

## Utilization of Solar Power for Irrigation of "Nyayur"

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### Abstract

**Purpose:** Around 10 hectares of rice fields, including nyayur land, in Subak Sembung Peguyangan, North Denpasar, Bali, do not receive water, especially in the dry season, due to the location of the land being higher than the main irrigation canal. For this reason, it is necessary to create water irrigation by installing a 125W/220V water pump with an electricity supply from solar power.

**Method:** The stages of implementing the service are carried out with the stages of socialization, installation and testing of tools/systems, training and maintenance of tools/systems.

**Practical Applications:** The installation of solar panels (PLTS) along with water pumps is hoped to overcome the water shortage, making it easier for vegetable farmers to get water to water their crops. Likewise, Subak members are expected to gain new knowledge about renewable energy.

**Conclusion:** After carrying out community service, especially members of the Sembung Subak, the results were obtained in the form of installing a PLTS unit with a water pump, making it easier to water vegetable and flower plants which previously had to carry water from far away but now just by turning on the water pump and water faucet, you can directly water the surrounding area. 31,400 m<sup>2</sup>.



## Introduction

Bali is famous for its natural tourism, rice fields with a subak irrigation system that has been neatly arranged since ancient times, known as Subak. One of the rice fields that is still beautiful and famous for its ecotourism is Subak Sembung, Br. Tektek, Peguyangan Village, North Denpasar City (Denpasar City Government, 2020). which is located about 7 km from the city of Denpasar or about 24 km from the Bali State Polytechnic, this subak cultivates almost 103 hectares of land from the 115 hectares of rice fields in Peguyangan Village. With an area of 6.4 km<sup>2</sup>, the population is not dense, where from the 2019 census the male population was recorded at 7,747 people while the female population was slightly less, namely 7,444 people. Of the total population of Peguyangan Village of 15,191 people (Denpasar City Central Statistics Agency, 2020), 180 people farm and join groups as members of the Sembung subak. With 60% ownership of rice fields, they are owners, and the remaining 40% work as cultivators. For those with large land, most of the land is planted with rice, and around 10 acres are planted with green vegetables, root kale, spinach, eggplant, chilies, and sometimes even gunitir flowers. After 2 years, the land previously planted with vegetables was again used for growing rice, while the land for growing vegetables was moved to another land with a fixed area of 10 acres. This is done considering that to earn income from rice crops, farmers need at least 4 months, while they need money for daily needs. For this reason, this vegetable plant has become a mainstay that can make money almost every day by harvesting at any time according to needs.

Not all of the rice fields in Subak Sembung are well-irrigated, around 10 hectares do not receive water because they are located far from the water channel at a height of around 4 meters from the water channel. Of the 10 hectares, 1.8 hectares are generally planted with vegetables or secondary crops or in the local term called "nyayur". To obtain water, some have used water pumps with additional long pipes to irrigate their land. The type of pump used uses a diesel fuel pump. This pump was operated for 2 hours per day for approximately 3 months. If we review the fuel usage required for 2 hours per day within 3 months to start the water pump, the total number of water pump operations will be 60 hours. If it is assumed that fuel usage is 0.78 liters per hour to pump 2 inches of water (George Alexander Maxwell Pasaribu, 2008), then the total fuel released for 3 months is 46.8 liters. With the current price of diesel in the range of IDR 9,500 - IDR 11,150 from the cheapest to the most expensive (Gridoto.com, 2022), the expenditure on buying fuel for the 3 months will be IDR 444,600 to IDR 512,820. There are 2 pumps donated by the government with a large capacity of 1 unit and a small capacity of 1 unit. Meanwhile, 3 farmers have small pumps to irrigate their fields and usually only use them for singing.

*Figure 1. Farmers plant spinach, chilies and flowers*



Source: Private Documentation, 2022

With the existing problems and limited costs, the initial stage will be to install 1 (one)

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600W PLTS unit and 1 (unit) 125W 220V water pump unit at the nyayur location which is intended for 4 subak members for nyayur irrigation covering an area of 31,400 m<sup>2</sup> (Sevira Rambanisa Hamzah, 2019). Likewise, training will be carried out to operate and maintain PLTS and its water pump installations.

## Method

Community service is carried out in Subak Sembung, Br. Tektek, Peguyangan Village, North Denpasar City. Determining the location begins with surveys and interviews to obtain information on villages and subak groups that produce/grow vegetables and flowers and one of which is easily accessible to the service team. Next, the selection of villages and subak groups was carried out purposively.

*Table 1. Solving Problem Strategy*

No.	Problem	Solution	Method
1	Lack of water in the dry season, or some areas are far from irrigation channels.	Building irrigation installations with water pumps utilizing solar energy as alternative energy	(1) Install a water pump and build a PLTS as a source of water pump energy; (2) Training on the operation and maintenance of PLTS and water pump installations.
2	The crops in vegetables and flowers do not look fresh due to lack of water.	Increase the volume of watering for vegetable and flower plants.	(1) Provide a water storage tank; (2) Watering uses a water pump and is distributed via a water hose.

Source: Private Documentation, 2022.

The methods used in implementing this PkM program are socialization, installation of water pumps and PLTS, training on the operation and maintenance of PLTS as well as water pump installation. The first step in starting this PkM activity is to socialize the solutions offered to members of Subak Sembung Peguyangan, North Denpasar, a total of 20 owners and cultivators with a land area of approximately 20 acres (2,000 m<sup>2</sup>) on the basis that this activity is a service activity to be able to work together to increase production and improve business management. To overcome the problem of water shortages needed by Sembung subak members, firstly, build a water storage tank with a size of 1.1304 M<sup>3</sup>, secondly, install a water pump with a power of 125W/220V and thirdly build a 600W/220V solar power plant (PLTS). 220V together with the service team, students and members of the Sembung subak. The electricity source for the water pump is supplied from a solar power plant (PLTS) using: 1) 300W/36V DC solar panels, which are installed at a fixed tilt angle (I.B.K. Sugirianta et al., 2021), 2) batteries with capacity 12V 50Ah battery which is sufficient to supply 3 hours of power per day with additional use for 2 days if the weather is cloudy, 3. solar charge controller (SCC) and 4) inverter (I.B.K. Sugirianta et al., 2018). SCC functions to optimize battery charging from electricity produced by solar panels (Andre Setyawan et. al., 2022). An inverter is a power electronic circuit that has the function of changing or converting direct current (DC) into alternating current (AC) (Sigit Sukmajati, Mohammad Hafidz, (2015), so that with PLTS, there is no longer a need to channel electricity from PLN, to supply electricity at the pump in the middle of the rice fields. To increase the knowledge of Subak group members regarding water pump installations which are supplied with power from PLTS (Zaenal Arifin et al., 2020), training is also provided regarding maintenance and repair of water pump installations and PLTS, so that it is hoped that these water pumps can be looked after and maintained so that in the future they can used for a long period, likewise the solar panels used can also operate

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according to their life time, which is up to 20-25 years (Dadan Kusdiana, (2020).

## Result

This community service program is carried out by the team that owns it appropriate qualifications and experience in implementing PkM programs. The main indicators of success are the multi-disciplinary areas of expertise of team members and the distribution of service team tasks according to needs in the field. Implementation of this service. This service program is also strengthened using additional/field personnel, namely 2 technicians and 3 automation engineering students. The stages in making PLTS are carried out by technicians appointed by the PkM team with the following results:

- a. Make a water storage tank with a diameter of 60 cm and a depth of 150 cm. This tank should function as a water reservoir, from which the water is pumped daily to water vegetable plants.

*Figure 2. Water Storage Tank*



Source: Private Documentation, 2022.

- b. Making a PLTS control panel consisting of MPPT Solar Charge Controller 48V 50A, Inverter 1,000W, Accu 12V 50Ah, MCB DC 20A 100V, MCB AC 220V 2A, Contactor, Panel Lights and on/off switch.

*Figure 3. PLTS Control Panel*



Source: Private Documentation, 2022.

- c. Carrying out the installation of a 125W/220V AC water pump with an electrical

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energy source from PLTS.

Figure 4. PLTS Installation



Source: Private Documentation, 2022.

- d. Training. Training on the operation and use of PLTS system equipment is carried out by providing an explanation of the working system of the PLTS to Subak members whose land receives water irrigation services from installed water pumps. The working principle of PLTS is that if sunlight hits the solar panel, the electrons in the solar cell will move from N to P, so that the output terminal of the solar panel will produce electrical energy. The amount of electrical energy produced by solar panels depends on the number of solar cells combined in the solar panel. The output from the solar cells is direct current (DC) electricity, where the output voltage depends on the number of solar cells installed and the amount of sunlight. An electric water pump is a tool to supply water by using a machine as a suction device from one place to another. The way water pumps generally work is to push water from the source which is then moved continuously using an impeller.

Figure 5. PLTS Operational Training



Source: Private Documentation, 2022.

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Figure 6. Watering Vegetable and Flower Plants



Source: Private Documentation, 2022.

## Discussion

In this service activity, we (the team) performed installation and training on installing water pumps with electricity from PLTS. With this activity, Subak members, especially those who get water irrigation services from installing water pumps, feel that it is conducive because before using water pumps with an electricity supply from PLTS, it was pretty troublesome. After all, they had to transport/carry water from quite far places back and forth so it took time. a lot is confiscated in the process of taking water compared to the results of watering, which is not so extensive. Likewise, with the installation of a water pump complete with electricity supply from PLTS, Subak members have been able to carry out watering of vegetable and flower plants more efficiently with a broader watering volume and sufficient soil moisture so that the vegetable and flower plants from the previous harvest do not look fresh. but now the results look fresh; apart from that, Subak members gain new knowledge about renewable energy and pollution-free solar power plants to maintain Subak's ecotourism.

## Conclusion

The implementation of PkM activities using the PLTS system for nyayur irrigation in Subak Sembung Peguyangan, North Denpasar which will be carried out in 2022 can be concluded in several ways, including: (1) The members of Subak Sembung in Peguyangan, North Denpasar, have provided the PLTS system and installation of water pumps needed for water irrigation by members of Subak Sembung in Peguyangan, North Denpasar to facilitate watering of vegetable and flower plants covering an area of 31,400 m<sup>2</sup>; (2) Training on the use and operation of water pump installations with electricity supply from PLTS has been understood by Subak members, especially those whose land receives irrigation services from installed water pumps and PLTS, while PLTS is equipment that converts solar energy into electrical energy using solar cells/panels Sun. And then to change the 12 volt DC voltage from the battery/battery to 220 volt AC voltage using the Pure Sine Wave inverter circuit; (3) With the installation of a water pump complete with electricity supply from PLTS, Subak members can carry out watering of vegetable and flower plants more easily with a wider watering volume and sufficient soil moisture, so that the vegetable and flower plants from the previous harvest do not look fresh but now the results look fresh; (4) Subak members gain new knowledge about renewable energy and pollution-free solar power plants so that Subak ecotourism is maintained. The current watering system for vegetable and flower plants in Subak Sembung Peguyangan, North Denpasar is still conventional, namely by using a hose combined with a shower, this can still be made more effective in the watering time with an automatic watering system, namely the watering time/hour can be set or can also be carried out using automatic control based on the dryness and humidity of the planted soil, so that almost stable soil

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moisture will be obtained according to the humidity setting.

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