Fidelity : Jurnal Teknik Elektro
Vol. 6, No. 1, January 2024, pp. 60-63
p-ISSN: 2686-3650 | e-ISSN: 2686-3642, DOI: 10.52005/fidelity.v6i1.201

Analysis of Aquaponics Solar Panel Innovation in Building C of Pembangunan Panca Budi University

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ABSTRACT

Continued population growth and increasing food needs require more innovation in the agricultural sector to increase crop productivity sustainably. An interesting approach to this challenge is solar panel-based aquaponics systems. Solar panels are integrated as an energy source to drive water pumps, and other system components in aquaponics. Research was conducted on the production of electricity generated by solar panels in aquaponics in Building C of Pembangunan Panca Budi University. Data analysis was carried out to evaluate and provide innovations regarding the efficiency and reliability of solar panels in the environmental conditions of Pembangunan Panca Budi University.

Article Info

Article history:

Received November 22, 2023
Revised December 18, 2023
Accepted December 26, 2023

Keywords:

Solar Panel
Aquaponics
Rewenable Energy

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1. INTRODUCTION

Aquaponics is an innovative farming method that uses water and fish. Aquaponics is a development of aquaculture innovation. Aquaponics in addition to organic food production, fish can also be cultivated as a source of protein. Innovations that can be developed to use aquaponics methods in agriculture are innovations in using solar energy more efficiently and reliably. The aquaponics work system that requires a constant flow of water is one of the reasons people consider planting with this system wasteful of energy because it requires electricity for almost 24 hours. Solar panels as a renewable energy source have great potential to meet the energy needs of aquaponic systems while reducing negative impacts on the environment. The combination of solar energy as an abundant natural resource and efficient aquaponics systems can be a sustainable solution to support food security.

Research was conducted on the production of electricity generated by solar panels in aquaponics in Building C of Pembangunan Panca Budi University. Analysis of solar panel aquaponics system Building C of Pembangunan Panca Budi University was conducted to evaluate system performance, energy efficiency from the application of this technology. The results of the research are expected to make a positive contribution to the development of sustainable agriculture to produce innovations related to reliable aquaponics systems.

2. METHOD

It uses a framework structure to explain the sequence performed during the study.

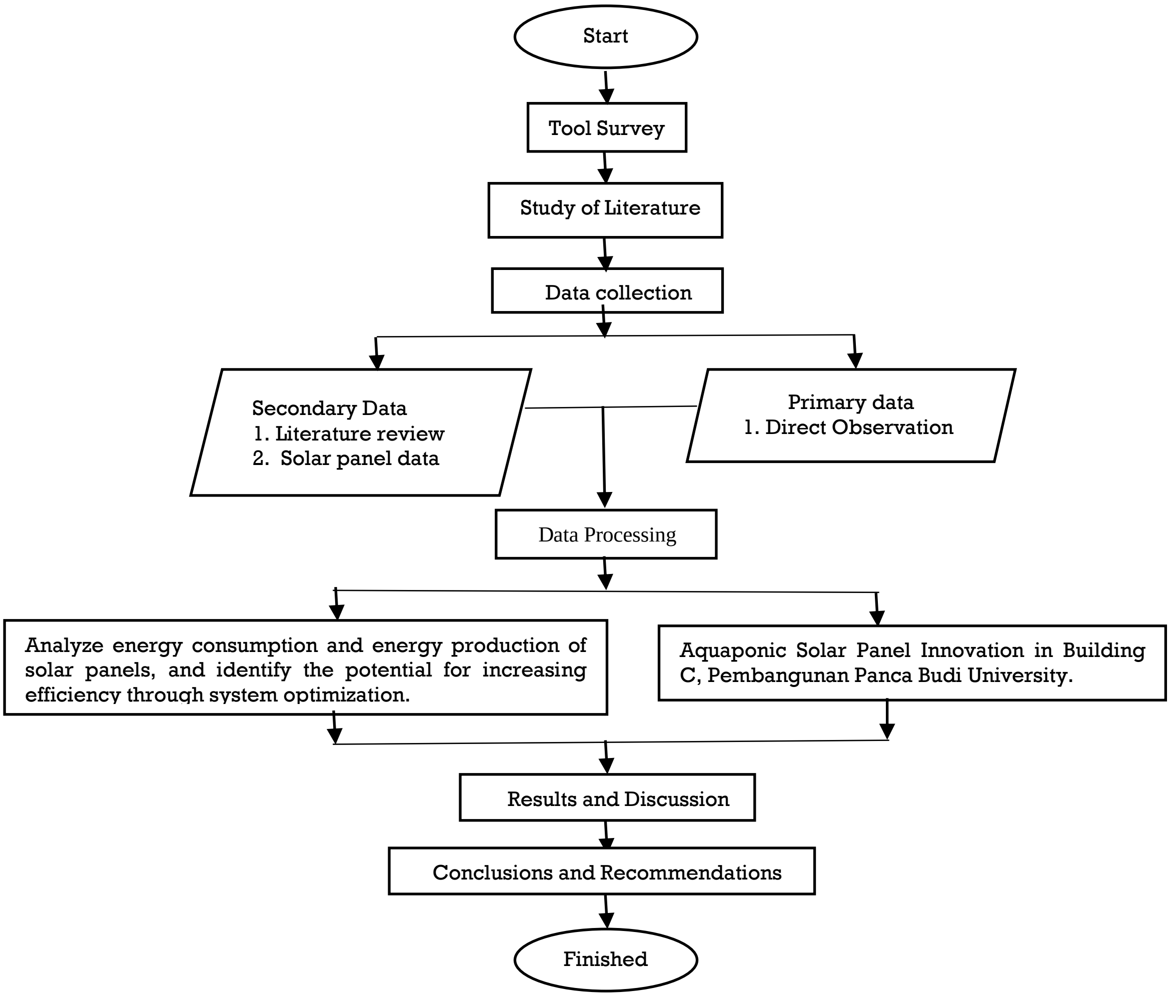

Figure 1. Research Metode flowchart

3. RESULTS AND DISCUSSION

In this study, an analysis was carried out on aquaponic tools in Building c of Pembangunan Panca Budi University. Innovation analysis is also presented in order to provide innovations related to aquaponic tools.

3.1. Aquaponic Solar Panel Analysis

To get the required energy, it is very important to know the specifications of the water pump. Knowing the specifics is one of the things we should consider. After calculation, the overall power needed in Aquaponics equipment is 50 Watts.

3.1.1 Water Pump Capacity

Brand	:	Kyoto
Model	:	P-105
Power	:	50 Watt
Max Head	:	3 Meters
Output	:	3000 Liter / H

Table 1. Water Pump Specification Table

3.2. Energy Generated by Solar Panels

In the Aquaponic Solar System using 3 units of solar panels with each solar panel with a capacity of 20WP assembled in series can produce energy power of 60WP. The power generated by solar panels in one day is as follows:

Power generated per day = panel power x irradiation efficiency
= 60 WP x 5 Hours
= 300 WP

So, the power produced by solar panels per day is 300 WP.

3.2.1 Battery Accommodating Energy Capacity

The energy capacity that can be accommodated by batteries in aquaponics equipment is as follows:

Battery power = battery voltage x battery current
= 12 Volts x 7.2 Ah
= 86.4 Watts

So, the energy capacity that can be accommodated by batteries in aquaponics tools is 86.4 Watts.

3.2.2 Battery Charging Test

From the data obtained during the phase 1 trial of battery charging on October 1, 2023 with sunny weather conditions with a light intensity of 99089 lux and an average current from solar panels of 14.5 V, it was found that charging the battery took 2 hours 10 minutes. The trial phase 2 of battery charging on December 2, 2024 with cloudy weather conditions with a light intensity of 11239 lux and an average current from solar panels of 12.7 V, found that charging the battery takes 4 hours 10 minutes. Phase 3 trial of battery charging on December 3, 2024 with cloudy weather conditions with a light intensity of 21608 lux and an average current from solar panels of 12.8 V, it was found that charging the battery took 4 hours.

3.2.3 Calculation of Battery Usage

The length of time required for a battery with a battery power of 86.4 Watts and a voltage of 12 volts to run a power load of 50 Watts is as follows:

Usage time = Battery Power / Load Power
= 86.4 Watts / 50 Watts
= 1.72 (2 hours 12 minutes)

So, the length of time it takes a battery with a battery power of 86.4 Watts and a voltage of 12 volts to run a power load of 50 Watts is 1.72 (2 hours 12 minutes).

3.3. Aquaponic Solar Panel Innovation

The overall power required on an aquaponics tool is 50 Watts. The innovation needed to create a reliable aquaponics tool is to add solar panel capacity. To find out the number of solar panels needed for the aquaponics tool so that the tool is with the following calculations:

P = 50 Watts
= 50:60%
= 83,3

The value of this solar module capacity needs to be increased by 15% to 25% as system losses In this innovation, solar panels can be added by 40 wp. So the total solar panel power used is 100 Wp.

3.3.1 Battery Requirement Innovation

The electrical energy in the battery is not 100% usable because, when in the inverter the potential energy loss can be as much as 5%, so there needs to be a 5% reserve that must be added.

Reserve = Power : (100% – 5%)
= 50 Watt : 95%
= 52,63 Watts

So, the reference electric power used to determine the battery is 52.63 Watts.

Next, choose the right battery specifications. On the market are also sold various types of battery specifications. This innovation uses a battery capacity of 12 V 50 Ah. The following is the calculation of the number of batteries to be used.

Number of batteries = Electric Power : Battery Capacity
= 52,63 Watt : (12 V x 50 Ah)
= 52,63 Watt : 600 Watt
= 0,08 Watts
= 1 pcs (rounded)

So, the number of batteries used is 1 pcs of batteries with a capacity of 12 V.5 Ah.

3.3.2 Innovative Solar Cell Controller Needs

The results of this study explore the use of PWM type solar cell controllers to increase the efficiency of energy generation using solar cells. This study evaluates the performance of the system in optimizing the absorption of solar energy and producing stable electrical output. The results showed that the use of solar cell controllers with PWM type succeeded in increasing the efficiency and reliability of the system significantly. In this innovation, it is recommended to use solar cells with PWM type because PWM type SCC in terms of price is cheaper and economical compared to MPPT type and PWM type SCC is more suitable for use on solar panels with a capacity below 200 WP.

3.3.3 Innovation Needs of Inveters

For about 50 watts of power, an inverter with a capacity of about 75-100 watts can be a suitable choice. In this innovation, it chooses an inverter with an output voltage that matches the device to be connected and has safety features such as overcurrent and overvoltage protection to maintain system stability.

4. CONCLUSION

Based on the results of research and calculations of the Solar Panel Aquaponics in Building C of Pembangunan Panca Budi University, several conclusions can be drawn, namely:

1. Based on the calculation results, solar panel innovation can be added 40 Wp power so that the total solar panel power used is 100 Wp.

2. Based on the calculation results, the innovation of solar cell controller needs is to use a solar cell controller with a PWM type because the PWM type is more suitable for use on solar panels with a capacity below 200 WP.

3. Based on the calculation results, the innovation of battery needs that can be used is to use a battery capacity of 12 V 50 AH as much as 1 pcs.

4. Based on the calculation results, the innovation of inverter needs that can be used is to use an inverter with a capacity of around 75-100 Watts.

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