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THE ROLE OF NODAL CENTERS IN ACHIEVING BALANCED REGIONAL DEVELOPMENT

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Abstract: Uneven regional development is characteristic of a large part of the society, from micro to macro regional level. One of the ways of overcoming this problem is effective spatial and functional connection of the largest nodal centers of the region, among themselves and with the settlements in the gravitational sphere. The paper analyzes the spatial and functional impact of nodal centers in the Serbian part of Banat. This region is located in Vojvodina Province, Northern Serbia. Nodal centers are presented as poles of convergence of the population and functions, from which development impacts — the main factors of socio-economic transformation of the region — are spreading out. The paper also deals with the possibilities for achieving balanced regional development presented through the prism of the functional impact of nodal centers in that process. Nodal (functional) region is a theoretical basis of the work. Also, the nodal region is a starting point of functional-process paradigm, resulting from modern processes which change the structure of space by their functional influence. Functional-process paradigm is one of the basic characteristics of modern regional geography.

Key words: functional regions, nodal centers, balanced regional development, Banat.

Introduction

At the beginning of the second half of the 20th century the level of development of the city networks in the Serbian part of the Banat Region (Vojvodina Province, Northern Serbia), and especially their spatial-functional cohesion, was extremely low. Planned implementation of industrialization and urbanization is emphasized comparative advantage of urban settlements and their close surroundings, at the expense of rural areas. Cities developed disproportionately rapidly in relation to their agrarian-rural surrounding areas due to the concentration of development activities. This uneven development trends between rural-urban areas were particularly pronounced in the monolith cultural landscape of Vojvodina Province. As a dominantly agrarian region, with minimum physiognomic and functional differences between cities and villages,

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Banat passed through a complex period of dynamic socioeconomic changes. Strong nucleuses of secondary activities were created in the largest cities of Banat. But, the functional links with other rural areas were mainly one-way. These links were based on the so-called “flushing effect” (by model of circular cumulative causation). The effects of these development influences of the cities in the network of settlements in Banat were extremely high, and their impact on the transformation of rural areas was very strong. Towards the end of the 20th century, the process of transition of economic activity leads to a stronger development of the tertiary sector of the economy, which does not have such expressed polarization effects. By the end of the 20th century spatial distribution of the population has significantly changed, and regional development disparities between the nodal centers (cities) and the periphery (villages) reached a high level. The basic cause of present unbalanced regional development lies in these socio-economic processes, which have defined spatial-functional connections in the network of settlements in Banat during the second half of the 20th century.

Theoretical basis of the concept of nodal regions

Functional region, as a new form of studying the elements of space, is succeeding in the center of the scientific community with the emergence of industrialization and urbanization. These two processes are characterized by high concentration of population and functions in the cities (nodes), which have become the centers of functional organization of surrounding area. In this way, new regional structure — city or urban (nodal) region — has been formed. The concept of nodal region (Krunić, 2012; Symanski & Newman, 1973; Tošić, 2000b; Tošić & Nevenić, 2007) is based on the fact that urban centers with their functions affect regional integration, disintegration and differentiation of complex and heterogeneous space, thereby forming a specific spatial system (urban, functional or nodal regions). In nodal region, based on city-surroundings (villages) relation, there is a permanent interaction that influences the transformation of space through changes of its demographic, socio-economic, functional and physiognomic characteristics.

Because of this role, the cities are the basic constituent element of the settlement network and they cannot be studied apart from surrounding area, in which they have emerged and expanded their zones of influence. About the importance of studying the town together with its surroundings, as well as the importance of considering the interconnections and relationships between the cities (nodes), Jean Gottmann (1984) said: “To understand the evolution of the modern world, of fundamental importance is the study of networks of cities” (p. 1). According

to Massey, Allen & Pile (1999) “It is impossible to tell a story about a town without understanding its connection with the surrounding area. Cities are essentially open, they are places of meeting — focus of geography of social relations” (p. 2).

Vresk (1990) pointed out that the nodal regions are separated by the principle of functional integration and interdependence, and the main directions of spatial circulation of people, resources and information moving through the individual nodes (cities). Constitutive elements of nodal region (settlements) maintain among themselves, especially with the main center, significantly stronger functional interaction, then with the other settlements in the region (Lawrence & Holmes, 1971). According to Vresk (1990), nodal regions are hierarchically organized functional systems, which means that a certain number of lower range settlements gravitate to the nodes (city) at the higher level of hierarchy. The central node (city) has a dominant role in the spatial-functional structure of space, while other settlements are classified as nodal centers of the second, third (etc.) order, depending on their functional capacity (Lawrence & Holmes, 1971).

The origin and development of nodal region, forms and shapes of its territorial and chronological expression, as well as importance and role in regional planning are detailed elaborated in many papers (Tošić, 1999; 2000a; 2012; Vresk, 1990; Friedmann, 1956; Boudeville, 1968; Symanski & Newman, 1973; Camagni, 1993; Dawkins, 2003; Parr, 2004 etc.). Nodal region is a complex, hierarchically composed system, consisting of the points (cities) of similar or different level of development. Nodality, which is a set of interactions which nodes together generate, provides a functional viability of the nodal regions (Haggett, 1972). In simple terms “The nodal regions are spatial forms derived from the role of cities in regional organization of space” (Tošić, 2000a, p. 51). The most important integration factor of nodal regions is functional connections and relationships that take place within it, expressed as a movement of people, material resources, ideas, money, information etc. There are two basic forms of physical expression of nodal region: monocentric and polycentric (Figures 1 and 2). Monocentric regional system is composed of one node and fields in which intensive connection is made under its influence. On the other hand, polycentric system consists of several, mostly hierarchically leveled nodes and their surrounding (Tošić, 2012). During the industrial phase of urbanization, the monocentric type of functional urban region was dominating. On the other hand, the post-industrial stage of socio-economic development is characterized by the diffusion of innovation and decentralization of urbanization, which is spatially expressed by the emergence of polycentric functional urban region. Friedmann (1956) has established the nodal region in the center of regional planning and

pointed out that it is the planning basis of the industrial economics. At the beginning of the 21st century, we can say that the nodal region is a basis of post-industrial economic, organization, using and spatial planning (Tošić & Nevenić, 2007).

In the seventies of the 20th century the concept of nodal-functional region got in the middle of functional urban region model, which represented a new form of studying the territorial impacts of the urbanization. Functional urban region is created from Walther Christaller's central place theory (A. Getis & J. Getis, 1966). Its base is the monocentric nodal region. Territorial expression of this theory makes one central settlement (nodes) and other villages in its gravitational sphere, which together form a functional urban area. All settlements in the region have their own functional areas, and the strongest one belongs to the city (node).

The modern stage of economic development directs socio-economic and spatial relations towards decentralization and depolarization. Increasing importance of tertiary sector activity in the world's economy and developing of modern information technology have caused complication and intensification of spatial-functional relations, not only between the cities and surroundings, but also between large urban regions. In conditions of modern economy, the organization of functional relationships between the major urban regions moves in the direction of networking. Since the 1990s, researchers suggest the emergence of a new model of spatial organization of the settlements based on the so-called "network model" (Camagni, 1993; Batten, 1995; Castells, 1996, etc.). Essentially, the network model represents a critique of current concept of central places and it is based on nodality, functional complementarity, two-way relationships and connections between settlements, etc. The role of nodal-functional concept in the network model is essential. Although the network model represents a dynamic, decentralized, polycentric system, its coherence is maintained across the functional connection and relation between the nodes (cities).

The nodal regions — the basis of the principle of polycentric and balanced regional development

Reducing development disparities and achieving balanced regional development is one of the most important goals of development policies, from micro to macro regional level. Instrument and aim of reducing regional development disparities in the European Union is the concept of polycentrism, formulated in detail and clarified in ESPON reports (European Spatial Planning Observation Network

[ESPON], 2005). The concept of polycentricism represents one of the instruments of decentralization, which reduces differences in the level of socio-economic development between the core and its periphery. Cities are the holders of balanced territorial development, which are located in the center of functional urban areas (with the principle of nodality as a basis of development). The ESPON program proposes the following definition of polycentricism: “Polycentric urban system represents a spatial organization of the cities, characterized by a functional division of labour, economic and institutional integration and political cooperation” (ESPON, 2003, p.3).

There are several synonyms in the literature within the various aspects of discussion about polycentric urban regions, as contemporary forms of nodal-functional regionalization. Camagni and Salone (1993) considered polycentricism through notion of “city networks”, while Westin and Östhol (1994) introduced a concept of city region with multiple cores, “multicore city region”. On the other hand, Batten (1995) defined network cities - “network of the cities”, while Dieleman and Faludi (1998) introduced the term polynucleated metropolitan region. Each of these concepts is based on a polycentric settlement structure and emphasizes polycentricism as the basic paradigm of spatial-functional organization of settlements. At the end of the 20th and the beginning of the 21st century, conceptions of “polycentric urban regions” are dominant in the discussions on functional interactions and spatial organization of the system of settlements. The network cities paradigm underlines the importance of common market, territorial cohesion and mutual cooperation between the cities, for whole and balanced regional development. Defined in one or the other way, contemporary theoretical concepts perform reorientation (decentralization) of spatial relations in the settlement system, from the central place theory to theories of polycentric development.

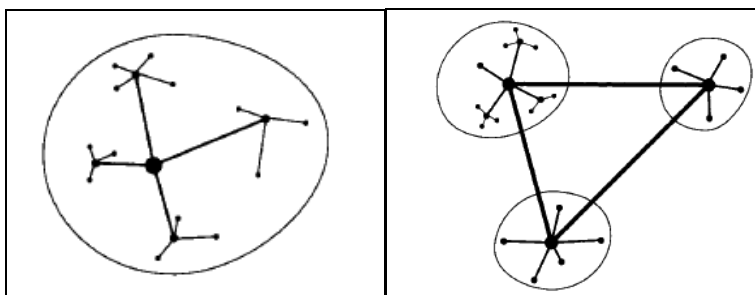


Figure 1. Monocentric urban structure Figure 2. Polycentric urban structure
(Source: Batten, 1995)

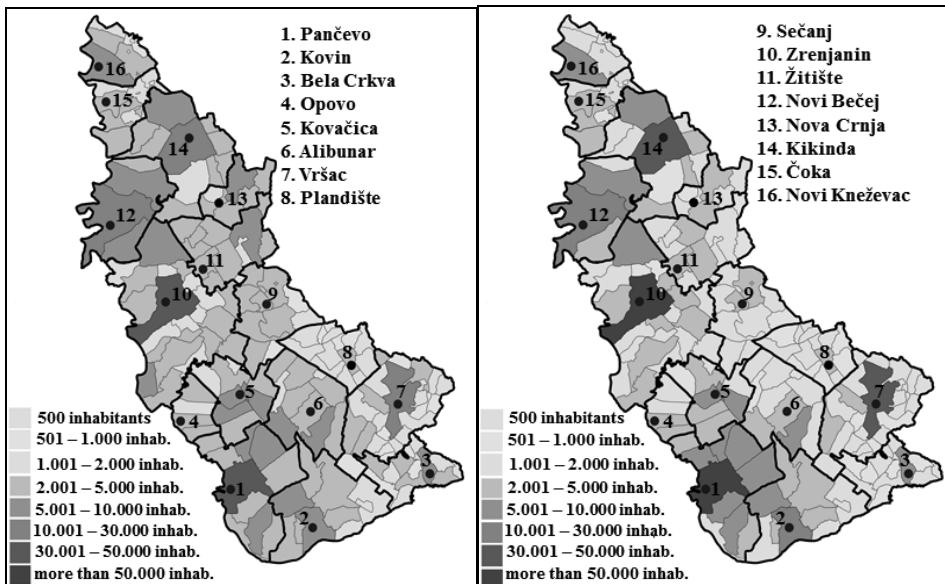
Polycentric urban regions could be defined as a historically, politically and administratively independent, infrastructure well-connected system of the cities, among which none of them stands out by political, economic, cultural, or population domination (Kloosterman & Lambregts, 2001). The level of interconnectivity and functional specialization is usually higher in polycentric urban region than in the surrounding areas, with different settlement structure (Parr, 2004). Bailey and Turok (2001) pointed out the advantage of formation and maintenance of strong relationships between neighboring cities with aim to develop complementary and specialized settlement structure, relative to creation of large urban conurbations which could influence the increase in uneven regional development. Region is considered as polycentric as long as individual cities and smaller settlements (villages) maintain mutual functional relations that contribute to a balanced regional development.

Nodal centers and demographic polarization of Banat

Processes of demographic polarization in the Banat region (over the last six decades) are manifested by intensive concentration of population in nodal (city) centers, on one hand, and rapid depopulation in rural areas, on the other. This has led to the continuous increasing of urban population, functional and physiognomy development of existing cities, formation of new urban settlements, gradual urbanization of suburban areas. In the second half of the 20th century urbanization and spatial redistribution of population are characterized by 3 phases. The first phase lasted until the eighties. It was characterized by the development of industry in the cities and spreading out their nodal-functional impacts. This phase was marked by strong migratory movement from rural to urban areas, causing extensive spatial redistribution of the population. The strengthening of demographic capacity of nodal center created the first precondition for increasing regional disparities. The second phase starts from the middle of the eighties and lasts until the beginning of the 21st century. Relocating the demographic potential from rural to urban areas has taken place in parallel with the transition of nodal centers from industrial to post-industrial stage of development. Along with the the economic migration, whose intensity has weakened until the eighties, an important component of population growth in urban centers was also a natural increase (cities are also the most vital biological areas in the region). The third phase (one and a half decade in 21st century) of the spatial distribution of Banat population is characterized by the opposite demographic trends. Horizontal (spatial) movement of population toward the cities (nodal centers) initiated by economic factors, weakened almost completely. Economic migrations are taking place within larger nodal (urban) regions, mostly on the basis of daily labor migration (daily urban systems).

The Figures 3 and 4 show the changes in the spatial concentration of the population in the Banat region in the period after the Second World War. In 1948, Banat was a region with a relatively uniform density over the entire area. Most of the settlements (75, or 43%) were in the category from 2,000 to 5,000 inhabitants, zone of extreme depopulation did not exist, while nodal centers represented zones of larger concentration of population. Centers with expressed spatial concentration of the population could be divided in two groups. Pančevo and Zrenjanin belong to the first group, characterized by extremely high concentration of population. In 1948 these two cities were in the category from 30,000 to 50,000 inhabitants. The second group includes Novi Bečej, Kikinda and Vršac (from 10,000 to 30,000 inhabitants). In 1948, 23% of the total population lived in the five largest cities of Banat. In the period up to 2011, there was an intensification of spatial polarization of population. Four largest nodal centers of the region (Pančevo, Zrenjanin, Kikinda and Vršac) moved to a higher category, while on the other hand, the number of less populated settlements also increased (in 1948, 14% of the population lived in the settlements of up to 2,000 inhabitants and in 2011, 18% of the total population in the region). Polarizing effect of the four largest urban settlements in Banat is best reflected in the fact that according to the 2011 census there lived 40% of the total population in the region (process of disperse concentrations). On the other hand, the decades of economic migration to the nodal centers have caused appearance of the zone with distinct depopulation, especially in the border area of eastern Banat. The increasing uneven population density is one of the first preconditions for the formation of uneven regional development.

In the early phase of industrialization, a rapid population increase occurred in the suburban areas of Zrenjanin (Elemir, Ečka, Klek, Lazarevo, Lukićevo and Stajićevo) and Pančevo (Jabuka, Kačarevo and Starčevo). These settlements are characterized by large proportion of commuters (daily migrants) and non-agricultural population. Secondary and tertiary sectors of economy have developed after the relocation of certain city functions into the suburban villages (especially in settlements in Pančevo gravitation zone). Permanent functional integration of surrounding villages with nodal center leads to formation of functional urban area. Gravitation zone of Pančevo is an integral part of the Belgrade metropolitan area. Vicinity of Belgrade has affected stronger concentration of population in Pančevo suburban area (Figure 4). Also, this is why depopulation is delayed in Pančevo suburban area (in the villages near Pančevo depopulation is present since 1991, and in Starčevo since 2002).



Based on the Figures 3 and 4, we can see a high concentration of population in the cities of Banat. During the second half of the 20th century the largest cities in the Banat region (Zrenjanin, Pančevo, Kikinda and Vršac) represented regional poles of growth and development. The largest population increase in examined period is recorded in Zrenjanin and Pančevo, and in Kikinda and Vršac in lower intensity. In 1948, 20% of the total population lived in four largest cities, but in 2011, there lived 40 % of all inhabitants in the region.

Nodal centers — generators of spatial-functional relationships

In order to determine the importance of nodal centers in spatial and functional relations and connections in the Banat region, socioeconomic and demographic indicators were analyzed in the context of functional development of settlements. Functional transformation of settlements is observed through the prism of changes in the structure of population activities. This type of analysis in a quality manner show spacious and temporal impact of nodal center on the functional development in Banat.

For a long time functional uniformity was the main characteristic of the Banat region. Systematic development of economy during the second half of the 20th century leads to a functional stratification and significant changes in the

structure of activity in the Banat settlements. Planned industrialization and urbanization have affected the grouping of secondary and tertiary activities in the towns. The need for a labor, in functionally developed settlements of the Banat region was met by engaging the rural population. These cause–effect relationships between cities and villages have caused fundamental changes in the structure of population activities in the entire region. Also, these relationships led to the establishing of “transitional” types (between villages and cities) of settlements (suburban areas and smaller population municipal centers which are functionally underdeveloped).

The urban settlement gets the character of nodal center when with its functional capacity starts to affect the demographic, social, economic and environmental changes on its surroundings. Pančevo and Zrenjanin are the cities with a major impact on the functional transformation of the settlements in their surroundings. With the expansion of functional capacities of nodal centers, the population of suburban areas has become an integral part of growing functional–urban system. Already in the sixties of the 20th century, the share of employed in the secondary activities in suburban settlements was high (31.38%). These are commuters, inhabited in suburbs, but employed in the cities (nodes). The number of industrial workers (secondary sector of economy) in 2011 was extremely high. Its relative share in suburban settlements is higher than in urban areas (about 48%).

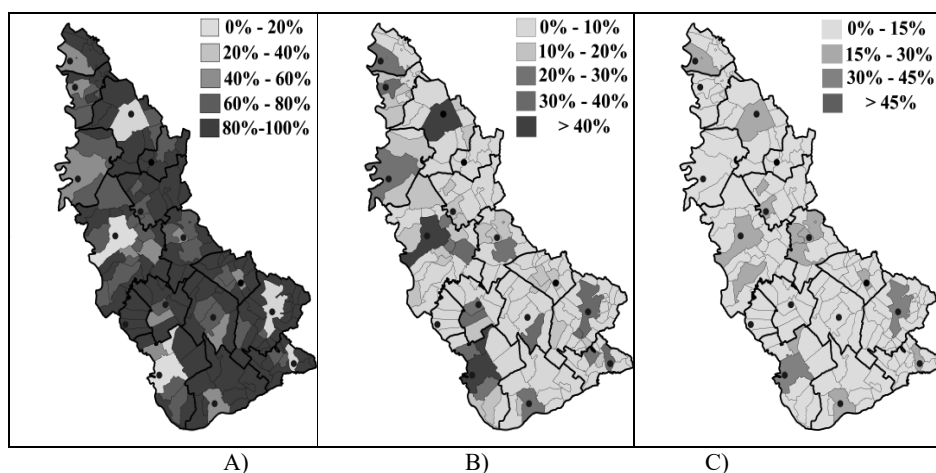


Figure 5. A) The share of primary sector in the structure of active population by activity in 1961, B) The share of secondary sector in the structure of the active population by activity in 1961, C) The share of tertiary - quaternary sector in the structure of active population by activity in 1961 (Source: V. Živanović, 2016)

In the sixties of the 20th century Banat was characterized by relatively equal level of development in almost entire territory. Settlements with extremely high share of primary activities (from 80 to 100%) were dominating in the region (Figure 5 A). The same Figure shows a very low rate of employees in the primary sector in the cities. Also, in the second half of the 20th century industry was located and developed in the cities. The Figure 6 shows that in 1961 Pančevo, Zrenjanin, Kikinda and Vršac were the zones of extreme concentration of industry (growth poles) and potential growth poles of surrounding areas.

In 1961, Zrenjanin with 56% and Pančevo with 55% in the secondary activities represented the cores of industrialization and urbanization and important future growth poles on the regional level. With the expansion of the zone of the functional impact of these nodal centers, the structure of the economy in their suburbs extremely changed. In addition to increasing growth of secondary activities in the structure of active population by 2011, an extremely high share of these activities is particularly noted in the wider influence area of the cities (more than 40% of the active population were engaged in secondary activities) (Figure 6 B). A higher level of economic development of Pančevo and its gravitation zone in relation to the rest of the Banat region is the result of impact of strong functional-urban system of Belgrade.

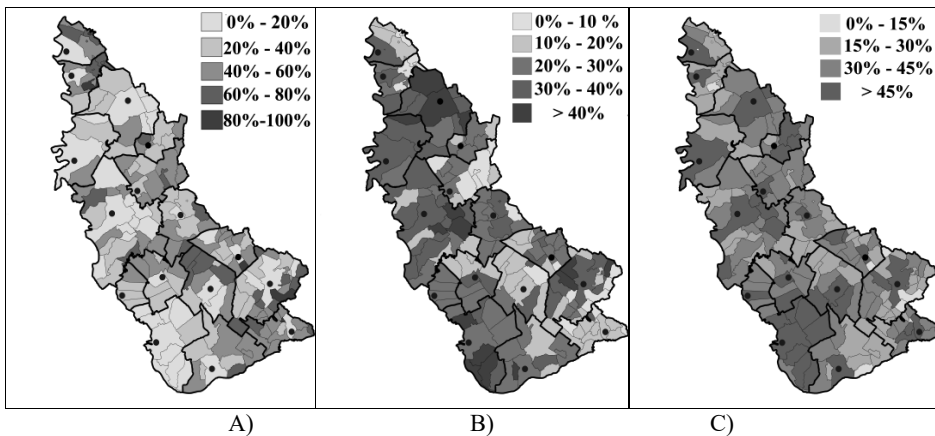


Figure 6. A) The share of primary sector in the structure of the active population by activity in 2011, B) The share of secondary sector in the structure of the active population by activity in 2011, C) The share of tertiary-quaternary sector in the structure of the active population by activity in 2011 (Source: V. Živanović, 2016)

In the sixties of the 20th century the tertiary-quaternary activities referred exclusively to major cities and municipal centers (Figure 5 C). Servicing, health, educational and cultural activities of rural areas were extremely underdeveloped,

due to planned orientation of population to be engaged in agriculture. At the beginning of the second decade of the 21st century (2011), high level of development of tertiary-quaternary sector has been maintained in the largest Banat cities (Pančevo 70 %, Zrenjanin 59 %, Vršac 66 %, Kikinda 55%). Also, the increasing share of this sector of economy is observed in the structure of population activities in suburban (30 to 45 %) and rural (15 to 30 %) settlements. This statistical overview could give a false file about the functional development of these parts of particular nodal region. High percentage of engaged in the tertiary – quaternary sector in the suburbs does not mean, a priori, a high level of development of these economic sectors in these settlements. Suburban settlements are located in a very close gravitational sphere and functional impact zone of the nodal centers. A large number of commuters inhabit the suburban settlements, but they are employed in nearby towns.

The Table 1 shows another form of functional transformation of settlements, based on mutual relation of economic sectors in the structure of population activities. The functional transformation of all municipal centers has been analyzed. Each of municipal centers represents one nodal center of different hierarchical levels (from local to national). Functional evolution of Banat, in the second half of the 20th century, took place in accordance with the functional evolution in the whole territory of the Republic. The transition from primary to secondary and tertiary activities included all municipal (nodal) centers in the region. According to the census of 1961, all local gravitational centers based their economic development on agrarian activity. Typical agrarian settlements were Alibunar, Opovo, Kovačica, Sečanj, Nova Crnja, Žitište. None of the nodal centers from higher hierarchical level belonged to the agrarian–industrial and agrarian–service type of settlement. The secondary sector of activity in the cities has already been developed. According to this, Kikinda belonged to the industrial–agrarian type, and Pančevo, Zrenjanin and Vršac were industrial–service settlements.

Table 1. Changes in the functional type of settlements in the period 1961–2011²

Functional type of settlement	Relation of economic sectors activity	Number of settlements in 1961.	Number of settlements in 2002.
Agrarian	I>or=60%	6	0
Agrarian-industrial	I>II>III	7	0
Agrarian-service	I>III>II	5	1
Industrial	II>or=60%	0	0
Industrial-agrarian	II>I>III	1	0
Industrial-service	II>III>I	3	0
Service	III>or=60%	0	6
Service-agrarian	III>I>II	0	2
Service-industrial	III>II>I	0	7

Source: Federal Statistical Office, SFR Jugoslavija (1965), Statistical Office of the Republic of Serbia (2014)

By the beginning of the 21st century tertiarization of economy have already affected almost all municipal centers in Banat. Agriculture remained dominant economic activity only in Nova Crnja. Based on the data in the Table 1, it can be noticed that tertiarization of regional economy is the main direction of functional transformation of the Banat region. Even 6 municipal centers (Alibunar, Bela Crkva, Sečanj, Kovin, Pančevo and Zrenjanin) belong to the service type of settlement. Service–agrarian activity is dominant in Žitište and Opovo, while Vršac, Kovin, Plandište, Kikinda, Novi Kneževac, Čoka and Novi Bečej belong to the service–industrial type.

Conclusion

The model of polycentricism, as a basis of functional integration and future regional development, is prescribed in regional planning documents about Vojvodina and Banat “Regional spatial plan of the autonomous Province of Vojvodina”, as well as in the spatial plans of local communities. The plan in detail elaborates and defines the problems and deficiency of current uneven socioeconomic development of the region, as well as the methods, instruments and measures for overcoming. Banat is “the area in which development

² The data in Table 1 relate only to the municipality (nodal) centers. Functional typology model of the settlements is taken from: Tošić, Krunic, Milajić (2009). *Spatial organization prospecting of Južno Pomoravlje settlements network in the function of spatial plan development*. Demography, 6, p. 175 – 195.

disproportions are particularly expressed in relationships between urban centers and suburban settlements (Provincial Secretariat for Urban Planning and Environmental Protection, 2011).

Dynamic and powerful urban (nodal) centers, with special emphasis on achieving strong functional relationships with their surrounding (nodal-functional region), will have a key role in achieving balanced development. The interrelation of the cities should be based on the principles of spatial-functional integration. The polycentric development includes the formation of common spatial and development strategies, with urban “clusters”, especially in border areas, as well as strengthening intraregional economic cooperation. The Regional Spatial Plan of AP (autonomous province) of Vojvodina defines the development goals of nodal centers as holders of the future development in the settlements network:

- Spacious, functional, economically, socially and ecologically balanced urban development;
- Development of territorial cohesion based on the principles of sustainable development, with the activation of capacity of the cities and other settlements to connect with the surrounding, increasing rural-urban cooperation;
- Development of the cities that will have a key role in the regional development of “urban nodes”; cities which due to specific location within settlements network and regional specificities have special significance; cities in the border zones that will become important factors in cross-border cooperation with the neighboring countries (Kikinda and Vršac) (Provincial Secretariat for Urban Planning and Environmental Protection, 2011).

Planning documents that define the future directions of the spatial-functional development of the Banat region recommend the model of networked nodal region as a means to an end. Operational objectives of the future regional development are based on the functional urban areas. These objectives are:

- Networking and better linking of functional urban areas for balanced regional development.
- Institutional strengthening of the regional administration.
- Defining the development policies for currently undeveloped functional urban areas and defining a policy that would allow independent development and progress of those areas that cannot be integrated in the functional urban area.

Three functional urban areas of national importance (Pančevo, Zrenjanin and Kikinda) and one urban area of the regional importance (Vršac) are planned to be developed in the Banat region. Nodal centers of lower hierarchical rank, which integrate settlements from their close surroundings, are formed in the zone of influence of each of these functional urban areas:

- Functional urban area Pančevo: Kovin, Kovačica, Opovo and Alibunar
- Functional urban area Zrenjanin: Žitište, Žabalj, Sečanj, Nova Crnja and Novi Bečej
- Functional urban area Kikinda: Novi Bečej, Nova Crnja, Čoka and Senta
- Functional urban area Vršac: Plandište and Bela Crkva (Provincial Secretariat for Urban Planning, and Environmental Protection, 2011).

The concept of the implementation of functional urban areas aims to increase territorial cohesion in the region, based on the principles of nodality and sustainable development. In order to reduce regional development disparities, it is necessary to activate maximum development capacity of all nodal centers, link them with surroundings and intensify urban-rural cooperation. Otherwise, the models of theoretical and planned directions of future functional space management will not get practical implementation, and balanced regional development will remain a utopia.

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