Technical guidance on the use of Sengon and Jabon Logging Waste as Renewable Fuel to increase the Economic Value of the Andalambe Village Forest Farmers Group, Konawe, Indonesia

Niken Pujirahayu[1], Zakiah Uslinawaty[2] Sitti Noorbaini [3],Nurrohana Ahmad[4], Lies Indriyani[5],Sahindomi Bana[6], Basrudin[7], Nurhayati Hadjar[8], Agus Setiawan[9], Abigael Kabe[10], Nurnaningsih Hamzah[11], Aura Charismailliah[12], Alfan Ananta Y[13], La Ode Muhammad Jafar Efendi[14]

[1,] *Forestry Department, Faculty of Forestry and Environmnetal Science, Universitas Halu Oleo, Kendari, Southeast Sulawesi*, Indonesia, [2] *Faculty of Applied Science, Universiti Teknologi Mara, Malaysia,* [3]*Department of Environmental Science, Faculty of Forestry and Environmnetal Science, Universitas Halu Oleo, Kendari, Southeast Sulawesi, Indonesia*

ABSTRACT

TECHNICAL GUIDANCE ON THE USE OF SENGON AND JABON LOGGING WASTE AS RENEWABLE FUEL TO INCREASE THE ECONOMIC VALUE OF THE ANDALAMBE VILLAGE FOREST FARMERS GROUP, KONAWE, INDONESIA. The International Collaborative Community Service Program, conducted by the Forestry Study Program of the Faculty of Forestry and Environmental Sciences in collaboration with the University of Technology of Mara, Malaysia, aims to: Provide training on utilizing sengon/jabon wood waste (harvested) by converting it into wood pellets as a renewable energy source; and Increase the economic value of community forests by improving the quality of primary wood and creating value-added products from waste. This community service activity is implemented through outreach and practical training on making wood pellets from sengon/jabon waste, introducing the potential of wood waste as a renewable energy source. Techniques for collecting, drying, and shredding wood waste, as well as the process of molding the shredded waste into pellets, are also covered. After this activity, community forest farmer groups can utilize and convert previously unused waste from sengon and jabon felling into wood pellet products. Environmental benefits include more sustainable forest management and reduced wood waste, which can otherwise pollute the environment. The expected benefits for the partner (UiTM) include applying existing knowledge and technology in the context of international community service and strengthening collaborative networks..

Keywords:	Community Forest, Economic Value, Renewable Energy, UiTM Malaysia, Wood Pellets, Wood Waste.

Received:	Revised:	Accepted:	Available online:
20.12.2025	25.12.2025	27.12.2025	01.01.2026

INTRODUCTION

The Community Forestry (HKm) Program is a strategic policy aimed at improving community welfare while maintaining the ecological function of the forest (Rumaday et al. 2025). The Andalambe HKm, located in Andalambe Village, Tongauna District, South Konawe Regency, covers an area of 630 ha and represents a concrete manifestation of the government's efforts to directly involve the community in forest management. The Village Forest Farmers Group is a key pillar in managing this areaan is committed to the responsible use of forest resources. As a manifestation of this commitment, farmers have planted fast-growing wood species, particularly Sengon (*Falcataria moluccana*) and Jabon (*Neolamarckia cadamba*), which have now reached a productive age of 5 to 7 years.

The 5-7 year period is a critical and highly anticipated phase in the Sengon and Jabon cultivation cycle, during which wood can be harvested to meet industrial needs, particularly for processed wood and pulp.Logging activities soon to be carried out by this Farmers Group will undoubtedly have a significant economic impact on the community. However, behind the potential income from primary wood, there are hidden problems and opportunities that are often overlooked, such as logging waste.

Logging activities are inextricably linked to waste production This waste can include defective wood, branches, twigs, trunk bases, and pieces of wood that do not meet the marketable size or quality standards. Conventionally, this wood waste is often considered worthless, left to rot at the logging site, or burned directly. This open burning practice is not only economically wasteful but also has negative environmental impacts, such as air pollution, greenhouse gas emissions, and the potential for uncontrolled fires (Nadun and Rakhmah 2022; Soenarno, Yuniawati, Dulsalam, Suhartana et al. 2023).

Thus a new paradigm needs to be introduced. Waste from Sengon and Jabon logging is not actually waste but rather a potential renewable energy resource. Wood residue from felling can be further processed into solid fuels, such as wood chips or wood pellets, which have a high market value and are in increasing demand. Converting waste into fuel not only solves the environmental problem of logging waste but also creates an additional source of added value for farmer groups that have previously wasted (Rimantho et al. 2023).

The potential of Sengon and Jabon as raw materials for wood pellets has been demostrated. Wood pellets from Sengon wood have an adequate calorific value of approximately 4.302 kcal/kg with a relatively low ash content (Setyawan 2024)(Setyawan 2024). This calorific value meets the quality standards for biomass fuel. Meanwhile, research by Lestari et al. (2019) confirmed that Jabon also shows very promising characteristics for wood pellets, with a calorific value of 4,584 cal/g and a moisture content that meets international standards. This finding is reinforced by research conducted by Nuryanti et al. (2018), who concluded that a mixture of Sengon and Jabon sawdust can produce wood pellets of good quality that meet the requirements of SNI 8021:2014 regarding wood pellets, particularly in terms of density and combustion value. Research shows that the calorific value of wood pellets is often correlated with density, with higher densities generally improving combustion characteristics and efficiency, which are crucial for meeting these standards (Nuwa and

Damanik, 2024). With these characteristics, wood pellets from Sengon and Jabon waste are not only feasible to produce but also competitive in the national and international renewable energy markets as an environmentally friendly substitute for fossil fuels.

However, this vast and scientifically validated potential remains untapped by the Andalambe Forest Farmers Group owing to knowledge and technology gaps. Farmers possess core cultivation skills but lack the understanding and technical skills required to process wood waste into economically valuable energy products. From efficient waste management techniques and proper chipper technology to drying processes and knowledge of product quality standards and marketing, this complex and unfamiliar knowledge remains a challenge. Without adequate technical assistance, this valuable harvest waste will simply end up as wood waste despite research demonstrating its high economic value.

Therefore, community service activity in the form of "Technical Guidance on the Utilization of Sengon and Jabon Logging Waste as Renewable Fuel is urgentl need ed. This technical guidance program is designed to bridge this gap by providing practical knowledge and training to the farmers group based on existing scientific evidence. Through this activity, it is hoped that farmers will not only be able to harvest their primary timber but also optimize the use of every part of the trees they have painstakingly planted. By converting waste into a high-value renewable energy source, they are expected to increase the overall economic value of their forest farming business, support the principles of a circular economy, and contribute to environmental conservation, ultimately improving the sustainable welfare of the Andalambe Forest Farmers Group.

METHOD

This activity was implemented using participatory methods and continuous mentoring, actively involving partners at every stage of the process. This method was designed to ensure that knowledge transfer is both theoretical and practical.

1. Preparation Stage (Pre-Activity)
   a. Conduct intensive meetings between community service teams from both universities (domestic and UiTMalaysia) to align the training curriculum, materials, and target outputs.
   b. A brief field survey or interviews with farmer representatives were conducted to re-map knowledge levels, specific needs, and availability of materials on site. The team went directly to the field to assess the potential of sengon and jabon in Andalambe Village, Tongauna District, and Konawe Regency.
   c. Logistics and Administration:*
     - Identify and prepare the location for practical training (e.g., a community forest area owned by partner farmer).
     - Prepare all equipment necessary for the demonstration, such as forestry measuring instruments, pruning equipment, wood chippers, and pellet machines.

2. Implementation Phase

The main training activities will be conducted in a Field School format with two core modules

Wood Pellet Production Training

Process Simulation from Start to Finish: Participants are guided through all stages of pellet production in an integrated sequence.

Project-Based Learning: Participants were divided into small groups. Each group was responsible for processing a batch of the prepared wood waste into pellets. This method encourages collaboration and collaborative problem solving.

Case Studies and Economic Analysis: Showcase successful examples of wood pellet utilization and provide a simple discussion on analyzing the profitability of waste.

Initial and Final Evaluations (Pre-test and Post-test): Conducted before and after the training to measure the participants' knowledge gains.

Skills Evaluation: Conducted through direct observation of participants' abilities during practical sessions.

Impact Evaluation (Medium Term): Conducted several months after implementation with success indicators such as:

The formation of groups or individuals who independently produce and market wood pellets.

RESULTS AND DISCUSSION

The collaborative community service program between the Faculty of Forestry and Environmental Sciences and Universiti Teknologi Mara (UiTM) Malaysia was successfully implemented and yielded several important achievements, both in terms of direct outputs and outcomes, as follows:

1. **Farmer Capacity Building**: Thirty partner farmers received comprehensive training and capacity building in Waste Conversion Technology. The participants gained skills in processing sengon/jabon wood waste into wood pellets as a renewable energy source.

2. **Prototypes and Demonstration Products**
   Wood Pellet Products: Wood pellet samples were successfully produced from sengon/jabon waste during the training session Wood pellets were made in the following stages:
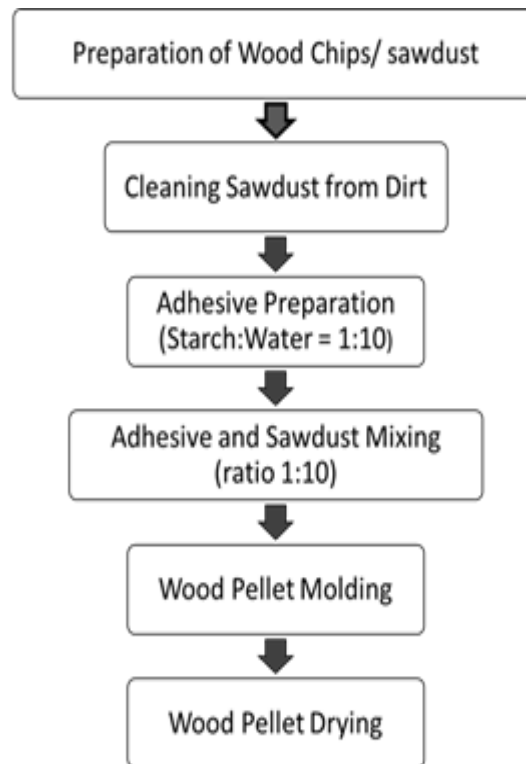
Figure 1. Wood pellet production flowchart

3. Established Networks and Commitments

A strong network was established between academics (domestic and UiTM).

Activity Implementation

Morning Session: Theoretical material on the economic potential of wood waste and the pellet-making process. The material was presented by a team from UiTM (Malaysia).

Afternoon Session: Demonstration of the pellet production process, including waste collection, shredding, adhesive production, mixing the adhesive and sawdust, and molding using a pellet machine. The participants were actively involved in each stage. This was followed by a group discussion on simple business analysis. The activity concluded with a post test and closing ceremony.

Demonstration of the wood pellet production process

Forest farmer group participants

Figure 2. Technical guidance activities for making wood pellets from wood logging waste

Sawdust of Sengon

Wood pellet

Wood Pellet Flame Testing

Figure 3. Wood Pellet Making and Wood Pellet Flame Testing

The participants were actively involved in each stage. This was followed by a group discussion on simple business analysis. The activity concluded with a post test and closing ceremony. The entire training process was participatory and interactive, with high enthusiasm among the participants.

Field Results

Based on the monitoring and evaluation conducted, the impacts and results observed in the field were as follows:

1. Significant Increase in Knowledge: The comparison of pre- and post-test results showed an average increase in participant understanding of 65%. Participants not only understood the theory but also felt confident in explaining their knowledge.

2. Immediate Technology Adoption: Several farmers began applying pruning techniques to their young sengon/ jabon trees within two weeks of training. This demonstrated a high level of acceptance and awareness.

3. Initiation of Wood Pellet Business Groups: Several farmers have taken the initiative to collect wood waste collectively and plan to establish small-scale businesses for wood pellet production. They began identifying local markets, such as home industries and brick makers, that require fuel.

4. Change in Mindset: A paradigm shift has occurred among farmers, from previously viewing waste as garbage to now viewing it as a potential source of additional income. The concept of a circular economy in community forest management is beginning to be fully understood.

5. Documentation and Replication: This activity has produced comprehensive documentation (photos and videos) that can be used as learning materials and a model for replication in other areas with similar problems.

Overall, this activity has achieved its targets. Long-term impacts, such as increased revenue from the sale of quality wood and wood pellets, are expected to begin to appear within the next 1-2 to years, in line with the commitment to ongoing mentoring.
.

CONCLUSION

Based on the entire series of community service activities, it can be concluded that

1. This community service program successfully addressed the core problem faced by partners, namely the underutilization of harvesting waste. Through an integrated approach from upstream (silviculture) to downstream (waste management), this program provides a comprehensive and applicable solution.

2. The participatory field school training model has proven to be effective in transferring knowledge and skills. The combination of theory, live demonstrations by experts, and practical practice by participants successfully increased farmers' understanding and confidence in applying this knowledge to their respective plots.

3. International collaboration with UiTM Malaysia provides significant added value, not only in terms of exchanging knowledge and the latest technology, but also in strengthening networks and global perspectives in solving local problems. This collaboration is both synergistic and productive.

4. These activities have produced concrete direct outputs in the form of increased capacity for 30 farmers, wood pellet product samples, and most importantly, a shift in farmers' mindsets regarding the economic value of quality wood and its waste. The initiation of the wood pellet business group was an early indicator of the program's success in creating new economic opportunities.

5. This program laid a strong foundation for sustainable and economically oriented community forest management. By adopting the techniques taught, farmers not only

increase their income but also contribute to environmental sustainability through efficient waste utilization.

Recommendations

Several suggestions should be considered to ensure sustainability and broaden the impact of this activity

1. For Partners (Farmer Groups):
   It is recommended to establish working groups or small cooperatives immediately to manage the wood pellet production business in a more structured manner, thereby gaining access to capital and a wider market. A continuous commitment to implementing silvicultural techniques across all planted areas is necessary to consolidate long-term results.

2. For Organizing Institutions (Faculties/Universities):
   A continuous, regular mentoring program (e.g., quarterly) is needed to monitor progress, evaluate obstacles, and provide follow-up solutions. Similar activities need to be replicated in other areas with similar community forest potentials, adapting to local conditions. The documentation can beused as a standard module. Collaboration with the wood and renewable energy industries is needed to create a stable supply chain for wood products and wood pellets produced by farmers.

3. For Regional Governments and Extension Workers:
   It is hoped that they will provide policy support and facilitation, such as assistance with shredders or pelletizers on a group scale to support farmer business independence. Thes training materials can be integrated into routine forestry extension programs to reach a wider audience.

4. For the International Network (UiTM Malaysia):
   established collaboration is expected to continue to be developed through follow-up research (action research), student exchanges, or joint scientific publications to disseminate the results and success models to an international audience.

Ethical Compliance

All procedures performed in This study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest declaration

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

REFERENCES

Lestari, Ratri Yuli, I. Dewa Gede, Putra Prabawa, and Budi Tri Cahyana. 2019. "Pengaruh Kadar Air Terhadapa Kualitas Pelet Kayu Dari Serbuk Gergajian Kayu Jabon Dan Ketapang (Effect of Moisture Content on the Quality of Wood Pellet Made from Jabon and Ketapang Sawdust)." *Jurnal Penelitian Hasil Hutan* 37(1):1–12.

Nadun, Paulus, and Diah Rakhmah. 2022. "Logging Waste Potential in Natural Forest and Its Affecting Factors." 02(01):33–41. doi: 10.29303/rimbalestari.v2i1.2081.

Nuwa and Damanik, M. .. 2024. "Pellets From Three Types of Wood As Alternative Energy Pellets From Three Types of Wood As Alternative Energy." *IOP Conf. Ser.: Earth Environ. Sci. 1421 012021*. doi: 10.1088/1755-1315/1421/1/012021.

Rimantho, Dino, Nur Yulianti, Vector Anggit, Agung Saputra, Ilhamsyah Akbar, and Anggina Sandy. 2023. "Heliyon The Strategy for Developing Wood Pellets as Sustainable Renewable Energy in Indonesia." *Heliyon* 9(3):e14217. doi: 10.1016/j.heliyon.2023.e14217.

Rumaday, Siti Masya, Ismail Munadi Sangadji, Masnia Isan, Fakultas Pertanian, Universitas Muhammadiyah Sorong, and Papua Barat Daya. 2025. "Pengelolaan Hutan Kemasyarakatan Sebagai Upaya Konservasi Dan Peningkatan Ekonomi Di Papua Barat Daya." *Agriva* 3(1):12–17.

Setyawan, Eko Yohanes. 2024. "Characteristics of Wood Pellets from Sengon Tree (Albizia Chinensis) Waste Materials for Eco-Friendly Fuel." *International Journal of Design & Nature and Ecodynamics* 19(2):691–97.

Soenarno, Yuniawati, Dulsalam, Suhartana, Sona, Jamaludin Malik, I. Wayan Susi Dharmawan, Titiek Setyawati, Eka Novrianti, Sarah Andini, Mutia Herni Ningrum, Totok Kartono Waluyo, and Pudja Mardi Utomo. 2023. "Potency , Type , and Quality of Wood Waste Harvesting Timber of Lowland Natural Forest in Two Forest Concessions in South Papua." *Journal of Ecological Engineering* 24(9):333–44.