

GEODATA AND GIS AS A DECISION-MAKING SUPPORT INSTRUMENT IN HEALTHY CITY GOVERNANCE

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ABSTRACT

During pandemic and post – pandemic period, after global health crisis when public health systems all over the world faced numerous challenges, Healthy City Concept got completely new significance and meaning. Reaching the Healthy City values and qualities implies innovative approaches to urban planning and governance. One of the key elements of these efforts' effectiveness is enabling an informed and place-based decision-making. Providing the deep insight in complexity of urban health matters, from different stakeholder's perspectives, is possible only with usage of technologies, like digital cartography, Geographic Information Systems (GIS) with specially designed integrated spatial and socio-economic Geodatabases. In modern extremely dynamic negative development trends, power of the integrated information is of key importance for both immediate or long-term strategic action planning regarding the sustaining the desirable urban health norms. This paper presents the conceptual model of "Healthy City" Geodatabase, which was developed within the City of Belgrade case study. It spatially integrates all the publicly available information that relates to urban health and enables several multicriteria territorial analysis. Through the description of methodological approach, the content, and reporting details, we underline the operational potentials which could bring significant contribution to the sustainable urban governance. The results show that even the spatial integration of public information has potential to be effective instrument in decision-making process. Potentially, furthermore enhanced Geodatabase with all relevant information owned or produced by different stakeholders could lead to development of GIS based Healthy City Planning Support System.

KEYWORDS *_ GIS, Geodatabase, Healthy City, Urban Planning, Urban governance*

INTRODUCTION

Healthy Cities was launched with the intention of placing health high on the social and political agenda of cities by promoting health, equity and sustainable development through innovation and change. Achieving the vision of healthy cities is based on understanding the importance of action at the level of local communities and cities, and the key role of local governments (WHO, 2013). The concept was created in 1988 as a strategic body of the World Health Organization (WHO) - Regional Office for Europe, which encouraged the establishment of the approach "Health for All" (Tsouros, 2015).

The HC approach is based on the principles of cross-sectoral cooperation, community participation and empowerment (Wilkinson, 2010). The WHO defines the qualities of a HC (WHO, 1991). By translating these qualities into the contemporary context of the 21st century, the main goals are articulated as follows: 1) promoting health and equity in all local policies and fully aligning with the sustainable development goals; 2) solving inequalities in health through the Social Determinants of Health (SDH) approach; 3) creating environments that support a healthy lifestyle; 4) provision of universal health insurance and social services that are accessible and sensitive to the needs of all citizens; 5) investing in health promotion and health literacy; 6) investing in the healthy start of children's lives and providing support to disadvantaged groups; 7) strengthening of disease prevention programs; 8) encouraging healthy urban planning and design (Barton, 2017); 9) investing in a green, clean, urban environment; 10) strengthening of local community, participation and resilience, and promotion of social inclusion and local community initiatives, and 11) strengthening of the capacity of the city to respond to risks/emergencies in the field of public health. These goals are shaped through the latest knowledge about health and how it is created, and formulated to solve urban challenges that most significantly affect the health, well-being and living conditions of citizens. The HC program is in line with the UN Sustainable Development Goals Agenda (UN, 2015) and they are mutually reinforcing. The qualities of a HC align with all 17 goals. Among the goals, health (Goal 3) is positioned as key to contributing to human development because it significantly affects the effectivity of policies in other sectors to succeed.

Modeled on the basis of international policies, Serbia adopted the Law on Public Health (2016), which regulates the areas of action, competences and planning for the implementation of activities to improve and preserve the health of the population through comprehensive measures. The field of action of public health refers to: 1) physical, mental and social health of the population; 2) promotion of health and prevention of diseases and injuries; 3) the environment and the health of the population; 4) working environment and population health; 5) organization and functioning of the health system; 6) handling in crisis and emergency situations. In this paper these areas served as a basis for the thematic framework for urban aspects of public health. Also, the Strategy on Public Health of Serbia was adopted in 2018, which supports improving health, preventing diseases and prolonging the quality of life of the population. The strategy relies on the document "Health 2020: a European policy framework supporting action at all levels of government and society for health and well-being" (WHO, 2016).

In 2019, the Government of the Republic of Serbia adopted the Strategy of Sustainable Urban Development of the Republic of Serbia until 2030. The general goal is the accomplished sustainable and integrated development of urban settlements by way of ensuring advancement in economic, social and cultural development, quality of urban space development, environment protection and adaptation to climate changes, improvement in social well-being (quality of life, public health and safety), affordable and quality housing, preservation and promotion of architectural heritage and urban identity. The following are the measures envisaged by the strategy that are important for the HC concept: applying the HC concept in local plans, urban development strategies, programmes and projects (4.3.11); improving accessibility and quality of public services in urban areas (education, health care, social protection, culture, recreation and sports facilities) (3.1);

¹ Number of the measure

Fostering social inclusion and mitigation of risk of poverty by way of improving access and expanding social services networks in local communities (3.2.1); development of public spaces and facilities in accordance with the concept of accessibility (3.2.2); adaptation to climate changes and establishment of a system for emergency response to incidents and hazardous situations in urban settlements (4.2); improvement of monitoring systems for water, air, noise, biodiversity, hazards and public health in urban settlements (4.3.6); coordinated development of information systems in order to improve urban and territorial governance (5.4.2); awareness-raising among citizens and stakeholders of their right to inclusion in the process of decision-making on urban development (3.4.1); support to development of partnerships and networks at all levels of governance and of universities, institutes and research organisations for the purpose of advancing the quality of work and introducing innovations in urban governance (5.1.4). In addition to the stated goals and packages of measures, the priority areas of intervention are of importance for this research - industrial zones and brownfield sites affected by pollution and hazards, illegally built and undeveloped zones and degradation of areas, endangered urban areas by an intensive concentration of activities, areas with a concentration of social problems and areas affected by environmental protection- and climate changes-related issues – which enable the perception and analysis of the spatial dimension of action within the HC concept. The aforementioned measures and the territorial focus of the national urban policy served as a supplement to the thematic framework and a basis for a spatial overview of urban aspects of public health, which we used in further research.

As a means of achieving integrated urban development, urban governance has found its role in different local contexts of more or less developed countries, but also in countries in transition (Jessop, 2016). The move towards urban governance, under the support of international influences, is evolving through the framework of sustainable and integrated urban development (Mueller et al. 2015; Fioretti et al., 2020). In line with the provisions of the national policy of sustainable urban development, this pathway is supported through higher education of architects and urban planners to train them to work in this field (Stupar et al., 2019; Čolić et al., 2023).

In order to support complex processes of integrated urban development, local self-governments are encouraged to foster a strategic planning approach demonstrating a strong political commitment to initiate and preserve continuous social dialogue among different actors in sustainable urban development (UN-HABITAT, 2015) (UN-HABITAT, 2018). The core challenge of strategic governance is establishing a powerful decision-making mechanism that enables addressing multilevel competing interests, the establishment of partnerships and innovating effective actions (Lalović, Živojinović, & Sentić, 2019). Therefore, scholars, for more than two decades highly recommended that urban planning should be tightly interconnected, and empowered with ICT tools based on Geographic Information Systems (GIS), enabling the spatial examination of numerous different types of territorial information (Greene R. W., 2000) (Greene, 2001) (UN-HABITAT, 2008; Buhren & Decker, 2008). The efficiency of quality evidence-based decision-making has vital importance in supporting stakeholders' active involvement in collaborative planning. Therefore, the research scope expanded towards multiple information support instruments, such as Planning Support Systems (PSS) (Brail & Klosterman, 2001; Harris, 1989; Klosterman, 2001) or participatory web-based open GIS platforms (Nyerges, Jankowski, & Drew, 2002; Jankowski & Nyerges, 2001; Jankowski & Nyerges, 2001) (Christiansen, 2007; Gar-On, 2008).

However, despite the significant advancement of information support to planning research and innovation (Brail & Klosterman, 2001; Batty, 2007), the creation and usage of GIS-based knowledge in planning is still missing in practice. Lack of trust in models (Nedovic-Budic, Pinto J., & Warnecke, 2004), fear of organizational power loss and lack of awareness of potential information support systems benefits (Boschetti, Hughes, Jones, & Lozano-Montes, 2018) are the main barriers identified to computer information support utilization in practice. On the other side, there is a significant potential for the wider use of systems by the planners. Systems should be made in a more "user-friendly" manner to support the information flows between stakeholders, through the "community of practice"

(Vonk, Geertman, & Schot, 2007). Planning theorists and practitioners become fascinated with GIS, due to the fact that this, adaptable to the different planning subjects, "chameleon technology" (Greene R., 2001) effectively provides useful functionalities to maintain, explore, analyses and display spatial relevant information collection in accordance to information needs of a wide range of users (Zanelli & Feaster, 2003).

National institutions traditionally hold a role that provides information support for urban and territorial development in Serbia. The Spatial Plan of the Republic of Serbia (2010) addressed for the first-time linkage between sustainable urbanization and quality information support. That was the opportunity to introduce a new GIS-supported planning practice, that could also influence the decision-making process. However, crucial lessons were learned from the several initiatives of decision-support-modelling through GIS that were implemented in the local planning agencies in Serbia (Lalović, 2003; Živković, Đukanović, & Lalović, 2004): GIS tools acceptance and further utilization depended more on cognitive and organizational capacities, and less on the technology or budget; professionals resist to learn and change standard working procedures unless personal motivation is gained, and – it is widely believed that necessary interdisciplinary or interorganizational innovation is constrained by a lack of instructive legislative regulations. Thus, these obstacles belong to the "soft" aspects of planning system.

The idea for the development of a database concept that would integrate the HC concept and relevant geospatial data arose as part of the research of this concept in the course IP03 - Integrated Urban Strategies, within the Master's study program Integrated Urbanism, Faculty of Architecture, University of Belgrade, academic year 2022/2023. The topic of research in the subject was the identification and formulation of Integrated pilot projects for promoting and raising the value of the Healthy City, at the training ground of the City of Belgrade.

METHOD

From the position of the planning profession, it is necessary to observe the HC concept through the spatial dimension in order to use the concept effectively as a planning and governance instrument. The spatial dimension of this concept was not clearly determined in advance, but was refined with the help of public policies and examples of good practice, and the topics that those documents and projects deal with. The question that arises is "What does a healthy city have, what are its characteristics and what makes a HC?". In a spatial sense, health in cities is mainly related to two key themes:

- 1) Health care system - This refers to the number, capacity and availability of health care facilities, from health to clinical centers and large health complexes. In this regard, spatial distribution and isochronous services, especially primary health care institutions, are very important data and starting points for urban health research;
- 2) The state and quality of the environment - The connection between the quality of the environment, both natural and built, and the health of the population is confirmed in most of the aforementioned public policies. The planning focus is on areas under protection regimes - protected natural areas, reservoirs and sanitary zones of water sources, floodplains, etc. In addition, there are brownfield sites, SEVESO plants and buffer zones, unsanitary settlements (without sewage network), illegal landfills, polluted watercourses, etc. For Belgrade, which is on the list of the most polluted cities in the world, the spatial distribution of measuring stations for air quality monitoring is also important (WHO, 2019). The availability and distribution of public transport lines, pedestrian and bicycle paths is also important.

In addition to the health care system and the quality of the environment, international and national policies also refer to the following topics: prevention and adaptation to changed climate conditions

and natural disasters in cities, thus also action in emergency situations; the quality of the urban environment, which means the availability, distribution and quality of open public spaces, parks, sports complexes (closed and open); community health and inclusiveness, social dimension of public health, etc. Thus, in relation to the availability of data, classes were formed in the GIS for: heat islands, availability of green areas and sports facilities. These are spatially clearly defined polygons and points, suitable for analysis.

FORMATION OF THE DATABASE

In order to collect spatial data related to the HC in digital form, a GIS database was created in QGIS. In addition to consolidating data in one place, the advantage of the GIS database is that it can be used to perform various spatial analyzes and reach results that could not be reached by standard means. One of the goals for creating a GIS database is the possibility of easier evaluation of space and the selection of zones that are most or least endangered in the territory of the General Urban Plan of the City of Belgrade (GUP). Official sources were mostly used as the information base for data entry: GeoSrbija (Republic Geodetic Institute), documentation of the GUP, Plan of General Regulation of the System of Green Areas of the City of Belgrade, Institute of Public Health of Belgrade, Republic Agency for Environmental Protection, SEVESO facilities of the Ministry of Environmental Protection, Action plan for adaptation to climate change with vulnerability assessment, Local waste management plan of the city of Belgrade until 2030, etc. As the only source of data, which is not a source of official institutions, OpenStreetMap (OSM) was used. OSM data is the largest volunteer GIS database in the world. That they have high accuracy is shown by the fact that numerous GPS services as well as various corporations cooperate with them in the field of geodata. Also, the City of Belgrade itself uses OSM data in certain of its services. Layers were entered into the database in different ways: 1) by direct download in .shp format and other related formats; 2) georeferencing, and 3) manual mapping based on the address key.

DATA ANALYSIS

The main task of the entire process was to collect as much data as possible from topics that are relevant for the analysis of the HC concept in Belgrade (health care system, state and quality of the environment, quality of the urban environment, prevention and adaptation in relation to the changed climate conditions and natural disasters, risk management), but also those topics that are recognized and promoted (health and inclusiveness of the community, social dimension of public health, etc.).

As the territory of the city itself is very complex, both data and database were complex as well, which was created as a result of research, collection, classification and analytical process. The first steps in this direction were the selection of layers that are significant for the topic, as well as the formation of a database and its storage, so that the necessary analysis could be performed. Accordingly, a preliminary list of selected layers was created (Table 1). After that, a set of maps was prepared that contain spatial data related to the analytical topics, using the data and layers previously proposed. The maps show input data from multiple sources, some of which are cross-referenced to obtain new analytical data and queries, which complete the picture of the spatial dimension of the HC concept. The maps include: 1) Network/distribution of health facilities; 2) Availability of primary health care facilities; 3) Air quality; 4) The average value of PM2.5 particles in the period October 2 - November 2, 2022; 5) Spaces for recreation; 6) Zone of protection; 7) Ecologically endangered locations; 8) Criteria for the analysis of a healthy city; 9) Evaluation of the HC area; 10) The spatial dimension of HC integrated projects. In addition, the entered data was used to propose a multi-criteria analysis, which resulted in an assessment of a HC on the territory of Belgrade.

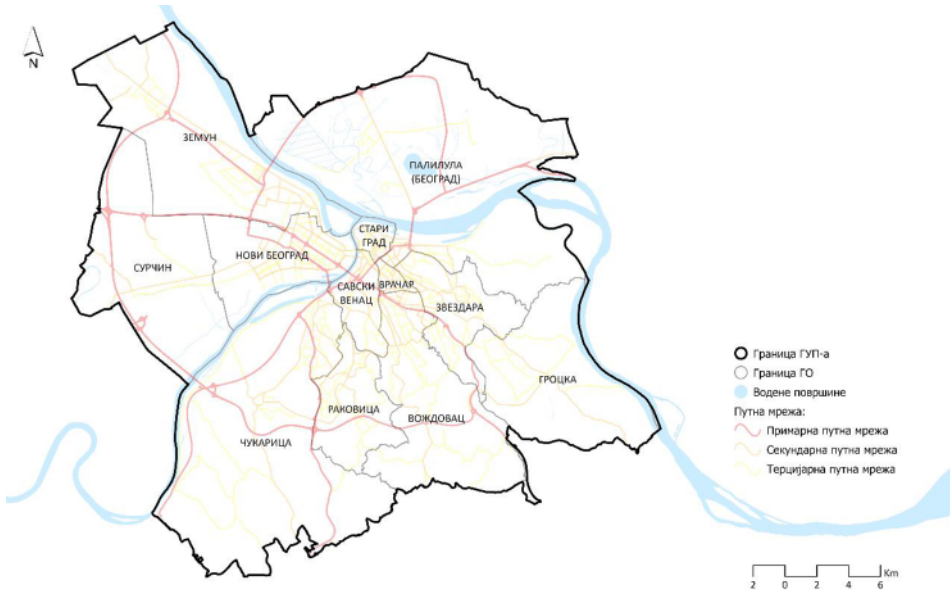


Figure 1: Spatial extent of research (Authors: V. Dmitrović, R. Čugalj)

On the basis of 12 spatial criteria, which were evaluated on a scale from 1 to 10, the preliminary results of the evaluation of the HC of Belgrade were obtained by spatial overlap. In the future research, this method of analysis needs to be supplemented with more criteria and spatial data and with evaluation/weighting of criteria in order to obtain a complex spatial model that gives results that realistically reflect the image of a HC of Belgrade. Within the set of maps, the last a map represents spatial dimension of the HC projects that have been developed, showing the locations and phenomena in the space around which the proposed projects are conceived.

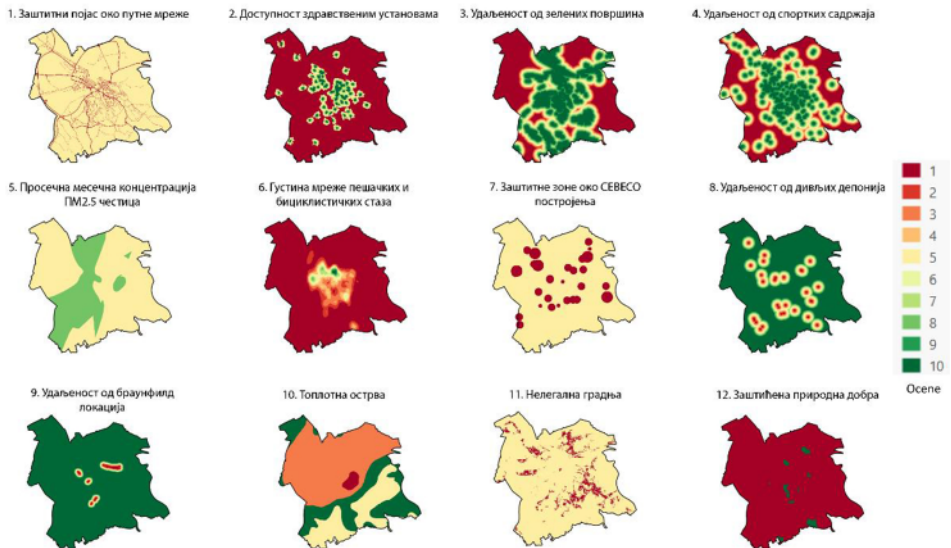


Figure 2: Multi-criteria maps (Authors: V. Dmitrović, R. Čugalj)

RESULTS

There are several results of this process. First, a geospatial database was formed, stored with a large number of layers and data, with systematically arranged attribute data, which can easily be used for visualization and further analysis within the territory of Belgrade. Second, a set of maps was created as a way of visualization by thematic areas, such as ecology, green areas, health care institutions, etc., in order to better understand and use the collected data in further stages of the decision-making processes. Thirdly, a set of metadata is arranged to represent the data used and to facilitate data usage by all users and actors. The metadata itself includes data about the source, up-to-datedness, display geometry, attributes, annotations, etc. Fourthly, a multi-criteria model was created for a comprehensive analysis of data and criteria, which provides an assessment of a HC and is capable of adding new criteria and changing existing ones. The most significant result of the mapping and analysis process is establishing an interactive WEB GIS application, which would offer collection of data in the same place, along with the results of all the analysis that were performed. Such a platform would serve to all interested groups of stakeholders as an insight into the quality of health and life in the city. It would also allow and access to the process of improving health in urban areas - by proposing topics and fields for expanding mapping or innovative ways of crossing data and analysis that can contribute to the improvement of some aspect of urban of health. Such a platform would also serve as a platform for monitoring other integral strategic and other projects, which deal with topics directly or indirectly related to the Healthy City concept, with the possibility of direct access to information about the projects.

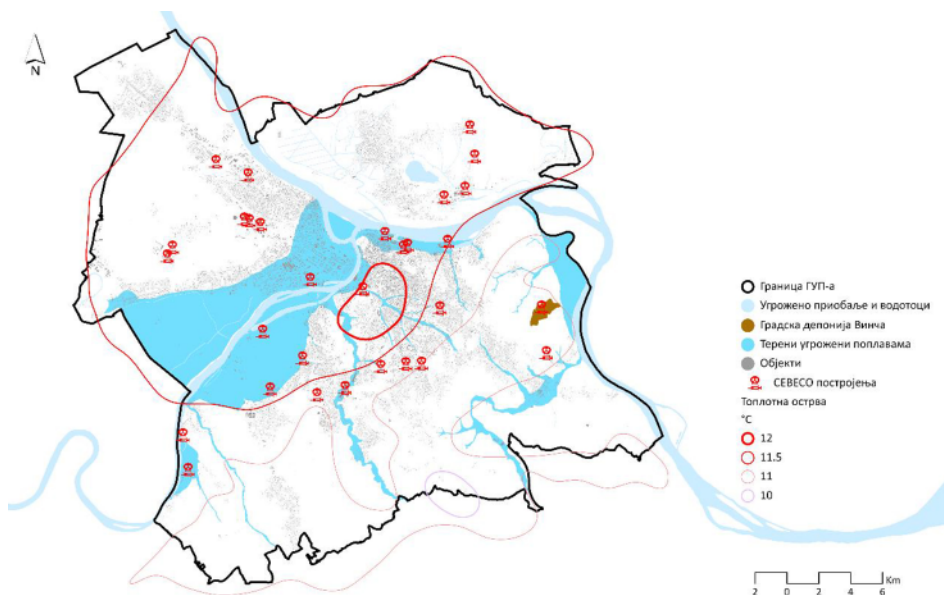


Figure 3: Ecologically endangered location, one of 10 thematic maps (Authors: V. Dmitrović, R. Čugalj)

CONCLUSIONS

This paper presents the conceptual model of the HC Geodata base, which was developed within the City of Belgrade case study. It spatially integrates all the publicly available information that relates to urban health and enables several multicriteria territorial analysis. Description of the methodological approach, the content, and reporting details, and the operational potentials could bring significant

contributions to sustainable urban governance. The results show that even the spatial integration of public information can be an effective instrument in decision-making. Furthermore, an enhanced Geodatabase with all relevant information owned or produced by different stakeholders could lead to the development of a GIS-based Healthy City Planning Support System.

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