Contemporary Spatial and Hierarchic Characteristics of Urban System of Bosnia and Herzegovina

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1 ABSTRACT

Spatial and hierarchical characteristics of urban settlements (cities) of Bosnia and Herzegovina were analysed in the paper. Graph theory method was used, and accessibility of settlements was determined according to time distance in the road network by using main traffic routes. Basic characteristics of the urban system were determined by main characteristics of its constituent parts: on the one hand with the urban network as a set of focal points in Bosnia and Herzegovina interrelated by traffic routes and on the other hand, by direction and intensity of traffic movements that are ongoing through the network, and which determine the position and significance of single cities in spatial organization of the observed area.

2 URBAN SYSTEM OF BOSNIA AND HERZEGOVINA

In addition to Sarajevo as the state capital, the network of urban systems consists of regional centres, among which the most developed are: Mostar, Banja Luka and Tuzla. Besides these centres, there are about 15 subregional centres which are bearers of development of the particular higher-rank functions against municipal centres, within the functional-hierarchic units. Small and medium towns located in the area of large cities, take advantages and also the deficiencies of large cities. Thus, spatial and hierarchic urban settlements or regional centres were formed in Bosnia and Herzegovina within which, on the basis of comparative experiences of the single towns, polycentric system of organically connected totalities is developing, adjusted with natural conditions. In accordance with social-economic and other factors of development, the forms and dynamics of urbanisation in Bosnia and Herzegovina are different. With economy strengthening, which has more recently been primarily a result of development of secondary and tertiary activities in the rural settlements; central settlements gradually change their hierarchical picture. Starting from the statement that urban systems are sets of elements between which there are certain connections and relations, it may be concluded that that urban system is made of the cities (hubs) and connections for traffic of people, goods and information, thus creating a functional wholeness in which a change of one element affects all other elements in the system. By means of ARC/INFO 3.5 programme, respectively NETWORK subprogram, utilisation of connections in time (isochronal) accessibility was tested.

During analysing the accessibility of road junctions, computer has recorded usage of each individual connection in special files. Number of utilisations of connections ranges from 20 to 6.348. The most utilised connections are located around the most accessible junction points. The connections that are under or above average value of 988 of utilising the connections were shown on Map 1. Even 103 connections or 71 per cent use fewer roads than average for Bosnia and Herzegovina. On the other hand, basic, the most important traffic routes in Bosnia and Herzegovina can be clearly distinguished. At this, one should have in mind that it is about connecting the cities in Bosnia and Herzegovina, and that the most important connections among them largely concur with international traffic connections passing through area of Bosnia and Herzegovina. (Fig. 1)

The basic characteristics of urban system were defined by main characteristics of its constituent parts: on the one hand by urban network as a group of junction points (cities) interrelated with traffic routes, and on the other hand with a direction and intensity of traffic movements that are ongoing through the network, and which define the place and significance of particular cities in spatial organisation of the observed area. As the urban network, as one of the fundamental elements of urban system consists of the cities and traffic routes by which interaction is ongoing, it is possible to analyse it by mathematical methods (network models) that were studied in a separate branch of maths- topology. Graph theory is quite frequently applied in this, according to which topological characteristics, directions and intensity of interaction can be determined, and the significance of single elements in system (Harvey, 1969).

Position and significance of junction points (city), is determined by degree of accessibility. That accessibility can be determined according to different criteria. The simplest method of determining the accessibility consists of determining the number of connections that are used in connecting all pairs of junction points in

the network. As only topological graph is used at this (network of connections and junction points in which there is only an information   on existence the connection between single junction points, and all characteristics of settlements were neglected-e.g. number of inhabitants and connections, e.g. length, quality of traffic route etc.) such accessibility is named topological. More complex and demanding analyses take into consideration characteristics of particular connections, therefore we talk about accessibility on the grounds of real (spatial) distance, according to time or price of travelling between single junction points- settlements etc.)
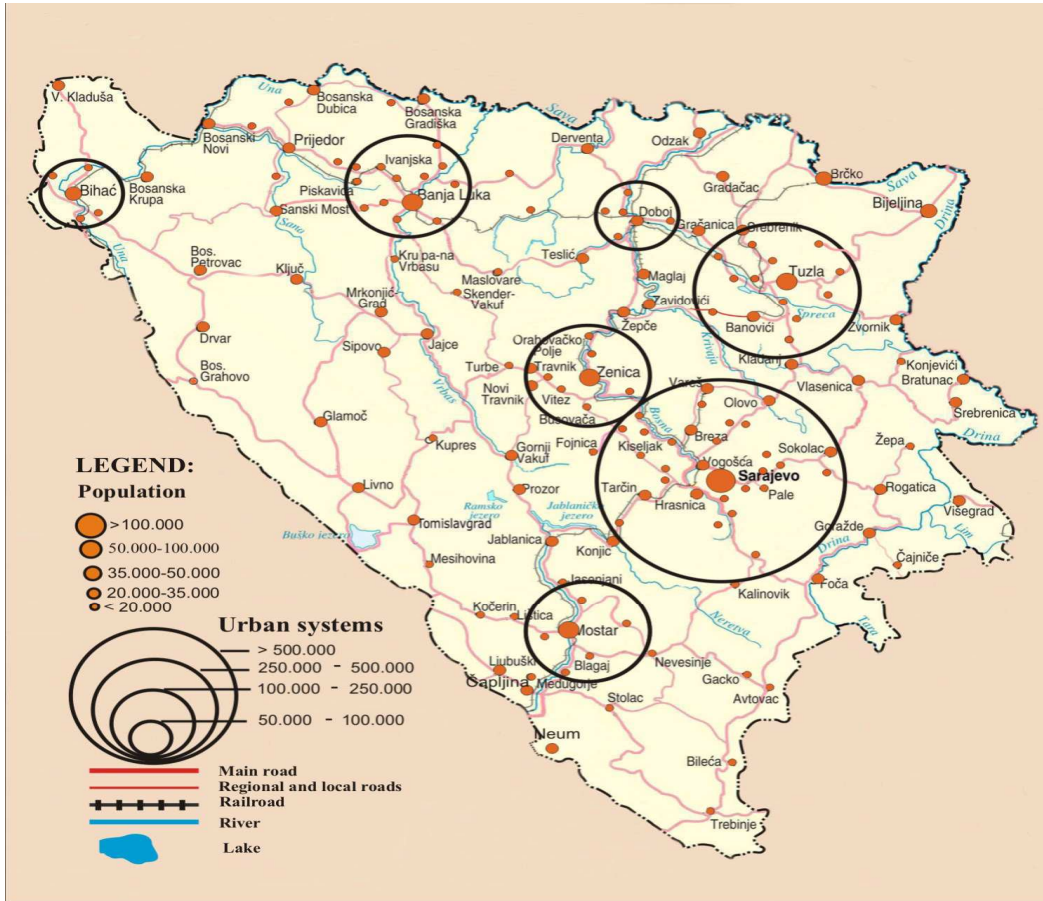

Fig. 1: Traffic network and distribution of cities in Bosnia and Herzegovina, 2010

3   CITIES IN THE NETWORK OF BOSNIA AND HERZEGOVINA

Some junction points in the urban network of Bosnia and Herzegovina are more important than the others because they are summing junctions of larger number of connections, therefore, such junction points are said to have a good accessibility. It is assumed that the settlements in which there are most of central functions will be most accessible, as it is a precondition of better spatial organisation. The least accessible junction points are located in south and east Bosnia and Herzegovina (Foča, Goražde, Trebinje and Mostar).

Generally, density of isolines increases by going from the Neum coastline toward the central cities

(particularly of central Bosnia and Herzegovina), which are the most crowded junction points in the urban system of Bosnia and Herzegovina Areas of equal accessibility were outlined on Map 1, and the cities with values under and above the average number of inhabitants were marked on it. It is noticeable that, according to expectations, junction points in the fringe areas of Bosnia and Herzegovina are less accessible than the average. Bending the isolines along the major traffic routes is obvious, so that certain directions even might be drawn into the cartogram.Value and distribution of the cities indicate to problem of marginality. Certain parts of urban system (regional subsystems) are the result of territorial form of Bosnia and Herzegovina, but also of unfavourable inheritance from the times when urban systems of Bosnia and Herzegovina developed as a subsystem of other larger systems.

 Major centres were out of the territory of Bosnia and Herzegovina (Ljubljana, Zagreb and Belgrade), and before World War II some B&H cities, due to different political geographic relations, were not fully (or were

not at all) a constituent part of the urban system of Bosnia and Herzegovina. After World War II, urban system of Bosnia and Herzegovina was developing inside the Yugoslav Federal State of that time, and it was only after Bosnia and Herzegovina had become an independent country that conditions for development of the unique national urban system were met and its adequate traffic connections were created. With regard to traffic accessibility, some cities become less traffic accessible (fringe cities) within the frame of national urban system, but in time that position may bring them even some advantages. It can be said that traffic accessibility indicates to regional differences inside the urban system of Bosnia and Herzegovina. The time interval of these processes, respectively lagging of Bosnia and Herzegovina behind the most developed European countries, has lasted for 30-40 years.

The population of Bosnia and Herzegovina developed according to industrial society model, which meant a gradual decrease of birth-rate, decrease, stabilization and then a mild increase in mortality, as well as strengthening the tendency of weakening the dynamics of growth of total population number, respectively lower and lower growth rates. It is characteristic of Bosnia and Herzegovina that a large number of deagrarized population belongs to nonurbanized population, so this rather high level is maintained almost in all inter-census periods, and reached its maximum in 1981 with 46,5 per cent and dropped to 37,2% in 1991. This part of the deagrarized population, which works, but does not live in a city, has an essential influence on daily migrations, and at the same time in a very specific way affects the system of settlements. This population was not able to settle permanently in the cities, and tried to get closer to the place of work by reproducing a scattered system of construction out of the urbanised area. The urbanized population has had high growth rates in entire period. The reached level of urbanisation in 2010 (as per criterion according to which settlements with more than 2000 inhabitants are deemed urbanised) of 49,5 per cents, shows that Bosnia and Herzegovina belongs to countries having a medium urbanisation level. Accelerated urbanisation level in the period from 1991 to 2010, may be attributed to considerably larger role of smaller settlements that become secondary centres in the municipalities, which is in accordance with the proclaimed principles of polycentric development that was supported also by the first generation of spatial plans of the municipality. Regarding active population share, in the group of settlements from 400-600 it was 4,9 per cent, in settlements up to 200 settlements it was 4 per cent, and in the settlements with 200-400 active inhabitants it was 3,8 per cent (Table 1 and Fig. 2).

The highest growth of number of settlements was achieved in a group of settlements from 2.001-10.000 inhabitants, and the highest demographic growth was achieved by settlements in the group from 50.001 - 100.000 inhabitants. The previous trends of the observed phenomena, as well as their anticipated development demonstrate that in the area of Bosnia and Herzegovina there is a simultaneous tendency of concentration, and also some forms of dispersion. On the one hand, that dispersion is a consequence of the form of settling in numerous (approx 5.800), scattered rural settlements that are permanently abandoned, but also keep significant part of population. On the other hand, a relatively dense network of centres was developed, which represents points in space at which social efforts toward more steadfast development are crystallised.

Settlement size– number of inhabitants	Active population (%)
to 200	4,0
201-400	3,8
401-600	4,9
601-800	3,6
801-1.000	3,5
1.001-1.200	3,5
1.201-2.000	3,6
2.001-3.000	4,3
3.001-5.000	3,1

Table 1: Total number of active inhabitants in economic activities per 100 inhabitants in the settlements without central functions and active population share in 2009
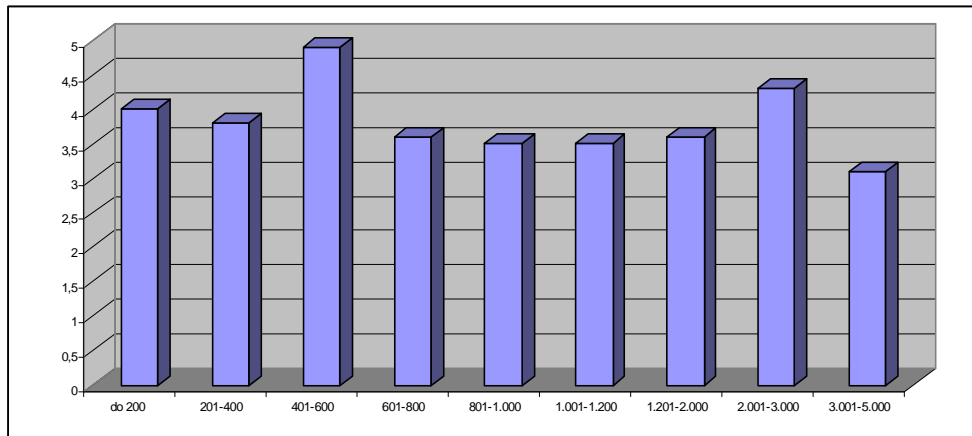
Fig. 2: Active population share (%) per100 active inhabitants in settlements for 2009

However, in order to get acquainted with urban structure of the settlements in Bosnia and Herzegovina as objectively as possible, we have applied four criteria. These are: settlement size, agricultural population share, share of households without agricultural households and share of employed workers of given settlement in total employment. The parameters have not been randomly selected in the model; they are a result of conducted analysis. By means of the mentioned models in Bosnia and Herzegovina according to the 1991 census data, five urban settlements in which 45 per cent of population lives, have been separated. In structure of urban settlements according to size, urban settlements up to 4.999 inhabitants were prevalent, and there were 34 of them. There were 48 medium-sized urban settlements from 5.000 to 19.999 of inhabitants, while 2 urban settlements had over 100.000 inhabitants. In five largest urban settlements of Bosnia and Herzegovina, 16,72 per cent of urban population, respectively 38,2 per cent of total population lived. (Table 2)

Size of urban settlements according to number of inhabitants	Number of urban settlements	% of total number	Number of inhabitants	% of total urban population	% of total active population
100.000 and more	4	4,0	980.000	29,9	6,9
20.000- 99.999	15	3,0	870.000	26,6	56,4
5.000-19.999	55	1,1	780.000	23,8	23,3
2000-4.999	42	2,1	640.000	19,5	13,4
Total	116	100	3.270.000	100	100

Table 2: Structure of urban population of Bosnia and Herzegovina according to size of urban settlements, 2010
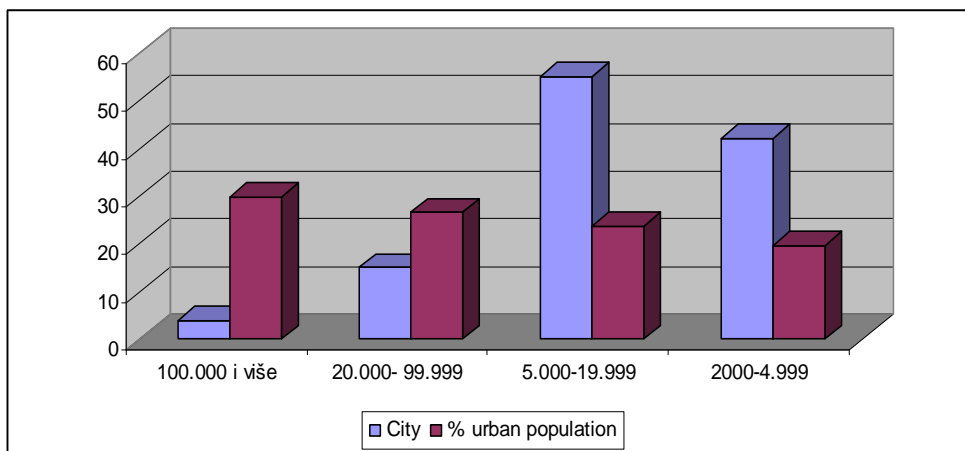

Fig. 3: Structure of urban population of Bosnia and Herzegovina according to size of urban settlements, 2010.

4 BASIC CHARACTERISTICS OF URBAN SYSTEM OF BOSNIA AND HERZEGOVINA

During analysis of urban system of Bosnia and Herzegovina, in the scope of this paper most attention has been paid to its hierarchic and spatial dimension. Basic goal is determining the deviation from certain regularities and currently achieved level of urban system development Analysis of hierarchic characteristics of urban system of Bosnia and Herzegovina has been performed by application of rank-size rule of the cities and indexes of urban primacy. It gave basic information on spatial dimension of the urban system of Bosnia and Herzegovina. Regular rank-size of the cities, respectively a deviation from it, also reflects in a certain way on spatial dimension of the urban network of Bosnia and Herzegovina. Besides the mentioned indicators, urbanisation level served as a comparative value with telecommunication system. Namely, the urbanisation level of a certain country or region, most directly depends on number and size of its cities (Vresk, 1992).

Basic characteristics of urban system are existence of three basics dimensions. These are hierarchic or vertical dimension, spatial or horizontal and temporal dimension. Hierarchic or vertical dimension reflects interdependence of cities in urban system. The cities within the urban system are in hierarchic relation. Smaller cities are functionally dependant on the developed, larger cities and, therefore, gravitate toward them. Influential areas of smaller cities of the urban system are therefore a part of influential area of the larger cities. In urban system, several hierarchic levels that are determined on the grounds of participation of central activities in the single cities, are distinguished. This dimension of urban system tells us about the number of hierarchic levels and centres of lower development that gravitate toward a centre of higher development.

The first more significant observations on hierarchic distribution of centres in a certain urban system appeared even before World War II. In 1913, the German geographer Auerbach noticed a regularity of distribution of towns with regard to their size. He has observed that a number of inhabitants on certain space, ordered by size, regularly decrease in relation to the largest city. On the basis of this idea, a model of rank-size rule, which explains the idea of regular vertical distribution the centres in urban system, was created. It says:

$$Sn = \frac{S1}{rnq}$$

In this formula Sn is a number of inhabitants of n city, S_1 is a number of inhabitants of the largest city, r is an ordinal numeral of city n in the series of cities ordered by size and q is a constant. (Vresk, 1986).

So, number of inhabitants of a city in a series of cities ordered by size is obtained when number of inhabitants of the largest city is divided by ordinal numeral of that city in the given series. Spatial or horizontal dimension represents a reflection of size of influential area of the urban system. With regard to size of urban systems, there are national, regional and local urban systems. Local or daily urban system consists of the town with its surroundings, which is functionally connected with it on daily basis. Daily urban system is determined on the grounds of the courses of daily migrations between the town and the surroundings. Thus, local or urban system is an area from which workers, pupils, students and others commute to the city every day for satisfying their needs, with simultaneous circulation of goods, people, information and alike.

Urbanisation process is the most intensive in local or daily urban system, with the highest concentration of population. Regional urban system represents a subsystem of the national urban systems; it is formed around larger and functionally more significant cities and has a higher level. The national urban systems consist of all cities, or all urban subsystems, among which there is a hierarchic interdependence at the level of particular country. National urban systems are more or less included into the international urban system. The international urban system is made of cities of the national urban systems. Global urban system consists of the network of interrelated global cities (Rebernik, 2008).

National urban systems have from five to seven levels, which depends on number of inhabitants, size of country, administrative and political division, urbanisation level and historical development of country. Each centre on certain hierarchic level has its influential area and its subsystem of the centre. More subsystems of lower level gravitate toward a centre of higher level. The highest level of nodality in the country has the capital, respectively the largest city. Judging by size of the cities, Bosnia and Herzegovina still has a very

poorly developed urban system. Dominance of smaller towns can be observed in it, and the lack of medium-sized cities. The towns with fewer than 5.000 inhabitants account for 65 per cent of all towns, and 33,8 per cent of towns have fewer than 2.000 inhabitants. On the other hand, only four towns in Bosnia and Herzegovina have between 50.000 and 100.000 inhabitants, respectively 4 towns with over 100.000 inhabitants (Nurković, 2005).

The basic characteristic of rank-size of the cities of Bosnia and Herzegovina is a clear dominance of Sarajevo, but in last decade of the 21st century a mild trend of decreasing a difference between Sarajevo and Banja Luka, the second largest city was (index of urban primacy in 1981 was 3,87, and in 1991 3,73)". In comparison with Sarajevo, all towns of Bosnia and Herzegovina are smaller than they should be according to rank size rule of the cities. For example, as a second largest city Banja Luka would have over 150.000 inhabitants, Mostar 130.000, Tuzla 150.000, etc.). If Sarajevo had around 980.000 inhabitants, rank-size would be much more regular. Such hierarchic characteristics of urban system of Bosnia and Herzegovina reflect on the spatial dimension of urban system (more uneven distribution of towns in the space with regard to their size and functional importance), which reflects in spatial difference of the achieved level of urbanisation of the single parts of Bosnia and Herzegovina. In 2010, 39,3 per cent of total population in Bosnia and Herzegovina lived in urban settlements. If we measure the urbanisation level with this percentage of urban population, then we can ascertain that Bosnia and Herzegovina reached a higher urbanisation level (51-75%) (Nurković, 2005).However, regional differences are noticeable on the level of large spatial-functional totalities (macroregions) in Bosnia and Herzegovina. So, the macroregions of Tuzla, Mostar and Sarajevo have larger share of urban population than macrorgions in the interior of Bosnia and Herzegovina. Explanation for these differences needs to be sought in poor agrarian basis and employment opportunities of population in industry and mainly in service activities (traffic and tourism), in the conditions of stronger and stronger littoralization. As per this indicator, we can say that certain macroregions had reached higher level of social-economic development than continental macroregions.

5 CONCLUSION

The key position and importance of the cities and connections that link the regions in the interior with other regions in Bosnia and Herzegovina have been determined. Such topologic characteristics of the urban network of Bosnia and Herzegovina emphasize importance of Sarajevo as the most significant urban centre, since Sarajevo, as the largest centre, has a more pronounced central position in urban network. According to accessibility, the regional urban system of Sarajevo as a core region is distinguished, and the other urban subsystems (Banja Luka, Tuzla and Mostar) have more or less emphasized peripheral position. The fact that with connection Sarajevo-Mostar-Tuzla-Banja Luka, traffic of the entire continental hinterland toward the seaside section is canalized, and a need has arisen for establishing the alternative direction for improvement of accessibility of the marginal parts of the urban system of Bosnia and Herzegovina. The towns situated in that traffic corridor have more favourable conditions for development that the others, situated on edges. . Accessibility of the regional urban systems of Tuzla, Banja Luka, Mostar is increased mainly by using the traffic routes passing through territory of Bosnia and Herzegovina. However, their inclusion into a normal traffic cannot be predicted with certainty for the time being. Results of analysis of using the connections clearly emphasize the most important connections in mutual connecting the towns of Bosnia and Herzegovina. The fact that those connections largely coincide with international traffic connections passing through territory of Bosnia and Herzegovina, is encouraging in the sense of construction and modernization of the road network of Bosnia and Herzegovina. With construction of highways on the most important traffic directions, traffic accessibility of the marginal parts of the urban system of Bosnia and Herzegovina will be considerably improved, as well as interconnections of four largest cities of Bosnia and Herzegovina, respectively their regional urban systems.

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