THESES OF PHD DISSERTATION

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IMPACTS OF THE DEVELOPMENT OF ROAD INFRASTRUCTURE ONTHE LANDSCAPE. APPLICATION OF LANDSCAPE PROTECTION PRINCIPLES IN MOTORWAY PLANNING.

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1. HISTORY, OBJECTIVES

The development of road infrastructure has been significant in recent decades and is expected in the future based on the current National Spatial Plan, so the integration of roads into landscape is a current landscape architectural task. From the perspective of landscape protection, it is important to highlight the European Landscape Convention, which was ratified by Hungary in 2007, thereby undertaking „integration landscape into policies with possible direct or indirect impact on landscape", so that into transport policies. In this context, one of the objectives of the National Landscape Strategy (2017-2026) is to realize the „infrastructures fitting into landscape".

The main goal of this research is to assess the enforceability of landscape protection in road planning processes. This work is an overall research summarizing the legal and planning framework of road development in Hungary, landscape aspects and tasks in connection with road infrastructure planning, and the impacts of road network development between 2006 and 2017 to landscape. Moreover, it evaluates the enforcement of landscape protection aspects in the planning processes based on case studies. The research addresses the following research questions.

Overall questions, groups of questions:

- **Q1.** What are the specific landscape protection requirements for road planning tools? Which planning tool (s) is (are) suitable for enforcing landscape protection principles in the current planning system?
- **Q2.** Which landscape protection principles are particularly important to consider during road planning processes? What are the possibilities of fitting roads into landscape and how can they be realized in the current planning system?
- **Q3.** Which impacts on the landscape are considered in the planning processes and which are not, or only peripherally? Which impacts can be mitigated, with which measures and which cannot? What kind of monitoring activities take place during and after road constructions? How can the results of monitoring activities influence the subsequent planning processes?
- **Q4.** As an impact of the road development implemented in the period between 2006 and 2017, how has the endangerment of the protected areas changed?
- **Q5.** How has the roadside land cover changed and what further changes can be expected related to the built-up areas surrounding roads?

Question on case studies:

- **Q6.** What are the key barriers or key driving forces to increasing the influence of landscape protection in motorway planning?

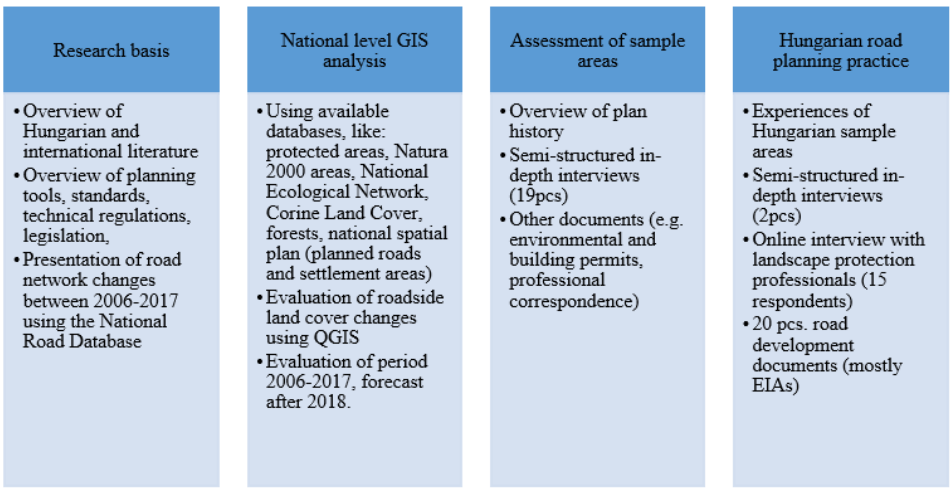
2. MATERIAL AND METHODS

Based on the relevant Hungarian and international literature, the impacts of road infrastructure on the landscape, the landscape protection principles and the possibilities of integrating roads into the landscape are summarized. Legislation, standards, technical regulations in connection with Hungarian planning tools are outlined, and some important changes of legislation are also highlighted. The material of my research is the main road and motorway network built in the period 2006-2017. The research can be divided into three well-separable, yet related topics, which are the followings:

- a national level analysis on the impacts of implemented road network development on the landscape has been performed using GIS tools and the available databases (it can be interpreted as a national level monitoring activity), and the main changes of the impacts have been forecasted based on the National Spatial Plan in force;
- analysing motorway planning, key issues and barriers of landscape protection principles' enforcement have been identified based on three motorway sample areas (two Hungarian: M7, M30; and one Swedish: E6);
- the Hungarian road planning practice have been evaluated focusing on the enforcement of landscape protection aspects.

The methods used in the research include standard methods such as literature analysis, summary of legal frameworks, GIS analysis, online interviews, and analysis of plans (see the figure below). In this research, however, I used semi-structured in-depth-interviews, which have not been used in Hungarian landscape architecture research before. The focus of the sample area analysis was on the planning process itself, the identification of conflicts between stakeholders and their resolution possibilities, as well as the factors influencing the enforceability of landscape protection aspects, which is also a novel research approach.

Overview of the methodology used in the research



3. SCIENTIFIC RESULTS

The formulation of the new scientific results is based on the legal framework and planning tools (Thesis 1), landscape protection principles and possibilities of fitting roads into landscape (Theses 2-3), national GIS analysis (Theses 4-7), assessment of sample areas (Theses 8-9), and the evaluation of the Hungarian planning practice (These 10-11).

Thesis 1.

The content requirement of landscape protection parts in planning tools related to roads are inhomogeneous and insufficient. Specified requirements are only laid down on documents to be submitted for environmental authorization.

Based on the overview of legal framework and planning tools, I have summarized the content requirements for the landscape protection parts for each planning tool related to roads. I found that the enforcement of consistently overlapping landscape protection aspects is impeded.

Thesis 2.

In case the technical and landscape protection requirements are met, the planned route of the road should affect the least amount of cultural and natural landscape values, should not endanger the existing ecological relations and should adapt to the existing or planned land uses, green space systems, hydrographic and terrain conditions. Thereby it prevents the potential land use conflicts in the future. Planning not only takes the impacts caused by the actual building phase into consideration, but also the potential long-term land use alterations caused by the existence of the road itself. The roads' immediate surroundings should be landscape designed: with appropriate planting, necessary environmental facilities and restoration of destroyed surfaces and unused infrastructure elements.

Based on international directives, conventions, strategies; Hungarian strategies, programmes, concepts, plans and the relevant literature, I have summarized the main landscape protection principles which are needed to consider during road planning. Based on these principles, I have formulated a target state for the roadside landscape, which would be a basic requirement for fitting the road into the landscape properly.

Thesis 3.

Only the road planning process, which integrates landscape protection aspects, and the conscious planning of surrounding land uses can together ensure the proper integration of the road into the landscape. An important aspect of the road planning process is the active involvement of local communities and stakeholders to the decision-making and planning processes.

Based on the landscape principles and literature review, I have summarized the main tools of fitting the road into the landscape. One of the main findings is the determination of key steps for fitting roads into the landscape: searching for conflict-poor corridor, then the selection and design of road within this corridor, at the same time with conscious (spatial) planning of the roadside land uses to prevent future land use conflicts. The involvement of local communities is also required by several international conventions, not only providing relevant information, but the active involvement of the public to the decision making, planning processes.

Thesis 4.

The land cover in the 2000 m wide environment of the road network built until 2017 (which is 6,3% of the area of Hungary in case of motorways, while 26,7% in case of main roads) peculiarly varies from the national average. The new routes of motorways were built on flat plough lands, while main roads were leaded near settlement fringes. In the last 30 years the land cover changed characteristically, which represents the impacts of road network on the landscape, like the increase of built-up areas and abandoned agricultural areas near roadside landscape.

I have found that the extent of forest areas near roads is less than the national average and the proportion of built-up areas is twice as much as the national extent. Until 2017, motorways were built in arable-dominant landscapes, and the main roads run more mosaic landscapes than the national average. Based on the evaluation of land cover changes between 1990 and 2018, I have found that the increase of industrial or commercial areas near motorways is four times greater in proportion than the national average (especially near the junctions), while near main road network the increase is twice as much as the national growth. The decrease of arable lands and vineyards, as well as the growth of forest areas is slightly faster than the national average near road network, for all examined road categories. In case of orchards, despite the national increase, along the motorways a significant decrease, and near main roads a less moderate increase below national average can be observed.

Thesis 5.

Spatial planning contributes to higher proportion of built-up areas along the road network. However, based on the current land cover the maximum built-in potential of urban areas in National Spatial Plan is similar along the road network and nationwide, the designated proportion of urban areas along the road network is several times higher than the national average. The possibility of this significant built-up potential leading to future land use conflicts cannot be precisely determined.

Based on the current land cover, I have determined the maximum built-in potential of the urban areas designated in National Spatial Plan, using GIS methods. Nationwide it is 46%, in the 2000 m wide environment of motorways it is 50%, while alongside main roads it is 44%, which means significant differences cannot be observed. In contrast, the extent of urban areas near motorways is almost three times bigger, while in case of main road network this rate is twice as much as the national average.

Thesis 6.

Between 2006 and 2017 the forest area increased in the 200 m wide environment of road network, due to consequences of the green space elements' conscious planning in spite of forest land utilization caused by road constructions.

Between 2006 and 2017 in the 200 m wide environment of the examined road network the extent of forest area has increased, based on the analysis using GIS methods. Near motorways 2% increase occurred, while near main roads the increase was 1%. Alongside road network the growth of forest areas for primarily protection purposes has been significant (19% near motorways, 9% near main roads), which can be seen as a result of conscious planning of transport green spaces, because most of the forest areas' function is soil or artefact protection.

This increase occurred despite the occupation of forest areas because of the building of road network elements, which can be observed between 2006 and 2017 based on the decrease of average forest area per 1 km road length. I have also found that the average size of forest area has been decreased alongside road network, which shows that forest areas were fragmented.

Thesis 7.

Between 2006 and 2017, the planning system could enforce the protection of Natura 2000 areas, national ecological network elements and protected natural areas more and more successfully against road development, however the negative impacts to national ecological network and Natura 2000 sites is expected to increase significantly after 2018.

Based on GIS methods I have found that the direct harming of protected natural areas is not typical in case of planning new roads. In the 200 m wide environment of the examined road network, road-natural area fringe conflicts are common, which increase in parallel with the growth of the road network. In addition, the average size of conflict areas per 1 km long road section decreased (in the period 2006-2017) and is expected to decrease in the future (after 2018) both near motorways and main roads.

The national ecological network and Natura 2000 sites have changed a lot since their (original) designation, both in terms of territorial scope and in case of the ecological network, during reclassification among the categories. I have found that despite of the continuous changing, the average size of conflict areas per 1 km long road section has been decreased overall, both near motorways and main roads. However, the expected conflict areas of the planned roads in the current National Spatial Plan will significantly increase, harming the national ecological network and Natura 2000 sites.

Thesis 8.

The enforceability of landscape protection aspects in road planning processes depends a lot on the success of the prioritization of landscape-related values and the personal relationships of professionals participating in planning, authorization and construction processes.

Based on the findings of planning processes related to sample areas and the detailed analysis of certain focus topics, one of the main conclusion is that the importance of personal relationships should not be underestimated in planning, permitting, construction processes, which also influence the enforceability of landscape protection aspects. This finding emphasizes the existence of informal strategies regarding rules which also may point out gaps in legislation.

Another key factor of the integration of landscape protection aspects into motorway planning processes is the appropriate prioritization of landscape-related values because harming landscape-related values (natural or cultural) is expected in any cases (e.g. due to significant occupation of areas). I found that in Hungarian planning practice, currently mainly protected natural areas and ‘ex lege’ (by law) protected values, Natura 2000 areas and forests are avoided if possible with the route of a new road.

Thesis 9.

The current Hungarian road planning practice does not offer enough space for the meaningful involvement of local residents into the decision-making and planning processes, like the choice of the road corridor. The methodology and practice of active involvement is also absent, the existing public participation process is mainly about informing the residents.

In accordance with the European Landscape Convention and Aarhus Convention public involvement and the provision of participatory procedures are important in the planning process of a new motorway, as it has a great impact on the lives of the local residents and thus on land use. Based on the analysis of sample areas, I have found that the methodology of active involvement is absent in the planning practice. The involvement of local residents into the corridor choice process does not take place directly, but through the mediation of the local municipalities. After the choice of the corridor, the first direct involvement of the public occurs in the public hearings during the environmental impact assessment phase, but this often no longer leaves room for meaningful input into the planning processes (decision-making), as the chosen route is typically decided by then. The public hearing is of a consultative nature and in some cases not all stakeholders are informed about it, so it does not completely fulfil its informative purpose.

Thesis 10.

Even though preliminary estimation of the impact of road network developments on landscape is a common practice, the follow-up is often missing, therefore the long-term impacts on land potential remain unknown.

Based on the analysis of the Hungarian planning system (sample areas, documents and online interviews), I have found that in accordance with legal regulations, the planning practice examines the direct changes of land use, landscape structure and landscape scenery that occur as a result of road development. After the construction of a new road, the follow-up activities of the roadside landscape are absent in terms of long-term indirect changes in land use, landscape structure and landscape scenery, so the long-term impacts on land potential remain unknown.

Thesis 11.

The enforceability of landscape protection principles is impeded in the current planning practice, especially during the choice of road corridor which is dominated by technical and economical aspects. Landscape protection aspects can be integrated on a local level in the phases of environmental impact assessments, detailed design and construction plans. The available amount of space is a significant limiting factor to realise the landscape protective proposals.

The choice of the road corridor is the most important tool for fitting the road into the landscape properly, if the landscape protection aspects can be integrated to the selection process. Based on the analysis of the Hungarian planning system (sample areas, documents and online interviews), I have found that the choice is often decided in the feasibility study phase. However, in this planning phase the enforceability of landscape protection aspects is basically limited to the identification of exclusion factors (e.g. significant territorial impact of protected natural areas), the choice of road corridor procedure is dominated by technical and economical aspects. In the later planning phases, minor corrections of the road line are conceivable due to possible conflicts during a more detailed examination of the roadside landscape, but no significant changes typically occur.

In the current planning practice, the environmental impact assessment (EIA) is a planning tool that examines the landscape features and values in the most detail, so it has an important role to play in terms of the enforceability of the landscape protection aspects. However, the EIA usually examines only one, or maximum two corridors, so that the enforceability of landscape protection principles can be influenced primarily on the local level by defining mitigation measures. Mitigation measures can be well enforced in further planning if they are included in the environmental permit as regulations. Detailed design and construction plans can also contribute to fitting road into the landscape properly, by designing the roadside planting or environmental facilities. However, a significant limiting factor for planning is the extent of the available area set by the expropriation boundary.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of this research are consistent with the main findings of the Hungarian and international literature in connection with e.g. planning tools, planning process, changes of roadside land uses and involvement of the public to decision making processes. Minor differences can be discovered between the theses and the pre-defined hypotheses, furthermore the results of this research offer significant additions to the hypotheses.

Suggestions are made for the practical applicability of the results and for more effective enforcement of landscape protection aspects in road planning processes, such as development of professional guides, creation of databases, modification in planning and permitting processes, and changes in legislation. In addition, due to the limiting factors of this research, I have identified other possible research directions. The most important recommendations are the followings:

- A complex landscape assessment part integrated in the project-level planning tools should precede the environmental impact assessment phase which is suitable for comparing the corridor alternatives and formulating proposals for their modification if necessary.
- A minimum percentage of the entry cost of a given project should be stipulated in legislation which must be spent on the landscape and environmental protection facilities of the road, including the provision of area required for planting and implementing the facilities. In addition, a minimum size of the area intended for planting is also proposed to specify in legislation. (The exact size should depend on road category.)
- The active involvement of the public need to be strengthen, in line with the European Landscape Convention and the Aarhus Convention, as stakeholders are currently informed in a passive way, often not completely. Strengthening the active involvement of the local population and farmers also requires a methodological foundation, as road planning practice now lacks it in this form, and it would be important to provide more type of platforms on which this could take place (e.g. exhibitions, information evenings).
- Professional methodological guide need to be prepared with formulation of proposals for planning tools, with special emphasis on the unification of the landscape protection part of the environmental impact assessment.
- A common database should be created including all the results of monitoring activities carried out in practice, with evaluation of the results, providing access for professionals involved in road planning processes. In addition, the monitoring of the impacts on landscape should be observed in long-term studies, beyond of the framework of this research.

5. THE AUTORS'S PUBLICATIONS RELATED TO THE TOPIC

Journal articles

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Szilvia Mészáros, Attila Gergely, Zsuzsanna Illyés (2018): Assessment of Landscape Conflicts in Motorway Planning, NE Hungary. *Journal of Environmental Geography*. Volume 11: Issue 1-2. pp. 27-36. Online ISSN: 2060-467X

Szilvia Mészáros (2017): Landscape Aspects of Sustainable Road Development. *Acta Scientiarum Transylvanica. Múzeumi Füzetek. Agronomia*. pp.21-39.

Conference proceedings, full paper

Mészáros Szilvia (2019): 2006-2017 közötti közúti fejlesztések és táji hatásaik. *In*: Fazekas I., Lázár I. (szerk.): *Tájak működése és arculata*. MTA DTB Földtudományi Szakbizottság. Debrecen. pp.121-127. ISBN: 978-963-7064-39-5

Mészáros Szilvia, Illyés Zsuzsanna, Gergely Attila, Módosné Bugyi Ildikó, Szappanos Márton, Gaál Kinga (2017): Az M30 autópálya Miskolc-Tornyosnémeti szakasz tervezésének tájvédelmi vonatkozásai. *In:* Blanka V., Ladányi Zs. (szerk.): *Interdiszciplináris tájkutatás a XXI. században. VII. Magyar Tájökológiai Konferencia tanulmányai*. U-GEO Alapítvány és Szegedi Tudományegyetem Földrajzi és Földtudományi Intézet. Szeged. 2017. május 25-27. pp. 425-435. ISBN 978-963-306-542-6

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Conference proceedings, abstract

Mészáros Szilvia, Gergely Attila (2016): Útfejlesztés táji hatásai hazai mintaterületeken. *In*: Horváth Gergely (szerk.): Tájhasználat és tájvédelem – kihívások és lehetőségek. *A Budapesten 2015. május 21-23. között megrendezett VI. Magyar Tájökológiai Konferencia előadásainak kivonatai.* p. 63. ELTE, Környezet-és Tájföldrajzi Tanszék. Budapest. ISBN 978-963-284-779-5

Mészáros Szilvia, Gergely Attila, Szappanos Márton (2016): Az M4 autópálya Püspökladány-Berettyóújfalu között tervezett szakaszának környezeti hatástanulmánya – táj-és élővilágvédelmi vonatkozások. *In*: Tóth Mihály et al. (szerk): *Vonalas létesítmények és élővilág: Kapcsolatok, megoldások, monitoring. Vonalas létesítmények IENE Műhelytalálkozó*, Dr. Puky Miklós emlékkonferencia. Program és összefoglalók. pp. 33-34. Budapest.

Mészáros Szilvia (2015): Landscape aspects of sustainable road development. / A fenntartható útfejlesztés tájvédelmi szempontjai. *In*: Fazakas Csaba – Benedek Klára (szerk.): *3. Erdélyi Kertész és Tájépítész Konferencia. Absztrakt kötet.* Sapientia EMTE, Műszaki és Humántudományok Kar, Marosvásárhely. pp. 63-64.