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THE EXAMINATION OF INDUSTRIAL LANDSCAPE LOAD IN THE DISTRICT OF KOMÁROM, WITH GIS METHODS

The theses of the PhD dissertation
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Introduction

Industrial activities have been determinative and significant factors in Europe for at least one hundred and fifty years. Industrial projects are present in the landscape in a significant way and, deriving from their position, they often form immediate parts of it. With respect to their appearance, they can be found in the landscape as patches, points and lines. They often not only significantly load the environment, but also strongly affect the landscape, landscape aesthetics, that is, the entire landscape balance. Moreover, certain industrial functions, in some regions, may significantly alter the landscape as a result of their after-effects. In view of all these factors, it seems important to be familiar with the strength of industrial loads in a given landscape as well as its rate of occurrence for different landscape details, with regard to future industrial developments in industrial areas. This especially holds true of the Komárom district, situated right by the Danube, and chosen as the sample district of our research. The immediate environment of the Danube has an important natural, economic, and cultural value, the preservation of which should be a major concern. The upper reaches of the Danube north of Budapest have been the most densely populated and most intensively exploited part, which has also played an important part in the industrial-agrarian landscape forming since the middle of the 19th century. Earlier, industrial projects had ignored environmental effects, which has resulted in accumulative problems in the landscape up to the present. Processes starting in the wake of the change of the political system have also affected this district, therefore the negative consequences of the change, in industrial structure and functions, are also present here. Consequently, the change in the industrial spatial structure with regard to landscape, holds a number of questions to answer.

The effect of industrial activity on the landscape in the sample district has been examined since the 1980s, and the growing number of problems became the focus of attention already then. After the change of the political system, the ends and means of scientific research have also changed due to the appearance of modern concepts of environmental protection. As a result, the most important industrial problems of this region have presented themselves from a different angle, though only to a limited degree. The extent of industrial development and industrial land-use conflicts have not been examined from a geographical (GIS) point of view, therefore the present doctoral research intends to fill the gap in the scientific study of both the region and the topic. The applied methods of assessment also form an important part of our achievements.
Research aims

The primary aim of our investigation was to explore landscape problems caused by industrial activities in the sample district, and to make them displayable with quantifiable methods of geoinformatics. These landscape problems were defined from the point of view of industrial landscape sensitivity, industrial landscape load, industrial effect and potential industry-induced land-use conflicts. Our main goal was to achieve that the new procedures should function on a scale larger than the earlier methods of environmental protection used with projects. Our intention was, on the one hand, to make a geographical database which can be continuously updated, expanded, and used to make various decisions on area planning and development. On the other hand, we aimed at making the industry-induced land-use conflicts in the sample district presentable by using methods based on the database as well as the geoinformatics models made presentable by the latter. It was also our concern to make concrete proposals for area development with regard to the suitability of the sample district for industrial projects.

In order to achieve these goals and answer the questions, we had to start out from the hypothesis that the effect of industrial activities on the landscape should be examined within their complex geographical context and not in themselves (e.g. on the level of a project). This is explained by the fact that landscape effects (depending on their direction and strength) can be deposited and they can strengthen each other. Besides, the effects point beyond the expansion of the landscape projects of industry and, are related to or, are in conflict with the systems forming the land, or the ones needed for the functioning of the landscape.

Theses and results

1) The definition of a system of geographical terms to be used in environmental protection and, also suitable for defining the accumulative effect of industry on both the landscape and the environment. Their use in practice is new as there has not yet been such an approach in landscape researches using GIS methods for representation.

- Industrial landscape load: The sum of the negative effects of an industrial project on the landscape.
- Industrial effects: The size of the landscape’s industrial load brought on by the loading effect of several industrial projects on the landscape in a given region.
- **Sensitivity to industry**: The appearance of landscape components in space, necessary for the optimal functioning of landscapes and, which are sensitive to industrial effects.

- **Conflicts in the industrial use of the landscape**: The clash of landscape components in the environment, sensitive to industrial effects, and the state of being influenced resulting from industrial functions.

2) **The field survey of industrial projects in the landscape of the sample district, and making field-survey sheets for it.** The survey and assessment of the field condition of industrial projects play an important part in the process of making indices. Certain environmental -- especially landscape -- effects could be defined only by field surveys and inspections. The field phases of work not only helped the spatial identification of projects, but also the harmonization of information on activities coming from different sources of data. The methodology necessary for this was also created during the research, with which all the patch-like industrial projects of the examined area could be surveyed. Therefore, it can be regarded as a necessary phase of our work. *It can be stated that an environmental and landscape survey of industrial projects provides a full and complex picture only together with their effect on the landscape’s character, which can be observed and registered only in the field.*

3) **Making an independent digital and cartographic database for the sample district.** For this purpose, we had to look at the available sources of data and establish methods of data collection from them, because the effects of industrial projects can be modelled only with an exact database suited to the topic in its details. The creation of a digital cartographic database is an important research methodological result since there has been no database in Hungary which could be used in the examination of industrial landscape load. 211 spotlike and 470 linear projects of 470km total length were identified in the geoinformatics sample database containing the spatial and descriptive data of industrial projects. This is a very important result also from the point of view of the geographical exploration of the sample district. Not only cartographic information from the different applied databases, but numerous data describing the environmental condition were made use of.

4) **The definition of industrial landscape load on the level of projects by using the so-called empirical effect matrix and, based on its result, the definition of the industrial landscape load index.** The creation of the methodology of empirical assessment was based on the numerical definition of the order of the strength of landscape effects. The empirical matrix made the standardization of data coming from various sources or, of varying
structure and measuring scale, as well as the numerical definition of effects, possible. Taking all these into consideration, it can be stated that introducing industrial landscape load on the level of projects, its spatial analysis, as well as the analysis of its sectoral and regional differences, appear as one of the most important research results forming the basis of further spatial models. The index of industrial landscape load not only indicates the order of environmental load, but may also provide new aspects of the examination of industry-related settlement development.

5) The definition of the index of industrial influence. This index was created by arranging the various landscape load features of industrial projects (parameters of density of patches, area use, fragmentation, and landscape load) on the same scale, and by adding them up using operations of GIS afterwards, in relation to the 1X1 km side-length matrix of the sample district. The creation of the cell-level model of industrial influence is a research result defining the extent of the transformation of certain units of the sample district by industry. It can be stated that the examination of industrial effects points beyond the usual environmental protection practice if the strength of effects is defined in such a way that it can be added up on a regional level. The complex methodology used to examine problems is an important achievement as compared to procedures used so far, because pointing beyond the project-level approach, it models the various effects of industrial activities by concentrating on the landscape and the network of environmental elements.

6) Modelling landscape sensitivity to industrial effects. Modelling industrial load and influence in itself would have meant defining only the side of load, therefore it was necessary to define constituent forms of the landscape which both tolerate and are sensitive to industrial effects. The definition of industrial sensitivity can be represented on a map in the examined area, which was made possible by using the cartographic model created from the environmental and landscape categories sensitive to industrial effects. A high-resolution (100mx100m) sensitivity map was also drawn up, by the generalization of which a sensitivity model of the matrix of the sample district was created on the basis of categories defined in advance. The creation of a 1 square km landscape-scale cartographic model was necessary in order to identify the industry-induced conflicts of landscape use. The numerical cartographic definition of sensitivity to industrial effects is an important partial result which is suitable in itself to introduce new aspects of examination for environmental protection and area development.
7) The cartographic model of potential industry-induced conflicts of landscape use was created in comparison to industrial influence and sensitivity, which reflects the features of spatial structure of the two (e.g. their concentrations). The essence of the method lies in the fact that areas of both high and critically high sensitivity and influence should reflect the largest industrial conflicts (they make up 6% of the sample district). Taking these into consideration, we can state that the largest industrial conflicts can be found in Almásfüzitő, which necessitate both local and regional intervention. Apart from this, several important industrial land-use conflicts can be demonstrated by this model, which are shown in figure 1. Industrial conflicts can be categorized according to strength and importance, therefore the cartographic model is suitable for making proposals for area development, environmental protection and loss adjustment. On the basis of the above-said we can conclude that the cartographic representation of industrial land-use conflicts is the most important new scholarly achievement with regard to the treatment of industrial problems by the science of landscape.

![Figure 1: The spatial model of industrial land-use conflicts](image)

1) border of the studied area; 2) administrative borders of settlements; 3) border of the country; 4) flows; 5) large surfaces of water; 6) inner areas of settlements;
N) Non-assessible conflicts, 0) Identification of non-justified conflicts;
I) Low-, II) Moderate-, III) Medium-, IV) High-, V) Critical-scale industrial land-use conflicts
8) A further remaking of the conflict method made it possible to define *the more and less suitable areas for a new industrial landscape use from the point of view of the landscape*. In areas with environmentally heightened sensitivity and bereft of industrial effects so far, it would be best to carry out area development suited to optimal landscape use by concentrating, first of all, on ecological aspects. Areas bereft of mapped industrial functions can be well fitted into this kind of development. In these areas, it would be justified to carry out landscape rehabilitation with a focus on nature. In areas with strong industrial influence but without industrial activities, after stopping harmful effects and rehabilitating them, new industrial functions may as well be started. On the basis of the aptitude test it can be stated that there are plenty of areas in this district (11% of the sample district, figure 2.) where planting completely new industrial projects would not meet with difficulties. The usefulness of this research in practice is underscored by the fact that these results provide practical advice for the landscape-focused treatment of future area development and environmental protection.

Figure 2: Proposals for the development of industry in the examined area
1) border of the studied area; 2) administrative borders of settlements; 3) border of the country; 4) flows; 5) large surfaces of water; 6) inner areas of settlements;
(A) Encouraging industry-free, close-to nature landscape farming;
(B1) Only industrial landscape rehabilitation is recommended;
(B2) Expansion within the premises at most;
(B3) Small and low landscape loading projects are recommended;
(C1) Low landscape loading and agro-industrial projects are also recommended;
(C2) To be recommended for a new industrial project.
Summary

The research aims of this paper were defined as the grouping of industrial projects, the categorization of their effects on the landscape environment, the disclosure of their conflicts, and the creation of spatial models from them. The created methods and the achieved results indicate an important step in the treatment of practical problems by the science of landscape, arising in industrial landscape use.

The sample district has proved to be a good choice from the point of view of the examination of industrial effects since here, the industrial and industry-like constituent elements of the landscape are especially varied regarding their functions and spatial appearance. It can be stated that within the Komárom district, more than 200 industrial and industry-like projects could be identified on a map (in 2016), which directly affected the landscape environment. The GIS database makes representation on large-scale maps as well as the accurate identification of loads possible. The cell-level cartographic representation of the results is suitable for the medium-scale presentation of spatial models.

The functional grouping of industrial projects and their order of landscape load shows the environmental and landscape side of industrial activities, therefore it can well supply the frequently used economic and statistical classifications. The research methods can be further developed in the landscape-focused strategic examination of industrial landscapes and degraded areas. Moreover, a landscape database of industrial projects in Hungary not examined so far, could be created by including new sample districts for research, in order to create a complete industrial landscape load matrix. Maps can be drawn up from the spatial models for making plans, which could be used not only in demonstration, but could also mean the practical solution to questions. Backing up environmental examinations with spatial models would greatly contribute to the adoption of a geographical approach and methodology in the practice of effect examination. It is important to explore these localities in order that future developments could be carried out in an optimal way, that is, by taking landscape effects into consideration. Economic factors are, of course, very important with any economic development, but the role of landscape should be focused on to a larger degree, at least to the degree as stated in the European Landscape Agreement and National Landscape Strategy.
Publications related to theses


