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# Application of Solar Energy-Based Pest Control Tools to Improve the Quality of Rice Plants to Reduce Farmer Losses

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## ABSTRACT

Rice is one of the most important staple crops in Indonesia. Rice is the main source of food for the majority of Indonesia's population, including the Stabat area, which is a small town part of Langkat Regency, North Sumatra Province. Rice itself needs water to grow and develop, and is a plant that is no stranger to pests in the form of birds, mice, javelin, and so on. In dealing with pests, farmers in Stabat usually still use traditional methods by installing scarecrows and using pesticides to kill the pests. The work carried out by always going to the fields takes up a lot of energy and time from farmers. The University of North Sumatra Community Service Team offers a solution, namely making tools to protect rice plants from pests (javelin, aphids, caterpillars, mice, fungi) using pest detection sensors to help farmers in caring for rice to maintain the quality and quantity of rice through spraying pests to reduce losses incurred by farmers, especially during the harvest period. Solar energy-based pest control tool to improve the quality of rice plants to reduce losses. Farmers can also reduce the spraying of rice pests using chemicals so that soil fertility is maintained.

**Keyword:** Rice, Pests, Solar Energy



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## 1. Introduction

Rice is one of the most important staple crops in Indonesia because rice is the primary source of food for most of the Indonesian population. Rice grows in almost all regions of Indonesia. Dryland rice is often found in Java, Bali, and Nusa Tenggara. Meanwhile, wetland rice is more commonly found in Sumatra, Kalimantan, and parts of Sulawesi.

Indonesia has two main planting seasons: the rainy and dry seasons. The rainy season is suitable for lowland rice plants using the wetland method, while the dry season is suitable for dryland rice [1]. Wet farming is the most used method for irrigating fields and planting rice. On dry land, farmers often use rain-fed systems or simple irrigation.

One of the problems often faced in rice farming in Indonesia is inefficient water management, pest and disease attacks, and climate change, which can affect productivity. The government and agricultural research institutions continue to develop technology and innovation in rice farming, such as superior varieties, better irrigation systems, and environmentally friendly pest control techniques [2].

Stabat City is a small city in Langkat Regency, North Sumatra Province. In some areas of the town of Stabat, many regions still need to experience significant development, and many residents make their living as farmers, such as rice farmers in the village of Kepala Sungai Dusun II Sukaramai, Kec. Secanggang Stabat. Generally, farmers will check the condition of the rice every day for three months. If rice leaves are found to be damaged (holes), it can be concluded that this could be due to being bitten by pests such as javelins, rats, caterpillars, and the like so that farmers suffer losses.

A straightforward countermeasure is carried out by rice farmers so that the rice plants continue to thrive by spraying pesticides on the rice leaves to prevent pests from coming. However, the impact of pesticide spraying is temporary, so spraying is carried out repeatedly at uncertain times. Before harvesting, farmers also experience difficulties, where many birds will damage the rice harvest process [3]. To deal with these bird attacks, farmers made scarecrows and put-up nets to ward off bird pests. Repelling bird pests using traditional methods is an inefficient method [4].



**Figure 1.** Some conditions of partner rice fields

After hearing about the problems in planting and harvesting rice, we provide a solution that can improve quality and reduce losses experienced by farmers, namely by offering a solar energy-based pest control tool to enhance the quality of rice plants to reduce farmer losses [5].

The aim of community service carried out in Kepala Sungai Dusun II Sukaramai Village, Secanggang Stabat District, is to help partners, namely rice farmers, by improving quality and reducing losses experienced by farmers caused by attacks by pests and diseases as well as birds eating rice without using substances. Chemical substances that can damage soil fertility [6]. The solution is to design and provide a pest control device using solar power as an electricity source and storing sunlight as an energy reserve for the rainy season.

From the results of this service, it is hoped that there will be benefits obtained by farmers in Kepala Sungai Dusun II Sukaramai Village, Secanggang Stabat District, including [7]:

1. Make farmers' work easier and reduce rice production losses so that farmers' income increases
2. Farmers can reduce spraying of rice pests by using chemicals so that soil fertility is better maintained

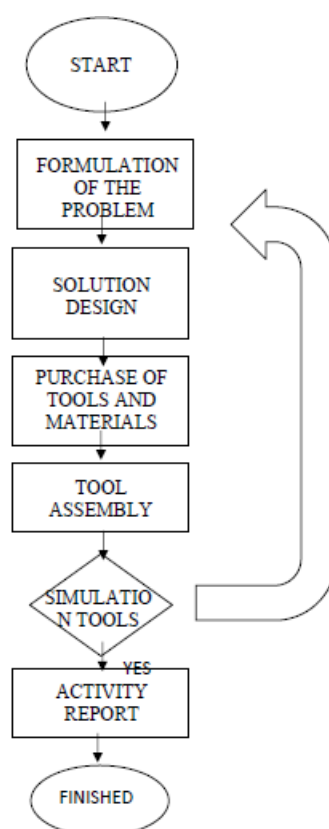
3. Help farmers not have to spray directly into the fields and enjoy more extended rest periods.
4. Before harvesting, farmers do not need to make scarecrows or put up nets to ward off bird pests

## 2. Methods

Making solar energy-based pest control tools to improve the quality of rice plants to reduce farmer losses consists of the following [8][9]:

- 1) Pest repellent tool that uses ultrasonic frequency sounds to repel birds, leafhoppers, and mice.
- 2) There is a UV lamp on the device, which helps repel insects such as spears at night, and a light that emits glare from reflected sunlight.
- 3) The automatic transmitter contains pesticides to reduce pests such as caterpillars, ticks, javelins, and wild plants so that rice can be looked after, and its quality is better maintained.
- 4) Using an automatic controller that can be set by the farmer where the sound or lights or pesticide can turn on automatically at the specified time.
- 5) There is an additional motion sensor on the device to detect the movement of pests such as birds or mice, where this movement automatically makes the device emit sound and light. The correct times to spray rice plants in the morning are 09.00 and 15.00 – 18.00. This tool can help farmers not have to spray directly into the fields and enjoy more extended rest periods. During harvest, the device will turn on more often to ward off rice-eating sparrows, easing farmers' work and reducing existing rice production losses.
- 6) Pest exterminators use solar power as an electricity source and store sunlight as energy reserves for the rainy season.
- 7) This tool can rotate 180° so that pesticide spraying on rice plants can be maximized.
- 8) The range of the tool is 40 – 50 m, where the tool will rotate 180o and spread along the tool placement.
- 9) Ideally, four tools should be installed to support the limited reach of the tools in dealing with rice fields covering an area of 2,000 m<sup>2</sup>.

The stages of Community Service are carried out in Figure 2



**Figure 2.** Flow diagram of stages of community service



### 3. Result and Discussion

From the activities carried out in making Solar Energy Based Pest Repellent Tools, the tool is shown as in Figure 3



**Figure 3.** Solar Energy Based Pest Control Device

Solar energy-based pest control tools use and store solar energy as an electricity source using Solar Cells. This energy will be stored when sunlight hits the surface. A device that contains electrical cells to store energy obtained from electrical energy sources such as solar panels is usually converted into power to supply electricity for electronics that will be used. The inverter is the heart of all electronics because it converts DC electric current (battery) into AC electric current to be connected to electronics to be active. The solar charge controller (SCC) controls charging from the solar panel to the battery, the power of which can be transferred to the lights on the device.

Some of the tools used in making solar energy-based pest control devices are the Arduino Uno microcontroller and the LDR sensor, a type of resistor with a changing resistance value depending on the intensity of light it receives. The spotlight will automatically turn on if the LDR sensor is active. The lights will function for the rice fields at night to provide light for the PIR sensors to detect the appearance of pests such as mice. The PIR sensor plays a role in detecting pests. If a pest is detected, the sensor will automatically direct the ultrasonic sensor to emit ultrasonic sound through the speaker. The function of the ultrasonic sensor is to emit ultrasonic sound to repel pests, especially birds, if the PIR sensor catches them.

### 4. Conclusion

Farmers in Kepala Sungai Dusun II Sukaramai Village, Secanggang Stabat District, can use solar energy-based pest control tools to improve the quality of rice plants, ease the work of farmers, and reduce rice production losses so that farmers' income increases. Rice farmers can also reduce the spraying of rice pests by using chemicals so that soil fertility is maintained, and before harvesting, farmers do not need to build scarecrows and install nets to ward off bird pests.

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