Forging the Future: Pioneering Approaches in Business, Management and Economics Engineering to Overcome Emerging Global Challenges - 2024

https://doi.org/10.24867/FUTURE-BME-2024-107 Original scientific paper

THE IMPORTANCE OF GRAPHIC DESIGN IN PLANNING URBAN GREEN SPACE

Slađana Milovanović[1] [0009-0004-0818-1405],
Katarina Stojanovic[2] [0000-0002-5261-3816]

Abstract
The rapid growth of cities and the modern concept of economy impact the urbanization process. Furthermore, urbanization has created negative consequences in urban green space and requires new solutions for urban planning. For urban planners, the planning and maintenance of urban green space must become an emphasis in the master plan. What new perspectives can graphic representation contribute to the design of urban green space in the master plan? This paper provides answers by researching how statistical analysis can affect master plan reformation to maintain and improve urban green space. In this paper, we study this topic through the applied R software environment for statistical computing and graphics. Based on the result, we suggest a tool for urban planners to improve green spaces using statistical analysis with graphic representation in master plans.

Key words: *statistical analysis, graphic design, urban green space, master plan*

Introduction

The rapid growth of our cities and modern concepts are affecting city planning. Furthermore, urbanization in the 21st century has led to negative consequences for urban ecosystems, and natural resource solutions for the future development of cities are required. According to goal 11 of the 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015, global development requires sustainable city and community planning strategies. Moreover, strategies should incorporate new criteria for promoting growth and enhancing the quality of urban green spaces in urban areas. In 2020, Judy Bush published an article: The Role of Local Government Greening Policies in the Transition towards Nature-based Cities, which defined the role of city authorities

[1] Faculty of Technical Sciences, University of Novi Sad, sladjana.milovanovic@gmail.com
[2] Faculty of Economics and Engineering Management in Novi Sad, katarina.stojanovic@fimek.edu.rs

in increasing initiatives for the development of urban green spaces in planning. New approaches involve combining strategic planning with innovative design and active community involvement (Bush, 2020).

Planning is one of the elements in the growth of urban green spaces. The most powerful tool available to planners is land use (Campbell, 2018). According to Campbell, the role of urban planners is to promote the essential vision of sustainable development. Green areas are fundamental for sustainable cities and communities (Kvartnik-Pruc and Trembecka, 2021). Through research, the authors identified that the domains of land use policy are not coherent with the green space policy. In the post-socialist sustainable transition, land policy has a significant role in the post-socialist transformation (Vujošević & Petovar, 2006). Post-socialist crises reflect in the chaotic urban development, resulting in the weakness of the state as a central entity and, on the other hand, the arbitrariness of management in market conditions (Stanilov, 2007). Furthermore, urban planners focus on land-use-oriented planning that supports market-oriented issues (Nedović-Budić, 2001).

Urban planners "need to redefine their role from reactive guardians who serve the interests of the political and economic elite to active defenders of public interests." Stanilov (2007, p. 424). The presence and quality of green spaces in cities (Bocconcino & Vozzola, 2022), understanding and measuring urban dwellers view-based exposure to greenery (Yu, Yu, Song, Wu, Zhou, Huang & Mao, 2016) are at the center of the urban planning policies. Graphic representations can help urban planners understand the dynamics of change in the planning area and trends that are likely to influence the success of the proposed development and identify balance competing demands and pressures (Meeda, Parkyn & Walton, 2007).

1.1 Methods

Belgrade has been chosen as a post-socialist city in the former Yugoslavia for a study focusing on changes in urban green spaces within master plans. We examined changes in the physical environment by analyzing population, housing, built-up, and green spaces. Using the R software environment for statistical computing and graphics in master plans, we demonstrate change, correlation, and interaction of urban parameters. Correlation tests help to evaluate the correlation between population growth and housing growth and between population and green space growth. Another, using multiple regression tests, we analyze the built- up and green space growth. On the other hand, we test the interaction between green growths per population in existing/newly planned urban environments. The data was collected from the Republic Institute of Statistics, local databases such as the Belgrade City Administration, and the Urban Planning Institute of Belgrade.

Results

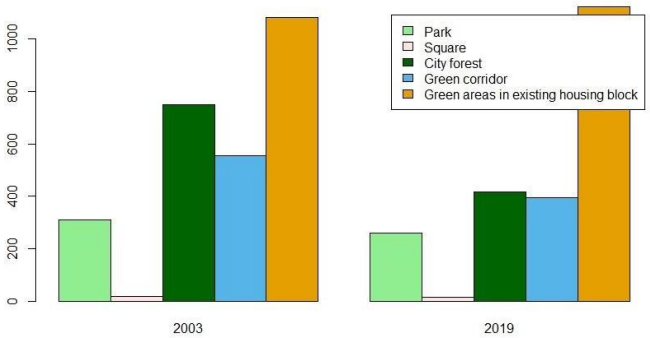

Figure 1: Graphic presentation of urban green space in master plan

Figure 1 illustrates the changing urban green area from 2003 to 2019, showing a significant decrease in city forests, green corridors, and parks. In the case of the presence of forests and public green spaces, in further planning elaboration than the established norms, they must be preserved as a fixed element of the green system of the city. Based on the data collected from the Master Plan of Belgrade (Official Gazette of the City of Belgrade, 27/03, 11/2016, 20/16, 110/2019), a graph clearly shows the decrease in urban green areas.

According to the Master Plan of Belgrade (Official Gazette of the City of Belgrade, 20/16), urban planners defined the highest percentage of housing. Due to specific parameters, we conducted a correlation test to examine the relationship between population growth and housing growth using data collected by the Statistical Office of the Republic of Serbia.

Table 1: Data on population and housing growth rate

	Population growth rate (%)	**Housing growth rate (%)**
2012	0.49	-17.49
2013	0.48	-11.28
2014	0.48	-17.83
2015	0.48	-7.13
2016	0.48	9.95
2017	0.48	24.25
2018	0.48	28.20
2019	0.31	37.40

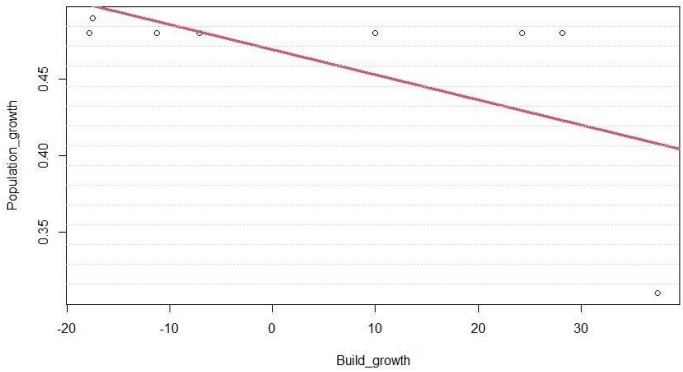

Figure 2: Simulation results of population growth and housing growth

Based on the result of the correlation test (t: -1.8256, df=6, p-value: 0.1177, cor=-0.5975933), in Figure 2, we identify a negative linear relationship between population growth and housing growth. However, population growth does not follow the housing growth.

In the next step, we conduct multiple regression tests to analyze the growth of built-up areas, green spaces, and open spaces. Additionally, we are examining the interaction between green space growth and population in existing/newly planned urban environments.

Based on the result of the multiple regression test (Multiple R-squared: 0.975; Adjusted R-squared: 0.9249; F-statistic: 19.48 on 2 and 1 DF, p-value: 0.1582), in Figure 3 and Figure 4, we identify a negative linear relationship between population growth and existing/new development green growth using data collected by the Statistical Office of the Republic of Serbia and Master Plan of Belgrade (Official Gazette of the City of Belgrade, 27/03, 11/2016, 20/16, 110/2019).

Table 2: Data on urban green space in master plan

	Green index- existing (%)	**Green index- planned (%)**
2001	14.65	26.30
2010	13.02	26.30
2016	12.65	17.81
2019	12.38	22.74

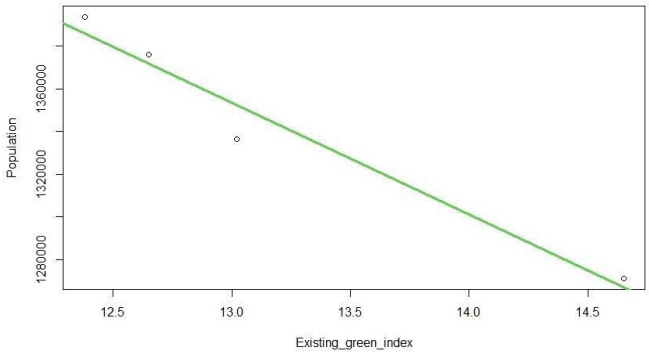

Figure 3: Simulation results of population growth and existing green space growth

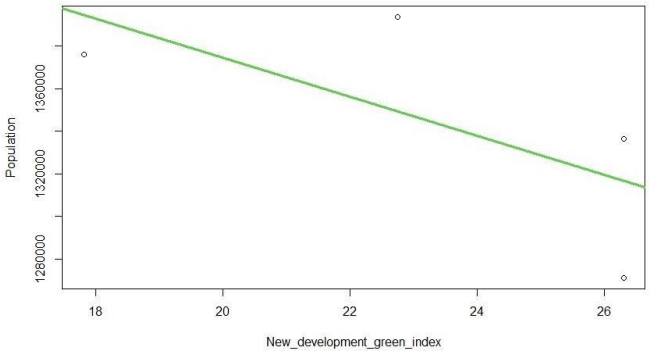

Figure 4: Simulation results of population growth and new planned green space growth

Discussion

As mentioned above, urban green spaces are of fundamental value in new urban planning to find a new balance within the built city. As evidence, the concept of sustainability needs to link and balance the skills of urban planners. Urban planners need a new tool in urban planning, which means the balance between the built and green structures. Due to green-based planning, the green area is integrated into the urban structure using innovative technological solutions, which can be classified and analyzed using various databases.

One of the most evident results noticed during the analysis of build form and green spaces defined in master plans was how the graph changed in typologies of urban green space (Figure 1). According to the urban parameters in the master plan, urban planners define the parameter of green spaces related to the block or plot as not to populations. As a result, population growth does not follow housing growth (Figure 2), and green space growth is incoherent with population growth in the new master plan (Figure 4).

Comparing data from one plan to another was difficult given that there is no continuity in planning, and differences and inconsistencies in defining the typology of urban green spaces are evident between plans. According to statistical data, one of the main problems identified was the low availability of urban green data resources. Data is kept in many places in the city administration, and there is no necessary continuity in monitoring, systematizing, and classifying data.

Conclusion

The land policy has a significant role in the urban planning. We can see that land-use policy is separate from green policies and built planning from green planning. Urban planners need a new tool to understand city development, an integrated approach to green space planning to balance built cities, and combine techniques and skills to balance built and green planning issues.

Our analysis involves the importance of using the R software environment for statistical computing and graphics in master plans. Data visualization can demonstrate the dynamics of change in the planning area and trends that are likely to influence the success of the proposed development and identify balance competing demands and pressures.

In conclusion, we have proposed an integrated tool for green-based planning using an R software environment for statistical analysis of population, housing, built-up, and green spaces in the master plan. Central themes are interoperability between information modeling environments and data organization in relational databases. With the new tool, urban planners can utilize data visualization to create a sustainable and green city.

Acknowledgments

This research is funded by the Seoul Metropolitan Government through the International Cooperation Fund-ODA.

REFERENCES

[1] Bocconcino, M. M., & Vozzola, M. (2022). Open repertoires for instructing ecological urban systems. Graphic tools and green transition. *AGATHÓN| International Journal of Architecture, Art and Design*, *11*, 214–225. https://doi.org/10.19229/2464-9309/11192022

[2] Bush, J. (2020). The role of local government greening policies in the transition towards nature-based cities. *Environmental Innovation and Societal Transitions*, *35*, 35–44. https://doi.org/10.1016/j.eist.2020.01.015

[3] Campbell, S. (2018). Green cities, growing cities, just cities? Urban planning and the contradictions of sustainable development. In *Classic Readings in Urban Planning* (pp. 308–326). Routledge. http://dx.doi.org/10.4324/9781351179522-25

[4] Kwartnik-Pruc, A., & Trembecka, A. (2021). Public green space policy implementation: A case study of Krakow, Poland. *Sustainability*, *13*(2), 538. https://doi.org/10.3390/su13020538
[5] Meeda, B., Parkyn, N., & Walton, D. S. (2007). *Graphics for urban design*. Thomas Telford, ISBN 978-0727733993.
[6] Milovanović, S. (2022). Belgrade post-socialist transitions: Role of actors in the governance of urban green spaces. Master thesis. International School of Urban Sciences of the University of Seoul.
[7] Nedović-Budić, Z. (2001). Adjustment of planning practice to the new Eastern and Central European context. *Journal of the American Planning Association*, *67*(1), 38-52. https://doi.org/10.1080/01944360108976354
[8] Stanilov, K. (Ed.), (2007). The Post Socialist City. Urban Form and Space Transformation in Central and Eastern Europe after Socialism (1nd ed.). Springer. http://dx.doi.org/10.1007/978-1-4020-6053-3
[9] Štefancová, L., Görner, K., Furdik, D., & Czafík, M. (2020). Graphics in urban design–possibilities of hand-drawn images and computer techniques. *Architecture, Civil Engineering, Environment*, *13*(4), 31–44. http://dx.doi.org/10.21307/ACEE-2020-028
[10] Urbanistički zavod Beograda (2003). Generalni plan Beograda 2021. Službeni list grada Beograda br. 27/03. https://www.urbel.com
[11] Urbanistički zavod Beograda (2016). Generalni urbanistički plan Beograda. Službeni list grada Beograda br. 11/2016. https://www.urbel.com
[12] Urbanistički zavod Beograda (2016). Plan generalne regulacije građevinskog područja sedišta jedinice lokalne samouprave –Grad Beograd (I-XIX). Službeni list grada Beograda br. 20/16. https://www.urbel.com
[13] Urbanistički zavod Beograda (2019). Plan generalne regulacije sistema zelenih površina Beograda. Službeni list grada Beograda br. 110/2019. https://www.urbel.com
[14] Vujošević, M., & Petovar, K. (2006). Javni interes i strategije aktera u urbanističkom i prostornom planiranju. *Sociologija*, *48*(4), 357–382, ISBN: 978-86-7924-283-9.
[15] Yu, S., Yu, B., Song, W., Wu, B., Zhou, J., Huang, Y., ... & Mao, W. (2016). View-based greenery: A three-dimensional assessment of city buildings' green visibility using Floor Green View Index. *Landscape and Urban Planning*, *152*, 13–26. http://dx.doi.org/10.1016/j.landurbplan.2016.04.004
[16] Zavod za planiranje razvoja grada Beograda (1985) Izmene i dopune Generalnog urbanističkog plana Beograda do 2000. godine.