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INCREASING THE INCOME OF MIE LIDI SME IN THE UNDERDEVELOPED VILLAGE OF BANJARSARI, DEMAK, INDONESIA, THROUGH THE UTILIZATION OF HYBRID INVERTER-BASED SOLAR ENERGY AND AUTOMATIC CONTROL

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Abstract

The Community Service Program (PKM) aims to improve production efficiency and product quality of the Mie Lidi Small and Medium Enterprises (SME) in Banjarsari Village, Sayung District, Demak Regency, through the application of renewable energy-based technology. The technology implemented includes solar panels with a hybrid inverter and an automatic drying system with temperature control. This technology reduces dependence on PLN electricity, ensures consistent product quality despite adverse weather conditions, and lowers operational costs. As a result, production capacity increased by 25%, and the sustainability of the SME's operations was better ensured. Additionally, technical training and managerial assistance were provided to support efficient and sustainable business management.

Keywords: SME, Solar Energy, Automatic, Control

INTRODUCTION

Banjarsari Village, located in Sayung District, Demak, Indonesia, is one of the villages classified as underdeveloped in Demak, Central Java. Located approximately 30.4 km from the University Maritime AMNI, the village covers an administrative area of 415,673 hectares. The area is divided into six hamlets, six community units (RW), and 19 neighborhood units (RT). Most of the land is used for agriculture: 302,443 hectares of rice paddies and 112.23 hectares of non-rice paddy fields.

Figure 1. The Mie Lidi SME location in Banjarsari Village, Sayung, Demak, Indonesia

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The partner in this activity is the Mie Lidi SME, which operates in Banjarsari Village. The Mie Lidi SME processes raw materials into stick noodle snacks with a distinctive shape and texture. Along with increasing market demand, the Mie Lidi SME's daily production capacity has reached 100 kg, with average daily sales of around 75 kg of semi-finished products. However, despite the increasing demand, the Mie Lidi SME still faces challenges, particularly related to energy efficiency and dependence on weather conditions that can affect production.

To address these challenges, one proposed solution is the use of solar panels with a hybrid system and automated controls. This technology is expected to increase production efficiency, reduce dependence on electricity from the state electricity company (PLN), and support the operational sustainability of the Mie Lidi SME. The implementation of this renewable energy technology will not only reduce operational costs but also positively impact the environment and the local economy. By increasing production capacity to be more stable and efficient, this MSME is expected to increase revenue and create new jobs for the surrounding community.

METHODOLOGY

This community service program adopts a participatory approach, where partners are actively involved in every stage of the program's implementation. The goal of this approach is to ensure that the proposed solutions truly align with the needs and conditions faced by the Mie Lidi SME. Thus, it is hoped that these solutions will be well-received and implemented effectively. Furthermore, this community service program also applies appropriate technology as a solution to address various challenges, particularly in efforts to improve the efficiency of the stick noodle production process, which is often affected by weather factors.

Identifying Partner Problems and Needs

The study focused on identifying the problems faced by the Mie Lidi SME, particularly those related to the drying process of the stick noodles, which is affected by various factors such as weather, power outages from PLN (State Electricity Company), and significant energy requirements. Interviews and observations were conducted to understand production capacity, operational costs, and current drying methods.

Figure 2. Lidi Noodle Drying Process

Based on the interview and observation process, it was found that the main problems experienced by partners were:

1. Production decreases by 50% during bad weather, requiring a better drying system.
2. Dependence on PLN in the drying process means that when there is a blackout, product quality decreases.
3. The product is still in semi-finished form and does not yet have a label that can be used for product promotion.

Designing Appropriate Technology Solutions

During the technology solution design phase, the team developed an automated drying system with weather-adaptive temperature control. The team's recommended solution is as follows:

1. Adopting more efficient technology by using a blower heater to assist the drying process.
2. Utilizing solar panels as an alternative energy source with an automatic hybrid inverter-based system to reduce energy consumption from PLN and prevent damage to products during power outages.
3. Create an attractive label design containing product information to increase consumer interest in stick noodle products.

Table 1. Solar Panel Components with Hybrid Inverter

No	Component	Amount	Information
1	ICASolar ICA550-72HMI 550Wp Mono	2 Unit	Solar panel with a capacity of 550 WP Monocrystalline
2	ICASolar SNV-GF1021 1kW/24V	1 Unit	Inverter Off-Grid to convert DC current from solar panels into AC current with a capacity of 1 kW.
3	WiFi Module SNV-GF/GH	1 Set	Wifi module for the ICASolar inverter for monitoring via mobile phone.
4	ICAL LIP12100D 12V/100Ah	2 Unit	Gel batteries use embedded gel technology and are designed for reliable, maintenance-free power for renewable energy.
5	Panel Box SNV-GF1021	1 Set	Control system panel for temperature monitoring and connection of PLN power used for the Inverter system, Hybrid Solar Panel
6	Aluminium Rail H 4850mm	1 Btg	An aluminum frame with dimensions H 4850 mm which is used to install solar panels on the roof
15	Kabel H1Z2Z2-K 1 x 4mm	50 m	Special cables for solar panels
16	Kabel NYAF 1 x 25mm	5 m	Special cable for the connector from the inverter to the automatic control or vice versa.

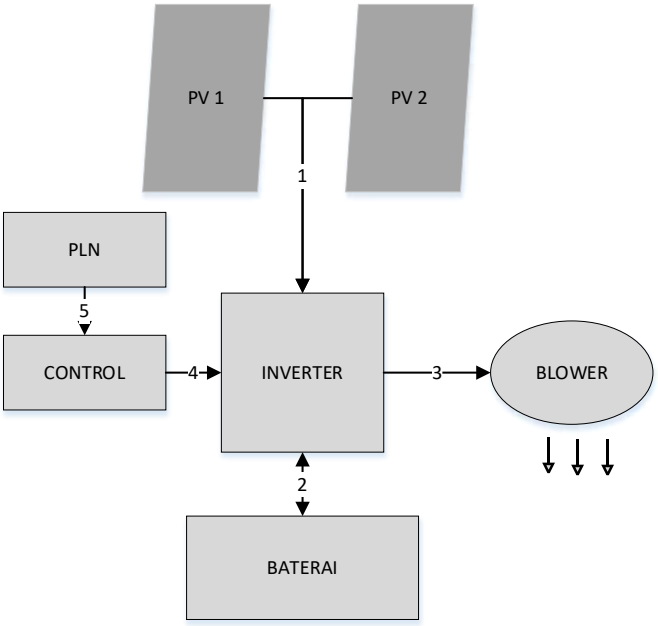

Figure 3. Hybrid Solar Panel System with 1 kW/24V Inverter

Technology and Infrastructure Implementation

The infrastructure inspection phase aimed to evaluate the condition of the facilities and infrastructure of the Mie Lidi SME, particularly in the production and drying processes. The inspection results revealed a reliance on fans, with 10 fans used on sunny days and 20 on cloudy days, which increases electricity consumption and operational costs. The energy infrastructure, which still relies on conventional electricity, impairs production efficiency. Furthermore, the products produced are still semi-finished, limiting market reach. These findings indicate the need for the implementation of energy-efficient technologies that support production efficiency and product diversification.

Figure 4. Fan Used in the Drying Process

Training and Mentoring

Following technology implementation, the next phase involves training partners on the operation of the newly installed 1000W solar panel-powered dryer and hybrid inverter. Regular mentoring is provided to ensure partners can operate the technology efficiently and understand

how to maintain and optimize the system. The goal of this phase is to ensure the continued use of the technology and provide technical support in case of issues or questions..

Figure 5. Assistance by the Head of Banjarsari Village

Continuous Evaluation and Monitoring

The evaluation was conducted to monitor system performance after technology implementation, including production capacity, product quality, and operational cost efficiency. Based on the evaluation results, the team will provide recommendations for further development and ensure that the implemented solution provides sustainable benefits for the Mie Lidi SME.

RESULTS AND DISCUSSION

The technology implemented is a solar panel with a hybrid inverter and an automated system. The implementation of this technology is designed to reduce operational costs and prevent product damage that can occur during power outages by PLN. Previously, the Mie Lidi MSME relied on conventional fans in the noodle drying process, which required high energy consumption and is highly dependent on weather conditions. When the weather is bad, production capacity decreases, and product quality is affected. With the implementation of hybrid solar panels and inverter technology, the noodle drying process can now be carried out more efficiently and stably, without being dependent on the weather. The blower heater, integrated with an automatic temperature-detecting system, ensures consistent product quality. Furthermore, this system allows for energy cost savings by reducing reliance on conventional electricity sources. The installation of solar panels to support operations mitigates the impact of PLN power outages, which previously caused product quality declines.

Identifying actual conditions on the ground, including infrastructure, technological needs, and obstacles faced by the Mie Lidi SME in Banjarsari Village. The community service team observed the production process, particularly the drying of stick noodles, which is dependent on weather and uses conventional energy. This evaluation also included an analysis of electricity dependence, energy efficiency, product quality, and infrastructure for installing solar panels

with hybrid inverters.

Figure 6. Production Room and Solar Panel Installation Location

The equipment installation was carried out to implement the designed technology, namely the installation of solar panels with a hybrid inverter. This process included installing solar panels at the Mie Lidi SME and integrating the hybrid inverter system for optimal function. The community service team ensured that all equipment was properly installed and functioning as planned, and provided technical training to partners on how to operate and maintain the newly installed system.

Figure 7. Solar Panel Installation on Predetermined Infrastructure

The hybrid inverter installation was carried out to optimize the use of solar energy in the production process. This inverter converts energy from solar panels into electricity that can be used to operate the automatic drying equipment. The installation process included installing the inverter into the Mie Lidi SME electrical system and connecting it to the solar panels and equipment requiring power. The community service team ensured that the inverter was installed safely and functioned properly and provided training to partners on how to operate and maintain the hybrid inverter to ensure maximum energy efficiency.

Figure 8. Hybrid Inverter and Battery Installation

After the equipment is installed, the next step is operating the equipment and providing training to SME partners. This operation ensures the system, including the solar panels and hybrid inverter, is functioning properly to support the noodle drying process. Training is provided to ensure partners understand how to operate the equipment efficiently, monitor the system, and maintain and optimize its performance. This training aims to ensure the continued use of the technology and enhance partners' ability to manage the newly installed system.

Figure 9. Equipment Operation and Training for Partners

During the implementation of the program, several obstacles were encountered, including challenges in adopting new technology by SME partners. Some partners experienced difficulties operating automatic dryers and hybrid inverters, as well as understanding temperature control systems. These obstacles were successfully overcome through intensive training and regular mentoring provided by the community service team. Furthermore, while solar panels reduce reliance on PLN electricity, renewable energy utilization remains dependent on the availability of sunlight. During the rainy season or cloudy weather, solar energy production is limited, which can impact the operation of the blower heater. However, backup energy solutions are still in place to address these limitations and ensure smooth operation.

Impact of PKM Activities

The implementation of innovative technology in Mie Lidi SME, both hard and soft, has a significant impact on operational efficiency and production capacity.

Technology and Innovation Products

1. Solar Panel
   The use of solar panels reduces dependence on PLN electricity, lowers operational costs, and supports a reduction in carbon footprint.
2. Hybrid Inverter with Automatic Control
   The hybrid inverter ensures smooth operation of the dryer even during power outages by the PLN, prevents product damage, and reduces operational costs.
3. Temperature Monitoring
   This system maintains temperature stability during the drying process, improving product quality and energy efficiency.

Technology and Innovation Products

1. Utilization of Renewable Energy
   The community and SME partners are given an understanding of the importance of renewable energy, supporting sustainability and reducing dependence on fossil fuels.
2. Technology Operating Skills
   Technical training ensures partners can operate and maintain the system efficiently, ensuring smooth operations.

By implementing this technology, the Mie Lidi SME experienced a 25% increase in production capacity, thanks to efficiency and consistency in the drying process and reduced dependence on weather.

Efforts to Sustain Activities

Tool Improvement: To increase the efficiency and effectiveness of the equipment, improvements were made to the temperature and humidity control system, solar panel capacity, and IoT-based monitoring features. Optimization of the blower heater design was also carried out to speed up the drying process and increase production capacity.

Mentoring: Ongoing technical and managerial assistance is provided to MSMEs, including training in equipment maintenance, IoT system management, and production and financial management. Furthermore, marketing assistance is provided to help SME design effective marketing strategies and utilize digital marketing to expand their markets.

CONCLUSION

The implementation of solar panel and hybrid inverter technology with an automated system at the Mie Lidi (Lidi Noodle) SME in Banjarsari Village has successfully reduced dependence on PLN electricity and reduced operational costs. This system also ensures consistency in the lidi noodle drying process even in unfavorable weather conditions. The use of renewable energy has increased production capacity by up to 25%, thanks to more efficient and stable drying, which in turn increases the SME productivity.

The implementation of this technology is supported by ongoing training and mentoring for the Mie Lidi partners, which focuses not only on equipment operation and maintenance but also on improving managerial and marketing skills. This mentoring ensures that the Mie Lidi can optimally utilize technology, manage production and finances efficiently, and expand their markets through digital marketing strategies. The implemented technology supports business sustainability and opens up opportunities for greater economic growth for the Mie Lidi in Banjarsari Village.

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