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LEAF WASTE SHREDDER AND LOW-SMOKE INCINERATOR

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Abstract. Household waste management in Sei Lekop RW 13, Sagulung, Batam, faces serious challenges due to the limited garbage collection system. Accumulated waste, especially dry leaves, is often left untreated or openly burned, causing air pollution and potential health risks. This Community Service Program (KKN) introduced two innovations: a leaf waste shredder and a low-smoke incinerator. The shredder accelerates composting by reducing leaf size, while the incinerator minimizes smoke emissions during burning. Results showed that these technologies not only reduced household waste volume but also raised community awareness about sustainable waste management. This program demonstrates that simple, low-cost, and locally adapted technologies can effectively address waste issues in residential areas

Keyword: Leaf Waste, Shredder, Low-Smoke Incinerator, Waste Management, Community Service

INTRODUCTION

Community service programs are organized by universities as part of the implementation of the Tri Dharma of Higher Education, namely education, research, and community service. Through community service programs, students are trained to interact directly with local residents, identify problems that occur in the field, and strive to provide creative, appropriate, and sustainable solutions (Syardiansah, 2019)

Waste is the residual result of various human activities or natural processes, generally in solid form. Every human being indirectly becomes a producer of waste, as daily activities constantly generate piles of refuse. In both urban and rural areas, waste production occurs continuously without pause. In general, waste is divided into two types: organic waste and inorganic waste. Organic waste refers to materials that can decompose naturally through the action of microorganisms, while inorganic waste is more difficult to break down (Paryono et al., 2023) Waste continues to be a serious environmental problem that has yet to be fully resolved. Household waste management poses a major challenge due to the increasing volume of waste that is often

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disposed of without prior sorting. Therefore, managing household waste requires attention and cooperation from all parties, both the government and the community, to address this issue more effectively (Widiyanti et al., 2024) The low level of public awareness regarding waste management is caused by various interrelated factors. A lack of education and socialization has led to limited understanding of the negative impacts of improper waste management and the benefits of sorting and recycling waste. In addition, the shortage of supporting facilities such as separate waste bins and adequate waste collection systems hinders community participation. Practical lifestyle habits and weak law enforcement further worsen the situation, as people tend to dispose of waste carelessly without a sense of environmental responsibility. The limited involvement of community leaders and the absence of sustainable waste management programs also make it difficult to build collective awareness (Ananda & Kurnisar, 2025)

Indonesia, as the fourth most populous country in the world, is facing a concerning increase in waste production. According to data from the Ministry of Environment's National Waste Management Information System (SIPSN) for 2024, out of the 342 regencies and cities that reported, only approximately 37.3 million tons per year—or 32%—were properly managed. (BRIN, 2025) Indonesia and Japan, despite their differences in culture and geographical conditions, both face challenges in managing the waste generated by their populations. Indonesia, as a developing country with a large population, continues to struggle with waste management issues. According to data from the Ministry of Environment and Forestry (KLHK), Indonesia produces approximately 67.1 million tons of waste each year, but only around 5% is successfully recycled or processed (Astri & Dompak, 2024)

Most of the waste is still disposed of in landfills or openly burned, causing various environmental problems such as air, soil, and water pollution. Meanwhile, Japan is recognized as one of the most successful countries in waste management. Despite its limited land area and high population density, Japan has developed a well-organized and efficient waste management system. According to data from Japan's Ministry of the Environment, in 2019 the country generated around 44.8 million tons of waste, with a recycling rate of 20.5% (Ministry of the Environment, Japan, 2021). This success is largely due to the implementation of strict waste separation policies and the active participation of its citizens. The differences between Indonesia and Japan in terms of waste management are influenced by several factors, including government policies, infrastructure availability, public awareness levels, and cultural values in each country (Astri & Dompak, 2024)

Our community service location is in Sei Lekop Subdistrict, RW 13, Sagulung District,

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which consists of three neighborhood units (RT). Based on observations, one of the fundamental problems in this area is household waste management. In almost every RT, piles of household waste can be found placed in front of residents' houses. This condition not only creates an impression of a slum environment but also causes various serious impacts, such as becoming a breeding ground for flies and other insects that potentially spread diseases, especially to children who are more vulnerable to health problems (Wulandari et al., 2020) In addition, the unpleasant odor from the waste piles clearly reduces the comfort of residents in their daily activities.

According to Law Number 18 of 2008 on Waste Management, waste should not only be regarded as discarded material but also as a resource that can be reused through the 3R principles (Reduce, Reuse, Recycle). In addition, the Indonesian Ministry of Health emphasizes that a clean environment plays an important role in preventing various environment-related diseases, such as diarrhea, dengue fever, and skin diseases. In other words, proper waste management is a crucial step to maintain public health quality while also improving living comfort (Nababan et al., 2024)

Air pollution from the odor of decaying waste, as well as soil and water pollution caused by hazardous waste seeping into the ground, also pose serious problems. This highlights the importance of proper waste management to maintain environmental balance and public health (Jannah et al., 2025) In this community service activity, the methods used were counseling and lectures (Rosa et al., 2022) There are many benefits gained from maintaining environmental cleanliness, not only achieving better health (Chaniago et al., 2023) The chosen solution is the development of a low-smoke waste incinerator and a leaf shredder. The low-smoke incinerator was selected considering the layout of residents' houses, which are closely packed together, as well as the relatively narrow road access. Therefore, the design of a low-smoke incinerator becomes a more environmentally friendly solution, as it not only reduces air pollution but also produces ash residue that can be utilized as compost (Rivai et al., 2023) On the other hand, the leaf shredder is designed to help process organic waste, especially the large amount of dry leaves in the surrounding environment, into useful compost (Syarifuddin et al., 2024)

This program is expected not only to practically solve the problem of household waste accumulation but also to create a long-term impact by increasing public awareness of the importance of maintaining environmental cleanliness and health (Hasaya et al., 2025) This innovation can serve as concrete evidence that waste management does not always require high costs or complex technology, but can instead be carried out in simple ways tailored to the needs and conditions of the local community.

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METHODOLOGY

The program was conducted over six days (August 23 – September 14, 2025) in RW 13, Sei Lekop. The implementation followed these stages:

1. Problem analysis through observation and discussions with residents and local leaders.
2. Solution formulation, proposing a leaf shredder and a low-smoke incinerator.
3. Product design, including sketches, references, and bill of materials.
4. Product fabrication, carried out collaboratively with students and residents.

Testing and implementation, involving training sessions and demonstrations. This participatory method ensured community involvement, knowledge transfer, and practical application.

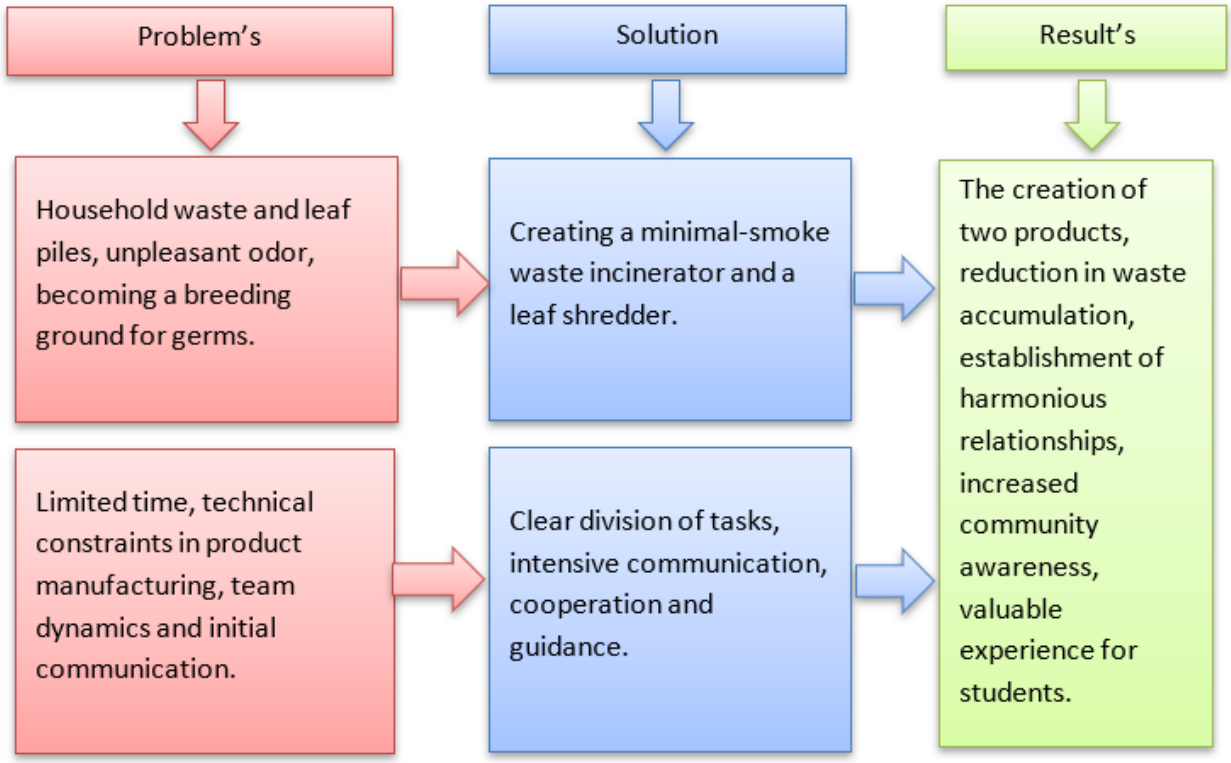

Figure 1. Problem formulation

RESULT AND DISSCUSION

The program produced two main outputs:

1. Leaf Shredder
   1) Reduced the size of dry leaves, enabling faster decomposition.
   2) Produced compost that can be used for gardening and soil improvement.
2. Low-Smoke Incinerator

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1) Equipped with improved air circulation to allow more complete combustion.
2) Reduced visible smoke and odor compared to traditional open burning.

Community participation was high; residents contributed labor, materials, and local knowledge. This strengthened the sense of ownership and sustainability. Despite challenges such as limited time (six days) and financial constraints, the program successfully demonstrated that simple technologies could provide real environmental benefits. These findings align with Hasaya et al., (2025), who highlighted that active community involvement significantly enhances awareness and sustainable practices in waste management.

Table 1. Level of Participation

Participants	***Number of people***	***Percentage***
a) Students	8 people	50 %
b) Community Leader	1 person	20 %
c) Residents	14 people	30 %
Total	***23 Participants***	***100 %***

Figure 2. Community Collaboration and Results

CONCLUSION AND RECOMMENDATION

The Community Service Program (KKN) in Sei Lekop RW 13 successfully introduced appropriate technology for waste management. The leaf shredder and low-smoke incinerator effectively reduced household waste, minimized pollution, and promoted community

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participation. It is recommended to continue improving these designs for greater efficiency and replicating them in other communities facing similar waste problems.

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