

RAINFALL MAPS FOR THE SUITABILITY OF SETTLEMENT AREA IN BOGOR RAYA

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Abstract

The rainfall map can be used as a reference for settlements in Bogor Raya while still paying attention to the surrounding environment so that no damage occurs. The research aims to identify the classification and score factor average rain intensity. Second, to make rainfall maps in Bogor Raya based on high and low rainfall intensity. Third, to identify the potential suitability of Resident Areas in Bogor Raya regarding rainfall variables. The method used is the overlay between the Meteorological, Climatological, and Geophysical Agency data and the Geospatial Information Agency. The data used are the annual average rainfall data for Bogor Raya based on the Meteorological, Climatological, and Geophysical Agency and Bogor Raya administration based on Geospatial Information Agency. Analyzing the suitability of settlement locations in Bogor Raya used SMCA as the primary method. The variables refer to site characteristics and land suitability, such as rainfall. The results show that the average rainfall map has three classes, such low (1,000 – 2,000 mm/year), middle (2,000 – 3,000 mm/year), and high (3,000 – 4,000 mm/year) in Bogor Raya. The results show that potential suitability for Residential Areas in Bogor Raya has high suitability potential because high rainfall levels dominate these areas (2.000 – 4.000 mm/year).

Keywords: Rainfall Maps; Spatial Multi-Criteria Analysis; Settlement; Bogor City; Bogor Regency

INTRODUCTION

Settlement and population are complex, especially in Bogor Raya (Umar Mansyur, 2021). The requirement for space as a place to live grows along with the population rise. However, the earth's surface area is constant. Residential land is used more frequently to live in areas with higher populations (Sejati et al., 2020).

The demand for housing in the Bogor area is relatively high due to the rapid growth of infrastructure, population and transportation facilities (U. Mansyur & Priatna, 2019). Settlement places are developed on some pieces of land that are not subject to rules (Munajati et al., 2019).—growing settlements in unsuitable regions, the environment's capacity must support the people. Hence, Land usage for

settlements must have specified criteria that are primarily physical (Sejati et al., 2020).

SMCA and SMCE assist policymakers in choosing from several alternatives based on priorities. SMCA and SMCE use a set of systematic procedures to analyze complex decision problems. SMCE is a method in the decision-making process in regional planning that uses a simulation model with several criteria and factors (Wibowo & Semedi, 2011). The basic strategy is to divide the decision problem into small understandable parts, analyze each, and integrate the parts logically to produce meaningful solutions (Puspita, 2018).

Natural and sociocultural conservation strategies are one of the policies and strategies contained in the RTRW document (Azhari et al., 2021). One

of the areas in the RTRW for Bogor Raya is a residential area. It is crucial to carry out the RTRW for Bogor Raya to adjust to all changes in the area (Fajarini et al., 2015). Planned settlement development is one of the studies that must be carried out properly (Mosbach et al., 2022).

Based on the Decree of the Minister of Agriculture No. 387/kpts/Um/11/1980 states that slope, soil type, and rainfall are the variables used in determining residential areas (Menteri Pertanian, 1981). The rainfall map is one of the variables that make up the suitability map for residential areas. It can be used to evaluate spatial patterns of residential areas in the Regional Spatial Plan (RTRW) of Bogor Raya as a reference for development (Setiawan et al., 2021). Settlement planning based on rainfall variables must be adjusted according to its designation, whether the location is dangerous or not. The research aims to identify the classification and score factor average rain intensity. Second, to make rainfall maps in Bogor Raya using data from BMKG based on high and low rainfall intensity. Third, to identify the potential suitability of the Spatial Plan for Resident Areas in Bogor Raya regarding rainfall variables.

METHOD

The research location is in two Regency/City Regions, Bogor Raya. The coordinate of Bogor Raya is 6° 18' North Latitude and -6° 47' South Latitude and between 106° 01' – 107° 103' East

Longitude. Bogor City has a total area of 111 km². Bogor Regency has an area of 2,990 km². Bogor City is in the middle, surrounded by Bogor Regency with many sub-districts, each of which is six sub-districts and 40 sub-districts. Population growth of 1.5% based on BPS data for 2011-2019. Bogor Regency showed a 66.9% increase in a built-up area in the 2008-2016 period (Wilza & Rustiadi, 2022).

This type of research is quantitative descriptive research. Descriptive research explains one or more variables without comparing and connecting other variables (Sugiyono, 2018). This quantitative descriptive research is based on criteria and guidelines for land suitability for settlements obtained from various references to existing policies, use, and data processing supported by related theories and reference sources. This study uses the variable to determine the suitability of residential area development. The primary variable is the natural physical factor of rainfall.

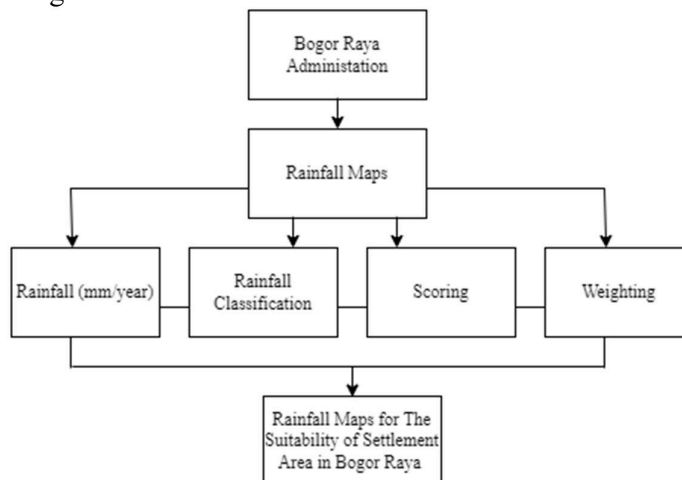
The secondary data comes from government agencies that handle specific primary. The Bogor Raya Administrative data from the Geospatial Information Agency. Rainfall data is based on the Meteorological, Climatological, and Geophysical Agency and other publicly accessible sources. The research area and procedure are shown in Figure 1 and Table 2.



Figure 1. Research Area

Source: Geospatial Information Agency, 2022

Table 2. Research Diagram



Data analysis in quantitative research is an activity after data from all other sources has been collected (Sugiyono, 2018). Data processing begins with obtaining rainfall data in Bogor Raya from the Meteorological, Climatological, and Bogor Raya administrations based on Geospatial Information Agency. Then, the research creates a Rainfall Map to evaluate Residential Areas in Bogor Raya.

Identification of high and low rainfall intensity is used to determine the potential for landslides and floods and the availability of clean water.

Using SMCA requires expert judgment in determining the score of interest between classes in one variable or map against the goals to be achieved. A score of 1-5 is given for each mapping class, representing its importance to a particular

purpose. A score of 1-5 based on Kusumaningtyas & Chofyan, 2013; Try, 2019; Setiawan, 2021. The higher and lower the rainfall, the score will decrease. Increased precipitation will further damage residential areas, and the process of making map layouts is carried out. In addition, weighting provides an overview of the comparison of interests between variables in determining land suitability goals for settlements. This study uses the assumption to compare variable weights to minimize tendency bias and human error.

The score on the map classification and the weights between variables will bring up the priority scale of the tendency of locations suitable for settlement development. Then in the Geographic Information System (GIS), through the Weighted Overlay process, spatial processing of the priority scale is carried out. This process produces land suitability maps for settlement development, with five classifications: very suitable, suitable, moderately suitable, not suitable, and very unsuitable.

RESULT AND DISCUSSION

A. Classification and Score Factor Average Rain Intensity

Determining the score of interest between classes in a variable or map versus the desired outcomes when using SMCA involves professional judgment. Each mapping class is assigned a value between 1 and 5 based on how important it is to achieve a specific goal. A rating from 1 to 5 is based on Kusumaningtyas & Chofyan (2013), Try (2017), and Setiawan (2017). The higher and lower the rainfall, the score will decrease. Creating map layouts is carried out, and increased precipitation will further harm residential regions. Additionally, weighting summarizes the comparison of interests across factors in determining land suitability objectives for settlements. This study applies the

assumption to compare variable weights to reduce tendency bias and human mistakes.

The higher and the lower the rain intensity value is, the lower the score set. Identifying high and low rainfall intensity determines the potential for landslides and floods and assumptions about clean water availability. The lower value of the rain intensity becomes the lack of clean water in a settlement. Conversely, the higher the value of the rain intensity, the greater the potential for landslides, floods, and other natural disasters in residential areas. Moderate rainfall is the highest score or five scores, which is suitable for settlement areas.

Rainfall intensity shows the amount of rainfall per unit of time. The moderate rainfall intensity value of 2,000 - 3,000 as rainfall suitable for settlements with a score of 5. The lowest annual rainfall intensity value is 0 - 1000 mm/year, where the classification is very unsuitable for settlements with a score of 1. The rainfall intensity value at the highest annual rate is >4000 mm/year, with a classification of rainfall unsuitable for settlements and a score of 2.

Table 3. Classification and Score Factor Average Annual Rain Intensity

Rainfall (mm/year)	Classification	Score	Assumption
0 – 1.000	Sangat Tidak Sesuai (CH Sangat Rendah)	1	10
1.000 – 2.000	Sesuai (CH Rendah)	4	25
2.000 – 3.000	Sangat Sesuai (CH Sedang)	5	30
3.000 – 4.000	Cukup Sesuai (CH Tinggi)	3	25
> 4.000	Tidak Sesuai (CH Sangat Tinggi)	2	10

Source: (Kusumaningtyas & Chofyan, 2013; Try, 2019; Setiawan, 2021)

B. *Average Rain Intensity For The Suitability Of Settlement Area*

The ranking of areas that are likely to be suitable for settling and developing communities will be determined by the weights assigned to the various characteristics and the score on the map classification. Next, spatial processing of the priority scale is carried out in the Geographic Information System (GIS) using the Weighted Overlay procedure. This procedure generates maps of the appropriateness of the land for settling, with five classifications: extremely suitable, more suitable, suitable, not applicable, and highly unsuitable.

One of the factors that affect settlement land is the intensity of rainfall. Rainfall intensity is identified as either high or low to assess the risk of landslides and floods and the accessibility of clean water. The assumption is that the lower the rain intensity value will be a clean water crisis in residential areas. The higher the rain intensity, the greater the potential for landslides, floods, and other natural disasters in residential areas. This assumption value decreases. However, the assumption increase is suitable for the settlement area.

The higher the rainfall becomes, the higher vulnerability in residential land. If the rainfall in the area is middle, the

vulnerability to settlement land will also be low. The lower the rain intensity value will be a clean water crisis in residential areas. The higher the rain intensity value will have the potential for landslides, floods, and other natural disasters in residential areas.

The higher the rainfall and the steeper the slope, the residential land becomes landslides. High-intensity rain can cause erosion and steep slopes, causing flooding and landslides. Soil types that easily absorb large amounts of rainwater are regosol and podzolic. If there is a high intensity of rainfall, it is easy to be flooded because the soil type does not collect rainwater, so it is unsuitable for settlements.

C. *Rainfall Map for The Suitability of Settlement Area*

The average rainfall in Bogor Regency is around 1,000-4,000 mm/year. The rainfall map is obtained from rainfall data in Bogor Raya, which is scored for each classification. The result of classification is in classes I, II, III, IV, and V. Bogor City is dominated by class III, where the average rainfall value per year is 3000-4000 mm/year. Bogor Regency is dominated by class II, where the average yearly rainfall value is 2000-3000 mm/year. The color description is greener and yellow. The higher is suitable for the settlement area. It is processed in the Weighted Overlay.

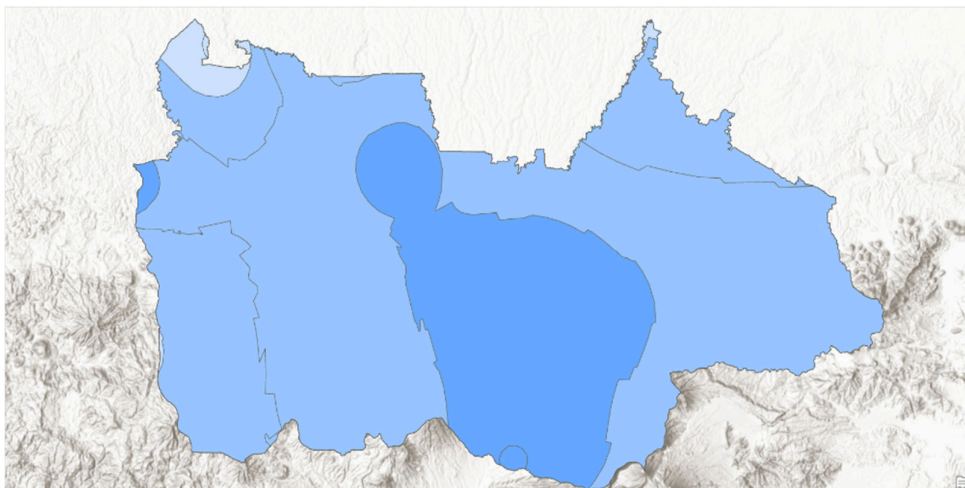


Figure 2. Rainfall Map in Bogor Raya

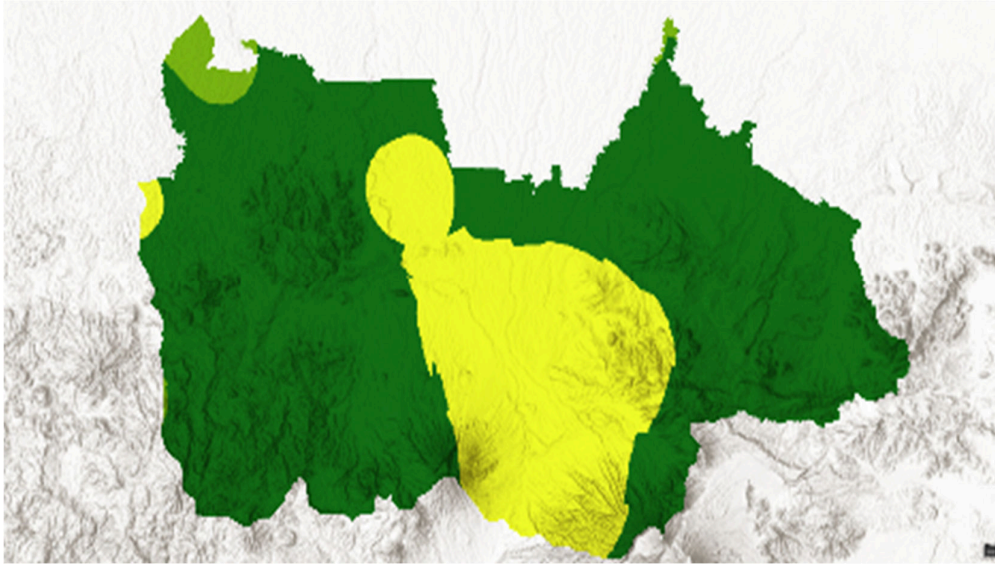


Figure 3. The Sustainable Rainfall Map in Bogor Raya

CONCLUSION

The variables refer to site characteristics and land suitability, such as rainfall. The results show that the average rainfall map has three classes, such low (1,000 – 2,000 mm/year), middle (2,000 – 3,000 mm/year), and high (3,000 – 4,000 mm/year) in Bogor Raya. The results show that potential suitability for Residential Areas in Bogor Raya has high suitability potential because high rainfall levels dominate these areas (2.000 – 4.000 mm/year).

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