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Revitalization of coconut shell waste management based on local community via a focus group discussion

Raynard Christianson Sanito, Markus Edison Keu, Hesti Loisa Maria Msiren, Korinus Nixon Waimbo, Roselin Naomi Devianty Wamea, Ece Febiolah Raunsay, Andronikus Asso

Department of Energy System Engineering, Faculty of Science and Technology, International University of Papua
Jl. Kamp Wolker Perumnas II, Abepura, Jayapura, Papua 99351, Indonesia

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ABSTRACT

Coconut shell waste has become an environmental challenge in rural areas of Indonesia due to limited waste management practices. However, this waste has the potential to be utilized as a renewable energy source, prompting the community service program to increase community awareness and skills in Skouw Mabo Village through the revitalization of coconut shell waste into charcoal as a value-added product. The activities included coordination with village stakeholders, field surveys, educational sessions, and Focus Group Discussions (FGDs) to explore community perceptions and identify opportunities for sustainable waste management. The results demonstrated that the community welcomed the program and implied the importance of strengthening waste management infrastructure and environmental education. Participants recognized the potential of composting and anaerobic digesters for organic waste management and identified coconut shell waste as a promising resource for charcoal and briquette production to support the transition from preexisting liquefied petroleum gas (LPG) to renewable energy. The practical demonstration encouraged active community participation in converting coconut shell waste into charcoal, reducing unmanaged waste while creating opportunities for local renewable energy utilization. Overall, the program strengthened community awareness, promoted sustainable solid waste management, and supported renewable energy development in Skouw Mabo Village.

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1. INTRODUCTION

The increasing population in a given area contributes to the generation of waste (Shoddo, 2024) particularly in developing countries where infrastructure lacks proper waste management facilities, community participations is insufficient (Asih et al., 2026), and low awareness and support from government (Asih et al., 2026; Sanito et al., 2026). Consequently, solid waste is dumped in open space (Dlamini & Zikhali, 2024), driving environmental health concerns due to improper management of solid waste (Dlamini & Zikhali, 2024; Mahmud et al., 2025). Abedin et al. (2025) reported that contaminants from solid waste causes the DNA alteration, thyroid problems, and cardiovascular disorders. Lincy et al. (2025) further added that solid waste, such as microplastics, are contaminant for the soils. Thereby, it is necessary to prevent the contamination of solid waste to the environment.

✉Corresponding Author: **Raynard Christianson Sanito:** Tel. +62 967-5171571 | E-mail: raynard_christian@yahoo.com

Skouw Mabo Village, located in Papua Province, Indonesia, faced an issue associated with improper management of solid waste. According to Sanito et al. (2026), the inhabitants of this village, which amounted to 21.043 people, are still facing a problem dealing with the coconut shell waste. Based on the observation in the field, it can be found that coconut shell waste is still dumped in open space area, specifically in the yards and streets.

In essence, the purpose of this community service is not limited to reducing the waste, but also give the residents an insight on the management of coconut shell waste. The coconut plants are widely cultivated as the main commodity of this village. Moreover, the Skouw Mabo Village also has a huge opportunity in tourism because of its beautiful scenery, Therefore, it is necessary to provide education in environmental basis on how to deal with solid waste while considering aesthetic purposes to boost the innate potential of the village.

Focus Group Discussion (FGD) is a qualitative research method that serves as a basis for providing education to participants through group discussions and the exchange of knowledge and experiences. Participants are engaged in a structured group discussion, guided by a moderator, and conducted interactive conversation to explore attitudes, perceptions, and opinions on the specific topics (Wilson, 2014). Nogueira et al. (2025) added that FGDs are able to encourage interaction and exchange of different perspective from the groups. Thus, the use of FGD delves to real perspectives of local communities associated with solid waste management.

The FGD was subsequently conducted to facilitate knowledge sharing on the existing conditions of solid waste management in Skouw Mabo Village. In addition, the discussion provided relevant information and recommendations for addressing solid waste management based on the perspectives of the local community. Particular attention was given to the management of coconut shell waste and its potential use in supporting the transition to renewable energy. The outcomes of this activity are expected to provide insights into developing appropriate solutions for managing coconut shell waste in Skouw Mabo Village.

2. METHODS

This study began with the development of questions and preparation of the educational presentation. The presentation was delivered to residents of Skouw Mabo Village, who served as the participants in this activity. Following the presentation, participants were given a series of questions to assess the perspectives and understanding of solid waste management. Most of the participants were residents of Skouw Mabo Village and belonged to the local Jayapura ethnic community. The stages of the activity are presented in Figure 1.

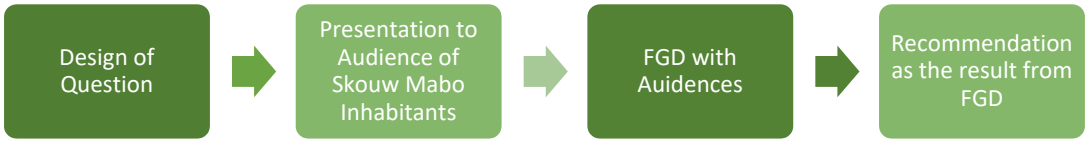


Figure 1. Activity stages

Coordination and Survey in Location

This community service was conducted in Skouw Mabo Village, Muara Tami District, Jayapura City, Papua Province, Indonesia. The focus group discussion was participated by 20 residents of Skouw Mabo Village. Prior to this community service, the coordination and agreement between the team and the head

of village. The activity was then scheduled for November 20, 2025, from 10:00 a.m. until completion. A preliminary survey was also conducted to assess the existing conditions in the area, particularly those related to solid waste management. In the duration community service activity, the team was assisted by three students.

Presentation in the Study

The presentation was conducted by the team to provide participants with knowledge about solid waste management, particularly the potential use of solid waste as a source of renewable energy. The presentation lasted approximately 30 minutes and covered the definition of solid waste, its potential impacts on human health, and recommended strategies for managing coconut shell waste. Particular attention was given to the potential use of coconut shells as a low-cost and readily available material that could be utilized by the local community.

Focus Group Discussion

At this stage, the FGD guidelines were prepared to address questions related to the perspectives of the local community. The study considered participants' gender, age, educational background, and personal history. Following the presentation, participants were given an opportunity to share the opinions and experiences regarding the topics discussed. A set of questions then provided to guide the discussion and collect the responses. The responses were subsequently summarized and discussed with the participants to identify appropriate recommendations for addressing solid waste management in the community.

Reuse of Coconut Shell Waste

In Skouw Mabo Village, coconut shell waste generated from local activities is largely unused. The village has numerous coconut trees that grow naturally, resulting in a considerable amount of coconut shell waste. Currently, the waste is often left in residents' yards without further treatment or utilization. However, coconut shells have the potential to be processed into briquettes, which can serve as an alternative to coal, reduce emissions, and support a cleaner environment (Irwan & Sitanggang, 2025; Li et al., 2026; Manolikakes et al., 2026).

The preparation of coconut shell waste into briquettes took approximately five days. This process demonstrates that the availability of coconut shell waste can serve as a valuable local resource for supporting the transition toward cleaner energy.

3. RESULTS AND DISCUSSION

Results

Description of activities

In general, the activity was conducted successfully. The local community of Skouw Mabo assisted with the preparation of chairs, food, drinks, and banners, while the team prepared the projector and computers for the presentation. Before the presentation began, the participants registered attendance with the assistance of university students (Figure 2a).

Before the presentation, the participants were also given a questionnaire to assess the initial knowledge and understanding of solid waste management. The responses provided insights into the

local community's perspectives and existing knowledge regarding solid waste management. Figure 3 presents the cover page of the presentation delivered by the team.



Figure 2. Local community services, (a) Registration of participant; (b) Filling the questionnaire; (c) Presentation activity; (d) The team answer the question from the participant

A total of 20 participants attended the activity and completed the questionnaire before the presentation began (Table 1 and Figure 2b). The oldest participant was 60 years old, while the youngest was 18 years old. The participation of individuals across a wide age range indicates the community's interest in gaining knowledge about recycling solid waste, including coconut shell waste, to support the transition toward renewable energy.



Figure 3. Cover page of presentation in Skouw Mabo Village

The analysis of the questionnaire responses showed that most participants had limited understanding of the potential of solid waste management and its application in renewable energy generation. These findings highlight the need for further education and practical guidance on utilizing locally available waste resources.

Most households do not separate organic and inorganic waste, while food waste is generally used only as animal feed. Although some community members have heard about composting and anaerobic

digesters, the knowledge of these technologies is still limited. Likewise, the participants are aware that plastic waste can be converted into renewable energy, but this knowledge also remains limited. In contrast, the participants recognized that coconut shell waste has strong potential to be directly utilized as a renewable energy resource to support the village's energy transition.

Table 1. Description of ages and gender of Skouw Mabo Villages

Respondents	Registration Number	Gender	Age
1	1	Male	18 years old
2	2	Male	23 years old
3	3	Female	27 years old
4	4	Male	23 years old
5	5	Female	21 years old
6	6	Male	44 years old
7	7	Female	33 years old
8	8	Female	36 years old
9	9	Female	50 years old
10	11	Male	65 years old
11	12	Female	45 years old
12	13	Female	38 years old
13	14	Female	35 years old
14	15	Male	60 years old
15	16	Male	53 years old
16	17	Male	43 years old
17	18	Female	18 years old
18	19	Male	42 years old
19	20	Male	42 years old
20	23	Male	21 years old

Presentation

Presentation of topics is given in Figure 2c and 2d. In this stage, brief explanations were given regarding various subjects, including sorting of dry and wet solid waste, definition of wet and dry solid waste, the reason of sorting wet and dry waste, how to produce energy from the solid waste, and technology associated with the production of energy from the solid waste.

Existing conditions in Skouw Mabo Village

Existing conditions in Skouw Mabo Village were observed during the activity. Plastic waste was found in residents' yards (Figure 4a) and along the beach (Figure 4b). In addition, a considerable amount of coconut shell waste was found in the yards near residents' houses (Figure 4c). These conditions indicate that community awareness regarding proper solid waste disposal remains limited. Waste disposal infrastructure in the village is also inadequate.

Figure 4d shows that the open burning of solid waste remains a common practice in the area. This condition highlights the need for more effective solid waste management to prevent soil contamination and other environmental impacts. Another issue concerns the waste bank that previously operated in Skouw Mabo Village. However, its activities are currently inactive, possibly due to limited operational support from the government.

Prolonged inactivity has also resulted in the deterioration of the waste bank's infrastructure, as shown in Figures 5, which depict the abandoned facility. These conditions suggest that limited government support may contribute to ineffective solid waste management in the village. The lack of

incentives and operational resources may also have contributed to the discontinuation of waste bank activities.

Documentation of the activities between the community service team and the participants is presented in Figures 6a–6c. Figure 6d shows the beach in Skouw Mabo Village, which implied certain potential for tourism development. Maintaining a clean environment and reducing solid waste can improve the area's appearance and create a more attractive setting for visitors. Therefore, the residents of Skouw Mabo Village recognized that proper solid waste management could contribute to the development of the local economy.



Figure 4. Existing conditions associated with solid waste in Skouw Mabo Villages:
(a) Plastic waste on the yard; (b) Plastic waste in Skouw Mabo Beach; (c) Solid waste from the coconut shells;
(d) Burnt waste in open space area



Figure 5. Abandoned bank waste



Figure 6. (a) Participants, the residents of Skouw Mabo; (b) The team gives the certificate of appreciation; (c) Post-activity; (d) Beach in Skouw Mabo Village as a suitable potential for the tourism activities

Potentials of solid waste

Based on the findings, the potential conversion of solid waste into renewable energy in Skouw Mabo Village is including composting and anaerobic digestion. The villagers considered composting and anaerobic digestion to be relatively simple and easy to operate, given the availability of food waste and biomass in the village. In addition, coconut shell waste represents another promising resource for renewable energy production. Its availability in the village provides a potential feedstock for further development of waste-to-energy applications.

Response of local communities

Local communities responded positively to the program and recognized the importance of improving solid waste management in Skouw Mabo Village. Based on the Focus Group Discussion (FGD), participants proposed several follow-up actions, including the development of waste management infrastructure through the establishment of recycling facilities, designated waste disposal sites, and an improved village-based solid waste management system. The community also emphasized the importance of strengthening environmental awareness by installing public information in the form of banners, providing household waste bins, and conducting continuous education and socialization in schools and government offices. In addition, participants highlighted the need to improve waste collection, reduction, processing, and recycling practices, particularly by utilizing organic waste such as coconut shells as raw materials for renewable energy production. The residents of the village also extended commitment to maintain a cleaner environment through regular community clean-up activities, including along the coastal area.

Furthermore, the participants identified several expected outcomes from the implementation of the proposed action plans in the village. These included reducing the volume of solid waste, improving waste transportation and management systems, and increasing community awareness of

the environmental and health risks associated with improper waste disposal. The participants also emphasized the importance of introducing environmental education on solid waste management from an early age through schools and community-based initiatives.

The proposed actions were expected to reduce electricity dependability through the utilization of renewable energy, improve environmental cleanliness, particularly along the village beach, and enhance the overall quality of life of the community. The villagers also expressed aspiration for Skouw Mabo Village to become a model for sustainable solid waste management in Papua Province. As a tangible outcome of the FGD, the community agreed to promote the conversion of coconut shell waste into charcoal as an alternative energy source, thereby supporting the transition toward more sustainable energy use.

Discussion

The lack of awareness, action, and infrastructure for solid waste management has become a major environmental issue in Skouw Mabo Village. However, the potential for utilizing solid waste presents significant opportunities, as the community has not yet implemented waste-to-energy or environmental applications such as composting and anaerobic digestion. Anaerobic digestion can produce hydrogen and methane from solid waste, providing a potentially low-cost source of renewable energy (Damayanti et al., 2024; Stroot, 2001; Zhang et al., 2019).

Food waste and leaf litter can be used as feedstock for anaerobic digesters. In addition, if livestock are raised in the village, animal manure can also be utilized as feedstock for anaerobic digestion and as fertilizer (Pajura, 2024). Therefore, the utilization of locally available waste resources has the potential to reduce household energy costs while also supporting agricultural productivity and increasing crop yields.

Agustina et al. (2025) demonstrated the conversion of organic waste into eco-enzyme products that can be used as organic fertilizer. Organic waste, such as fruit peels and vegetable scraps, can serve as raw materials for producing eco-enzymes. During the training activity, 9 kg of organic waste was successfully converted into 30 liters of eco-enzyme.

Similarly, Juwita et al. (2024) conducted an activity focused on processing vegetable waste into liquid organic fertilizer. The results indicated that 50 kg of vegetable waste could be processed into 250 mL of eco-enzyme. These findings demonstrate the potential for utilizing organic waste to produce value-added products while reducing the amount of waste requiring disposal.

Cellulose can also be used as a suitable feedstock for producing energy and biomass. The availability of biomass in Skouw Mabo Village provides an advantage, as the village is surrounded by forested areas. In addition, because many villagers work as farmers, there is considerable potential for utilizing locally available agricultural and organic resources (Pajura, 2024).

Hayashi et al. (2022) found that the use of water-soluble organic matter derived from animal manure in compost production can increase the uptake of essential nutrients by plants, including calcium, magnesium, and potassium. Therefore, the use of animal manure as a raw material for composting represents a promising approach to recycling organic waste while supporting soil fertility and plant growth.

To address the large amount of solid waste, the abundant coconut shell waste in Skouw Mabo Village can be utilized to produce charcoal and subsequently converted into briquettes to support the local community's transition toward renewable energy. Figure 7 illustrates the process of producing briquettes from coconut shell waste. This approach can generate socioeconomic value for the local

community while promoting waste valorization by utilizing waste generated from coconut cultivation (Alfian et al., 2025).

The local community actively participated in the production of briquettes from coconut shell waste available in the village. First, coconut shell waste was collected from residents' yards and dried to reduce its moisture content. The dried shells were then burned to produce charcoal, which was subsequently crushed into smaller particles and processed into briquettes. This process demonstrates the potential of coconut shell waste as an alternative renewable energy resource that could partially reduce household dependence on LPG. For example, using coconut shell briquettes for cooking could help reduce household energy expenses by decreasing the need to purchase LPG. Therefore, the availability of coconut shell waste provides a valuable local resource for waste valorization while supporting the transition toward more sustainable energy use.



Figure 7. The process to create the charcoal as the potential material of briquettes as the new source of energy for local communities

4. CONCLUSION AND RECOMMENDATIONS

The community service program aimed to provide information, insights, and knowledge to participants regarding solid waste management in Skouw Mabo Village, Muara Tami District, Jayapura City, Papua Province, Indonesia. The presentation provided the local community with greater understanding of solid waste management and the potential utilization of coconut shell waste. However, further assistance and mentoring are needed to support the community in implementing proper solid waste management practices. Government support is also needed to address the issue of coconut shell waste and promote a cleaner environment while facilitating the adoption of renewable energy solutions. The FGD successfully provided new insights and improved the community's understanding of coconut shell waste management. The revitalization and utilization of coconut shell waste can be further developed through collaboration among local residents, the government, and other relevant stakeholders. The implementation of appropriate technologies has the potential to help the community

address coconut shell waste issues, although further studies and analysis are required to determine the most suitable technologies and implementation strategies. As part of the renewable energy transition, the community of Skouw Mabo Village has begun utilizing coconut shell waste through waste valorization. The production of coconut shell briquettes represents a tangible outcome of the community service program and provides an alternative energy source while supporting the sustainable utilization of local waste resources.

This community service program was limited to raising community awareness and identifying the potential utilization of coconut shell waste through educational activities and Focus Group Discussions. The technical implementation of waste processing technologies and supporting infrastructure has not yet been carried out comprehensively. Therefore, several recommendations are proposed for future community service programs. First, environmental education on solid waste management should be expanded to elementary, junior high, and senior high schools to foster environmental awareness from an early age. Second, collaboration with the local government should be strengthened to support the provision of waste management facilities, such as waste bins, information banners, and the development of community-based waste banks. Third, future programs should focus on implementing appropriate technologies for waste utilization, including composting, anaerobic digestion, eco-enzyme production, fermentation, black soldier fly (*Hermetia illucens*) larvae cultivation, and the conversion of coconut shell waste into charcoal and briquettes. Lastly, continuous training and mentoring are recommended to improve community capacity in producing value-added products from coconut shell waste, thereby supporting sustainable solid waste management and renewable energy development in Skouw Mabo Village.

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