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# Technological Mushroom Cultivation as a Means of Food Security In Supporting Natural Disaster Resilience

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**Abstract:** West Nusa Tenggara is a region prone to natural disasters, requiring strategies to strengthen food security as part of efforts to build community resilience. One potential alternative is mushroom cultivation based on simple technology. This community service activity aims to introduce and implement a technologically advanced mushroom cultivation model to support food security and disaster resilience in Sembalun Bumbung Village, East Lombok. The method used was participatory training with a learning-by-doing approach, involving the local community in all stages of mushroom cultivation, from media preparation and sensor-based environmental control to harvesting and post-harvest. The results of the activity showed that most participants initially lacked knowledge of mushroom cultivation, but after the training, there was an increase in interest and understanding of the economic and consumption benefits of mushroom cultivation. The implementation of mushroom houses with technology to monitor temperature, humidity, lighting, and biogas utilization was deemed effective and easily adopted by the community. Technologically advanced mushroom cultivation has the potential to become an adaptive and sustainable local food source, thus supporting food security and community resilience in the face of natural disasters.

**Keywords:** Mushroom House, Straw Mushroom, Technological Cultivation, Food Security, Disaster Resilience.

## Introduction

Indonesia, located on the Pacific Ring of Fire, is highly vulnerable to various natural disasters, such as earthquakes, volcanic eruptions, landslides, and extreme climate change. One area with a high level of vulnerability to these disasters is Sembalun Regency, particularly Sembalun Bumbung Village, located at the foot of Mount Rinjani. When natural disasters occur, access to food sources is often disrupted, leading to significant nutritional and socio-economic vulnerability for local communities.

In this context, food security is a crucial aspect that must be strengthened, not only during normal times but also as an adaptive strategy during disasters. One potential alternatives solution is the development of mushroom cultivation, particularly oyster mushrooms or wood ear mushrooms, which have high nutritional value, a relatively short harvest period, and can be cultivated in limited space and under controlled environmental conditions.

However, successful mushroom cultivation is highly dependent on microclimatic conditions such as temperature, humidity, air pressure, and lighting. Therefore, the application of sensor-based technology for real-time monitoring of environmental parameters is important in increasing the productivity and sustainability of this business. Sensor technology can assist local mushroom farmers in maintaining ideal growing conditions while facilitating the learning process and technology transfer to the community.

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This community service activity, conducted by the Disaster Mitigation Study Program at the University of Mataram, aims to introduce a simple technology-based mushroom cultivation model as a form of local innovation to support food security and community resilience to disasters. This approach is expected to provide sustainable solutions that not only increase community income but also strengthen community preparedness in facing potential crises due to disasters.

Sembalun Bumbung Village, located at the foot of Mount Rinjani, is a region rich in natural resources but highly vulnerable to disasters, such as earthquakes, landslides, and extreme weather. In this context, food security is a crucial aspect in building community resilience in the face of disasters (BNPB, 2020).

Cultivating button mushrooms (Agaricus bisporus) is a strategic alternative solution. Besides being nutritious and having high economic value, these mushrooms can also be cultivated indoors with limited land and relatively easy environmental controls (Putri et al., 2022). Button mushrooms were chosen because they are highly economically valuable, nutritious, and suitable for cultivation in cool areas like Sembalun. Furthermore, these mushrooms do not require large areas of land and can be cultivated indoors. This makes them a resilient option in post-disaster emergencies, when agricultural land is damaged or difficult to access.

## Method

This activity involved 20 local participants, who were trained in a participatory approach at a prepared cultivation site. The training used a "learning-by-doing" approach, with participants directly involved in all stages of mushroom cultivation.

Instructional delivery is done through:

1. Interactive lectures and discussions on the basics of mushroom cultivation and their resilience to food risks.
2. Direct practice starting from media preparation, seed inoculation, daily care, to harvesting.
3. Simulation of the use of technological tools, including how to read sensors and interpret data.

The participants were given a questionnaire with questions related to their knowledge and interest in mushroom cultivation, as well as observing how mushroom cultivation is carried out in the mushroom house, with mushroom experts from Yogyakarta. They also participated in a festival showcasing a variety of mushroom-based cooking methods. On the occasion of the following 2 months, at the end of the activity, training participants were invited to receive a briefing from the NTB provincial Industry and Trade Center to get information on how mushroom harvests can be preserved and packaged for sale in the market.

## Result and Discussion

This community service activity was held at the At-Tazkiyah Qur'an House in Sembalun, near the foot of Mount Rinjani, East Lombok. A facility has been built there, serving as a Sembalun mushroom house, for mushroom cultivation (Figure 1).


**Figure 1.** Location of the technological mushroom cultivation service

Interviews with a number of participants for the mushroom cultivation training revealed data showing 24 participants, consisting of 10 from Sembalun Lawang and 14 from Sembalun Bumbung. They were asked questions related to their knowledge of mushroom cultivation, their interest in mushroom cultivation, and the benefits of mushroom cultivation. The results of these three questions are shown graphically in Figures 2, 3, and 4.

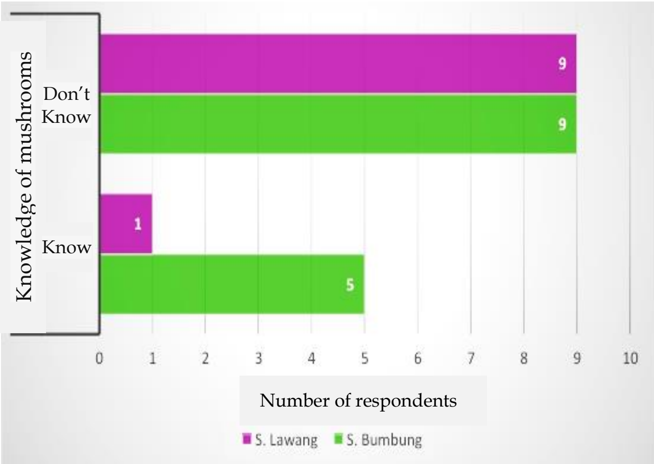


**Figure 2.** Knowledge of Mashroom

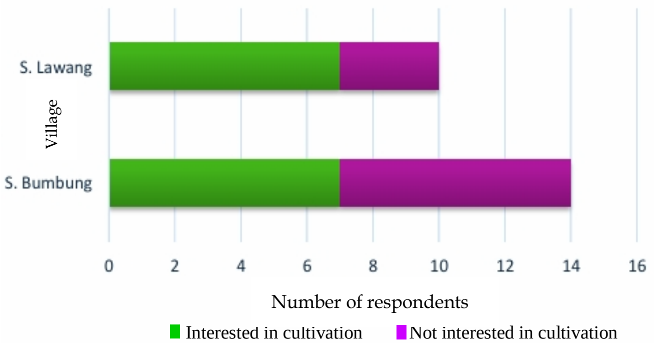


**Figure 3.** Interest in Mushroom Cultivation.

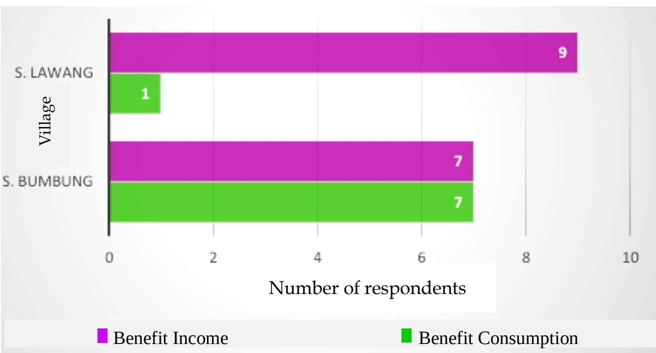


**Figure 4.** Benefits of mushroom cultivation

Based on the information from the graph above, it shows that in Figure 2, the participants from both Sembalun Lawang and Sembalun Bumbung, most of them do not know how to cultivate mushrooms. It turned out that out of 24 participants, 18 people didn't know. In the graph in Figure 3, it shows that there are 14 people who are interested and 10 people who are not interested. Meanwhile, regarding their opinions about the benefits of mushroom cultivation, Figure 4 shows that 16 people hope to increase income and 8 people for personal consumption only. However, they were still given guidance on how to cultivate mushrooms.

During the training session, participants were introduced to the stages of mushroom cultivation in stages:

1. Introduction to planting materials and media, such as straw compost and fermented manure.
2. Sterilization of the planting media, either manually or using hot steam from biogas.
3. Inoculation of button mushroom seedlings, using hygienic techniques to prevent contamination.
4. Daily maintenance, including temperature (20–25°C), humidity (85–90%), and lighting.
5. Monitoring with digital sensors, including recording changes in parameters as part of the learning process.
6. Harvesting and post-harvesting, including how to sort and package mushrooms for high sales value.

During the community service activities, a cooking festival was held, using mushrooms as the main ingredient. Mushroom cooking groups were formed and competed, with prizes awarded to the most popular mushroom dishes. The mushroom cooking competition is shown in Figure 5.

**Figure 5.** Team Mushroom Competition

The culinary results were displayed indoors to be assessed by a team of judges, while there was also counseling from mushroom experts from the Mount Merapim Yogyakarta Mushroom Community, as shown in Figure 6.


**Figure 6.** Mushroom cultivation counseling and marketing methods

*Button Mushroom Cultivation Stages*

The initial stage of button mushroom cultivation begins with the preparation of a growing medium consisting of compost, a mixture of straw, manure, and other fermented additives. The main ingredients used include rice or wheat straw, chicken manure, lime ($CaCO_3$), and bran. All ingredients are mixed in a ratio of 70% straw, 20% chicken manure, 5% bran, and 5% lime. Then, the compost is watered sparingly and stirred every two days for 14–21 days until the fermentation process is complete. Mature compost is characterized by a change in color to blackish brown, no pungent odor, and a decrease in media temperature (Rahayu & Sutedjo, 2019).

The mature growing medium then undergoes pasteurization or sterilization to eliminate pathogenic microorganisms that could potentially interfere with mushroom growth. This process involves placing the medium in a plastic rack in the growing room or drum, then heating it using steam from a biogas stove or simple boiler for 6–8 hours at 60–70°C. After the heating process is complete, the medium is allowed to cool for one day before inoculating the seedlings (Nasution & Suwondo, 2023).

Inoculation was performed using F3 button mushroom seeds as ready-to-plant seedlings. The seeds were sprinkled evenly over the growing medium to a depth of approximately 2–3 cm. The entire inoculation process was carried out hygienically using sterile gloves and in a clean room to minimize the risk of contamination. After planting, the medium was covered with plastic or gauze for the incubation period (Putri & Hartono, 2022).

The incubation stage is the growth phase of the fungal mycelium, lasting 14–21 days, depending on environmental conditions. Incubation is carried out at an optimal temperature of 22–25°C, with an air humidity level of 85–90%, and low lighting conditions or a dark room. During the incubation period, temperature and humidity parameters are monitored daily using digital sensors. Success in this stage is indicated by the growing medium being covered with white, cotton-like fungal mycelium (Kartika & Wijaya, 2021).

After the mycelium has grown evenly, the media enters the fruiting body formation stage. At this stage, the media is given a 2–3 cm thick casing soil mixture of soil and sterile lime. Environmental settings are adjusted by lowering the temperature to 16–20°C and increasing the lighting intensity to 150–300 lux, while maintaining high humidity through fine spraying. Environmental conditions are monitored using a light sensor and digital thermometer to ensure compliance with the growth requirements of the mushroom fruiting bodies (Iswanto & Trisnawati, 2020).

Button mushrooms are generally ready to harvest 30–40 days after the first inoculation. Harvesting is done before the mushroom caps have fully opened, approximately 3–5 days after the fruiting bodies emerge. Harvesting is best done in the morning by gently plucking the mushrooms without cutting the base. To extend their shelf life, harvested mushrooms are stored at a low temperature, around 4–5°C (Rukmana, 2014).

All stages of button mushroom cultivation in this activity are supported by a simple technology-based monitoring system. The equipment used includes sensors for temperature, relative humidity (RH), air pressure, and light intensity, connected to an external digital display to display the environmental conditions of the mushroom house in real time. Furthermore, a biogas-powered space heater utilizes organic waste from cow dung as an energy source, which maintains temperature stability, especially at night, given Sembalun's relatively cool climate (Rahman, Hidayat, & Sulastri, 2021).

This technological innovation in the mushroom house is also equipped with a pH meter to control the acidity level of the growing medium within the optimal range of 6.5–7.5, as well as a light intensity meter to ensure appropriate lighting for each phase of mushroom growth. The application of this technology not only increases productivity and crop quality but also serves as an educational tool to introduce the concept of precision agriculture to rural communities through a simple and easy-to-adopt data-driven smart farming approach (Nasution & Suwondo, 2023).

Through this series of technology-based button mushroom cultivation trainings, the community not only gained technical skills but also raised awareness of the importance of food security as part of efforts to build family and community resilience in the face of disaster risks. In emergencies when food distribution is disrupted, locally and sustainably produced mushrooms provide an adaptive alternative food source. With the support of simple technology and community collaboration, Sembalun Bumbung Village demonstrates the potential to develop as a disaster-resilient village based on local food security.

## Conclusion

Based on the results of community service activities carried out in Sembalun Bumbung Village, it can be concluded that mushroom cultivation based on simple technology has significant potential as a strategy to strengthen food security and support community resilience to natural disasters. The implementation of mushroom houses with the support of environmental monitoring technology, such as temperature, humidity, and lighting sensors, as well as the use of biogas for media pasteurization, has been proven to increase the effectiveness of the mushroom cultivation process and serve as an educational tool for the local community.

Based on the results of community service activities carried out in Sembalun Bumbung Village, it can be concluded that mushroom cultivation based on simple technology has significant potential as a strategy to strengthen food security and support community resilience to natural disasters. The implementation of mushroom houses with the support of environmental monitoring technology, such as temperature, humidity, and lighting sensors, as well as the use of biogas for media pasteurization, has been proven to increase the effectiveness of the mushroom cultivation process and serve as an educational tool for the local community.

With the characteristics of mushrooms that are easy to cultivate, have a relatively short harvest period, and do not require large areas of land, technological mushroom cultivation can be an adaptive local food alternative in post-disaster conditions. Therefore, the development of mushroom cultivation in a sustainable and massive manner has the potential to become one of the pillars of food security and disaster resilience in disaster-prone areas such as Sembalun Bumbung.

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