Examination of Eco-environmental Relations of Urban Areas

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***Abstract*—The main reason for the examination was to clarify the interactions between urban areas and its surroundings. To reveal the conflicts in urban areas measurements were made around urban and semi-urban areas considering air, water and soil status. The protection of the urban green areas and the prevention of the built structures had a top priority in this research considering the increasement of the urban environmental life quality and the development of the environmental protection infrastructure. Therefore it was necessary to study and evaluate the so called urban ecological parameters. The next step was the creation of an environmental cadaster and the elaboration of an eco-friendly urban development plan proposal. The results of these complex studies should be a part of the urban development processes in the near future.**

I. INTRODUCTION

Landscape ecology which includes urban ecology is a multidisciplinary subject since it exploits several results of social and natural sciences. The location of urban areas was basically influenced by environmental components. The relationship is mutual because not only the environment defines the urban areas' location but the urban areas have an effect on the environment. There is a permanent flow of material, energy and information between the cities and the environment. Although the two components had been examined separately several times there is only a little knowledge about their impact on each other especially the ecological aspect. The aim of our study is a better understanding of these relationships.

Figure 1. Map of Székesfehérvár

source:maps.google.com

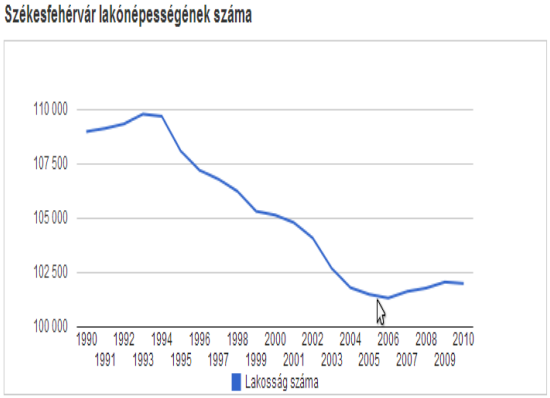

Figure 2. Population changes in Székesfehérvár

During our work the connection between the urban and periurban areas and their mutual effects on each other were studied. Important part of our work was the examination and evaluation of the so called urban ecological parameters (climate, water balance, vegetation, noise, air pollution, etc.); creation of an environmental cadaster and working out of ecological based suggestions for urban management and city development. These ecological city development suggestions become an organic part of urban development and urban management programmes.

The examination of the urban environmental conflicts and their location aroused as a major task of the project or rather the decisions connected to the urban land use. The spatial elements concerned may consist natural systems such as agricultural and natural ecosystems, land coverage elements, ecological networks, and green areas. The maintenance of the green areas and the avoidance of damages caused by erosion and drying in built environment is an important issue which can be achieved by the improvement of environmental quality, environmental protection infrastructure, and protection of built and cultural heritages.

Figure 1 and 2 show one of the studied cities' map and its changes of the population.

II. DATA AND METHODOLOGY

The main objective during the land ecology examination data collection procedure was the complexity of data sources which assure the high level data procession. During our work satellite images, topographic maps, meteorological datasets, green areas maps, etc. were collected and used. Some of the data were available in raster format but most of them were used and examined in vector format such as point located spatial data.

Long term statistical datasets which were collected by the Hungarian Statistical Office (KSH) (i.e. population, precipitation, temperature, wind, etc.) were also used for timeline analyses. Detailed study was made in Székesfehérvár, but only major urban ecological data were examined in Szombathely.

The study of changes in demographical data of a city considering the urban environmental examinations is very important since the population carrying capacity of a settlement can be seen. Demographical trends correlates strictly with the intensiveness of environmental usage and environmental impact (Konkolyné, 2003).

The population of Székesfehérvár decreased permanently in the past decades, the number of inhabitants is around 100.000 persons. This number correlates with the general trends in Hungary, some of the inhabitants move to the periurban areas. The population density is around 600 persons per square kilometer which is not too high compared to the western European countries. The advantages (i.e. green areas) and disadvantages (less developed areas) of the city must be revealed by the city's decision makers in order to make the city more comfortable. The creation of spatial usage map and spatial structure map is a good tool in decision making process.

Different amount of samples were collected according to the environmental elements and affecting factors in the examined cities. At the end of the project the following matrix is used to define the given status of the environment. Table 1 shows the environmental matrix.

TABLE I.
EVIRONMENTAL STUDY MATRIX

Pollution source	Concerned environmental elements, and effect factors					
	Air	Water	Soil	Green surface	Waste	Noise
Traffic	X	X	X	X	X	X
Industry, trade	X	X	X	X	X	X
Health	X	X		X	X	X
Wastewater management	X	X	X		X	
Agriculture	X		X	X	X	
Cities and built up environment	X	X	X	X	X	X

During our examination the advantages of GIS software were utilized. The IDRISI Taiga software showed the directions of the urban areas' increasement. The ArcGIS 9.3 software was used to visualize the spatial structures of the urban areas. The two software above complete each other during the data processing procedure and can handle both type of data models (raster and vector data).

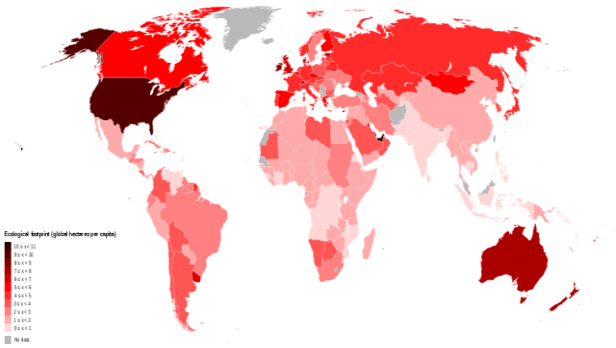

Figure 3. Ecological footprint of the world

source:Wikipedia.org

The modelling of the urban areas' increasement was done by visual interpretation, the spatial structure analyses was made by the help of GIS software.

III. RESULTS

The spatial structural examinations were conducted considering several aspects. One of these aspects was the demarcation of the green areas which was a great job since there are big green areas in Székesfehérvár. The green areas which are intended to increase the ecological capability of a city must be integrated to the whole city's spatial structure (Konkolyné, 2003). The large part of the urban dendroflore (trees) is not native at that area. The number and species of the urban trees are various considering the different cities and a large number of different tree species can be found in the cities (Nagy 2008).

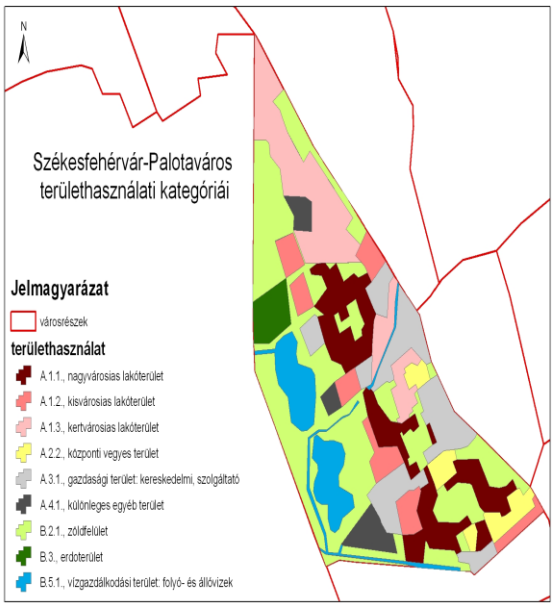

Figure 4. Land use categories in Székesfehérvár

In this study the protected trees of the different cities were localized during the examination process of the green areas. As it is written in the literature it can be said that significant number of trees can be found in alleys and city parks. Protected areas and parks were localized in a different category. Figure 5 and 6 show the location of trees and green areas of Székesfehérvár.

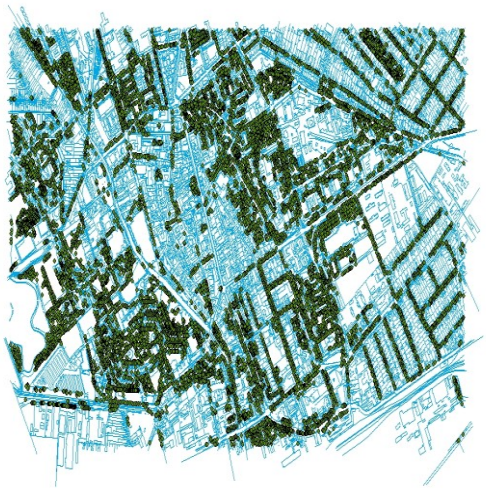

Figure 5. Tree map of Székesfehérvár downtown

Land usage index is a complex indicator which characterize the urban structure. Thus land use types were created which were characterized in details by further indicators which consider their ecological contents. With the help of the analyses of the existing databases available at the local municipalities the land use types can be interpreted easily thus the studying of the urban ecological structure also can be made. On the basis of the existing database a new urban area use database can be created which considers the ecological aspects and helps to make a complex comparative study with other cities (Nagy 2008).

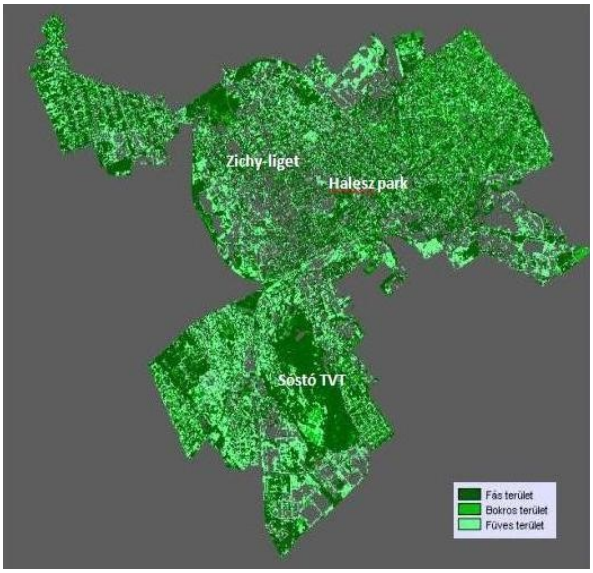

Figure 6. Green areas in Székesfehérvár done by using remote sensing techniques

Land use changes and urban area increasement were examined in Szombathely and statistical analyses were done. It can be seen that the city area doubled in the last 200 years which was caused by its favorable location, geographical conditions and special natural-economical potential.

The increasement of the urban area in Szombathely is not parallel with the changes of the population but because of the increasement of the industrial areas and the need for residential areas. The size of the residential areas get bigger in the past decades as it happened in west Europe (Mizseiné et al., 2012).

One of the main objectives during the study was to determine the urban ecological footprint. The measurement method for the environmental impact was developed by Wackernagel and Rees called 'ecological footprint' evaluation method. This value is determined in hectares and contains the input and output energy and materials used by the certain group of people. Figure 3 shows the ecological footprint of the world.

After finishing the calculation the result reveals the quantity of land and water surface that is necessary to sustain the system. The impact of any regional economy or enterprises or sport event or a single human being can be specified with this method. Figure 4 and 7 shows the land use and spatial structure of Székesfehérvár.

The results of studying the human-environmental interaction in urban areas help the determination of real and specific environmental problems and the specification of the environmental sensitivity of the groups. In former researches on individual and its surrounding environment scientists mainly focused on social environment instead of natural and material environment. These factors were only studied in the recently.

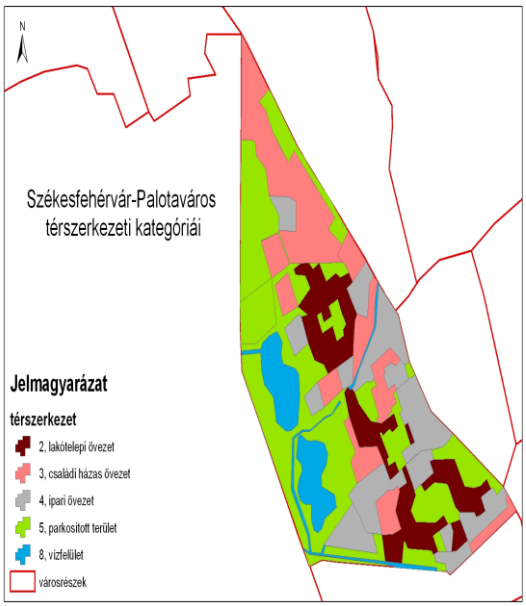

Figure 7. Spatial structure in Székesfehérvár

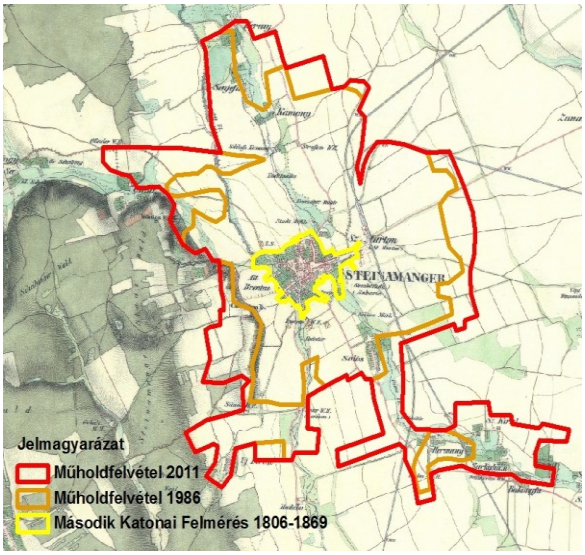

Figure 8. Land area changes in Szombathely in the past 200 years

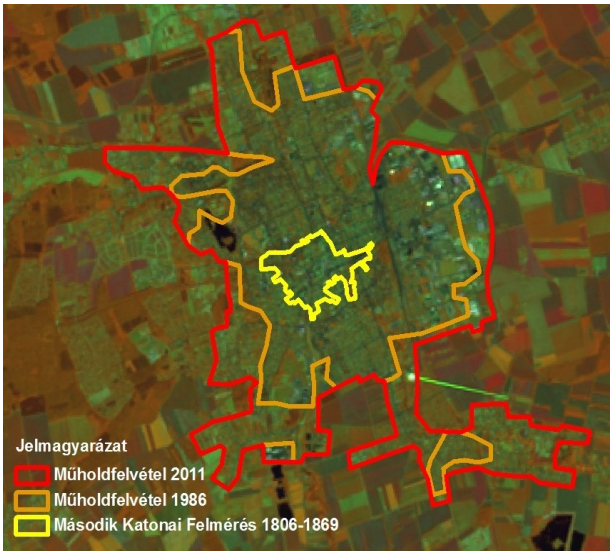

Figure 9. Land area changes on LANDSAT image

The urban ecology science reveals the connection and cause and effect interaction between the urban inhabitants and the biosphere, the environmental harms and conflicts and highlights the regularities of social mechanism and social and psychical reaction (NAGY 2008).

Figure 8 and 9 shows the land area changes of Szombathely in the last centuries.

IV. SUMMARY

The aim and objectives of the research study is in harmony with the cities development projects thus the results can be used in decision making process. The implemented project proposals can be specified upon the results of the health check and the professional and NGO's' requirements. This study gives a scientific support and adequate information for decision makers on these specific fields: urban environmental hygiene, precipitation sludge management, sewage sludge management and purification, communal waste management, local public transportation management, air pollution management, drinking water supply, energy management, green area management, wreck control, natural and built heritage protection, urban environment protection, landscape protection, biosphere and natural conservation. management, local public transportation management, air pollution management, drinking water supply, energy management, green area management, wreck control, natural and built heritage protection, urban environment protection, landscape protection, biosphere and natural conservation.

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