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Increasing Agricultural Land Productivity through the Introduction of Protani Gogo Rice Technology and Solar Water Pumps

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ABSTRACT

The aim of this PKM is to increase the income of farmers in Pruwatan Village, Bumiayu District, Brebes Regency. The problems faced by the Mukti Farmers Group in Pruwatan Village are problems in the Production Sector, Technical Sector of Production Equipment, Human Resources (HR) and Business Networks. To overcome this problem, we introduced Protani Gogo Rice technology. Solar Power Technology for Rice Field Irrigation Pumps, business management and group management as well as functioning of BUMDes institutions. The method to overcome this problem is through socialization and consolidation of program implementation to partners of the Mukti Farmers Group in Pruwatan Village, technology transfer for the application of Solar Panel Pump technology innovation and Transfer of Gogo Rice Technology or National Superior Variety of Inpago Unsoed Protani Rice, improving business management capabilities, group management and group administration as well as improving the institutional function of BUMDes. The results of this activity will produce 8 tons of grain per 1 ha of land, so that there is an increase in production capacity from 17.5 tons to 40 tons per 5 ha of land or sales from IDR 85.5 million to IDR 200 million per 5 ha of land, increased business management capabilities, group management and increased institutional functions of BUMDes and networks between Bumdes and the Mukti Farmers Group in Pruwatan Village.

Keywords: Protani Upland Rice Technology, Solar water pump, Rainfed Rice Fields, BUMDes institutions, Pruwatan Bumiayu Village

1. Introduction

Pruwatan Village, Bumiayu District, Brebes Regency, has long been in the spotlight because of its status as one of the underdeveloped villages in its area. The latest data from BKKBN (2024) shows that 1,574 heads of families or the equivalent of 10,088 people in this village live in poverty. This is also reinforced by the Decree of the Regent of Brebes Regency Number: 050/177/Year 2023 concerning the Determination of Priority Villages for Extreme Poverty in 2024.

Brebes Regency is also included in the disaster-prone areas in the 2024 Kosabangsa Program (Directorate of Research and Education, 2024). More specifically, Pruwatan Village is one of the disaster area villages based on the Regional Environmental Management Performance Information Document (DIKPLHD) of the Brebes Regency Government (2019). In 2010, a disaster struck this village, namely a dam burst and an irrigation channel cliff collapsed. As a result of the disaster, 85 farmers with a total of 75 hectares of land were forced to switch to a rain-fed system, causing a sharp decline in harvest yields. This condition is further exacerbated by the lack of knowledge of farmers regarding modern cultivation techniques, limited access to subsidized fertilizers, and minimal agricultural support infrastructure such as solar-powered water pumps.



Figure 1. Condition of the dam, collapsed irrigation canal cliffs, and dry rice fields

The Mukti Farmers Group, a partner in this community service activity, is a real example of the impact of the disaster. The farmer group consisting of 33 people with 5 hectares of barren land ownership faces various obstacles such as low land productivity, difficulty controlling pests and diseases, and limited market access. Therefore, to overcome these problems, one of them starts with the Mukti Farmers Group in Pruwatan Village as an effort to empower farmer groups (Putri, L., and Pratama, 2022).

Some of the problems faced by the Farmer Group are: a. Problems in the Production/Processing Sector, namely 1) Rice fields have experienced drought and have become rain-fed rice fields since 2010 until now due to a broken dam and landslides in the irrigation cliffs, causing rice field productivity to decline significantly. 1 ha of land only produces 3.5 tons; 2) Less intensive in controlling pests and weeds; 3) Difficulty in obtaining fertilizer and if available, the price is expensive because it is non-subsidized; 4) Problems in the Technical Sector of Production Equipment; 5) Not having a solar panel pump that can irrigate rice fields at a cheaper cost; 6) Not having equipment to process dry rice fields efficiently; b. Problems in the Human Resources (HR) Sector, namely 1) Lack of understanding of superior varieties of high-yielding, drought-tolerant Gogo rice; 2) Lack of knowledge about high-protein rice cultivation techniques; 3) Limitations in business management capabilities; 4) Limitations in group management capabilities; 5) Limitations in group administration and financial records; 6) Limited ability to conduct business networking; c. Business Network Problems, namely: 1) The problem of cheap grain prices at harvest time and 2) Purchasing fertilizer at a cheaper price.

To overcome the partner's problems, two technologies will be implemented, namely the first Off-Grid Solar Power Technology for Rice Field Irrigation. The

manufacture of solar water pumps to lift water from the Pemali River uses technology owned by the Mentoring Team Members based on No. HKI: EC00202475588, Grant Date: 2024-08-01, Independent Solar Power Module Equipped with Automatic Backup for Dry Land Irrigation and Patent No.: IDS000002649, Grant Date: 2019-11-14, Dual Plate Soil Water Level Sensor. The technology to raise water from the Pemali River with an outlet of 150 m is to use a large submersible pump, which is ± 3 HP. The pump is used to meet the volume of water for irrigating 5 Ha of rice fields. The operation of the deep pump well uses full solar power. The function of solar power is as an independent electricity source for irrigation pumps that will provide water and distribute it to the rice field area. The electrical power load that must be met by solar power to meet the electricity needs of a 3 HP deep well pump is ± 10 kW (considering the efficiency of the solar panels and fluctuations in sunlight intensity). The solar power model chosen is off-grid, which is independent electricity without a connection to PLN. The Solar Power Unit will be placed in a panel house and pump well.

The second technology used to overcome partner problems is the National Superior Variety Technology of Inpago Unsoed Protani Rice. Inpago Unsoed Protani is a superior variety of rice with high protein content assembled by a team of plant breeders and researchers from the Plant Breeding and Biotechnology Laboratory, Faculty of Agriculture, Jenderal Soedirman University (Unsoed), consisting of Prof. Ir. Totok Agung Dwi Haryanto, MP., PhD., et al. The assembly of this high-protein upland rice began in 2010, was tested in more than 16 locations in various regions of Indonesia, and has been released as a national superior variety based on the Decree of the Minister of Agriculture of the Republic of Indonesia No. 980/HK.540/C/10/2020 dated October 13, 2020. In addition to having a higher protein content (9-13%) compared to rice varieties in general (6-7%), Inpago Unsoed Protani has the special characteristic of soft rice texture and Zn nutrient content of 27ppm which makes it prospective for development in nutritious rice agro-industry and stunting prevention programs.

The superior variety of upland rice with high protein content Inpago Unsoed Protani has various advantages, including high yield stability so that it is adaptive in various regions with various conditions, high yield (> 9 tons / ha GKG is much higher than the average yield of upland rice in general which is less than 5 tons / ha GKG). Other advantages of this high protein rice variety are drought resistance, adaptive to planting in dry land or rice fields, short plants (91cm) so that they are relatively resistant to lodging. The resistance of this rice to major pests and diseases is also quite complete, namely resistant to blast disease race 101, somewhat resistant to blast races 041, 023 and 073, and has upright flag leaves and higher than panicles so as to reduce the risk of loss of yield due to bird pest attacks.

The tolerance of Inpago Unsoed Protani to water and nutrient limitations, wind, and plant pests and diseases makes this high-protein upland rice variety technological innovation prospective for use in disaster-affected or disaster-prone areas as part of disaster mitigation and management. Disaster-affected areas often experience damage to agricultural support infrastructure, so that agricultural land that is a source of livelihood for the community is no longer ideal for use as rice production land. The impact of landslides, earthquakes, and droughts that have an impact on agricultural land requires improvement in the rehabilitation and reconstruction phase during the post-disaster recovery process which of course requires a long period of time. The use of superior Inpago Unsoed Protani varieties that are tolerant to all limitations in crop production support capacity, especially water caused by damage to irrigation infrastructure, will be able to help the food crop agriculture sector run again during the post-disaster recovery phase.

The third technology and science used to overcome partner problems is technology and science about business management, group management and business networks. Partners are given knowledge about Production Management, Financial Management, Marketing Management and Human Resource Management. Partners are also taught about Group Management and how to administer groups. Partners are taught how to make standardized financial reports from the businesses they run. Knowledge about business networks will also be taught to synchronize farmer and livestock groups by utilizing BUMDes institutions so that farmer groups and BUMDes are more empowered.

Addressing poverty issues in underdeveloped areas, such as Pruwatan Village, is very important in reducing social disparities and improving the quality of life of local communities. Various village development programs continue to strive to improve the conditions of underdeveloped villages by focusing on strengthening the local economy, increasing human resource capacity, and developing sustainable agricultural infrastructure (Putra, A., and Wahyuni, 2021). As one of the areas prone to disasters, Pruwatan Village also faces major challenges in developing the agricultural sector which is the backbone of the community's economy. Various studies show that villages that are vulnerable to disasters tend to have higher poverty rates, especially when agricultural irrigation infrastructure is damaged, so that land productivity decreases drastically (Kusuma, R., and Heriyanto, 2020). Therefore, the use of appropriate technology such as drought-resistant rice varieties and renewable energy-based irrigation systems can be a solution to increase agricultural and economic productivity in this village (Budianto, A., and Wibowo, 2023).

2. Methodology

Time and Place of Implementation

The program will be implemented for 6 months starting from August to December 2024. The activity will be carried out in Pruwatan Village, Bumiayu District, Brebes Regency, Central Java Province.

Method of Approach and Application of Science and Technology

- a. Socialization and consolidation of program implementation to target partner 1
- b. Technology transfer for the application of Solar Panel Pump technology innovation
 - 1) Counseling on the purpose of use, installation and maintenance of Solar Panel Pumps.
 - 2) Preparation of materials and equipment for the application of Solar Panel Pump technology innovation.
 - 3) Installation of solar panel pumps with deep wells
 - 4) Practice of using solar panel pumps with deep wells.
 - 5) Assistance in the use of solar panel pumps.
- c. Technology Transfer of Upland Rice or National Superior Variety of Inpago Unsoed Protani Rice:
 - 1) Counseling on superior varieties of Upland Rice with high yields and drought tolerance, high protein rice cultivation techniques and control of major pests and diseases and weeds.
 - 2) Preparation of materials and equipment for the application of Upland Rice Protani technology innovation.
 - 3) Land preparation.
 - 4) Soil processing.
 - 5) Planting of gaga protani rice
- d. Dissemination of information and technology transfer of business management, group management and group administration.

- e. Development of business networks between Farmers and Breeders through BUMDES institutions

3. Results and Discussions

1. Socialization and consolidation of program implementation to target partners
The activity began with socialization and consolidation of activities through coordination with all partners. Furthermore, a series of programs for the next few months were presented to address village and partner problems. This activity was carried out on September 15, 2024.
2. Technology transfer for the application of Solar Panel Pump technology innovation
 - a. Counseling on the purpose of use, installation and maintenance of Solar Panel Pumps
The method used to solve the problem of lack of knowledge of partners regarding the installation, use, and maintenance of solar panel pumps is by counseling partners. In this activity, the community service team acts as a resource person while the partners act as training objects which are also attended by village heads, village officials, and BUMDes directors. This counseling activity was carried out on September 22, 2024.
 - b. Preparation of materials and equipment for the implementation of Solar Panel Pump technology innovation
The process of preparing materials and equipment was carried out on October 2, 2024. Preparation of materials and equipment was carried out collaboratively by partners in this community service program, which will later become group assets and be inventoried by the village.
 - c. Installation of solar panel pumps with deep wells
Furthermore, from the preparation of tools and materials, the installation of solar panel pumps with deep wells was carried out through mutual cooperation by partners. The process of installing solar panel pumps with deep wells was carried out on October 3 and 4, 2024.
3. Technology Transfer of U pland Rice or National Superior Varieties of Inpago Unsoed Protani Rice:
 - a. Extension on superior varieties of high-yielding dry-tolerant Gogo Rice, high-protein rice cultivation techniques and control of major pests and diseases and weeds
The method used to solve the problem of lack of knowledge of partners regarding superior varieties of Gogo Rice is by providing extension to partners. In this activity, the community service team acts as a resource person while the partners act as training objects. This extension activity was carried out on October 11, 2024.
 - b. Preparation of materials and equipment for the application of Protani Upland Rice technology innovation
 - c. Land preparation
The land preparation process was carried out on October 11, 2024. This activity was carried out by farmer partners so that the land was ready for planting.
 - d. Land processing
The land processing process for agricultural land was carried out on October 11, 2024. This activity is a continuation after the land was prepared, which was also carried out by farmer partners.
 - e. Planting of Gaga Protani Rice

The planting process of gaga protani rice was carried out on October 13, 2024. This activity was carried out by resource persons, community service teams, and farmer partners using methods to maximize the gaga protani rice planting area.

4. Dissemination of information and transfer of business management technology, management groups and group administration

In implementing this program, the Community Service Team provides knowledge about small business management which includes production management, HR, marketing and finance. In this activity, the community service team acts as a trainer and facilitator while the partner acts as the training object. This activity was carried out on October 13, 2024.

- a. Counseling on small business management skills and financial reporting skills. In implementing this program, the Community Service Team provides knowledge about small business management which includes production management, HR, marketing and finance. In this activity, the community service team acts as a trainer and facilitator while the partner acts as the training object.
- b. Practice of preparing Financial Reports. This counseling activity is continued with the practice of preparing financial reports. In providing training on preparing financial reports, the Team will carry out the process as shown in Figure 3. In this activity, the community service team will act as a trainer and facilitator while the partner will act as the training object. The bookkeeping provided includes recording Cash Book, Cash Purchase Book, Credit Purchase Book, Cash Sales Book, Credit Sales Book, Accounts Receivable Book, Accounts Payable Book, Balance Sheet and Profit and Loss Report.
- c. Assistance in the implementation of financial report preparation. In this activity, the community service team acts as a companion who provides direction and guidance on the implementation of financial report preparation.

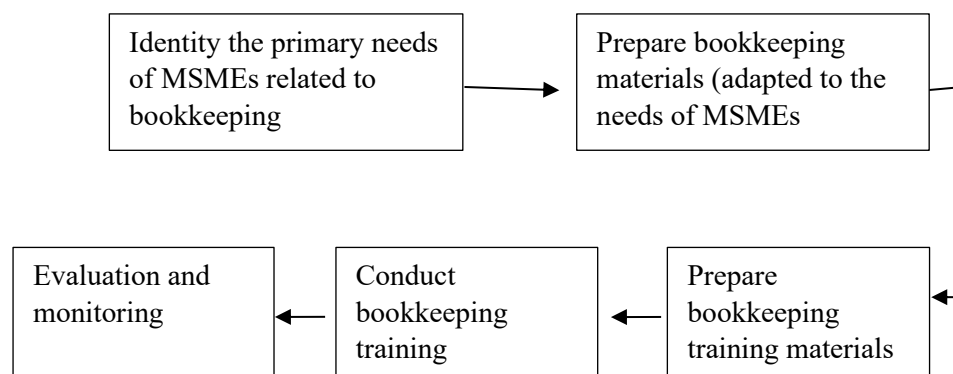


Figure 12. Bookkeeping training process

5. Development of business networks between Farmers and Breeders through BUMDES institutions

In the process of land processing for planting Gaga Protani Rice, a lot of compost is needed. To process 1 ha of land, 5 to 10 tons of compost are needed. Based on a survey conducted by the PKM Team, it is very difficult to get compost around Pruwatan Village, only plant shops sell compost packaged in kg units, even though the need for compost is very large. Meanwhile, in Pruwatan Village, up to 2 tons of animal waste are produced every day. Therefore, training will be provided on processing animal waste, especially goats, into compost so that the compost can be sold to farmers. The processing of animal waste will be carried out at the fertilizer and animal feed business center which will be managed by BUMDES.

Therefore, in this activity, a shredder machine was also provided to be used as a material for making compost.

4. Conclusion

Pruwatan Village, Bumiayu District, is categorized as an underdeveloped village and has a fairly high poverty rate, with 1,574 families or 10,088 people living in poverty. The disaster that occurred in 2010 damaged irrigation infrastructure, which resulted in crop failure and decreased rice field productivity. To overcome this problem, the technology of Superior Inpago Unsoed Protani Rice Variety which is drought-resistant and has high protein content, solar water pump technology for more efficient and environmentally friendly irrigation has been implemented. In addition, business management, finance, and business networking training were also carried out to strengthen their capacity in managing agricultural businesses.

The results of this PKM activity will be able to increase land productivity which in dry rice field conditions per 1 ha only produces 7 quintals of grain or 3.5 tons so that for a 5 ha rice field only produces 17.5 tons of grain. If the price of grain is IDR 5 thousand per kg, then per 5 ha of land produces IDR 85.5 million. If the technology trial by supplying water for 5 ha is successful, the profit is 4 tons then 1 year can harvest 40 tons of grain. If the price of GKP is 5 million per ton, then IDR 200 million is obtained from 5 ha for 1 year. So if this program is successful there will be an increase in production capacity from 17.5 tons to 40 tons or sales from IDR 85.5 million to IDR 200 million.

To overcome the partner's problems regarding the low price of rice and the high price of fertilizer, they were taught about business networks between farmers and ranchers and outside parties by further empowering BUMDES of Pruwatan Village. In addition, the group was also given training in business management and group management. This technological and managerial approach aims to increase agricultural productivity and reduce poverty, as well as create a more sustainable system amidst the limitations of existing natural resources.

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