ANALYSIS OF THE BATANG LANGKUP WATER DISCHARGE USING THE FLOATING METHOD FOR MICRO-HYDRO POWER PLANT NEEDS (PLTMH)

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ABSTRACK

Water resources are renewable natural resources that have a volume with constant conditions in the hydrological cycle. The constant presence of water in the hydrological cycle can make water a source of energy. Water potential is also influenced by the presence of high rainfall in an area. The higher the rainfall, the higher the potential of water as a source of renewable energy, one of which is a micro-hydro power plant. The use of energy sources from hydropower has great potential in hilly complexes that have large river networks. To meet the need for electrical energy in the Rantau Kermas Village area, Jangkat District, Merangin Regency, Jambi Province, a water discharge calculation is needed to determine the estimated availability of energy. The calculation of water discharge in the Rantau Kermas Village Area, Jangkat District, Merangin Regency, Jambi Province was carried out using the floating method with the results obtained being 4,644 m3/s. and can increase or decrease depending on the rainy season or dry season. Water discharge value data can be used as information for the purposes of developing water resources as a Micro Hydro Power Plant (PLTMH) in the discharge

Keywords: *Renewable Energy; Water Discharge; Floating Method; Micro-Hydro Power Plant (PLTMH)*

INTRODUCTION

Electricity production in Indonesia until 2015 was 281,757 GWh, where 65.9% of the energy obtained came from coal combustion in PLTU, and 14.4% was produced from PLTGU. The use of renewable energy from water energy as of 2019 was only 6.8% or equivalent to 19,063 GWh (Badan Pusat Statistik, 2020).

Water resources are the renewable natural resources that are stable because they have a volume with constant conditions in the hydrological cycle. The constant presence of water in the hydrological cycle makes water become a source of energy. Rainfall is a factor that influences water potential. The higher the rainfall in an area, the higher the potential of water as a renewable energy source, one of which is micro-hydro power plants.

Microhydro Power Plant (PLTMH) according to Damastuti (1997) is the use of water resources as renewable energy to produce energy, where the energy produced is classified as small scale energy (less than 200 kW). The potential for PLTMH development is still very large. Utilization of PLTMH is around 60 MW of which the potential that can be generated by hydroelectric power is around 7,500 MW and 10% is used as PLTMH (Basuki, 2007). To find out the potential and estimate the availability of energy to meet electrical energy needs in Rantau Kermas Village, Jangkat District, Merangin Regency, Jambi Province, it is necessary to carry out a calculation analysis of river water discharge, because the Microhydro Power Plant is a type of run of river generator that utilizes river water flow or irrigation canal. The condition of the water used is a certain capacity and height. The higher the flow speed and water capacity, as well as the installation height, the greater the electrical energy produced.

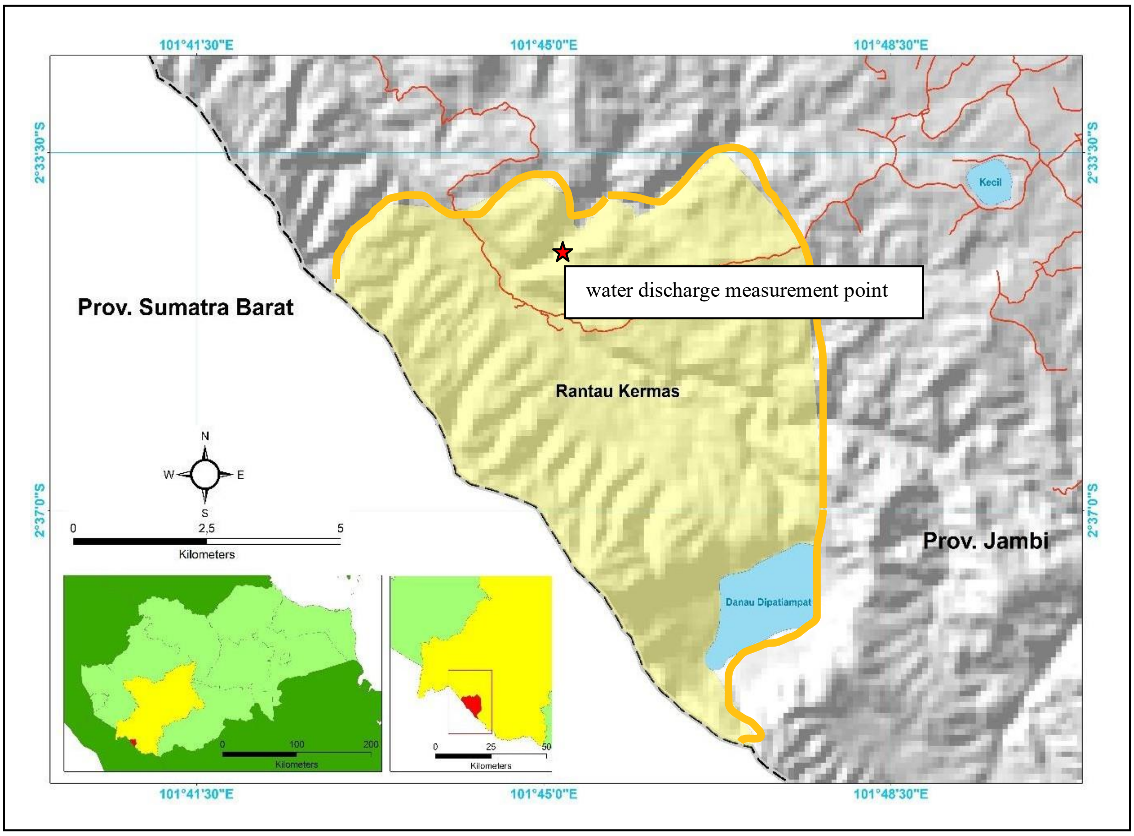

Figure 1. Administrative map of the Rantau Kermas Village Research Area, Jangkat District, Merangin Regency, Jambi Province

DATA AND METHOD

This study focuses on the study of water resource potential for the development of micro-hydro power plants with a hydrological approach that includes measuring water discharge. The research method applied is the collection of primary and secondary data. The primary data obtained is in the form of water discharge measurement data, while the secondary data obtained in this study based on previous research is the geomorphological landform of the research area, drainage patterns, and rainfall.

Field observations were conducted in the form of water discharge measurements at observation points. Discharge measurement points were determined based on initial studies through estimation of the area of the water catchment area through contour/topography interpretation. Measurements were conducted using the Floating Method with tools and materials including raffia rope, cork, meter, stick, and stopwatch.

The Floating Method is carried out to measure the average speed of river surface flow. The working mechanism of the measurement is as follows: 1. Preparation of tools and materials, 2. Preparation of measurement media in the river flow by measuring the observation distance using a meter. 3. Travel time of the floating object along the path made using a stopwatch. 4. Measurements are made on the river body, including the width of the river and the depth of the river..

The calculation of water discharge is carried out using the average velocity formula for river surface flow and the discharge calculation uses the following equation.

$$V = \frac{s}{t} \quad \rightarrow \quad Q = A \times V$$

Information:
V: Average velocity of surface flow (m/s)
s : Observation Point Distance (m)
t : Object travel time (s)

Q : Water Discharge (m^3/s)
A : Cross-sectional area (m^2)

Calculation and analysis of river cross-sectional area can be obtained by using cross-sectional width and water depth data that have been obtained through field observations, the results of which have been presented.

RESULT AND DISCUSSION

Based on the results of previous research from (Siregar, 2023) observations of the geomorphological landform of the research area in the form of a structural valley, this is indicated by the presence of hills around the research location with an elevation of 958 meters above sea level. The drainage pattern at the drainage location at the research location is in the form of a parallel and sub-dendritic drainage pattern (figure 2), and the analysis of rainfall data from 2021 to 2023 is included in the high category. From the rainfall data, it can affect the river water discharge, so that the higher the rainfall, the higher the river water discharge will be. The use of energy sources from hydropower is very potential in hilly complexes that have large river networks.

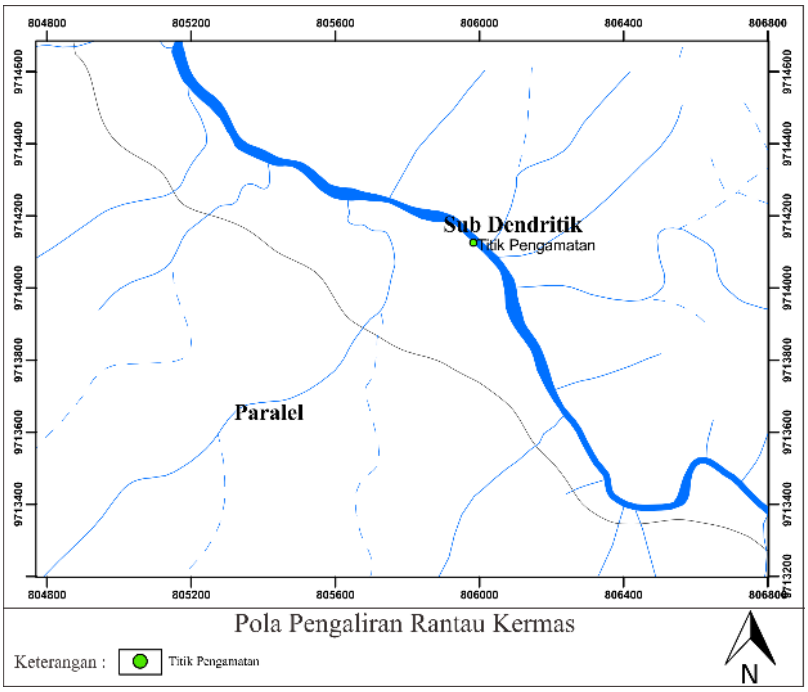

Figure 2. Flow Pattern (Siregar, 2023)

Discharge measurements were carried out at the main river branch and the flow towards the turbine. The measurements were carried out using the floating method. Measurements using the floating method only require a raffia rope, cork, meter, stick, and stopwatch. The data obtained such as river water speed data, river depth data, river cross-sectional area, and river water discharge analysis. River depth measurements use the provided stick and are measured per point.

Analysis of water flow velocity is obtained through processing distance data from observation data that has been taken, namely the distance of the track and the travel time of the cork from the start line to the finish line. Analysis of the river water cross-sectional area can be obtained by using data on the width of the cross-section and the depth of the water that has been obtained through field observations, the results of which have been presented. Analysis of river water flow discharge can be obtained by processing data from the calculation of the cross-sectional area and water flow velocity. Figure 3 is a picture of the calculation of water discharge using the floating method.

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Figure 3. the calculation of water discharge using the floating method

River Cross-sectional Area

Analysis of river water cross-sectional area can be obtained by using cross-sectional width and water depth data obtained through field observations. Table 1 is a table of water discharge measurement results using the floating method.

Table 1. Water Discharge Measurment using the Floating Method

River Width	: 7.35 m		
Length of Track	: 10 m		
Displacement between Point	: 1.47 m		
d 0	: 0.78 m	t 0	: 15.99 s
d 1	: 1.47 m	t 1	: 14.41 s
d 2	: 1.56 m	t 2	: 17.72 s
d 3	:1.52 m	t 3	: 24.50 s
d 4	: 1.05 m	t 4	: 19.83 s
		$t_{rata\text{-}rata}$	: 18.49 s

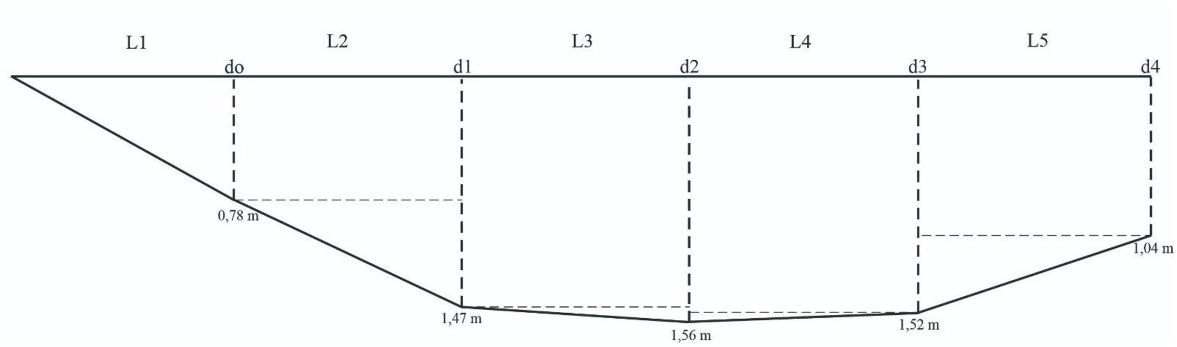

Figure 4. River Cross-section Results

Table 2. Cross-sectional Area Measurment

No.	Cross-sectional Area	River Width (m^2)
1	L1	0.57
2	L2	1.65
3	L3	2.23
4	L4	2.26
5	L5	1.88
6	L_{total}	8.6

In Table 2, the results of the analysis based on the data obtained using the calculation of the cross-sectional area equation follow the shape of the width and depth of the river in the cross-sectional results in Figure 4. Cross-sectional area 1 with a triangular cross-sectional shape with a width of 1.47 m and a length of 0.78 m, the cross-sectional area value is 0.57 m^2. Cross-sectional area 2 with a triangular and rectangular shape with a width of 1.47 m and a length of 1.47 m, the cross-sectional area value is 1.65 m^2. Cross-sectional area 3 with a triangular and rectangular shape with a width of 1.47 m and a length of 1.56 m, the cross-sectional area value is 2.23 m^2. Cross-sectional area 4 is triangular and rectangular with a width of 1.47 m and a length of 1.56 m, the cross-sectional area value is 2.26 m^2. Cross-sectional area 5 is triangular and rectangular with a width of 1.47 m and a length of 1.52 m, the cross-sectional area value is 1.88 m^2. The overall result of the river cross-sectional area is 8.6 m^2.

Velocity Analysis

Flow velocity analysis is obtained through processing distance data from observation data that has been taken, namely the distance of the track and the travel time of the cork from the start line to the finish line. The less time taken, the higher the speed (Siregar, 2023).

$$\boxed{V = \frac{s}{t}} \quad V = \frac{10\,m}{18{,}49} = 0{,}54 \text{ m/s}$$

The data generated using the equation above obtained a water flow velocity value of 0.54 m/s with a distance of 10 m and an average time of 18.49 s.

Discharge Analysis

Analysis of river water flow discharge can be obtained by processing data from calculations of cross-sectional area and water flow velocity. The method used in the measurement uses the floating method. Discharge data is taken from data from calculations of flow velocity and river depth that have been taken from each measurement point.

$$\boxed{Q = V.A}$$

$$Q = 0{,}54 \text{ m/s} \,.\, 8.6 \text{ m}^2$$
$$Q = 4{,}644 \text{ m}^3\text{/s}$$

The results of the water discharge analysis sourced from the Rantau Kemas River obtained a value of 4,644 m3/s with a cross-sectional area of 8.6 m2 and a velocity value of 0.54 m/s.

CONCLUSION

The results of this study are data obtained from the research area location in Rantau Kermas Village, Jangkat District, Merangin Regency, Jambi Province. Based on the obtained speed and cross-sectional area values, the water discharge value is 4.644 m^3/s and can increase or decrease depending on the rainy season or dry season. Water discharge value data can be used as information for the purposes of developing water resources as a micro-hydro power plant (PLTMH) in the discharge area.

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