



## Optimizing Rice Farming Productivity Using Smart Farming Technology and Sprinkler Sprayer in Podorejo Village

Construction of a Pest Control Tower (Mendalima) to increase the economic productivity of rice farming in the Sido Makmur Farmer Group

Sandhika Muji Laksana <sup>1</sup>, Widya Putri Ardana <sup>2</sup>, Nazwa Rifdatunnisa <sup>3\*</sup>, MGC Yuantari <sup>4</sup>, Izzatul Alifah Sifai <sup>5</sup>

<sup>1</sup>Public Health, Dian Nuswantoro University ,

<sup>2</sup>Public Health, Dian Nuswantoro University

<sup>3</sup>Public Health, Dian Nuswantoro University , [411202003168@mhs.dinus.ac.id](mailto:411202003168@mhs.dinus.ac.id)

<sup>4</sup>Public Health, Dian Nuswantoro University

<sup>5</sup>Public Health, Dian Nuswantoro University

### Abstract

This research aims to optimize the productivity of lowland rice cultivation in Podorejo Village, Semarang City, Central Java Province by developing innovation in the form of a Pest Control Tower (MENDALIMA) based on smart agriculture. Rice cultivation has an important role in meeting the basic needs of the Indonesian people, and the majority of the population in this region are farmers. However, rice cultivation faces the challenge of pest attacks that can disrupt agricultural productivity. The use of pesticides to control pests is a solution that is widely used by farmers, even though the use of pesticides has a negative impact on the environment and farmers' health.

In an effort to overcome this problem, the Ormawa HMKM PPK group developed MENDALIMA in Podorejo Village. MENDALIMA is a tower equipped with various equipment, including pesticide and fertilizer sprayers, ultrasonic sound to repel rodent pests, and rice nets to protect plants from bird attacks. This tower operates automatically with solar energy or is powered by solar energy.

The MENDALIMA development process includes location potential analysis, focus group discussion (FGD) to assess community needs, development program design, physical construction of the tower, and system programming, automation systems. The result is an innovation that will help farmers fight pests more effectively, as well as improve rice quality and yield.

#### Correspondence Address:

Jalan Menoreh Utara A4  
Samapangan, Gajah  
Mungkur, Semarang City ,  
Indonesia  
Email:  
[411202003168@mhs.dinus.ac.id](mailto:411202003168@mhs.dinus.ac.id)

#### Keywords:

*Pest Control; Rice farming; Smart Farming*

## Introduction

Indonesia is an agricultural country that has large, extensive agricultural land, diverse and abundant natural resources. In agricultural countries, agriculture has a very important role in fulfilling basic needs. The agricultural sector is also a primary sector and plays a very important role in the national economy. One of the basic needs for agricultural products is rice. Rice is a very important food commodity to be developed for the national economy because it is the largest staple food for the Indonesian population (Ruvananda & Taufiq, 2022) . Indonesia, as an agricultural country, also has the majority of its people working as farmers.

The agricultural sector is the center of attention because it plays an important role in nation development, especially in the use of agricultural products related to food (Pratama et al., 2021) . Based on data from the Central Statistics Agency (BPS), agriculture in Indonesia is also the sector that absorbs the most workers, in 2020 there were around 33.4 million people working in the agricultural sector ( Juniwati et al., 2022 ) . One of the largest agricultural products in Indonesia is rice, which is the staple food of Indonesian people, therefore the presence of rice can indirectly influence other consumption materials (Rohimah, 2017) .

Quoted from the Web Jatengprov.go.id, Head of the Central Java Agriculture and Plantation Service, Suryo Banendro, said the number of farmers in Central Java currently reaches 2.88 million and manages 1,022,570.86 hectares of rice fields. (ikp, 2022) . Therefore, the cultivation of rice plants must be done well in order to produce paddy or rice of high quality and quantity. However, several pest problems such as planthoppers, mice, sparrows and weeds hamper and impact agricultural yields. So, farmers choose pesticides as a means to reduce pest disturbances to improve the quality of agricultural products. In overcoming this problem, farmers have used various methods, such as using pesticides as pest control. However, the use of pesticides causes many negative impacts on the environment and farmers themselves, so that the dangers of pesticides are increasingly felt by the public, especially due to unwise use of pesticides (Wulandari, 2023) .

Pesticides are chemical substances, microorganisms, viruses and other substances used by farmers to protect plants (Miana & Suraji, 2020) . Pesticides are usually used by spraying them manually using a pest spray tank which functions to break down a liquid, solution or suspension into droplets or spray. This pesticide spraying is carried out once a week or adjusted to the conditions and needs of agricultural land. However, with continued use of manual spray equipment, farmers will experience ergonomic problems which have an impact on the farmer's health. Therefore, we need a tool that can control these pest attacks so that rice productivity remains stable. Therefore, the Ormawa HMKM PPK Team

inspired to create an innovation in the form of a pest control tower (MENDALIMA) which was built in Njurang Hamlet, Podorejo Village, Ngaliyan District, Semarang City, Central Java Province. Geographically, Podorejo Village has an area of 605,349 hectares with an agricultural land area of more than 50 hectares. The regional boundaries for Podorejo Village are that to the north it borders Wonosari Village, to the south it borders Ngadirgo Village. To the west it borders Darupono Village (Kendal Regency), and to the east it borders Wates Village. According to the Head of Podorejo Village, information was obtained that the majority of the people of Podorejo Village work as farmers with a population of 8,846 people in Podorejo Village, with 4,391 male residents and 4,455 female residents. Judging from the vast agricultural land, the majority of the people work as farmers, namely 75% and the other 25% work as entrepreneurs.

There are several farmer groups in Podorejo Village, one of which is the Sidomakmur Farmer Group. From the information obtained from the farmer group, farmers in Podorejo Village still use manual pest control tools. In fact, the area's agricultural land is very large, so it requires a long time and a lot of energy during the pest control process. From this, the innovation of the Pest Control Tower (MENDALIMA) emerged.

Pest control tower (MENDALIMA) is a tower containing several tools that can be used simultaneously, such as a sprinkler sprayer for spraying pesticides and fertilizers, ultrasonic sound for rat pest problems, and rice nets for dealing with bird pests, during the plant growth cycle, which is designed using an automatic system using solar power. MENDALIMA can help streamline farmers' work time and effectiveness in maintaining rice plants, so that they can improve the quality and yield of agriculture. However, of course farmers need training in using MENDALIMA, to get maximum results.

## Methods

The construction of pest control towers is one approach in pest management that aims to reduce plant pest populations in a more innovative and sustainable way. Pest control towers include the installation of physical structures of tall towers or poles that can attract and support the presence of natural predators of pests . The following is the method used in constructing the mendalima;



**Figure 1.** Method of Implementing Ormawa Strengthening Program

source: primary data, 2022

a Analysis and survey of the potential conditions of Podorejo Village

Podorejo Subdistrict has agricultural land with an area of 86.9 Ha and dry land of 947.4 Ha. Rice crops in this area can be cultivated throughout the year because of the availability of irrigation water, so it is the main source of livelihood for 90% (Purbowati et al., 2003) . This condition is supported by the existence of the Sido Makmur Farmers Group with members of 20-35 farmers or administrators who have the same goal, namely to make changes to problems surrounding agriculture. This group was also given monitoring and evaluation by the agricultural service agency through direct monitoring and filling out accountability reports for each member of the Sido Makmur Farmers. From these results, the existing potential was used in efforts to control pests by building pest control towers or mendalima on agricultural land belonging to the Podorejo sub-district which is managed by the chairman of the Sido Makmur farmer group.

b Focus Group Discussion (FGD) Needs Assessment

This group communication method is used to obtain input and opinions from various stakeholders about a particular topic or project. In the context of the construction of the Pest Control Tower in the Podorejo sub-district, relevant stakeholders were identified to attend this FGD, such as regional officials, administrators of the Sido Makmur farmer group, sub-district heads, RT/RW, UPT Agriculture Service and sub-district secretaries. This FGD discussed readiness and agreement regarding the most urgent needs and input that can be used in planning the construction of a Pest Control Tower to fulfill project planning and development of the required tools.

c Schematic design for the construction of a Pest Control Tower

The design of the pest control tower scheme is designed based on the location of the agricultural land area with an area of 53x76 M. The land is quite large and close to people's houses, so that the period from construction to maintenance of the pendaliman will be easier together with the residents of Podorejo sub-district. A simple scheme will be designed using Shop Drawings whose materials are adapted to the land area, soil characteristics, soil quality, drainage and irrigation, as well as accessibility to the mendalima's needs.

d Mendalima Development

After obtaining a detailed project plan in the form of designing a mendalima scheme , construction is then carried out starting from land preparation by clearing the land, preparing the soil, and arranging the irrigation system, then acquiring all the necessary equipment, including construction materials for the Mendalima and carrying out the construction of the mendalima in accordance with the design and specified specifications. The construction of the pest control tower will be carried out during August-September 2023 with assistance from the people of Podorejo Village.

## Results

a **Location of agricultural land for the construction of pest control towers**

Activities are carried out with regional officials to obtain approval from the Village Head and the community. This survey was also carried out to determine conservation areas and efforts to obtain approval and establish cooperation in utilization from the owner with the Chair of the Sido Makmur Farmers Group . Apart from that, there is a socialization program that can increase sympathy and open up farmer members to ask for help with participation from the surrounding community.

The results of the survey of the selected location are that pest control towers will be built in strategic areas, easy to access, easy to reach, and make it easier for farmers to carry out their activities. The agricultural land used is precisely in Podorejo Village RT 03 RW 10, Ngaliyan District, Semarang City. Land for the Mendalima to be built meets several characteristics, such as close proximity to the main agricultural land that wants to be protected, land that is relatively flat or sloping is easier to build the Mendalima, and there is an adequate irrigation system to provide water for the plants in the Mendalima.

**b Needs Assessment FGD**

After carrying out a location survey with the people of Podorejo Subdistrict and determining the conservation land where Mendalima will be built, a Needs Assessment FGD or form of socialization was carried out to request approval for the development of Mendalima with the community and stakeholders of the Podorejo Subdistrict area. The socialization event was held in July 2023, and the result was that the community and stakeholders in the Podorejo Village area agreed and were very happy with the construction of the pest control tower. It was also agreed that the chairman of the Sido Makmur farmer group would be the person in charge who would take part in leading the construction of Mendalima and this would take place within 1 month.

The FGD activities were formed with outreach to the community, discussing the existence of the Ormawa Capacity Strengthening Program, the function of establishing the Pest Control Tower, asking for support from targets and a question and answer session between the Ormawa PPK Team, Partners (Agriculture Service) and the Podorejo Village community. This needs assessment FGD was attended by 15 members, accompanying lecturers, Plant Pest Organism Observer Officers (POPT), Field Agricultural Instructors (PPL), heads of farmer groups and 8 members of farmer groups.

**c Designing a scheme for building a Pest Control Tower**

Designing a pest control tower construction scheme is a complex process and must consider various factors, including the type of pest to be controlled, geographical location, size and shape of the tower, and the technology to be used. Based on the results obtained, a plan was created for the construction of Mendalima located in Podorejo Village, namely:

- Identification of pest types, Determining the type of pest you want to control as an approach in designing pest control towers. Pest identification is an important step in designing a pest control tower, with a program that focuses on vertebrate pests, such as mice, which can damage plants by digging holes and eating roots or fruit.  
In addition, the focus of this program states that some birds can become pests because they tend to eat fruit or plant seeds, thereby threatening crop yields and agricultural productivity in general. By identifying these vertebrate pests clearly and completely, we will be able to develop appropriate and effective control strategies in designing pest control towers to protect agricultural crops from these threats.
- Location and site survey, 50M empty agricultural land was determined as Mendalima development land.  
The location or empty land is determined because it is close to the infested area to ensure effective control and is easily accessible so that monitoring and maintenance activities can be carried out more effectively.
- Tower design plans, in designing a pest control tower, carefully consider various factors, including the size of the tower that is appropriate for the area to be protected, the shape of the tower that is most effective in dealing with specific pests, construction materials that are durable and suitable for environmental conditions, and necessary facilities inside the tower, such as monitoring and maintenance devices. In designs made using *shop drawings*.
- Selection of control technology, in this program the team selects technology, licenses and regulations. It is important to carry out a thorough inspection of all permits and legal requirements that apply to the pest control tower construction project. This process requires coordination with local environmental institutions or related government institutions.
- Maintenance and monitoring, in the process of completion of construction, there needs to be the development of a monitoring and maintenance plan related to equipment, work systems, and monitoring the effectiveness of tower control measures.
- Education and training, Providing training for targets and those responsible for the operation and maintenance of pest control towers. So, we can be sure that people understand how to use control technology correctly.

- Evaluation and improvement: Always evaluate the performance of the pest control tower. If there are weaknesses or changes in environmental conditions, you can consider efforts to improve the design or control technology.
- Information and communication, Communicate with relevant stakeholders, such as farmer leaders and groups, sub-district government institutions, RT/RW, and the Podorejo sub-district community to provide information about the benefits of pest control towers and overcome any concerns that may arise.

Each design stage of a pest control tower construction project must be carried out carefully and consider relevant environmental and social factors. It is also important to consult with experts in agriculture, the environment and pest control technology to ensure the success of the project.

#### **d Construction of Pest Control Towers**

Based on the results obtained in the design for the construction of the mendalima, the construction process was then carried out with the building foundation stage by the Ormawa HMKM PPK Team and the farmers. The selection of materials used for building foundations is based on the use of materials that are suitable for the conditions of the rice fields. This foundation selection uses materials such as cement, sand and bricks. The construction process begins by digging 50 cm deep in the paddy field, totaling 4 holes. Then build the foundation by arranging bricks with cement and sand from the bottom of the excavation to a height of 1 meter. Then the foundation is plastered and plastered so that it has a smooth surface. After forming a solid foundation, the next process is installing light steel on the foundation by cutting and connecting bolts and nuts so that the resistance is very strong. The installation of the light steel has been adjusted to the design of the placement of tools and systems according to the layout, the work was carried out for 5 days.

Next, install the system by connecting existing tools such as a controller, converter, adapter, VRLA12v 100ah battery which can be recharged via 2 100wp solar panels and a water pump. Then the system is programmed with Arduino software as a power supply to run the watering system which is controlled via an ESP 32 microcontroller. The final process is assembling the paralon according to the existing rice fields. The paralon is equipped with a sprayer which is useful for spraying liquid fertilizer and pesticides in caring for rice plants.

## **Conclusion**

The construction of a Pest Control Tower (MENDALIMA) in Podorejo Village, Ngaliyan District, Semarang City, Central Java Province is a program that aims to increase the effectiveness of pest control and continuous monitoring of rice plants. This reform was implemented to help farmers, especially the Sido Makmur Farmers Group, Podorejo Village, in overcoming obstacles in farming activities.

In the MENDALIMA development process, it is carried out in accordance with ongoing activities, namely (1) Location Survey of agricultural land for the construction of a pest control tower, (2) Focus Group Discussion (FGD) Needs Assessment, (3) Design of a scheme for the construction of a Pest Control Tower, (4) Construction of Pest Control Towers. Apart from that, the construction process also includes physical stages, such as making foundations, installing light steel as supports, and automatic control using a programmed system.

The development of MENDALIMA is a collaboration between stakeholders, including the Ormawa HMKM PPK Team, the Sido Makmur Farmers Group, the Podorejo Subdistrict regional government and the Semarang City Agriculture Service. FGD (Focus Group Discussion) and outreach were carried out to ensure support and approval from the local community.

With the MENDALIMA system working, it is hoped that farmer groups in Podorejo Village can control pests more effectively and efficiently. It is also hoped that the pest control tower can help reduce the workload and health impacts of farmers due to manual use of pesticides.

Evaluation of programs with targets in line with achievements, that is, must be an ongoing process involving monitoring to ensure that MENDALIMA is functioning as intended and delivering the expected

benefits. The results of this evaluation can be used to identify areas of improvement and make decisions about future expansion or enhancement of the project.

## Funding

This research was funded by the Directorate General of Higher Education, Research and Technology (Ditjen Diktiristek) through the Directorate of Learning and Student Affairs (Belmawa) and Dian Nuswantoro University College with the main aim of increasing the ability of the Public Health Student Association Student Organization at Dian Nuswantoro University in managing various the process of activities in it, especially the construction of a Pest Control Tower based on Smart Farming . The funds provided by Belmawa and PT will be used to organize a series of development, training, coaching and other development activities that will develop the Public Health Student Association Student Organization to better achieve its goals.

## Acknowledgments

The team would like to thank all parties who have supported and contributed to the research and development of this activity. The achievements that have been achieved in optimizing rice farming productivity in Podorejo Village and the construction of the Pest Control Tower (Mendalima) for the Sido Makmur Farmers Group will not be possible.

The financial support, knowledge and technical assistance that has been received are the main drivers of the success of this project. Smart Farming and Sprinkler Sprayer technology has provided innovative solutions for our rice farming, increasing yields and making a positive impact on the community economy. It is hoped that the team is committed to continuing to maximize the benefits of this activity and providing a sustainable positive impact on the Podorejo Village community and the Sido Makmur Farmers Group.

## Reference

- ikp, b. (2022). *Land is shrinking, Central Java's agricultural production is actually increasing* . 03 DECEMBER 2022. Retrieved 06 October 2023 from <https://jatengprov.go.id/publik/lahan-pemempit-produk-pertanian-jateng-justru-meningkat/>
- Juniwati, J., Lestari, Y., & Yetti, H. (2022). Analysis Of Controlling Pesticide Exposure In Farmers. *Journal of Health* , 13 .
- Miana, V. M., & Suraji, C. (2020). Pesticide Use Is Associated with Skin Irritation in Rice Farmers. *Permas Scientific Journal: STIKES Kendal Scientific Journal* , 10 (1), 51-56.
- Pratama, DA, Setiani, O., & Darundiati, YH (2021). Literature Study: The Effect of Pesticide Exposure on Farmers' Health Disorders. *Bandung Department of Health Polytechnic Health Research Journal* , 13 (1), 160-171.
- Purbowati, E., Mulatsih, RT, & Surahmanto, S. (2003). Empowering Farming Communities With The Application Of Local Feed-Based Cattle Fattening Technology In Podorejo Village, Ngaliyan District, Semarang City.
- Rohimah, U. (2017). Factors Influencing Lowland Rice Production in New Opened Rice Fields (*Oryza sativa* L.)(Case Study of Sindangasih Village, Cikatomas District, Tasikmalaya Regency-West Java). *Agritas Scientific Journal* , 1 (2).
- Ruvananda, AR, & Taufiq, M. (2022). Analysis of factors influencing rice imports in Indonesia. *Performance* , 19 (2), 195-204.
- Wulandari, S. (2023). *Design And Construction Of a Plant Pest Removal Tool Using IoT Based Light Trap* [Diponegoro University].