




## Integration of Solar Panels and Agriculture through Agrivoltaic Farming in Harapan Farmer Group, Palangka Raya

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### Abstract

This community service activity aims to increase energy independence and agricultural productivity in the Harapan Farmer Group, Palangka Raya, through the application of solar panel-based agrivoltaic farming technology. Socialization and education were conducted to provide partners with an understanding of the agrivoltaic concept, which integrates agricultural production and renewable energy. Results showed a significant increase in partners' understanding of this technology. The selection of land for solar panel installation was based on stable sun exposure, so that the panels can function optimally without disrupting agricultural activities. The technology transfer process involved the installation of solar panels, the construction of greenhouses, and the application of supporting technologies such as sensor-based automatic irrigation systems. This technology has increased the efficiency of water and energy use, and created more stable farming conditions. Overall, the program succeeded in supporting energy security and agricultural productivity in peatlands, as well as having a positive impact on the welfare of farmers and environmental sustainability.

**Keywords:** Agrivoltaic Farming, Renewable Energy, Solar Panels, Food Security, Agricultural Technology, Peatland

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## INTRODUCTION

Food security in the area supporting the National Capital City (IKN) is one of the strategic issues that must be managed properly to ensure economic stability and community welfare. Central Kalimantan, as one of the supporting provinces of the National Capital Region, has an important role in providing sufficient food for the local community and national needs. However, the challenges faced in food security are increasingly complex with limited arable land, especially in large peatland areas, such as in Palangka Raya (Surahman et al., 2017; Yeny et al., 2022). In this case, innovative solutions are needed that are not only able to increase agricultural productivity, but also support environmental sustainability.

One approach that is increasingly relevant in facing the challenges of food security is the utilization of renewable energy, particularly solar panels (Bathaei & Štreimikiene, 2023; Domingues Martinho, 2018). Renewable energy offers an environmentally friendly

alternative to reduce dependence on conventional energy sources(Alfanaar et al., 2021). Solar panels, as a key technology in renewable energy, can provide stable energy resources to support various productive activities, including the agricultural sector(Diantoro et al., 2018). Central Kalimantan, which has abundant sunlight potential, is ideal for the application of solar panel technology in supporting energy security and food production.

The principle of integrity between agriculture and renewable energy can be implemented through an agrivoltaic farming system, where solar panels are installed on agricultural land without reducing land productivity(Pretty, 2008). This system allows agricultural land to be dual utilized, both for energy and food production. With agrivoltaic technology, farmers can utilize solar energy to support agricultural activities, such as automatic watering, soil moisture regulation, and efficient monitoring of crop conditions. This can also reduce operational costs and improve the sustainability of agricultural businesses.

In this context, Harapan Farmer Group in Palangka Raya, which has been operating since 2011, faces various challenges that hinder its productivity. The group manages 2 hectares of peatland with a primary focus on fruit and horticultural commodities. However, the farmer group has not been able to fully utilize modern technology to increase production. In addition, limited energy and the use of conventional farming systems mean that productivity remains low and the farmer group's turnover is still far below its potential.

Some of the main problems faced by farmer groups include technological limitations, lack of efficient business management, and limited energy resources. In addition, about 70% of farmer group members are not active in productive activities, which further exacerbates low productivity. The absence of standardized farm management systems and modern production methods contributes to the lack of success in achieving maximum agricultural yields.

As a solution, the application of solar panel-based agrivoltaic farming technology is designed to address the problems faced by Harapan Farmer Group. Through this technology transfer, the farmer group will be empowered with technology that enables the integration of renewable energy and smart farming systems. Solar panels will be installed on top of the farmland to generate renewable energy that can be used to support automation in land management, such as watering and crop monitoring. This will reduce dependence on conventional energy sources and increase farm efficiency and productivity. In addition, through training and mentoring, farmer group members will be actively involved in the management of the agrivoltaic system, which is expected to increase their participation and strengthen overall farm management.

With this agrivoltaic farming technology transfer, Harapan Farmer Group is expected to achieve energy independence while increasing agricultural productivity on peatlands. This will have a positive impact on the welfare of farmer group members and strengthen food security in the Palangka Raya region.

## **METHOD**

This community service activity consists of several stages that are systematically designed to ensure the implementation of agrivoltaic farming technology goes well in the Harapan Farmer Group, Palangka Raya. Each stage is designed to involve partners directly and provide comprehensive assistance, from socialization to technology implementation in the field. The stages in this method are as follows:

### **Technology Socialization and Education**

The initial stage of this activity was the socialization of the concept of agrivoltaic farming and the benefits of using renewable energy, especially solar panels, in supporting agricultural productivity. This socialization activity is carried out through farmer group meetings involving all members and stakeholders in the Harapan Farmer Group. At this stage, partners will be given an understanding of the basic principles of agrivoltaic farming, such as how solar panels work, the benefits of using renewable energy, and the resulting positive impacts on the environment and agriculture.

In addition, at this stage, education will also be conducted on the potential benefits of smart agriculture, which can increase efficiency in farm management, such as irrigation automation and real-time crop monitoring using sensor systems.

### **Land Planning and Selection**

After the socialization stage, the activity continued with a survey and selection of suitable land for the application of solar panels. Given the condition of the peatlands owned by the Harapan Farmer Group, the selection of the location for installing solar panels is very important to ensure that the selected land does not interfere with agricultural productivity. The service team will work with partners to determine the optimal layout of solar panels, so that land use can be optimized for energy production and agricultural products simultaneously. This planning also includes the design of integration between solar panel technology and existing agricultural systems.

### **Technology Transfer and Solar Panel Installation**

This stage is the core of community service activities, namely the technology transfer process through the installation of solar panels on agricultural land. The technical team will assist partners in the process of installing solar panels on the selected land. This process includes technical training related to the installation, operation, and maintenance of solar panels to ensure that partners can independently manage this renewable energy system after the program is completed. In addition, the team will also integrate smart farming technology to automate some farming processes, such as watering and monitoring crop conditions using sensors.

In this technology transfer, farmer group members will be actively involved in every installation and trial process to improve their skills in operating and maintaining the agrivoltaic farming technology.

## **RESULTS AND DISCUSSION**

The first stage of this activity was the socialization and education of agrivoltaic technology through casual discussions and exchange of opinions. This method was chosen to facilitate knowledge transfer and increase active participation from all members of the Harapan Farmer Group. The results of the socialization showed a significant increase in understanding regarding the concept of agrivoltaic farming, which was initially not well understood by the partners. Interactive discussions helped farmer group members understand how this technology can integrate agricultural production and renewable energy simultaneously (Figure 1).

The discussion showed that a participatory discussion approach is very effective in accelerating the adoption of new technologies by farmer groups. Although the concept of agrivoltaic was initially unfamiliar to the partners, the use of methods that allowed for an open exchange of opinions and questions made it easier for them to accept and understand the benefits of this technology. Active involvement in discussions also

increased the sense of ownership of the technology to be implemented, which is important for long-term success.



**Figure 1.** Casual discussion as an effort to socialize and educate partners

The second stage, land design and selection, was carried out by considering the main criteria, namely the area with the most stable sun exposure throughout the day (Figure 2). The results of the location survey conducted by the service team and partners showed that the selected area was optimal for the installation of solar panels without disrupting agricultural land productivity. The location of solar panels is strategically placed to maximize the receipt of solar energy, while ensuring that agricultural areas can still be used for production activities (Selvi et al., 2023).



**(a)**



**(b)**

**Figure 2.** (a) and (b). Siting of agrivoltaic technology implementation

In the discussion, the importance of careful planning at this stage was emphasized. Proper land selection allows the agrivoltaic system to work efficiently, both in terms of energy production and agricultural productivity. With a good layout, agriculture and energy can operate together without compromising each other's potential. This confirms that solid planning is key to the successful integration of agrivoltaic technology on farms.



(a)



(b)

**Figure 3.** (a) and (b). Green house and solar panel technology transfer process

The core stage of this activity is technology transfer which includes the installation of solar panels and supporting technologies (Figure 3). The technology transfer process begins with the construction of a greenhouse that serves to protect plants from extreme weather and create more stable environmental conditions. After the construction of the greenhouse, solar panels were installed and integrated with other supporting technologies, such as an automatic irrigation system controlled (Figure 4). This technology is designed to save water usage and ensure that the plants only get water as needed, thereby improving resource use efficiency.



(a)



(b)

**Figure 4.** (a) and (b). Control panel for solar panel assembly and system

From the discussion related to these results, the technology transfer that includes the installation of solar panels and automatic irrigation shows that the integration of renewable technologies with traditional agriculture can be done efficiently. The constructed greenhouses also support more stable farming conditions, while the solar panels double as renewable energy providers that can be used for smart farming purposes. The use of an automatic irrigation system helps reduce water wastage, which is very important in the context of peatland management. The use of this technology is expected to increase agricultural productivity by minimizing the use of resources, while reducing dependence on conventional energy.

## CONCLUSION

This community service activity succeeded in increasing the understanding and skills of the Harapan Farmer Group in adopting solar panel-based agrivoltaic farming technology. Through socialization and education, partners who initially did not understand the concept of agrivoltaic now have better knowledge about the integration of

agriculture with renewable energy. Optimal land selection based on sun exposure has ensured the efficiency of solar panel installation without reducing agricultural productivity. The installation of solar panels and supporting systems, such as automatic irrigation, provide effective solutions to improve energy and water use efficiency. The built greenhouses also help create more stable farming conditions, supporting the success of this agrivoltaic system. The transferred technology can reduce dependence on conventional energy sources and improve the sustainability of agriculture on peatlands. Thus, this activity succeeded in having a positive impact on agricultural productivity and the welfare of farmer groups in Palangka Raya.

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