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Empowering Urban Community in Kediri through Training to Convert Used Cooking Oil into Eco-Friendly Soap

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ABSTRACT

This paper discusses waste management in urban areas, with a focus on household liquid waste, particularly used cooking oil. Households are the largest contributors to waste in Indonesia, and cities tend to generate more waste than rural areas. Waste management in urban settings includes stages such as collection, sorting, recycling, composting, incineration, and public education. The community service team from the Faculty of Agriculture, University of Kadiri, initiated educational and training activities on household liquid waste management in Kediri City, specifically targeting used cooking oil. The activity aimed to empower the urban community, particularly residents of Persada Sayang Housing, to convert used cooking oil into soap products. Persada Sayang Housing was selected due to its central location in Kediri City and its residents' active involvement in waste management, as demonstrated by the existence of a local waste bank (Bank Sampah). The program involved needs identification, planning, resource mobilization, implementation, evaluation, and coaching to ensure sustainability. As a result, all 25 participants successfully produced solid soap from used cooking oil. Based on the questionnaire results, 80% reported increased knowledge and skills, and all participants expressed commitment to applying the practice in their homes. This finding suggests that with proper education and community involvement, household liquid waste can be effectively managed and transformed into value-added products. The success of this initiative highlights the importance of collaboration between the government, waste management agencies, and communities in improving urban waste management practices.

Keywords: community empowerment, household byproducts, oil-based soap production, sustainable waste management, urban sustainability

BACKGROUND

In Indonesia, household waste constitutes approximately 70% of the national waste volume, including both organic (e.g., food scraps) and inorganic (e.g., plastic, metal) waste. According to data from the Indonesian Ministry of Environment and Forestry (2022), around 70% of the total volume of waste generated in Indonesia comes from households. Several factors cause households to produce the most waste. First, the household population in Indonesia is very large, so the amount of waste generated by each household collectively becomes a significant amount. In addition, people's consumption patterns also play a role in the high volume of household waste. Increasing urbanization, changing lifestyles, and rising levels of consumption have led to an increase in purchases of products and packaging, which in turn has increased the amount of waste generated.

In general, urban areas tend to produce the most waste compared to rural areas in Indonesia. Some of the factors that cause this are population density, lifestyle and consumption, and waste management infrastructure. Cities in Indonesia generally have a higher population density than rural areas. A dense population in a limited area means that there are more households, businesses, and institutions that generate greater amounts of waste (Kediri City Regional Regulation Number 3 of 2015 Concerning Waste Management, 2015). Urban lifestyles tend to be more consumptive, with easier access to various products and

services. High consumption often results in more packaging, single-use products, and non-organic waste (Annur, 2023). Meanwhile, in rural areas, lifestyles are often simpler and rely more on natural, organic ingredients. Furthermore, urban areas usually have a more complex waste management infrastructure compared to rural areas. There are more regulated waste collection systems, more advanced waste processing facilities, and more recycling and treatment options. This can actually encourage awareness and action on better waste management in urban areas.

Waste management in urban areas involves a series of steps to manage waste efficiently and responsibly. According to Penebar Swadaya (2008), there are several general stages in waste management in urban areas. The first is the collection stage. This stage involves collecting waste from households, offices and public places. Usually, waste is collected by waste collectors using transport trucks or special containers. The next stage is sorting. After collection, waste is taken to a processing facility, where waste is sorted and segregated. At this stage, recyclable materials such as paper, plastic, metal and glass are separated from organic and non-recyclable waste. At the recycling stage, recyclable waste is then processed through steps such as washing, grinding and purification so that it can be reused (Mariyono et al., 2022; Probojati et al., 2022). This recycling process helps reduce the use of new natural resources and reduces the amount of waste that pollutes the environment. Organic waste such as food scraps and leaves can be processed through the composting stage (Lisanty et al., 2021; Lisanty & Junaidi, 2021). This organic waste is placed in a special composting pile or tub, where bacteria and microorganisms break it down into humus which is useful as a natural fertilizer for plants.

Waste that cannot be recycled or processed through composting can be burned in waste processing plants equipped with waste processing technology. This activity is part of the Incineration and Final Disposal stage. This process produces heat energy that can be used to generate electricity. The remaining ash from burning is usually sent to a secure landfill. The last stage is Education and Public Awareness. The importance of good waste management and the application of recycling practices needs to be emphasized in urban communities. Educational campaigns and waste reduction programs can help increase public awareness of the importance of maintaining cleanliness and the environment.

While urban waste management systems are more advanced, household liquid waste, such as used cooking oil, is often neglected and discharged improperly, leading to environmental damage. Management of household liquid waste is very important because liquid waste can harm the environment and human health if not managed properly (Subekti, 2009). Liquid waste that is not managed properly can pollute the environment, especially if it is discharged directly into rivers, lakes or other waters. Chemicals or toxic substances in the liquid waste can damage aquatic ecosystems, affect the life of aquatic organisms, and disrupt the ecological balance (Sunarsih, 2014). With good management, household liquid waste can be reduced, processed and reused safely and sustainably. This helps protect the environment, safeguards public health, and relieves pressure on increasingly limited water resources.

Waste management in urban areas involves cooperation between the government, waste management agencies and the community (Yogiesti et al., 2010). Continuous efforts are needed to reduce the amount of waste generated, increase processing efficiency, and reduce the negative impact on the environment. The government and various parties continue to increase awareness and implement good waste management practices in all sectors, both households and industry. This effort involves waste reduction, recycling, efficient processing, and public awareness campaigns to manage waste properly to maintain environmental cleanliness and sustainability.

To address this issue, the community service team from the Faculty of Agriculture, Kadiri University, initiated a training program to convert used cooking oil into solid soap—a method that is simple, affordable, and environmentally friendly. The term "eco-friendly" refers to the use of waste materials without hazardous chemicals and the resulting reduction in environmental pollution. The activity also builds on previous efforts involving aromatic candle production, offering diversified and sustainable waste management practices. This activity builds upon previous initiative which trained the same community to recycle used cooking oil into aromatic candles (Andajani et al., 2024). The current project introduces a different product (solid soap) and reinforces

sustainable behavior through diversification of recycling practices.

Based on the preliminary field assessment conducted by the team, it was estimated that each household in Persada Sayang Housing, a housing complex in the centre of Kediri City, produces approximately 1 to 1,5 liters of used cooking oil per week. With over 80 active households in RW 03, the total waste cooking oil generated could reach around 80–120 liters weekly. Prior to this training, most residents disposed of used cooking oil by pouring it directly into kitchen sinks or drainage systems, which contributes to environmental pollution. A few residents reused the oil multiple times for frying, but no structured reuse or recycling practices were identified.

The purpose of this activity is to educate urban communities, namely the target community residents of Persada Sayang Housing, to be able to manage household liquid waste, especially used cooking oil, into soap products. Kediri City was chosen because it is one of the Adipura cities in Indonesia, but until now it is still facing waste problems (Government of Kediri City, 2022b). In the City of Kediri, waste management is managed by the Sanitation and Landscaping Service of the City of Kediri (Government of Kediri City, 2022a).

METHOD

Community Profiling and Needs Assessment

Community service activities were conducted involving the target community, namely residents of Persada Sayang Housing, Kediri City, particularly in RW 03. The implementation team consisted of two lecturers and six students from the Faculty of Agriculture assigned by LP3M of Kadiri University. The lecturers served as program coordinators and lead facilitators, responsible for designing the training modules, supervising the implementation, and conducting evaluations. The students supported community outreach, prepared materials and equipment, documented the activities, and provided hands-on guidance to participants during the soap-making sessions.

The team identified community needs through direct observation and informal interviews to understand the problems and challenges faced by residents. Community members were actively involved in this stage, where their aspirations and input were considered. Based on the findings, the team developed a structured program plan with specific goals, target outcomes, and relevant activities. Community representatives were engaged in the planning process to ensure the program's relevance and acceptability.

Training Preparation

To implement the program, the team mobilized necessary resources. These included human resources (lecturers, students, local officials, and volunteers), financial support (institutional funding), and physical resources. The materials prepared included used cooking oil, sodium hydroxide (NaOH), mixing containers, spatulas, molds, digital scales, gloves, aprons, safety goggles, and instructional brochures.

Participants were informed in advance not to bring personal equipment, as the team provided standardized tools to ensure safety and consistency. On the training day, several participants assisted in arranging the workspace, which fostered engagement and ownership.

Training Implementation

The training session was held on Sunday, February 12, 2023, in the communal open area of RW 03. The session began with a welcome from the Head of RW and was attended by 25 residents, primarily women. Activities included:

1. A short lecture on household liquid waste and its environmental impacts,
2. A live demonstration of the cold-process soap-making technique,
3. Guided hands-on practice,
4. An interactive Q&A and reflection session.

The soap-making process followed a standard cold-process saponification method, which is safe and suitable for home application. The detailed steps are as follows:

1. Preparation of Lye Solution: Dissolve 60 grams of sodium hydroxide (NaOH) in 150 ml of clean water. This step should be done carefully, and the solution should be left to cool.
2. Oil Filtering: Strain 200 ml of used cooking oil to remove food particles and impurities.
3. Mixing: Slowly add the lye solution into the used oil while stirring continuously. A hand mixer or spoon was used to combine the two until the mixture reached a thick consistency (called “trace”).
4. Additives (Optional): After tracing, participants could add optional ingredients such as rose fragrance or food-grade

coloring to enhance the soap's appearance and scent.

5. Molding: The mixture was then poured into silicone soap molds and left to rest undisturbed for 24–48 hours until it solidified.
6. Curing: The solid soap was removed from the molds and left to cure in a dry, ventilated space for 3–4 weeks before use, to allow the saponification process to complete and reduce alkalinity.

All steps were conducted under supervision, and participants were required to use gloves, aprons, and safety goggles for protection.

Monitoring and Evaluation

To evaluate the effectiveness of the training, the team developed a structured questionnaire consisting of both closed and open-ended questions. The questionnaire aimed to assess three main aspects: (1) perceived usefulness of the training, (2) participants' knowledge and skills related to soap-making, and (3) their commitment to applying the practice at home. The questions were designed in simple language to ensure clarity and accessibility for all participants.

The questionnaire was distributed at the end of the training session and collected immediately after completion. Participant responses were analyzed quantitatively using percentage-based summaries, and qualitative feedback was also reviewed to gain insights into suggestions and perceived challenges.

Monitoring and evaluation were conducted immediately after the training session and again one month later through follow-up communication with selected participants. The initial evaluation took place on the same day as the training, using structured questionnaires to assess the achievement of program objectives, changes in participants' knowledge and behavior, and overall satisfaction.

To support sustainability, the team scheduled one follow-up visit and maintained communication through messaging groups for three months after the training. During these follow-ups, participants were encouraged to share their experiences, challenges, and progress in continuing soap production independently.

The evaluation process was designed to occur at least twice—immediately post-training and one month later—with potential additional mentoring upon request. Community input was also gathered during each follow-up to refine future program designs. This ongoing interaction aimed to ensure that the skills and knowledge imparted would be retained and applied long-term.

RESULTS AND DISCUSSION

The training successfully reached the intended number of participants, with all 25 targeted residents attending and completing the session. The full participation rate indicates that the target was fully achieved. Moreover, feedback collected through post-training questionnaires confirmed that the content was well-received and the participants were highly engaged in both the theoretical and practical components.

The activity began with an introduction to the importance of managing household liquid waste, specifically used cooking oil, followed by a live demonstration on how to convert it into solid soap. The team explained the saponification process, safety procedures, and the proper use of personal protective equipment (Fig. 1a). After the demonstration, the participants conducted hands-on practice under the supervision of the facilitators, measuring, mixing, and stirring their own soap formulations. The team provided counselling about the dangers and safety of the processing method and explained the use of safety equipment, precautions, and safety measures that need to be followed (Wardani et al., 2021). The team also distributed brochures on steps for making soap, as shown in Figure 1b below.

Figure 1(a). Preparation of training equipment and materials and introduction to trainees; (b) Brochure of soap making work steps distributed to trainees

Next, the team explained the steps of making soap from used cooking oil. The training applied the saponification process, which is a well-established chemical reaction between triglycerides (found in used cooking oil) and an alkali solution, typically sodium hydroxide (NaOH), to produce soap and glycerol. This method was chosen because it is scientifically proven to be an effective and low-cost approach to recycle used cooking oil into a value-added product. Saponification does not require advanced technology or expensive materials, making it suitable for household-scale application. Moreover, the resulting soap can be safely used for cleaning purposes, contributing both to waste reduction and improved sanitation. Studies have shown that saponification is one of the most sustainable methods for converting lipid-based waste into reusable materials (Arlofa et al., 2021; Lubis & Mulyati, 2019). The rest of the team took turns explaining the proper proportions of ingredients and providing information about choices of dyes, fragrances or other additives that could be used in soap making (Anindita et al., 2022; Lisanty et al., 2022; Mardiana, 2020).

After the lecture, a demonstration process was carried out. The team member in charge of the demonstration directly showed the steps in making soap. Residents are taught how to measure ingredients, mix used cooking oil, lye, and water properly, and stir the mixture until it reaches the thickening stage (Bidilah et al., 2017; Erviana et al., 2018). Additional explanations were provided by other team members regarding detailed explanations of changes in color, texture, and temperature during the process (Hajar et al., 2016).

After the demonstration stage was over, the team allowed participants to try making their soap with supervision and guidance. Teams let them measure ingredients, mix, and stir their soap mixture. Figure 2a illustrates participants actively engaged in the soap molding process. The team just needs to make sure they are following the correct procedures and using the safety equipment properly. Figure 2b showcases the final eco-friendly soap products, hardened and ready for use, which were successfully produced from recycled cooking oil. These soaps are presented in distinct variations, incorporating natural essential oils such as lemon, lavender, and apple, and utilizing different colorants to differentiate the scents.

Following the practical session, a discussion and Q&A session was held to allow participants to clarify doubts and share experiences. A feedback questionnaire was then distributed to evaluate the effectiveness of the training. The results showed that 100% of participants found the activity helpful and expressed a commitment to continue practicing soap-making at home. Additionally, 80% reported increased knowledge and practical skills, while 20% indicated a more positive attitude but acknowledged they still needed further practice for sustainable application. The training ended with a summary of conclusions and an emphasis on the importance of managing used cooking oil in an environmentally friendly manner (Handayani et al., 2021; Hanjarvelianti & Kurniasih, 2020). Evaluation is carried out to get feedback from participants about the quality and effectiveness of the training using a questionnaire.

Figure 2. a) Soap molding activity from used cooking oil
b) Produced soap products with various essential oil and different colorant variants

This initiative builds upon a previous community service activity conducted by the same team, where residents of Persada Sayang Housing were trained to recycle used cooking oil into aromatic candles (Andajani et al., 2024). The current project introduces a different product—solid soap—demonstrating a broader application of waste management techniques and encouraging behavioral change through variety and creativity.

Compared to aromatic candle-making, which is more aesthetic and optional, the transformation of used oil into soap provides a more essential household utility product, with broader potential for daily use and even micro-entrepreneurship. This strategic diversification of end-products can help sustain community interest, reduce waste, and potentially generate economic value.

Concerning the evaluation of the shortcomings of the soap, team acknowledged that while the visual presentation (Fig. 2b) indicates aesthetically pleasing products, a comprehensive assessment of potential shortcomings requires specific physicochemical analyses. Based on general challenges in handmade soap production from used cooking oil, potential shortcomings could include variability in consistency and hardness, curing time and water content, scent retention, potential for rancidity (long-term), and lathering properties.

Due to the inherent variability in the composition of used cooking oil and manual production, consistency and hardness may vary slightly between batches. Inadequate curing time can lead to softer soaps with higher water content, potentially affecting durability and longevity. Moreover, the natural essential oils, while providing pleasant aromas, might exhibit reduced scent retention over extended periods compared to synthetic fragrances.

Although saponification neutralizes most fatty acids, residual unsaponified oils, if any, could potentially lead to rancidity over very long storage periods, especially if not cured properly. While efforts are made to optimize the recipe, the lathering properties might differ slightly compared to commercially produced soaps.

To address these, future work will include detailed quality control measures, such as pH testing, hardness tests (e.g., using a penetrometer), lather volume assessment, and stability tests under various environmental conditions. This will provide quantitative data to identify and mitigate any shortcomings effectively.

The results of processing the questionnaire data are shown in Table 1 below. Table 1 shows that all participants felt the benefits of this cooking oil processing education and training activity. All participants also committed to continuing the practice of processing used cooking oil and making soap in their respective environments after the training was completed. 80% of participants acknowledged that education and training not only increased their knowledge but also increased their ability and creativity in making new works from waste. 20% of participants felt that their knowledge had increased and their attitude towards household waste management had become more positive. However, they feel that they are still not fully able to sustainably make soap from used cooking oil in the future.

Table 1. Results of processed questionnaire data distributed to training participants

No	Questions	Trainees Response	Percentage (%)	Trainees' Comments and Suggestions
1.	The benefits of today's educational and training activities.	a. Very helpful b. Moderate benefits c. Useless	100 0 0	To hold training on processing liquid waste into other new products.
2.	The commitment of participants to apply the results of educational and training activities in their environments.	a. Yes b. Maybe c. Nope	100 0 0	Participants realized that all this time it was wrong to dispose of liquid waste directly into waterways.
3.	Increased knowledge, skills, and changes in participants' attitudes towards used cooking oil and soap making.	a. Increasing knowledge b. Increasing skill c. More positive attitude d. All three improving e. None	100 80 100 95 0	Participants felt that education greatly increased their knowledge, understanding, and attitude towards used cooking oil management, however, a small number still felt that they were unable to apply soap making (this new skill) in a sustainable manner.

The team ended the activity by distributing soap products that the team had made one month before the activity. The participants seemed happy because they received souvenirs, not only in the form of new knowledge and skills but also in the form of products that they could use in their respective homes. The team asked the participants to follow safety rules, maintain cleanliness, and recycle used materials during the training. Some of the participants who were still at the training location were then invited to document the activity by taking a group photo (Fig. 3).

The findings also reinforce that effective community training not only improves knowledge but can shift perspectives and practices regarding environmental management. By providing practical skills that are immediately applicable in the household context, such programs empower residents to become active agents in promoting sustainability.

Moreover, this activity supports local environmental goals, as Kediri is recognized as an Adipura city, yet continues to face challenges in waste management. Simple household-based interventions like this contribute meaningfully to broader municipal waste reduction targets while fostering grassroots environmental awareness.

Figure 3. Group photo with some of the training participants

CONCLUSION

The community service activity successfully achieved its objective of educating and empowering residents of Persada Sayang Housing in the management of household liquid waste, particularly used cooking oil. Through structured training, live demonstrations, and hands-on practice, participants not only gained new knowledge but also practical skills in converting waste into valuable soap products. Post-training evaluations showed that all participants found the program helpful, and 80% demonstrated improved understanding and ability in sustainable waste processing. Furthermore, all participants expressed their commitment to applying these practices in their households, indicating a positive behavioral shift in waste management awareness. This outcome confirms that the activity was effective in increasing community awareness and capacity in household waste management, and it offers a replicable model for similar urban communities seeking to reduce environmental impact through community-based education.

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