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## Simple Micro-hydro Uses Water as a Renewable Energy Source

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### ABSTRACTS

Fossil fuels are the main source in producing electrical energy continuously on a large scale in various countries. This will have an impact on the exhaustion of fossil fuels. Therefore, energy substitute for fossil fuels is needed. PLTMH is a renewable energy source that uses water to solve the problem of electrical energy. The purpose of this study is to determine the water discharge, the speed of water flow that comes from tap water as a source of electricity generation. Based on research in the journal, the novelty is the manufacture of power plants using simple tools to produce good and accurate research data. The research method used is literature study. Literature studies are taken from various sources that describe power generation tools using energy. From the research results in the journal, it can be seen that the higher the water discharge, the higher the mechanical efficiency of the propeller turbine. In addition, the higher the water discharge also affects the generator output power. The conclusion of this study is that the water flow that is flowed from tap water to the hose greatly affects the voltage generated, where the electric voltage will be greater if the efficiency of the turbine mechanism which acts as a mechanical energy converter and the generator output power as an electrical energy converter is high enough. The impact of the research is expected to continue to be developed and be useful as renewable energy for electrical energy problems.

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## 1. INTRODUCTION

Electricity is one of the human needs which is very important and beneficial for human activities (Suyanto & Subandi, 2020). However, the distribution of electrical energy is still not evenly distributed, especially in remote areas that are difficult to reach by the State Electricity Company network that shown in **Figure 1**. PLTMH is a renewable energy power plant by utilizing endless water resources. The purpose of conducting this PLTMH study is in the context of equitable distribution of electricity needs for all communities (Gunawan, et al., 2013).

According to the Ministry of Energy and Mineral Resources on January 9, 2020, the national electricity consumption continues to increase (Grag, 2012). In 2015 the consumption was only 910 kilowatt hours (kWh) per capita. Then it increased to 1,084 kWh/capita in 2019. This increase is in line with the electrification ratio which also shows an increase. The ratio is from 84.35% in 2014 to 98.89% in 2019. The Ministry of Energy and Mineral Resources projects that this year's national electricity consumption will reach 1,142 kWh / capita (Kurniady, 2019).

The purpose of this study was to determine the electric voltage generated from tap water using a simple micro-hydro tool by paying attention to variables such as water flow rate and the level of falling water (Martiningsih, 2019). The novelty of this tool is that PLTMh is made using simple items (used goods).

## 2. METHODS

In the preparation of this research, research methods are used that are sourced from literatures studies. The literature study takes data from previous research on hydroelectric power using propeller turbines. To make this power plant, several tools and materials are needed as follows.

1. Dinamo, as a generator producing electricity.
2. Shaft, as aliaison between the dymano and the propeller turbine.
3. Propeller turbine, as the main tool that produces rotation of the water that passes through it
4. Hose, as water circulation from the lower reservoir by means of a pump that flows to the upper reservoir unit.
5. Faucet, as an opening to drain the flow of water in order and a cover to stop the flow of water.
6. Suction pipe, as a sucker for water flow in order to produce a stable rotation.
7. Reservoir, as a reservoir for water flow from the upper reservoir through the suction pipe.
8. Pump, to move the water flow from the lower reservoir to the upper reservoir through the hose.

In research, there are several variables that will be tested as follows.

- Independent variable, namely water level.
- Controlled variables, namely, turbine, mechanical efficiency and generator output power.
- Controlled variable, namely, time (per 5 minutes)

In finding the value of the above variables, calculate the calculations and measurements. The rotation of the turbine shaft, the rotation of the connecting shaft is measured using a tachometer, the electric power of the generator and the output of the generator are

measured using an AVO meter. **Figure 2** shows the Micro-hydro prototype. Here are formulas to help process data.

$$Volme = \frac{1}{4} \cdot \phi \cdot r \cdot r \cdot t(m)$$

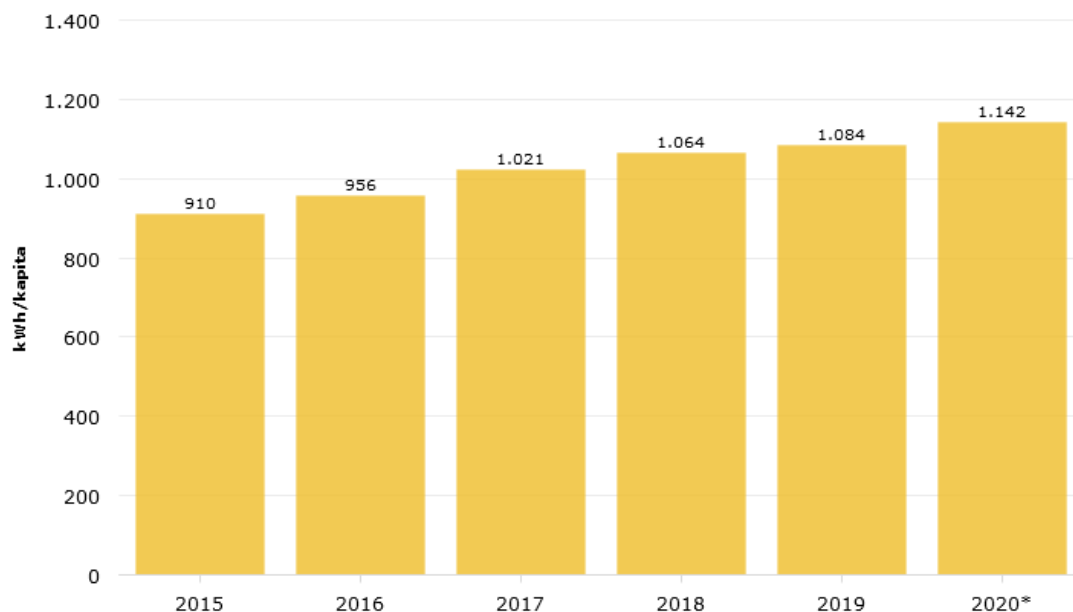
$$Speed\ of\ water = \frac{Discharge\ of\ water}{Cross-sectional\ area} (meters/second)$$

$$water\ discharge = \frac{volume}{time} (liter/second)$$

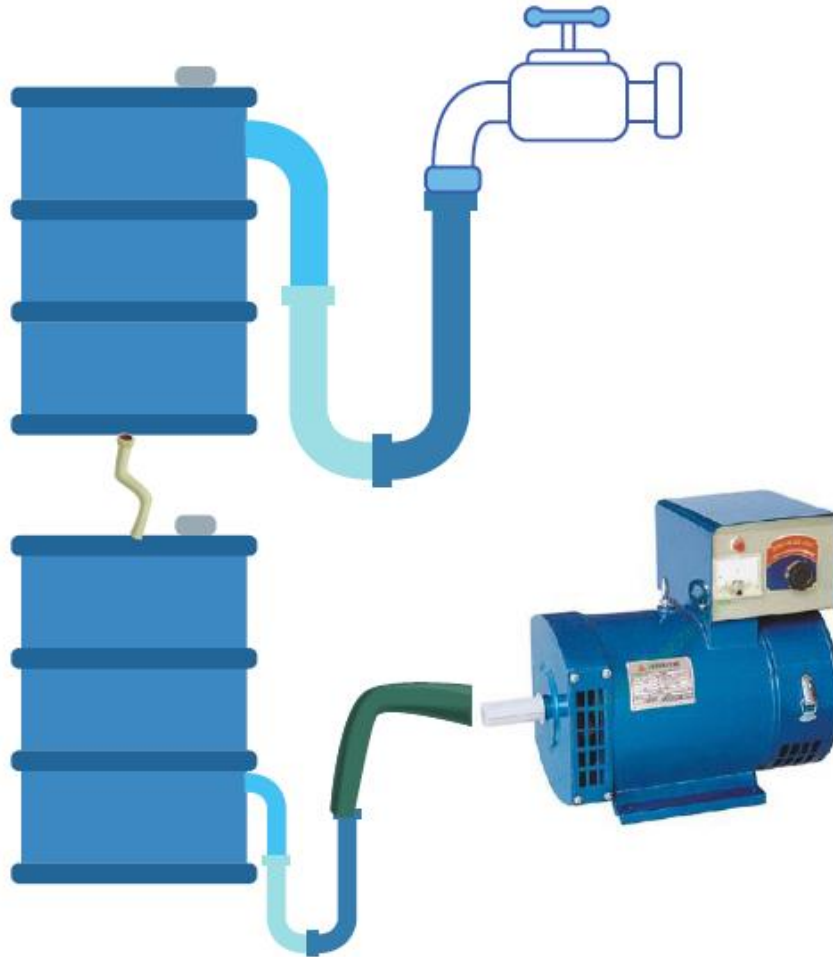
$$Turbin\ efficiency = power\ coefficient \times 100\%$$

### 3. RESULTS AND DISCUSSION

Based on **Table 1** and **2**, it can be seen that the higher the air flow, the higher the turbine engine mechanics (Taba & Allo, 2017). In addition, the higher the air flow rate also affects the generator output power as shows in **Figure 3**.



**Figure 1.** National electricity consumption.



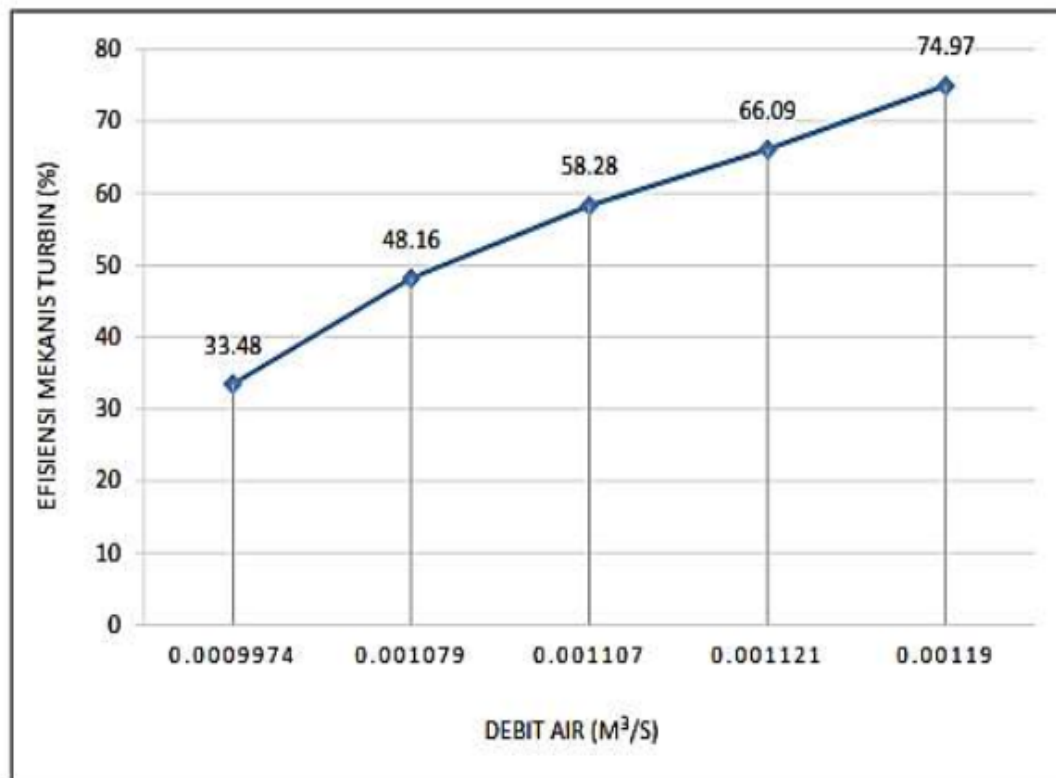
**Figure 2.** Micro-hydro prototype.

**Table 1.** Test result data.

| No. | Time (per minute) | Water level (meters) | Rotation of the turbine shaft with generator (rpm) |
|-----|-------------------|----------------------|----------------------------------------------------|
| 1.  | 5                 | 0,47                 | 711,22                                             |
| 2.  | 5                 | 0,57                 | 853,18                                             |
| 3.  | 5                 | 0,67                 | 1073,00                                            |
| 4.  | 5                 | 0,77                 | 1135,70                                            |
| 5.  | 5                 | 0,87                 | 1314,80                                            |

**Table 2.** Pump power.

| Cross sectional area (m <sup>3</sup> ) | Water discharge (m <sup>3</sup> /s) | Flow velocity power (m/s) | Turbine mechanical power (watt) | Power coefficient | Effisiensi (%) | Generator power (watt) |
|----------------------------------------|-------------------------------------|---------------------------|---------------------------------|-------------------|----------------|------------------------|
| 0,00203                                | 0,0009974                           | 0,4923                    | 5,7002                          | 0,3348            | 33,48          | 0,403                  |
| 0,00203                                | 0,001079                            | 0,5326                    | 0,5326                          | 0,5326            | 0,5326         | 0,5326                 |
| 0,00203                                | 0,001107                            | 9,4316                    | 9,4316                          | 9,4316            | 9,4316         | 9,4316                 |
| 0,00203                                | 0,001121                            | 0,4816                    | 0,4816                          | 0,4816            | 0,4816         | 0,4816                 |
| 0,00203                                | 0,00119                             | 48,16                     | 48,16                           | 48,16             | 48,16          | 48,16                  |



**Figure 3.** Graph of turbine mechanical efficiency on water discharge.

#### 4. CONCLUSION

The conclusion of this study is that the water flow that is flowed from tap water to the hose greatly affects the voltage generated, where the electric voltage will be greater if the efficiency of the turbine mechanism which acts as a mechanical energy converter and the generator output power as a converter of electrical energy is high enough.

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#### 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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