MAGYAR AGRÁR- ÉS ÉLETTUDOMÁNYI EGYETEM

Theses of Doctoral (PhD) Dissertation

IMPACT ANALYSIS OF LAND USE AND LAND PROTECTION POLICIES IN THE LIGHT OF AGRICULTURAL LAND TAKE

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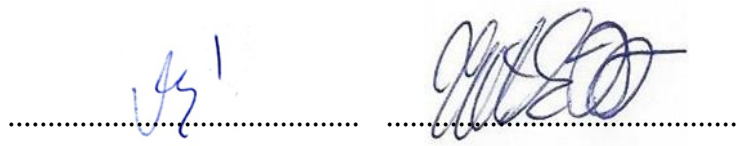
The candidate has fulfilled all the requirements of the Doctoral Regulations of the Hungarian University of Agricultural and Life Sciences, and has taken into account the comments and suggestions made in the workshop discussion of the thesis when revising it, therefore the thesis may be submitted for the defence procedure.



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1. Background and Objectives

The aim of the thesis is to examine existing EU and national policies on land use and soil protection, and in particular to analyse and evaluate the impact of soil cover regulation, one of the major threats of soil degradation, in the light of agricultural land withdrawals. After the regime change in Hungary, agri-environment has been one of the most dynamic areas of legislative development in the country to integrate sustainability requirements. The explosive growth in the scope and complexity of regulation has inevitably had the consequence that the enforcement of written law has lagged behind legal policy objectives, becoming soft law in some areas, and undermining the social prestige of environmental issues (Fodor, 2005). Although the assessment of the necessity, fairness and coherence of legislation - 'regulation of regulation' - is a prerequisite for modern public administration, it is only recently that the quality of legislation, in addition to its content and objectives, has come to the fore, particularly with regard to its effects (Futó, 2006). This is particularly true in the case of regulations concerning soil protection, where often the regulations themselves are not complete, and impact analysis of soil and land protection regulations is rare and scarce.

Based on the above, the objectives of the thesis can be summarised as follows:

I. To analyse the issue of land cover from both a legal and a scientific point of view, and to clarify the basic concepts (land cover, land abandonment, land use for other purposes, land reclamation), thus establishing a legal definition of land cover and laying the foundations for its incorporation into a new complex legal system at national and EU level.

II. Detailed evaluation and impact assessment of the three levels of regulation (EU-27, national, local) of land cover on agricultural land in relation to the qualitative and quantitative changes in agricultural land affected by land grabbing.

III. To develop proposals for the objectives and instruments of public regulation based on the conclusions of the new scientific findings.

2. Materials and Methods

2.1. Methodology for ex-post regulatory impact assessment

Ex-post impact assessment is crucial in the context of soil protection in order to identify its potential consequences for natural systems. At the same time, the literature also draws attention to the difference in the levels of decision-making (impact assessment subjects): the more direct and specific the intervention, the more specific the environmental impacts can be assessed. The more direct the environmental impact, the more difficult it is to assess, the more uncertainty there is, and the more consequences that are less likely to occur. The ex-post analysis of soil sealing legislation (a term used only in EU policies and absent from domestic legislation) covers the existing legislation described above, its actual effectiveness and impacts. In the course of the analysis, conclusions based on monitoring the evolution of the various environmental (land use) indicators applied (soil cover indicator, soil productivity index, relevant soil categories) led to conclusions and feedback in the form of de lege ferenda proposals. The analysis was based on the LANDSUPPT decision support system database presented above and conclusions were drawn using the DPSIR impact assessment model.

2.2. The DPSIR (Driving forces – Pressures – State – Impacts – Responses) model

Gabrielsen and Bosch (2003) further developed the so-called Driving Force-Pressure-State-Impact-Response (DPSIR) model, originally developed by the European Environment Agency, to assess the relationships between human activities and the environment, as applicable to soil conservation policy. The drive-load-state-impact-response cycle described in the model is in fact a complex causal network in which each factor affects all the others, and each process reinforces or weakens the others in its effects.

- D (driving force) - sectoral driving force: in our case, the processes (e.g. economic) that cause the pressure (land extraction and land cover)
- P (pressure): the impact of human activity (land cover) on soil functions
- S (state): the state of the soil in physical quantities, with measurable indicators
- I (impact): environmental, economic, social effects resulting from a changed environmental condition

- R (response): societal response to reduce environmental pressures or negative environmental impacts (policy, legal instruments)

2.3. Complex modelling of the land cover indicator of land use change

The development of a model to "measure" the legislation requires the rapid and accurate processing of a large amount of data to analyse ecological changes, assess soil impacts and classify the characteristics of the land covered, and complex models to assess and predict soil impacts (Mezősi, 1991). Geospatial decision support software was used to present the results in detail. In our study, CORINE land cover map data were compared with LANDSUPPORT land cover data. As the two databases cover different periods, we estimated the 2006-2015 land cover withdrawal by weighted average calculation based on the CORINE database layers (CORINE Land Cover Change C.H.A. 2006-2012 and CHA 2012-2018, 2020). Then, we compared the resulting value with the LANDSUPPORT 2006-2015 land cover data. The method developed by the LandSupport project provides more accurate information than the CORINE database. The system collects the available space maps on an annual basis, from which it then calculates the current biomass production. By applying specific vegetation indices, the appearance or disappearance of 'greenness' at a given spatial point or even over large areas, it is possible to track the land cover caused by building development. In the case of infrastructure developments, areas permanently taken out of agricultural production do not show the 'greenness' typical of the growing season for a longer period, so that these areas can be delimited and their size quantified. The first step is to set up a Region of Interest (ROI), using a boundary line of our own and the database of municipalities in the system. Once you have selected a municipality, you can carry out an analysis of the built-up areas within the area enclosed by its perimeter. Once the area has been selected, it is possible to specify the time interval for which the change analysis is to be run. In our study, we have carried out our analysis of the area under land cover for the period 2006-2015. The visualized result map of the area affected by change calculated on the basis of greenness can already provide a good basis for monitoring land cover, as it is easy to identify areas in red which indicate the loss of green areas, or areas that have been reclaimed by green cover, and areas in green which indicate areas that have been reclaimed by some kind of greening. In addition, a downloadable report in pdf format can be downloaded from the system, which, in addition to the area covered or released by greening, also takes into account soil productivity data, and provides a numerical estimate of the productivity of the lost areas, thus expressing quite precisely the loss of land cover due to the loss of soil as one of our most important natural resources. Based on these calculations, Figures 10 to 14 show the calculated production capacity losses due to land cover by land use and soil quality category. They allow us to better interpret and detect processes that

may call for the withdrawal of areas of higher soil productivity. To quantify and categorise soil fertility, the LandSupport application is based on the fertility map developed by Tóth et al. 2013. Since the LandSupport database also contains data on the quality of the covered soil, it is also possible to investigate to what extent the soil quality of the covered areas corresponds to the poorer categories expected under the set-aside rules. For the evaluation of the soils of the covered areas, the MÉM-NAK genetic soil map based on Kocsis et al, (2015) were used (Figure 2). The soil categories were obtained by converting the soil types. Our analysis was carried out to find out which soils were affected by the LandSupport 2006-2015 land cover based on the MÉM-NAK map. The analysis calculated the number of hectares of land covered by each soil category nationally based on the MÉM-NAK soil map and the soil categories covered.

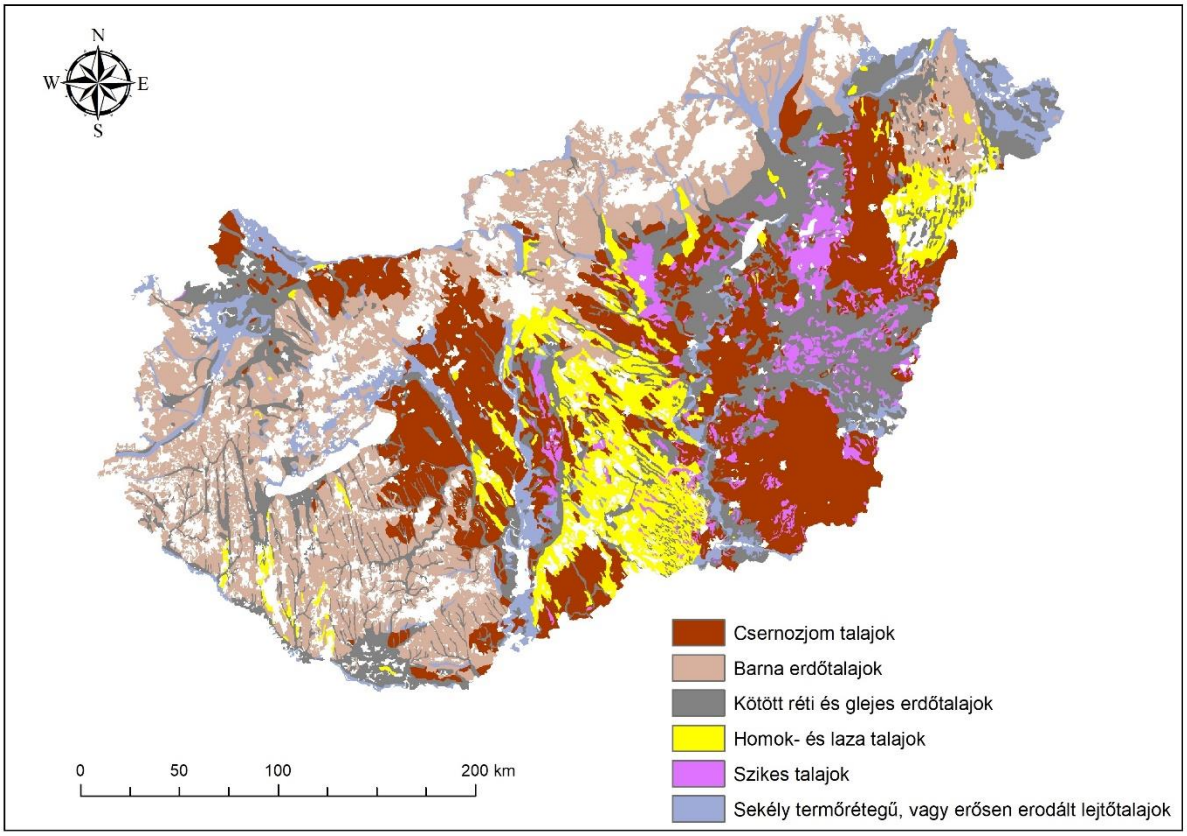
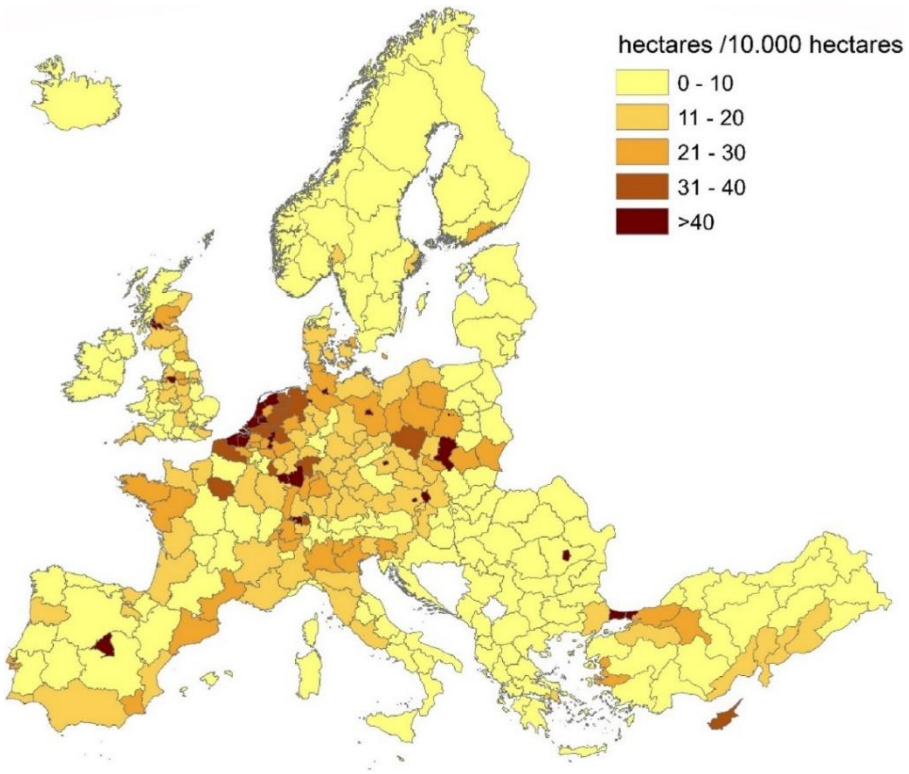


Figure 2: Soil category map derived from the MÉM-NAK soil map based on Kocsis et al, (2015) and NÉBIH (2022) (own editing)

3. Results

3.1. Results of the impact assessment of policies at EU level

Land cover is expressed per 10,000 hectares, as the NUTS2 regions have different areas. The total area covered during the period under study was 1 543 635 ha. The map clearly shows that the regions with the highest land cover are those with a high level of built-up areas. This is clearly linked to urbanisation processes and confirms our hypothesis that EU policy is not currently addressing land cover in a way commensurate with the scale of the problem. Based on our results, we calculated a 49% rate of soil cover on set-aside land. This means that 51% more land is affected by land take than the area covered by sealing.



9. Figure: Soil cover in Europe 2006-2015 at NUTS2 level per unit area (land cover ha / 10 000 ha) based on LANDSUPPORT H2020 project data (own editing)

3.2. Results of the impact analysis of the national legal instruments

Between 2006 and 2015, a total of 12,360 hectares of land was covered in Hungary, which is equivalent to the area of a medium-sized city (e.g. Zalaegerszeg has an area of 102 km2). The results of the research show that 45% of the land that was taken out of cultivation was covered. In principle, non-agricultural land use can be allowed on lower quality soils with the least possible land use, but as shown in Figure 3, even the highest quality soils are still being used for development. Hungary is using up its land resources for infrastructure investment and land development at an alarming rate and almost indiscriminately. Decision-makers do not pay enough attention to the ecological and biomass production importance of soil and do not take into account its finite nature.

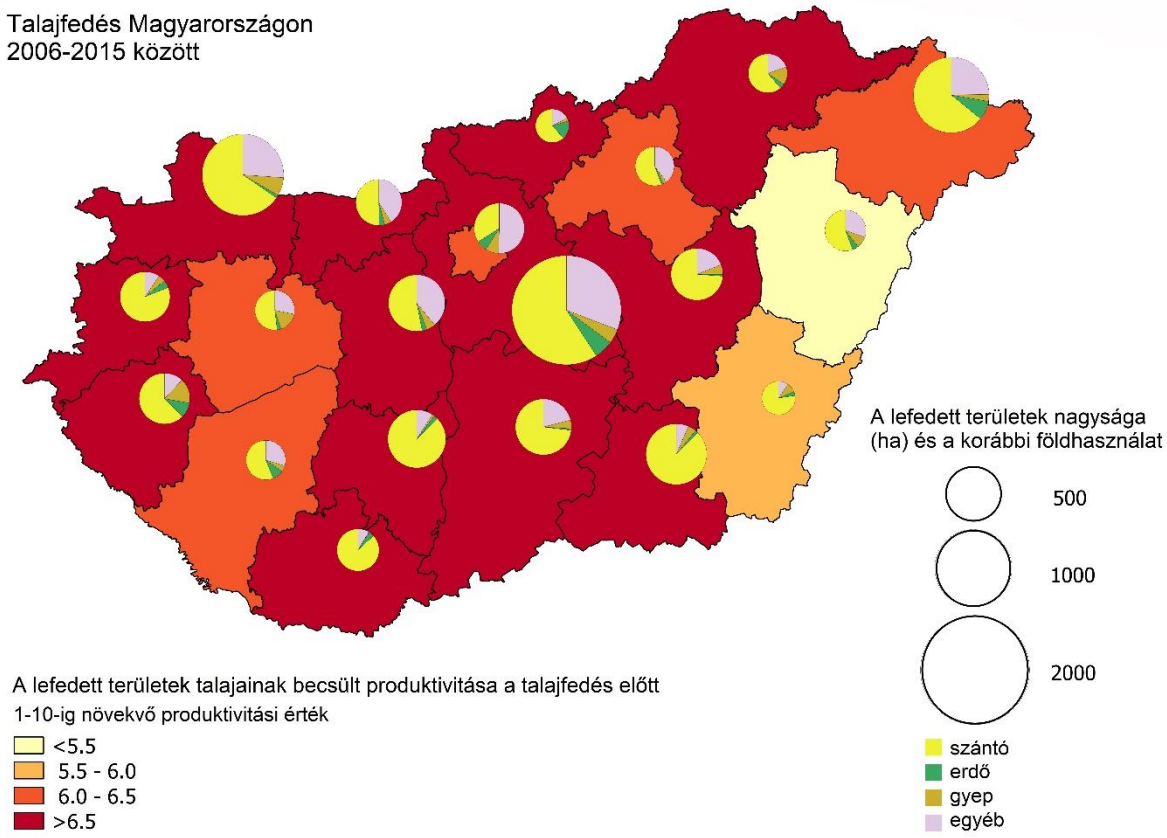


Figure 3: Soil cover in Hungary (2006-2015) based on LANDSUPPORT H2020 project data (own editing)

3.3. Results of the impact analysis of local level jurisprudence

In the local level impact analysis, we describe the changes in the seven municipalities of the Association of Pannonian Cities (Pápa, Keszthely, Kőszeg, Nagykanizsa, Tata, Veszprém, Zalaegerszeg). The studies show that the cities of the Pannonian Cities Association are adding between 0.1 and 8 hectares of land per year, which is unsustainable for most cities and does not seem justified in the context of a steady population decline. In the municipalities studied, an average of 5 to 10 m2 per inhabitant per 9 years is being built on. This is more favourable in the case of Kőszeg, where the value is 0.8 m2 per inhabitant, while Nagykanizsa faces a serious problem with a high land loss of 23 m2 per inhabitant in the period 2006-2015. For Keszthely, the most significant developments/investments affecting soil cover in the period 2006-2015 are the construction of a bypass road and the expansion of large supermarkets in the outskirts of the town. Both investments affected agricultural land. It is concluded that the regulation in the municipalities under study does not prevent the practice of subverting the public interest by incorporating the outskirts into the interior, thereby meeting the needs of non-agricultural use.

4. Drawing conclusions using the "DPSIR" system

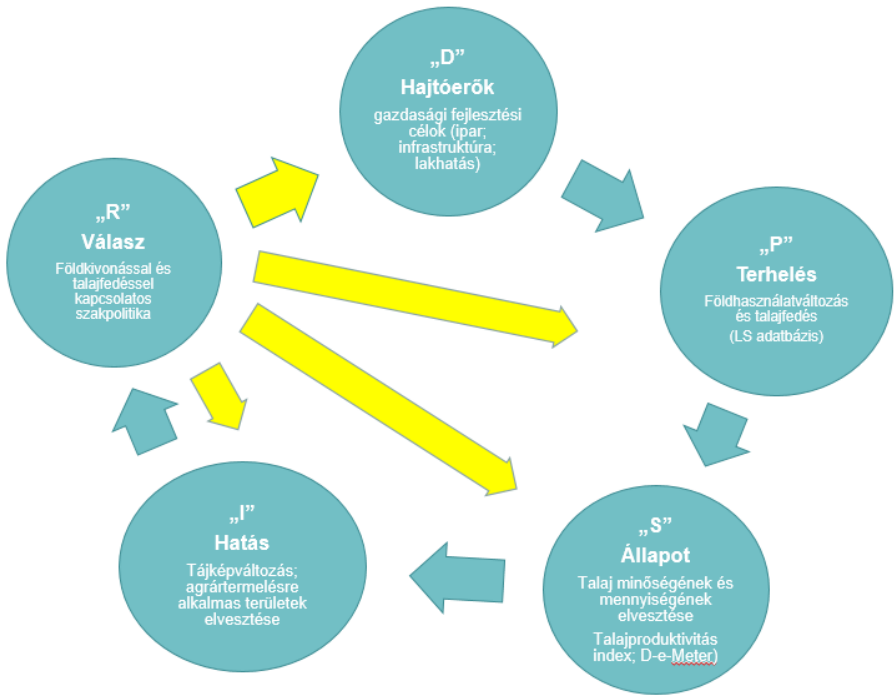


Figure 4: DPSIR approach (own editing)

Overall, EU soil policies contain a range of promising objectives, but concrete soil protection measures have not significantly improved the situation of soil degradation processes that threaten both the quantity and quality of soil (P-Pollution + S-Soil + I-Influence). Decision support systems can significantly support spatial planning if they are able to present and assess the consequences of existing spatial and sectoral policies and legislation on land use, based on a comparison of current and future land use, and to prepare scenarios for spatial and sectoral decisions by comparing the expected land use impacts (the differences in future land use patterns that can be expected for different decisions under different scenarios). In addition to the benefits of using decision support systems, there are also risks. These decision support systems may contain data at different scales (European/global; national; regional; local), which is dangerous in terms of land cover, because domestic soils are considered medium in EU terms. On the basis of a larger scale (e.g. European/global) soil quality index, the authorities could almost always authorise the extraction of soils of medium or poorer quality, while these soils could be considered good at national level and, where appropriate, excellent at municipal level. Therefore, in all cases, policies should be harmonised with the databases used. In conclusion, it is necessary and worthwhile to improve the quality and availability of databases and SDSS on land cover and agricultural land withdrawals.

In the relevant Hungarian legislation (R-Response), different legal instruments approach land protection with different regulatory approaches. The Tfvt., which describes the protection of agricultural land in detail, does not deal with the protection of urban land, industrial land and small gardens. It can be concluded that the provisions of the Soil Protection Act would provide an adequate basis for the protection of individual soil components and the soil as a whole, as well as its processes and its multifunctional function, but the same cannot be said of the Land Use Act. It is proposed de lege ferenda that land in quality classes I to III should not be used for any other purpose, thereby preventing the coverage of our good and high-quality soils.

5. New scientific results

1. **The introduction of the legal concept of soil cover as a soil degradation hazard and its complex uniform regulation within the framework of the Tfvt. is justified.**

Instead of the current fragmented regulation, a new regulation should be introduced, which would contain a single definition of the extent of cover and, together with the

permitted extent of other uses, the quality of the soil that can be covered, with more specific and precise parameters than at present (e.g. The concepts of set-aside, other use, land consolidation, incorporation and soil cover should be clarified and separated in the relevant provisions of the Land Use Ordinance. In addition to/instead of the legal category of 'buildability', the legal concept of 'soil seling' should be introduced. Proposal for a definition of soil sealing: the permanent covering of the surface of the soil with an impenetrable material, resulting in the destruction of the soil.

2. **As a result of the application of the evaluation and impact assessment of land use and soil protection policies at national and international level, it can be concluded that:**
    - The impact assessment of legislation is one of the most important tools available to improve the adequacy of soil protection policy and to inform the decision making of the legislator.
    - In Hungary, the use of legislative impact assessment in relation to soil cover is scarce. The LandSupport and DPSIR systems, which are under development and first used for impact assessment of land cover policy, represent new methodological approaches.
    - Increasing the relevance of impact assessments requires new methodological approaches, which can even provide quantified data to demonstrate the direction and extent of changes that have occurred

3. **Holistic modelling, which also aims at optimising the optimisation of new land use, could help to prevent land cover, but this requires the use of soil quality indicators based on new legislation in line with the latest scientific definitions of soil quality.**

As well as the benefits of using decision support systems, there are also risks. Decision support systems can contain data at different scales (European/global; national; regional; local). Decision support models that are too large in scale are not harmonised with local relative soil quality values. Therefore, in all cases, policies should be harmonised with the databases used. In conclusion, it is necessary and worthwhile to improve the quality and availability of more precise databases and DSSs on land cover and agricultural land withdrawals at local level. Without this, the negative trends in land cover may even be exacerbated by the use of different decision support models.

4. **The investigations carried out have shown that there is a dangerous trend in EU and national land extraction and land cover practices, and the following results have been obtained for the areas under investigation:**

- For the EU-27, a 49% set-aside rate was calculated for the period 2006-2015, covering a total of 1 543 635 ha. Based on the results of this research, we found that recent policy measures have not improved the quantity and quality of agricultural soils. The quantitative analyses show an ecologically negative trend. There is a need to establish a uniform soil monitoring system for soil cover, which would allow continuous monitoring of the quantitative and qualitative state of the soil and, on the basis of the knowledge gained, to identify the most important actions for soil management and further specific soil protection interventions.
- In the national context, the impact analysis shows that 45% of the areas withdrawn from cultivation were covered between 2006 and 2015, which affects a total of 12.360 ha, corresponding to the area of a medium-sized city (e.g. Zalaegerszeg 102 km2). A significant part of the country is cultivated as arable land, and therefore the analysed withdrawals from cultivation affect arable land the most. In principle, non-agricultural land use can be allowed on lower quality arable land with the minimum possible use of arable land, but research has shown that even the highest quality soils are still being lost to development. Hungary is wasting its land resources at an alarming rate and almost indiscriminately, when infrastructure investments and urban development do not take into account its ecological, biomass production and water-holding importance. At this level, regulation is failing to protect the quantity and quality of land in terms of soil cover.
- In the case of the Association of Pannonian Cities, studies show that between 0.1 and 8 hectares of land are being incorporated each year, which is not a sustainable rate and is not justified in the context of a continuing population decline. The policy impact assessment at local level shows that there is still a lack of effective regulation to encourage land use efficiency from an ecological point of view. Typically, ploughland of above average quality has been withdrawn. It is particularly worrying that the use of land has been mainly for greenfield development of industrial, commercial and infrastructure facilities, often instead of brownfield investment, which is a good alternative. When the administrative authority gives priority to any other use of land over its role as a food-producing land, it destroys its capacity to provide soil functions, as it can no longer become arable land in the future.

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