

## LANDSCAPE DYNAMICS IN THE BRNO'S SURROUNDING BETWEEN 2001 AND 2011

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**Received: February 28, 2013**

### Abstract

VAVROUCHOVÁ HANA, TOMAN FRANTIŠEK: *Landscape dynamics in the Brno's surrounding between 2001 and 2011*. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 2013, LXI, No. 5, pp. 1451–1457

In surroundings of the larger cities there are possible to observe one of the symptoms of today's postmodern society – suburbanized surface. A number of primary and secondary negative effects of this process are undisputed. To identify these influences in specific locality, analyze of structural and functional changes of territory are appropriate to make first. Spatial indicators are a suitable analytical tool for the synthetic evaluation of these changes. The indicators are simple and able to document the changes within land use categories in the time period, to identify just those categories with the most significant transformations and to objectify the main landscape processes. In frame of the suburbanization, Brno's agglomeration is polarized (northern and southern part with individual development) with redistribution of dominant functions (residential and commercial). To rationalize land use and to balance the spatial disparities by planning tools, it is just this specific phenomenon which is detailed analyzed by these indicators (with emphasis on the period between 2000 and 2011) and on their basis are derived recommendations for strategic development. The greatest changes recorded in the studied territory relate to agricultural land resources. Should we take into account the surveyed territory as a whole, the loss of arable land between the years 2001 and 2011 was ca. 1% and the proportion of built-up area increased by about the same.

landscape change, suburbanization, sustainable spatial development, indicator/index, Brno's surroundings, Czech Republic

Transformation of landscapes in the hinterlands of larger towns represent an important syndrome of today's post-modern society – our settlement are changing continuously. But nowadays wave of suburbanization is not the first phenomena of this kind (more e.g. Nagle, 1998; Balogh, Csapó, 2012). The process doubtlessly induces a range of primary and secondary impacts (e.g. Altrock, 2006). To be able to identify these impacts *ad hoc* in a concretely demarcated territory, an analysis of structural and functional transformations of the territory should be conducted first. Suitable tools for the analytic and synthetic evaluation of these transformations are territorial indicators (land use change index, relative change of individual land use categories etc.). These indicators can document in a simple and comprehensible way the land use changes according

to categories in a time interval and can identify exactly the categories in which the most profound transformations occur, thus objectivising the main landscape-forming processes.

The hinterland of Brno is very specific in the development of its suburbs. A polarization occurs into the northern and southern parts, particularly due to physical and geographical conditions and re-distribution of dominant functions (residential and commercial building) between them. For the rationalization of land use and elimination of disparities in the context of planning tools, this specific phenomenon is a subject of detailed analysis using the above-mentioned indicators (with emphasis on the period between the years 2000 and 2011), on the basis of which recommendations are derived for the strategic development.

## MATERIALS AND METHODS

The territory has a typical contrasting line running in the NE-SW direction, which creates preconditions for the secondary landscape structure. The north of the territory is covered mainly by forests, the southern part is represented mainly by the agricultural landscape and the western part is a mosaic of agricultural landscape with forests, forest and agricultural landscapes (dominated by the type of agricultural landscape with forests).

The south-eastern part represents an old residential area in terms of the settlement history. The north-western part of the territory was colonized later (within a so-called medieval colonization) with respect to the primary landscape structure.

The dominant relief type in the south-eastern part of the territory is a landscape of plateaus and hilly lands, which is enriched only along watercourses with a landscape type of broad river alluvia lined with the landscape type of plains. The north-eastern part of the territory is formed mostly by the landscapes of highlands with a minor representation of the landscapes of incised valleys; however, the karst area NE of Brno (Moravian Karst) must not be forgotten either.

Many authors deal with the quantification and qualitative evaluation of changes in the landscape structure and structure of the society in the hinterland of large towns – e.g. Kupková (2007), Bičík, Kupková (2007), Cílek, Baše (2005), Seidenglanz, Mulíček (2008) and Romportl, Chuman (2010) in the Czech Republic and e.g. Švéda (2010) in the Slovak Republic.

There are altogether 95 municipalities and towns in the South Moravia Region that have been included into the suburban zone of Brno (5 from the Vyškov district, 8 from the Blansko district and 82 from the Brno district). The territory is formed by a homogenized ring of municipalities adjacent to peripheries of Brno and meeting the following criteria: new construction and positive migration

balance in the last two decades and a relatively easy access from the Brno (up to 20 km; see Fig. 1).

The group of municipalities, which can be included in the suburban zone of Brno, is very heterogeneous; the size of municipalities according to the population ranges from the minimum of 123 inhabitants to the maximum of 10 833 inhabitants (median of the group is 916 inhabitants). The population increase in the last decade ranges from 11 to 1829 inhabitants (median of the group is 106 inhabitants). Compared with the population trend in the previous decade, we can see that depopulation is more apparent in municipalities or towns affected by labour market changes (Rosice, Adamov, Mokrý-Horákov). The population increase in the other municipalities is gradual and suggests a trend for the coming decade (maximum increase is 325 inhabitants, median of the group is 25).

Indicators calculated for the area demarcated like this were as follows:

**a) Index of change** – providing a basic information about the intensity of changes in a given territory over a given period

The general relation for calculating the index of change (IZ; Antrop, 2004) is as follows:

$$IZ_{(a-b)} = \frac{\sum_{i=1}^n |r_{ib} - r_{ia}|}{2c} \times 100 [\%]$$

$IZ_{(a-b)}$  ..... Index of change from period  $a$  (2001) to period  $b$  (2011),

$n$  ..... number of land use categories (namely 9),

$r_{ia}$  ..... area of land use category  $i$  in the year  $a$  (beginning of the studied period),

$r_{ib}$  ..... area of land use category  $i$  in the year  $b$  (end of the studied period),

$c$  ..... total area of the territorial unit.

**b) Relative change of selected land use types** (regarding the character of suburbanization, a relative change was examined particularly in arable land area, permanent grasslands and



1: South Moravia Region in frame of Czech Republic and the suburban zone in frame of Region  
Source: own processing (Jana Pokorná)

built-up area). The general relation for calculating the relative change (ZP; Švédá, 2010) is as follows:

$$ZP_{k(a-b)} = \left( \left( \frac{r_{ib} \div c_{ib}}{r_{ia} \div c_{ia}} \right) \times 100 \right) - 100, [\%]$$

$ZP_{k(a-b)}$  ..... area change of the given land use category,

$r_{ia}$  ..... area of land use category  $i$  in the year  $a$  (beginning of the studied period),

$r_{ib}$  ..... area of land use category  $i$  in the year  $b$  (end of the studied period),

$c_{ia}$  ..... total area of the territorial unit in the year  $a$  (beginning of the studied period),

$c_{ib}$  ..... total area of the territorial unit in the year  $b$  (end of the studied period).

### c) Establishing a dominant landscape-forming function (Antrop, 2004)

The method used for the establishment of a dominant landscape-forming function determining the character of changes in the territory dwells on assessing an absolute change in the acreage of the given land use type. Based on these values, other determinants of landscape changes can be defined: deforestation/development intensification/grassing/extension of water bodies/intensification of agriculture.

Input values used in the calculation of target indicators were data of the Czech Statistical Office (land use types at the level of municipalities in 2001 and 2011).

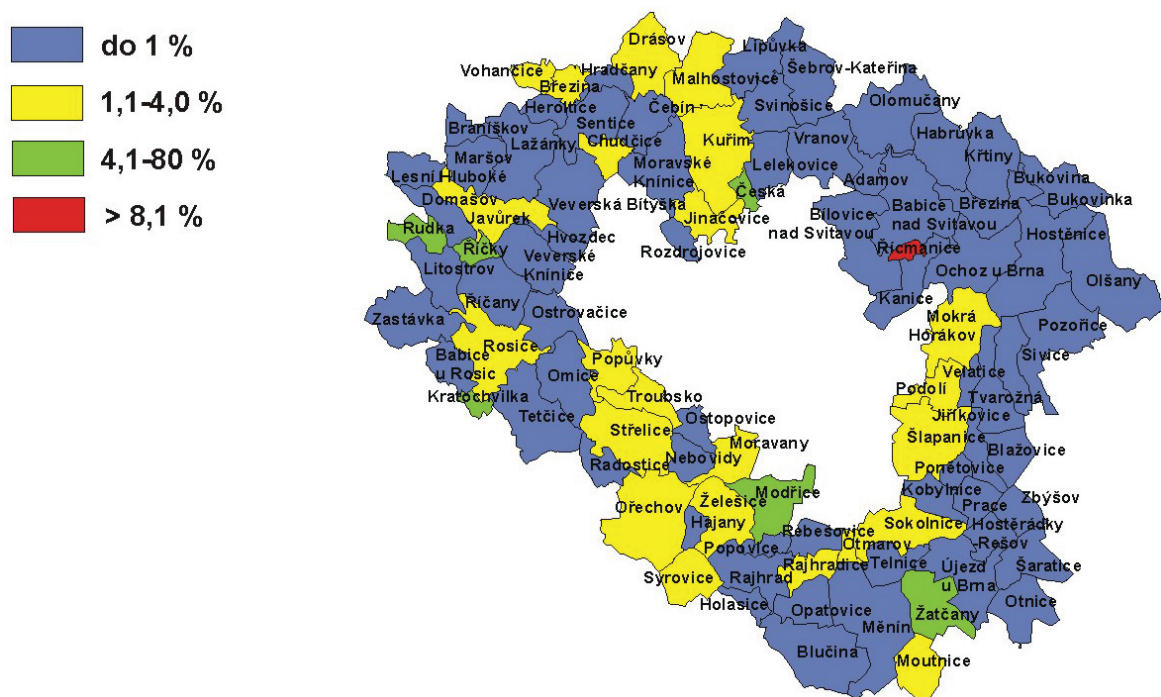
## RESULTS AND DISCUSSION

### Ad a) Index of changes

Values of this indicator, related to the studied group of municipalities and towns, range from 0.1–10.3% with at least 1% being reached only by a third of them (median of the group is 0.7%). Only five municipalities show the value above 5% and only one of them slightly exceeds 10%. The results of the analysis suggest that the changes recorded in the last decade did not reach high intensity and the suburbanization trend is slowing down in the hinterland of Brno. For more details see Fig. 2.

Some more significant changes were recorded in the municipalities of Chudčice (3%), Malhostovice (3.1%), Sokolnice (3.3%), Syrovce (3.9%), Česká (4.2%), Kratochvílka (4.2%), Zbýšov (5.2%), Modřice (5.4%), Rudka (5.9%), Říčky (6.0%) and Řícmanice (10.3%). These are mostly municipalities occurring in the size category up to 1,000 inhabitants, in which more profound changes in the number of inhabitants were recorded as late as exactly in the period from 2001–2011 (the previous decade showed rather a loss or only a negligible population increase – with the exception of Česká and Modřice).

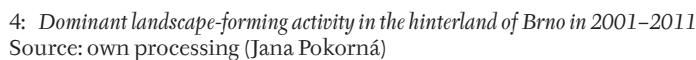
It is just increasing intensity of development in the municipalities that does this large change. The busy roads it is usually bonding line, the size of cadastre is not determining for the intensity changes.



2: Index of changes between 2001 and 2011, in the hinterland of the city of Brno  
Source: own processing (Jana Pokorná)







The dynamics of changes in the landscape surrounding the South Moravia metropolis can be valued in the last decade as less intensive, namely as compared with the development of other cities such as Prague (Kupková, 2007) or Bratislava (Seidenglanz, Mulíček, 2008). This logical development is underlined by specific physical and geographical pre-conditions of the territory, which are limiting for a further growth (specific relief in the northern part of the territory, conservation regime in the north-eastern part etc.) and suggests a change in the trends of housing preferences, supply of real estates and design of developer projects. In the last decade, we can see a wider supply of tenement houses in villages behind the Brno City boundary, which mitigates the total impact on the landscape structure and functionality due to the concentration of building activities. It can also be expected that the intensity of landscape changes in town quarters (their area was not included in this chapter) is higher than in municipalities adjacent to Brno peripheries.

## CONCLUSION

Big developer projects for commercial or residential building very often affect the environment, yet are usually not subject to legal assessment. Elements of the rationalization of building can be found in the construction law, which stipulates a number of mechanisms restricting an uncontrolled housing development (obligatory justification for newly specified plots suitable for building, concept of public infrastructure as a part of the development plan, cohesion of area development principles with area development plans etc.). Nevertheless, an area development plan will always be a strongly subjective document and a certain persistence of currently valid area development plans with a high proportion of plots suitable for construction has to be considered, too. In addition to the voluntary strategic assessment of area development plans (SEA), newly planned suburbia should be subjected also to an assessment at a project level (EIA). The planning of extensive construction work should then be duly subject to the SIA (Social Impact Assessment) procedure or alternatively to the newly developing TIA (Territorial Impact Assessment) as a complement of existing procedures.

## SUMMARY

Transformation of landscapes in the hinterlands of larger towns represent an important syndrome of today's post-modern society. The process doubtlessly induces a range of primary and secondary impacts. To be able to identify these impacts *ad hoc* in a concretely demarcated territory, an analysis of structural and functional transformations of the territory should be conducted first. Suitable tools for the analytic and synthetic evaluation of these transformations are territorial indicators (land use change index, relative change of individual land use categories etc.). These indicators can document in a simple and comprehensible way the land use changes according to categories in a time interval and can identify exactly the categories in which the most profound transformations occur, thus objectivising the main landscape-forming processes.

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Indicators calculated for the area demarcated like this were as follows:

- a) Index of change
- b) Relative change of selected land use types
- c) Establishing a dominant landscape-forming function.

The dynamics of changes in the landscape surrounding the South Moravia metropolis can be valued in the last decade as less intensive, namely as compared with the development of other cities such as Prague or Bratislava. This logical development is underlined by specific physical and geographical pre-conditions of the territory, which are limiting for a further growth (specific relief in the northern part of the territory, conservation regime in the north-eastern part etc.) and suggests a change in the trends of housing preferences, supply of real estates and design of developer projects. In the last decade, we can see a wider supply of tenement houses in villages behind the Brno City boundary, which mitigates the total impact on the landscape structure and functionality due to the concentration of building activities. It can also be expected that the intensity of landscape changes in town quarters is higher than in municipalities adjacent to Brno peripheries.

The greatest changes recorded in the studied territory relate to agricultural land resources. Should we take into account the surveyed territory as a whole, the loss of arable land between the years 2001 and 2011 was ca. 1% and the proportion of built-up area increased by about the same.

## Acknowledgement

This study was supported by the Research plan No. MSM6215648905 "Biological and technological aspects of sustainability of controlled ecosystems and their adaptability to climate change", which is financed by the Ministry of Education, Youth and Sports of the Czech Republic.

The research was also supported by Internal Grant Agency of the Mendel University in Brno in 2012 within the project "Landscape changes on the periphery of the large cities".

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