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Research Article

Value of Surface Rule Coefficient (C) in Uwemanje Village, Kinovaro District, Sigi Regency

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ABSTRACT

Along with the increasing population growth, the demand for water and land needs also increases. So it tends to cause changes in land use, especially forests, which will affect the water system function of a watershed. This shows that there is a need for conservation efforts to maintain the sustainability of the watershed and its water availability. Land use is a reflection of human activities on land. Land use can be detected based on the land cover. Flood disasters occur due to land use that is not suitable for its designation. Changes in land use result in changes in surface water runoff which can be known based on the coefficient of surface runoff. The greater the rain that occurs, the greater the surface flow, resulting in floods and landslides. The Uwemanje sub-watershed is a hydrological regulator as well as a source of irrigation water for the villages of Porame, Binanngga, Baliase, Boya Baliase, Padende, Sibedi and Uwemanje Alone. The Uwemanje sub-watershed has a very important role in life, especially the daily needs of the Uwemanje community as well as agriculture, animal husbandry and plantations. To find out whether the hydrological characteristics of the Uwemanje sub-watershed are getting better or worse, the flow trend of the Uwemanje sub-watershed can be seen by calculating the runoff coefficient (C), by first analyzing the discharge and rainfall. This research was conducted from April to June 2022 in Uwemanje Village, Kinovaro District, Sigi Regency, and Central Sulawesi Province. The method used to determine the value of the runoff coefficient (C) is the rational method. Based on the observations and measurements made in this study, the results showed that the area of the Uwemanje Village watershed was 12,470,000 m², daily discharge was 12,966.57 m³, rainfall was 0.07893 meters, and the runoff coefficient (C) was 0.0013. The hydrology of the water catchment area (DTA) of the Uwemanje Village is still in a stable condition, which means that the forest with its function as a water regulator has not experienced high physical disturbances.

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1. INTRODUCTION

Water is a very important resource for the survival of life on this earth. Scarcity and decline in water quality that occurs due to environmental degradation will trigger the emergence of various disasters such as food scarcity, flooding, and so on (Wiadnyana, 2019).

Along with increasing population growth, the need for water and land needs also increases. So it tends to cause changes in land use, especially forests, which will affect the water system function of a watershed.

This shows that there is a need for conservation efforts to maintain the sustainability of the watershed and the availability of water. Land use is a reflection of human activities on land. Land use can be detected based on the land cover. Flood disasters occur due to land use that is not suitable for its designation. Changes in land use result in changes in surface water runoff, which can be determined based on the coefficient of surface runoff. The greater the rain that occurs, the greater the surface flow, resulting in floods and landslides (Suprayogi et al., 2014).

Watershed (DAS) is a land area which is an integral part of a river and its tributaries, which functions to accommodate, store and drain water from rainfall to lakes or to the sea naturally, the boundaries of which on land are topographical separators.

Central Sulawesi has 1,654 watersheds (DAS) which are under the working area of the Palu Poso Watershed Management Center (BPDAS). Of the 1,654 watersheds, 13 of them are cross-provincial watersheds, which means watersheds the area is in the crossroads between Central Sulawesi Province and other provinces (BPDASHL PALU-POSO).

Events of floods and landslides in Central Sulawesi are still happening. This condition is signaled to be due to the suboptimal management of the River Basin (DAS) in Central Sulawesi. This condition is a common challenge to realize healthy watershed management. To realize this, strategic steps are needed to improve watershed management and need to be a common concern. (BPDASHL PALU-POSO)

The Uwemanje sub-watershed acts as a hydrological regulator and also as a source of irrigation water for the villages of Porame, Binangga, Baliaese, Boya Baliase, Padende, Sibedi and Uwemanje Alone.Uwemanje Sub-watershed has a very important role It is very important in life, especially the daily needs of the Uwemanje people as well as agriculture, animal husbandry and plantations. To find out whether the hydrological characteristics of the Uwemanje sub-watershed are getting better or worse, the flow trend of the Uwemanje sub-watershed can be seen by calculating the runoff coefficient (C), by first analyzing the discharge and rainfall.

Formulation The formulation of the problem in this study is how the hydrological conditions and the value of the runoff coefficient (C) in the sub-watershed of Uwemanje Village, Kinovaro District, Sigi Regency are.

Objectives the purpose of this study was to determine the value of the runoff coefficient (c) in the sub-watershed of Uwemanje Village, Kinovaro District, Sigi Regency, Central Sulawesi.

Benefit of this research in general is that it becomes one of the information materials regarding the value of the runoff coefficient (C) in the sub-watershed of Uwemanje Village, Kinovaro District, Sigi Regency, Central Sulawesi and as one of the requirements to obtain a bachelor's degree in Forestry Study Program, Faculty of Agriculture, University Muhammadiyah Palu.

2. RESEARCH METHODS

2.1 Time and Place

This research was conducted from April to June 2022 in Uwemanje Village, Kinovaro District, Sigi Regency, and Central Sulawesi Province.

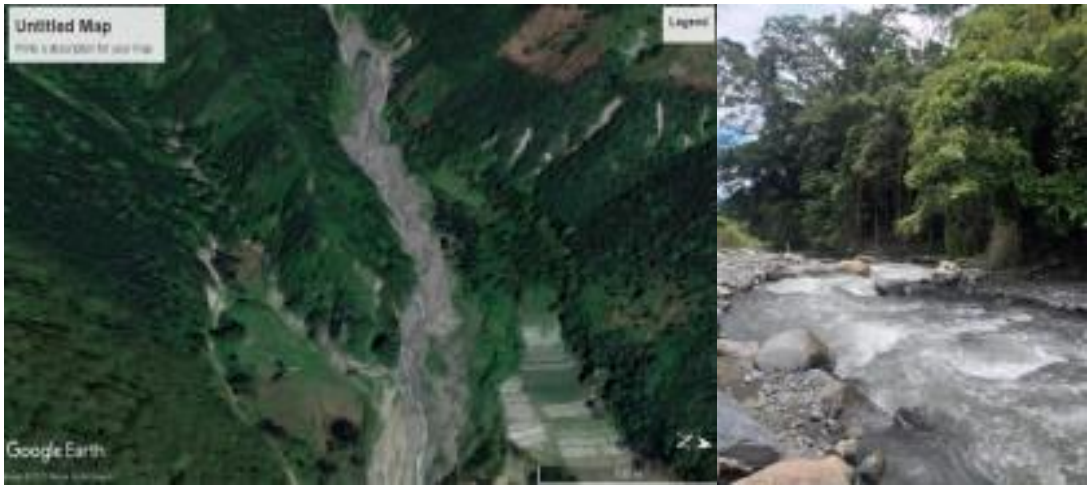

Figure 1. Research Location

2.2 Tools and Materials

The tools used in this study are: 1) Writing utensil to write data; 2) Meter, to measure the area and cross-sectional length of the river; 3) Wooden stick to measure the depth of the sub-watershed; 4) Stop watch to measure the time of flow velocity; 5) Calculator to calculate primary data; 6) GPS to determine the location of the location; 7) Buoy (600 ml mineral bottle) as a tool to determine the speed of water flow; 8) Camera to document research. Materials used 1) Tally Sheet, 2) Raffia rope and 3) Simple rain gauge.

2.3 Types of Data

Data Primary data is data obtained directly from the field including the total volume of discharge in the month concerned, the total volume of rainfall and runoff coefficient.

Data Secondary data is data obtained from other existing sources. includes data on topographic conditions, geomorphology, land cover, rainfall data around the watershed and sub-watershed of Uwemanje Village.

2.4 Data Collection Methods

The preparation phase includes the following activities: 1) Increasing understanding related to research concepts, methods, data collection techniques, data analysis, steps that must be carried out in research and visualization of research objects and research results. 2) Knowledge and understanding of the data needed aims to understand and understand the data used in research in order to facilitate data collection and to determine the availability or completeness of data to support research. 3) Preparation of tools and methods to be used in order to use time effectively and efficiently.

The data collection techniques that will be used in this study are as follows: 1) Field observation, this technique aims to obtain actual and direct data by systematically observing and recording symptoms or phenomena that exist in the object of research (Moh. Pandu Tika, 2005). The purpose of this research observation is to find out the actual situation in the field so that later accurate data will be obtained. 2) Measurement of River Water Discharge, measurement of river water discharge is carried out by first determining point 0 (zero) as the measurement location point. The next step is to measure the wet cross-sectional area of the river by measuring the length and width and depth of the water in several parts of the river segment, then measuring the velocity of the river water using a floating device with several repetitions. Each measurement result is added up and then the average value is calculated with the intention that the average value is close to the actual depth and speed of the water. From the average value of water velocity, depth and cross-sectional area wet then processed to determine river water discharge using the formula (Asdak, 2002) as follows:

$$Q=A \times V \ (m^3/detik)$$

3) Rainfall, measurement Measurements were made to see daily rainfall data and determine the intensity of rainfall for 1 month of observation and measurement of the coefficient value (C). By using a simple rainfall gauge that is placed in the observation area and measuring water discharge. This data is also used to compile a description of the climatic conditions in the study area. 4) Documentation is a method of searching for data regarding things in the form of notes, books, newspapers, magazines, and so on (Suharsini Arikunto, 2010). Data obtained from documentation as secondary data. The secondary data used in this study is data related to the parameter value of the runoff coefficient (C).

2.5 Data Analysis

The analytical method used is the USSCS Rational (Unified Soil Classification System) with the following measurement details: 1. Calculating the discharge (Q) which is the volume of runoff (flow) that comes out of the catchment area of the watershed (DAS) /sub-watershed (DAS) at the river outlet in units of millimeter (mm) or cubic meter (m^3) as follows:

$$total\ debit\ setahun = \sum_{n=1}^{12} dn\ x\ 86400\ x\ Qn\ (M^3)/\mathrm{A}$$

Where:
Dn = number of days in the month concerned
Qn = total debit in the month concerned
A = area of watershed (DAS) /sub watershed (DAS)

2. Coefficient Runoff (C)

$$(C = \sum_{n=1}^{12} dn\ x\ 86400\ x\ Qn\ (M^3)/\text{A}) : \text{P}/1000 \text{ x A}$$

a. The number 86400 is the convention 1 day to hour, minute, second = 24 x 60 x 60 sec.
b. Calculate the total volume of discharge (Q) divided by the area of the watershed (DAS)/sub-watershed (DAS)
c. Calculating the total volume of rainfall in the watershed (DAS)/sub-watershed (DAS)
d. The runoff coefficient (C) can be calculated as follows:

3. RESULTS AND DISCUSSION

3.1 Area and Location

Based on the results of observations and measurements in the Sub-watershed of Uwemanje Village, Kec. Kinovaro Kab. Sigi for 30 days starting from April 12 to May 12, 2022 data obtained that the area of the catchment area (DTA) whose water flows in the Uwemanje river is 1,274 ha then converted to square meters obtained 1,274 = 12,470,000 m². Uwemanje River Basin is a confluence of water from several villages in the mountains of the Kinovaro and West Marawola sub-districts that flows up to the Palu River.

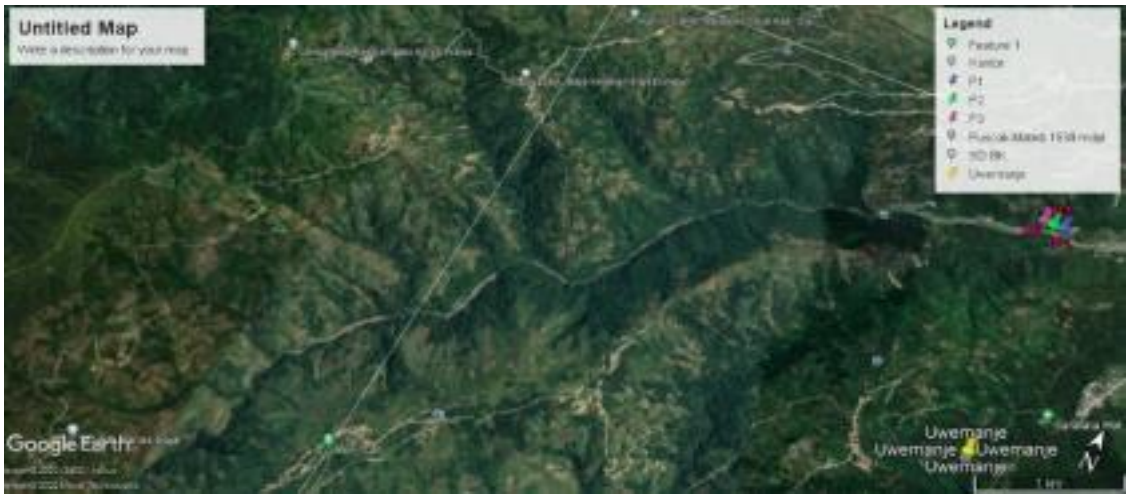

Figure 2. Image of River Confluence

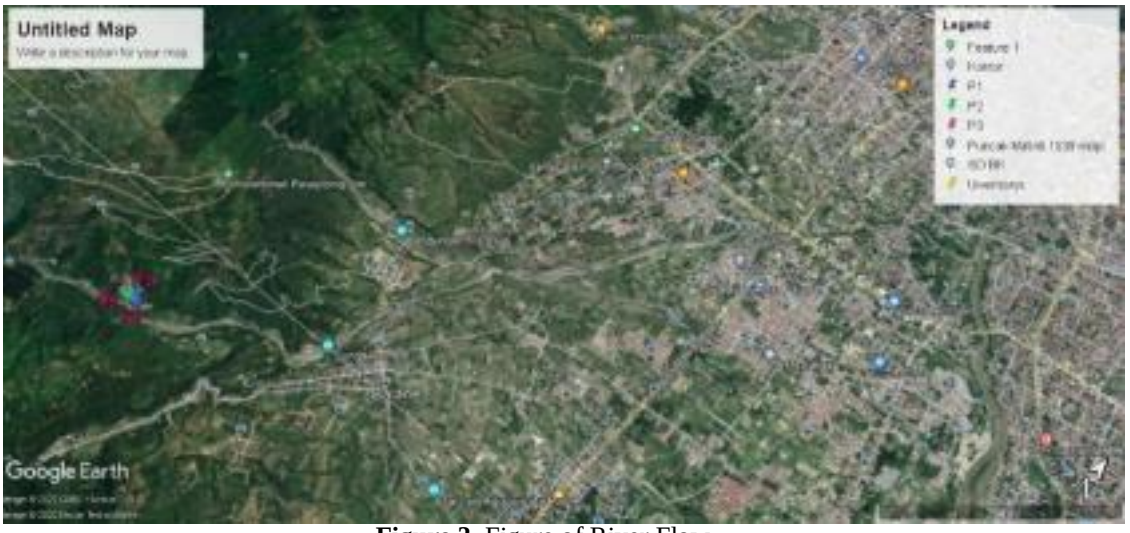

Figure 3. Figure of River Flow

5.2 Daily

Discharge the daily water discharge obtained in the field is multiplied by one day where 1 day = 24 hours which is converted to 24 x 60 x 60 = 86,400 seconds. Based on the Water Level (TDC) the velocity of the water is then multiplied by one day which is converted to seconds (86400 seconds) in one second, the daily discharge can be calculated using the rational theory of Asdak (2002), with the formula:

$Q = A \times V$

Where: A = Wet Cross-sectional Area (m^2)

V = Water velocity (m/s)

The daily discharge (Q daily) obtained after the data is processed is 13,011.99 m which is contained in Appendix 1

According to the daily discharge in Appendix 1, from April 12 to with May 11, there was the lowest value of 45.41 m^3, this was due to four days without rain and high hot weather on April 19 - April 24 and the lowest daily discharge value was also the base flow (Base Flow / BF).) using a holistic amount of 45.42 m^3. Base flow means that river water exists and permanently flows without rain falling for a long time.

The highest daily discharge occurred on May 22 at 2,658.74 m^3 the high daily discharge was caused by high intensity rainfall on April 26.

So the daily discharge value is the total daily discharge minus the base flow Base Flow / BF (13,011.99 m - 45.42 m = 12,966.57 m^3).

5.3 Rainfall

Rainfall based on the research results totaled 78.93 mm, where the highest rainfall occurred on April 26 at 25.3 mm due to heavy rainfall and long duration. While the lowest rainfall occurred on May 9, amounting to 2.54 mm. Rainfall data and values are in appendix 2 table 7.

Rain data obtained through a simple rainfall gauge consists of 8 rain events that occurred from April to May 2022. The amount of rainfall, time of concentration, and rainfall intensity can be seen in Appendix 2 Table 7.

According to Asdak (2004), the rational method cannot be used to explain the relationship between rainfall and discharge in the form of a hydrograph. The higher the rainfall, the greater the Qp produced and the lower the rainfall, the smaller the Qp produced. This is not in accordance with the estimation results of peak discharge and conditions in the field that high rainfall does not necessarily result in high discharge because it is influenced by physical and biological factors in the watershed such as soil moisture due to previous rain events.

5.4 Runoff

Coefficient The runoff coefficient (C) means the ratio between the thickness of runoff (Q.m^3) and the thickness of rain (P) in the catchment area (DTA), watershed. based on data on area of DTA (Sub-watershed), daily discharge, and rainfall after processing and analysis.

Uwemanje catchment area (Sub watershed) = 12,470,000 m^2

Daily discharge (Q) = 12,966.57 m^3

Rainfall (P) = 78.93 mm = 0.07893 m Coefficient (C) = 12,966.57 m^3 0.07893 mx 12,470 ,000 m^2 = 0.0013. The runoff coefficient (C) of the Uwemanje river based on the calculation results is 0.0013. This value is an indicator that the hydrological condition of the Uwemanje sub-watershed is in a stable condition according to the runoff coefficient classification (C) in table 6. The coefficient value (C) of 0.0013 is greater than 0 (zero) and less than 1 = $0 < C > 1$. Dijen RLPS, (2009) means that 0.13% of rainwater is runoff, this illustrates that forests and The land in the Uwemanje sub-watershed area is in good condition and does not experience high physical disturbances.

The runoff coefficient (C) is a number that shows the ratio (ratio) between the amount of runoff to the amount of rainfall that causes it, the value is $0 < C < 1$. For example, the value of C = 0.2, meaning that 20% of the rainfall becomes runoff. Director General of RLPS (2009).

Calculation of Surface Runoff that occurs every year Daily direct runoff is calculated based on the daily inflow debit minus the base flow. Then, the daily direct runoff obtained is accumulated to produce the amount of direct runoff for one year.

Calculation of Surface Runoff Volume To calculate the volume of runoff that occurs, the results obtained in the calculation of the previous direct runoff are multiplied by the time of day which is 24 hours = 86400 seconds.

The runoff coefficient value obtained is smaller, namely 0.0013. This value shows that 0.13% of the rain that falls in the watershed area will become surface runoff and is classified as low and normal.

4. CONCLUSION

Based on the results of research and discussion, it can be concluded that the Runoff Coefficient Value (C) in the Uwemanje Village Sub-watershed, Kinovaro District, Sigi Regency is 0.0013, meaning 0.13% of

the total volume of rainfall in the catchment area. water into runoff water that flows through the Uwemanje River is still in a stable condition, which means that the forest with its function as a water regulator has not experienced high physical disturbances.

5. SUGGESTIONS

To maintain the sub-watershed of Uwemanje Village, Kinovaro District, Sigi Regency as a water catchment area in good condition, it is hoped that there will be people's awareness to maintain the existing vegetation and plant trees that are useful both for the protection function as well as the production function into land cover vegetation so that the forest and water remain sustainable because of care environment today for a better life tomorrow.

Conduct counseling and assistance for the surrounding people in land use so as not to damage the sustainability of forests and water.

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