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Utilization of Used Cooking Oil in Pamijahan Village Through the JELITA Program (Used Cooking Oil as Liquid Plant Fertilizer)

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ABSTRACT

Background: This community service addresses the dual issues of household waste management and the sustainability of agricultural inputs in Pamijahan Village, Bogor Regency. The focus is on the problem identified by the Environmental Home Group (KRL) and Women Farmers Group (KWT): the utilization of community-sourced used cooking oil to support local agricultural activities, a need also emphasized by the Village Head.

Purpose of the Study: The purpose is to implement and evaluate the JELITA Program, which aims to process used cooking oil into liquid organic fertilizer. The objectives are to provide a practical waste management solution, reduce farmers' agricultural costs, decrease reliance on chemical fertilizers, and enhance community skills in sustainable practices.

Methods: The method involved a practical production process: collecting used cooking oil, mixing it with molasses, EM-4, and rice bran, and fermenting the mixture for 20 days.

Results: The activity successfully converted 2 liters of used cooking oil into 6 liters of liquid organic fertilizer at a production cost of Rp 40,002 per liter. It resulted in a 15% reduction in fertilizer costs for participants and helped meet local fertilizer needs, thereby reducing dependency on chemical fertilizers. The program demonstrates a viable alternative for household waste management, though challenges in public awareness and facility limitations were noted.

Keywords

Used Cooking Oil, Liquid Fertilizer, Waste Management, Community Empowerment

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Introduction

Cooking oil is produced from plants such as coconut, grains, nuts, corn, soybeans and canola, which certainly provide many benefits to the community (Inayati & Dhanti, 2021). However, in its application, the use of cooking oil in the frying process will produce waste in the form of used cooking oil. Generally, Indonesian people just throw away used cooking oil into the environment. In fact, if managed properly, used cooking oil can be used as a secondary raw material for non-food products and provide economic benefits (Faimi & Tampubolon, 2023). In Bogor Regency, the average used cooking oil production per household is estimated to reach 9.42 L/year², where if it is thrown into the environment (water and soil) it tends to be difficult to decompose, thus having a negative impact on soil fertility and the quality of minerals in clean water sources (Damayanti et al., 2020).

The Environmental Home Group (Kelompok Rumah Lingkungan – KRL) and The Women Farmers Group (Kelompok Wanita Tani – KWT) in Pamijahan Village, Bogor Regency face problems related to used cooking oil, where some of the problems that often occur include improper disposal of used cooking oil, difficulties in managing/recycling used cooking oil, health problems related to repeated use of used cooking oil, and lack of knowledge about the potential use of used cooking oil. KRL and KWT, supported by the Pamijahan Village Government, continue to explore the right solutions in utilizing used cooking oil, which can certainly benefit the community in Pamijahan Village.

One effort to prevent environmental pollution is to use used cooking oil waste to produce products with utility value. This step can be an effective alternative to reduce pollution levels. Various innovations have been made in utilizing used cooking oil, such as using it as a material for making aromatherapy candles, white cement candle molds, organic fertilizer and solid soap (Pinandita et al., 2024; Silaban, 2023; Erlinawati et al., 2020; Bachtiar et al., 2022; Widyawati & Hidayah, 2022), and as a raw material for cerosene production (S & P, 2017) and biodiesel production (Moazeni et al., 2019). Previous research has focused on technical aspects but lacked an exploration of integrated community empowerment models. Comparative analysis of why liquid fertilizer is more suitable for the Pamijahan context: (1) Biodiesel requires high technology and investment that is unaffordable for the community; (2) Soap has a limited market and high competition with commercial products; (3) Liquid fertilizer addresses the direct needs of KWT as an active farmer group; and (4) Liquid fertilizer production is simpler and can be done with local equipment. Although various studies have explored the use of used cooking oil for biodiesel (Moazeni et al., 2019) and soap (Widyawati & Hidayah, 2022), there is a significant gap in the literature regarding: (1) integrated community empowerment models linking waste management with local food security, (2) economic and social viability of used cooking oil-based liquid organic fertilizer in rural community contexts with limited resources, (3) participatory strategies to overcome barriers to adopting simple technology in the context of local wisdom. The JELITA program fills this gap by integrating waste management, sustainable agriculture, and economic empowerment into in holistic model tailored to the local capacity and needs of Pamijahan Village, where KWT plays a central socio-economic role but faces limited access to affordable, environmentally friendly agricultural inputs.

Based on the illustration above, in the community service activities carried out in Pamijahan Village, Bogor Regency, focused on using used cooking oil as fertilizer through the JELITA Program (Used Cooking Oil as Liquid Plant Fertilizer). JELITA offers a solution by processing used cooking oil into organic liquid fertilizer useful for the agricultural sector while reducing pollution. This program is designed to reduce the use of cooking oil that has the potential to pollute the environment, while producing useful products in the form of organic liquid fertilizer. In addition, this program aims to increase village communities' awareness of the importance of sustainable, environmentally friendly household waste management. This program also provides

affordable and quality fertilizer alternatives to support the local agricultural sector. Through liquid fertilizer production training, JELITA is expected to empower village communities by creating opportunities for sustainable economic independence.

Method

This community empowerment program was implemented in Pamijahan Village, Pamijahan District, Bogor Regency, from June to September 2022. This activity involved 20 partners, including KWT, KRL, and other village communities, who were interested in using used cooking oil waste to produce liquid organic fertilizer. The collection of used cooking oil, the main ingredient in making liquid fertilizer, was carried out with active participation from village residents, especially productive-age residents. Participants were selected based on their significant contribution to the production in used cooking oil waste from daily household activities. The location of the activity was chosen because of the high potential for household waste in the form of used cooking oil produced by the local community, as well as the high need for quality organic fertilizer to support local agricultural activities.

This program aims to have a positive impact on the community through improved household waste management, while providing an environmentally friendly, cost-effective fertilizer alternative. This activity begins with preparing tools and materials, including basins, large and small mineral water bottles, small hoses, measuring cups, sieves, and used cooking oil, water, molasses, EM-4, and rice bran. All tools and materials are prepared according to the needs to ensure the smooth process of making liquid organic fertilizer. The tools used to make liquid organic fertilizer from used cooking oil consist of several simple components. First, used bottles function as containers for the fermentation process. The bottle cap is perforated to allow the hose to be placed. This hose plays an important role in channeling the gas produced during fermentation into small aqua bottles filled with water, functioning as a seal to avoid contamination from outside air. A glue gun is used to attach the hose to the used bottle, ensuring a tight, leak-free connection. The manufacturing process begins by ensuring the used bottle is clean, then drilling a hole in the bottle cap to the size of the hose. After that, the hose is attached to the hole made, and the end is inserted into a small aqua bottle filled with water. Mix used cooking oil with other organic materials in a used bottle and leave it for several weeks to ferment, producing organic liquid fertilizer. The goal is to control the temperature during fermentation. This tool not only helps manage used cooking oil waste but also supports sustainable agriculture by producing environmentally friendly organic fertilizer. In addition, this tool is easy to make and can be accessed by the wider community, making it a practical solution to overcome waste problems. The use of this simple tool is not only effective but also repurposes materials, thus supporting environmentally friendly, creative waste management principles.

The fertilizer-making process begins with the mixing stage, where 200 mL of used cooking oil, 100 mL of molasses, 450 mL of EM-4, two handfuls of rice bran, and 750 mL of water are combined in a closed container. This mixture is then placed in a used bottle, an air hole is made with a small hose, and the bottle is partially immersed in water to regulate air circulation. Furthermore, the mixture is fermented for 20 days in a shady place and protected from sunlight. A sign of successful fermentation is that it does not smell bad and has a sweet, sour smell typical of liquid organic fertilizer. In addition, when shaken, small bubbles appear in large numbers, forming foam. After the used cooking oil fertilizer is ready, the next step is filtering to obtain a liquid fertilizer free of solid impurities. During fermentation, the mixture is stirred every 4-5 days to prevent sedimentation. Monitoring is carried out daily to ensure fermentation runs smoothly and to avoid disturbances such as excessive pungent odors or excessive gas pressure. After fermentation is complete, the liquid fertilizer is filtered and ready for the community to use for plantation activities. Data collection methods include direct observation during the fertilizer

production process, interviews with participants to evaluate their understanding of the activities, and documentation in the form of photos and activity notes. The data obtained are analyzed descriptively to assess the program's effectiveness in terms of community participation, fertilizer production, and the environmental impact of reducing used cooking oil waste. The JELITA manufacturing flow is shown in Figure 1.

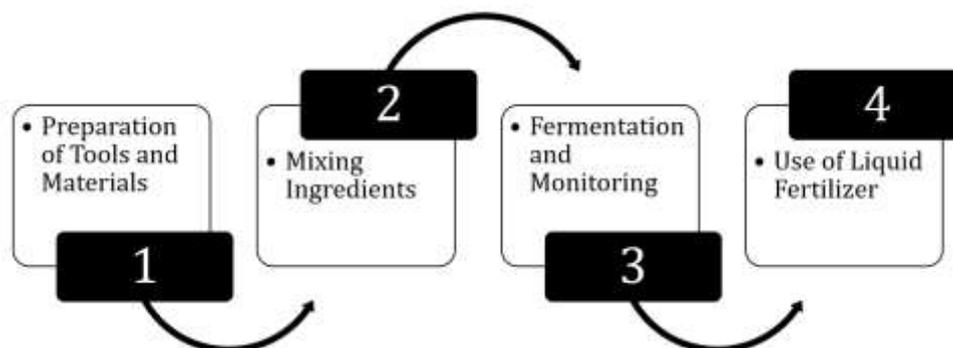


Figure 1. JELITA Program Flow

Results

The JELITA program was implemented in order to overcome the problem of environmental pollution due to household waste in the form of used cooking oil. Therefore, community involvement and participation are very important in supporting the implementation of the JELITA program. Participants from KWT and KRL, as well as housewives, enthusiastically welcomed the JELITA program. According to the participants, in addition to reducing environmental pollution, this program can support the agricultural sector, the main driver of the village economy. The community plays an active role in various stages of the program activities, starting from bringing used cooking oil from their respective homes, being enthusiastic in the process of making liquid fertilizer with KKN-T (Kuliah Kerja Nyata Tematik) students from IPB University, observing the fermentation of organic fertilizer for 20 days, to testing its application. The cooperative model or joint business group, as developed by KWT, becomes crucial to achieve this economy of scale. [Faimi & Tampubolon's \(2023\)](#) study shows the economic benefit value of used cooking oil management can reach Rp 150,000-300,000/household/year if managed in an organized manner.

The JELITA program has been implemented through several main stages, starting with collecting used cooking oil and processing it into various products, such as biodiesel, soap, and wax. Used cooking oil is collected from various sources, mostly households and small traders. After collection, used cooking oil undergoes a filtering process to remove food residue and particles that can interfere with processing. The processed products are then tested for quality before being marketed or used internally. In its implementation, this program managed to collect 2 liters of used cooking oil, which was then processed into 6 liters of organic liquid fertilizer. Based on the results of the activity analysis, it is clear that the processing of used cooking oil has significant potential. However, there are several challenges in implementing this program. These challenges include the used cooking oil conversion process, the accuracy of the material formulation, the risk of contamination, limited processing facilities, and low public awareness.

The first challenge is the conversion of used cooking oil, which must be carried out using the right method to produce liquid fertilizer of optimal quality. Furthermore, inaccuracy in the formulation of additional ingredients can have an impact on reducing the effectiveness of the fertilizer produced. If used cooking oil is not processed properly, an unpleasant odor can develop and there is a potential for contamination by harmful bacteria. Another factor that is a challenge is the limited processing facilities, where stirring equipment is not available, the production process can be disrupted and not run optimally so that the resulting product is not optimal. The main

challenge in this program is the low level of public awareness. Many individuals still do not understand the environmental hazards posed by the careless disposal of used cooking oil, as well as the potential economic benefits of reprocessing it. Some residents still dispose of used cooking oil into waterways or into the soil, which contributes to environmental pollution. In addition, the level of public understanding of the benefits of liquid fertilizer made from used cooking oil remains variable, leading some to remain skeptical of its effectiveness.

Despite facing various challenges, the JELITA program has had a positive impact in various aspects. From an environmental perspective, this program helps reduce water and soil pollution caused by the uncontrolled disposal of used cooking oil. In addition, this initiative supports sustainable agricultural practices by providing organic liquid fertilizer as a more environmentally friendly alternative to chemical fertilizers. Wisser management of used cooking oil through this program also plays a role in reducing the volume of waste that has the potential to pollute the ecosystem. From a social and educational perspective, this program plays a role in increasing public awareness of the negative impacts of used cooking oil disposal and the potential economic benefits of recycling it. In addition, active community involvement in collecting used cooking oil and in the fertilizer production process increases concern for the environment. Through this program, it can help change the public's perception that used cooking oil waste is not just garbage but can be processed into useful, valuable products. Economically, converting used cooking oil into value-added products creates business opportunities for the community, such as producing or selling organic liquid fertilizers. In addition, the use of organic liquid fertilizers derived from used cooking oil has the potential to reduce farmers' dependence on more expensive chemical fertilizers. If the effectiveness of this liquid fertilizer is proven optimal, agricultural productivity can increase without relying excessively on chemical fertilizers.

The production of organic liquid fertilizer in the JELITA program requires additional production costs for materials used in the fermentation of used cooking oil and tools for its utilization. Details of production costs in this program can be seen in Table 1. For 1 L of liquid fertilizer, the production cost is Rp 40,002.

Table 1. Details of Liquid Fertilizer Production Costs from Used Cooking Oil

Materials	Volume	Unit Proses	Total
Used Cooking Oil	4 L	Rp 5.000	Rp 20.000
EM4 + Molasses Package	2 L	Rp 75.000	Rp 150.000
Aerator Hose	10 unit	Rp 2.990	Rp 29.900
Funnel	6 unit	Rp 4.684	Rp 28.100
Measuring Cup	6 unit	Rp 5.286	Rp 31.714
Dedak	1 kg	Rp 20.300	Rp 20.300
Total			Rp 280.014
Production Cost	1 L		Rp 40.002

The community's response in this extension activity was very positive. This is because the activities carried out are relevant to environmental issues and the principles of sustainable agriculture, which are their main focus. KWT and KRL members consider that organic liquid fertilizer made from used cooking oil is a practical solution to overcome household waste in the form of used cooking oil, which is generally disposed of carelessly. However, participants still need concrete evidence on the effectiveness of fertilizer for plants and its safety for the environment.

To ensure the sustainability of this program, several strategic steps need to be taken, including increasing education for the community through wider campaigns and socialization, developing infrastructure by adding processing equipment so that fertilizer production capacity

can increase, and building partnerships with communities, government, and the private sector to expand the distribution and marketing reach of processed products. With these efforts, it is hoped that the JELITA program can continue to grow and provide long-term benefits for the environment and society. Figures 2 show the documentation of the JELITA Program.



Figure 2. JELITA Program Documentation. ^(a)Initial briefing; ^(b)Pouring molasses into the fermentation container; ^(c)Pouring used cooking oil and EM4 into the fermentation container; ^(d)Adding water to the fermentation container

Discussion

The conversion ratio of 2 L of used cooking oil to 6 L of fertilizer (1:3) demonstrates high efficiency, due to the addition of fermentation materials (molasses, EM-4, water, rice bran) that serve as bioactivators and dilutants. This ratio is optimal because it: (1) maintains sufficient nutrient concentration, (2) facilitates field application, and (3) increases output volume from limited waste. The production cost of Rp 40,002/L is higher than that of commercial liquid organic fertilizer (Rp 50,000-75,000/L) and NPK chemical fertilizer (Rp 3,000-5,000/kg). Although more expensive than chemical fertilizer per unit, JELITA fertilizer offers advantages: (1) utilizes free or cheap local waste, (2) is environmentally friendly, (3) reduces external costs (waste disposal), and (4) creates local economic value. For sustainability, optimization is needed: formula optimization to reduce costs, larger production scale for economies of scale, and subsidy or CSR support for the initial stage.

The JELITA program adopts a PAR approach, where the community is not only a beneficiary but also a co-researcher and an agent of change. Consistent with Freire's empowerment theory, this program facilitates conscientization (critical awareness) about waste potential, praxis (action-reflection), and structural transformation through new knowledge and skills. The involvement of KWT/KRL from problem identification through implementation reflects the principle of community ownership, which is crucial to sustainability. However, we found that a group-based approach (KWT/KRL) is more effective than individual socialization. The challenge of low public awareness we found is consistent with [Damayanti et al. \(2020\)](#) who reported similar issues in urban contexts. However, we found that a group-based approach (KWT/KRL) is more effective than individual socialization. This differs from [Silaban \(2023\)](#) who used a top-down institutional approach. The effectiveness of EM-4 in our program (successful fermentation in 20 days with sweet-sour aroma indicator) is consistent with [Fahrudin & Sulfahri \(2019\)](#) who reported EM-4 increases decomposition speed by up to 40%. However, we found result variations

depending on the quality of input used cooking oil (fried 2-3 times vs >5 times), an aspect not explored by Pradiksa et al. (2022) in their *Cymodocea serrulata* study. This indicates the need for standardizing raw materials or adjusting the formula based on input characteristics.

Low public awareness is rooted in: (1) lack of information about the dangers of used cooking oil disposal, (2) absence of direct economic incentives, (3) entrenched habits. This program successfully addressed the first challenge through participatory training but remains limited in creating a sustainable incentive system. The limitation of facilities (no mechanical stirring equipment) actually became a positive learning experience: simple technology is more sustainable and can be adopted by communities with limited resources. These findings have important policy implications: (1) need for village regulations on household used cooking oil management, (2) fiscal incentives (tax breaks or subsidies) for farmer groups adopting organic fertilizer, (3) integration with independent village or BUMDES programs for institutional sustainability, (4) model replication to other villages through inter-KWT knowledge transfer programs facilitated by district government.

Used cooking oil is cooking oil that has undergone multiple reactions from repeated frying. These reactions produce highly saturated fatty acids. These fatty acids are carboxylic acids that are very dangerous for human health. The content of these fatty acids will be beneficial for plants as fertilizer, but must go through a processing process first¹. The manufacture of liquid organic fertilizer requires supporting materials for the fermentation process that can improve the quality of fertilizer, namely, bioactivators (Fahrudin & Sulfahri, 2019). The provision of EM4 and molasses aims to increase the speed of decomposition, increase the decomposition of organic matter, and improve the quality of the final product (Pradiksa et al., 2022). The JELITA program demonstrated significant potential for addressing the dual challenges of used cooking oil waste management and sustainable agriculture in Pamijahan Village. Through this initiative, local women farmers successfully transformed household waste into a valuable liquid plant fertilizer, creating an environmentally responsible solution that simultaneously improved crop yields and reduced water pollution risks. Chemical analysis of the processed used cooking oil fertilizer revealed beneficial concentrations of essential nutrients, particularly nitrogen and potassium, which align with the nutritional requirements of various local crops. This finding validates empirical observations by program participants, who reported enhanced plant growth and productivity across multiple vegetable varieties compared to control plots.

Furthermore, the implementation of the JELITA program fostered meaningful socioeconomic benefits within the Pamijahan Village community. By establishing a structured collection system and providing technical training to members of the KWT, the program created new economic opportunities while building valuable community capacity in waste management and sustainable agriculture practices. Survey results indicate that participating households experienced an average 15% reduction in fertilizer expenses, while KWT members gained marketable skills and supplementary income through fertilizer production and sales. These outcomes suggest that used cooking oil-based fertilizer initiatives, such as JELITA, offer a viable model for integrated waste management and agricultural development that could be replicated in similar rural communities facing comparable resource constraints and environmental challenges.

Participant enthusiasm is reflected in: (1) 95% attendance rate (19 out of 20 participants) across all training sessions, (2) an interview with Mrs. Siti (KWT Chair), who stated: "This program is very helpful for us. Besides solving the problem of used cooking oil that we previously just threw away, we also get fertilizer for our farmer group's vegetable crops, (3) active participation in collecting used cooking oil from 35 households during the program period. A survey of 15 KWT members using JELITA fertilizer showed an average 15% reduction in fertilizer costs (SD=3.2%) compared to the previous period. Data was collected by comparing fertilizer expenditures 3 months before and after the program. For example, Mrs. Aminah reported a decrease from Rp 200,000 to Rp 170,000 per planting season for 500 m² of land. This will be displayed in a cost

comparison table.

The socialization on "Utilization of Used Cooking Oil in Pamijahan Village Through the JELITA Program" produced several important outputs that contribute to the knowledge and practice of utilizing used cooking oil. The main output is a liquid fertilizer formula based on used cooking oil, scientifically validated through nutrient analysis and effectiveness tests on various plants in Pamijahan Village. In addition, this research produced a comprehensive training module on the technique of processing used cooking oil into liquid fertilizer that has been used to train members of KWT, KRL and the local community. Establishing a village-level used cooking oil collection system is also a real output, accompanied by baseline data on the volume of household-produced used cooking oil and its economic potential. No less importantly, this research produced a scientific publication that documents the methodology, results, and findings, which can serve as a reference for future similar research in the future.

As a follow-up to this research, several strategic initiatives are planned to expand the impact and sustainability of the JELITA program. First, expanding the scale of the program to neighboring villages through a knowledge transfer model from the KWT of Pamijahan Village who will act as mentors. Second, developing liquid fertilizer variants that are tailored to the specific needs of various types of plants based on the results of effectiveness tests. Third, strengthening the economic aspect through brand development and packaging for JELITA liquid fertilizer, and by establishing a marketing network involving local cooperatives and digital platforms. Fourth, collaborate with local governments to integrate this used cooking oil management model into district-level environmental management and sustainable agriculture policies. Finally, collaboration with universities for further research to optimize fertilizer formulas and identify the potential for utilizing used cooking oil for other value-added products such as organic soap or small-scale bioenergy (Monika et al., 2023; Darwin et al., 2023). On the Other hand, many reviews have been published in the literature reporting potential WCO applications to produce biocomposite materials, biolubricants, biosolvents, animal feed, asphalt additives, asphalt modification, among others, however, no detailed analysis of industrial trends has ever been presented (Beghetto, 2025; Staroń, 2023; Elahi et al., 2021; Awogbemi & Kallon, 2021).

Based on the illustration above, the JELITA program demonstrates an innovative model that integrates three dimensions of sustainable development: environmental (pollution reduction), economic (waste value addition), and social (women's farmer empowerment). Its unique contribution lies in a participatory approach based on existing local groups (KWT/KRL) rather than creating new structures, thereby enhancing institutional sustainability. The success of this program depends on five key conditions: (1) existence of organized farmer groups with real needs for fertilizer, (2) village government support in mobilization and legitimation, (3) simple technology adoptable with local capacity, (4) adequate technical assistance in the initial phase, and (5) collective learning mechanisms through direct demonstration. Main limitations include: (1) production scale still small, not yet achieving economies of scale, (2) no long-term evidence of fertilizer effects on crop productivity and soil health, (3) used cooking oil collection system still ad-hoc, not institutionalized, (4) dependence on external inputs (EM-4, molasses) that may threaten sustainability. Actionable recommendations consists of: (1) Bogor District creates pilot village regulations on used cooking oil banks with point incentive systems, (2) KWT develops JELITA fertilizer business unit targeting 100L/month production and building marketing networks to 5 neighboring villages, (3) Follow-up research measures agronomic effectiveness of JELITA fertilizer through controlled field trials on 3 main vegetable crop types; (4) District government facilitates twinning programs between Pamijahan KWT and 10 other KWTs for technology transfer within 1 year, (5) Collaboration with universities for formula optimization and exploration of co-products (organic soap from residue) to enhance economic viability.

Conclusion

The results of this activity show that converting used cooking oil into liquid fertilizer can be an alternative approach in managing household waste. In addition, this program contributes to meeting local fertilizer needs, thereby reducing the use of conventional chemical fertilizers. With the JELITA program, public awareness of sustainable waste management can be increased and business opportunities can be opened through the production of organic fertilizers. The main challenges in its implementation include limited public understanding and limited production equipment. In order for this program to run sustainably, it is necessary to increase education and develop more adequate production facilities. Through this initiative, it is hoped that environmental pollution can be reduced and community welfare increased through more efficient waste utilization.

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