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Increase the economic potential of the Ambulu Community by providing appropriate batik drying technology

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ABSTRACT

One of the UMKM developed Batik as a regional product is Rezti's Batik. Rezti's Batik is located in Ambulu, Jember Regency, about 28.4 km from the University of Jember. Increasing the number of consumer orders has made Rezti's Batik production continue to increase. One of the obstacles faced by Rezti's Batik is the process of making Batik which takes a long time because the drying process still relies on heat from the sun, which takes 4-6 hours. The process can also take longer if the rainy season slows the production process's completion. The solution method is the manufacture of appropriate technology in the form of installing a batik cloth dryer. The batik cloth drying installation implementation at Rezti's Batik is a drying system that utilizes heat from the furnace in the sagging process as a heating medium. The designed dryer consists of a stove as a heat generator which will later be distributed with air from the blower so that the hot air will spread evenly throughout the room.

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1. INTRODUCTION

Batik is a distinctive work of the Indonesian nation, a blend of art and culture that received recognition from UNESCO in 2009 (Raya et al., 2021). The Indonesian government welcomed this positively by issuing Presidential Decree of the Republic of Indonesia No. 33 of 2009 regarding the establishment of National Batik Day, which is celebrated every October 2nd. In Indonesia, batik has evolved in both its production process and the motifs used. Several batik entrepreneurs have adopted motifs that are characteristic of their respective regions. One of the MSME sectors that has the potential to become a leading sector in supporting Indonesia is the creative batik industry. One of the contributions to developing creative batik as a regional superior product is Rezti's Batik. One reason the owner of

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Rezti's Batik chose the batik-making business was to preserve Indonesia's cultural heritage while also creating job opportunities for local residents. This preservation of cultural heritage is realized by Rezti's Batik through the selection of motifs that highlight the uniqueness of the Jember region, such as tobacco leaf, coffee, and cocoa motifs. At the end of 2012, Mrs. Lestari Kusumawati pioneered the establishment of a batik business named Rezti's Batik by employing two workers. As the batik business developed and progressed, Rezti's Batik now has 20 employees. Rezti's Batik was chosen as a service partner because it is one of the MSMEs located in the Ambulu area. The batik fabric craftsmen who are part of the Rezti's Batik MSME are experts who can skillfully operate in carrying out a series of processes, from the preparation of materials to the final product that can be sold in the market.

Figure 1. The process of drying batik cloth in the sun

Problems that often occur in MSMEs include production, marketing, technology, and human resources (Andarwati et al., 2018). The drying process of batik fabric is a problem faced by the Rezti's Batik MSME in the production process. The drying process used by the partner is the conventional method that relies on sunlight. The conventional drying process utilizing sunlight can be seen in Figure 1. This often becomes an obstacle during the rainy season, so the drying process is only done by airing the fabric out. This method of drying takes a considerable amount of time. The drying time needed to produce 50 pieces of batik fabric under sunlight is 3-4 hours, while using the airing method takes longer, around 6-7 hours. Conversely, during the rainy season, it takes 2-3 days to dry 20-25 pieces of batik fabric. This creates a problem with time efficiency, which reduces the daily production of batik fabric, thus impacting the economy of the MSME partner. Additionally, the long drying process also reduces the quality of the fabric, as extended drying time can cause the fabric to become musty due to dampness, eventually requiring it to be washed again. On the other hand, customer satisfaction is a primary concern that must be maintained, so a solution is needed for the batik fabric drying process (Dwipasari et al., 2017).

Based on the existing problems, a tool was designed to dry batik fabric in a short time and can be used in all weather conditions. The drying tool implemented works by utilizing heat from a stove (Wardana et al., 2022). The drying room used to dry the fabric is lined with aluminum foil on the walls to reflect the heat inside the room. To reduce the humidity produced by the evaporating water from the fabric, excess humidity is expelled using an exhaust fan (Kamelia et al., 2017). Additionally, this system is equipped with an automatic working system based on sensor readings, including room air temperature and humidity. The temperature controlled by the sensor is 45°C, as batik fabric can dry more effectively in terms of temperature and time efficiency (Rosmawar et al., 2022).

This village mentoring program aims to enhance the capabilities of Rezti's Batik employees in operating appropriate technology for batik fabric drying to develop the economic potential of Rezti's

Batik. This activity provides a solution to the problems faced by the partner related to accelerating the production process by conducting training and implementing a more modern batik fabric drying tool, thus increasing productivity and leading to an increase in revenue (Ramadhan et al., 2020). The use of the batik fabric drying tool can improve fabric quality compared to the manual drying process. Therefore, the installation of the drying tool is also necessary as a solution to the problems faced by the Rezti's Batik partner (Zainuddin et al., 2019).

2. METHODS

In this village mentoring activity, the approach used to address the various issues faced by the partner is through active participation between the proposing team and the partner. The proposing team, as the program controller, plays an active role in conducting training and implementing appropriate technology for the partners through intensive coordination. The partner's employees who participated in the training activities totaled 10 people. This mentoring program was carried out in Tegalsari Village, Ambulu District, Jember Regency. The implementation method of the program is shown in Figure 2.

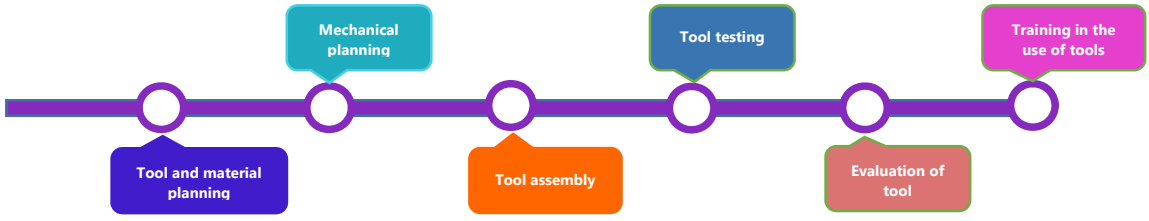

Figure 2. Program implementation methods

Based on Figure 2, the method applied is training and implementation of appropriate technology. The training and implementation of appropriate technology for the batik fabric drying tool use an approach consisting of lectures, discussions, and practice (Syaharuddin & Ibrahim, 2017). The operation of the tool was taught through presentations supported by booklets distributed to all partner employees (Muhsinin et al., 2019). In this context, the proposing team explained the steps for using the tool and demonstrated them to ensure that the material was fully conveyed to the partner employees. Measurement was necessary to determine the level of knowledge of the partners before and after the training was conducted. The measurement was carried out with the training participants through two-way discussions after the socialization activities. The aspects measured included the partners' knowledge of operation, safety, and maintenance of the tool. The discussions were conducted in a two-way format with a question-and-answer session so that the partner employees could understand all the steps of operating the tool. The MSME partner employees directly practiced operating the drying tool after the discussion activities. The results of the activity were obtained through the practice training session after the activities (Hernawati & Amin, 2017). Monitoring activities were carried out to measure the success level of the training by assessing the impact on the MSME partners' knowledge improvement in absorbing the information provided through the training. Monitoring involves careful observation of the situation, including behavioral activities, as a basis for making further decisions. The evaluation of activities was conducted to determine how well the partners understood the operation of the batik drying tool and its application in their business (Andrijono & Sufiyanto, 2018).

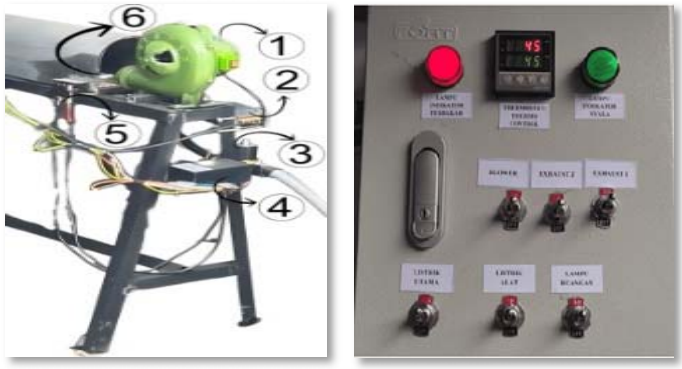

Figure 3. Batik dryer and panel boxes

Table 1. Tool Specifications

Tools	Function
Blower	Blowing hot air from the stove into the room
Thermo Controller	Regulating the blower rotation speed
Selenoid	Cutting off the gas flow into the stove
Selenoid Controller	Regulating the solenoid valve from the micro controller command
Igniter	Igniting the stove flame
Stove	Emitting heat
Panel	Temperature switch, lights, exhaust, blower, and electricity

Figure 3 and Table 1 shows a batik drying tool. The working procedure of the batik fabric drying tool begins with placing the fabric to be dried into the drying chamber and hanging it on the drying rack. Next, attach the regulator to the LPG gas and adjust the gas pressure by turning the regulator switch to the right. Then, turn on the main power switch, room lights, exhaust 1 and exhaust 2, stove burner, and blower on the control panel. The next step is to set the room temperature to the desired level by pressing the button on the microcontroller; press the up arrow to increase the temperature and the down arrow to decrease it. After that, wait for the fabric to dry; if the indicator light on the control panel is red, it means the dryer is still on. If the light turns green and an alarm sound, it indicates that the dryer will automatically turn off and the fabric can be safely removed.

The batik fabric dryer works by heating the fabric and reducing the humidity in the room. The heat generated from the stove burner is then blown into the room with the help of a blower. The room is lined with aluminium foil to retain heat and minimize heat transfer to the walls. To reduce the humidity in the room, two exhaust fans, namely exhaust in and exhaust out, are used to circulate the moisture caused by evaporating water.

The schedule and stages of the village mentoring program implementation are listed in Table 2. This schedule aims to increase batik fabric production by creating appropriate technology in the form of a batik fabric drying installation. This mentoring activity is a community empowerment effort carried out through training and implementing appropriate technology for the batik fabric dryer. The training and implementation of the batik fabric dryer use an approach that includes lectures, discussions, and practice. The program was conducted on September 14, 2023.

Table 2. Schedule and stages of implementation

Stage 1	**Preparation of Proposal**
Activity	- Discussion on selecting work partners - Preparation of proposals
Purpose	- Ensuring that the implementation of appropriate technology is on target and in accordance with the needs of partners
Implemented on	January – Febuary 2023
Stage 2	**Site Surveys**
Activity	- Knowing directly about the condition of the work partners - Discussion with work partners regarding the service to be carried out
Purpose	- Ensure the location of the dryer installation - Discuss the possibilities or considerations in installing the dryer
Implemented on	February – March 2023
Stage 3	**Effective Technology Installation**
Activity	- Design of batik dryer - Installation of batik dryer in drying room - Installation of exhaust in the room
Purpose	- Practice and supervision of dryer design - Adjustment of equipment installation to room conditions
Implemented on	March - June 2023
Stage 4	**Dryer Testing**
Activity	- Testing using temperature indicators to obtain optimal conditions - Checking system control against the indicators shown - Checking the condition of the tool after use
Purpose	- Ensure that the batik dryer is functioning properly and without errors - Know the condition of the dryer before and after use
Implemented on	June – August 2023
Stage 5	**Socialization of the Use of Batik Drying Equipment and Handover of Equipment**
Activity	- Explanation using lecture method regarding the use and maintenance of batik dryers - Introduction to employees regarding batik dryers
Purpose	- Understanding to employees regarding the benefits and use of batik dryers - Employees are able to operate batik dryers
Implemented on	August – September 2023
Stage 6	**Tool Performance Review**
Activity	- Review of the effectiveness and condition of the tool during daily use of batik cloth drying
Purpose	- Ensure that the tool is in good condition and running optimally during continuous use with the result that the tool can function properly - Know if there is a problem with the tool or its use is not in accordance with the procedure
Implemented on	September – November 2023
Stage 7	**Preparation of Reports and Outputs**
Activity	- Evaluation of the performance of the use of drying equipment - Collection of data and information - Execution of activity outputs and reports
Purpose	- Get report results and activity outputs with comprehensive and accurate data
Implemented on	November 2023

3. RESULTS AND DISCUSSION

Tool and Material Planning

The results of planning tools and materials are adjusted based on literature studies and level of need. Purchase of tools and materials is reviewed based on the price and quality of the goods used, so

that the final results of the tool can be adjusted to the initial target while still adjusting the available fund allocation. The tools and materials needed are presented in Table 3 and the documentation of tool and material planning in Figure 4.

Table 3. Tools and materials

Tools and Materials	Quantity	Specification
Room Temperature Measuring Device	1 Piece	-55°C up to +125°C
Aluminium Foil	2 Rolls	50 Meter
Angle Iron	4 Pieces	3 inches x 3 inches
Blower	1 Piece	2 inches
Panel Box	1 Piece	30 x 25 x 15 cm
Exhaust	2 Pieces	5 inches
Cable	120 Meters	9 mm
Stove	1 Piece	50 cm
LED Panel Light	2 Pieces	220 volts
Buzzer Panel	1 Piece	220 volts
Igniter	1 Piece	220 volt/50 Hz
PID REX	1 Piece	250V AC 3A
Regulator	1 Piece	SC-T12R
Switch and Terminal Block	8 Pieces	8 mm
Solenoid	1 Piece	¼ inch

Figure 4. Preparation of tools and materials

Mechanical Planning

The working system is designed with central control on the microcontroller. When the system is turned on, the micro controller will receive every sensor data reading (Debele & Qian, 2020). The system that has been designed will make it easier for partners to operate the tool and the efficiency of using the required heat. The micro controller system will automatically turn on the dryer if the room temperature is below 45 ° C, if the dryer is activated. The micro controller will read the room temperature and humidity and will be shown on the panel and will command the connected device so that it can work automatically. The mechanical design documentation is presented in Figure 5.

Figure 5. Mechanical planning

Tool Assembly

The systematic assembly of the tool sequence starts from making the stand to installing each component. The stove stand functions as a sturdy main frame to support all components. Each tool that was previously assembled has been measured in detail. The stove sensor, room exhaust, and blower have been confirmed to be functioning during the assembly of the tool. The process of making and assembling the dryer has a workflow in Figure 6. As well the documentation during the assembly of the tool as presented in Figure 7.

Figure 6. Tool making series
Figure 7. Tool assembly

Tool Testing

Testing was carried out after the dryer was installed. Batik cloth was used as a tool to test the performance of the dryer, including the features on the tool and the duration of drying the batik cloth. This aims to make the entire system that works on the dryer work optimally according to the needs and problems (Cahyanto et al., 2018). The results of drying using the dryer can be seen in the documentation of the tool experiment in Figure 8.

Evaluating Tool Performance

The design phase to the implementation of the tool is carried out as an evaluation of the tool's performance (Andarwati et al., 2018). The evaluation is carried out by referring to user satisfaction in

improving the performance of the tool while the dryer is operating. User satisfaction is an indicator to underlie the increase in profits obtained by partners and the delivery of partner testimonials while using the batik dryer. Documentation of the tool's performance evaluation is presented in Figure 9.

Figure 8. Test the dryer

Figure 9. Evaluation of tool performance

Training in the Use of Tools

The socialization was carried out at the location of the MSME partner, Rezti's Batik, in Tegalsari Village, Ambulu District, Jember Regency. The participants in the socialization were the employees of the mentored partner. The socialization material consisted of the implementation of the community service activities, including the series of events such as socialization, training, result measurement, monitoring, and evaluation. The socialization aimed to provide an understanding of the activities that would be conducted together, the stages of the activities, and the target outcomes of each activity. The targeted outcome at the socialization stage was the partner's understanding of the implementation of the activities, both in terms of form and stages. During the socialization stage, a session for sharing, discussion, and Q&A related to the activities to be conducted together was also provided. The socialization activity concluded once the partner's questions were answered, indicating that the partner had understood the activities to be conducted. Socialization and mentoring are important factors in the sustainable transfer of appropriate technology to the community. Based on this, the first step taken by the community service team in implementing appropriate technology was socialization (Ismawati et al., 2024). The documentation of the socialization activities is presented in Figure 10.

The socialization regarding batik fabric drying using a stove burner and blower dryer was also conducted. The socialization included an introduction to the parts of the tool, how to use it, and how to maintain it, with the distribution of booklets and the installation of an SOP board for using the tool at the front of the drying room (https://shorturl.at/RE6bR). The socialization activity proceeded smoothly and

concluded with the signing of a handover document for the equipment by the owner and employees of the MSME partner at Rezti's Batik in Ambulu.

Figure 10. Socialization with Rezti's Batik partners

Discussion

Drying of batik cloth was done to determine the efficiency of the difference in drying with the tool compared to conventional drying. Conventional drying is done using sunlight in an open room so that weather factors and surrounding conditions affect the length of drying time. The batik cloth dryer was designed to solve the problems that occurred by speeding up the drying time. The results can be seen in Table 4.

Table 4. Drying duration

Batik Types	Drying duration	
	Conventional	Batik Drying Tool
Batik with wax	6 hours	45 minutes
Ordinary batik	4 hours	30 minutes

The use of the dryer can significantly increase production capacity, positively impacting the economic growth of the MSME partner. The time required for drying the fabric is reduced, allowing for an increased frequency of drying and production, making it up to 8 times faster compared to conventional drying methods. Additionally, the dryer can work efficiently during the rainy season, ensuring that drying time is not hindered. Wet batik fabric can dry at a room temperature of 45°C in 30 minutes, while batik with wax dries in 45 minutes. This ensures that the drying process is faster and more efficient. Table 5 shows a comparison of production results with indicators of the initial condition of soaking wet fabric, both using the dryer and without the dryer.

Table 5. Comparison of production result data

Parameters	Without Dryer	With Dryer
Production capacity 1 working day (sunny weather)	50 sheets of fabric	100 sheets of fabric
Production capacity 1 working day (rainy weather)	25 sheets of fabric	75 sheets of fabric
Sunny weather revenue	Rp5.150.000	Rp10.300.000
Rainy weather revenue	Rp2.700.000	Rp7.850.000

Using the drying tool can maximize the production capacity achieved by the partner in one working day. Without the tool, 25-50 pieces of fabric can be dried in one day, whereas using the drying tool can

target up to 100 pieces of fabric per day. The net profit from each stamped batik is Rp 70,000 and from handwritten batik is Rp 180,000. Thus, when the partner achieves maximum production, the total profit reaches Rp 10,300,000 on sunny days and Rp 7,850,000 on rainy days. This was also confirmed by the partner owner and a satisfaction survey among 25 out of 30 MSME employees regarding the efficiency of batik fabric production over a 6-month period. The use of the batik drying tool has helped the partner increase daily income up to twice as much.

4. CONCLUSION AND RECOMMENDATIONS

The batik drying tool is an appropriate technology successfully implemented at MSME Rezti's Batik by utilizing heat from the stove directed into the fabric drying room. Additionally, the training on appropriate technology for the batik fabric dryer has improved the participants' understanding of using the drying tool, which provides drying efficiency in 45 minutes compared to 6 hours without the tool. Knowledge of using appropriate technology tools has enhanced the partner's understanding of operating the equipment and the fabric drying process. The transfer of appropriate technology has increased the partner's daily income by doubling the production volume of batik fabric.

As a further effort in partner development, research and development of the tool is necessary. This research will support the sustainability of the business by addressing energy efficiency and capacity needs through heat control parameters. The program will also be followed up through collaborations with other partners or external parties to gather broader responses regarding the implementation of the community service program. The partner can provide useful information about aligning needs with the capabilities and knowledge required to carry out similar community service programs effectively.

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