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COMMUNITY SERVICE THROUGH THE APPLICATION OF ARDUINO-BASED MULTIPURPOSE DRYER FOR MSMES IN BALONGMOJO VILLAGE MOJOKERTO.

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Abstrak.

Kegiatan pengabdian kepada masyarakat ini bertujuan untuk membantu UMKM di Desa Balongmojo, Kabupaten Mojokerto, dalam mengatasi kendala pengeringan bahan pangan (daun kelor dan produk pangan lokal) yang masih mengandalkan panas matahari. Ketidakpastian cuaca membuat proses produksi terhambat dan kualitas produk menurun. Solusi yang ditawarkan berupa penerapan mesin pengering multiguna berbasis kontroler Arduino yang dapat dioperasikan secara manual maupun melalui aplikasi Android. Metode pelaksanaan mencakup sosialisasi, pelatihan, dan uji coba pengeringan bersama mitra. Kegiatan diikuti oleh 14 peserta yang terdiri dari pelaku UMKM dan masyarakat sekitar. Hasil kegiatan menunjukkan peserta mampu mengoperasikan mesin secara mandiri, waktu pengeringan lebih cepat (6–8 jam dibandingkan 1–2 hari dengan matahari), serta kualitas produk lebih konsisten. Teknologi ini terbukti meningkatkan produktivitas dan memberi kepastian dalam jadwal produksi.

Kata kunci: pengabdian masyarakat, UMKM, mesin pengering, arduino, produktivitas

Abstract.

This community service activity aimed to support MSMEs in Balongmojo Village, Mojokerto Regency, in overcoming food-drying challenges (moringa leaves and local food products), which previously relied on sun drying. Weather uncertainty often delayed production and reduced product quality. The service team provided a solution by implementing an Arduino-based multipurpose dryer machine, operable both manually and via an Android application. The program consisted of socialization, training, and collaborative drying trials with partners. A total of 14 participants, including MSME actors and local residents, joined the training. Results showed that participants were able to operate the machine independently, drying time was reduced (6–8 hours compared to 1–2 days with sun drying), and product quality became more consistent. The application of this technology increased productivity and improved production reliability for the partners.

Keywords: *community service, MSME, dryer machine, arduino, productivity.*

Introduction

Micro, small, and medium enterprises (MSMEs) are key drivers of Indonesia's economy, particularly in the agricultural and food processing sectors. One of the promising commodities

developed by MSMEs is moringa leaves (Moringa oleifera), which are widely recognized for their high nutritional value and medicinal properties. Moringa leaves contain proteins, vitamins, minerals, and antioxidants that are beneficial for human health, making them suitable for functional foods, herbal teas, and dietary supplements [1], [2].

However, maintaining the nutritional quality of moringa leaves during post-harvest handling, especially drying, remains a major challenge. Traditionally, MSMEs in rural areas—including those in Balongmojo Village, Mojokerto Regency—rely on sun drying. This method is inexpensive but highly dependent on weather conditions. During the rainy season or in high-humidity environments, drying becomes inefficient, uneven, and often leads to microbial contamination or nutrient degradation [3]. Prolonged drying times, which can reach 1–2 days, also limit production capacity and reduce MSMEs' competitiveness in the market.

Several studies highlight the importance of mechanical drying technology as a solution. Controlled drying systems allow the regulation of temperature and humidity, ensuring more consistent quality and reduced drying times. For example, forced-air dryers significantly reduce moisture content in leafy vegetables while preserving their color and nutritional quality [4]**,** [13], [14]. Similarly, the use of hot-air dryers for moringa leaves results in better retention of vitamin C and chlorophyll compared to sun drying [5]. Other studies also show that integrating renewable energy such as solar-assisted dryers with control systems can provide more sustainable solutions for moringa leaf processing [6]**,** [15], [16].

In recent years, innovations in microcontroller-based drying systems have expanded opportunities for MSMEs. The integration of Arduino controllers enables precise monitoring of drying parameters, automation of processes, and user-friendly operation. These systems can also be combined with mobile applications for remote monitoring, improving efficiency and flexibility [7], [8]. In addition, ergonomic design ensures that the machines are safe, easy to use, and accessible for small-scale entrepreneurs [9]**,** [17], [18]. Productivity measurement approaches, such as work-time analysis, further demonstrate that appropriate technology adoption contributes directly to increased production efficiency [10-12].

Considering the potential of moringa leaves as a high-value product and the challenges faced by MSMEs in traditional drying methods, it is crucial to introduce appropriate technology that is affordable, efficient, and sustainable. Therefore, this community service program aims to empower MSMEs in Balongmojo Village, Mojokerto Regency, through the implementation of an Arduino-based multipurpose dryer machine. By providing training, demonstration, and hands-on practice to 14 local participants, the program seeks to improve production reliability, enhance product quality, and ultimately strengthen the economic resilience of the community.

Method of Implementation

The program was carried out in four stages:

1. Needs Assessment: Field observation and discussion with MSME partners in Balongmojo Village identified drying constraints and production challenges.
2. Socialization: The service team explained the importance of mechanized drying technology, benefits of Arduino-based control, and safety considerations.
3. Training and Demonstration: A training session was attended by 14 participants consisting of MSME owners and community members. Participants learned to operate the dryer both offline (via panel keypad) and online (via Android application).
4. Trial and Evaluation: Drying trials were conducted using moringa leaves. Participants actively engaged in setting parameters, recording drying results, and evaluating machine performance.

Training methods have been widely used in various community service activities, especially for participants in MSMEs. This training activity was held in Balongmojo Village, Mojokerto Regency. The training participants were 14 MSMEs. The training materials covered preparation, operating training tools, work quality, attitude/work ethic, and job outcomes. The assessment process for the training participants is shown in Table 1.

Table 1. Training Assessment Matrix for Participants.

No	Assessment Aspect	Score	Score Achieved	Remarks
Preparation				
1	Reading the Training Module	2		
2	Reading the Device SOP	3		
Operating the Dryer Device				
1	Basic knowledge of drying system	10		
2	Identification of dryer components	10		
3	Understanding of wiring/control diagram	10		
Work Quality				
1	Accuracy of Operation	20		
2	Accuracy in Identifying Components	10		
3	Accuracy in Identifying Diagram	20		
Attitude / Work Ethic				
1	Proper Use of Tools	2		
2	Responsibility	2		
3	Thoroughness	2		
4	Initiative	2		
5	Independence	3		
Completion of Work				
1	Turning off the Device Properly	2		
2	Cleaning the Workspace	2		
Total		**100**		
Note:				
1. Score <70 means Failed.				
2. Score >70 means Passed.				

Figure 1. Preparation phase of the training with participants being introduced to the Arduino-based dryer

Figure 1. Preparation phase of the community service activity, where participants were introduced to the Arduino-based multipurpose dryer. The facilitators demonstrated the main control panel, including the keypad interface, manual switches, and safety buttons. This stage was important to familiarize the participants with the machine before the actual training and drying trials. By providing direct interaction with the equipment, participants gained early understanding of the functions and features of the dryer, thus creating a more effective learning environment during the hands-on training session.

Figure 2. Multipurpose dryer with five trays and control panel for temperature and time settings.

Figure 2. The multipurpose dryer machine is equipped with five stainless-steel trays arranged vertically inside the drying chamber. Each tray is perforated to facilitate optimal airflow circulation, ensuring more uniform heat distribution during the drying process. The design enables simultaneous drying of multiple layers of moringa leaves or other local food products, thus increasing capacity and efficiency. The control panel located on the side of the machine allows users to set temperature and time parameters, ensuring that the drying process can be adjusted to specific product requirements.

Figure 3. Training session where participants practiced operating the dryer.

Figure 3. Implementation of the training session for operating the Arduino-based multipurpose dryer. Participants were directly involved in hands-on activities, including connecting electrical components, adjusting machine settings, and observing operational safety procedures. The training created an interactive environment where the 14 participants could exchange experiences and

collaborate in understanding the technical aspects of the machine. This stage ensured that knowledge transfer was not only theoretical but also practical, thereby enhancing the participants' confidence and ability to operate the dryer independently in their respective MSMEs.

Figure 4. Drying results of moringa leaves showing even drying with consistent moisture levels.

Figure 4. Drying results of moringa leaves inside the multipurpose dryer. The trays show evenly spread leaves exposed to controlled hot air circulation, supported by heating elements and airflow design. Compared to traditional sun drying, the use of this machine significantly reduced drying time to 6–8 hours and produced moringa leaves with consistent moisture levels of 8–12%. The uniform color and texture indicate better preservation of nutritional quality, making the dried leaves more suitable for further processing into tea, powder, or functional food products.

Results and Discussion.

Figure 5. Preparation Scores. This aspect assessed participants' readiness before operating the dryer. The evaluation included reading the training module and the device standard operating procedure (SOP). The maximum total score for this aspect was 5 points (2 + 3). The results show that preparation is fundamental to ensure participants clearly understand the steps and safety procedures before conducting hands-on practice. Adequate preparation reduces the likelihood of mistakes and improves the effectiveness of subsequent training stages.

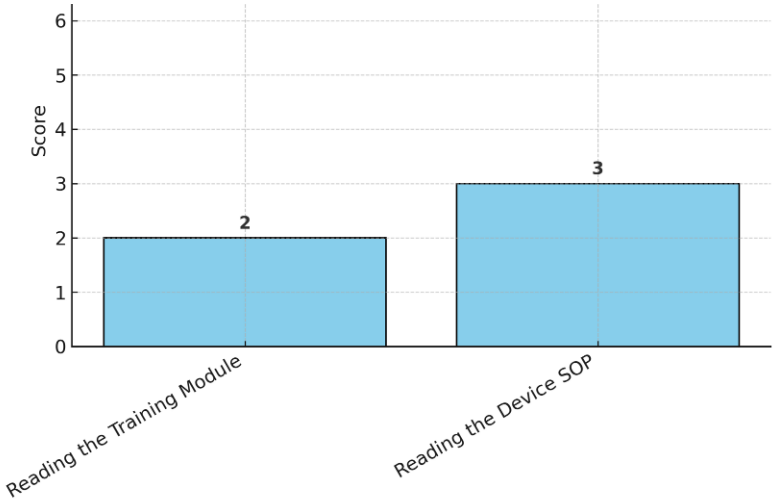

Figure 5. Preparation Scores

Figure 6. Operating the Dryer Device Scores. This aspect evaluated participants' ability to operate the dryer machine, covering basic knowledge of the drying system, identification of dryer components, and understanding of wiring/control diagrams. With a total maximum score of 30 points, this aspect was central to technical competency. A strong performance in this category reflects the participants' ability to translate theoretical knowledge into practical operation, which is essential for ensuring reliable and safe machine use in real MSME contexts.

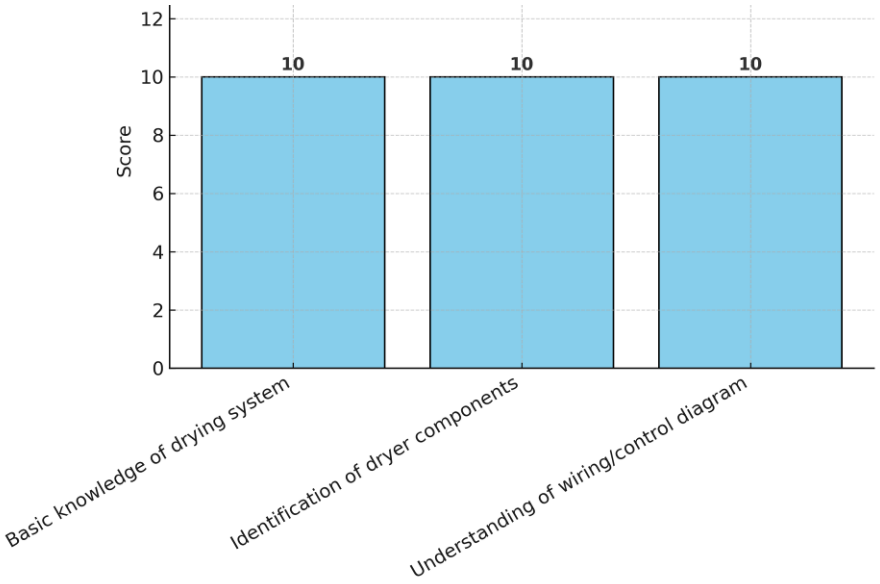

Figure 6. Operating the Dryer Device Scores

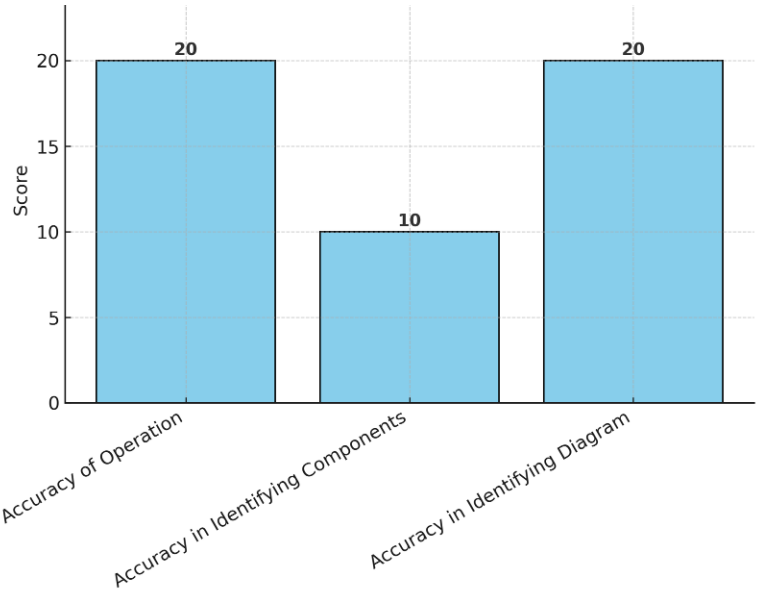

Figure 7. Work Quality Scores

Figure 7. Work Quality Scores. Work quality focused on accuracy in operating the dryer, identifying components, and interpreting diagrams. It carried the highest weight, with a maximum score of 50 points. This emphasis reflects the critical importance of precision when using the machine. Achieving high marks in this aspect ensures that drying results are consistent, efficient, and safe. Errors in this area could directly affect both product quality and machine reliability, hence the high scoring priority.

Figure 8. Attitude/Work Ethic Scores. This aspect assessed participants' behavior and professionalism during training, including proper use of tools, responsibility, thoroughness, initiative, and independence. The total maximum score was 11 points. Although the score weight is smaller compared to technical aspects, work ethic plays a crucial role in sustaining long-term technology adoption. High scores in this aspect indicate that participants not only mastered the operation but also developed positive attitudes such as carefulness, responsibility, and the ability to work independently.

Figure 9. Completion of Work Scores. This aspect measured participants' ability to properly shut down the dryer and clean the workspace after use, with a maximum of 4 points. Even though it carries the lowest weight, this aspect is critical to safety and machine durability. Proper shutdown

procedures and cleaning ensure that the dryer remains functional, hygienic, and ready for the next operation. High achievement in this aspect demonstrates that participants internalized not only operational skills but also maintenance discipline.

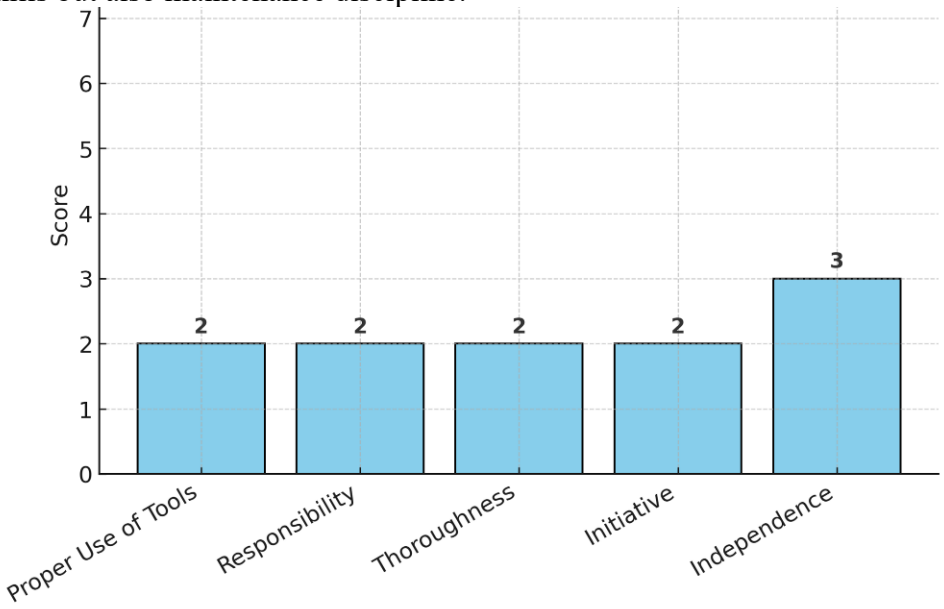

Figure 8. Attitude/Work Ethic Scores

Figure 9. Completion of Work Scores

Conclusion.

The community service program in Balongmojo Village, Mojokerto Regency, successfully introduced an Arduino-based multipurpose dryer to MSMEs. With 14 participants involved, the program enhanced knowledge, skills, and confidence in using drying technology. The machine significantly reduced drying time and improved product quality, providing a practical solution for MSMEs to overcome weather-related constraints. Future community service activities should focus on optimizing machine airflow, training in maintenance, and expanding the application to other local agricultural products.

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