Biotope networks in the agricultural-dominant landscape - evaluation of establishment and conservation possibilities support systems

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1. Introduction

The loss of biodiversity in agricultural-dominated landscapes is a particularly pronounced issue in Hungary, where 57% of the country's territory is covered by agricultural landuse (KSH 2019). One of the most widely used indicators of farmland biodiversity in Europe is the Farmland Bird Index (FBI). The FBI_HU index, adapted to Hungarian conditions, shows a dramatic picture of the population changes of 16 bird species associated with agricultural habitats (Szép et al. 2012). The FBI_HU has decreased by 37% overall between 1999 and 2019. In addition, the survey of 114 bird species shows that 70% of the species with significant population declines (around 5% per year) are predominantly associated with agricultural habitats (MMM database). This indicates that agricultural-dominated landscapes are currently the fastest biodiversity declining areas in Hungary.

In addition to agro-ecosystem degradation, agricultural-dominated landscapes are also increasingly affected by the worsening consequences of climate change. Compared to an estimated increase of 0.9℃ in global average temperature between 1901 and 2018, the national average temperature has increased by 1.23℃ over the same period. However, the most serious consequence of climate change on agricultural land will not be an increase in average temperatures, but an increase in the distribution of precipitation, which is becoming more extreme, and an increase in the length of drought periods (Report by Ministry of Innovation and Technology, 2020). As illustrated above, two very dangerous processes are taking place in agricultural-dominant landscapes, to which it is vital to respond as quickly and effectively as possible. Such a response could be the creation of biotope networks even in intensively farmed agricultural areas.

2. Background and Literature Review

According to the European Environment Agency the term biotope network means: “Intersection of corridors connecting patchy ecological communities”, and adds that: “Species survival tends to be higher in patches that have higher connectivity” (GEMET). In the Hungarian literature, a biotope network is a connected, networked system of habitats (biotopes) that ensures the conservation of landscape biodiversity and the natural structuring of space (Ángyán and Menyhért 2004). Within this, the literature distinguishes between woody biotopes (forest strips, hedgerows, shrubs, forest patches) and herbaceous biotopes (grassy margins, field margins, ditch banks, ecotopes) and transition areas (pasture forest) (Szalai 2010). In addition, small ponds, water bodies and inland waterways with wetland functions can also be considered as biotopes. In this interpretation the category of permanent grasslands such as meadow and pasture are excluded.

The favorable microclimatic associations of field protective forest strips as woody biotopes for agricultural production have been demonstrated in several subject-specific literatures (Gál and Káldy 1977; Barna 1994; Baudry et al. 2000; Kuemmel 2003; Esaulko, A. N. 2016; Szarvas 2010). Field protection forest strips with appropriate parameters have a beneficial microclimatic effect by reducing wind speeds at a distance of 15-25 times their tree height (Szarvas, 2010). Their beneficial effects can be measured in terms of dew formation, horizontal evapotranspiration and soil moisture enhancement. In addition to improving microclimatic conditions, the role of woody biotopes in biodiversity is also significant. Even in relatively narrow 15-25 meters wide forest strips, there is evidence of higher diversity of bird and mammal species, as well as the micro- and meso-fauna (Faragó 1997; Macdonald M.A. 2003; Szarvas 2010; Haddaway N.R. et al. 2016). Herbaceous biotopes also play an important role in biodiversity. Grassland margins sown with native diverse seed mixes have a multifunctional role in the ecological balancing of arable land. Among others, they provide vital habitat for native herbaceous plants, pollinating insects and insectivorous birds (Juan Pablo Torretta and Santiago L. Poggio 2013; ECPA 2014; Lorna J.Cole et al. 2015; Annelie M.Jönsson et al. 2015; D.B.Westbury et al. 2017). The greenway function of biotope network elements in the agricultural-dominated landscape is also essential in terms of ecological corridor, recreational greenway and landscape-scale green infrastructure. An infographic produced by the European Court of Auditors illustrates the relationship between the intensity of land use patterns and the biodiversity of agro-ecosystems (Figure 1).

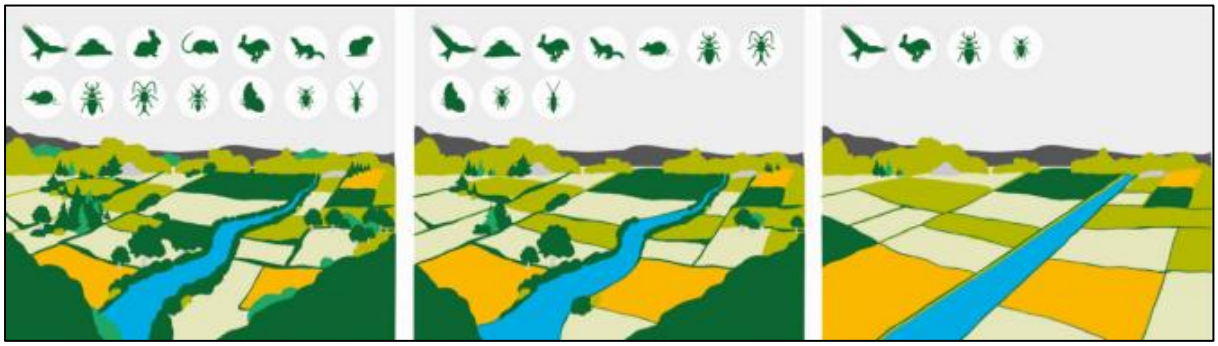

Figure 1. Relationships between land use intensity and biodiversity loss, (ECA 2020)

According to a study carried out by experts from the Hungarian Ministry of Agriculture, the most important interventions for biodiversity in arable land are those that promote the maintenance and creation of close to nature micro-habitats, or in other words biotopes and their connected network. In the same study, it is also pointed out that the indirect effect of the CAP agricultural support received by Hungary in the 2014-2020 period is that these biotopes are slowly disappearing from the agricultural-dominated landscape and this can be linked also to the drastic decline in bird populations mentioned above. (Special Report by Ministry of Agriculture 2020; ECA 2020). Between 2013 and 2020, the total area of woody vegetation categories are decreased by 53% and the area of herbaceous vegetation categories (excluding grassland) by 20% (Special Report by Ministry of Agriculture 2020). Indirect negative impacts on biodiversity linked to Single Area Payment Scheme are discussed in more detail in the next chapter.

If biotope networks play such an important role in the climate adaptation of agricultural-dominant landscapes and the biodiversity of agro-ecosystems, the question may arise: on the threshold of the climate and biodiversity crisis what are the reasons for the current decline in these types of microhabitats in Hungary, instead of their increase? This is why our research will focus on exploring in more detail the legal systems that support and encourage the establishment and conservation of biotope networks.

The objectives of our research are:
1. To examine the current Hungarian and EU legal framework about the establishment and conservation of biotope networks and to identify any shortcomings in them.
2. To assess the current and planned future support schemes based on our own criteria to determine to which extent the proposed programmes and measures address the current shortcomings.

3. Method and Data

In the first part of the research, we review the current agricultural support schemes included mostly in the Rural Development Programme (2014-2020), that concerns the establishment or conservation of a biotope network. Results-Based Agri-environment Payment Schemes (RBAPS) remain to this day one of the most important EU financial incentive schemes linked to the protection of biodiversity in agricultural areas. The forms of aid can be divided into horizontal categories with general environmental objectives and zonal categories with specific species and habitat conservation objectives. Zonal support is available to farmers in areas called: High Nature Value Areas (HNVA) designated nationally by law, which is the same idea that comes from the British model called Environmentally Sensitive Area. The aids cover the loss of production caused by environmental over-commitments, paid annually and last for 5 years per subsidy cycle. In both forms of aid, only the requirements of a 3-6 m wide chemical-free herbaceous field margins can be linked to the establishment of a biotope network element (RBAPS 2015). The difference is that while this is compulsory for zonal aid, it is only optional for horizontal aid.

Existing biotope network elements in the agricultural-dominant landscape are protected by the Good Agricultural Environmental Status (GAES) regulation alone. The regulation protects single trees, non-linear groups of trees and shrubs, small ponds and water protection strips (buffer strips of 5 meters from surface water and 20 meters from standing water) inside the agricultural fields. However, a significant shortcoming is the lack of protection for the linear wooded and grassed strips or field margins along the periphery of the parcel, which are contributing to the landscape-scale connectivity of biotopes and their greenway function. The situation of these linear biotope elements is made even worse by the fact that they are excluded from the most important EU agricultural support called Single Area Payment Scheme (SAPS), because these elements are registered as ineligible areas. As a result, farmers have become reluctant to conserve them.

From 2013 a core share of CAP direct payments - 30% to be precise - should be specifically devoted to agricultural practices that are climate and environmentally sustainable. The latter package is collectively referred to as Greening (Greening Handbook 2015). The requirements of the Greening regulation are mandatory, but they are considered as an aid requirement for all farms that fall within the criteria of the legislation, so the purpose of the aid is the same as for RBAPS to compensate the farmers for additional environmental commitments and crop losses. From the three main practices that can be linked to the greening, only the practice called designation of ecological focus area (EFA) is relevant for us. EFA areas should only be designated for arable farms larger than 15 ha. The average size of arable land per farm is 18 hectares in Hungary in 2020 (KSH 2020). The trend over the last decade is that the average size of arable land per farm is increasing as fewer farms are operating in Hungarian agriculture (KSH 2020). EFA areas must be established on 5 % of the total area of the estate. Farmers can choose from 18 different types of EFA areas (Greening, 2015). From these, the types that can be linked to the creation of a biotope network are the creation of a herbaceous field margin, an

alley and a wooded strip. However these types are at a great disadvantage compared to the other optional types, which offer farmers a more convenient option, such as sowing legume or simple second sowing. Only 2% of the farmers used the biotope element relevant types of EFA in 2015 according to a study (Gyuricza 2016). The already existent linear biotope network elements cannot be calculated under EFA designation, because greening aid can only be claimed for areas covered by the SAPS support. However there is a small innovation that, after complicated mathematical calculations, these linear elements in contact with the edge of the parcel can be partially counted as EFA designation.

The last current form of support to encourage the creation of a biotope network element is a tender from the Rural Development Programme (2014-2020) called: "Non-productive investments for habitat development" financed from EU funds. The hedgerow planting and bee-keeping field margin target area can be classified as a relevant biotope element of the application. It is a one time payment after which the farmer is obliged to maintain the plantation for 5 years. The main disadvantage is that the planting becomes ineligible under the SAPS. Under these conditions, it is no wonder that this form of support is characterised by a lack of interest on the part of farmers (Tóth 2021).

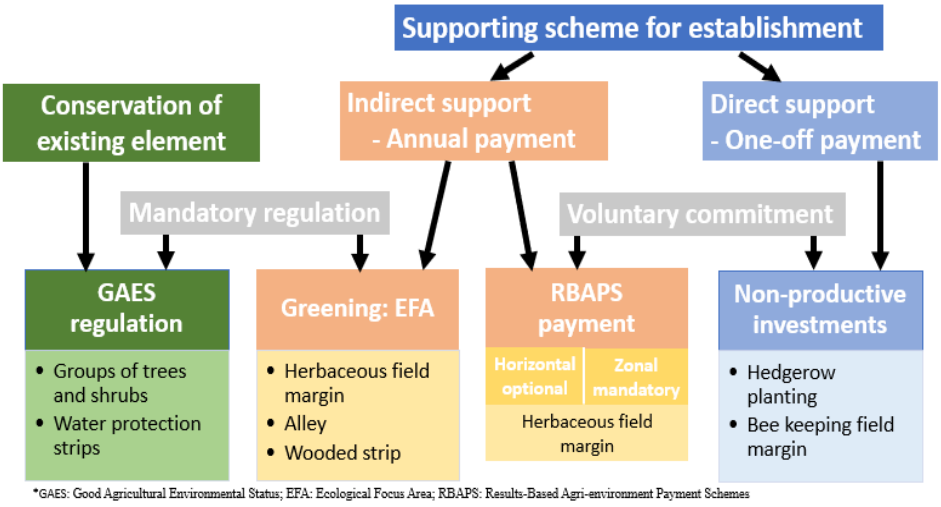

Figure 2. Structure of the current (2014-22) support schemes for biotope network elements in Hungary, (own editing)

The shortcomings identified in current regulations for the establishment and conservation of biotope networks are listed in column 2 of Table 1. The study by the Ministry of Agriculture referred to earlier also looked at which support schemes make a demonstrable contribution to halting or increasing biodiversity. According to the FBI_HU indicator, the only areas where biodiversity loss was halted (from the aids we examined earlier) were the horizontal arable lands with a high proportion of RBAPS support, and those with a lower spatial share of SAPS support (Special Report by Ministry of Agriculture 2020). So the lack of SAPS support implies a halt in biodiversity loss. This correlation is attributed mainly by two reasons according to the study by the Ministry of Agriculture. The first, which we have mentioned before, is that direct area payments crowd out elements of the green infrastructure network from the eligible areas. The second is that SAPS contribute to the maintenance of irrational production systems (forced cultivation in areas at risk of drought, inland water, erosion) (Special Report by Ministry of Agriculture 2020).

After a short description of the current support schemes available for the establishment of biotope networks, we briefly outline the plans for future changes. 40% of the new CAP budget for 2022-27 should be climate change relevant (instead of 30%) according to EU regulation (Regulation 2021). The latest CAP reform is linked to several points of the ambitious EU Green

Deal (CAP 2020). These include: the dissemination and promotion of new agri-environmental practices; the creation of a green advisory network to help farmers; and the creation of a new financial fund called ”eco-schemes” (Meredith S. and Hart K. 2019). There are two other very important strategic links with the new CAP one is the Farm to Fork strategy and the other is the EU Biodiversity Strategy to 2030 (EU BS, 2020). Among the ambitious targets set out in the Biodiversity strategy, the most important for biotopes is: "*By 2030, at least 10% of agricultural land should be restored to high-biodiversity landscape features. These include buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls, and ponds.*" (EU BS 2020). The target of converting 10% of agricultural land into high biodiversity landscapes has also been transposed into the draft of National Biodiversity Strategy 2030 (NBS 2021). Information on the draft changes to the support scheme was provided at the National Biodiversity Strategy Forum on 21 October 2021 by the Ministry of Agriculture. According to a presentation by István Madarász, Head of the Agricultural Strategy Coordination Unit, the new support scheme in the National CAP strategy (in line with the EU CAP strategy) structure will cover: development of a new green advisory network; extension of the concept of SAPS eligible area to include wooded and grassed strips on field margins, areas with intermittent water cover; merging and slightly changing the mandatory regulations like greening and GAES (conditioning); agro-ecological basic programme (”eco-schemes”); forestry subsidies: e.g.: provision of propagating material; additional financial support for non-productive investments, e.g.: for field protection forest strips, field margin; compensatory aid for arable land in Natura 2000 areas if the relevant standards are met.

After having explored the current forms of aid and the envisaged future development plans, we were curious to know how these two aid structures relate to each other: do the new development directions and plans provide an appropriate response to the shortcomings of the current aid schemes? This was assessed in tabular form (Table 1). We first identified the shortcomings and weaknesses of the support schemes and related legislation of the previous budgetary period (2014-2020) that we considered important for the conservation and establishment of biotope networks. Weaknesses considered to be of particular importance for biotope networks are underlined (Table 1 column 2). We compared these features with the measures in the new support structure to obtain an answer as to whether the development plans could provide some type of solution to the current gaps or whether it is not specified yet meaning we have no information that there is a proposal to do so (Table 1 column 3). The content of the following development programmes were examined: eco-schemes; agri-environmental programme; non-productive investments; forestry subsidies; conditionality; compensation plan for Natura 2000 arable land.

In a separate column (Table 1 column 4), possible solutions to problems not or only partially addressed by the draft have been proposed and commented on by us. In the fifth column of the table, the development proposals (together with our own proposals) are assessed according to their direct or indirect link to the creation or conservation of biotope networks. Directly linked refers to some type of biotope network element that could potentially be created or protected in the agro-dominant landscape if the proposal is implemented. Indirect linkage means that the proposal contributes to the establishment of a particular biotope network element in some non-direct way (e.g. maintenance support, land use change). The indicator is intended to show how many of the proposed support scheme solutions are considered to be direct proposals, which could be considered more appropriate.

4. Results

Abbreviations used in the table: GAES: Good Agricultural Environmental Status; EFA: Ecological Focus Area; RBAPS: Results-Based Agri-environment Payment Scheme; Single Area Payment Scheme SAPS; HNVA: High Nature Value Areas; Non-productive investments: NPI.

Table 1: Comparison of current subsidies and shortcomings of legislation related to the establishment and preservation of biotopic networks with the development proposals and supplementation with our own proposals, (own editing)

1. Current grants and legislation relating to the establishment and conservation of biotope network	2. Current subsidies, legislation weaknesses Underlined: Key deficiency	3. Is there a solution to the shortcomings in the planned support programmes? There is: in which / Not specified	4. Our suggestions, comments	5. How would the proposals relate to the establishment and conservation of biotope networks? Directly / Indirectly
RBAPS horizontal arable land specification group	Only optional specifications for the establishment of a field margin are included	Not specified	In the New RBAPS regulation could be made a mandatory requirement	Directly
	There is no requirement to provide woody micro-habitats	Not specified	It would be possible to expand in the New RBAPS regulation	Directly
RBAPS HNVA arable land specification group	There is no requirement of woody micro-habitats in any of the provision (although some small mammal species vital habitats)	Not specified	It would be possible to expand in the New RBAPS regulation	Directly
Greening EFA areas	For estates over 15 ha only, it is mandatory to choose an EFA area	Not specified: (but within the framework of eco-schemes, the threshold is reduced to 5 ha there)	When standardizing conditioning, it would be possible to reduce the estate size threshold	Indirectly
	Application of biotope-related EFA areas-shareholding is low	Not specified	In the process of standardizing conditioning, it would be possible to exclude e.g. the requirement for second sowing and sowing of legume from the optional categories	Indirectly
	Maintenance of target areas is mandatory for 5 years, but no additional support is granted for maintenance	There is: Within the framework of eco-schemes		Indirectly

Non-productive investments (NPI)	Large quantities of specific propagating material from farmers must be purchased	There is: It will be among forestry subsidies		Indirectly
	Only hedge bar installation support appears among wooded biotopes	There is: support for a forest strip biotope type of field protection is included in the New NPI		Directly
GAES regulation	There are no protected landscape elements category with lined forest strips and field margins	Not specified : (but they will be among the eligible areas)	Placing the lined woody strips and field margins under the protection during the unification of conditioning	Directly
	There is no legal definition of the physical parameters for the establishment of a bee grazer	Not specified	There will be an emphasis on a number of future support, so the unification of conditioning will have to be determined.	Indirectly
	A maximum size limit is not set for merged tables	Not specified :(but there will be a relevant regulation within the framework of eco-schemes)	Standardization of conditioning- at a higher level of legislation, it would be worthwhile to have this type of requirement	Directly
SAPS	SAPS eligible area does not include lined wooded strips and field margin areas, inland waterways	There is: extension of eligible areas with forest strips, woodland strips, woody and bushy strips, areas periodically inundated with water		Directly
	They contribute to the forced cultivation of areas with poor production conditions	There is: eco-schemes and Natura 2000 arable land use requirements are expected to support land use conversion		Indirectly
Other	The network of consultants is fragmented, their goals are diverse	There is: "Green" advisory network is on the horizon		Indirectly
	Direct support for establishment is provided only by non-productive investment	There is: In eco-schemes, the establishment will also be among the regulations		Directly
	No support for the acquisition of equipment for environmentally friendly technology	There is: Within the framework of the New NPI		Indirectly

The assessment identified 16 shortcomings of the current support schemes in regard to the establishment and conservation of biotope network elements, including 11 priority deficiencies. In 8 cases the new support schemes provide some degree of a solution to the deficiencies, in the remaining 8 cases there is no solution or there is no information available if there is one. Of the deficiencies identified as high priority, 6 are addressed by the new schemes and 5 are not. It can be concluded that, in terms of the establishment and conservation of the biotope network, the measures of the planned support schemes can lead to improvements in half of the deficiencies. As regards priority deficiencies, 54.5% of cases could be improved by the planned support schemes.

In 8 cases the proposals made by us and the planned programmes together are directly linked to the creation or conservation of biotope networks and in 8 cases indirectly. If we consider only the measures linked to the 8 solutions of the proposed support programmes, 5 of these involve an indirect contribution and 3 a direct contribution. This shows that only 37.5 % of the measures under the planned aid schemes contribute directly to the creation and conservation of biotope networks which can be described as more purposeful.

5. Discussion and Conclusion

Our research has shown that the establishment of biotope networks can be one of the most effective responses to the climate and biodiversity crisis in agricultural-dominated landscapes. Nevertheless, the declining extent of biotope networks is a trend that is currently being detected. Based on a literature synthesis of the support schemes related to the previous budget period of the Rural Development Programme (2014-2020), we have identified the gaps that could be the trigger for this negative trend. The gaps have been compared with the most recent drafts and development programmes of the National CAP Strategy for the next budget period.

We have found that more than half of the rules that are particularly disadvantageous for the establishment and conservation of biotope networks are planned to be addressed in the development programmes of the next budget. Of the conservation programs, we would highlight the importance of expanding eligible areas of SAPS to include wooden strips and field margins and wetlands in areas with periodically inundated with water. Of the establishment programs, there are the provisions for new types of non-productive investment and the promising conditions of the eco-schemes programme, which will also support the maintenance of biotopes.

These are encouraging signs compared with similar reform efforts in recent years. However, more ambitious interventions would be needed to transform 10 % of agricultural land into high biodiversity landscapes if this is not only to be achieved by expanding the fallow land (which would be far from the most ideal solution). Important shortcomings remain unanswered, such as how ineffective greening measures - in terms of biodiversity - are planned to be corrected under the frames of 'conditionality'. This omission highlights one of the most important dilemmas: the separation of the optional from the compulsory, and the private from the public interest.

Can we entrust the fate of our birds or pollinating insects, which are linked to agricultural habitats, to the discretion of private landowners who farm more than half the country's agricultural land? If the answer to this question is yes, the fate of our beloved birds and insects will depend on the persuasiveness of the experts in the 'green' advisory network that we plan to set up in the coming years. But if we are not willing to trust only this, we still have a chance at the development of a well thought-out and efficient regulatory system, which does not excluding but including the farmers in the decision making process, so that the concept of “Greening” would finally be filled with the meaningfulness of increasing biodiversity and climate adaptation. This requires the development of decision-support methodological research based on the assessment of the ecosystem services provided by biotope network elements present in the agricultural-dominated landscape.

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