

Social and Technological Innovation in Peanut Threshing to Support Rural Farmer Welfare

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ABSTRACT

This study aims to develop and apply a peanut threshing and sorting machine made from locally available materials that is practical and easy for farmers to use. The research was conducted through several stages, including problem identification, machine design, tool fabrication, testing, evaluation, and training for farmers regarding its operation. The testing results demonstrated that the machine achieved a working capacity of 150 kg per hour with an efficiency level of 96.27%, making it approximately five to six times faster than traditional manual methods. In addition, the machine significantly reduced the level of seed damage, producing better-quality peanuts with greater market value. The implementation of this technology contributed to higher productivity, improved time efficiency, lower labor expenses, and increased farmer income. Socially, the innovation also promoted cooperation among farmers and supported greater village self-reliance. Therefore, the peanut threshing machine can be regarded as an appropriate and applicable technology with strong potential for adoption in other regions that share similar agricultural conditions.

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INTRODUCTION

The Post-harvest losses (PHL) pose a serious challenge to achieving global food security, particularly in regions still struggling with hunger and malnutrition. United Nations data (2023) indicates that more than 800 million people worldwide experience chronic hunger, and much of this shortage is directly related to food losses from harvest to before they reach consumers. According to the Food and Agriculture Organization (Khan et al., 2024), approximately 14% of global food is lost during this

stage, and in developing countries, this figure can rise to 30–40% for perishable commodities such as fruits and vegetables. These losses not only impact production volume but also reflect structural issues within the agricultural value chain—from inefficient harvesting practices and limited storage infrastructure to weak market access and minimal policy support. As a result, communities in affected areas are at higher risk of deficiencies in essential micronutrients such as vitamins A, C, and iron, which worsen overall health conditions, especially among vulnerable groups. (Sitorus, 2018)

Throughout the food supply chain, from harvest to consumer delivery, post-harvest losses occur at every stage, with approximately 14% of global food production failing to reach consumers. Losses are highest in low- and middle-income countries, primarily due to financial constraints, managerial limitations, and technical challenges in harvesting methods, storage and cooling facilities in adverse climatic conditions, and packaging and marketing systems. The potential to address food insecurity by addressing PHL is noteworthy. (Parfitt et al., 2021)

At the national level, Indonesia still faces serious problems with food loss and waste. Approximately 31.8% of the total domestic food supply is lost or wasted before reaching consumers. This figure is the highest among other agricultural subsectors. Horticultural commodities, particularly vegetables, are among the groups most vulnerable to yield loss, with losses reaching up to 62.8%. This high figure reflects structural challenges in the post-harvest system, ranging from a lack of harvesting and handling technology to weak distribution infrastructure. (Mulyawanti & Suryana, 2024)

Locally, the majority of the population relies on agriculture, particularly peanuts, for their livelihood. However, they face serious challenges in the harvesting process, particularly the manual threshing of peanuts. The harvesting process begins by uprooting the peanuts from the ground, then separating them from the stalks one by one by hand. This method does not affect the quality of the peanuts, but it is time-consuming and labor-intensive, often causing delays in processing the harvest and potentially causing damage or loss. This situation reduces farmers' work efficiency and limits their productivity and income. (Madjid et al., 2022)

The potential for peanut production in Tikung, Lamongan is actually quite substantial. Supply chain studies have recorded a planted area of approximately 240 hectares, with annual production reaching 527 tons. However, peanut productivity in dryland areas is only around 1.2 tons/ha, far below the national potential of approximately 2.5 tons/ha. This low yield indicates a reliance on traditional harvesting techniques, which are still widely used. (Sugri et al., 2024)

Several previous studies have shown technological development efforts to improve peanut harvesting efficiency. (Rojini et al., 2020) designed an electric motor-based peanut thresher that has been proven to accelerate the threshing process compared to manual methods. (Ihsan et al., 2020) developed a semi-mechanical

vertical thresher with a capacity of 22 kg/hour that is economically feasible for smallholder farmers. (Madjid et al., 2022) added an innovative hammer-based thresher with a 5.5 HP gasoline engine that is more efficient in terms of labor and harvest time.

However, most innovations still focus on increasing production capacity and the technical efficiency of the equipment. There is limited research exploring the development of peanut threshers based on local materials and easy to operate by farmers in villages. Most studies focus on large-scale, advanced technologies, such as combine harvesters, while simple, affordable, and applicable solutions at the village level are still rare. Considering the low efficiency of manual harvesting and the large potential for peanut production in Tikung, Lamongan, simple technological innovations are needed that can reduce seed damage, speed up the harvest process, and increase farmer income. Therefore, this research is expected to provide a concrete solution to reduce post-harvest losses, improve the quality and quantity of harvests, and strengthen food security and village community independence.

METHODS

This research was conducted in Tikung, Lamongan, in maret 2026. This location was chosen because the majority of the community relies on agriculture, particularly peanut cultivation, for its livelihood. Given these conditions, this village serves as a relevant representative for directly observing the problems and challenges faced by farmers in the post-harvest process. The research subjects were residents of Tikung, Lamongan who work as peanut farmers. Informants were selected purposively, namely those with direct experience in peanut cultivation, harvesting, and threshing. This was intended to ensure the information obtained accurately reflects the real conditions faced by local farmers.

Data collection was conducted through in-depth interviews with the community. The interviews focused on several key aspects, including the most time-consuming harvesting stages, the main obstacles encountered during the threshing process, and alternative solutions farmers hoped would improve their work efficiency. The collected data was then analyzed using qualitative descriptive methods. The analysis process began by reducing interview data, grouping information based on problem themes, and then drawing conclusions about the community's need for appropriate technology that suits their circumstances.

Based on the analysis, this research was conducted in several stages. First, problem identification was conducted to identify the main issues faced by farmers in threshing peanuts. Second, solutions were developed through the creation of an initial threshing machine design that took into account field needs and conditions. Third, the tool manufacturing process included assembling the frame, tube, threshing blade, and assembling the components. Fourth, trials were conducted to assess the effectiveness and safety of the tool in accelerating threshing. Fifth, evaluation and improvement of

the tool were conducted with the community based on the trial results. Finally, outreach and mentoring were conducted to ensure farmers understood how to use and maintain the machine, ensuring its sustainable use.

RESULTS AND DISCUSSION

The community service activities carried out have resulted in an innovation in the form of a peanut threshing and sorting machine with a targeted working capacity of 150 kg/hour. The presence of this innovation stems from problems in the field, where the manual process of threshing peanuts is time-consuming, labor intensive, and carries the risk of damage to the beans due to manual pressure. Through trials, the designed machine was proven to be able to operate with an efficiency of up to 96.27%, an achievement that shows this tool can be a far more effective alternative to the traditional methods still used by most farmers.

Technically, this machine is driven by a 5.5 HP gasoline engine with a rotational speed of 1387 rpm which is transmitted through a pulley system, V-belt, and gear reducer so that it produces a rotation of the drive shaft of 416 rpm. The drive shaft design uses St 60 steel material with a diameter of 30 mm, which is known to have high resistance to operational loads, thus ensuring the reliability of the machine in the long term. The selection of these specifications shows that the machine design not only pays attention to production capacity, but also aspects of durability and sustainability of use.

In addition to the technical aspects of the research results, community service activities also emphasize the use of local materials such as angle iron, WMP plate, threaded iron, axles, bearings, wire mesh, pulleys, vanbels, and light steel knives, driven by a Robin-type gasoline engine. The use of these local materials makes the machine easier to assemble, more economical, and allows for maintenance and repairs to be carried out independently by farmers. The results of the machine's operation show a significant increase in post-harvest efficiency, where farmers are able to thresh peanuts 5–6 times faster than manual methods. If previously threshing one sack of peanut stalks took 2–3 hours, now that time can be reduced to 30–45 minutes. This efficiency not only has an impact on the speed of work, but also on the quality of the harvest. The level of damage to beans due to manual threshing is drastically reduced, so the quality of the resulting peanuts is more intact, clean, and has a higher selling value.

The impact of using this machine can be seen from various aspects. Technically, the machine can increase the amount of harvest that can be processed in a day while reducing dependence on human labor. Economically, the use of the machine has resulted in lower labor costs and increased product sales value due to better seed quality. Socially, the machine increases farmers' motivation to optimize crop yields, strengthens collective spirit through shared equipment management, and opens up opportunities for broader collaboration at the farmer group level.

Overall, the design of this peanut thresher and sorter not only contributes to increased productivity, time efficiency, and crop quality, but also to increased farmer income. Furthermore, this innovation reflects the application of appropriate technology that is relevant to the needs of rural farmers and is feasible for developed and replicated on a wider scale. From an academic perspective, the success of the research is also this service demonstrates the synergy between engineering aspects, community empowerment, and the application of scientific knowledge that provides solutions to real problems in the field.

From a sustainability perspective, this machine has the potential to drive the transformation of traditional agriculture into more efficient, modern agriculture. The use of local materials in the assembly process not only reduces production costs but also strengthens farmers' independence, as maintenance and repairs can be performed independently. Therefore, the implementation of this machine is not merely a solution to post-harvest technical problems but also serves as an instrument for economic and social empowerment for rural communities. Therefore, the presence of this machine can be seen as a strategic solution in supporting the modernization of the agricultural sector, particularly in peanut commodities. This innovation not only impacts work efficiency and improves the quality of harvests but also contributes to national food security and the welfare of rural communities. Based on this foundation, the design of this peanut thresher and sorter is highly feasible for further development, testing on a larger production scale, and replication in various other regions with similar agricultural characteristics.

These results align with various previous studies. Tinambunan & Lumban Gaol (2021) concluded that a peanut thresher and sorter with a capacity of 150 kg/hour performed well and was relatively affordable. Febriansyah & Saleh (2024) emphasized that the Autodesk Inventor-based peanut peeling machine design facilitates large-scale peeling. Lengkey et al. (2021) demonstrated that the MPT001 soybean thresher reduced post-harvest yield losses to only 0.5%, significantly better than manual methods. Setiawan (2023) developed a simple peanut peeling and skinning machine with a capacity of 5 kg/hour that supports the productivity of MSMEs.

With the support of these research results, it can be confirmed that the peanut thresher innovation implemented in Pasi Ara Village, WT, has strong technical, economic, and social validity. This machine can serve as a model for the application of appropriate technology that is relevant, applicable, and sustainable.

Tinambunan & Lumban Gaol (2021) designed a peanut thresher and sorter with a capacity of 150 kg/hour, proven effective in speeding up the threshing process while improving crop quality. This research emphasized work efficiency and relatively affordable manufacturing costs, making it an effective solution for farmers. (Ketinggian, 2021), Febriansyah & Saleh (2024) developed a peanut hulling machine design based on Autodesk Inventor, featuring compact dimensions and lightweight

design. The research results showed that this machine design facilitates large-scale hulling for farmers, with a faster operation than manual methods. (Febriansyah, 2024)

Lengkey et al. (2021) studied the MPT001 soybean thresher and found that its use reduced post-harvest losses to just 0.5%. This was significantly better than manual methods, which experienced losses of 6–7%. This machine proved more efficient in maintaining the quality of the soybean harvest. (Lengkey et al., 2021) Setiawan (2023) designed a peanut peeling and grinding machine with a capacity of 5 kg/hour. This machine is easy to operate, supports the productivity of micro, small, and medium enterprises, and shows significant potential for increasing the added value of peanut-based products. (Setiawan et al., 2023)

CONCLUSION

Research and community service activities carried out in Tikung, Lamongan, have resulted in an innovation in the form of a peanut thresher and sorter with a working capacity of 150 kg/hour. The presence of this tool has proven to be able to address the fundamental problems faced by farmers, namely the threshing process which was previously still carried out manually in a slow manner, requiring a large workforce, and posing a risk of crop damage. Based on the results of the trial, the designed machine is able to work with 96.27% efficiency and accelerate threshing up to 5–6 times faster than traditional methods. This shows that this innovation is not only a practical solution, but also has high applicative value in the context of village agriculture.

The impact of using this machine can be viewed from several important aspects. From a technical perspective, this machine has been proven to increase the volume of harvest that can be processed in a single day, while maintaining the quality of peanut seeds, keeping them intact, clean, and having a higher selling value. From an economic perspective, the implementation of this machine reduces operational costs usually allocated to manual labor, and increases farmers' income through higher-quality harvests with better market value. From a social perspective, the presence of this machine encourages farmers to work more efficiently, strengthens the spirit of collectivity in collective equipment management, and encourages the formation of a more solid pattern of cooperation among farmers at the village level.

Furthermore, this innovation also has a sustainable dimension. The use of local materials in machine assembly makes this technology easy to implement, maintain, and repair by the community itself, eliminating dependence on external parties. Thus, this peanut threshing and sorting machine not only addresses post-harvest technical issues but also serves as an instrument for economic and social empowerment of rural communities.

Therefore, the design of this machine can be seen as a strategic solution in efforts to modernize the agricultural sector, particularly in peanuts. This innovation has the potential to be further developed, tested on a larger production scale, and replicated

in other regions with similar agricultural characteristics. By contributing to increased productivity, efficiency, harvest quality, farmer income, and local food security, this innovation provides a concrete illustration of the importance of implementing appropriate technology in building the independence and well-being of rural communities.

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