cover of 10%; it has a minimum size of 0.5ha.

HSAL covered with a land cover mosaic of non-forest woody vegetation of less than 50%, further with arable land, pastures and meadows influence positively the biodiversity, and therefore, protective management would be applied here. Adequate maintenance of HSAL is needed especially in economically weak and marginal regions in Slovakia, as is the

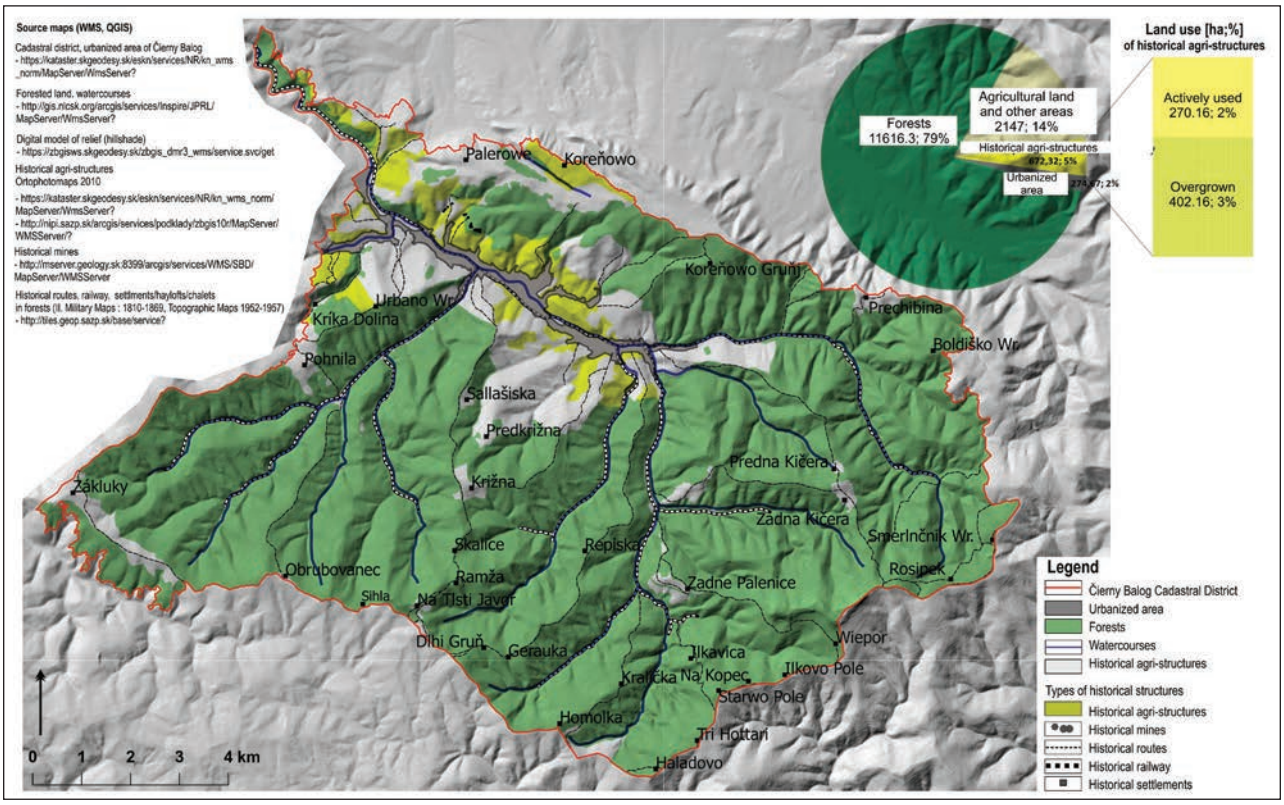

Figure 4: Current land use and historical structures of the agricultural landscape, settlements, routes and railways (Source: Authors, 2018).

case of the Čierny Balog municipality because the landscape shall provide added value for the tourism development. In this case, incentives to reconstruct and revitalize terraces are expected.

RESULTS

HSAL - Current Situation of Land Use. Historical Infrastructure, Settlements and Mines

The investigated area of 14,710.43 ha was predominantly covered with forests (11,616.30 ha; 79%). The agricultural land of 2819.46 ha (19%) was used mainly as pastures and meadows (2,147 ha) and HSAL were found in 23 localities (672.32 ha). The village located in the deep valley of the river Čierny Hron covers an area of 274.67 ha (2%). Historical railways, routes and small settlements (hamlets), chalets and haylofts, old mines, and their historical names were indicated in Figure 4. All historical structures represent valuable features of the landscape character of Čierny Balog.

HSAL occupied an area of 672.35 ha (23.85%) of the agricultural land (Figure 4) and detailed characteristics are in Table 1. Agricultural terraces were identified in the ortophotomaps (2010) in categories 1, 4, 5, 6, 7, 8 in the total area of 639.86 ha (95.17 %). They were confirmed in the field (2016) in categories 2, 3 but they were not visible as a specific land cover pattern in the ortophotomaps.

Pastoral activities prevailed in the past in the southern part of the cadastral district and pastures have still been visible here (Figure 5).

HSAL with terraces covered with ploughland altering meadows and pastures were observed in the northern part of the cadastral territory (Figure 6) and extensive pastures were not present here. There was also a higher concentration of agricultural terraces than in the southern part of the cadastral district. Natural reason for such land use distribution in the cadastral district was the slope exposition because slopes were exposed mainly to the south, south-east and south-west. Nevertheless, future research could bring relevant data explaining historical background of the land use differences in the cadastral district.

HSAL were actively used in the total area of 270.16 ha (40%). On the other hand, more extensive area of 402.16 ha (60%) was overgrown with non-forest woody vegetation due to low intensity of their cultivation (Figure 7). The northern part of the cadastral district with the HSAL (terraces were delineated with non-forest woody vegetation) (Figure 4; category no. 4) was more

Table 1: Historical structures of the agricultural landscape with terraces (Source: Authors, 2018).

Categories of HSAL	Area [ha]	Area [%]
(1) Terraces covered with non-forest woody vegetation and arable land near settlements (hamlets)	53.56	7.9
(2) Arable land on terraces near hamlets	7.31	1.1
(3) Non-forest woody vegetation (covering vanished terraces)	5.9	0.9
(4) Non-forest woody vegetation and arable land on actively used terraces	480.34	71.45
(5) Non-forest woody vegetation on vanishing terraces	28.34	4.22
(6) Arable land on actively used terraces	19.25	2.89
(7) Meadows and pastures on actively used terraces	9.55	1.42
(8) Terraces covered with non-forest woody vegetation near settlements (hamlets)	68.07	10.12
Total	**672.32**	**100**

Figure 5: Historical terraces managed by pastoral activities in the southern part of the cadastral district (Photo: M. Slámová, 2016).

Figure 6: Terraces covered with ploughland altering meadows and pastures on the slopes in the northern part of the cadastral district (Photo: M. Slámová, 2016).

overgrown with successive non-forest woody vegetation than the southern part with dominant pastoral activities.

Proposals of Incentives for the Management of HSAL

Proceeding from results, the following groups of incentives were proposed (Figure 8):

Remediation (RE) incentives were proposed for localities where non-forest woody vegetation (shrubs) covered an area of more than 50% of the locality or it was covered with trees higher than 5 m and a canopy cover of 10% and with a minimum size of 0.5 ha. The measures were proposed for the locality marked with the letter I and covered an area of 27.03 ha. These HSAL were proposed to be legally delimited to the forest.

Protective and remediation incentives proposals (PRO/RE) were proposed for localities where HSAL were overgrown with non-forest vegetation up to 50% and terraces were partly actively cultivated by residents from hamlets in their vicinity. These measures shall be applied for localities A, H, J, Q, S, U, V and Z covering an area of 375.13 ha. Protective incentives focused on habitat protection, the preservation of landscape character as well as on micro-scale landforms revitalization which provide environmental functions (the soil protection, water retention in countryside and prevention against floods) (Figure 6).

Protective measures (PRO) were proposed for localities where HSAL were actively managed and successive vegetation appeared minimally; in localities B, C, D, E, F, G, K, L, M, N, O, P, R, and T covering an area of 270.16 ha. These terraces were considered to be the most important for the preservation of the landscape character.

DISCUSSION

Future Sustainable Management of Ancient Heritage – Terraces

(1) Identifying and defining the landscape heritage should be an important component of spatial planning processes. Based on the study of landscape heritage resources of the commune the local government could prepare catalogues of good practice focused on different landscape-related themes in spatial planning (Kopidura, 2017, 874). According to indices extracted from historical

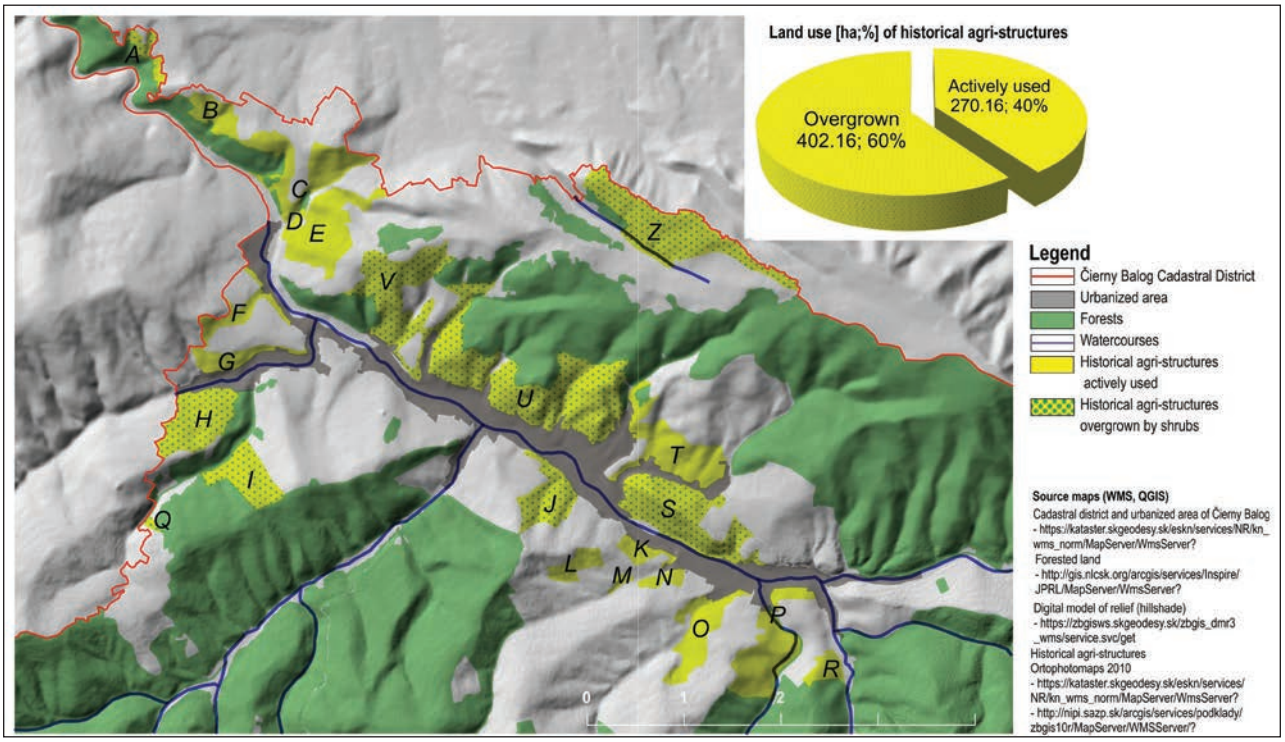

Figure 7: Intensity of land use of historical structures of the agricultural landscape (Source: Authors, 2018).

maps (Figure 4) we expected to find not yet discovered HSAL in surroundings of old hamlets in future research. Remote sensing technologies, particularly digital photogrammetry (ortophotomaps, stereoscopic evaluation of photos) are welcome to be used in forest mapping or in mapping of overgrown land parcels where terrestrial methods are insufficient (due to access difficulties or rugged terrain). These methods bring continuous mapping of required content, extent and recency with clearly identified proprietorial borders (Chudý et al., 2012). Contactless – remote sensing methods have a broad perspective for application in many other disciplines and field survey. If terraces are mapped as a separate entity they could be properly identified from accurate and detailed DMRs (developed by aerial photogrammetry or light detection and ranging - LiDAR technologies), which was not carried out for the purpose of the article. However, we can see high potential of remote sensing technologies in terraces survey mainly in forested areas or agricultural land overgrown with shrubs. Their application in extensive areas is the main advantage in comparison with the traditional methods using terrestrial measurements in the field survey. Remote sensing technologies are time-saving and with acceptable finances have become more popular in the last decades (Chudy et al., 2014).

(2) The cadastral district of Čierny Balog was covered predominantly with forests (today nearly 79%) and historically, agriculture developed here as the secondary economic activity. Our results documented land abandonment of terraces; 60% of HSAL suffered from overgrowing with non-forest woody vegetation. The same trend affected many regions in Slovakia (Špulerová et al., 2016) as well as regions all over the Europe (Faulkner et al., 2003; Otero et al., 2015). Economic rentability and sustainability aspects would be taken into consideration when remediation incentives (removing successive vegetation) are proposed. Naturally reforested was about 27 ha of HSAL in the cadastral district. These land parcels were not listed as a forested land in the cadastre of real estate of the Slovak Republic. It means that the actual type of the land parcel did not correspond with the parcel type registered in the cadastre of real estate. Legally, it is understood to be unauthorized change of land use and therefore legal transfer of these land parcels to the forested land was proposed regarding the FAO (2015) classification of forests. Removing non-forest woody vegetation, eventually terraces reconstruction is recommended for about 375 ha of HSAL. This process would be sustainable only in the case when residents could increase their agricultural activities.

Local inhabitants have experience with and a deep knowledge of optimal and sustainable farming practices (Calvo-Iglesias et al., 2006, 335). The traditional agricultural landscape is the cultural context of living, historical, and archaeological indigenous belief systems. Therefore, the most effective conservation and management mean protecting the valuable indigenous knowledge system (Ericson, 2003). The cadastral district

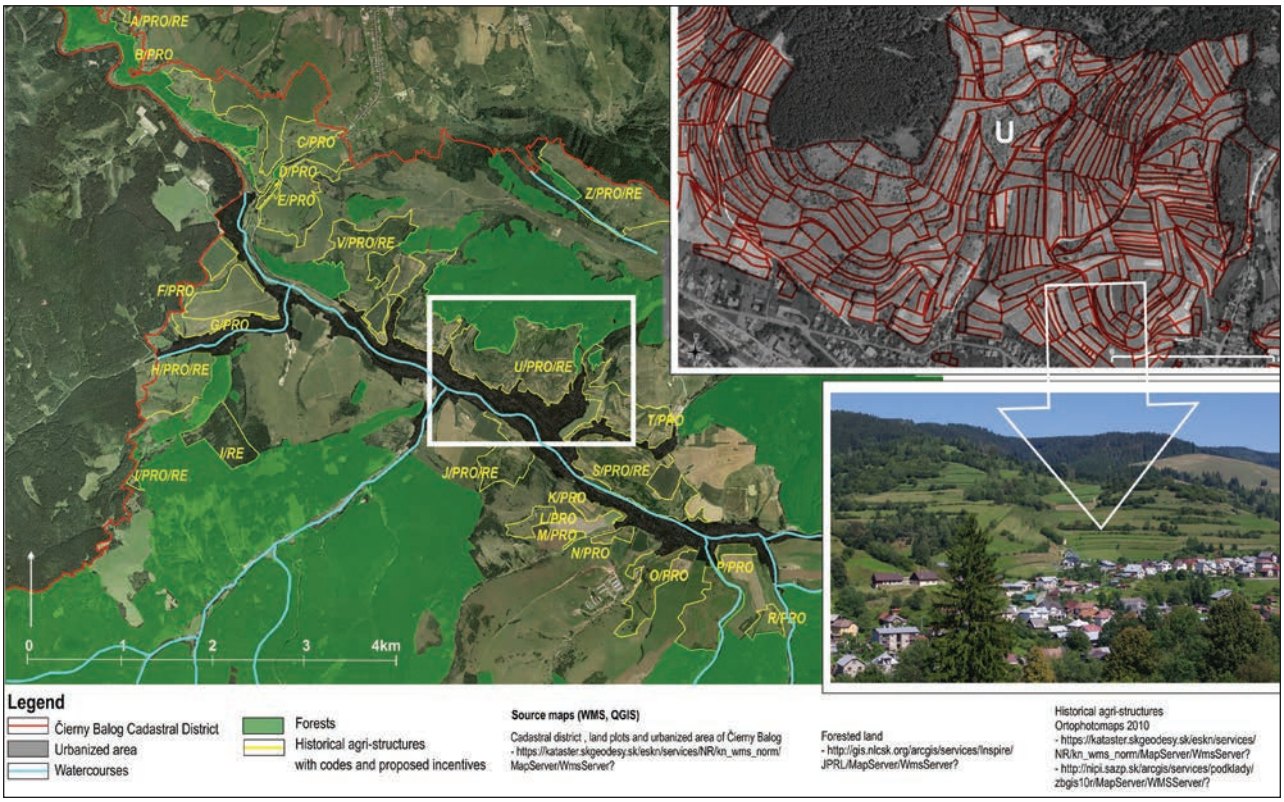

Figure 8: Proposals of incentives providing sustainable management of historical agricultural terraces (Source: Authors, 2018).

of Hriňová is a very good example of a heterogenous landscape with terraces actively managed in a traditional way creating a countryside that is very attractive for tourists (Figure 9). We shall preserve the diversity of the European landscapes as a common resource of natural and cultural heritage, as it is defined in the European Landscape Convention (Council of Europe, 2000) that Slovakia adopted in 2005.

(3) Terraces improve soil conditions, protect the soil from erosion and slow down the surface run-off in the water catchment. The setup of protective measures has a high priority. Abandoned terraces exhibited increased erosion processes (Faulkner et al., 2003, 90). The destruction of terraces could have consequences on the water regime in the river basin of Čierny Hron. Blahušiaková & Matoušková (2012) documented floods in the Čierny Balog village (located along the river of Čierny Hron) which have been monitored since the 60-thies (1961, 1970, 2002, 2005, 2006, 2009). Floods regularly destroyed many residential properties in the past. However, considering the average of annual rainfall sums, the runoff from the water catchment is significantly below average, as a considerable part of precipitation occurs during the summer months. On the contrary, during the spring months, precipitation is lacking and there is insufficient water supply from the snow cover (Šipikalová et al., 2014, 487). From this point of view, more effective water retention would be achieved by using graded terraces on the slopes in the river basin.

CONCLUSIONS

Properly classified HSAL in the real estate cadastre maps as "agricultural land" or "forest" is the first step in their successful sustainable management. From this aspect, remote sensing technologies play indispensable role in identifying a mismatch between real state of the landscape and cadastral records (e.g. Bahýľ & Šadibol, 2011). The second important aspect, is detailed classification of HSAL which we applied in the article. The classification lead to the decision model on how to provide future optimal land use maintenance for different categories of HSAL with terraces. The Rural Development Program (RDP) (2014–2020) of the Slovak Republic (European Commission, 2017) is a guaranteed financial management tool for improvement of the rural environment, the diversification and multifunctionality of the rural landscape and the support of competition in agricultural trade. Agri-environmental payments for agriculturally handicapped regions or NATURA 2000 (a network of nature protection areas in

Figure 9: Different land use of terraces in the Hriňová municipality (Slovakia) is a good example of optimal multifunctional management performed by residents (Photo: B. Beláček, 2008).

the territory of the European Union) sites are to a large extent addressed to regions covered with agricultural terraces in Slovakia. We do not consider this way of allocating subsidies to agriculture sustainable from the long-term point of view. The fragility of the economic situation and low incomes of small farmers will not foster sustainable farming methods. It is necessary to solve this Gordian knot in order to foster the broad implementation of win-win situations between farming and the landscape. The local economy shall operate short regional market chain and shall implement landscape added value linked with the unique cultural landscape and its natural environment into economic benefits of farms (Kruse et al. 2017). Inspirational examples of sustanaible farming practices can be found in the case studies of the project ERASMUS+ 2016-1-SK01-KA202-022502, FEAL: multifunctional Farming for the sustainability of European Agricultural Landscapes.

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ZGODOVINSKA TERASIRANA KRAJINA – TRENUTNO STANJE IN PRIHODNJE PERSPEKTIVE ZA OPTIMALNO UPRAVLJANJE RABE ZEMLJIŠČ: ŠTUDIJA PRIMERA ČIERNY BALOG

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POVZETEK

Zgodovinske strukture kmetijske krajine (HSAL) so navadno razpršene po pokrajini. Imajo vrsto pomembnih ekoloških in bioloških funkcij; so nosilke kulturnih, zgodovinskih in estetskih vrednot, prispevajo pa tudi k varovanju tal in izboljšanju njihovih lastnosti. Ta merila je treba upoštevati, kadar pri prostorskem načrtovanju uporabljamo sodobne koncepte zasnove krajinskega oblikovanja. Z uporabo ortofoto kart (2010), zemljiških kart, zgodovinskih zemljevidov (1952–1957) in izsledkov terenskih raziskav (2016) smo na katastrskem območju Čierny Balog na 23 krajih identificirali 8 kategorij HSAL. Kmetijska zemljišča so skupaj pokrivala 19 % področja; 40 % zgodovinskih kmetijskih struktur s terasami je bilo v aktivni uporabi, 60 % pa jih je zahtevalo odstranjevanje sukcesijskega negozdnega olesenelega rastja, da bi bile terase privlačnejše za turiste. Ohranjene terase imajo pomembno vlogo pri omejevanju odtekanja v povodju, ki ga v nekaterih mesecih redno prizadenejo poplave ali suša. Z uvajanjem večnamenskega poslovnega modela bi lahko majhne in srednje velike kmetije zagotovile učinkovito in optimalno upravljanje teras.

Ključne besede: tradicionalna krajina, trajnostno kmetovanje, podatki daljinskega zaznavanja, značilnosti krajine

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