

AN APPROACH TO EVALUATING POTENTIAL OF CULTURAL AGROECOSYSTEM SERVICES

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Abstract

This paper present an approach to evaluating recreation potential (outdoor recreation) based on the analysis of natural factors affecting recreational opportunities and attractiveness of the area and its potential for summer, winter or year-round recreation. Seven agricultural study areas, each of them with two different land use categories (arable land and permanent grasslands) located in various natural conditions of Slovakia, were evaluated. Potential for outdoor recreation of model areas was compared with its provisioning services. The capacities of grassland to supply cultural agroecosystem services at the two model areas were higher than their provisioning services. Agroecosystems providing cultural services can significantly contribute to the economic stability and prosperity of a particular region, using the soils with low production potential for recreational purposes.

Key words: *cultural agroecosystem services, recreation potential, outdoor recreation*

1. INTRODUCTION

The concept of ecosystem services has become an important tool for modelling interactions between ecosystems and their external environment in terms of global bio-climatic changes. The concept makes clear the links between material flows, hydric and biogeochemical cycles in ecosystems and the external environment. It is based on the assessment of ecosystem functions. The concept of assessment and evaluation of agro-ecosystem services explains and clarifies the links between ecosystem services and the external environment in terms of global bio-climatic changes. The concept is based on an analysis of existing scientific knowledge on soil and soil cover functions and services at the national and international level. The provision of ecosystem services depends on biophysical conditions and changes over space and time due to human induced land cover, land use and climatic changes (Burkhard et al. 2012). Ecosystem services linked to natural capital can be divided into three services categories (provisioning, regulating and cultural) adding ecosystem functions (structures and processes relevant for ecosystem self-organisation (Dominati, Patterson & Mackay 2010, Burkhard, Kandziorai & F. Müller 2014). However, cultural ecosystem services have not yet been fully integrated into these frameworks, because of their transdisciplinarity as well as of the lack of data for assessments. Nevertheless few studies on ecosystem services are conducted in agroecosystems (Feld et al. 2009, Vihervaara et al. 2010). Agroecosystems are managed to fulfil basic human needs, such as food and raw materials (Zhang et al. 2007). Cultural ecosystem services are defined as non-material benefits people obtain from ecosystems (MEA, 2005). Recreation and tourism is one of the six categories of cultural ecosystem services recognized by the Millenium Ecosystem Assessment, the others being: spiritual services, heritage value, cultural identity, inspiration, aesthetic appreciation of cultural and cultivated landscape (MEA, 2005). However, cultural ecosystem services cannot be treated independently and depend on supply and regulating services as well as on supporting processes. Supporting processes (photosynthesis, water and nutrient cycles, soil formation, production of atmospheric oxygen and atmospheric composition) are necessary to keep the balance of the ecosystem.

The work presented in this paper aims at potential for outdoor recreation as an example of cultural agroecosystem services (recreational activities tied to the natural resources). Outdoor recreation and

tourism were selected due to its importance for a lot of people and because outdoor recreational activities generating benefits in daily life.

2. MATERIAL AND METHODS

The approach to evaluating recreation potential (outdoor recreation) is based on on the analysis of natural assumptions that affect outdoor recreation possibility using knowledge of literature (Maes, Parachini & Zulian 2011, Milcu et al. 2013, Crossman et al. 2013, Burkhard et al. 2009,) and on the Methodological framework for integrated assessment of ecosystem services in Czech Republic (Vačkář et al., 2013). Model study sites are located in all main soil-ecological areas (Džatko, 2002) of Slovakia (Figure 1). For the analysis of the cultural agro-ecosystem services seven study sites were selected on the basis of the following criteria: 1/polluted area (inorganic contamination) - locality Medovarce, 2/non polluted area (without the inorganic contamination) - locality Strážany, 3/ area threatened by erosion – locality Čoltovo, 4/ abandoned land – locality Vikartovce, 5/ low productive land – locality Závod, 6/ productive land – locality Zeleneč, 7/medium productive land – locality Tajov. For each locality two study sites was selected: arable land with annual plant and permanent grassland.

Modelové lokality na mape kategórií potenciálu poľnohospodárskeho využívania pôdno-ekologických regiónov SR

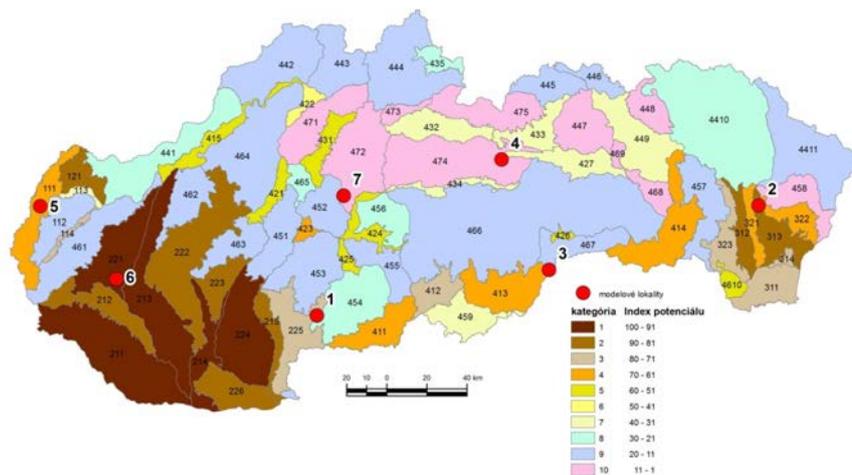


Figure 1 Model study sites located in all main soil-ecological areas

Recreation potential was evaluated through agroecosystems landscape components that have a specific link with summer, winter and year-round recreation. This is a pilot study, the results of which will be applied to the entire territory of the Slovakia. For this reason, only data which are available on NPPC/VUPOP for Slovakia have been used. In researching we used the dataset of the National Agricultural and Food Centre/ Soil Science and Conservation Research Institute Bratislava (database of Comprehensive pedological survey (KPP) and Soil monitoring database, geodatabase BPEJ (valuated land-ecological units), and LPIS. An identification system of production units on the agricultural land (LPIS) is used for identifying agricultural areas and is also an essential substrate in the system of subsidies in agriculture.

We presume that each agroecosystem has the potential (capacity) for carrying out the outdoor recreation. All agro-ecosystems are considered to be potential providers of these services.

In the analysis of the suitability of the area in terms of recreational usage, the altitude, inclination, present of the area, drainage, precipitation, temperature (climate) and their distance to the roads were

taken as basis. The water recreation has not been evaluated, because there are not water bodies in the vicinity of study sites. The following assessment factors and sub-criteria have been determined (tab. 1, 2, 3).

Table 1. The assessment factors and sub-criteria for hiking

<i>Assessment factors</i>	<i>sub-criteria</i>	<i>suitability degree (point value)</i>
Altitude in (m a.s.l.)	< 600	1
	600 – 1200	2
	> 1200	3
In close proximity to Marked trails, nature trails	Marked trails, nature trails	4
Distance to the roads	< 100 m	1
	100 – 200 m	2
	200 – 500 m	3
	> 500 m	4

Table 2. The assessment factors and sub-criteria for cycling

<i>Assessment factors</i>	<i>sub-criteria</i>	<i>suitability degree (point value)</i>
Inclination in (°)	0 - 2	1
	2 – 5	2
	> 5	3
In close proximity to Marked trails	Marked trails	4
Distance to the roads	< 100 m	4
	100 – 200 m	3
	200 – 500 m	2
	> 500 m	1

Table 3. The assessment factors and sub-criteria for cross-country skiing

<i>Assessment factors</i>	<i>sub-criteria</i>	<i>suitability degree (point value)</i>
Inclination in (°)	0 - 2	1
	2 – 5	2
	> 5	3
In close proximity to Marked trails	Marked trails	4
Climate	02,01,00	1
	03,04,05	2
	06,07,08	3
	09,10	4

Slovakian climatic conditions were specified according to the site classification, with the following climatic regions: 00-very warm, 01-warm,very dry lowland, 02-moderately warm, dry, hilly, 03-warm, very dry, continental plain, 04-warm, very dry, basin-like, continental, 05- relatively warm, dry, basin-like, continental, 06- relatively warm, moderately dry, highland-like, continental, 07- moderately warm, moderately humid, 08-- moderately cold, moderately humid, 09- cold, humid, 10- very cold, humid.

The recreational potential of summer recreation or winter and year-round were calculated as sum of sub-criteria point value. In the case of the proximity to Protected areas (Natura 2000) we added 1 point and in the case of the proximity to forest we added 1 point, too. The resulting values can range from 2 to 10 points for hiking, for cycling as well as for cross-country skiing. The assessment scale reaches from 2- no relevant capacity of the agroecosystem to provide outdoor recreational services, 3 – very low relevant capacity, 4 - low relevant capacity, 5 – relevant capacity, 6 – medium relevant capacity, 7- high relevant capacity, 8, 9- very high relevant capacity. The recreational potential for all these activities was calculated as sum of individual recreational activities potential without added points which were added to the final sum in order to prevent multiple evaluations of additional factors.

An analysis of natural assumptions is based on a comparison of the potential for recreational services evaluation with the potential for the provisioning agroecosystem services. We refer to an assessment of agro-ecosystem services, i.e. evaluation of benefits for the consumer. The basis for analysing the potential for the provisioning agroecosystem services is a point value (BH) of productive potential based on typological and production classification of agricultural soil of Slovakia (Džatko 2002).

$BH = (HPJ + SE + KH + Z) * T$, where HP - point value of the main soil unit, SE - inclination score and exposure score, KH - score of skeleton and soil depth, Z - texture score, T - coefficient for climatic regions. The BH value is a basis for the rationalization and environmental exploitation of natural resources of a particular territorial unit (Džatko 2002) and its value in Slovakia ranges from 0 to 100.

3. RESULTS AND DISCUSSION

We evaluated 7 different study sites with two different land use (arable land - AL and permanent grasslands - PG) located in different natural and climate conditions of Slovakia (Tab. 4).

Table 4. Study sites characteristics

Study sites	Geographical location	Altitude (m a.s.l.)	Climate	Inclination (°)	Distance to the roads (m)	Soil type
ST	Eastern Slovak Hills	121	02	0	100 – 200 m	Fluvisol
ME	Krupina Plain	151	04	0	100 – 200 m	Fluvisol
ZA	Borská Lowland	170	00	2	100 – 200 m	Regosol
CO	Slovak Karst	354	06	7	200 – 500 m	Cambisol
TA	Kremnica Mountain	647	07	2	100 – 200 m	Cambisol
VI	Low Tatras	945	08	5	> 500 m	Rendzina
ZE	Danube Slovak Hills	136	01	2	> 500 m	Chernozem

Abbreviations: ST – Strážany, ME – Medovarce, ZA – Závod, CO – Čoltovo, ZE – Zeleneč, TA – Tajov, VI – Vikartovce

3.1 The potential for year-round recreation, for summer recreation and for winter recreation

The potential for year-round recreation, for hiking shows figure 2. The potential is with respect to assessment factors the same for arable land as well as for grassland. The very low relevant capacity are determined for 4 study sites, relevant capacity for 1 site and very high relevant capacity for 2 sites.

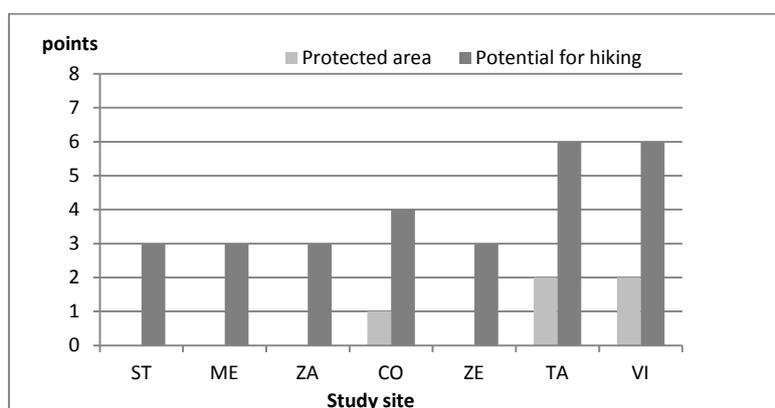


Figure 2 The potential for year-round recreation (hiking)

Figure 3 shows the potential for summer recreation - cycling, with the point value ranges from 3 points to 8 points. The agroecosystem capacity for cycling is very similar to the agroecosystem capacity for hiking.

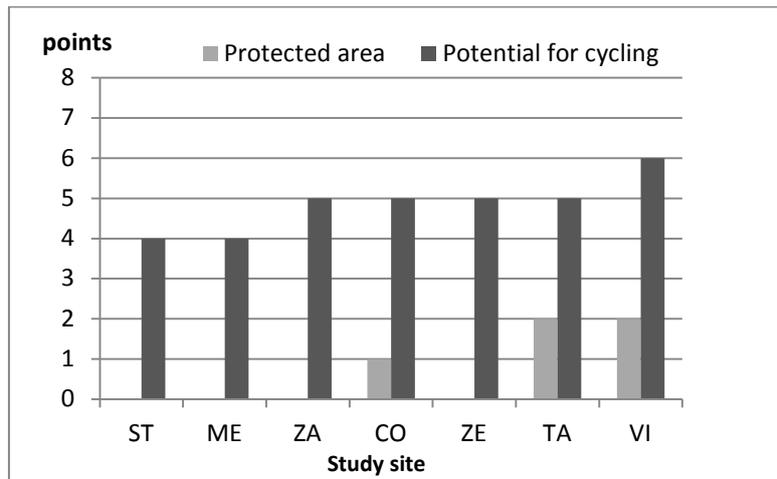


Figure 3 The potential for summer recreation (cycling)

The capacity for the cross-country skiing activity (fig.4) is determined as follows: no relevant capacity 1 study sites, very low relevant capacity 3 study sites, medium relevant capacity 1 site and very high relevant capacity 2 sites.

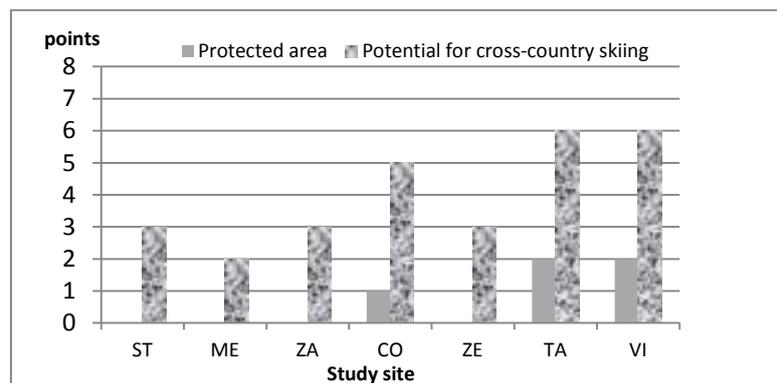


Figure 4 The potential for winter recreation (cross-country skiing)

The recreational potential (RP) for all these activities calculated as sum of individual recreational activities potential and added points ranges from 8 to 21 points (fig. 5).

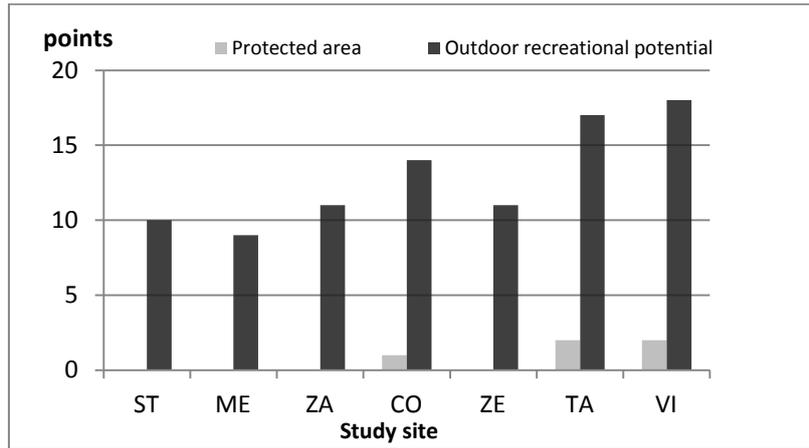


Figure 5 Outdoor recreational potential (RP) – cultural services

3.2 The production potential of study sites in context with provisioning services potential

An agroecosystem's assessment to provide cultural agroecosystem services give an idea about potentials, capacities as well as possible conflicts with provisioning services and limits in environmental management and landscape planning. Traditionally, agroecosystems have been considered primarily as sources of provisioning services, but more recently their contributions to other types of ecosystem services have been recognized (MEA 2005). According to several authors (Power 2010, Daily 1997) agroecosystems can provide a range of other regulating and cultural services to human communities, in addition to provisioning services and services in support of provisioning. By Power (2010) cultural services and biodiversity conservation are also often viewed as tradeoffs with production. The production potential (BH) of study sites in context with provisioning services potential (RP) shows figure 6 (arable land) and figure 7 (grassland). The differences between BH of arable land and BH of grassland are caused by different soil subtype, different humus content, different nutrient content as well as presence of stone in the soil.

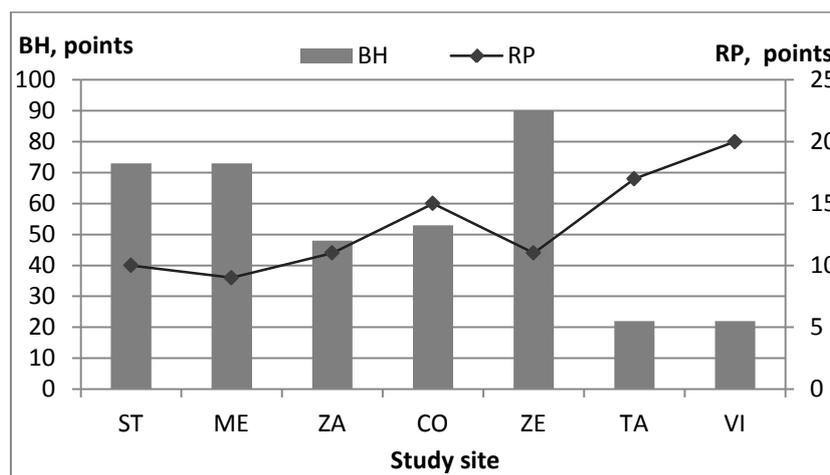


Figure 6 Production potential (BH) in context with provisioning services (arable land)

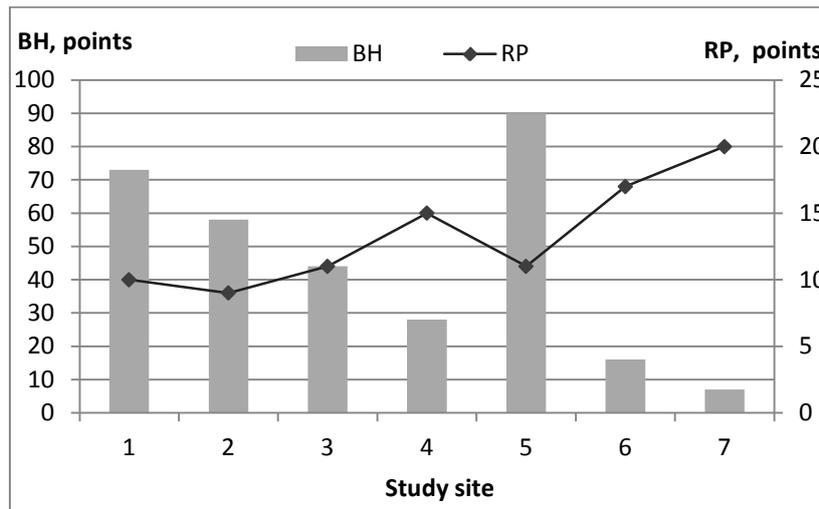


Figure 7 Production potential (BH) in context with provisioning services (grassland)

Despite the fact, that all agro-ecosystems are considered to be potential providers of outdoor recreation services, primary services of arable land are provisioning services. The management of arable land as a provider of provisioning services and as a provider of cultural services have been in opposition. Study sites Strážany, Medovarce, Závod and Zeleneč belong to the arable soils with higher provisioning potential compared to outdoor recreation potential. In the case of these study sites, provisioning services have the first priority with the exception site Medovarce. Study site Medovarce belong to the polluted area (inorganic contamination), soil is not able to fulfill its hygienic function (makovníková, Barančíková&Pálka 2007) and crops grown on this soil can not be used for human consumption. This locality is more appropriate used as grassland or for production of energy crops. Agriculture can contribute to ecosystem services, but can also be a source of disservices, for example study site Čoltovo. The study site Čoltovo is area threatened by erosion. The ecosystems affect the water balance through two processes, interception and infiltration (Nedkov & Burkhard 2012). The interception depends on the structure of the ecosystem, on the land cover. It would be appropriate to change the land use of this locality and use this area as grassland. The role of grassland is also to prevent and reduce potential erosion. This regulating role is emphasized in the works of several authors (Nedkov & Burkhard 2012, Pert et al., 2010, Fisher, Turner & Morling 2009). The study sites Tajov and Vikartovce have had low provisioning potential and their use as arable land may have only local significance.

In the case of grassland can be used simultaneously their provisioning and their cultural services (outdoor recreation). The capacities of grassland to supply cultural agroecosystem services at the two study sites (Vikartovce and Tajov) are higher than their provisioning services.

The result shows that, study site Vikartovce (abandoned grassland) belong to the soils with very low provisioning capacity, with very low BH value. Only 1.45% of agricultural soils in Slovakia have the BH value ranging from 0 to 10. These soils are not suitable for extensive or intensive agricultural use. Nevertheless, it is important to take care of such areas to prevent decay of these areas as well as overgrown with shrubs. The role of grassland is to maintain its erosion control function. The locality Vikartovce should be appropriate use of only recreational activities.

In Slovakia, 8.81% of agricultural soils have BH value in the range from 11 to 20, these include the study site Tajov (grasslands). The recommended management is extensive management of natural grasslands, extensive grazing and partly mowing, which contributes to the preservation of the species composition of plant habitat (ŠefferoVá Stanová 2011). The recommended management is fully consistent with the recreational use of localities.

CONCLUSIONS

The analysis of the recreational potential allows optimum use of the soil and the preservation of its services. Agricultural management practices are key to realizing the benefits of ecosystem services, especially if trying to synergism effect. In other words, a synergism occurs when ecosystem services interact with one another in a multiplicative or exponential fashion as indicated in work Felipe-Lucia (2014). These can be positive, i.e., multiple services improving in provision. The capacities of grassland to supply cultural agroecosystem services at the two model sites (Vikatrovce and Tajov) were higher than their provisioning services. Agroecosystems providing cultural services can significantly contribute to the economic stability and prosperity of a particular region, using these soils with low production potential primary for the recreational purposes.

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