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Technology Implementation of Rice Thresher to Improve Productivity of Lestari Farmer Group in Secang District, Magelang Regency

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Abstract

One of the post-harvest rice-handling processes is threshing, which is still performed manually with a small board. This method results in longer processing times, lower processing capacity, and greater physical exertion. The community service program was implemented in five main stages: discussion, design, manufacturing, performance testing, and demonstration and trials. The program involved designing and manufacturing a rice thresher to improve the effectiveness and efficiency of the threshing process, thereby increasing processing capacity and reducing processing time. The program led to the development of a rice thresher that significantly increased threshing productivity from 60 kg/hour to 240 kg/hour. The use of a rice thresher improves the quality of the threshed product by increasing threshing efficiency, minimizing yield losses, and producing significantly cleaner grain. The fuel consumption test showed that the rice thresher consumed 0.6 L/hour at a constant engine speed of 1,200 rpm. The operational profit achieved by using the rice thresher was IDR 1,275,000 per hectare. In addition, the Lestari Farmer Group gained greater knowledge, skills, and understanding of the application of appropriate technology, particularly rice threshers. The objectives of this program were achieved through the integration of social and technological approaches. Furthermore, this initiative has enhanced the Lestari Farmer Group's knowledge and understanding.

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INTRODUCTION

The Lestari Farmer Group is located in Pirikan Village, Secang District, Magelang Regency, approximately 8 km from Tidar University. This area serves as a key source of food supplies, contributing to agricultural output through common commodities such as rice plants. The process of transforming harvested rice plants into marketable rice involves several stages crucial to ensuring high quality. Most of the post-harvest handling from start to finish is still carried out manually. In general, the post-harvest handling process for rice consists of several processes: harvesting, collecting, threshing, transportation, drying, cleaning and sorting, packaging, and storage.

Agricultural mechanization services aim to improve production technology efficiency for enhancing agricultural productivity and promoting sustainable agricultural development (Zhu et al., 2025). The post-harvest handling stage is one of the main stages in agricultural mechanization. The threshing process is a post-harvest handling stage that separates the grain from the panicles and straw by applying pressure or impact to the panicles. It is an essential pretreatment for evaluating rice yield-related traits, and the rice thresher is an important focus of agricultural machinery automation (Huang et al., 2013). Currently, the rice threshing stage of post-harvest processing is still performed manually using simple tools, such as a wooden board. The farmers must repeatedly bend over and strike bundles of rice stalks against a board to dislodge the grains; however, this manual method causes the grains to mix with leaves and stalks, necessitating a subsequent separation process (Waluyo et al., 2023). This manual process is time-consuming and labor-intensive (Pratama, 2023) and results in yield losses (Guna et al., 2024). Another drawback of the manual method is that not all rice grains detach from the stalks, as the process requires a high level of force.

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Furthermore, farmers frequently report lower back pain because threshing work is performed all day during the harvest season (Sugandi et al., 2024). The threshing process capacity of Lestari Farmer Group is only around 60 kg/hour. To overcome the issue, appropriate technology is required to enable faster threshing at higher capacities while reducing the need for manual labor. It also improves process effectiveness, which has an impact on reducing production time and costs, increasing quality, creating added value, and increasing income, which contributes to reducing production costs (Susanto et al., 2022). One solution is the use of a rice threshing machine (Pasae et al., 2023). A rice threshing machine is a device used to separate rice grains (paddy) from the straw after harvesting (Purba et al., 2025) and operates using a mechanical system driven by a power source, such as an electric motor or a fuel-powered engine that generates impact and friction forces (Sihombing et al., 2024). Mechanical threshing offers advantages such as increased speed, cleaner output, reduced physical strain on farmers (Kuswoyo, 2017), and improved grain quality (Lagia & Haluti, 2024).

Several previous studies have been conducted regarding rice threshing machines. A larger-scale thresher powered by a 5.5 hp motor has been developed; it can thresh 700–800 kg of rice per hour with a four-person operating team (Sriyanto et al., 2023). Additionally, a thresher powered by a 6.5 hp motor was designed using SolidWorks 2024 software, featuring a length of 730 mm, a drum diameter of 370 mm, and threshing teeth 8 cm in length (Hanun & Riandadari, 2021). A portable rice thresher has also been designed using a biomechanical approach to account for ergonomic factors (Suhartono et al., 2023). Other threshing machines have been shown to achieve threshing capacities of up to 126 kg/hour (Ismail, 2022). A thresher powered by an alternative energy source, specifically solar energy, has also been developed, achieving a threshing capacity of 120 kg/hour (Sumardiyanto & Prasetyo, 2021). The use of a rice thresher reduces processing time by 65.69%, energy consumption by 67.43%, and impurities in the rice by 79.52%, while increasing productivity by 205.5% (Kristanto & Widodo, 2015).

Previous research has predominantly focused on maximizing rice-threshing capacity, often at the expense of operational efficiency and mechanical flexibility. This study addresses these limitations by introducing a medium-capacity threshing machine engineered for high efficiency and operational adaptability, specifically tailored to the needs of the Lestari Farmer Group. The novelty of this community service program lies in its dual-functional design: a highly adaptable, user-friendly flexibility mechanism combined with a strategically positioned product-retrieval outlet that minimizes grain loss, cross-arranged threshing blades, and accelerates post-threshing handling.

MATERIALS AND METHODS

The specific approach taken in community service regarding the rice threshing process is the application of appropriate technology. The application of appropriate technology aims to enhance the post-harvest efficiency of Lestari Farmer Group (Hermawan & Nagoro, 2021). The program is a university outreach initiative carried out by a team of lecturers from the Applied Bachelor's program in Manufacturing Design Engineering Technology, alongside students possessing competencies in design, machining, and welding. The three participating lecturers specialize in the design and manufacturing of rice threshers. The project also involves the active participation of two students throughout the entire process, from inception to the completion of the rice thresher's implementation.

The program was carried out in five main stages: (1) discussion and observation, (2) design, (3) manufacturing process, (4) performance test, and (5) demonstration and trials of the rice thresher (Fig. 1).

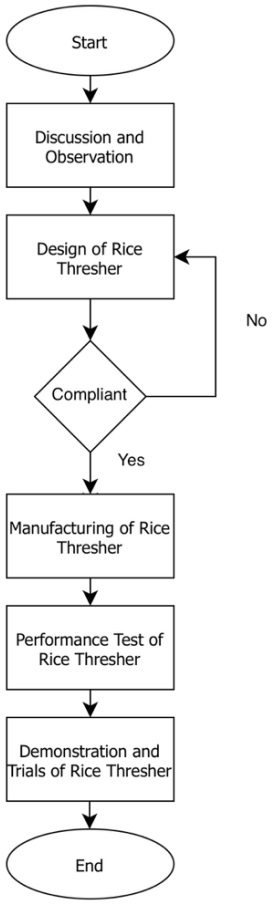


Fig.1. Flowchart of community service program

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Discussion and Observation

Discussions and observations conducted with the Lestari Farmer Group aimed to analyze the partner's situation, particularly the threshing process, which is still carried out manually. This sub-activity identified the primary problems facing the partner that require immediate resolution. The first sub-activity outlined the main challenges encountered by Lestari Farmer Group: (1) the rice threshing process is still carried out manually using a simple tool, a small board, and (2) the members of Lestari Farmer Group possess limited knowledge, skill, and understanding regarding appropriate technology, specifically rice threshing machines.

Design of Rice Thresher

Design of the rice thresher is carried out using CAD software. The specifications of the rice thresher are presented in Table 1. The diameter and length of the threshing drum of the rice thresher are 200 mm and 580 mm; the number of threshing teeth is 36 in total; the pulley ratio is 1:2; V-belts are used in transmission; and the shaft speed is approximately 1200 rpm under load. The design of the rice thresher is shown in Fig. 2. Key considerations in the design process included the configuration of the threshing blades and the discharge chute. Creating an accurate design before fabrication is a crucial step in this process, as it helps minimize errors in manufactured equipment (Eswanto et al., 2025; Eswanto & Hasan, 2022).

The machine's simple, compact functional design makes it easier for farmers to operate. At the top of the rice thresher is an intake hopper, which serves as an opening for feeding the rice into the machine. Its funnel-like shape allows for efficient loading of the rice. The threshing bin cover, located at the top, protects the internal threshing components, such as the threshing blades and the threshing shaft, while also shielding the operator from moving parts, thereby ensuring operational safety. The discharge chute is the exit point for rice after threshing; its design ensures efficient discharge. The machine is powered by a gasoline engine mounted at the bottom of the frame, which drives the threshing components. A drive shaft pulley transmits power from the motor to other critical parts of the machine. The use of cross-arranged threshing blades ensures more effective and efficient shredding of rice plants. The machine's compact size makes it easy for farmers to move around. Despite its small dimensions, the overall design is highly efficient, optimizing the available space to house all necessary components. The machine's height is tailored to the operator, sparing farmers from bending over or lifting heavy loads.

Table 1. Specifications of rice thresher

No	Specification	Details
1	Dimension	Height: 800 mm Length: 700 mm Width: 500 mm
2	Drive motor	Gasoline engine: 5.5 hp
3	Capacity	240 kg/hour
4	Speed	0-1200 rpm
5	Material	a. Frame : hollow steel 40 x 40 x 2 mm b. Bin and discharge chute: steel plate 1 mm c. Threshing roll: flat steel bar d. Threshing teeth: steel rod

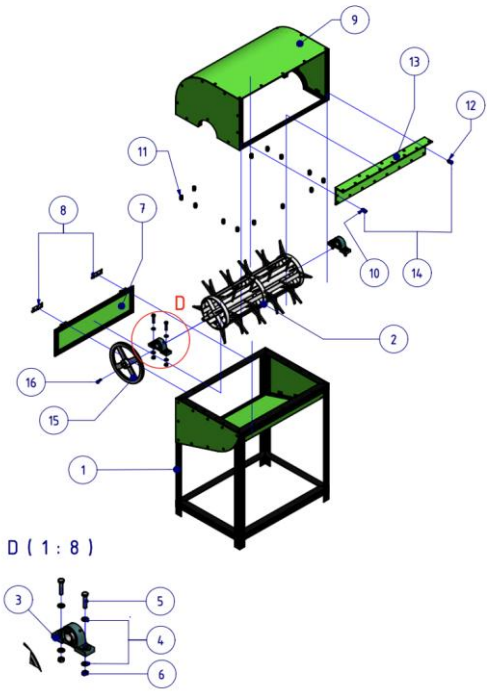


Fig. 2. Design of rice thresher

Manufacturing Process of Rice Thresher

The design of rice thresher was done and validated, the next stage is the manufacturing stage, utilizing equipment such as an electric welding machine, a grinder, and a lathe. Required materials included black steel plate, hollow steel sections, and flat steel strips. The manufacturing process involved material cutting, the production of supporting components, and the assembly of the rice thresher parts (Fig. 3).

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The result achieved from the program is a rice thresher as shown in Fig. 4. Performance testing of the rice thresher was conducted over three trial runs to evaluate the machine's operation.

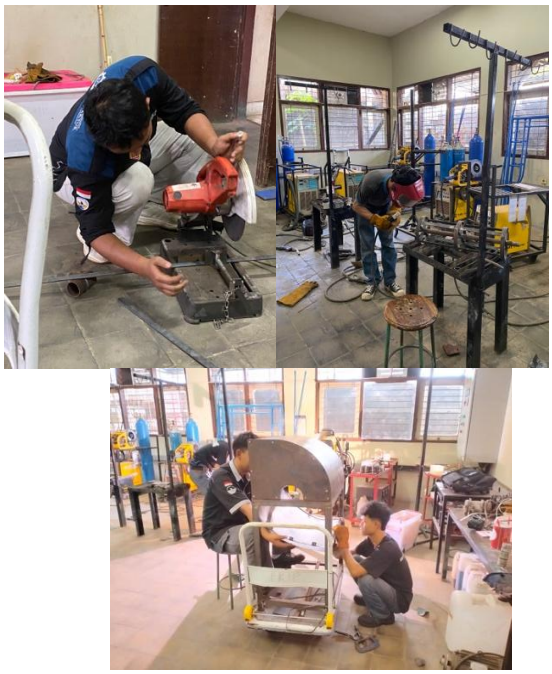


Fig. 3. Manufacturing process of rice thresher

The bin cover is made of sheet metal to contain the grain and prevent it from scattering when the bin spins, and to protect the operator from friction and rotating machine components. A threshing roll is made of a flat steel bar that separates grain kernels from straw stalks through a combination of impact force and friction as the roller spins. The threshing teeth are made of steel rods to strike and shake the rice plant into the machine. The frame is constructed from hollow steel and serves as a mounting base for the drive motor and other supporting components of the rice thresher. The discharge chute is made of sheet metal and serves as the outlet for the rice separated during threshing.

Capacity of Threshing

To calculate the threshing capacity of the rice thresher, use the formulation as mentioned below:

$$C = \frac{W_t}{t} x\ 3600 \qquad (1)$$

Where, C: capacity of rice thresher (kg/hours); W_t: weight of threshed rice collected from the discharge chute in a certain time (kg); and t: the time.

Performance Test of Rice Thresher

The primary objective of performance testing for a rice thresher is to evaluate the machine's effectiveness and work quality in separating rice grains from their stalks. More specifically, the performance test aims to assess the machine's operating capacity, minimize post-harvest losses, and analyze operational requirements, such as fuel consumption.

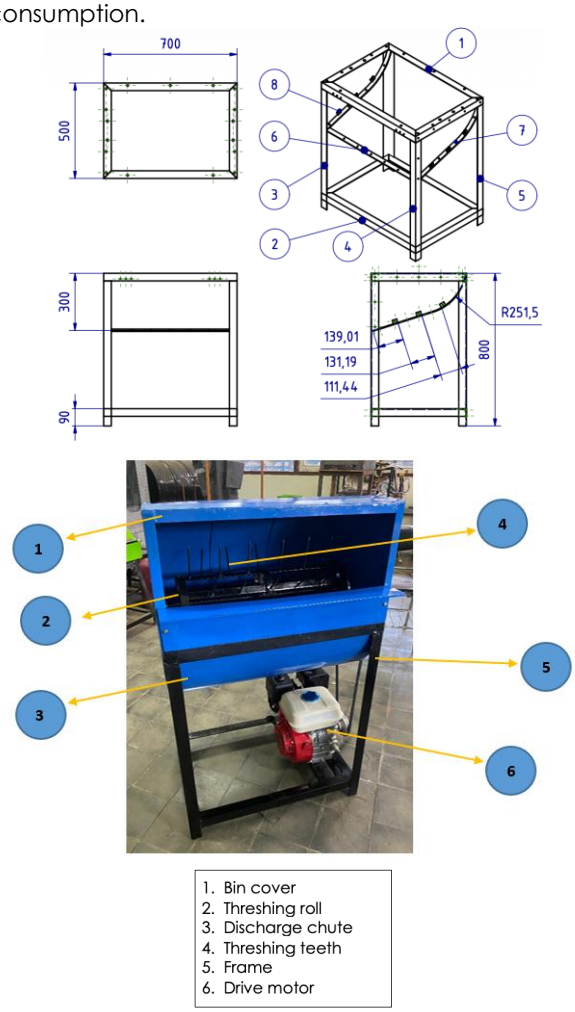


Fig. 4. Rice thresher

Fuel Consumption Test of Rice Thresher

Fuel consumption testing for a rice thresher is conducted to optimize operational efficiency and reduce post-harvest production costs for farmers. More specifically, the primary objectives of such fuel consumption tests include calculating and minimizing operational costs (economic efficiency), measuring energy efficiency, and machine performance.

Profit Calculation of Rice Thresher

Calculating the profitability of using a rice thresher aims to assess operational cost efficiency and ensure that modernizing such equipment yields a positive financial impact for farmers. The primary objectives of conducting a profit analysis for a rice thresher are to identify production cost efficiency

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(operational efficiency) and evaluate the effectiveness of reducing post-harvest losses.

Demonstration and Trial of Rice Thresher

The demonstration and trial of the rice thresher aim to ensure that the Lestari farmer group is able to operate and maintain the machine correctly. Monitoring of the program is also conducted to ensure the rice thresher functions properly, measure the level of success or target achievement in the field (Prasasti et al., 2025), and maintain efficiency in the use and maintenance of the appropriate technology provided to the community. The evaluation of the program was conducted using both qualitative and quantitative methods. Quantitatively, performance was measured in terms of rice threshing capacity (kg/hour). At the same time, qualitative insights were gathered through interviews with members of the Lestari Farmer Group to assess differences in conditions, especially in knowledge, skills, and understanding, before and after the implementation of the technology.

RESULTS AND DISCUSSION

Performance Test of The Rice Thresher

The performance test of the rice thresher aims to ensure the machine operates according to its design specifications, particularly regarding threshing capacity (kg/hour), threshing efficiency (%), grain loss (%), broken grain (%), and grain purity (%). Additionally, the testing seeks to detect potential early-stage component failures, allowing for repairs to be made before the machine is put into widespread use. This ensures optimal machine operation (Setiawan et al., 2025). The performance test results of the rice thresher for three trials are shown in Table 2.

Table 2. Comparison of grain threshing performance

Performance indicator	Manual threshing (Mean ± SD)	Rice thresher (Mean ± SD)
Threshing capacity (kg/hour)	60.00 ± 4.50	240.00 ± 8.50
Threshing efficiency (%)	90.20 ± 0.95	98.10 ± 0.55
Unthreshed grain losses(%)	5.90 ± 0.60	1.60 ± 0.18
Broken grain (%)	1.10 ± 0.20	1.35 ± 0.25
Grain purity	89.50 ± 1.45	97.80 ± 0.40

The rice thresher resulting from the program is capable of increasing the threshing capacity to 240 kg/hour from the previous capacity of 60 kg/hour. It still saves up to 75% of operational time. The threshing process that can be completed manually in 4 hours can be completed in just 1 hour with a rice thresher. Furthermore, the use of a rice thresher improves the quality of the threshed product by increasing threshing efficiency, minimizing yield losses, and producing grain that is significantly cleaner. Therefore, it provides benefits for Lestari Farmer Group.

Fuel Consumption Test of Rice Thresher

The fuel consumption test of the rice thresher was conducted using 750 ml of fuel. The fuel consumed over 15 minutes at 1200 rpm is shown in Table 3. Calculating fuel consumption is essential for optimizing operational efficiency. By conducting a 15-minute fuel consumption test, it becomes possible to estimate fuel requirements over longer periods.

Table 3. Fuel consumption of rice thresher

Time	rpm	Remain fuel
15 minutes	1200	600 ml
Fuel consumption for 15 minutes		150 ml
Fuel consumption for 60 minutes		600 ml

Mathematically, approximately 600 ml of fuel is consumed in 60 minutes. This serves as a basis for determining the optimal operating point for the rice thresher, balancing output performance against the associated costs. Increasing the rotational speed enhances threshing capacity but increases fuel consumption.

Profit Calculation of Rice Thresher

Operational profit can be increased with the implementation of a rice thresher compared to the manual process. The operational profit comes from minimum losses and operational cost efficiency. If the expected harvest yield was 4000 kg, the manual method results in a loss of approximately 10 % (400 kg), whereas using a rice thresher results in a loss of only 3% (120 kg). It means that 280 kg of unhusked rice (grain) was saved. If the price of unhusked rice is IDR 6,500 per kg, the farmer can gain an additional profit of = 280 kg x IDR 6,500 per kg = IDR 1,820,000.

In terms of operational costs, the rice thresher machine consists of variable and fixed costs. Fuel consumption is about 15 liters at IDR 13,000 per liter = IDR 195,000. Machine operator (2 people): 2 people x IDR 150,000 = IDR 300,000. Machine depreciation and maintenance are about IDR 50,000 per hectare. So, the total machine cost is IDR 545,000, and the operational profit from using the rice thresher is IDR 1,820,000 – IDR 545,000 = IDR 1,275,000.

Demonstration and Trial of Rice Thresher

Another outcome of the program is that Lestari Farmer Group gained a better understanding and

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acquired significant insight into the rice thresher through trials and short training conducted by the team. The short training aims to develop personal capabilities and facilitate learning experiences. The increase in knowledge was evaluated through interviews with 10 participants. Initially, only 4 participants were familiar with the rice thresher, but with the program, this rose to 100%, meaning 10 participants were familiar.

Assessments of the members of the Lestari Farmer Group were conducted before (pre-test) and after (post-test) the activity. These assessments were based on the ability to identify machine components (1), perform independent machine trials (2), and carry out routine maintenance (3). The details of the competence score are illustrated in Table 4 and Fig. 5.

The team received full support for this activity from the Lestari Farmer Group. The partners greatly benefited from the availability of the rice thresher, as most residents work as farmers.

Table 4. The results of farmers' pre-test and post-test

Specific competency dimension	Pre-test score (Mean ± SD)	Post-test score (Mean ± SD)	N-Gain score (Mean)
1	56.80 ± 7.47	85,20 ± 4,42	0.66
2	42.70 ± 7.38	85,20 ± 4,42	0.62
3	52.30 ± 6.60	83,20 ± 5,35	0.66

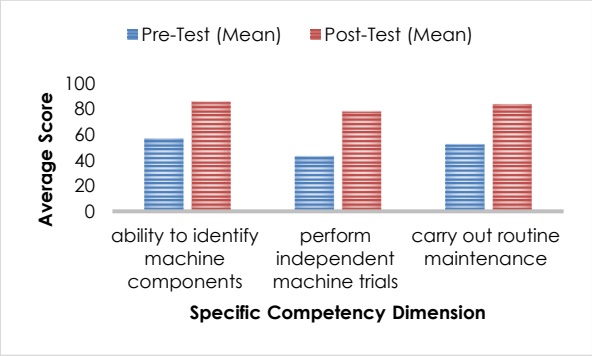


Fig. 5. Graph comparing farmers' competency performance

The smaller standard deviation value in the post-test indicates that the abilities among farmers became more evenly distributed after the intervention program was implemented. The three competencies have N-Gain scores ranging from 0.62 to 0.66. This values fall in the medium category, indicating that the intervention program substantially increased competency. The *p*-values for three specific competencies are < 0.001 (far below α = 0.05), indicating a statistically significant difference between before and after the program in these three competencies.

The rice thresher was handed over to the Lestari Farmer Group on June 25, 2026, as shown in Fig. 6. Throughout the activity, the partner demonstrated great enthusiasm, as shown in Fig. 7. The partner also expressed hope that a similar community service program would be conducted in the future. The team also conducted an evaluation to identify any challenges the partner might face when using the rice thresher. Should the partner encounter difficulties during machine operation, the team will provide further assistance. The advantages of the rice thresher developed by the team include its portability and ease of operation and maintenance.



Fig. 6. Handover of rice thresher to Lestari Farmer Group



Fig. 7. Demonstration of the use of rice thresher

Demonstration of the rice thresher was carried out to thresh approximately 60 kg of harvested rice

belonging to the Lestari Farmer Group. During the demonstration, training on machine operation and maintenance was conducted for the Lestari Farmer Group, facilitated by lecturers and students from the Applied Bachelor's program in Manufacturing Design Engineering Technology. This aimed to ensure members of the Lestari Farmer Group could properly operate the rice thresher and perform routine maintenance. The use of a rice thresher is a modern method for separating rice grains from the stalks, significantly accelerating the post-harvest process compared to traditional or manual techniques and reducing harvest losses. Furthermore, it alleviates the physical burden on farmers by saving labor and reducing physical fatigue, such as that caused by prolonged stooping during the threshing process. Ergonomics and operator safety are important factors in machine manufacturing, where enhancing safety and ergonomics is considered a key aspect of improving the sustainability characteristics of the machinery (Vigoroso et al., 2025). In this community service program, there is still a need for improvements regarding the safety of the rice thresher, particularly concerning its transmission system

CONCLUSION

The developed rice thresher has a capacity of 240 kg/hour and a power requirement of 5.5 hp. It is also equipped with a discharge chute to facilitate the collection of the threshed rice. The fuel consumption test showed that the rice thresher consumed 0.6 L/hour at a constant engine speed of 1,400 rpm. The operational profit achieved by using the rice thresher was IDR 1,275,000 per hectare. The community service activities undertaken have succeeded in boosting post-harvest productivity and reducing the physical effort required during threshing. Furthermore, the initiative has enhanced the knowledge, skills, and understanding of the Lestari Farmer Group in Secang District, Magelang Regency regarding rice threshing machinery, shifting their familiarity from the traditional manual method, which relied on small wooden boards, to modern mechanical threshing.

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