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MORALITY BEFORE KNOWLEDGE

Study of surface flow discharge in the bompon sub watershed, Magelang District

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ABSTRACT

Background: The Bompon sub-watershed can be divided into 3 parts, namely upstream, middle and downstream and has a catchment area in residential areas and mixed gardens. The five river areas in the Bompon Sub-watershed have different levels of water discharge. This is influenced by the area size, rainfall, land cover, slope, shape of the watershed area, and density of rivers in the watershed area. This research was conducted in Margoyoso Village, with the aim of knowing the amount of river water discharge in the upstream, middle and downstream Bompon Sub-watershed, residential catchment areas and mixed gardens. **Methods:** In this research, water flow discharge was calculated using the Area-velocity Method using floats. This study uses a quantitative approach. The object of this research is the amount of flow discharge in the five river sections, while the subject of this research is the observation water points in the five river sections in the Bompon Sub-watershed. **Findings:** The results of this research show that the largest discharge magnitude is in the downstream section. Meanwhile, the smallest discharge amount is in the middle section, because the river order in the downstream section is a meeting between several river orders in the upstream and middle sections. **Conclusion:** Then for measuring surface flow discharge in the water catchment area, it shows that the amount of discharge in residential areas does not contain flowing water. This is caused by land use factors around the weir which are dominated by residential areas, where there are buildings which make it difficult for water to enter the ground. Meanwhile, in mixed plantation areas there is a fairly large amount of discharge, because the water supply comes from subsurface flows or seepage.

KEYWORDS: buoy; downstream; middle; upstream; water discharge.

1. Introduction

A river basin is a land area which is a unit with a river and its tributaries, which functions to accommodate, store and channel water originating from rainfall to a lake or to the sea naturally, where the boundary on land is a topographical divider and the boundary on sea to water areas that are still affected by land activities (RI Government Regulation No. 37 of 2012).

The Bompon Sub-watershed is a part of the Bogowonto Watershed. Administratively, the Bompon Sub-watershed includes several villages, namely Kwaderan Village, Kajoran District, Wonogiri Village and Margoyoso Village, Salaman District.(Haykal et al., 2018). The

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constituent materials in the Bompon watershed consist of Mount Sumbing Muda and Menoreh Mountains. The position of the Bompon watershed is in the transition zone of southern Java (lifting zone). This condition results in endogenous and alteration processes that control the Bompon Sub-watershed(Iryanthony et al., 2019).

The Bompon sub-watershed can be divided into 3 parts, namely the upstream part, the middle part and the upstream part. The physical characteristics of the upstream tributary have relatively small channel dimensions with a shape like a rice field irrigation canal. These tributaries are seasonal where the water flow is only available during the rainy season, some even only exist when the intensity is high for several days. The main river in the middle has medium channel dimensions and is slightly larger than its tributaries. The largest river dimensions are found in the main river downstream with a fairly fast flow. The rivers in the downstream are not only used for irrigation but also as water reserves for various needs of the people in this area because they are perennial.

The three river areas in the Bompon Sub-Watershed have different flow rates. This is influenced by the area size, rainfall, land cover, slope, shape of the watershed area, and density of rivers in the watershed area. The presence of the rain factor will make the river flow greater, so that it will also have an impact on the value of the sediment load discharge becoming greater. Meanwhile, the relatively steep and sloping slopes that dominate the area will facilitate surface flow quickly towards the river body.

Based on the background that has been stated, the objectives of this research are to (1) Identify the magnitude of river flow water discharge in the upstream, middle and downstream Bompon Sub-watersheds, (2) Identify the magnitude of flow discharge in the water catchment area (catchment area) settlements and mixed gardens, (3) Analyze the factors that influence differences in water discharge in both river basins and catchment areas in the Bompon Sub-watershed.

This research will focus on calculating the amount of water discharge and factors What influences the amount of water flow discharge is the catchment area and vegetation cover. There are several studies regarding the study of water discharge which researchers use as a reference for researchers in conducting this research, including (Sulaxono et al., 2020) who conducted research on the study of water discharge which is connected to the KRA Value (Flow Regime Coefficient) in each section of the river. The upstream section shows the recovery qualification is very low, the middle section shows the recovery qualification is low, and in the downstream section the KRA value shows the recovery qualification is very high.

Another research by (Hauteas et al, 2021) regarding calculating the amount of water discharge using a flow meter and floating method to determine the level of suitability of the discharge magnitudes of the two methods. From the test results, it shows that the average percentage of conformity between the discharge measurement methods between flow meters and floating devices in the Upper Watershed is 80%. These results are influenced by the character of the flow rate in each part of the watershed and wind speed which allows for differences in the measurement results.

2. Methods

2.1 Flow Rate Measurement

The data used in this research comes from primary data and secondary data. Primary data was obtained by observation including direct flow discharge measurements in the field in the upstream, middle and downstream parts of the river as well as in the water catchment area around residential areas and mixed gardens using the float method by dividing it into several segments. Secondary data was obtained from aerial photography of the 2020 Bompon watershed to determine the location of each section. The population of this study is the Bompon sub-watershed river flow in the upstream, middle and downstream parts as well as river flow in residential catchment areas and mixed gardens. Meanwhile, the research samples were water points in each sub-watershed that entered the three canals in

the Bompon Sub-watershed as well as river flows in residential catchment areas and mixed gardens.

2.2 Measurement of Catchment Area

The tool used to measure the catchment area is ArcGis software. Measurements of the size of the catchment area were carried out in the water catchment area around settlements, mixed gardens, as well as in the three river sections based on plotting the measurement coordinate points which act as an outline. This measurement is used to obtain data on area area as one of the factors that influences the magnitude of surface flow discharge to a greater or lesser extent.

2.3 Data Analysis Technique

Data analysis was carried out using qualitative and quantitative descriptive methods. Quantitative descriptive analysis describes the calculation of surface flow discharge in each section using the formula:
Discharge (Q) = K x A x V

Where :

- Q = discharge (m3/sec)
- V = average flow speed (m/sec)
- A = wet cross-sectional area (m2)
- K = Float coefficient

Meanwhile, the qualitative descriptive analysis used aims to describe the results of field observations in the form of factors that influence the size of the flow discharge in each upstream, middle, downstream section, as well as water catchment areas in residential areas and mixed gardens. AThis kind of analysis is needed to find out what factors influence the flow rate based on data obtained in the field.

3. Result and Discussion

3.1 General Conditions of the Bompon Sub-Watershed

The Bompon sub-watershed is part of the Bogowonto watershed. Administratively, the Bompon Sub-watershed crosses three villages, namely Kwaderan Village, Kajoran District in the north, Wonogiri Village, Kajoran District in the middle, and Margoyoso Village, Salaman District in the south. Geographically, the Bompon Sub-watershed is bordered by Pandanretno and Bambusari Villages, Kajoran District in the north, Madukoro Village, Kajoran District and Kaliabu Village, Salaman District in the east, Mayungsari Village, Bener District in the south, and Wuwuharjo Village, Kajoran District in the west.

Geomorphologically, the Bompon Sub-watershed is located on the slopes of the Sumbing Volcano foothills. These slopes have wavy to hilly characteristics. The surface cover comes from weathered materials from the Old Sumbing and Young Sumbing Volcanoes as well as weathered base materials from the Menoreh hills. Even though it is located on the slopes of Sumbing, the Bompon Sub-watershed is not included in the Sumbing system. The constituent materials are formed from old cleft deposits and also from the Menoreh hills. These deposits make the Bompon Sub-watershed area have a thick layer of soil which is the result of volcanic deposits which are dominated by clay material with breccia bedrock.

The Bompon sub-watershed is divided into 3 (three) river sections, namely the upstream section, the middle section and the downstream section. The main river in the downstream part of the Bompon Sub-watershed has the largest river dimensions with quite fast water flow. Meanwhile, the main river in the middle of the Bompon Sub-watershed has

medium-sized channel dimensions and is slightly larger than the dimensions of its tributaries.

3.2 Debit Water

The results obtained during research in the Bompon Sub-watershed of the Bogowonto Watershed are located in Salaman and Kajoran Districts. The upstream part of the Bompon Sub-Watershed is located in Wonogiri Village, while the Central, Downstream, Mixed Garden and Settlement Catchment Areas of the Bompon Sub-watershed are located in Margoyoso Village with the coordinates presented in Table 1.

Table 1. Coordinates of research locations

No	Place of Measurement	Coordinate point (X)	Coordinate point (Y)
1.	Upstream	-7.551752	110.062886
2.	Middle	-7.562929	110.066338
3.	Downstream	-7.562968	110.06636
4.	Settlement	-7.562257	110.065671
5.	Mixed Gardens	-7.562176	110.065617

(Primary Data, 2023)

3.3 Upper, Middle and Lower Parts

Water discharge measurements in the Bompon Sub-watershed are located at three different points. The three points include, upstream, middle and downstream. Water discharge measurements were carried out on May 7 2023. Water discharge data was obtained from the results of measurements and calculations using the float method which are presented in Table 1. Each watershed section is calculated based on the wet cross section which is divided into several segments, with a width of 0.3 meters per segment at upstream, the width in the middle section is 0.3 meters per segment and the width in the downstream section is 0.3 meters per segment and the cross-sectional area varies with the existing river conditions. The width and cross-sectional area affect the discharge of a river(Sulaxono et al., 2020). The deeper the river, the greater the water discharge produced. The results of wet cross-sectional images of the upstream, middle and downstream sections can be seen in Figures 1, 2 and 3.

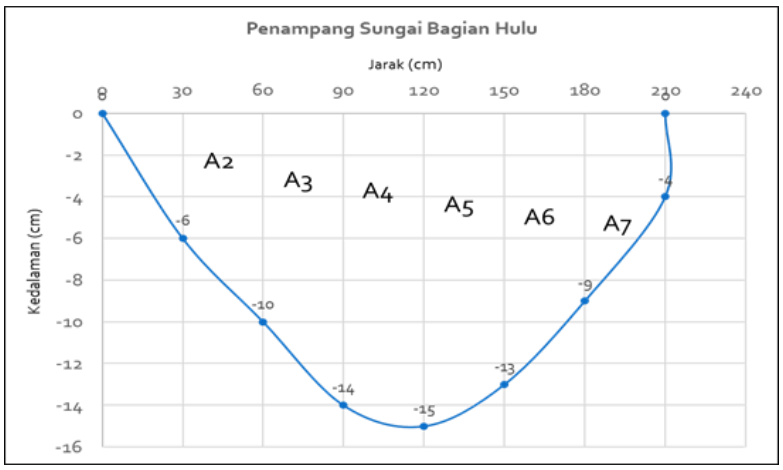

Fig 1. Cross section of the upstream sub-watershed

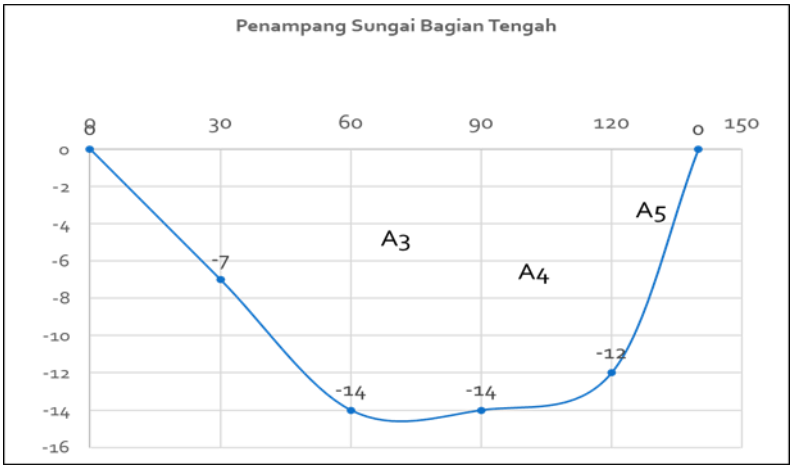

Fig 2. Cross section of the central sub-watershed

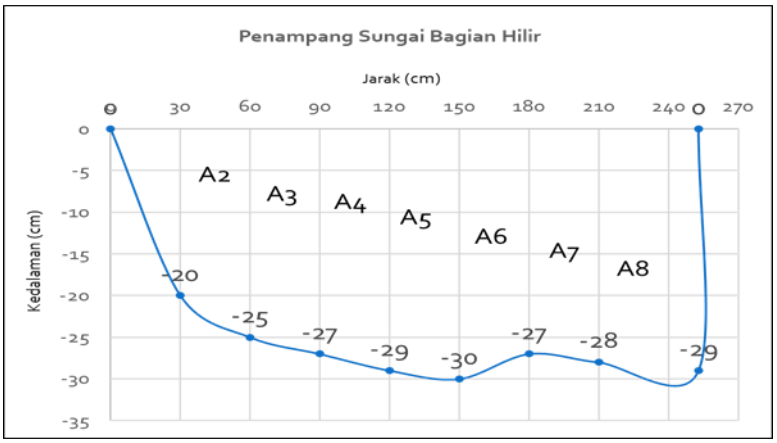

Fig 3. Cross section of the downstream sub-watershed

The results of discharge calculations for the upstream, middle and downstream sections can be seen in Table 2.

Table 2. Measurement of water discharge in the upstream, middle and downstream sections

Measurement Point	Constant	River Width (m)	River Depth (m)	Cross-sectional Area (A) (m2)	Distance (m)	Time(s)	Speed (V) (m/s)	Discharge (Q) (m3/s)
Downstream	0,91	2,57	0,29	0.639	5	13.35	0.341	0,20
Middle	0,93	1,4	0,14	0.123	5	8.93	0.520	0,06
Upstream	0,93	2,1	0,15	0,174	5	10,5	0.443	0,07

(Processed Primary Data,2023)

Based on the results of measurements of the water flow of the Bompon Sub-watershed carried out in the upstream, middle and downstream sections, the discharge values are different using buoys. Measurements with a float have a discharge value of 0.06 m^3/s to 0.20 m^3/s. The results of water discharge can vary due to several factors such as the width and depth of each section of the river. The results of the water flow discharge graph in the three river sections can be seen in Figure 4.

Fig 4. Graph of bompon sub-watershed water flow discharge

Based on the results of the calculation of the water flow discharge of the Bompon Sub-watershed which is displayed on the graph. It can be concluded that the part of the Bompon Sub-watershed that has the fastest water flow is in the downstream section. Many factors influence the size of the water flow in the Bompon Sub-watershed, but in this study the researchers only focused on the area and vegetation factors around the Bompon Sub-watershed.

3.4 Water Catchment Area Section

Water discharge measurements in the Bompon Sub-watershed catchment area are located at two different points. These two points include the mixed garden and residential areas. Water discharge measurements were carried out on May 8 2023. Water discharge data was obtained from the results of measurements and calculations using the float method which are presented in Table 3. In the Water Catchment Area section, the wet cross section is not calculated into several segments, due to the spatial dimensions in the water catchment area. it's the same. The results of wet cross-sectional images of the mixed garden and residential water catchment areas can be seen in Figures 5 and 6.

Fig 5. Cross section of the mixed plantation river catchment area

Fig 6. Cross section of the river catchment area settlement

The results of discharge calculations for the upstream, middle and downstream sections can be seen in Table 3.

Table 3. Measurement of water discharge in the catchment area

Measurement Point	River Width (L) (m)	Cross-sectional area (A) (^{2})	Distance (m)	Time(s)	Speed (v) m/s	Discharge (Q) m^3/s
Mixed Gardens	0,73	0.0511	5	16.8	0,3	0.01533
Settlement	0	0	0	0	0	0

(Processed Primary Data, 2023)

Based on the results of measurements of the water flow discharge of the Bompon Sub-watershed carried out in the mixed garden and residential water catchment areas, the discharge values were different using a float device. Measurements with a float have a discharge value of 0.0 m^3/s to 0.0153 m^3/s. The results of water discharge can vary due to several factors such as the width and depth of each section of the river. According to Soebarkah (1978), there are several factors that influence the amount of water flow in rivers, namely, rain (intensity), topography (slope), geology (rocks), and the state of vegetation (vegetation). So it can be seen that the higher the water level, the higher the discharge produced. The results of the water flow discharge graph in both parts of the river catchment area can be seen in Figure 5.

Fig 7. Water flow discharge graph in the catchment area

Based on the results of calculating the water flow discharge of the Bompon Sub-watershed in the water catchment area which is shown in the graph. It can be concluded that the water catchment area that has the fastest water flow is in the mixed plantation section. This is because at the time of measurement, there was no water flowing in the residential catchment area. Meanwhile, in the mixed garden section, the water supply comes from subsurface flow or seepage, where rainwater that falls enters the ground and comes out as seepage or spring water. Apart from that, there are many factors that influence the size of the water flow in the Bompon Sub-watershed, but in this study the researchers only focused on the area and vegetation factors around the Bompon Sub-watershed.

3.5 Factors that Influence the Amount of Water Flow Discharge Relationship of Water Catchment Area and Vegetation Density with Upstream Water Flow Discharge

Based on satellite imagery of the Bompon Sub-watershed, at the upstream measurement point it can be seen that the measurement point is in an area that has quite sparse vegetation density with a water catchment area of 32 Ha. Under these circumstances, it is known that the flow rate in the upstream part of the Bompon Sub-watershed is 0.07 m3/s.

The characteristics of the upstream river are mostly natural vegetation where the river is adjacent to a fairly steep cliff on the right side, far from residential areas, but on the left side of the river there are many rice fields belonging to residents. The vegetation that grows most is ferns and bamboo.However, many bamboo plants have tilted due to landslides so that landslide sediment enters the river, so this is also one of the factors that influences flow discharge in the upstream section.

3.6 Relationship of Water Catchment Area and Vegetation Density with Central Water Flow Discharge

Based on satellite imagery of the Bompon Sub-watershed, at the middle measurement point it can be seen that the measurement point is in an area that has quite dense vegetation density with a water catchment area of 50 Ha. Under these circumstances, it is known that the flow rate in the middle part of the Bompon Sub-watershed is 0.06m3/s.

The characteristics of the river in the middle are mostly ferns and bamboo trees, but on the right and left of the river there are rice fields belonging to residents, but the position of the rice fields is higher than the river. Therefore, the rice fields located around the middle of the watershed are rain-fed, meaning that the rice fields rely on rainwater for irrigation.

This is of course one of the factors that makesinfluences the flow rate in the middle part of the Bompon watershed, because the water in the middle part is allowed to flow naturally, without being used for agricultural needs.

3.7 Relationship of Water Catchment Area and Vegetation Density with Downstream Water Flow Discharge

Based on satellite imagery of the Bompon Sub-watershed, at the downstream measurement point it can be seen that the measurement point is in an area that has quite dense vegetation density with a water catchment area of 16 Ha. Based on these conditions, it is known that the flow rate in the downstream part of the Bompon Sub-watershed is 0.2m3/s.

The characteristics of the river downstream are cliffs on the left and rice fields on the right. However, the cliffs to the left of the river consist of alteration material originating from

landslides or rocks. The color of the material is brownish red and has a fairly rough and clayey texture.

This alterization material is also often found in downstream river beds, therefore, the presence of alterization material in river beds is one of the factors that influences flow discharge downstream.

3.8 Flow Discharge in Catchment Areas in Mixed Settlement and Garden Areas

Based on the results of measurements in the field, it was found that the flow rate in the catchment area in the settlement was 0 m3/s. This is not without reason, because in residential areas there is no water runoff. This is because in residential areas run off occurs only when it rains. After the rain stops, run off will no longer occur.

In contrast to mixed plantations, it was found that the flow rate in the catchment area was as large as0.01533m3/s. This is not without reason, because in the mixed garden area the vegetation is still green and there are no buildings or other things that could interfere with water runoff in the mixed garden area. Apart from that, in the mixed garden area, rainwater that enters the soil will be stored by the existing vegetation, so that when there is no rain in the mixed garden area there is still water flowing, this water comes from seepage from the soil pores resulting from water previously collected rain.

4. Conclusion

Based on a results of the calculations and analysis that have has a been carried out, several things can be a concluded, including: (1) The flow rate in the river in the upstream Bompon Sub-watershed is 0.07m3/s, in the middle part it is 0.06 m3/s, and in the downstream part it is 0.20. (2) The flow rate in the residential catchment area is 0 m3/s and the flow rate in the mixed plantation catchment area is 0.01533m3/s. (3) Many factors influence the differences in water flow in the upstream, middle and downstream parts of the Bompon Sub-watershed. In the upstream part, the vegetation density is quite sparse and also in the upstream part it is far from settlements, however, river water in the upstream part is used for rice farming.

In the middle part the density is quite dense but the river is not too big, apart from that in the middle part the river water is not used for agricultural needs, because agriculture in the middle part is a rain fed river so the river water in the middle part is allowed to flow naturally. In the downstream section, the vegetation density is quite dense, but on the right side of the river there are cliffs formed by landslides in the form of alteration material, this material is also found in the downstream riverbed.

In residential water catchment areas, the influencing factors are the presence of settlements and little vegetation, this causes rainwater to not be collected properly and runs out immediately when the rain stops. In the mixed garden area there is a density of vegetation and there are no settlements, so that rainwater can be absorbed optimally and stored in the soil, so that when the rain stops the water can still flow due to seepage from rainwater storage that enters the ground.

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