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Original Scientific Paper

PREDICTION OF RUNOFF FROM ROOFS IN THE CENTRAL PART OF THE CITY OF NIŠ BASED ON L-MOMENT AND GIS APPROACH

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Abstract. *Serbia, like many other countries, works to manage and protect water resources, promote sustainable practices, and improve infrastructure. However, there is no systematic advocacy for the implementation of sustainable stormwater management practices (SWM) in urban areas in Serbia. As highlighted by the Development Plan of the City of Niš For the Period 2021-2027, in the last decade the number of flash floods has increased, causing infrastructure and property damages. As a result, reducing the risk of flooding by external and internal waters is prioritized under the territorial development and environmental protection axis. As a contribution to the development of SWM practice, in this research, the prediction of the potential of runoff from roofs in the city of Niš, was performed using L-Moment and GIS. The research included 262 buildings in the city center and results indicate an increasing trend in average runoff from roofs across all sectors.*

Key words: *L-Moment, GIS, Decision Support, sustainable stormwater management practices.*

1. Introduction

Rapid urbanization and increased flash floods can be recognized as one of the main challenges urban areas are facing today [1-6]. High levels of urbanization are confronting varying hydrological phenomena [1]. Extreme weather conditions that are a consequence of long-term climate change and increased rainfalls that cause problems in managing water resources [6] are becoming more frequent and severe due to inadequate drainage systems and increased impermeable surfaces in urban areas. As cities expand, the increase in impermeable surfaces like roads, rooftops, and pavements leads to higher volumes of runoff during rainfall events. They can cause extensive infrastructure damage and significant

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economic losses, and they can also disrupt transportation networks, and carry pollutants, debris and sewage into natural water bodies, resulting in water contamination that affects the overall functioning of the city. On the other extreme, along with population growth, economic development and industrial progression, rapid urbanization is one of the main contributors to the global water scarcity problem [7,8]. Some estimations are that every fifth person globally is facing water scarcity [8]. Considering that two-thirds of the population will live in the cities by 2050 [3], water scarcity will become dominantly an urban issue.

Urgency in solving the mentioned challenges led to a number of scientific discoveries that suggest various solutions under the wider umbrella of sustainable stormwater management (SuDS, WSUD, LID, BMPs, etc.) and ecologically based urban planning approaches NbS, EbA, UGI, BGI, etc.) [9-21]. In a broader sense, urban stormwater management (SWM) involves the collection, control, and treatment of rainwater runoff in urban areas to prevent flooding, reduce water pollution, and manage water resources sustainably. In urban planning and design, stormwater management is integrated into the overall strategy for creating sustainable, resilient cities involving but not limited to: 1) infrastructure development - incorporating green infrastructure, such as green roofs, permeable pavements, rain gardens, and bioswales, helps absorb and filter runoff, reducing the load on conventional drainage systems; 2) water quality improvement - treating runoff to remove pollutants before it reaches natural water bodies, using constructed wetlands or retention ponds; and 3) flood prevention: designing urban landscapes to manage large volumes of water, minimizing the risk of floods through proper grading, stormwater basins, and overflow routes [9-21]

Almost 40 to 50% of the unused impermeable space for collecting atmospheric precipitation is discovered in roofs, making them a significant agent in SWM [22]. In addition, fast urbanization in the future will lead to growth in the number of buildings due to intensified migration to cities leaving the possibility to increase total roof surface [23]. Other than ground-surface stormwater collection, harvested rainwater is naturally the cleanest source of water that is at the same time sustainable because the rainfalls are captured before they touch the surface [24]. Latest discoveries showed that more than 70% of non-drinking water demand in non-residential buildings such as industry, retail, offices and recreational space could be replaced by the use of rainwater [25]. However, such collected atmospheric water cannot be used as freshwater drinkable water unless it is treated well [9]. Except for being useful for water scarcity problems, management of runoff from the roofs mitigates failure of the urban drainage system and minimizes flood hazard events [36]. It brings flexibility to existing conventional water supply systems and allows for secure water supply in times of climate change [24,26].

The need for sustainable water management is evident in Serbia. Consequences of climate change are recognized as well, however, there is no information on advocacy and effort for the systemic implementation of a sustainable SWM system in urban areas in Serbia. As highlighted by the Development Plan of the City of Niš For The Period 2021-2027[1], in the last decade the number of flash floods has increased, causing infrastructure and property damages, and reducing the risk of flooding by external and internal waters are recognized as a priority under the territorial development and environmental protection axis: Improving territorial development while preserving the environment. In line with above mentioned, the objective of this study is to contribute to SWM by analyzing one of its aspects, runoff from the roofs, by predicting potential runoff in the exemplary city area

[1] https://www.eupropisi.com/dokumenti/NI_036_2021_003.pdf

in the city of Niš, to inform the development of SWM strategies and urban planning and design practice. The rest of the paper is organized as follows: Section 2 describes the research methods. Section 3 presents the results. Section 4 discusses the results and provides suggestions for future research.

2. MATERIALS AND METHODS

The runoff from the roofs (in L/year) may be computed using catchment area (A, in m2), runoff coefficient (RC, non-dimensional), and local precipitation (P, in mm/year). These variables and the methods used for their estimation are explained below.

2.1. The case study

The study area of 0.2 km2 is located within a mixed-use neighbourhood of the central zone of the City of Niš. The selected area has similar spatial morphological characteristics as the wider city central zone that includes: a high level of impermeable surface area, small parcels, functional diversity, and a low percentage of green spaces. Thus, it is representative of the large part of the city and similar dense urban areas. The city of Niš is a regional hub, an administrative and socio-economic centre of the Region of South and East Serbia [27]. With a population of 249.816 inhabitants, Niš is the third-largest Serbian city [28]. According to the reports of the Republic Hydrometeorological Institute of Serbia a mean maximum temperature of 19.9ºC and the annual mean rainfall of 534.9 mm. The temperature of this area is +10·75 °C, varying from −1.9 to +24.6 °C from winter to summer. The coldest and hottest months are February and August, respectively. Climate change scenarios for Serbia indicate a prominent increase in temperature towards the end of the century for the whole territory. Thus, it is reasonable to expect increased pressure on water resources. Current urban planning and construction practice do not recognize the systemic application of SWM.

2.2. Data

For the purpose of this study, a spatial database is created in widely available, free and open access, and open source Geographic Information System software QGIS3.4.

2.2.1. Roof catchment area (RCA)

The catchment area contains 262 buildings in the city center zone (Figure 1). The footprint shapefile of the objects is generated from the Open Street Maps (OSM) using the QuickOSM plug-in.

Since the total roof surface covers approximately half of the surface of the study area (0.09 km2) they significantly contribute to the total urban storm-water runoff flow. Roof type and material for each roof are analyzed firstly through the desktop analysis using Google Earth Pro while afterwards they are confirmed by on-sight observation. Identified roof covers include clay tiles, metal, bitumen and gravel. The majority of roofs fall in the category of pitch roofs covered by clay tiles. The clay tiles for the local climate require a slope between 25 and 35 degrees. Therefore, for the calculation of RCA an average slope of 30 degrees is applied.

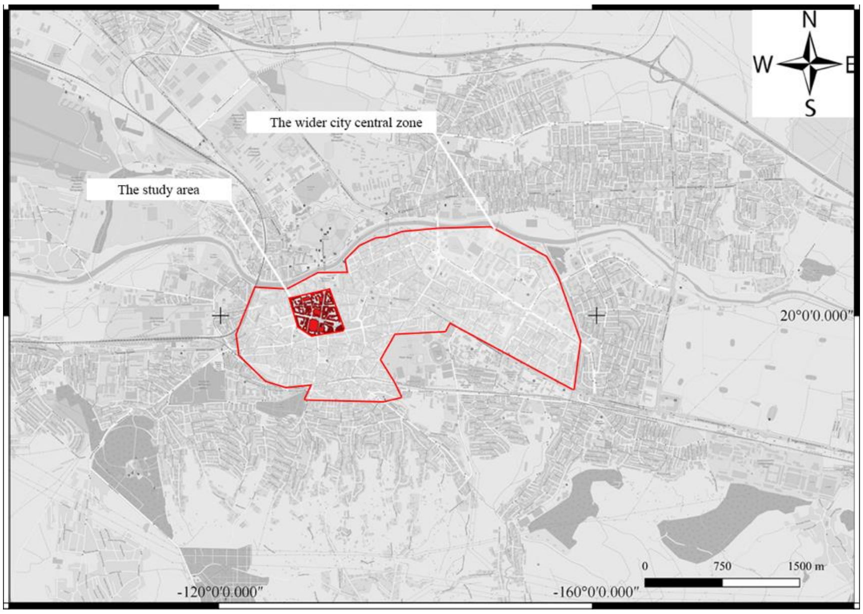

Fig. 1 Study area.

2.2.2. RC coefficient and RCA

The collection of rainwater is usually represented by a runoff coefficient (RC). The RC is a dimensionless value that estimates the portion of rainfall that becomes runoff, taking into account losses due to spillage, leakage, catchment surface wetting and evaporation. For instance, an RC of 0.75 means that 75% of the rainfall will be accumulated. So, the higher the runoff coefficient, the more rain that will be collected. Thus, the RC is useful for predicting the potential water running off a surface, which can be conveyed to a rainwater storage system. The roof RC varies significantly on the basis of the characteristics of the recipient surface of the rainfall (slope, impermeability, etc.). In this context, in the assessment of the quantitative potential of runoff from roofs in the study area, several types of roofs are identified and relevant RCs are assigned (Table 1). We used the average value of RC suggested by the literature.

Table 1 Runoff coefficients for traditional roofing materials.

Roof type	Runoff Coefficient (RC)	Source
Pitched roofs		
Concrete/asphalt	0.9	[29]
Metal	0.9	[29,30,31]
Bituminous tiles	0.8	[32]
Clay tiles	0.84	[31]
Flat roofs		
Gravel	0.83	[29,31]
Bitumen	0.7	[33]
Flat cement roofs	0.65	[34]

2.2.3. Local precipitation

The amount and frequency of precipitation in a city are key factors in determining its water-collecting potential. Cities with consistent and relatively high rainfall are more likely to have a substantial amount of water that can be collected. For the calculation of local precipitation the L – moment methodology is applied [35,36]. Time series of meteorological data used for the prediction of local participation covers the period 1946-2019 (Table 2).

Table 2 Parameters of the annual precipitation of the City of Nis for the period 1946-2019

Station name	Longitude (E)	Latitude (N)	Elevation (m a.s.l.)	Mean precipitation (mm)	Standard deviation (mm)
Nis	21°54'	43°20'	204	587.0	116.2

For this purpose, three distributions were fitted to the annual precipitation data collected from meteorological stations in Nis for the period 1946–2019 using the method of L-moment: generalized extreme value (GEV), generalized Pareto (GPD), and generalized logistic (GLO) [3]. The goodness-of-fit for the selected three distributions was confirmed using the L-diagram and three measures namely relative root mean squared error (RRMSE), relative mean absolute error (RMAE), and probability plot correlation coefficient (PPCC). From the results of this analysis, the GLO distribution was selected as the best-fitting distribution of the annual precipitation data for the City of Nis:

$$f(x)=\begin{cases}\dfrac{\left(1+\kappa\dfrac{x-\xi}{\alpha}\right)^{-1-\frac{1}{\kappa}}}{\alpha\left(1+\left(1+\kappa\dfrac{x-\xi}{\alpha}\right)^{-\frac{1}{\kappa}}\right)^{2}}, \kappa\neq 0\\[2ex] \dfrac{e^{-\frac{x-\xi}{\alpha}}}{\alpha\left(1+e^{-\frac{x-\xi}{\alpha}}\right)^{2}}, \kappa=0\end{cases} \tag{1}$$

where:

$$\begin{aligned}\kappa&=-\tau_3\\ \alpha&=\frac{\lambda_2}{\Gamma(1+\kappa)\Gamma(1-\kappa)}\\ \xi&=\lambda_1+\frac{\lambda_2-\alpha}{\kappa}\end{aligned} \tag{2}$$

(ξ ,α, κ are location, scale and shape parameters of distributions; Γ is the symbol of gamma function).

Best fitting distribution based on L-diagram and determined based on the combined RRMSE, RMAE, and PPCC goodness-of-fit measures for stations of the City of Niš is generalized logistic (GLO). In our case, estimates of the parameters for GLO distribution for the City of Nis using *L*-moments are:

$$\xi = 589.2500, \alpha = 63.0145, \kappa = -0.0153$$

In accordance with that, the GLO distribution was used to determine precipitation estimates for different return periods from 2 to 1000 years for the City of Niš stations. The T-year return level namely x_T is the level exceeded on average only once every T years. By the inverting $F(x_T) = 1 - 1/T$ in GLO:

$$x_T = \xi + \frac{\alpha}{\kappa}\left(1 - \left(\frac{1}{T-1}\right)^{\kappa}\right), \kappa \neq 0 \tag{3}$$

The estimated precipitation in the City of Nis for different return periods from 2 to 1000 years is presented in Table 3.

Table 3 The City of Nis annual precipitation estimations

Return period (year)	Best distribution (GLO)
2	589.25
3	633.16
4	659.06
5	677.54
10	730.06
15	758.95
20	779.04
25	794.46
30	806.99
35	817.57
40	826.70
45	834.75
50	841.94
100	889.23
200	936.68
300	964.59
400	984.47
500	999.94
1000	1048.30

2.3. Runoff calculation

The potential amount of runoff from roofs is computed using the equation:

$$Q = RC \times R \times A, \tag{4}$$

where Q is the amount of water that runs off, RC is the runoff coefficient, R is the total rainfall (L/y), and A is the roof area or catchment area (m^2). For each building, we calculated the potential amount of water that can be collected for the return periods.

3. RESULTS

Modelling showed that the city of Niš will experience a steady growth in precipitations over the studied return periods, compared to the referent period 1946-2019.

Although the previous section presents annual precipitation estimations for return periods up to 1000 years, the illustrative assessment of potential runoff from roofs is presented for return periods of 2, 5, and 10 years. The analysis identifies four main functional types of buildings within the study area: administrative, educational, commercial, and residential. Their distribution is shown in Figure 2.

Fig. 2 Functional distribution.

Before calculating the average values the outliers are removed by applying the IQR (Interquartile Range) method. The IQR is the range between the first quartile (Q1) and the third quartile (Q3) of the data. Data points outside the range [Q1 – 1.5 * IQR, Q3 + 1.5 * IQR] are considered outliers.

The analysis indicates an increasing trend in average runoff from roofs across all sectors considering observed periods. The average runoff for the study area is 176762.7 L for the RP of 2 years and goes up to 215798.3 L for the RP of 10 years (Figure 3). Looking at the sectors individually, modelling shows noticeable differences. The sector of educational buildings shows the highest values, from an average of 440648.761 L for the RP of 2 years up to 537959.924 L for the RP of 10 years. A sector of administrative buildings is somewhat below the total average with 136249.97 L and 166338.9 L for the RP of 2 years and 10 years respectively. The administrative sector is followed by residential with 74914.06 L and 91457.79159 L for the return period of 2 and 10 years respectively, while the commercial sector shows the lowest runoff potential with 55237.9 L and 67436.4 L for the return period of 2 and 10 years respectively.

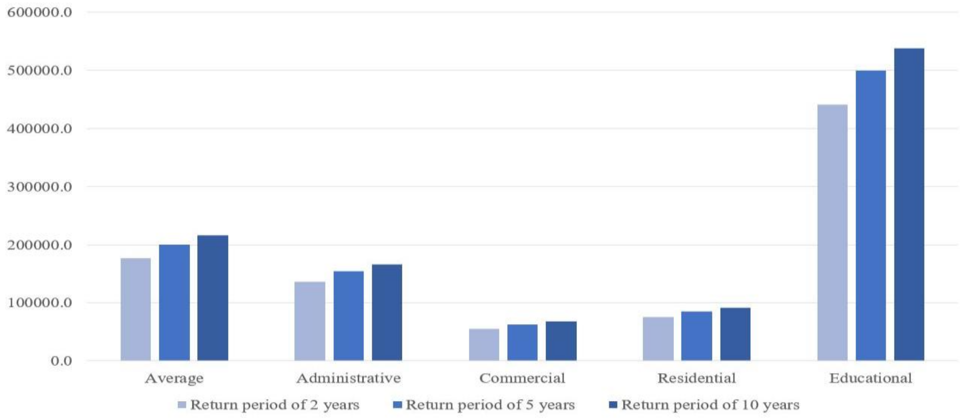

Fig. 3 Estimated average runoff from roofs according to functional categories.

On the other hand, when exploring individual buildings, the influence of multiple structural characteristics like roof type, total surface area and roof material on runoff potential is more prominent. As can be seen from Figure 4, available runoff from roofs widely differs from case-by-case. This is very apparent when extremes are considered.

4. Discussion

In line with the objective of this research - predicting potential runoff in the exemplary city area - the results of this GIS model contribute to the geospatial analysis for sustainable SWM and have the potential to be leveraged by planners, developers, urban advocacy groups, and the public. They indicate there is a substantial amount of roof area that has the potential to support water harvesting in the inner-city area. Given that technical water accounts for approximately 80% of total water consumption, the results indicate that there is a significant amount of runoff in the study area that could potentially be used as technical water.

However, some key factors necessary for precise calculation are complex to predict. Firstly, there are ongoing changes in functions in certain categories of objects. On the other hand, parts of the residential buildings are transformed into office spaces, restaurants, or apartments. Secondarily, the inner city is undergoing intense densification i.e. single-family houses are replaced by multi-family mid-rise residential buildings, thus the roof structure and materials are changing too. These shifts may significantly influence both catchment area characteristics and water consumption patterns. Thirdly, despite the steady increase in the amount of participation, the region has experienced extreme participation events in recent years, i.e., the distribution of participation has become more uneven, as observed by [7,37], which can lead to uncertainty in runoff reliability.

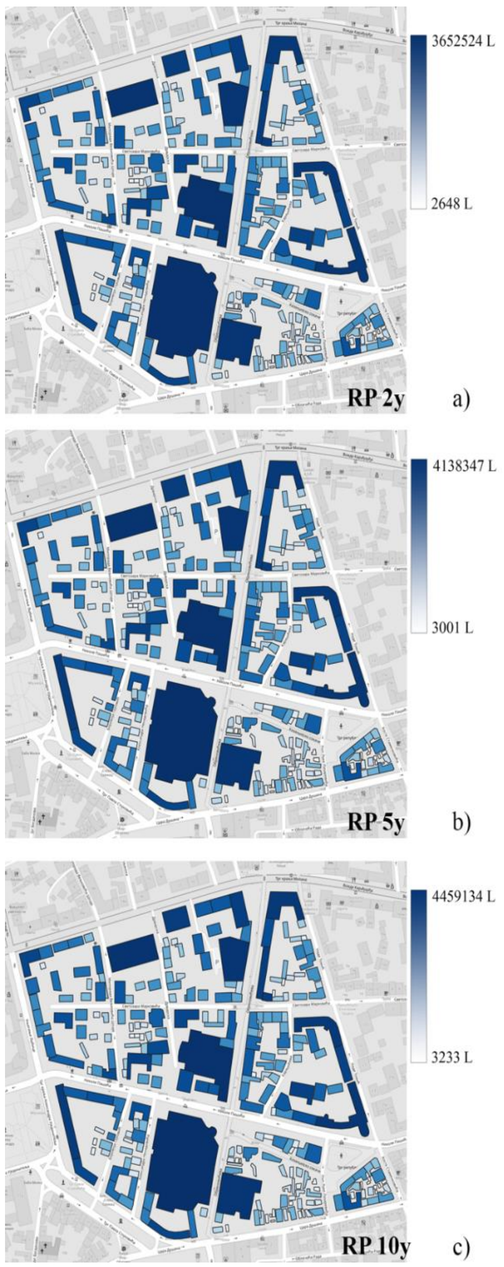

Fig. 4 Estimated runoff from roofs for the return period of 2 years, b) return period of 5 years, and c) return period of 10 years.

5. CONCLUDING REMARKS

This is a baseline research for understanding the potential runoff from roofs in Niš. The presented methodology allows for fast estimation of potential runoff from the roof. The first goal of this GIS analysis is to raise awareness about the water harvesting potential and its benefits among the policy-makers, community and potential users. Furthermore, they inform both urban planning and design, and SWM practice affirming synergetic research towards addressing the highlighted challenges in the Development plan for the City of Niš related to stormwater management. To advance its capacity to inform in the decision-making process, future studies may include the following: 1) the analysis of the structural characteristics of the buildings and land availability for installation of storage tanks; the factors like storage tank size and overflow systems need to be detailed, in order to understand the full participation collection system capacity, 2) the estimation of the costs associated with system installation, maintenance, necessary water treatment equipment and pay off periods and 3) the assessment of the environmental impact of rainwater harvesting, considering factors like reduced stormwater runoff and potential benefits to local ecosystems.

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REFERENCES

1. Kourtis, I. M., and Tsihrintzis, V. A. (2021). Adaptation of urban drainage networks to climate change: A review. Science of the Total Environment, 145431.
2. United Nations. (2019b). World Urbanization Prospects, the 2018 Revision. Retrieved from https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf
3. Rosenberger, L., Leandro, J., Pauleit, S., and Erlwein, S. (2021). Sustainable stormwater management under the impact of climate change and urban densification. Journal of Hydrology, 596, 126137.
4. Berndtsson, R., Becker, P., Persson, A., Aspegren, H., Haghighatafshar, S., Jönsson, K.,... Tussupova, K. (2019). Drivers of changing urban flood risk: A framework for action. Journal of Environmental Management, 240, 47-56.
5. Yang, W., and Zhang, J. (2021). Assessing the performance of gray and green strategies for sustainable urban drainage system development: A multi-criteria decision-making analysis. Journal of Cleaner Production, 293, 126191.
6. Hadjikakou, M., Stanford, B. D., Wiedmann, T., Rowley, H. V., Kobayashi, Y., Ishii, S.,... Khan, S. J. (2019). A flexible framework for assessing the sustainability of alternative water supply options. Science of the Total Environment, 671, 1257-1268.
7. Haque, M. M., Rahman, A., and Samali, B. (2016). Evaluation of climate change impacts on rainwater harvesting. Journal of Cleaner Production, 137, 60-69.
8. Silva, A. S., and Ghisi, E. (2016). Uncertainty analysis of daily potable water demand on the performance evaluation of rainwater harvesting systems in residential buildings. Journal of Environmental Management, 180, 82-93.
9. Balian, E. H., Eggermont, H., and Le Roux, X. (2014). Nature-based solutions in a BiodivERsA context. In L-Outcomes of the strategic foresight workshop. Brussels, Belgium: BiodivERsA Report.
10. Doswald, N., and Osti, M. (2011). Ecosystem-based approaches to adaptation and mitigation – good practice examples and lessons learned in Europe. BfN-Skripten. Bonn, Germany: Bundesamt für Naturschutz.
11. Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. Environmental Science & Policy, 93, 101-111.
12. Brink, E., Aalders, T., Adam, D., Feller, R., Henselek, Y., Hoffmann, A., Ibe, K., Matthey-Doret, A., Meyer, M., Negrut, N. L., Rau, A.-L., Riewerts, B., von Schuckmann, L., Törnros, S., von Wirth, T., and Abson, D.

J. (2016). Cascades of green: A review of ecosystem-based adaptation in urban areas. Global Environmental Change, 36, 111-123.

13. Munang, R., Thiaw, I., Alverson, K., Liu, J., and Han, Z. (2013). Climate change and ecosystem-based adaptation: A new pragmatic approach to buffering climate change impacts. Current Opinion in Environmental Sustainability, 5(1), 67-71.
14. Benedict, M. A., and McMahon, E. T. (2006). Green infrastructure. Linking landscapes and communities. Washington, DC: Island Press.
15. Millennium Ecosystem Assessment (MEA). (2005). Ecosystems and human well-being: Synthesis. Millennium assessment report. Washington, DC: Island Press.
16. Zhang, S., Lin, Z., Zhang, S., and Ge, D. (2021). Stormwater retention and detention performance of green roofs with different substrates: Observational data and hydrological simulations. Journal of Environmental Management, 291, 112682.
17. She, L., Wei, M., and You, X. Y. (2021). Multi-objective layout optimization for sponge city by annealing algorithm and its environmental benefits analysis. Sustainable Cities and Society, 66, 102706.
18. Yang, Y., Li, J., Huang, Q., Xia, J., Li, J., Liu, D., and Tan, Q. (2021). Performance assessment of sponge city infrastructure on stormwater outflows using isochrone and SWMM models. Journal of Hydrology, 597, 126151.
19. Liu, W., Engel, B. A., and Feng, Q. (2021). Modelling the hydrological responses of green roofs under different substrate designs and rainfall characteristics using a simple water balance model. Journal of Hydrology, 602, 126786.
20. Cheng, Y., and Wang, R. (2018). A novel stormwater management system for urban roads in China based on local conditions. Sustainable Cities and Society, 39, 163-171.
21. Scholz, M. (2015). Sustainable drainage systems. MDPI
22. Stovin, V., Vesuviano, G., and Kasmin, H. (2012). The hydrological performance of a green roof test bed under UK climatic conditions. Journal of Hydrology, 414, 148-161.
23. Naserisafavi, N., Yaghoubi, E., and Sharma, A. K. (2021). Alternative water supply systems to achieve the net zero water use goal in high-density mixed-use buildings. Sustainable Cities and Society, 103414.
24. Amos, C. C., Rahman, A., and Gathenya, J. M. (2018). Economic analysis of rainwater harvesting systems comparing developing and developed countries: A case study of Australia and Kenya. Journal of Cleaner Production, 172, 196-207.
25. van Dijk, S., Lounsbury, A. W., Hoekstra, A., and Wang, R. (2020). Strategic design and finance of rainwater harvesting to cost-effectively meet large-scale urban water infrastructure needs. Water research, 184, 116063.
26. Lopes, V. A., Marques, G. F., Dornelles, F., and Medellin-Azuara, J. (2017). Performance of rainwater harvesting systems under scenarios of non-potable water demand and roof area typologies using a stochastic approach. Journal of Cleaner Production, 148, 304-313.
27. Spatial Plan of Republic of Serbia 2010-2013-2020.
28. Census. Census of Population, Households and Dwellings. Statistical Office of the Republic of Serbia, 2022.
29. Lancaster, B. (2006). Rainwater Harvesting for Drylands and Beyond: Guiding principles to welcome rain into your life and landscape (Vol. 1). Rainsource Press: Tucson, Arizona.
30. Liaw, C. H., and Tsai, Y. L. (2004). Optimum storage volume of rooftop rain water harvesting systems for domestic use. Journal of the American Water Resources Association, 40, 901e912.
31. Farreny, R. (2011). Roof selection for rainwater harvesting: Quantity and quality assessments in Spain. Water Research, 45, 324-3254.
32. Biswas, B. K., and Mandal, B. H. (2014). Construction and evaluation of rainwater harvesting system for domestic use in a remote and rural area of Khulna, Bangladesh. International Scholarly Research Notices, 751952.
33. Ward, S., Memon, F. A., and Butler, D. (2010). Harvested rainwater quality: the importance of appropriate design. Water Science and Technology, 61(7), 1707-1714.
34. Worm, J., and van Hattum, T. (2006). Rainwater harvesting for domestic use (Report No. 43). Agromisa Foundation.
35. Gocic, M., Velimirovic, L., Stankovic, M., and Trajkovic, S. (2021). Regional precipitation-frequency analysis in Serbia based on methods of L-Moment. Pure and Applied Geophysics, 178, 1499-1511.
36. Gocic, M., Velimirovic, L., Stankovic, M., and Trajkovic, S. (2021). Determining the best fitting distribution of annual precipitation data in Serbia using L-moments method. Earth Science Informatics, 14, 633-644.
37. Alim, M. A., Rahman, A., Tao, Z., Samali, B., Khan, M. M., and Shirin, S. (2020). Suitability of roof harvested rainwater for potential potable water production: A scoping review. Journal of Cleaner Production, 248, 119226.

PREDIKCIJA POTENCIJALA SKUPLJANJA KIŠNICE U NIŠU, PRIMENOM L-MOMENTA I GIS-A

Srbija, kao i mnoge druge zemlje, radi na upravljanju i zaštiti vodnih resursa, promovisanju održivih praksi i unapređenju infrastrukture. Međutim, ne postoji sistematsko zagovaranje za primenu održivih praksi upravljanja atmosferskim vodama (SVM) u urbanim sredinama u Srbiji. Kako se ističe Planom razvoja Grada Niša za period 2021-2027. u poslednjoj deceniji se povećava broj bujičnih poplava koje izazivaju infrastrukturne štete, pa se smanjenje rizika od poplava od spoljnih i unutrašnjih voda prepoznaje kao prioritet teritorijalnog razvoja i zaštite životne sredine. Kao doprinos razvoju SVM prakse, u ovom istraživanju, izvršeno je predviđanje potencijala kišnog oticanja sa krovova u gradu Nišu korišćenjem metode L-Momenta i GIS-a. Istraživanje je obuhvatilo 262 zgrada u centru grada. Rezultati ukazuju na trend povećanja prosečnog oticanja sa krova u svim sektorima.

Ključne reči: *L-Moment, GIS, podrška odlučivanju, održive prakse upravljanja atmosferskim vodama*