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Green infrastructure and EU agricultural policy

Abstract: *We explored the trends and scales of landscape changes in two pilot rural regions of different landscape characters in Hungary (micro-region Csorna, micro-region Gönc). The result of the continuous intensification is the loss of biodiversity and shrinking of the natural, semi natural vegetation, habitats. To halt the loss of biodiversity the European Union has introduced the 'greening' measures in the Common Agricultural Policy (CAP). These measures contribute to realising the objectives of green infrastructure (GI) planning. Green infrastructure represents a crucial approach in maintenance and development of ecosystems and ecosystem services. In our study we explored the relationships between the greening of the CAP and GI planning. We formulated the most important GI development objectives in our pilot regions. We elaborated three different scenarios based on the present trends and the realisation of GI development objectives in these regions. The scenarios show that the present incentives for GI development are not enough to halt the loss of biodiversity and enhance life quality of rural regions.*

Keywords: *greening of CAP, micro-region Csorna, micro-region Gönc, landscape changes*

Introduction

People have changed their surrounding for thousands of years, especially because of agricultural production. In early history these changes were of local scale but mostly since the 18th century great scale landscape changes have occurred. In Hungary, the major landscape changing activities in the 19th century were drainage, river regulation, meadow-plough land conversion and deforestation. Production was shifted from extensive to intensive methods which resulted in the growth of plough lands. In the 20th century, during the socialist regime, the organisation of agricultural associations and further intensification of agricultural production brought further changes in landscape structure. Analysing the former trends, we explore the most effective ways for the development of the Common Agricultural Policy (CAP) 'greening' measures and green infrastructure (GI) in two pilot regions.

Since 2004 the CAP has had the most significant effect on Hungarian agriculture, and thus on agricultural landscapes. It has direct or indirect effects on the farm size, the type of the crops, the ratio of the crop and livestock production, the land cover structure, and the size of the ecologically valuable areas in the agricultural regions. In terms of the landscape structure, some of the most important regulations and subsidies were the following: encourage afforestation, 'set-aside' payments to withdraw land from production, payment to limit stocking levels, 'decoupling'[1].

The reformed CAP came into force in 2014[2]. From the view of our research, in the 2014-2020 period the most important CAP innovation is the 'greening'. To make the direct payments more environmentally-friendly, to strengthen the environmental sustainability of agriculture and enhance the efforts of farmers, the European Commission (EC) is proposing to spend 30 per cent of direct payments on the improved use of natural resources. Farmers receiving an area-based payment must make use of various straightforward, non-contractual practices that benefit the environment and the climate. These require action each year. They include:

- diversifying crops;
- maintaining permanent grassland;
- dedicating 5 per cent of arable land to 'ecologically beneficial elements' ('ecological focus areas')[3].

The CAP greening measures fit entirely into the framework of GI. GI planning is becoming a widely used tool in Hungary as well but so far mostly in relation to cities (e.g. the term 'green city'). In our study we highlight a different approach. GI planning is a complex, multifunctional tool which can deal at the

[1] COM (2003) 23 final

[2] COM (2010) 672 final

[3] SWD (2016) 218 final

same time with protection and development issues so it is appropriate to realise objectives related to nature conservation, rural development and sustainable agriculture. While grey infrastructure is designed to perform only single functions, GI networks serve multiple functions as 'ecosystem services' (Ely and Pitman, 2014). GI can be an important tool in rural development because of its multifunctional approach. Different terms and definitions exist in the professional literature in relation to GI. According to Benedict and McMahon (1996): "a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains natural eco-logical processes, sustains air and water resources, and contributes to the health and quality of life".

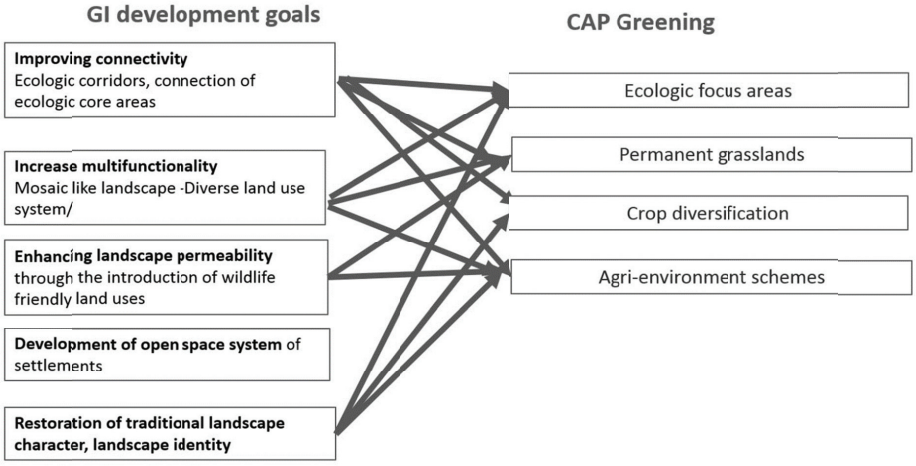

Figure 1. Potential connections between green infrastructure and CAP greening
Source: not stated.

There are several ways to distinguish GI elements; however, the most frequently used typology of GI is as follows (Dancsokné Fóris, 2015; Civic and Siuta, 2014):

- Natural and semi-natural ecosystems, such as pastures, woodland, forest (no intensive plantations), ponds, bogs, rivers and floodplains, coastal wetlands, lagoons, beaches, marine habitats;
- Extensive agricultural and forest landscapes, large marsh and bog areas, rivers and floodplains;
- Restored ecosystem types;
- High nature value farmland and multi-use forests (such as watershed forests); protection forests;
- Greenways, green belts, metropolitan park systems.

The EU intends to integrate GI into different policies such as the Biodiversity Strategy to 2020[4], the roadmap to a Resource Efficient Europe[5], the EC's proposals for the Cohesion Fund and the European Regional Development Fund[6], the new CAP[7], the new Forest Strategy[8] (especially relevant since many GI elements might be forest-based), or the forthcoming communication on 'land as a resource'. The European Union (EU) accepted in 2011 the Biodiversity Strategy that sets the following objectives: by 2020, ecosystems and their services are maintained and enhanced by establishing GI and restoring at least 15 per cent of degraded ecosystems.

The main objectives of GI development are: improving connectivity, enhancing landscape permeability identifying multifunctional zones. The improvement of connectivity is possible by safeguarding hedgerows, wildlife strips along field margins etc. The way of enhancing landscape permeability means, for example, wildlife-friendly land uses or agri/forest environment schemes for existing farming practices. The multifunctional zones can be areas where farming, forestry, recreation and ecosystem conservation operate together. These multifunctional zones can provide valuable ecosystem services also to the society (e.g. water purification or soil improvement) (EC, 2010).

The provision of ecosystem services and the whole multifunctional idea of the GI fit into the CAP multifunctional agriculture endeavour. It means the GI development through providing valuable ecosystem services also can help to fulfil the objectives of multifunctional agriculture (e.g. quality of life in rural regions).

Based on the literature review (historic overview of the transforming of the Hungarian countryside/agriculture areas and analysis of CAP greening measures and GI), the objectives of our research are the following:

- to identify the historical changes in the agricultural landscapes in two study areas;
- to identify the regularities of these historical policies, general trends in the context of the landscape structure;
- to explore the current situation and landscape structures in the study areas;
- to find common enforcement options of 'greening' and GI initiative in the study areas;
- to identify potential areas for 'greening' in the study areas (similarities and differences between the study areas);
- to develop different scenarios in the pilot regions based on the intensity of the enforcement of 'greening' principles.

[4] COM (2011) 244 final

[5] COM (2011) 571 final

[6] COM (2011) 612 final/2

[7] COM (2010) 672 final

[8] COM (2013) 659 final

Methodology

The research material can be divided into three groups: written sources, map databases and statistical data. We used the data of the Hungarian Statistic Office, and other types of databases (Spatial planning and development Information System – TEIR, landscape values – TÉKA, nature and environmental protection databases – TIR, CORINE Land Cover database) for the evaluation of the historical and the present structure of the landscape.

We used various methods in the different parts of the work. GIS analysis was used during the identification of the historical changes in the agricultural landscapes (based on historical maps) and during the scenario development/modelling. We also employed GIS techniques to identify the potential areas for 'greening'. The statistical information was analysed using Microsoft Excel.

Pilot regions

We have chosen two rural regions lying along the western and north-eastern borders of Hungary (Figure 2). Both pilot regions contain backward settlements, suffer from severe depopulation processes and are peripheries or have peripheral parts. Agricultural land use forms are significant in both landscapes.

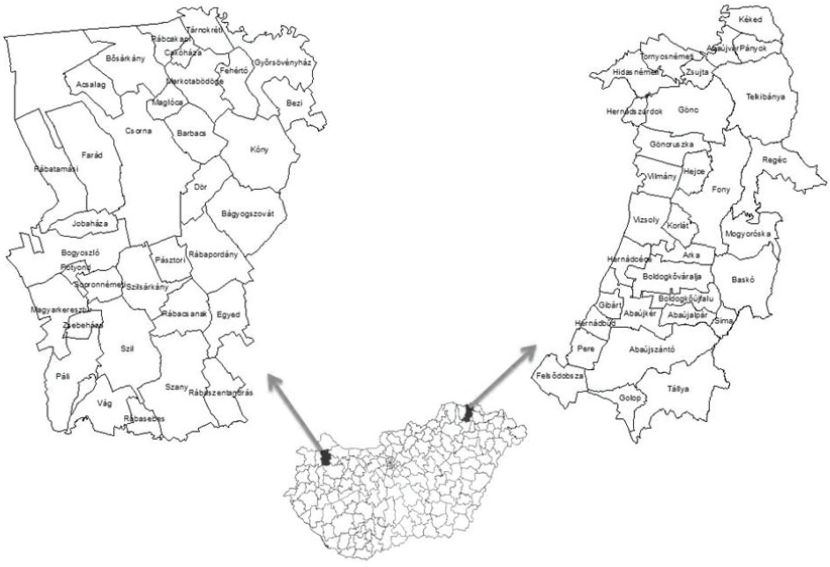

Figure 2. Location of the two pilot regions (micro-regions of Csorna and Gönc)
Source: not stated.

The micro-region of Csorna is situated in the Small Hungarian Plain between the great centres of Győr-Moson-Sopron County. It consists of two major landscape units: Hanság and Tóköz with wetlands, swamps and forests, ex-

tensive agriculture, and the intensive agricultural landscape of Rábaköz. The ratio of plough fields is extremely high in the micro-region (national average 48 per cent, locally 66 per cent with great local differences).

In the micro-region of Gönc, the settlements belong to the most disadvantaged areas of the country. The sample area can be divided into two main parts with different landscape characteristics, the upper valley of the Hernád River and the mountains of Zemplén. In the Valley of Hernád the ratio of arable land is very high. This region historically was called the 'pantry of Kosice', so the agriculture has a great tradition. The southern settlements of the micro-region belong to the 'Tokaj Wine Region Historic Cultural Landscape' World Heritage Site. The other interesting area is Gönc and the settlements in its surroundings, which are traditionally fruit product areas ('pálinka of Gönc').

Results

The pilot regions can be characterised by different landscape conditions but the scale and trends of landscape changes are similar. We can distinguish five periods of local landscape changes in the pilot regions (Tables 1 and 2). For centuries people were just capable to change their direct environment for survival or achieving a better quality of life. At first it just meant the adaptation to nature, hunting, fishing, limited agricultural use. Since the 1st century we can more talk about local changes. In Hanság it meant local drainage, but the vast marshland of Hanság has not changed much. Deforestation and grazing were also typical, and a slowly increasing rate of arable land can be witnessed in both pilot regions, and a growing importance of vine growing and fruit production in Gönc.

Table 1. The first two periods of local landscape changes in the pilot regions

Period	Time period	Characteristics of land use, landscape changes		Drivers of land use changes
		Rábaköz	Gönc	
I. Survival, adaptation	-1st century	The region was settled since the Neolithic ages, adaptation to nature, hunting, fishing, agricultural use mostly in Rábaköz. Limited agricultural use on the elevated surfaces.	The region was settled since the Upper Paleolithic ages, grazing on higher sand-islands of Hernád valley, and on foothills of Zemplén-mountains, small scale deforestation in Hernád valley.	Adaptation for better life quality
II. Adaptation, local landscape changes	1-18th century	Local drainage, the marshland of Hanság has not changed much. Deforestation. Grazing, slowly increasing rate of arable land. Specific pond management system in Tóköz.	Local drainage, the marshland of Hanság have not changed much. Deforestation in Hernád valley. Optimal extension of arable land. Vineyards and fruit gardens on foothills of Zemplén-mountains.	Adaptation, local changes for better life quality.

Source: own construction.

Table 2. The latest three periods of local landscape changes in the Micro-region of Gönc

Period	Characteristics of land use, landscape changes	Drivers of land use changes
III. Large scale landscape changes End of 18th century –WW1	Grasslands and forest were turned to arable land even in the floodplain of Hernád Bársonyos was regulated in 1860s; 1865: 44.7 per cent arable land, 29.8 per cent grassland; 1913: 69.1 per cent arable land, 17.8 per cent grassland; In 1880s phylloxera destroyed the vineyards, partial revival of the vine region, mostly fruit gardens and arable land In 1895 2 million fruit trees were registered in the region,	High yields by changes of the landscape in large estates. Instead of adaptation great scale land use changes.
IV. Intensive land use 20th century–1980s	Continuing river regulation, Regulation of Hernád in 191's; Stady land use system, Effects of Trianon: the region become a peripheral region Intensive crop production and stock-raising. Fruit production, Extending vine yards in Southern region.	The values of the society are formed by the socialist regime, intensive urbanisation process. Land use is led by rationalisation industrial agriculture. Decreasing value of rural life.
V. Nature protection, wetland restoration, growing intensification of agriculture Since the end of 1980s	Growing importance of nature protection, wetland restoration, Natura 2000 network. Increasing crop production shrinking stock-raising. decrease of grassland. 2011: 68 per cent arable land, 16 per cent grassland.	Continuous conflicts between economy and nature protection. Strong constraints of nature protection. Growing land concentration.

Source: own construction.

Especially for the 19th century the organisational level of the society and the technological development made landscape change on a greater scale possible. There is a characteristic period of great scale landscape changes which lasted until WW1. It meant intensive drainage, river control and retreating wetlands of Hanság. It brought almost 30 per cent growth of arable land and the area of grassland halved. More or less the same trends occurred the micro-region of Gönc, the regulation of Hernad river changed the cultivation patterns of the valley and in the 1880s phylloxera destroyed the vineyards. Afterwards the vine region only just partially revived, mostly fruit gardens and arable land replaced the former vineyards.

A fourth characteristic period of landscape history was when the intensive land use became common, drainage continued, even in the inner parts of Hanság. Intensive crop production and stock-raising characterises the land use systems. Such major land use changes have not occurred. Land use is led

by rationalisation of industrial agriculture, efficiency of agricultural production. In the micro-region of Gönc river regulation continued. Fruit production became a major economic base of the region; vineyards were extended in the southern part of Gönc.

In the fifth period of landscape history we see the appearance of nature protection in both pilot regions; firstly, landscape protection areas and later national park were created and the Natura 2000 network was set up. The Landscape Protection Area of Hanság was set up in 1976 and in 1994 became part of the Fertő-Hanság National Park. In the micro-region of Gönc the Landscape Protection Area of Zemplén was set up in 1984. There were continuous conflicts between economy, agriculture and nature protection. Agricultural production is characterised by increasing crop production and shrinking stock-raising. There were also strong constraints of nature protection and growing land concentration. Similar trends in landscape change can be witnessed in the other pilot region, as a detailed example we just highlight the periods of micro-region of Gönc (Tables 1 and 2).

Present trends of landscape changes

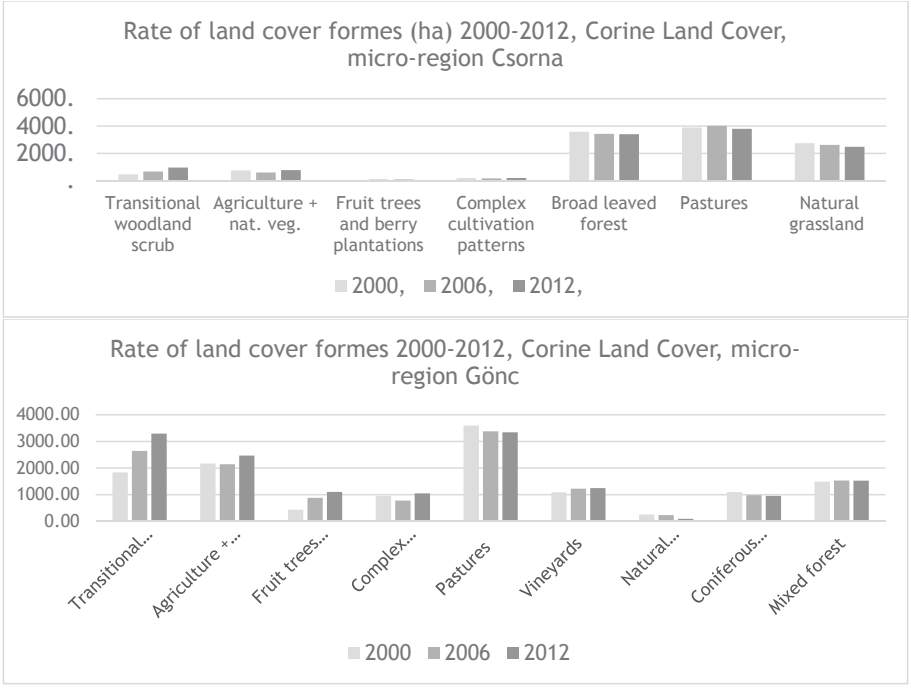

Figure 3. Land use forms in Csorna and Gönc micro-regions

Source: Corine Land Cover 2000, 2006, 2012.

The Corine land cover maps and data (2000, 2006 and 2012) made it possible for us to explore the present trends. In the pilot areas the set of land use forms are influenced by different landscape conditions. Gönc micro-region is mostly a hilly landscape with high incidences of forests, woodland, and pastures and plain landscape of Hernád valley, while Hanság-Rábaköz is a typical plain landscape where arable land dominates (72 per cent) and the ecologically-valuable pastures and natural grasslands make up around 10 per cent of the micro-region's territory. In both areas the share of arable land has been quite stable in the last fifteen years, but there has been a steady decrease in pastures and natural grassland, and a growth of transitional woodland, especially a drastic growth of transitional shrub areas in Gönc micro-region. In Csorna micro-region pastures dropped by 3 per cent, natural grassland by10 per cent; while in Gönc pastures dropped by 2 per cent and natural grassland by 63 per cent (Figure 3).

Present state of green infrastructure in the pilot regions

In the Northern and Eastern part of the micro-region of Csorna, Hanság-Tóköz dispose of high ecological value of the remnants of the former marshland, mosaic-like landscape in the remnants and in the drained marshland. Here the GI network is dense and mostly intact. Rábaköz is plain mainly monotonous agricultural landscape with missing or low value sections, elements of GI. From East and South the Rábaköz is bordered by river Rába, the riparian forests and meadows are of high ecological value. Forests just make up approximately 6 per cent of the micro-region and the majority of these are plantations of *Robinia pseudoacacia* L.

In micro-region of Gönc the mountains of Zemplén can be characterised by high ecological value of the extensive forests. The Hernád-valley is mostly plain, monotonous agricultural landscape, the only elements of the GI networks are the valleys of the creeks between the Mountains and the River Hernád. There are extensive orchards on the foothills of Zemplén of moderate ecological value. Along the river Hernád the forests and backwaters are of high ecological value.

The continuous intensification of agricultural production has led to a series of land use conflicts in both pilot regions. In Hanság-Rábaköz maybe the most serious one is the high rate of excess waters. In general, 12 per cent of the territory of the micro-region has frequent occurrences of excess waters, but there are settlements especially in Hanság where this proportion is above 30 per cent. Owing to the continuous intensification of agricultural production, arable land covers such areas also where the conditions are not the best for this cultivation form. For example, there are huge areas of Csorna with a high potential of excess waters which in the middle of the 19th century were cultivated as pastures, but by the end of the century had mostly become arable land (Figure 4). Crop production is more profitable fore farmers than grazing and animal husbandry, which leads to the continuous loss of grassland.

Figure 4. Land use in the middle of 19th century in the micro region of Csorna (II. Military survey, 1845-1846); at the end of the 19th century (III. Military survey 1872-1884); present state with frequent occurrence of excess waters
Source: www. mepar.hu.

In Gönc micro-region the cultivation of hillsides is problematic; much of the arable land is situated on steep slopes where the potential of erosion is quite high. Also in Hernád valley in the past there were swampy areas which are now arable land with high risk of excess waters.

Green infrastructure development

In the field of GI development there are wide range of development possibilities which help to enhance the multifunctionality of the landscape (Figure 5). In spite of the different characteristics of GI in the pilot regions, the development goals are more or less similar (Table 3). To maintain and stop the declining trends of ecosystem services it is essential to improve the GI system in the pilot regions, especially on intensive agricultural land. Both pilot regions have great monotonous agricultural landscapes where the diversification of the production structure, higher rate of horticulture and growing importance of animal husbandry would improve the ecological value of the region and enhance employment potential of agriculture. In arable land the protection and development of semi-natural ecosystems such as forest belts, hedges etc. are crucial for landscape connectivity and permeability. The creeks, channels, and the green buffer zones along them could be the potential backbone of any regional green and blue network so it is essential to maintain 5-10 m wide buffer zones along watercourses (especially along the creeks of the Hernád valley and in Rábaköz).

The old, traditional orchards are important elements of landscape character and identity in micro-region of Gönc. The maintenance and development of these orchards and the development of the food processing sectors based on fruit production are important issues of rural development programmes.

In terms of the future trends of land use changes there is the question of whether the steady loss of biodiversity and intensification will continue or the growing importance of the GI approach, development and greening measures of agricultural production could change the trends. According to the possible future trends we elaborated three scenarios visualising the development of rural areas.

The realisation of the objectives of GI planning which are also important from the rural development point of view require great efforts from the local society and authorities but in the long term these improve the life quality and population retention capacity of rural regions (Figure 5). In scenario C with the full realisation of rural development programmes and environmentally-friendly methods and diversification of local economy we can visualise flourishing rural regions with diverse agricultural production structures, and significant shares of sectors with higher added value (Table 4) in the future. Tourism, multifunctional agriculture and food processing can absorb the local human resources so the strong ageing and depopulation process will be slowed down or reversed.

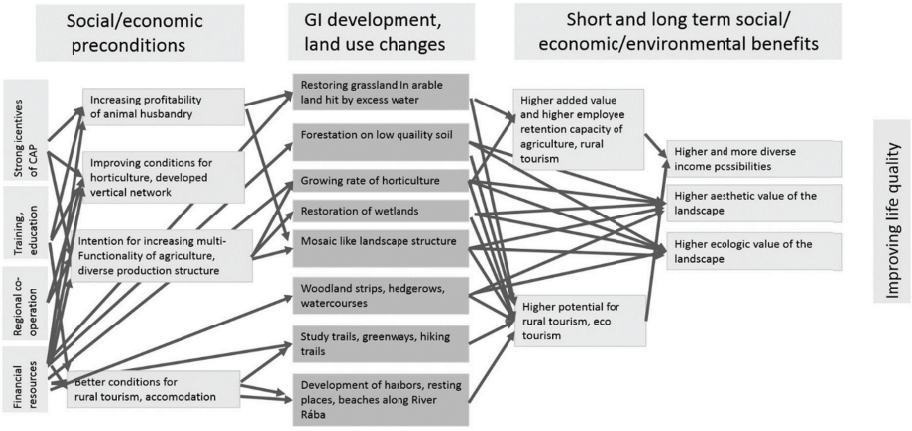

Figure 5. Preconditions and long-term effects of green infrastructure development
Source: not stated.

Table 3. Green infrastructure objectives in the pilot regions

Micro-region of Csorna	Micro-region of Gönc
Diversify agriculture, enhancing multifunctional production structure (more horticulture, animal husbandry, grassland). Protection and development of semi-natural ecosystems in the agricultural land (maintenance and development of forest belts, hedges etc.) Increase the share of grassland, especially in areas of frequent excess water. 5-10 m wide buffer strips along watercourses. Increase the share of forest by at least 3 per cent at settlement level and 10 per cent at regional level. Enhance eco-tourism potential by GI development (Hanság, Rábaköz, along river Rába).	Decrease the intensity of agriculture in the Hernád-valley, diversification. Protection and development of semi-natural ecosystems in the agricultural land especially in the valley. Development of the green connection between the Mountains of Zemplén and the river Hernád. Increase the width of the riparian forests. Maintenance of the old, traditional orchards on the foothills of Zemplén. 5-10 m wide buffer zone along watercourses (especially along the creeks of the Hernád-valley). Enhance eco-tourism potential by GI development.

Source: own construction.

Table 4. Possible scenarios in rural regions on the basis of the scale of realisation of green infrastructure development and CAP greening

	Scenario A Trend scenario	Scenario B Greening (basic)	Scenario C High level of GI development, growing significance of rural development
Driving forces	Maximum profit from agricultural land, decreasing employee absorption capacity of agriculture.	Protection of permanent grasslands, partial protection of non-production areas otherwise continuing trends in agricultural production.	Strong incentives in rural development and agricultural policy for changing, diversifying production structure, nature protection.
Major land use changes	Decreasing share of grassland, increasing share of arable land and transitional woodland-scrub, increasing land use concentration	Lower, but steady decrease of grasslands, continuous growth of arable land.	Growing share of grassland, forests, growing share of horticulture, mosaic-like landscape.
Structure of agriculture	Decreasing multifunctionality, growing significance of arable land.	Decreasing multifunctionality, growing significance of arable land.	Diverse production structure, high share of sectors with higher added value, increasing employee retention capacity of agriculture.
Effect on biodiversity	Decreasing biodiversity.	Positive effects are questionable, probably in a lower rate, but steady decrease of biodiversity.	Decrease is stopped.
Demographic trends	Continuing strong depopulation and aging process in the region.	Continuing strong depopulation and aging process in the region.	Lower rate of depopulation and aging process in the region.

Source: own construction.

As stated above, the greening measures of the CAP contribute to the realisation of GI development. The question is how effective will be the greening in halting the loss of biodiversity. The greening has been just recently introduced and spatial data are not available about the practical realisation in Hungary but we can estimate the effects on the basis of the guidelines, interviews with experts. Several studies (van Zeijts et al., 2011, Máté and Kollányi, 2016) highlighted the fact that greening will have just limited effects, it will increase biodiversity especially in North-Western-European regions with high shares of intensive farms, and will have less impact in extensively-managed regions. Our pilot regions because of their varied landscape characters have intensive but also extensively-managed areas as well. The greening measures were softened in such a way through the negotiations that the farmers do not really have to realise considerable changes in their farming practice to fulfil the requirements. So unfortunately the possibility of realisation of A and B scena-

rios are higher. This means that the present trends of landscape changes will be continued in the future with further intensification and biodiversity loss. The labour need of intensively-cultivated arable land is low; the decreasing biodiversity and heterogeneity of the landscape will result in lower levels of ecosystem services. These processes result in continuing strong depopulation and aging processes of rural regions (Table 4).

Discussion

In spite of the fact that greening has been just recently introduced, the majority of scientific literature highlights its failure to stop the loss of biodiversity. What are the reasons for the limited positive effects? Significant core elements of greening are the so called Ecological Focus Areas which are important backbones of GI as well. These EFA elements such as landscape features, buffer strips and hedges may also be protected under cross-compliance. Also such crops qualify for EFA which are not beneficial to biodiversity (nitrogen-fixing crops, catch crops etc.), so the really valuable EFA elements cover usually maximum 1-2 per cent of the farm area. Originally conservation scientists and professionals recommended that 10 per cent of arable land within each farm should be allocated for ecological purposes, and permanent grassland cannot be considered (Máté and Kollányi, 2016).

In agricultural landscapes, grassland and pastures are important core areas of GI, which is why among greening measures the maintenance of grassland is crucial. Unfortunately, the present trends show a steady decrease in grasslands. In the micro-region of Csorna pastures dropped by 3 per cent and natural grassland by 10 per cent in the last fifteen years. In the micro-region of Gönc there are more drastic decreases: natural grassland dropped by 63 per cent in this hilly landscape, which meant land abandonment and the acceleration of natural forestation processes. A core element of greening is the protection of permanent grassland. But this measure allows a further loss of 5 per cent of their extent by 2020 at the regional level. This 5 per cent threshold is quite high: in some cases, it can just slow down the loss of grasslands.

Crop diversification requires at least 2-3 crops in large farms (above 10-30 ha) which does not really mean heterogeneity especially in cases when diversification is fulfilled by using spring and winter plantings of the same crop. So the crop diversification measures do not really mean any ecological, heterogeneity not even at the farm level, but especially not at the landscape level.

GI planning has become a popular approach in nature and landscape protection. But there are no effective financial and legal incentives to encourage the restoration of degraded ecosystems, or development of areas of low ecological value. Not even in rural development is GI development a priority. All these facts and processes highlight the possible realisation of Scenarios A or B.

The objectives of nature protection and agricultural production often contradict each other. These contradictions can be eliminated by the complex approach of GI development and considering the most effective ways of greening measures. In our study we have drawn attention to the overlapping functions of agricultural greening and GI. The improper agricultural management cause severe negative effects, which in the long term hinder effective and profitable production and contribute to the loss of biodiversity, low level of ecosystem services and finally to the depopulation of rural regions. Harmonisation of GI development with greening of agricultural production would improve the ecological network and the efficiency and diversity of production and the local economy. We have identified the most effective locations of greening and GI development in the pilot regions. With the scenario building we tried to give guidance for future planning in landscape management and development. Our scenarios highlighted the fact that the present incentives for greening of agricultural production and GI development are not enough. Much more effort is needed to stop the negative trends of rural regions.

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