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Implementation of Hygienic Solar Drying Technology to Increase Sales Turnover of Melinjo Chips MSMEs

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ABSTRACT

The constraints of MSMEs emping melinjo are on the supply side, where the increase in demand for melinjo chips cannot be matched by production capacity. Production capacity is highly dependent on the drying process. The drying process of emping melinjo is highly dependent on the season. In addition to requiring a relatively long time, emping melinjo is easily contaminated by microbes, making it unhygienic. Related to the constraints faced by MSMEs, the drying process must be improved so that the drying process is fast and hygienic by implementing a hygienic dryer. This PKM activity is divided into several stages, starting with the survey and literature study stage, ending with the evaluation stage. This dryer is constructed knockdown with 5 mm transparent clear glass material, the door is made of a vertical lift door, the walls of the dryer are insulated with glass wool and equipped with a turbine ventilator for better air circulation. Based on the evaluation results, this technology is able to speed up the drying process so that MSME turnover increases by up to 79% and workers' wages increase by 66.7%, resulting in better product quality and of course hygienic.

Keywords: *emping melinjo, MSMEs, hygienic dryer technology, drying process improvement, production capacity, productivity and income increase*

1. INTRODUCTION

MSMEs or Micro, Small, and Medium Enterprises play a role in helping boost economic activity in Indonesia and the regions. MSMEs can absorb a large workforce, thus improving community welfare **(Muharam et al., 2023)**. One such entrepreneur is Yuni Purwanti, a melinjo chips MSME entrepreneur located in Bernung Village, Gedong Tatataan District, Pesawaran Regency, Lampung Province. Yuni Purwanti is a partner in this community service activity (PKM).

In producing melinjo chips, the PKM partners employ 23 people, five of whom work at their homes, and the rest from their own homes. The workers who assist the partners come not only from the surrounding area but also from outside the village. Workers' wages are calculated based on the weight of the melinjo seeds processed, not the amount of melinjo chips produced. They are paid Rp 6,000 per kg. Each worker can process 3-5 kg of melinjo seeds per day, earning between Rp 18,000 and Rp 30,000 per day.

There are several similar MSMEs within the partner MSME environment, but the partner MSME is one of the largest. In addition to producing its own melinjo chips, the partner also accepts melinjo chips produced by other MSMEs , so the presence of this partner MSME helps increase economic activity in the community. Thus, MSMEs need to be encouraged to develop and progress **(Giovanni et al., 2023)**. Helping PKM partners in running their businesses so that they develop and progress is the same as assisting the state's task of advancing public welfare.

Figure 1. Partner Discussion Session on Identifying Problems and Formulating Solutions

However, to become a growing and advanced MSMEs, based on the results of discussions between the Malahayati University PKM team and partners, as shown in Figure 1, the partner need assistance to increase sales turnover. The partners stated that the problem in increasing sales is not on the demand side; the market potential is large enough to prevent any obstacles. Constraints occur on the supply side, where the increase in demand for melinjo chips is not matched by production capacity.

Currently, the production capacity of PKM partners reaches 40 kg of melinjo chips per day during the dry season and 10 kg per day during the rainy season. With a selling price of Rp. 70,000 per kg, PKM partners' sales turnover is Rp. 2,800,000 per day during the dry season or Rp. 700,000 per day during the rainy season, a decrease of 75% due to seasonal differences. In addition to impacting sales turnover, seasonal differences also impact the income of group members/workers, even to the point of not earning any income at all.

Figure 2. Melinjo Chips Production Process

The production process for melinjo chips begins with the roasting process, as seen in Figure 2, where the melinjo seeds are roasted for a few moments in a pan filled with sand over low heat . Once the seeds are deemed to be sufficiently roasted, they are removed from the pan and ground onto a still-hot plastic sheet. For type 2 melinjo chips, two melinjo seeds are ground, for type 3, three seeds are ground, and so on. Once the plastic sheet is full of melinjo chips, the pounding process continues on the next plastic sheet.

Figure 3. Drying Melinjo Chips

The next process is the drying process, and this is a crucial process because it concerns product hygiene and production capacity. Based on the results of discussions with MSME partners and field observations, drying process by sun drying as shown in Figure 3. Sun drying is highly dependent on the season, where during the rainy season, the drying process takes a long time, thereby reducing production capacity. The drying process of more than 24 hours makes the color of the melinjo chips red, this color is not preferred by consumers. In addition, it also has an impact on the melinjo chips are susceptible to microbial contamination, making the product unhygienic **(Widhiantari et al., 2024)**. Therefore, MSME partners need a drying technology that can overcome problems, both related to production capacity and related to product quality, ultimately impacting worker wages through increased MSME sales turnover.

Problems related to the drying process are a common issue experienced by many MSMEs, including those producing wheat flour crackers **(Buwono et al., 2025)**, rice crackers **(Rizqiati et al., 2021)**, butterfly pea flowers **(Pandiangan & Nainggolan, 2021)**, herbal raw materials **(Fatchullah et al., 2022)**, coffee **(Qirom et al., 2024)**. The solution to these problems is to implement drying technology.

2. METHOD

The implementation of PKM with productive economic partners is divided into several stages, as described below:

2.1 Literature Survey and Study

In the early stages of implementing the PKM program, the PKM implementation team from Malahayati University conducted a field survey to meet potential PKM partners and observe the potential partners' businesses. The PKM implementation team and prospective partners

discussed the problems faced by prospective partners related to the melinjo chips micro business.

After conducting a survey directly in the field, the next step is the PKM implementation team conducted a literature study (collecting information obtained from scientific articles, regulations, or books) to find solutions. The results of finding solution would be discussed with partners. After the PKM implementation team and partners agree on the proposed solution, including a demonstration of the drying machine to be built. This agreement is outlined in a PKM cooperation agreement letter.

2.2 Manufacturing of hygienic solar dryer.

The first step is the PKM team and partners determine the location of the dryer. The location is determined by considering the direction of sunrise and sunset, ensuring the sun's heat is directed toward the dryer. After determining the location, the PKM implementation team manufactured and implemented a hygienic solar dryer technology.

In general, this dryer technology similar to the dryer previously manufactured in the 2022 DRTPM grant PKM activity **(Abdul, Nelson, et al., 2022)**, but modifications were made so there are several differences. The first difference is in the volume of the drying chamber, where the previous dryer had a volume of around 4 m^3 with a capacity of 10 kg of melinjo chips, while the drying chamber volume of this dryer is around 8 m^3 with a capacity of 20 kg of melinjo chips. The second difference is in the transparent material used, where the previous dryer was 3 mm acrylic material, in this dryer; the transparent material uses 5 mm clear glass material. Replacing the 3 mm acrylic material with clear glass material is rationalized because the heat efficiency value of the drying device with clear glass transparent material is higher than acrylic material **(Abdul, Indriyani, et al., 2022)**. The third difference is in the way the door is opened and closed. Whereas previous dryers opened and closed manually, this dryer uses a hand winch, making it lighter.

After the manufacturing and assembly process is complete, the dryer will be tested to determine its ease of operation and performance, and repairs will be made if it does not meet specifications.

2.3 Evaluation

Evaluation activities were carried out to determine the impact of the dryer for MSMEs, particularly regarding increasing production capacity, quality and its impact on workers.

3. RESULT AND DISCUSSION

3.1 Solar Dryer Manufacturing

The first stage of the PKM activity is a field survey and literature study. The result of this activity is the formulation of partner problems and solutions agreed upon by the PKM team and Partners. To increase the role of MSMEs in helping the community's economy is by increasing MSME sales turnover, but is constrained by the drying process. Drying by sun-drying is highly dependent on the season, making the color of melinjo chips red and susceptible to microbial contamination, making the product unhygienic. MSME partners need a hygienic drying tool that can overcome problems, both related to production capacity and related to product quality, ultimately impacting worker wages through increased MSME sales turnover.

The second stage is the construction of the hygienic dryer. This stage begins with determining the location where the dryer will be installed. The location is determined by considering the direction of sunrise and sunset, ensuring the sun's heat is directed toward the dryer. Once the location has been determined, all obstacles need to be removed, even electricity poles need to be moved if they hinder the function of the dryer. After the location is free from obstacles, the next step is to make a floor where the cooling equipment will stand, in the form of a concrete floor.

Figure 4. Manufacturing Process of Hygienic Solar Dryer Components

Next is the process of making a hygienic dryer, as seen in Figure 4, starting with the component manufacturing process, consisting of a base frame, front and rear legs, wall frame, floor frame, door frame, and wall reinforcement frame.

Figure 5. Wall and Door Construction Process

The next process is making the walls and doors, where the walls and doors consist of 3 layers, as seen in Figure 5. The inner layer is made of aluminum plate, in the middle is installed heat-resistant material and the outer layer is made of galvalum zinc plate. The heat-insulating material used was glass wool with a density of 32. Glass wool is a widely used thermal insulation material in various studies **(Abdul, Indriyani, et al., 2022)**.

Figure 6. Painting Process

Next is the painting process, as shown in Figure 6. The walls of the chamber room are painted black, black color is chosen because black objects increase the thermal conductivity of objects due to their high emissivity **(Chung & Chen, 2023)**, while the rest are painted green.

Figure 7. The Process of Assembling the Base Frame and Legs

Figure 8. Wall, Ventilator, Glass and Floor Installation

Next is the assembly process, as shown in Figures 7 to 9. In this assembly process, there is no longer any welding as a connection method, all connections use bolts, nuts, and rivets. Thus, with this connection method , the dryer can be easily disassembled when it is needed to be moved, adjusting to a more appropriate location. The process begins by installing the base frame and legs at the location where the dryer will be installed. After the base frame and legs are installed, the next step is to install the wall. Continued with the installation of the turbine ventilator, door assembly, installation of glass and drying room floor.

Figure 9. Trial Operation of the Solar Dryer

After the manufacturing and assembly process is complete, the dryer will be tested to determine its performance, as shown in Figure 9. Repairs will be made if it does not meet specifications.

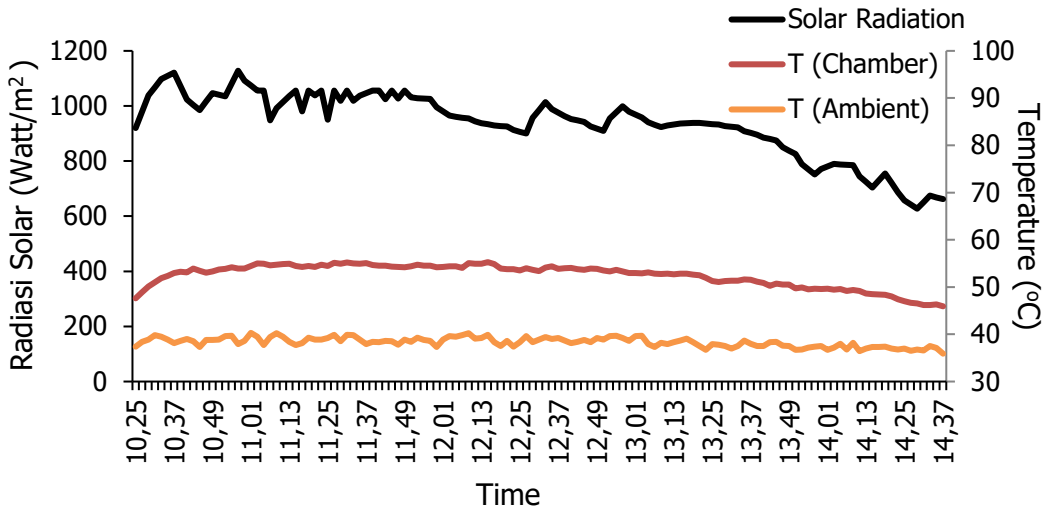

Figure 10. Trial Results Data

In addition to determining the ease of operation and making necessary improvements, the trial process also measures the performance of the dryer. The trial was carried out between 10:25 and 14:35, or for 4 hours. As seen in Figure 10, the trial results show that the temperature of the drying room can reach 60° C and the temperature is relatively stable during the trial, even though the solar radiation fluctuates and tends to decrease. Based on the results of this trial, the dryer is able to speed up the drying process up to two (2) times faster than the drying process (from 4 hours to 2 hours) with a capacity of 15 kg for each drying, resulting in better product quality and of course hygienic.

The next stage is evaluation, where evaluation activities are carried out to determine the impact of the dryer for MSMEs, especially regarding increasing production capacity, quality and its impact on workers.

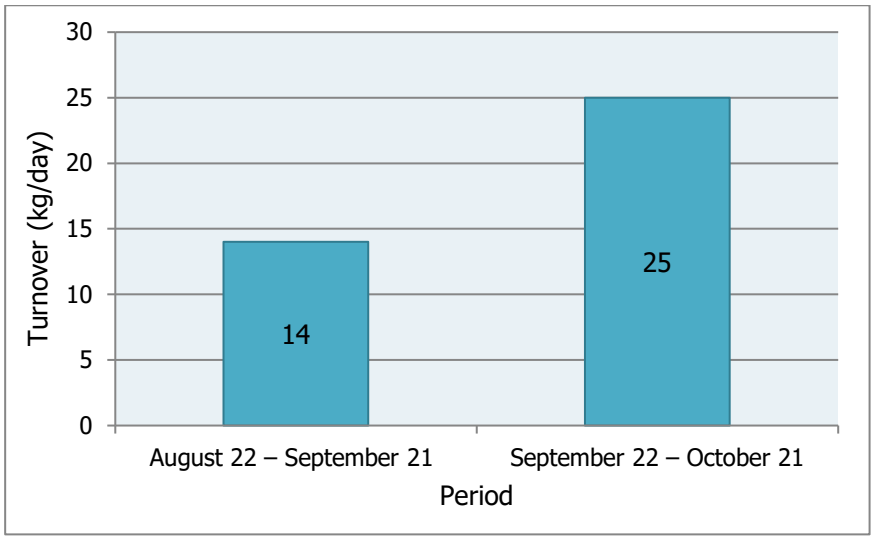

Figure 11. Sales Turnover Comparison

Based on data collected in the period before and after the dryer was implemented, where the period before was August 22 – September 21, 2025 and the period after was September 22 – October 21, 2025, as seen in Figure 11, there was an increase in average sales turnover. In the period before implementation, the average sales turnover was 14 kg, in the period after implementation, the average sales turnover was 25 kg. There was an increase of 79%.

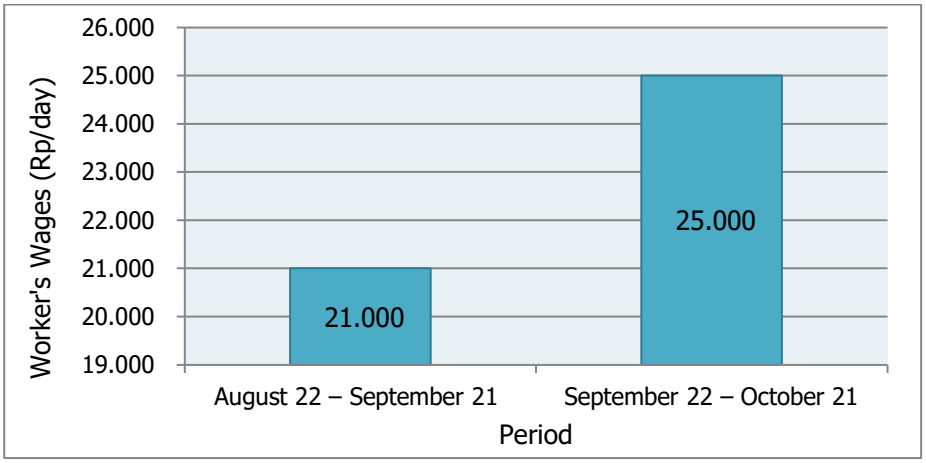

Figure 12. Comparison of workers' wages

Meanwhile, there was also an increase in workers' wages, as seen in Figure 12, where in the period before implementation, the average wage received by workers was IDR 21,000 per day. In the post-implementation period, wages increased to Rp. 35,000 per day, or an increase of 66.7%.

4. CONCLUSIONS

Based on the evaluation of the implementation of a hygienic drying device at Yuni's melinjo chips UMKM in Bernung Village, it can be concluded that this PKM activity successfully achieved its main objective. With the implementation of the accompanying device, the UMKM's sales turnover increased by 79% compared to the same period in the previous year. This increase in sales turnover also impacted workers' wages, which increased by 66.7 % compared to the same period in the previous year.

This hygienic dryer is capable of increasing capacity, even 30 kg/day. However, to achieve this capacity additional working capital is required. So far, partners have only been able to access capital from financing institutions in small amounts, which is not enough to significantly increase capacity. The difficulties faced by partners in accessing greater capital are related to access to adequate financial information and reporting required so that financing institutions have the confidence to provide access to capital. As a sustainability plan for this PKM activity, this problem can be helped to be solved so that partner MSMEs are able to access capital from financing institutions.

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