Vol. 9., No. 2, August 2025, pp. 56-62

ISSN 1978-0524 (print) | 2528-6374 (online)

Enhancing the capacity of tray integrated with spice drought detector at Koperasi Wahana Mandiri spice processing house

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Received 12 November 2024; accepted 8 May 2025; published 13 August 2025

ABSTRACT

Koperasi Wahana Mandiri Indonesia (WMI) produces processed herbal products with a processing house for spices such as red ginger, emprit ginger, turmeric, and temu lawak. One of the problems faced by Koperasi WMI is the limited drying capacity. The community service project conducted by Universitas Ahmad Dahlan (UAD) aims to increase the production of processed spices of Koperasi WMI by applying multilevel trays and dryness detection devices on solar dome dryers. The project unfolded in three stages: preparation, implementation, and mentoring. This activity empowers 11 members of the Koperasi WMI and involves MPM PWM DIY and MPM PDM Kulonprogo as collaborator partners who will assist and ensure the program's sustainability. The main activity is to apply technology by constructing multilevel trays and drought detectors. After the tray was made, training on the integrated multilevel tray with drought detector was conducted. The drought detector was simulated to determine the indicator that will light up when the dried material is completely dry with a moisture content of less than or equal to 12%. This activity has successfully installed multilevel trays and drought-detection devices. The construction of the multilevel trays succeeds in processing spices of Koperasi WMI from 200 kg to 400 kg.

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KEYWORDS
Koperasi WMI
Spice
Tray
Drought detector
Solar dome drying

1. Introduction

Indonesia boasts an abundance of natural resources that are pivotal for driving inclusive and sustainable economic growth. This potential aligns perfectly with global development initiatives centered around the Sustainable Development Goals (SDGs) [1]. Among its outstanding natural products, Indonesia's spices stand out as a critical asset [2]. The country's rich history is intricately tied to the spice trade [3]–[5]. Indonesia is well-positioned to become a leading global supplier of spices, which could significantly boost its economy through strong export activities [5], [6]. The Central Statistics Agency (BPS) reported that in 2020, the total export of spices, medicinal plants, and aromatics reached an impressive 275,300 tons, valued at around $618.4 million. This underscores Indonesia's significant capacity in the global spice market [7]–[9].

Ginger, a notable biopharmaceutical spice, has shown notable export dynamics in recent years. In 2020, ginger exports reached 183.52 thousand tons, largely driven by its use as an alternative ingredient to boost immunity during the COVID-19 pandemic. The following year, 2021, saw a significant surge in ginger exports, which increased to 307.24 thousand tons—representing a 67.42% rise compared to 2020 [10].

Vol. 9., No. 2, August 2025, pp. 56-62 ISSN 1978-0524 (print) | 2528-6374 (online)

Koperasi Wahana Mandiri Indonesia (WMI) is a producer of processed herbal products with a processing facility located in Gerbosari Village, Samigaluh, Kulonprogo, Yogyakarta. The Koperasi aims to enhance the local economy by producing various spices, including red ginger, emprit ginger, turmeric, lemongrass, temu lawak, cardamom, and more. The workforce at WMI consists of widows from the surrounding community who contribute to the cooperative's production efforts.

Drying simplisia (raw plant material) is a significant challenge in spice processing [11]. Solar energy presents an abundant, safe, and environmentally friendly alternative energy source for this process [12]. Properly dried products are more suitable for storage and transportation, allowing them to remain marketable for a longer time. The primary goal of drying is to reduce the moisture content of the product to a level that prevents degradation during a specific timeframe, often referred to as the "safe storage period" [13]–[16].

At Koperasi WMI, several issues related to production and management have been identified. Although there is a high demand for simplisia products, the drying capacity is currently limited. Additionally, the process of checking the dryness level of the dried spices is still performed manually. As a result, spices that are not optimally dried are prone to mold growth, leading to poor quality. This project aims to enhance the production of processed spices at the Koperasi WMI by implementing multilevel trays and dryness detection tools in solar dome dryers. With these improvements, it is expected that the Koperasi WMI will be able to increase its production capacity for completely dry spices.

2. Method

This community service activity was conducted in three stages: preparation, implementation, and mentoring and evaluation. In the preparation stage, we made an initial visit to the Koperasi WMI, established the schedule for program implementation, and conducted a debriefing session for the students. During the implementation stage, we conducted socialization efforts, applied technology, and provided training. The details of these three stages are explained below:

2.1. Preparation

The preparation for the program began with a visit to the Koperasi WMI to gather information and investigate the issues it was facing through interviews. The personnel from the Koperasi WMI involved in these interviews included the head of the cooperative, the manager of the production house, and several production team members. Meanwhile, the service team also engaged in thorough preparation and debriefing. Their activities included coordinating with the Koperasi WMI about the technical program to be implemented. The team meticulously outlined the stages of program implementation, including a mutually agreed-upon date with the Koperasi WMI.

Students involved in the program underwent a debriefing to clarify their roles and responsibilities. They also received training to understand the technical aspects of the program, particularly the solar dome dryer drying process, which incorporates an integrated drought detection tray, as well as the application's services, governance, and market networks that will be introduced to the Koperasi WMI. To facilitate the launch of this program, the team coordinated with CV Agradaya Indonesia, PT Pelabuhan Indonesia, MPM PWM DIY, and MPM PDM Kulonprogo as collaborative partners to ensure the program's sustainability.

2.2. Implementation

The stages of implementing the service program are carried out through socialization, technology application, training, mentoring, and evaluation. The details of the implementation stages carried out are described as follows:

2.2.1. Socialization

During the first month of the service program, a socialization event was held to explain the initiatives that the service team would implement at the Koperasi WMI. This included the application of integrated

ISSN 1978-0524 (print) | 2528-6374 (online) Vol. 9., No. 2, August 2025, pp. 56-62

drought detection multilevel trays, service application systems, governance, and market networks. The socialization involved the service team, management from the Koperasi WMI production house, and all Koperasi WMI members. Additionally, representatives from the village, hamlet, RW (neighborhood associations), and RT (community units) were invited as guests. The presence of these local government officials is crucial for the program's sustainability and is expected to facilitate relevant policies regarding spice cultivation and its processing in Kulonprogo.

Collaborator partners, including MPM PWM DIY and MPM PDM Kulonprogo, were also invited to assist in ensuring the program's success and longevity. During the socialization, participants were informed about the integrated drought detection multilevel trays, emphasizing their potential to increase production. Similarly, the service application system, governance, and market networks were discussed to enhance business management effectiveness.

The socialization event also provided an opportunity for participants to share their feedback on the features of the applied technology. It is hoped that through this initiative, the technology will be fully embraced by the beneficiary partners (Koperasi WMI), collaborator partners, and other stakeholders.

2.2.2. Technology Implementation

The technology implementation process consists of several sub-activities, including the manufacturing of multi-level trays, drought detectors, and application systems. The production of the multi-level trays and drought detectors took place from month 2 to month 3. Concurrently, the development of the application system was conducted from the 3rd month to the 4th month. This parallel construction of the multi-level trays and drought detectors was essential to ensure their effective integration.

From the 2nd to the 4th month, the technology integrating the multi-level trays with the drought detectors and the application system for services, governance, and market networking was implemented at the Koperasi WMI. The integrated drought detection systems were embedded in the trays installed within the Koperasi WMI drying house.

2.2.3. Training

Once the tool application is completed and confirmed to be functioning properly, the next step is training. This training took place in the fifth month and involved the following personnel: the service team, the manager of the production house, the management of the Koperasi WMI, and all members of the Koperasi WMI.

The first training session focused on operating the integrated drought detection multilevel tray. This part of the training was brief, as the specifications of the new tray are similar to those of the existing trays. However, the training on the drought detector was conducted more intensively, with a strong emphasis on its operation and adjustment based on the types of commodities being dried. During this session, the dryness detector was simulated to demonstrate how its indicator lights up when the dried material reaches a moisture content of 12% or less, indicating that it is completely dry.

2.3. Mentoring and Evaluation

Mentoring activities take place after the technology has been applied and training has been completed. This process occurs from the 5th to the 8th month. During these four months, it is expected that the WMI Cooperative, as a partner, will effectively use the integrated multilevel tray technology with a dryer detector. Additionally, this period will involve evaluating the implemented technology and other related activities. The service team will provide additional sessions if further training is deemed necessary. Similarly, if any issues arise with the applied technology, the service team will address and resolve them as quickly as possible.

The service activities conducted have proceeded smoothly. During the preparation stage, several discussions were held with the Koperasi WMI to outline the program implementation plan. Additionally, training sessions for students successfully enhanced their understanding of the technical drying process

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using a solar dome dryer, which includes an integrated tray to monitor dryness levels. Furthermore, students received training on service duplication, governance, and market networking.

In the socialization activities, village, hamlet, RW (Rukun Warga), and RT (Rukun Tetangga) officials were invited as guests. The involvement of these government officials is crucial for promoting the sustainability of the program and is expected to lead to the development of policies related to spice cultivation and processing in Kulonprogo. This socialization also included collaborations with MPM PWM DIY and MPM PDM Kulonprogo, who are providing support to ensure the program's long-term viability. The socialization of the application of integrated drought detection multilevel trays was explained to the participants by emphasizing to increase in production. In the socialization of the application of the technology, there was an opportunity for participants to provide input related to the features of the technology applied. Through socialization, it is expected that the applied technology can be fully accepted by the beneficiary partners, collaborator partners, and stakeholders.

3. Results and Discussion

3.1. Manufacture of Multilevel Trays and Drought Detection Devices

The multilevel trays and the drought detection device were constructed from August 27 to September 21, 2024. Previous research studies have informed us of the design and technical specifications for the trays [17]–[20]. During the manufacturing process, the team engaged in discussions with technicians and members of the Koperasi WMI.

The trays and drought detection devices were produced in the UAD workshops and laboratories, while their installation took place at the WMI Cooperative's production facility in Kulonprogo (Fig. 1). The proposing team was responsible for calculating the materials needed and designing the trays. Students assisted technicians in both the manufacturing and installation processes at the WMI Cooperative. Additionally, partners provided guidance on the specifications to ensure that the sizes matched the pre-existing trays.

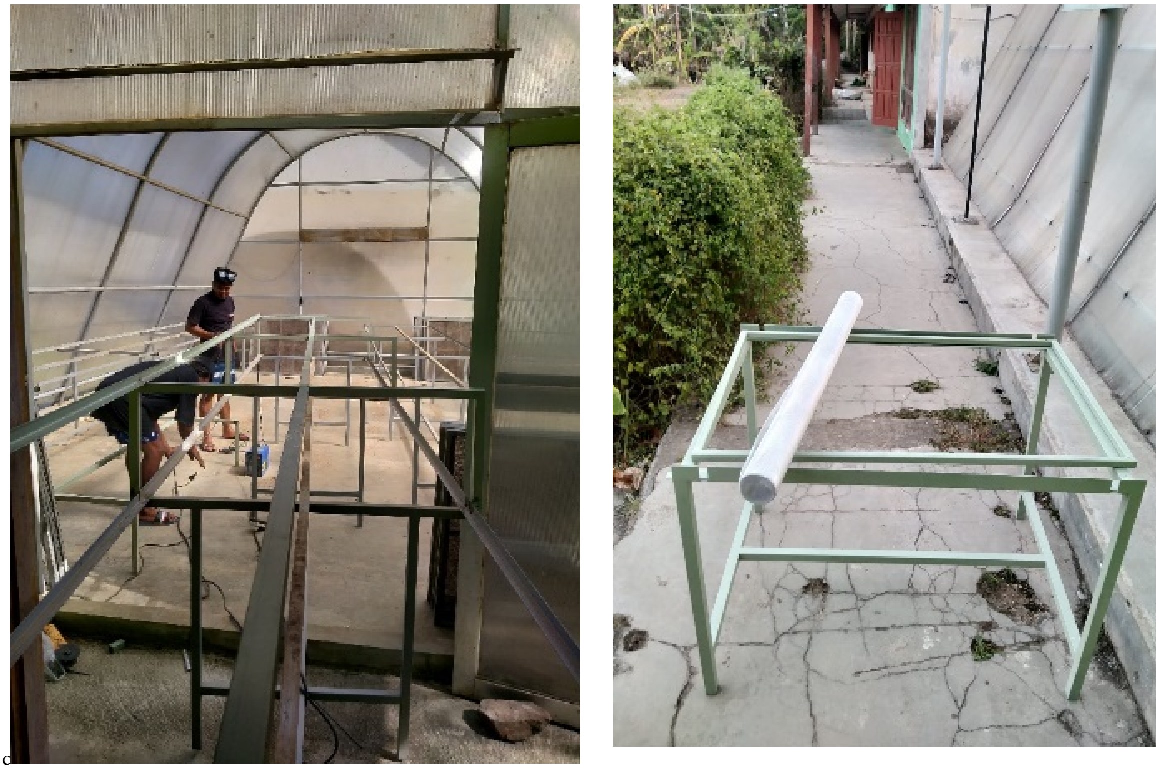

Fig. 1. Documentation of the construction of the multilevel tray and drought detection device

ISSN 1978-0524 (print) | 2528-6374 (online) Vol. 9., No. 2, August 2025, pp. 56-62

As a result of these collaborative efforts, the multilevel trays have been fully installed. However, the student team is still finalizing the drought detection device. Documentation of the activities related to the construction of the multilevel trays and the drought detection tool is displayed in Fig. 2.

Fig. 2. Utilization of multi-level trays for drying spices

3.2. Delivery of System Implementation to the Community

The products delivered to the community, specifically the Koperasi WMI, include hard and soft technology innovations: a multi-level tray integrated with a drought detector and a business management information system. The specifications of the multi-level tray are detailed in Table 1.

Table 1. Tray Specification

Specification	Description
Dimension	P:100 cm, L: 100 cm
Quantity	24 pcs
Capacity	@2 kg
Additional feature	Drought level detector

With the installation of the multi-level trays, spice production increased twofold, rising from 200 kg to 400 kg. This result aligns with the initial goal of using multi-level trays to enhance spice production. Additionally, the drying time of the product has been reduced due to a continuous drying process. An optimal combination of design and operational methods for the drying system is crucial for achieving better product quality.

3.3. Partner Participation in Program Implementation

Koperasi WMI plays an active role as a partner in implementing this service activity. This involvement includes providing the service location and engaging partner members in various activities. A total of 11 partner members participated in discussions with the implementation team and participated in socialization and mentoring activities. In the process of utilizing integrated multilevel tray technology along with a drought detection device, the WMI Cooperative prepared the location, gathered raw materials for the spices, and handled the cleaning and slicing of the materials until they were ready for drying. Additionally, the WMI Cooperative assembled a team of technicians who are available to assist with training and the operation of the multilevel trays integrated with drought detection tools.

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3.4. Evaluation of Program Implementation

The evaluation of the program implementation is conducted through several methods. The primary method is a monthly evaluation (Fig. 3). After the program for implementing integrated multilevel tray technology for drying detection and training has been conducted, the service team carries out routine evaluations every month. These evaluations involve monitoring the operational processes of the technology by the Koperasi WMI's team. The observed parameters include the Standard Operating Procedures (SOP) for the spice drying operation, as well as an assessment of the dried spices to determine the success of the drying process carried out by the Koperasi WMI.

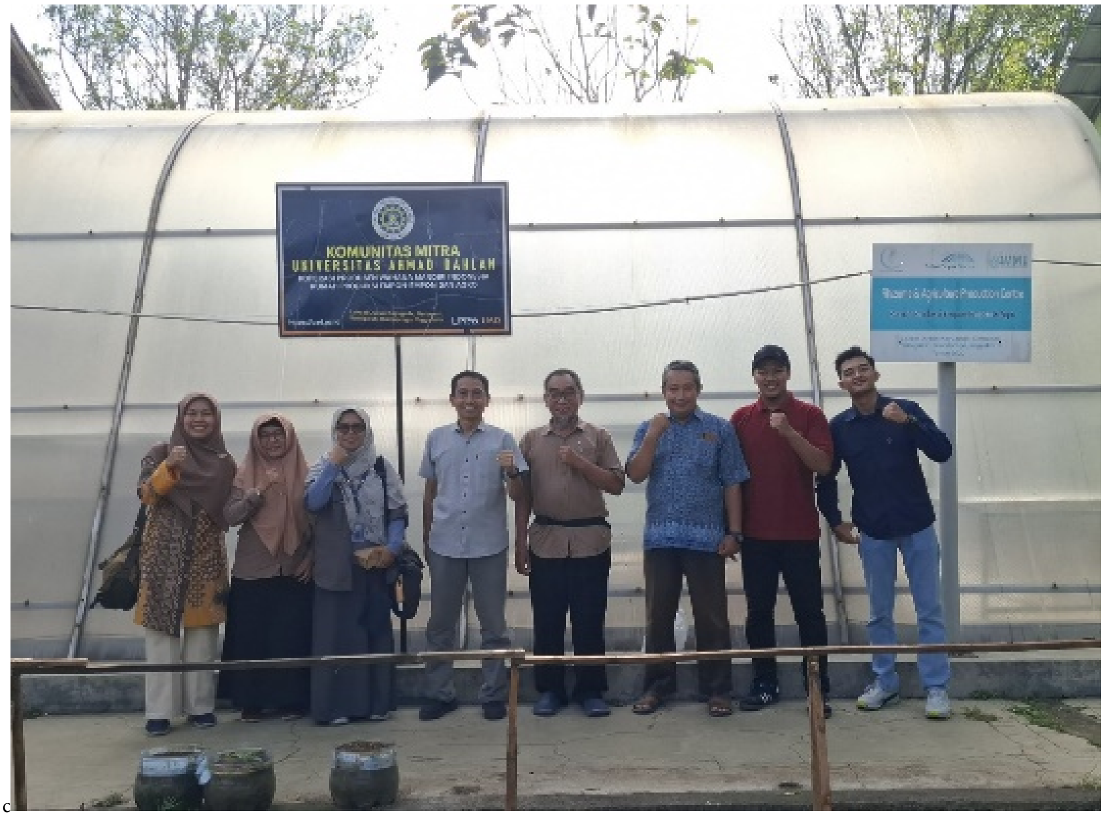

Fig. 3. Evaluation of program implementation

4. Conclusion

Implementing multilevel trays and dryness detection tools in solar dome dryers enhances output dry spices of Koperasi WMI from 200 kg to 400 kg. With these improvements, it is expected that the Koperasi WMI will be able to increase its production capacity for completely dry spices.

Acknowledgment

We appreciate the financing provided by DPPM of Ministry of Higher Education, Science, and Technology of the Republic of Indonesia which has funded the Community Service program for the year 2024 with Contract No: 068/E5/PG.02.00/ PM.BATCH.2/2024.

Declarations

Author contribution. All authors contributed equally to the main contributor to this paper. All authors read and approved the final paper.
Funding statement. None of the authors have received any funding or grants from any institution or funding body for the research.
Conflict of interest. The authors declare no conflict of interest.
Additional information. No additional information is available for this paper.

ISSN 1978-0524 (print) | 2528-6374 (online) Vol. 9., No. 2, August 2025, pp. 56-62

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