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Decision support system for urban river water quality as a source of clean water using the SMART method

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Abstract. Rivers play an essential role as vital water sources with roles spanning sanitation, hygiene, drinking, and agriculture, particularly in rural areas. However, Kabupaten Sleman's river water quality, including its Kabupaten Sleman region in Yogyakarta, has severely degraded due to pollution from solid and liquid sources. Chemical contaminants have rendered the water unsafe, posing health risks. The primary objective of this study is to evaluate the water quality in the rivers of Bedog and Sembung located in Kabupaten Sleman. This evaluation utilizes Water Quality Criteria from the Republic of Indonesia Government Regulations Number 82 of 2001, alongside assigned weights. The research employs a diverse range of methodologies, including in-depth literature analysis, meticulous field observation, interviews, and comprehensive water quality assessment. A Decision Support System is adeptly employed as a strategic tool to grapple with the intricate facets inherent in the issue, thereby formulating pragmatic resolutions that facilitate judicious decision-making across diverse contexts. In addressing the dimension of water quality for communities along the Bedog and Sembung rivers, the study seamlessly integrates the SMART (Simple Multi-Attribute Rating Technique) approach. SMART's agility in steering multi-attribute decisions expedites the decision-making process. SMART's computational outcomes yield values of 0.304 and 0.395 for the Bedog and Sembung Rivers, respectively, both falling within the 0 to 0.49 range. This collective conclusion indicates that neither river meets the criteria for clean water quality, making it unsuitable for activities like sanitation, hygiene, drinking, and agriculture. The study underscores the urgency of rectifying river water quality, particularly in urban settings, to ensure safe and sustainable water sources for communities. The seamless integration of SMART as a decision-making tool amplifies the potential for effective interventions in navigating water quality management complexities. Keywords: Chemical Contaminants, Decision Support System, SMART Method, Urban River, Water Quality

1. Introduction Clean water is an essential requirement crucial for sustaining human life. The right to clean water and sanitation is a fundamental human right [1]. One pivotal source of accessible clean water is represented by rivers [2], serving as conduits for the gravitational flow of water resources from upstream to downstream. Forming an integral part of the natural water cycle, rivers discharge into oceans, lakes, seas, or other interconnected river systems. Rainwater, upon descending onto land, traverses through

3 International Conference on Sustainable Energy and Green Technology 2023 IOP Conf. 2 Series: Earth and Environmental Science 1372 (2024) 012038 IOP Publishing doi:10.1088/1755-1315/1372/1/012038 2 rivers, ultimately reaching bodies of water such as lakes or seas [3]. Beyond human dependence, rivers play a vital role in providing

water for various organisms, including animals and plants, supporting their survival [4]. Furthermore, rivers fulfill fundamental human needs such as drinking, bathing, washing, and other necessities [5]. However, the hygienic suitability of river water for daily consumption or usage is not consistently guaranteed. The prevalence of domestic and industrial activities along riverbanks, coupled with the dynamic nature of river flows, leads to substantial alterations in both the quality and quantity of river water. Sustaining the quantity, continuity, and quality of rivers requires concerted efforts. Strategies for monitoring and controlling river water pollution involve the measurement and analysis of water quality, as stipulated in Indonesia's Government Regulation No. 82 of 2001[5, 6]. The determination of the water quality status, as outlined in Minister of Environment's Decree No. 115 of 2003 [8], can be conducted through methods such as the STORET Method or Index Method. Currently, the assessment of river water quality utilizing the STORET Method involves manual computation of test parameters, resulting in prolonged timeframes and substantial testing costs [9]. There are many rivers that flow in Yogyakarta, Indonesia, including the Bedog River and the Sembung River. Areas around Sembung River has been recently developed as residential areas from former agricultural areas or undisturbed areas [10]. Around the waters of the Bedog River, there are several types of land use and changes in environmental conditions that can reduce the quality of the water [11]. Notably, the geographical attributes of the Bedog and Sembung rivers add a layer of complexity, with the former originating from the southern slopes of Mount Merapi and being influenced by cold lava flows, while the latter serves as a water source for agricultural irrigation during drought seasons. To ensure that river water quality meets the hygienic standards for daily consumption or usage, it is imperative to develop a decision support system for evaluating the appropriateness of river water for clean water purposes in residential areas [12]. The Simple Multi Attribute Rating Technique (SMART) method evaluates alternatives based on criteria with assigned values, each criterion carrying weights that indicate its relative importance compared to others [13]. Notably, the SMART method allows for the incorporation of diverse preference functions and weights during the alternative ranking process [14]. In the context of determining the cleanliness of river water, the SMART method proves valuable in formulating specific criteria and indicators, streamlining the assessment 5 of river water quality. The objective of this research is to appraise 1 the water quality in the Bedog and Sembung rivers in Sleman Regency using the SMART method, focusing on whether it meets the criteria for clean water suitability in various applications, including washing, bathing, drinking, and irrigating rice fields. The research employs defined criteria such as Cleanliness, Water Quality, Water Source, Water Flow, Water Needs, and Sustainability to provide a comprehensive assessment, aiding public awareness regarding recommended rivers suitable for clean water use. 2. Materials and Method 2.1. Research Methods The research methodology involves a meticulous and comprehensive exploration of a particular problem to derive precise solutions. In this study, the 11 Simple Multi Attribute Rating Technique (SMART) is employed as the decision-making approach for optimal assessment. Figure 1 illustrates the sequential stages undertaken in evaluating the quality of river water in residential areas as a viable source of clean water.

3 International Conference on Sustainable Energy and Green Technology 2023 IOP Conf. 2 Series: Earth and Environmental Science 1372 (2024) 012038 IOP Publishing doi:10.1088/1755-1315/1372/1/012038 3 Figure 1. Research stages. The SMART method functions as a tool for multi-criteria decision-making [14, 15]. It operates on the premise that each alternative encompasses various criteria, each possessing specific values and individual weights signifying its relative importance among other criteria. The weightings in the SMART method are assigned within the range of 0 to 1, facilitating seamless calculation and comparison of values across different alternatives [14]. The model used in the SMART method has several stages that must be carried out, as follows [15]: 1. Identify the quantity of criteria and sub-criteria employed in the analysis. 2. Assign weights to each criterion on a scale of 1-100, indicating the priority of importance for each criterion. 3. Normalize each criterion by comparing its weight value ( ) with the total weight

of all criteria (∑) using equation 1:

International Conference on Sustainable Energy and Green Technology 2023 IOP Conf. Series: Earth and Environmental Science 1372 (2024) 012038 IOP Publishing doi:10.1088/1755-1315/1372/1/012038 4 = ∑ (1) Where is the weight value of a criterion. 4. Specify parameter values for each criterion pertaining to each alternative. 5. Calculate the utility value by transforming the criterion values for each alternative into standardized data criterion values, utilizing equation 2: ( ) = 100 % (2) Where ( ) signifies the utility value of the first criterion for the i-th alternative, max represents the maximum criterion value, min is the minimum criterion value, and out is the value of the i-th criterion. 6. Determine the overall value of each alternative by adding up the calculated utility values for all criteria, taking into account the weights assigned to each criterion. ( ) = Σ . , = 1, … , (3) Where u( ) signifies the total value of the alternative, denotes the normalized weight of criteria and ( ) indicates the normalized utility value for each criterion. 3. Results and Discussion SMART Method Calculation 1. Determining criteria and sub-criteria in determining water quality. There are 6 criteria and 3 sub-criteria used in determining water quality as seen in table 1 below. Table 1. River water quality criteria. No Criteria Code Criteria Sub-Criteria 1 C1 Water Cleanliness Very clear Fairly clear Not clear enough 2 C2 Water Quality Very clear Fairly clear Not clear enough 3 C3 Water Sources Very safe Fairly safe Not safe 4 C4 Water Flow Strong Weak 5 C5 Water Requirements Urgently require Quite require Less need 6 C6 Sustainability Long-term Medium-term Short-term 2. Assigning weights to each criterion involves using a scale of 1-100 for each criterion, emphasizing the highest priority. The criteria weights can be found in Table 2, while Table 3 displays the weights for sub-criteria. Table 2. Weights of criteria. No Criteria Weight of the Criteria 1 C1 70 2 C2 50 3 C3 60 4 C4 55 5 C5 30 6 C6 35 TOTAL 300

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Table 3. Weights of sub-criteria. No Criteria Sub-Criteria Utility Value 1 C1 Very clear 100 Fairly clear 50 Not clear enough 10 2 C2 Very clear 100 Fairly clear 55 Not clear enough 15 3 C3 Very safe 100 Fairly safe 65 Not safe 10 4 C4 Strong 100 Weak 10 5 C5 Urgently require 100 Quite require 60 Less need 20 6 C6 Long-term 100 Medium-term 55 Short-term 30 3. The weights 10 assigned to each criterion will be normalized, a procedure that includes dividing the weight of each criterion by the total weight of all criteria. Table 4 provides a comprehensive overview of the normalized criterion weights, specifically focusing on the quality assessment of river water in residential areas as a reliable 1 source of clean water. 4. Providing parameter values for each criterion across various alternatives involves presenting utility values obtained from 7 the evaluation of the Bedog River and Sembung River, as illustrated in Table 5. Table 4. Weight normalization. No Criteria Weight Normalization 1 C1 ∑ = 70 300 = 0,2333 2 C2 ∑ = 50 300 = 0,1667 3 C3 ∑ = 60 300 = 0,2 4 C4 ∑ = 55 300 = 0,1833 5 C5 ∑ = 30 300 = 0,1 6 C6 ∑ = 35 300 = 0,1166 Table 5. Utility values for each sub-criterion. No River Criteria Utility Value Sub-Criteria 1 Bedog River C1 50 Pretty Clean C2 55 Fairly Clear C3 65 Fairly Safe C4 10 Weak C5 100 Urgently require C6 100 Long-term 2 Sembung River C1 50 Pretty Clean C2 55 Fairly Clear C3 65 Fairly Safe C4 10 Weak C5 60 Quite Require C6 100 Long-term 5. Calculating of the Utility Value criteria for the Bedog River and Sembung River using equation 2, whether they are included in the category that has 1 river water quality as a source of clean water. The calculation of the utility value obtained from each criterion is presented in table 6.

doi:10.1088/1755-1315/1372/1/012038 6

Table 6. Utility values calculation. No Object Criteria Utility Values 1 Bedog River (R1) C1 ( ) = 1 − 1 1 − 1 = 50 − 10 100 − 10 = 0,4444 C2 ( ) = 2 − 2 2 − 2 = 55 − 15 100 − 15 = 0,4705 C3 ( )

= 3 − 3 3 − 3 = 65 − 10 100 − 10 = 0,6111 C4 ( ) = 4 − 4 4 − 4 = 10 − 10 100 − 10 = 0 C5 ( ) = 5 − 5 5 − 5 = 100 − 20 100 − 20 = 0 C6 ( ) = 6 − 6 6 − 6 = 100 − 30 100 − 30 = 0 2 Sembung River ( ) C1 ( ) = 1 − 1 1 − 1 = 50 − 10 100 − 10 = 0,4444 C2 ( ) = 2 − 2 2 − 2 = 55 − 15 100 − 15 = 0,4705 C3 ( ) = 3 − 3 3 − 3 = 65 − 10 100 − 10 = 0,6111 C4 ( ) = 4 − 4 4 − 4 = 10 − 10 100 − 10 = 0 C5 ( ) = 5 − 5 5 − 5 = 60 − 20 100 − 20 = 0,5 C6 ( ) = 6 − 6 6 − 6 = 100 − 30 100 − 30 = 0 6. Determining the final utility values that has been provided can be presented below: a. R1 (Bedog River) = (0,2333 * 0,4444) + (0,1666 * 0,4705) + (0,2 * 0,6111) + (0,1833 * 0) + (0,1 * 0) + (0,1166 * 0) = 0,1036 + 0,078+ 0,1222+ 0 + 0 + 0 = 0,3038 b. R2 (Sembung River) = (0,2333 * 0,4444) + (0,1666 * 0,4705) + (0,2 * 0,6111) + (0,1833 * 0) + (0,1 * 0,5) + (0,1166 * 0,3571) = 0,1036 + 0,078 + 0,1222 + 0 + 0,05 + 0,041 = 0,3948 The following decision table for assessing the SMART method calculation results is visible in table 7 below. Table 7. Decision table. No Final Values Explanation 1 0 s/d 0,49 Not included in the clean water category for washing, bathing and not for consumption. 2 0,50 s/d 0,75 It is appropriate to consider it in the clean water category for washing, bathing and not for consumption 3 0,76 s/d 1 Enter the clean water category for washing, bathing and not for consumption

3 International Conference on Sustainable Energy and Green Technology 2023 IOP Conf. 2 Series: Earth and Environmental Science 1372 (2024) 012038 IOP Publishing doi:10.1088/1755-1315/1372/1/012038 7 Based on table 7, to determine the decision, the assessment results show between 0 and 0.49. This indicates that these two rivers are not included in the category of clean water for washing, bathing and not for consumption. 4. Conclusions From the results obtained through the application of the SMART method for assessing the water quality of 1 the Bedog and Sembung rivers in Sleman Regency, the following conclusions can be derived: 1. Effectiveness of the SMART Method: This research shows that the SMART method can be used effectively in choosing the right

clean water source for residential areas. This method allows a comprehensive assessment based on several important attributes related to water quality, availability, sustainability and residential needs. 2. From the final calculation results obtained from the Bedog and Sembung rivers using the SMART method where the value for the Bedog river is 0.304 and the Sembung river is 0.395. So these two rivers are not included in the clean water criteria. 3. Decision Making Efficiency: Employing a decision support system through the utilization of the SMART method also increases efficiency in decision making regarding clean water sources. This method allows systematic comparison between several alternatives and avoids decisions based solely on one factor or subjective preference. 5. References [1] S. Ricart, “Water Governance and Social Learning: Approaches, Tools, and Challenges,” in Clean Water and Sanitation, W. L. Filho, A. M. Azul, L. Brandli, A. L. Salvia, and T. Wall, Eds., Switzerland: Springer Nature Switzerland, 2022, pp. 796–808. doi: 10.1007/978-3-31970061-8_152-1 [2] V. Dutta, D. Dubey, and S. Kumar, “Cleaning the River Ganga: Impact of lockdown on water quality and future implications on river rejuvenation strategies,” Science of the Total Environment, vol. 743, Nov. 2020, doi: 10.1016/j.scitotenv.2020.140756 [3] M. S. Hussain, H. F. Abd-Elhamid, A. A. Javadi, and M. M. Sherif, “Management of Seawater Intrusion in Coastal Aquifers: A Review,” Water (Switzerland), vol. 11, no. 12. MDPI, Dec. 01, 2019. doi: 10.3390/w11122467 [4] Office of Habitat Conservation, “Rivers: Lifelines to the World.” Accessed: Feb. 11, 2022. [Online]. Available: https://www.fisheries.noaa.gov/national/habitat-conservation/riverhabitat [5] K. S. Uralovich, T. U. Toshmamatovich, K. F. Kubayevich, I. B. Sapaev, and S. S. Saylaubaevna, “A primary factor in sustainable development and environmental sustainability is environmental education,” Caspian Journal of Environmental Sciences, vol. 21, no. 4. University of Guilan, pp. 965–975, 2023. doi: 10.22124/cjes.2023.7155 [6] Republic of Indonesia Government, “Government Regulation No. 82/2001 on Management of Water Quality and Control Over Water Pollution.,” 2001. [7] T. Widodo, M. T. Sri Budiastuti, and Komariah, “Water Quality and Pollution Index in the Grenjeng River, Boyolali Regency, Indonesia,” Caraka Tani: Journal of Sustainable Agriculture, vol. 34, no.

2, pp. 150–161, Oct. 2019, doi: 10.20961/carakatani.v34i2.29186 [8] Minister of State for The Environment Republic of Indonesia, “Minister of State for The Environment Decree Number 115 of 2003 about Guidelines for Determining Water Quality Status,” 2003. [9] F. Hayat and N. Kurniatillah, “Microbiological and Water Quality Status of Cibanten River,” in 8 Proceedings of the First International Conference on Social Science, Humanity, and Public Health (ICOSHIP 2020), Jember, Indonesia: Atlantis Press, 2021, pp. 198–200. doi: 10.2991/assehr.k.210101.043 [10] V. Asriningtyas and E. Rahayuningsih, “Sembung–Kladuan Watershed Nitrate Water Quality,” Jurnal Bumi Lestari, vol. 12, no. 1, pp. 71–76, 2012.

3 International Conference on Sustainable Energy and Green Technology 2023 IOP Conf. 2 Series: Earth and Environmental Science 1372 (2024) 012038 IOP Publishing doi:10.1088/1755-1315/1372/1/012038 8 [11] A. Z. Fauzia, Suhartini, and Sudarsono, “The Quality of Waters in Bedog River, Yogyakarta Based on The Various Kinds of Planktons,” 50 Jurnal Biologi , vol. 5, pp. 50–61, 2016, doi: 10.21831/kingdom.v5i6.6023 [12] A. Alamanos, A. Rolston, and G. Papaioannou, “Development of a decision support system for sustainable environmental management and stakeholder engagement,” Hydrology, vol. 8, no. 1, Mar. 2021, doi: 10.3390/HYDROLOGY8010040 [13] S. Nanayakkara, M. N. N. Rodrigo, S. Perera, G. T. Weerasuriya, and A. A. Hijazi, “A methodology for selection of a Blockchain platform to develop an enterprise system,” J Ind Inf Integr, vol. 23, Sep. 2021, doi: 10.1016/j.jii.2021.100215 [14] B. Ezell, C. J. Lynch, and P. T. Hester, “Methods for weighting decisions to assist modelers and decision analysists: A review of ratio assignment and approximate techniques,” Applied Sciences (Switzerland), vol. 11, no. 21. MDPI, Nov. 01, 2021. doi: 10.3390/app112110397 [15] Riswandi and R. Rahim, “Study of the Simple Multi-Attribute Rating Technique For Decision Support,” Int J Sci Res Sci Technol, vol. 2, no. 6, pp. 491–494, 2016. [16] W. Lipka and C. Szwed, “Multi-attribute rating method for selecting a clean coal energy generation technology,” Energies (Basel), vol. 14, no. 21, Nov. 2021, doi:

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