Analysis of the Batang Langkup River Discharge using the Floating Method for Micro-Hydro Power Plant Needs (PLTMH)

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Abstract

Water resources are a renewable natural resource that has a volume with constant conditions in the hydrological cycle. The constant presence of water in the hydrological cycle can make water an energy resource. 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 renewable energy source, one of which is micro-hydro power plants. Utilization of energy sources from hydropower has great potential in hilly complexes that have a large river network. To fulfill the electrical energy needs in the Rantau Kermas Village area, Jangkat District, Merangin Regency, Jambi Province, water discharge calculations are needed to determine the estimated energy availability. Water discharge calculations carried out using the floating method are more efficient to carry out.

Keywords: *River Discharge, Floating Method, Micro-Hydro Power Plant (PLTMH).*

1. Introduction

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.

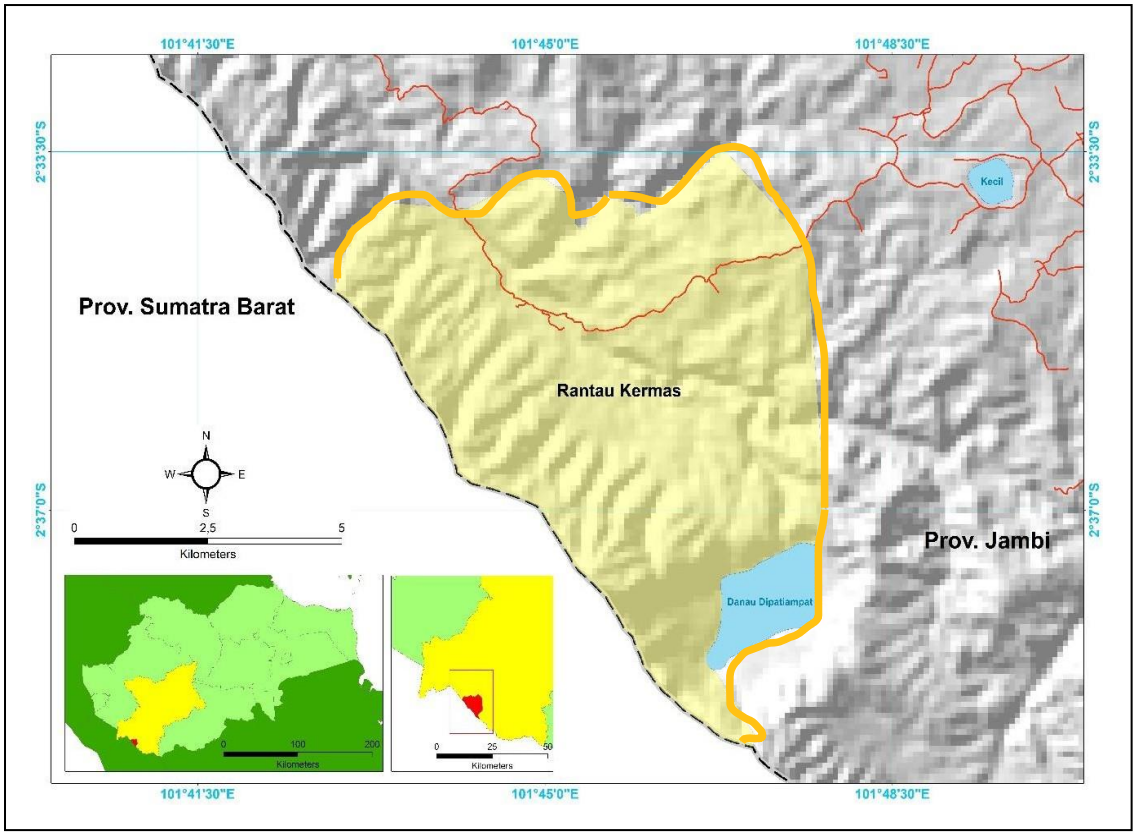

Figure 1. Administrative map of the Rantau Kermas Village Research Area, Jangkat District, Merangin Regency, Jambi Province.

2. Data and Method

Based on preliminary studies to obtain detailed information regarding river flow direction data and estimates of rain catchment areas, highest and lowest elevations, descriptions of the names and types of rivers, and determination of points for collecting field data based on indications of head and water discharge capable of being electrical energy. Determination of head is determined based on the elevation difference between the intake and trailrace placement areas at the observation point. The observation point is the location for taking the discharge measurement point.

The measurement method used to measure water discharge is the floating method. This method is used to measure the average speed of river surface flow. The mechanism of the measurement is as follows: 1) Preparation of tools and materials; floating object, rope, meter, stopwatch, millimeter block, GPS, ruler and stationary. 2) Preparation of measurement media in the river flow by measuring the observation distance using a meter. 3) Calculate the travel time that the floating object passes along the path made using a stopwatch. 4) Measurements are made of the river body, including the width of the river and the depth of the river.

Water discharge calculations will be carried out using the formula for the average velocity of river surface flow and discharge calculations using the following equation:

$$V = \frac{s}{t}$$

Keterangan :

V = Average velocity of river surface flow (m/s)

s = Length (m)

t = Time (s)

$$Q = V.A$$

Keterangan :

Q = Water Discharge (m^3/s)

V = Average velocity of river surface flow (m/s)

A = Area (m^2)

3. Result and Discussion

Based on the results of the floating method, average velocity data and water discharge calculations from the Batang Langkup River were obtained. The Batang Langkup River has a width of 7.35 m with a floating method measuring length of track 10 m.

River Width : 7,35 m

Length of Track : 10 m

Displacement between point : 1,47 m

d_0	: 0,78 m	t 1	: 15,99 s
d_1	: 1,47 m	t 2	: 14,41 s
d_2	: 1,56 m	t 3	: 17,72 s
d_3	: 1,52 m	t 4	: 24,50 s
d_4	: 1, 05 m	t 5	: 19,83 s
		t	: **18,49 s**

River Area Calculation

$A_n = I_n \times (\frac{d0+d1}{2})$

$A_1 = 1,47 \times (\frac{0,78+1,47}{2}) = 1,64\ m^2$

$A_2 = 1,47 \times (\frac{1,47+1,56}{2}) = 2,21\ m^2$

$A_3 = 1,47 \times (\frac{1,56+1,52}{2}) = 2,26\ m^2$

$A_4 = 1,47 \times (\frac{1,52+1,05}{2}) = 1,88\ m^2$

$A_{total} = 1,64 + 2,21 + 2,26 + 1,88 =$ **7,99 m^2**

Average Velocity of river surface flow

$$V = \frac{s}{t}$$

$$V = \frac{10\ m}{18{,}49}$$

$$= 0{,}54\ m^2/s$$

Water Discharge

$$Q = V.A$$

$$= 0{,}54\ m^2/s\ .\ 7{,}99\ m^2$$

$$= 4{,}314\ m^3/s$$

$$= 0{,}4314\ L/s$$

By using the floating method, it was found that the average velocity of river surface flow was 0.54 m^2/s. This average velocity is then processed using the water discharge formula to obtain the water discharge from the Batang Langkup River. The result of the water discharge of the Batang Langkup River were obtained at 4.314 m^3/s or 0.4314 L/s. To sufficient the energy needs, it is necessary to estimate the availability of energy produced from river flows based on water discharge data.

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