Panrannuangku Jurnal Pengabdian Masyarakat *ISSN: 2798-1096 (online)*
Vol. 5 No. 3 (2025)
https://doi.org/10.35877/panrannuangku4310

Smart Irrigation Pump Based on Solar Cell (SIAP BOS) to Improve Agriculture prodution Rainless Land in Sallasae

Ismail Aqhsa*, Labusab, Mohammad Ikbal Riski A. Danial, Sudarmanto Jayanegara, & Fahri Anwar

Universitas Negeri Makassar, Makassar, Indonesia

Abstract

The Community Service Program seeks to empower the Ulu Galung 1 Farmer Group in Salassae Village, Bulukumba Regency through the implementation of a solar-powered irrigation system. The first stage involves initial observation to identify partner conditions and challenges, followed by discussions to formulate solutions through appropriate technology selection and tool design. The second stage focuses on socialization to provide farmers and the community with knowledge about Smart Irrigation Pump technology utilizing solar energy. The third stage emphasizes training to enhance farmers' skills in operating and maintaining the equipment. The fourth stage applies Solar Cell-based Smart Irrigation Pump technology directly to agricultural land as an effective irrigation solution. The fifth stage consists of mentoring to ensure optimal system performance, evaluate the benefits of the technology, and guarantee program sustainability. This initiative aims to strengthen agricultural productivity and promote environmentally friendly irrigation practices.

Keywords: Smart, Irrigation, Improve, Agriculture, Production

1. Introduction

The agricultural sector plays a crucial and strategic role in supporting national food security and is a primary source of livelihood for rural communities. Bulukumba Regency, located in South Sulawesi Province, is one of the regions with significant agricultural potential, with a total rice field area of 22,958 hectares. In Bulukumba District, according to 2020 data from the Bulukumba Regency Food Crops, Horticulture, and Plantation Service, 3,073 hectares of rice fields are irrigated, while 397 hectares still rely on rainwater. Some of these rice fields are located in Salassae Village, within Bulukumba District. Salassae Village covers an area of approximately 917 hectares, or 9.17 square kilometers. Most of the village area is used for agricultural purposes, including plantations and rice fields, while the remainder is used as residential areas. According to information from the village government, Salassae's primary potential lies in its vast agricultural and plantation areas. The total rice fields cover 310 hectares, with an average yield of between 4 and 5 tons per hectare. This potential has encouraged the local community and farmer groups to develop a nature-based farming system. Since 2011, Salassae Village has implemented sustainable organic farming practices, without the use of synthetic chemicals, but instead utilizing natural materials such as compost. Currently, nine farmer groups actively contribute to village agricultural activities, one of which is the Ulu Galung 1 Farmer Group, a partner in this community service program**.**

Considering the various challenges faced, interventions are needed covering aspects of production and marketing of agricultural products. One relevant solution is the renewal of irrigation systems by utilizing renewable energy, particularly through the use of solar water pumps. This empowerment initiative aligns with the achievement of the Sustainable Development Goals (SDGs), particularly points 1 (poverty reduction), 2 (food security), 7 (access to clean and affordable energy), and 13 (climate change mitigation). Furthermore, this program also supports the achievement of higher education Key Performance Indicators (KPI), such as student involvement in off-campus activities, increasing lecturers' practical experience in the community, and utilizing lecturers' work results by the community. Nationally, this activity contributes to the Asta Cita agenda, particularly in strengthening economic independence based on strategic domestic sectors and encouraging sustainable development. To achieve this goal, the program's target partners will

* Corresponding author:
E-mail address: ismail.aqsha@unm.ac.id

implement solar panel-based irrigation pump technology. The energy generated will not only be used to power the irrigation pumps but can also be used for lighting and other electrical agricultural equipment. Thus, through community empowerment activities through the implementation of an irrigation system using solar pumps, it is hoped that the Ulugalung Farmers Group in Salassae Village will be able to increase productivity and become a model for the application of renewable energy technology in the rural agricultural sector.

The Ulugalung 1 Farmers Group, located in the village of Salassae, covers approximately 21.52 hectares of rain-fed rice fields. It is managed by an active group of 25 administrators and members. It is located in the hamlet of Maremme and boasts an average harvest yield of 96.84 tons. This group was founded in 1994 and has provided extensive support to farmers in the area, including agricultural extension services, seed and fertilizer distribution, and agricultural product exhibitions in Salassae. The challenges faced by this farmer group with its extensive rice fields include the irrigation system during the dry season, as most of the rice fields are rain-fed. In addition to irrigation issues, the farmers also face limited agricultural technology. The Ulugalung Farmers Group faces a limited irrigation system that is unable to reach all of the rice fields due to insufficient water flow and the terraced nature of the rice fields. Water sources are lower than the rice field areas, and there is a lack of utilization of existing resources.

According to the Head of the Farmers Group, Arif Tahir, the agricultural conditions in his area are largely agricultural, but these rice fields are only dependent on the seasons, known as rain, and irrigation is limited and has not been able to reach all existing rice fields. Water sources greatly determine how much agricultural yield farmers obtain. Irrigation is essential for farmers, especially rice plants because they require water. Water is essential for producing the best quantity and quality. Meeting the water needs of rice plants occurs from the planting process until the rice produces perfect fruit. Providing appropriate water not only increases the efficiency of water use but also helps prevent the growth of pests and diseases in plants. The river basin (DAS) is located lower than the farmers' rice fields. Farmers have attempted several methods to irrigate their fields, using combustion engine-powered irrigation pumps. However, these measures have been ineffective due to the scarcity of fuel in rural areas and limited availability. A 30-acre rice field requires 7-8 liters of fuel, with an average of 12 hours required to ensure the soil surface is saturated with water. This is expensive and time-consuming. Furthermore, combustion engine-powered machines produce air and noise pollution. Discussions with the village head and farmer groups revealed several challenges faced by farmers in Salassae village, including the need for irrigation for rain-fed rice fields and the development of resources to utilize solar energy as a source of energy for agricultural production. Furthermore, specialized knowledge and skills are required to manage and implement agricultural technology in rice fields and plantations.

The objectives of this Community Service Program (PKM) activity are:

a. To increase the efficiency and effectiveness of environmentally friendly irrigation systems using solar energy to increase agricultural productivity.
b. To provide farmers with knowledge about organizational and resource management in implementing environmentally friendly and sustainable technologies utilizing solar energy in agriculture.
c. To develop irrigation infrastructure and resource development.

2. Methods and stages of implementation

The following is a method for implementing irrigation solutions for rain-fed agricultural land using solar-based irrigation pump technology and training in organizational management and utilization of agricultural technology, namely:

2.1. Sosialization

Socialization is conducted to provide understanding to the community and farmers about Smart Irrigation Pump technology that uses solar energy. The stages are:

a) Holding village seminars or discussions with farmer groups and village governments to explain the importance of using environmentally friendly energy-based irrigation technology.
b) Explaining the benefits of solar cell-based Smart Irrigation Pump technology in optimizing water efficiency and reducing dependence on conventional irrigation methods.
c) Providing insight into the development of solar cells and their application in areas with limited access to water and electricity from the state electricity company (PLN).
d) Holding question-and-answer sessions to explore challenges in the field and gather input from farmers

2.2. Collection tolls and materials

The service team identifies the tools and materials needed.

a) Compiles a list of equipment and components needed to provide tools and materials in accordance with the technology design specifications.
b) Purchases tools both offline and online.
c) Arranges logistics for the transportation and storage of tools and materials.
d) Develops a training format for organizational resource development

2.3. Training

The training was conducted to improve farmers' skills in using and maintaining the solar cell-based Smart Irrigation Pump system. The stages were:

a) Providing technical training on the installation and use of the Smart Irrigation Pump system, including the working principles of submersible pumps and solar cells.
b) Training farmers on how to maintain and ensure optimal system performance.
c) Conducting live field simulations to involve farmers in the installation and testing of solar cell-based irrigation technology.
d) Conducting management and organizational resource development training by providing supporting materials, such as manuals and video tutorials, as reference materials for farmers

2.4. Implementation Technology

Implementation of solar cell-based Smart Irrigation Pump technology on agricultural land as an irrigation solution. The stages are:

a) Determining the location and installing solar panels on land based on irrigation needs and potential for good sunlight exposure.
b) Utilizing water reservoirs on higher ground.
c) Testing the technology to ensure optimal performance, such as ensuring the solar panels are functioning properly to generate electricity, the submersible pump can suck and push water, and control the flow/discharge of water to the reservoir or rice fields.
d) Inviting farmers to actively participate in the installation process and providing hands-on training.

2.5. Mentoring and Evaluation

This activity aims to provide support to partners/farmers to ensure optimal irrigation system performance and to evaluate the function and benefits of this irrigation technology. The stages involved are:

a) Providing 2-4 months of mentoring to help overcome technical and operational challenges in the use of solar cell-based Smart Irrigation Pump technology.
b) Regularly monitoring pump performance, solar energy absorption management on solar panels, and their impact on increasing agricultural production.
c) Holding discussions and evaluations with farmers and village governments to analyze technology implementation and operational cost efficiency.
d) Comparing before and after to assess the effectiveness of technology implementation

3. Result and Discussion

Fulfilling the water requirements of rice plants from planting to fruiting is essential for optimizing irrigation efficiency and preventing pest outbreaks (F. Darmawan et al., 2023). Agricultural sector revitalization involves enhancing infrastructure quality, expanding access to training and education, promoting policies that support sustainable farming practices, and integrating modern technologies to improve productivity (Tantawi, Prof. Dr. Ir. Ahmad Rafiqi et al., 2024). One notable benefit is that farmers gain new insights into environmentally friendly and efficient solar-powered irrigation technologies (F. A. Darmawan et al., 2023).

The implementation of the Smart Irrigation Pump Based on Solar Cell (SIaP-BoS) Community Service Activity to Increase Agricultural Production on Rain-Prone Land in Salassae Village has been carried out in several stages, namely:

Figure 1. Implementation method

3.1. Sosialization

Socialization is carried out to provide understanding to the community and farmers about Smart Irrigation Pump technology that uses solar energy. The stages are: Holding village meetings or discussions with farmer groups and village governments to explain the importance of using environmentally friendly energy-based irrigation technology, Explaining the benefits of solar cell-based Smart Irrigation Pump technology in optimizing water efficiency and reducing dependence on conventional irrigation methods. Providing insight into the development of solar cells and their application in areas with limited access to water and PLN electricity. Holding a question and answer session to explore obstacles in the field and gather input from farmers.

Figure 2. Sosialization

3.2. Collection tolls and materials

The service team procures tools and materials to be used from the list of equipment and components needed to provide tools and materials in accordance with the technological design specifications. Purchasing tools is done offline and online and makes logistical arrangements for the transportation and storage of tools and materials as well as distributing tools to the service locations. In addition to procuring tools, the team also formulated a training format for the development of organizational resources for members of the Ulugalung 1 farmer group in Salassae village.

Figure 3. Procurement of material

3.3. Training

The service team conducted training to improve farmers' abilities in using and maintaining the Solar Cell-based Smart Irrigation Pump system. The stages include providing technical training on the installation and use of the Smart Irrigation Pump system, including the working principles of submersible pumps and solar cells, training farmers on how to maintain and maintain the system's performance to remain optimal, and conducting simulations directly in the field to involve farmers in the installation and testing of Solar Cell-based irrigation technology

Figure 4. Training to using and maintenance

3.4. Implementation Technology

The implementation of activities in applying Solar Cell-based Smart Irrigation Pump technology on agricultural land is carried out in several stages, namely, determining the point and installing solar panels on the land location based on irrigation needs and the potential for good sunlight exposure, utilizing water reservoirs, testing the technology to ensure its maximum performance such as solar panels functioning properly to produce electrical energy, electric water pumps can suck and push water, and control the flow/discharge of water to the rice fields, inviting farmers to actively participate in the installation process and providing direct training.

Figure 5. Implementation Techology

3.5. Mentoring and Evaluation

This activity is in the implementation phase to provide support to partners/farmers so that the irrigation system works optimally and to conduct an evaluation of the function and benefits of this irrigation technology. This stage will assist in overcoming technical and operational obstacles in the use of Solar Cell-based Smart Irrigation Pump technology. Routinely monitor pump performance, solar energy absorption management on solar panels, and its impact on increasing agricultural production, holding discussions and evaluations with farmers and village governments to analyze technology implementation and operational cost efficiency.

Enhancement of Partner Empowerment Level. Technical Aspect of the Farmer Group in Implementing Solar Panel Pumps (85%) The application of the solar-powered pump system has brought significant changes in providing irrigation for rice fields and plantations. Farmers are able to assemble and operate the solar-based irrigation system independently, resulting in more stable water distribution and increased agricultural productivity. Organizational Management Aspect (80%). This PKM program also aims to strengthen the organizational capacity of the Ulugalung 1 Farmer Group so they can utilize agricultural technologies to improve farming productivity in Salassae Village. In addition, it enhances members' ability to optimize resources in addressing agricultural challenges within their region.

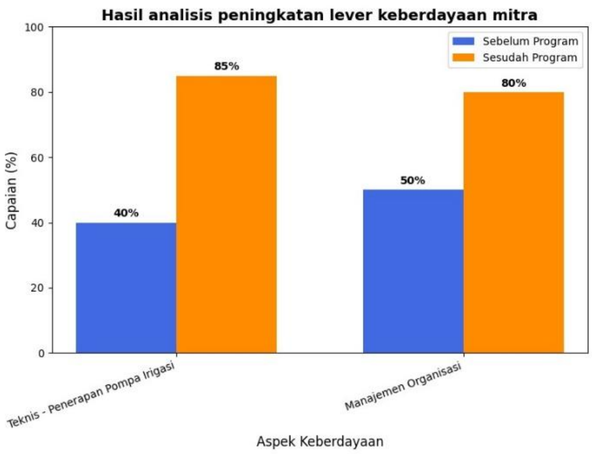

Figure 6. Diagram of Empowerment Quality

4. Conclusion

This activity is in the implementation phase to provide support to partners/farmers so that the irrigation system works optimally and to conduct an evaluation of the function and benefits of this irrigation technology. Farmers utilize water level and soil moisture data to regulate pump operation and control water distribution to their fields (Habibi et al., 2021). This stage will assist in overcoming technical and operational obstacles in the use of Solar Cell-based Smart Irrigation Pump technology. Routinely monitor pump performance, solar energy absorption management on solar panels, and its impact on increasing agricultural production, holding discussions and evaluations with farmers and village governments to analyze technology implementation and operational cost efficiency. This irrigation system has proven effective in increasing crop yields and addressing water scarcity, particularly during the dry season (Asepta Surya Wardhana et al., 2023).

The use of solar-powered electric pumps offers an efficient solution for meeting the irrigation needs of rice fields (Rahman et al., 2023). The solar-powered irrigation pump operates continuously for up to 8 hours daily, delivering approximately 400 liters per minute. It runs on 850 watts and is supported by a battery with a backup capacity of up to 76 hours (Kurniadi Wardana et al., 2023). Farmers are able to assemble and operate the solar-based irrigation system independently, resulting in more stable water distribution and increased agricultural productivity.

Acknowledgements

We extend our sincere gratitude to all parties who have contributed to the successful implementation of this program. In particular, we wish to thank the Directorate of Research and Community Service (DPPM) under the Ministry of Education, Science, and Technology (Kemdiktisaintek) for their financial support through the Community Partnership Program (PKM). We also express our appreciation to our partner, the Ulugalung 1 Farmer Group in Salassae Village, for their active participation in the PKM activities, as well as to the Regional Government of Bulukumba Regency, especially the Head of Salassae Village, and the dedicated team of lecturers and students from Universitas Negeri Makassar.

References

Asepta Surya Wardhana, Ayende, A., Pujianto, P., Roni Heru Triyanto, & Astrie Kusuma Dewi. (2023). Pemanfaatan Panel Surya Untuk Pompa Irigasi Tanaman di Area Perhutani Jatirejo Cepu. *ABDIKAN: Jurnal Pengabdian Masyarakat Bidang Sains Dan Teknologi*, *2*(4), 547–557. https://doi.org/10.55123/abdikan.v2i4.2691

Darmawan, F. A., Aqsha, I., & Hambali, A. (2023). Penerapan Teknologi Pompa Irigasi Sawah berbasis Tenaga Surya di Desa Parambambe Kabupaten Takalar Sulawesi Selatan. *SEMAR (Jurnal Ilmu Pengetahuan, Teknologi, Dan Seni Bagi Masyarakat)*, *12*(1), 54. https://doi.org/10.20961/semar.v12i1.65873

Darmawan, F., Aqsha, I., Ibrahim, H., & Suhardi Rahman, E. (2023). Penerapan Teknologi Sistem Pengairan Tanaman Holtikultura berbasis Tenaga Surya di Desa Gunung Silanu Kabupaten Jeneponto. *Jurnal Pengabdian Masyarakat*, *1*(2), 33–38. https://doi.org/10.59562/abdimas.v1i2.598

Habibi, M. A., Prastyo, B., Zulkarnain, A. Z. A., Ni'am, F., & Hidayati, B. (2021). Rancang Bangun Sistem Monitoring Air Irigasi Berbasis Internet of Things Pada Pompa Air Bertenaga Surya. *Prosiding SENAPENMAS*, 1169. https://doi.org/10.24912/psenapenmas.v0i0.15153

Hasanah, A., Hariyani, F., Pasiriani, N., & Murti, N. N. (2023). Central publisher. *Central Publisher*, *1*, 274–288.

Kurniadi Wardana, H., Ummah, I., & HasyimAsyàri Tebuireng Jombang, U. (2023). Pembuatan Pompa Air Tenaga Surya untuk Irigasi Persawahan Bagi Masyarakat Desa Mlaras Sumobito Jombang. *JPM (Jurnal Pemberdayaan Masyarakat)*, *8*(2), 166–172. https://doi.org/10.21067/jpm.v8i2.7525

Tantawi, Prof. Dr. Ir. Ahmad Rafiqi, M. ., Jusran, S.TP., M. S., Danial, Mohamad Ikbal Riski A., S.Pd., M. S., Marhayati, S.Pi., M. P., Effran, Dr. Ir. Endy, S.P., M. S., Setyowati, Dr. Nuning, S.P., M. S., Riptanti, Dr. Erlyna Wida, S.P., M. ., Hadiwiyono, Prof. Dr. Ir., M. S., Muhlis, S.TP., M. ., Barokah, Dr. Umi, S.P., M. ., Simamora, Dr. Ture, S.Pt., M. S., & Supriyono, Prof. Dr. Ir., M. . (2024). *済無No Title No Title No Title* (Vol. 1).