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# AN APPROACH FOR RESEARCHING URBAN AND METROPOLITAN AREAS UNDER THE CONDITIONS OF DYNAMIC CHANGES

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**ABSTRACT**

*Big cities, or their metropolitan areas, represent an important arena for research of spatial and socio-economic changes, with implications in a wider (national) framework. Urban dynamics, mainly from the aspect of land-use and distribution of population, is theoretically analysed following the sustainable development paradigm. Recently, with the growing influence of factors of uncertainty and vulnerability, that are exhibited also in the network of settlements, ideas such as "renewal","transformation" and "reorganisation" gain a new significance. This paper makes an overview of the short period in which the transformations of land-use as well as some demographic and socio-economic changes of population took place and have been observed on the metropolitan areas of Belgrade and Novi Sad. Some potential directions of future changes in the selected metropolitan areas have been determined, with the goal of achieving a more successful urban areas' steering through constant cycles of transformation and adaptation.*

**Key words:** *metropolitan areas, land use, population distribution, dynamics of change.*

## INTRODUCTION - ECOLOGICAL ASPECTS OF URBAN/METROPOLITAN AREAS

Urban areas presently encompass already more than half of the world's population. According to the UN projections, the number and share of urban population will continue to rise to 5 billion people by 2030, i.e. to more than 60% of the total population, thus inducing profound impacts on the environment, society and global and local economies (Forman, 2008). Even though the total area covered by the urban areas is seemingly small (1-6% of the total Earth surface), a dominant urban population relies on a wide range of products and services which derive from outside the geographical boundaries of urban areas and it alters virtually all of the Earth's ecosystems (Meyer and Turner, 1992; McIntyre et al., 2000).

In order to understand what constitutes an "urban" ecosystem as well as to understand its nature in parallel with "human dominated" area, it is necessary to employ knowledge from both natural and social sciences. Human settlements are social-ecological systems, i.e. both physical and social in their construct. With that in view, disciplines which research urban settlements from the aspect of natural or social sciences should include those variables that are usually attributed to the other branch of science, i.e. to use the interdisciplinary approach for comprehending what "urban" means when applying the demographic, economic, cultural, psychological, etc. criteria in conjunction with geospatial and ecological criteria (McIntyre et al., 2000). Various disciplines of the natural and social science domain demonstrate tacit assumptions what the term 'urban' means. Still, when reviewing how 'urban' is understood by ecologists and social scientists, one cannot discern a single overarching or precise definition, mainly because 'urban' may be understood as 'entity' as well as 'quality' (Pacione, 2001). Social sciences generally offer more consistent, quantitative definitions of 'urban'. Sociology, for example, often employs the population size as a criterion for identifying urban places. Yet, in practice urban population size thresholds vary over time and space. The United Nations defines "urban" as: 'an area with more than 20,000 people' (United Nations, 1968:38). However, in countries with sparse distribution of settlements, e.g. Sweden, any settlement with more than 200 inhabitants is classified as 'urban'. On the other hand, in densely settled countries, e.g. Japan, population threshold for considering a settlement urban is 30,000 inhabitants. In addition to this, many countries apply

administrative definition of urban places, which however has a very little correspondence with the actual physical extent of the urban area. In the science of ecology, the definition of ‘urban’ often omits the density or any parameter which could be accurately measured (e.g. ‘urban area consists of houses and lawns’ (Emlen, 1974), or as Erskine (2002) puts it: “urban” is a “built-up area”). Subjective, or cognitive structure of ‘urban’ relates to the urban as a ‘quality’, and this mental categorisation is equally pertinent in the sphere of urban ecology as in social disciplines such as environmental psychology. According to McIntyre et al. (2000), in comparative urban studies, integrative definitions of ‘urban’ should endorse both quantitative and qualitative attributes: population density; economic characteristics; governance type; growth pattern; relation to other urban areas; historical, current, and adjacent land-use types; land-cover type; housing type and density; road type and density; traffic frequency, etc. The same authors conclude that each study of urban environment is recommended to have at least a working definition on what makes the ‘urban’ construct, ‘explicitly including baseline information on demography, physical geography, socioeconomic, and cultural factors that can potentially explain existing urban structure and predict trajectories of urban growth’ (ibid:18).

As Stearns and Montag (1974) point out, urban ecosystems are created by humans specifically for dwelling and are dominated by “built environment”. Urban ecosystems certainly bear the effects of human influence since humans occupy (live in) them, whereas human-dominated ecosystems, which cover much broader territory, may or may not be actually inhabited by people. This notion is clearly linked to the point that cities have always been dependent on their hinterlands for the resources supply and waste disposal. Depletion of resources is driven by the ‘humankind’s insatiable desire to produce and consume’ (Walker and Salt, 2006:4). This is almost an evolutionary drive, which was not a problem when human population and its activities were small and limited and when there was no overshoot of the Earth’s carrying capacity. However, ‘business as usual’ of increasing efficiency and optimizing the performance of an urban system and its integral parts, but failing to acknowledge negative impacts on the bigger system may jeopardise sustainability of all. In line with ecological economics, when addressing the resource flows in terms of inputs and outputs of and urban ecosystem, several models may be used for accounting for them, including the well-known “ecological footprint”. This tool uses ‘area’ measured in hectares or acres as the ‘universal currency’ to calculate population or person’s impose or ‘load’ on the biosphere (Forman, 2008). As calculated more than a decade ago, average ecological footprint was already 2.2 global hectares per person, whereas only 1.7 global hectares have been available per person as a ‘fair earthshare’, which means that we require 1.2 planets in average to sustain the current population with its production and consumption patterns. There should be stressed that there is also the intra-generation inequality meaning that the average ecological footprint does not equally apply to the whole World. While the ecological footprint of average African or Asian consumer (with smaller GDP per capita) is less than 1.4 global hectares per person, the average Western European’s ecological footprint is 5.6 global hectares per person, and the average North American consumes 9.6 global hectares per person. To put it in our perspective, Serbian ecological footprint is currently 2.6 global hectares per person, which is above the World’s average but still much below the average for more developed countries (Happy Planet Index, 2003). A strong point of ‘ecological footprint’ as a measurement tool is that it takes in account the effects of humans on both their immediate surroundings and areas of influence which are on much wider distance (McIntyre et al., 2000). Also, ecological footprint as a biophysical measure, rather than monetary, is better in expressing the interrelationship between humans (their constructs) and biosphere. However, ecological footprint analysis also shows the lacks, particularly when large urban regions are in concern having that their boundaries are not always consistently defined, what may prevent the comparability of data (ibid.: 9).

The idea of city as an ecosystem is applied in urban ecology, where city is regarded as a part of a much larger system, i.e. urban region. Considering the city itself as a system was especially emphasized over the second half of the 20th century, which was possibly related to the increasing popularity of the idea of urban metabolism (Marcotullio and Boyle, 2003). Urban metabolism of modern cities is of linear nature as ‘resources flow through the urban system with little concern about their origin or about the destination of wastes’ (Pacione, 2001:582). In contrast to that, nature has a cyclical metabolism, where ‘every output by an organism is also an input that sustains the whole

environment' (ibid.:583). Urban metabolism approach, based on modeling material and energy flows between human societies and their environment, was largely popular in the 1970s being synchronised with the discourse presented in the famous book 'Limits to Growth' and the Club of Rome. In the 1980s, the popularity of urban metabolism concept declined, only to re-emerge in the late 1990s with a critical question whether cities can move towards sustainability and adaptation, i.e. to evolve in different trajectories (non-linearly) within multi equilibrium states and with short, medium and long-term perspectives, integrating the dynamics of social and ecological systems as paired/coupled ones (Chelleri, 2012).

With increase of the process of population concentration in towns and cities, which was sequelled by outward distribution of people and built areas, the regional city (city-region, or metropolitan region) as a form of decentralised concentration has been proposed in relation to sustainable urban development. Being inspired by Ebenezer Howard's 'Garden City', the 'Regional City' concept (coined by the American planner and architect Clarence Stein in the 1920s) addressed the issue of suburbanization and sprawl as unsatisfactory spread out (rather than compact) pattern of distributing built structures. Spatial organisation of a 'Regional City' is aimed to retrieve people's sense of belonging to the local environment, and more broadly, this model should achieve a balance between urbanisation and environmental requirements. It should comprise 'a series of separate medium-sized communities surrounded by large areas of open space and connected by major roads' (Pacione, 2001:591). The 'Regional City' concept envisages further development of polycentric city cluster. Instead of a monocentric city of an equivalent size, the network of close polycentric cities should therefore develop with complementary urban functions which also achieve certain 'urbanisation economies' (Vujošević et al., 2012:97). Present emphasised importance of polycentric urban development doesn't relate only to big metropolitan cluster-regions but also to smaller, remote and even rural regions aiming to achieve 'territorial cohesion' being promoted by all European spatial planning documents. Planning support to selective dispersal and complementarity of functions within certain urban nodes of urban region may be challenged by the change of their relative growth in time, where the current complementarity of functions represents an outcome of particular dynamics, i.e. of "natural" historical-geographical competitiveness between cities (ibid.:247).

## TRANSFORMATION IN THE NETWORK OF SETTLEMENTS – CHALLENGES UPON THE RESILIENCE THEORY

On the basis of the explorations of urban agglomerations development, as well as spatial and functional relations and connections in them, general model of the urban development level has been formed. Urbanisation is, according to this view, considered as a transitional process, complex and continuous, which manifests itself through: 1) concentration of economic and social activities and population in the city; 2) spatial and functional integration of the city and surrounding settlements achieved due to the economic interactions and social mobility of population; 3) development of communication systems and infrastructure, which leads to the deconcetration of socioeconomic activities and the increase in the radius of the daily migration of population; 4) development of suburbs with various functional purposes and roles; 5) reduction of disparities between the quality of life of the population living in the centre and the one living on the peripheries of urban regions; and 6) achievement of spatial and functional and socioeconomic equilibrium (Ravbar, 1997; Tošić, 2012.)

Development of cities and their role in the organisation of space in Serbia has three key features: a) demographic growth of cities; b) increase in the number of urban settlements; and c) transformation of rural into urban/urbanized settlements and areas due to the spreading of urbanization from urban centres/nucleuses over regional surroundings-periphery. Social division of labour, mobility of capital, development of industry as well as local and regional trade have turned rural areas into influential spheres of cities which due to this acquire regional centrality and become places of concentration of complex functions (Tošić, 2012).

From the historical perspective, the network of settlements in Serbia has been largely influenced by parallel processes of politically initiated de-agrarisation and emphasised industrialization after the

Second World War. In the period until the 1980s, unlike planned industrialisation, the course of urbanisation was not systematically steered by the former country (SFRY), and the consequence was concentration of population and work places in towns and cities, accompanied by general exodus of rural population. Similar processes took place at the local (municipal) level with intensified growth of municipal seats on the account of depopulation and decay of a traditional village. The concentration of people in urban centres, however did not result in enhanced policentricity of the network of settlements in Serbia. In contrast, Serbian network of settlements has been featured by functional and other dominance of Belgrade as the capital city. When observed at the macro-regional level, the development of networks of settlements in Central Serbia and Vojvodina had different paths until the end of 1980s. As Veljković et al. (1995) put it, polarisation effects and development stimuli in Central Serbia were pronounced to a greater extent only around a small number of cities, i.e. around Belgrade, Niš, Kragujevac, Kruševac, Kraljevo and Loznica. At the same period of time, i.e. until the 1980s, Vojvodina (northern province of Serbia) had a polycentric polarisation, which related not only to two of its biggest cities (Novi Sad and Subotica) but also to a number of towns of more or less similar size (Zrenjanin, Pančevo, Sombor, Kikinda, and Vršac) (Krunić, 2012). Domination and respectively stronger position of Belgrade has increased in Serbia in the period after the 1990s, but simultaneously the network of settlements in Vojvodina has been transformed due to strong monocentric polarisation with Novi Sad attaining a dominant position (ibid.). Some previously developed urban centres started lagging back, which is particularly the case for a group of small and medium-sized towns. In the latest inter-census period (2002-2011) these towns faced depopulation and economic decline largely as the consequence of loss of employment and one of the greatest de-industrialisation processes that happened in the former communist world.
Although it is inevitable that the biggest cities of the country demonstrate a stronger respective position in terms of competitiveness and agglomeration advantages, moreover if they are physically close one to another as the case is with Belgrade and Novi Sad, the main challenge from the aspect of ‘resilience of cities’ is to achieve balanced development of the network of settlements. This presumes targeted, i.e. concentrated decentralisation, based on selection of priority projects (including much needed reindustrialisation) in order to advance the position of macro-regional and regional centres in the country and their polarization effects. Consequently, such scenario should bring to enhancement of the quality of living not only for the parts of the country that are now lagging back, but also the quality of living would improve within Belgrade-Novi Sad urban agglomeration due to its better position on the international scene based on competitiveness and urban twinning process.

From the aspect of ‘resilience in cities’ which is closely linked to ‘urban form’ and ‘land-use patterns’, one needs to consider the mechanisms by which built environment (urban form) affects ecosystem functions including the change of land cover (Alberti, 2005). With that in view, Serbian cities have been affected by sprawl, i.e. scattered development of built up area into rural land in the city periphery, qualified by lower density, single housing, inadequate infrastructure and social facilities supply, etc. Although sprawl is not a unique phenomenon for Serbian cities alone, it is largely emphasised here through spontaneously and illegally developed city outskirts, without adequate provision of quality of living standards. When big cities of Serbia are in concern, their urban form and land-use pattern have not been influenced only by the conditions of sprawl towards periphery, but also by the so-called ‘implosive sprawl’ (Graovac and Đokić, 2008). The latter involves development towards the inside of the city area, where large zones of open spaces, such as: green areas, forests, riverbanks, and land occupied for infrastructural objects, have been transformed into built-up developed land, and converted to single-use districts, typically for housing, but also for commercial or industrial use. This process brings to much higher densities within the city (and perceived compactness) but it deteriorates the quality of living standards, hence reducing the desirability of inner-city areas. Analysis of the change in relation between demographic strength of urban centre and inner urban area of Belgrade (defined by Živanović and Gatarić, 2013), indicates the larger growth of the inner urban area of Belgrade than the rest of the city (measured by index of population development). Additionally, the demographic aspect, i.e. the in-migrations especially to the periphery of Belgrade and Novi Sad that were intensified in the late 20th century due to war conflicts in the former Yugoslav republics, led to intensification of uncontrolled urban expansion. This was not just an

outcome of the weakness of planning policy to protect public goods from this type of development but also an issue of incomplete and prolonged post-socialist transition of the country.

## SPATIAL AND FUNCTIONAL DEVELOPMENT OF URBAN/ METROPOLITAN AREAS IN SERBIA

Recent explorations of urban regions in Serbia are teoretically and methodologically based on paradigms of spatial organisation. That is functional and process approach, based on the priniciples of the nodal regionalism whose instrument is urban region (nodal/functional region, or functional-urban region). The chosen process-functionalism approach has given to the spatial and functional structure of the network of settlements evolutionary character, viewing the relations between the elements of the settlements system as changeable categories dependent on the force, intensity, quality, duration and territorial reach of the relations constituted in the mentioned networks. Every functional relation is the outcome of processes whose synergistic or individual effects cause the changes of the structures of settlement network systems. On the other hand, the concept of nodal region has been chosen due to the empirically established fact that urban settlements, through their functioning, have an impact on regional integration and differentiation of complex and heterogeneous space.

Urban regions are the product of complex interactions between urban settlements and their surroundings. The extent of their influence on the functional integration and regional differentiation of the territory is directly reliant on the transitional phase of urbanisation. Regions are developed in the conditions of dynamic processes of concentration and decentralisation of functions, population, working places and public utilities and services. Evolutionary development stages of urbanisation are synchronized with the attained economic development, that is, with the level of socioeconomic transformation of population. This is the reason why urban regions are regarded as core elements of spatial and functional organisation of the territory. Urban region is, therefore, the space of functional integration of the city and the settlements in its zone of influence and represents an open and dynamic system.

### Morphological structure of Serbian urban systems

One of the latest models of urban systems in Serbia distinguishes 4 types of cities according to their functions (Tošić and Krunić, 2004; Tošić and Maksin-Mićić, 2007): 1) cities of great importance for the international integration of Serbia; 2) cities of great importance for the integration of Serbian geospace; 3) cities at the internal development axes; and 4) cities of local integrations. Primary axes of development are those of the Danube, the Morava (the Velika Morava and the Južna Morava) and the Zapadna Morava. Secondary axes of development are not sufficiently differentiated, or lack adequate infrastructure. In addition, the model distinguishes geospaces with demographic and economic depression, which are out of reach of the axes' influences and include peripheral, border and mountain parts of Serbia. In most parts of the country the hierarchy of urban centres has been established, with the formation of zones of influence around these centres based on spatial and functional complementarity. It is worth emphasizing that the mentioned hierarchical relations are the consequence of the position of the centres in territorial and administrative organization of Serbia.

Morphologically and structurally, several forms of nodal centres and areas have been formed (Tošić, 1999; Derić et al., 2003; Krunić et al., 2009). Belgrade-Novi Sad metropolitan areas distinguished by its complex and dynamic system of urban settlements with high level of functional and morphological connections, specific hierarchy, large zone of influence which surpasses the borders of Serbia, and which possesses the potential to become the centre of the future European metropolitan region.

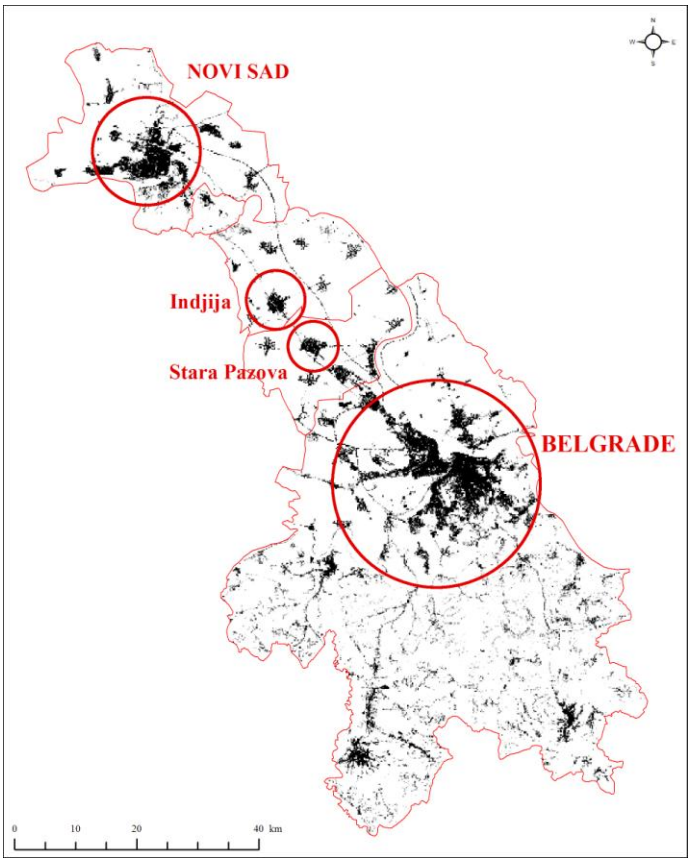


*Figure 1. Urban areas of the analyzed Belgrade - Novi Sad metropolitan area*

Analysed metropolitan area (Figure 1) includes 5 administrative units (City of Belgrade, City of Novi Sad, and municipalities of Inđija, Stara Pazova and Sremski Karlovci) and covers about 4718 km2 (about 5,3% of the Republic of Serbia), with total population of about 2096250 (around 29,4% of the total population of the Republic of Serbia). This metropolitan area is the most attractive for commuting and its daily urban system is the most developed in the country.

A brief analysis of spatial changes was conducted and it is aimed to track the recent land use changes and its dynamics within Belgrade-Novi Sad metropolitan area in the period between 1990 and 2006. Dataset1 are obtained from publically available dataset from European Environmental Agency (EEA) (Table 1, Figure 2).

In Table 1 changes of the spatial structures (i.e. land cover) are shown. It is indicated that in the observed period artificial areas (mainly urban areas) grew by the rate of over 115%, dominantly on the account of the agricultural areas (which slightly declined).

[1] For this preliminary analysis following datasets are acquired: Corine Land Cover 1990 - 2000 changes (dataset consists of raster data, spatial resolution 100x100 m, about changes between the CLC1990 inventory and the CLC2000 inventory; and Corine Land Cover 2000 - 2006 changes (dataset consists of raster data, spatial resolution 100x100 m, about changes between the CLC2000 inventory and the CLC2006 inventory) and administrative borders of study areas.

*Table 1: CLC Structure and changes in the land cover between 1990 and 2006 (ha, %)*

| CLC | 1990 | % | 2000 | % | 2006 | % | Change 2006-1990 | Change, % |
|---|---|---|---|---|---|---|---|---|
| Artificial surfaces | 49738,9 | 10,5 | 53296,1 | 11,3 | 57257,5 | 12,1 | 7518,7 | 115,12 |
| Agricultural areas | 342215,7 | 72,5 | 344957,8 | 73,1 | 341595,0 | 72,4 | -620,8 | 99,82 |
| Forests and semi-natural areas | 55324,9 | 11,7 | 59322,8 | 12,6 | 58626,8 | 12,4 | 3301,9 | 105,97 |
| Wetlands | 2040,3 | 0,4 | 2040,3 | 0,4 | 2268,0 | 0,5 | 227,7 | 111,16 |
| Water bodies | 12099,0 | 2,6 | 12168,9 | 2,6 | 12038,6 | 2,6 | -60,4 | 99,50 |
| Unknown | 10367,1 | 2,2 | - | - | | - | - | - |
| Total | 471785,9 | 100,0 | 471785,9 | 100,0 | 471785,9 | 100,0 | 10367,1 | 100,0 |

*Table 2: Demographic development of the Belgrade-Novi Sad metropolitan area (1991 – 2011)*

| | Pop, 1991 | Pop. 2011 | Change 1991-2011 | Change ratio |
|---|---|---|---|---|
| City of Belgrade | 1552151 | 1639121 | 86970 | 105,6 |
| City of Novi Sad | 261121 | 335701 | 74580 | 128,6 |
| Sremski Karlovci | 7403 | 8722 | 1319 | 117,8 |
| Stara Pazova | 55871 | 65508 | 9637 | 117,2 |
| Inđija | 42849 | 47204 | 4355 | 110,2 |
| Total - Metropolitan area | 1919395 | 2096256 | 176861 | 109,2 |

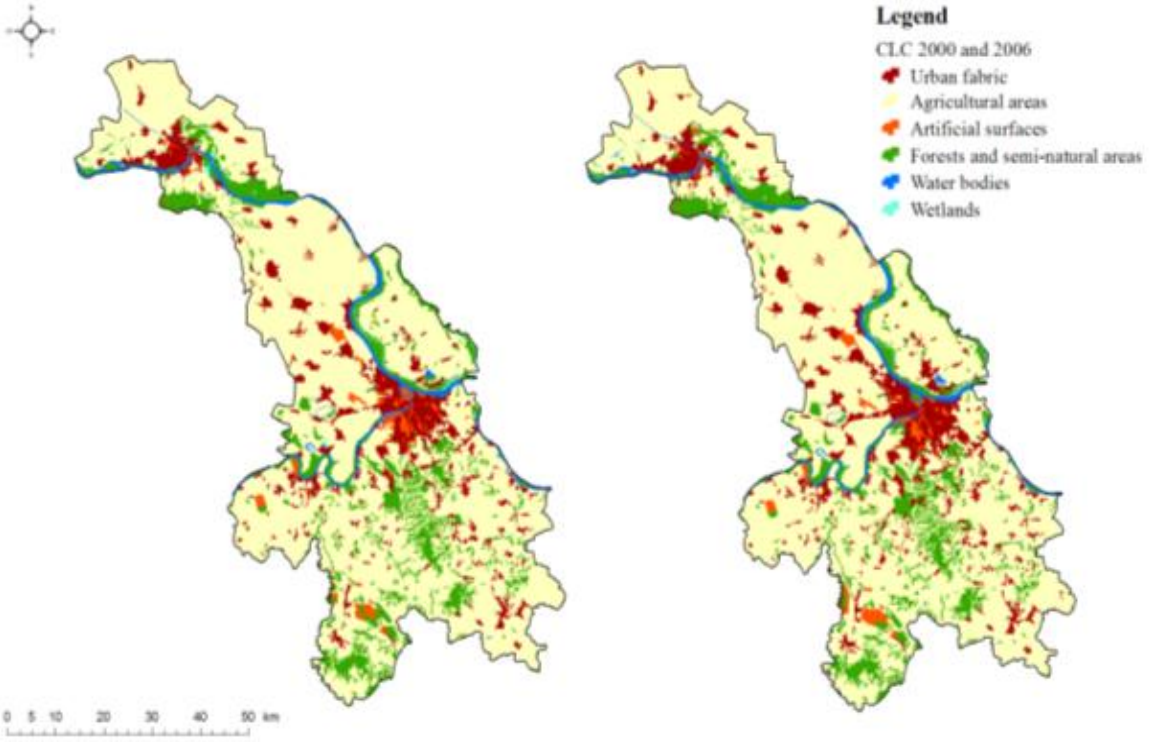


*Figure 2. CLC for year 2000 (left) and 2006 (right)*

During the analysed peiod, over the last 25 years, total population of the Belgrade-Novi Sad metropolitan area grew from about 1919400 to about 2096250 (by ratio of almost 10%), caused by the positive natural growth and positive migration trends (Table 2). For the same period, demographic

development was followed by the relatively intensive spatial changes in the land use. Agricultural areas and forests have been transformed in the artificial surfaces – urban areas.

In contrast to the development of the infrastructural systems and industrial areas, newly urbanized areas that consist of residental and commercial buildings are developed during the spontaneous process regardless the implementation of the spatial and urban plans and regulations.

More details about spatial dynamics in analysed metropolitan area, and differences between planned and actual development can be found in research conducted by Samardžić-Petrović et al. (2013), who applied advanced GIS and statistics modelling to analyse the similarity between the Master plan and the actual land use map for the City of Belgrade. The results suggest that largest discrepancies between these maps can be observed in the following land uses: green areas, industrial and agricultural categories. Observed discrepancies within the green areas and agriculture areas wich are classified as unbuilt land, are caused by the illegal construction. Interesting for the analysis of economical development of the City is that only of 47% of the total area anticipated by the Master plan for industrial development was used for this purpose by 2010. Similary to this, only 54% of traffic areas have been realised at the moment although they are located according to the plan. It is obvious that planned spatial developement of the City was overestimated by the Master plan. The peripheral municipalities (Surčin) have very slow spatial development in the contrast to the central ones (Novi Beograd). During the analysed period the construction of residential and commercial structures dominated all development projects. It is very interesting that there is almost no match between planned commercial areas and build ones in the peripheral municipalities (Samardžić-Petrović et al., 2013).

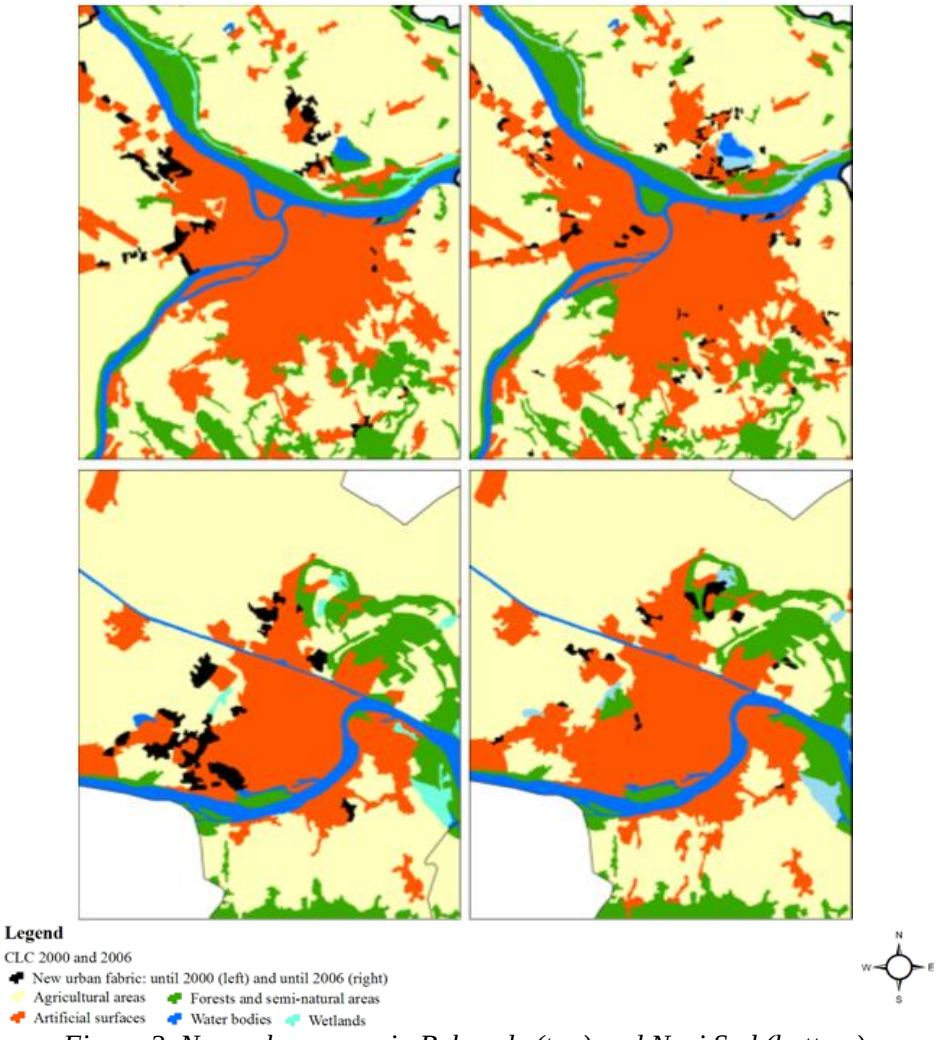


*Figure 3. New urban areas in Belgrade (top) and Novi Sad (bottom)*

Figure 3 illustrates that intensive urban development and changes in the land cover during the observed period occured in the peripheral areas of both cities. New urban areas are characterised by residental and mixed residental-commercial uses, with often poor infrastructure facilites, both social and technical, with potentially negative ecological impacts.

## CONCLUDING DISCUSSION – TOWARDS A SUSTAINABLE AND RESILIENT SPATIAL DEVELOPMENT OF URBAN/METROPOLITAN AREAS

Urban society and cities reflect now more than ever accelerated changes, driven by place-specific contextual conditions on the one hand and the effects of globalisation, on the other. In order to respond to challenges of sustainable spatial development and urban resilience, the existing socio-economic, ecological and other perspectives on cities need to engage the alternative paths (solutions).

Urban/metropolitan areas, which are understood as social-ecological systems, experience continual evolution that happens non-linearly, has multi equilibrium states, with short, medium and long-term perspectives. Such notion requires a shift from planning for a ‘predictable future’ to transitions in urban planning and governance, that would help navigating human settlements through continual transformation and adaptation cycles.

During the analysed period, over the last 25 years, population growth of the Belgrade-Novi Sad metropolitan area was followed by the general transformation of the land cover and land-use, in favour to new artificial surfaces, i.e urban areas. These new urban areas are developed in the city outskirts during mainly spontaneous process regardless spatial and urban plans and regulations, and that resulted in their poor infrastructure equipment and overall lower quality of living.

The research presented in this paper shows a preliminary analyses that identify changes in the land cover and population dynamics of the Belgrade-Novi Sad metropolitan area in the period after the 1990s. Future directions of research should be concentrated on the driving factors and implications for the parts of urban areas that are more likely to experience changes and consequent particularities of demographic structures in such areas.

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