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The Edu-Innovation of Smoke Level Waste Incidents and Composters from Reused Gallons in Kalibaros Village

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Abstract. *The rubbish problem in Indonesia, especially in densely populated areas such as Kalibaros Village, Pekalongan City, is increasingly severe and negatively impacts the environment. This study aims to educate the community about the separation of organic and inorganic rubbish and introduce an innovative low-smoke rubbish incineration device and the production of compost from used gallons. The method used in this community service is Participatory Action Research (PAR). The results showed an increase in community awareness, 95% of participants reported an increased understanding of waste sorting after the training. The innovative low-smoke incineration device successfully reduced air pollution emissions, while the composting of organic rubbish provided dual benefits by reducing rubbish and producing natural fertilizer. This activity is expected to continue with regular assistance to ensure the sustainability of rubbish separation and management practices in the community.*

Katakunci: *Pemilahan Sampah; Inovasi Alat Pembakar; Kompos; Edukasi Masyarakat; Lingkungan.*

Abstrak. Masalah sampah di Indonesia, terutama di daerah permukiman padat penduduk seperti Kelurahan Kalibaros Kota Pekalongan, semakin meningkat dan berdampak negatif terhadap lingkungan. Penelitian ini bertujuan untuk mengedukasi masyarakat tentang pemilahan sampah organik dan anorganik serta memperkenalkan inovasi alat pembakar sampah minim asap dan pembuatan kompos dari galon bekas. Metode yang digunakan dalam pengabdian ini adalah PAR (Participatory Action Research). Hasil penelitian menunjukkan adanya peningkatan kesadaran masyarakat, 95% peserta melaporkan adanya peningkatan pemahaman tentang pemilahan sampah setelah pelatihan. Inovasi alat pembakar sampah minim asap berhasil mengurangi emisi

polusi udara, sementara pembuatan kompos dari limbah organik memberikan manfaat ganda dalam mengurangi limbah dan menghasilkan pupuk alami. Kegiatan ini diharapkan dapat berlanjut dengan pendampingan rutin untuk memastikan keberlanjutan praktik pemilahan dan pengelolaan sampah di masyarakat.

1 Introduction

Waste is still a problem in various regions in Indonesia. The amount of household waste generated will be influenced by the number of settlements. The amount of scattered waste can cause environmental damage and environmental pollution. Waste can come from activities at home, in the office, in markets, on roads, and in other places. Waste can be in the form of solid, liquid, or gas (Ahmad et al., 2022).

In Indonesia, the waste problem is getting worse due to the lack of public attention and concern for a healthy lifestyle, a clean and waste-free environment. Many people do not realize how important waste management is, however, some people realize it but do not do it. For example, many people do not sort their waste properly before throwing it into the final disposal site. The lack of education and teaching of the community about the impacts caused by waste, how to manage and sort waste makes them consider this trivial. However, the community remains the victim. Therefore, to make the processing process easier, household waste sorting is needed (Saptenno et al., 2022).

Waste burning innovation can be done by optimizing existing resources or by transforming them into fuel (Amalia Ardianti, 2019; Aruan et al., 2021; Kasih Bratha & Putri, 2023; Priyono et al., 2021; Sari et al., 2023; Surapati et al., 2023). This innovation is done by first conducting waste sorting and selection. Waste sorting is the initial stage in efforts to separate waste before the waste is processed. The waste sorting process is carried out based on the type of waste. Various stages are needed in the waste sorting process starting with containerization, collection, transportation, processing to the disposal stage (Qadri et al., 2020).

Waste sorting is a very important first step in effective waste management (Kumar & Singh, 2024; Tsunematsu et al., 2024; Zhuo et al.,

2024). By sorting waste into two parts, namely organic and inorganic, we can reduce the volume of waste that goes into landfills (TPA) and minimize the negative impact on the environment. According to Taufiq & Fajar Maulana (2015), waste sorting not only helps reduce environmental pollution, but also provides an opportunity to reuse existing resources, thus supporting the principle of a circular economy. With proper sorting, organic waste can be processed into compost, while inorganic waste can be recycled or burned in a more environmentally friendly way, the use of municipal solid waste incinerators reduces emissions from waste-to-energy plants and the excessive dependence on them, the performance of geotechnical applications of municipal solid waste incinerator increasing when reinforced with fiber, digital marketing is more effective and efficient in introducing smoke-free waste incinerators, and whether it is feasible to regulate the rate at which various organic solid wastes are mixed in the municipal solid waste incinerator within a tolerable (Alnezami et al., 2024; Kumar & Singh, 2024; Lin et al., 2024; Zhuo et al., 2024).

The main purpose of waste sorting is to group waste based on its type, thus facilitating further processing. Sorting inorganic waste to be burned aims to reduce the volume of unmanaged waste, while sorted organic waste can be processed into compost which is useful for increasing soil fertility. Good sorting can increase the efficiency of waste management and reduce negative impacts on the environment. Thus, waste sorting is a strategic step in creating a cleaner and more sustainable environment (Ghufron et al., 2023).

This waste sorting education program aims to increase public awareness of the importance of waste sorting and the proper ways to do it. Through this program, it is hoped that the public can understand the difference between organic and inorganic waste, as well as how to process it. The expected benefits of this program include reducing the volume of waste disposed of in landfills, improving environmental quality, and increasing public participation in waste management (Ajay & Prathish, 2024; An et al., 2024). In addition, this program also aims to provide practical knowledge about making compost from organic waste and the use of efficient burning tools. Educational efforts and regulations

have been carried out by local governments to address important problems for residents, especially regarding waste (Asri, 2022; Suwandi, 2022; UU Republik Indonesia et al., 2022).

From this education program, it is expected that there will be a change in behavior in the community regarding waste management. The community is expected to be able to actively sort waste in households, thereby reducing the amount of waste that is not managed properly. Another hope is the increase in the production of organic compost from the waste produced, which can be used for local agriculture. Thus, this program not only contributes to better waste management, but also supports environmental sustainability and community welfare.

2 Method

The Asset-Based Community Development (ABCD) approach is highly suitable for empowering women in rural areas to enhance their economic value (Kretzmann & McKnight, 1996). This approach leverages the existing strengths and resources within a community to create sustainable development. The activities were conducted in Tegalsari Village, Plered District, Cirebon Regency, from July 15 to August 25, 2024. The target of the initiative was a group of housewives from Wadas Ilir Block, Tegalsari Village. Various tools and equipment were utilized during this program, including village demographic data, stationery, a camera, interview forms, buckets, catfish seedlings, kale seedlings, and pellet feed.

This activity is carried out through socialization and education methods with the participation of some community leaders in Kalibaros Village such as RW and RT Chairmen, PKK members, and local Karang Taruna youth. Table 1 below shows the participants of the edu-innovation of low smoke waste incinerator and composters from reused gallons.

The initial steps in preparing this activity include determining the date and place of implementation, namely on 1 December 2024 in the Kalibaros Village Hall, providing equipment and materials for the

introduction of innovations in the smoke-free waste incinerator and composters from used gallons.

Table 1. Participants of the Research

No	Description	Frequency (person)	Persentage (%)
1	Member of community service	11	50,00
	PKK Members	5	22,73
	Village Government	6	27,27
	Total	22	100,00
2	Gender		
	Male	5	22,73
	Female	17	78,27
	Total	22	100,00
3	**Age (Years)**	11	50,00
	< 21	4	18,18
	22 – 35	7	31,82
	36 – 50	22	100,00
4	**Education**		
	Under SMA	1	4,55
	SMA	7	31,82
	D3	3	13,63
	S1	11	50,00
	Total	22	100,00

The making of organic waste compost from used gallons and the demonstration of a low-smoke inorganic waste burner were carried out in the village yard. In this activity, we invited posyandu cadres, PKK members, RT Heads, RW Heads, as well as youth and other community leaders.

Several stages carried out in the waste sorting education activity shown in the diagram bellow.

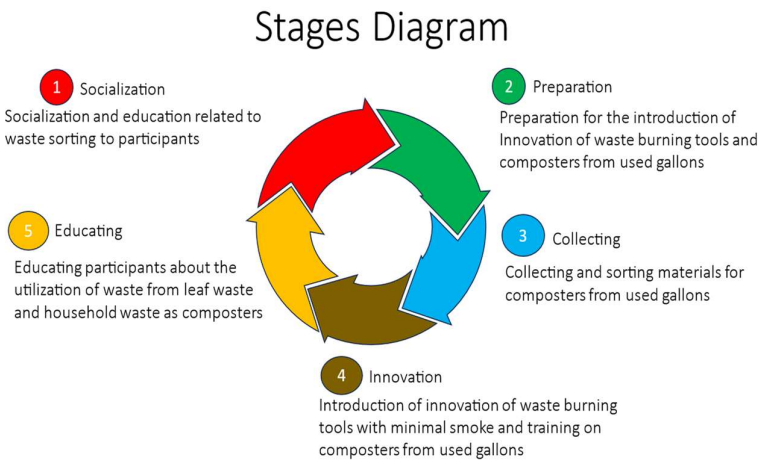

Figure 1. The Stages Diagram of Activities

The diagram illustrates the stages of a waste management process using an innovative approach. The first stage is Socialization, where participants are educated about the importance of waste sorting. Next is the Preparation stage, which focuses on introducing innovative waste-burning tools and the use of used gallons as composters. This is followed by the Collecting stage, where materials for composting from used gallons are gathered and sorted.

Once the materials are collected, the Innovation stage begins, involving the implementation of waste-burning tools that produce minimal smoke and training on composting using used gallons. Finally, the Educating stage provides participants with knowledge about utilizing leaf waste and household waste as compost. By going through these five stages, participants are expected to understand and apply more environmentally friendly waste management practices

3 Results

Time and Place of Implementation

Waste Sorting Education Activity: Innovation of Low-Smoke Waste Burning Devices and Gallon Composter was held in the Kalibaros Village

Hall on 1 December 2024, targeting the community by inviting the RW and RT Heads, community leaders and PKK members.

Implementation Stages

This activity was carried out through socialization and education methods with the participation of some community leaders of Kalibaros Village such as RW and RT Chairmen, PKK members, and local Karang Taruna youth. This activity was carried out in the Kalibaros Village Hall and the Kalibaros Village yard. The socialization was delivered by Abdul Mukti as the director of the Main Waste Bank (BSI) 3R Waju Joyo. He conveyed waste management through waste banks, types of waste, how to reduce waste using the 3R method, and introduced the government's waste bank program.

Table 2. The Activities of Community Empowerment

Activities	Impacts	Engagement	Photos
The introduce of low smoke waste incinerator	The community's of 90 percent participant is awareness that burning garbage can minimize smoke.	The community's of 70 percent participant do not want to burn rubbish carelessly anymore	
Practice of using low smoke waste incinerator	95 percent of the training participants understand the technique of burning waste with a low-smoke waste burner	70 percent of community participants want to use low-smoke waste incinerators	

Collecting materials for the composter	80 percent of participants from the community are aware of the importance of recycling	70 percent of community participants want to use used materials for fertilizer	
Enumeration Process	95 percent of the training participants understand the enumeration process	70 percent of community participants want to practice in everyday life	
Composting process	80 percent of the training participants understand the composting process	60 percent of community participants want to practice on their farmland	
Composting process	80 percent of the training participants understand the technique composting process	60 percent of community participants want to practice on their agriculture farmland	

Innovation of a low-smoke waste incinerator. Before practicing the use of the tool, we first explained the background and benefits of using a low-smoke waste incinerator. In making this tool, we use used oil drums that are cut into 2 parts, then we make holes in the bottom of the drum to create optimal air flow, the holes at the bottom help air circulation so that combustion takes place more perfectly with less smoke. Make sure before burning, the waste burner is placed in a safe place and away from flammable materials, then put in the waste to be burned. The waste that

can be burned in this device is inorganic waste, for example plastic waste, cardboard, and styrofoam, it is advisable to burn the waste in a dry state. Here is some documentation in the introduction session of the innovation of a minimal smoke waste burning device.

Stage of collecting materials for the composter. The materials used in making compost can be produced from pruning or cutting plants such as bushes, leaves, grass or plant remains. The collected waste such as leaves, grass, bushes are then chopped or cut into small pieces measuring 1 to 2 cm. Supporting materials are also needed in the composter such as 2 used gallons of mineral water, nails, cutters and knives, EM4 liquid, and water to dissolve EM4.

Making compost fertilizer with used gallons. After the tools and materials are ready, cut the used gallon container into 2 parts, the top of the gallon is given a circular hole from the gallon cap using a nail. Put in dry leaf waste first then put in vegetable waste and so on. Make sure we have prepared one liter of water to dissolve EM4. Then, pour in enough water that has been dissolved with EM4 which aims to speed up the process of decomposing waste, cover it using black plastic so that the smell of the waste does not attract flies and no air enters, if air enters, the EM4 liquid evaporates and does not function in decomposing waste.

4 Discussion

Kalibaros is a sub-district resulting from the merger of Sokorejo and Baros sub-districts in East Pekalongan district, Pekalongan City. Kalibaros was formed on 1 January 2015 and has an area of 2.20 km². Based on data owned by the Kalibaros Village Government, the number of residents in Kalibaros Village is 6,886 people. The number of residents according to gender, Male: 3,521 people and Female: 3,365 people with a total of 1,713 families.

Kalibaros has potential in various fields. In the economic sector, with many convection businesses and snack food production such as crackers, Kalibaros can become a center for creative industries and a center for home industries that can encourage local economic growth, absorb labor, and increase local competitiveness. In the agricultural sector, with

the availability of productive land for farming, it can provide food and increase food security.

The human resources owned are mostly of productive age with various skills. Having a joint business group that helps market local products is useful for encouraging a community-based economy or association and strengthening networks between businesses. The villagers have a strong mutual cooperation life both in community service activities and in traditional and religious events. Having youth organizations such as Karang Taruna and PKK mothers who are active in social activities.

The main problem currently in the environmental sector is the accumulation of waste. Rubbish piles up not only from local residents but also from outside residents, causing the increase in waste to become uncontrolled. From these potentials and problems, community service were implemented. Drainage and waste management are not optimal, TPS 3R is not operational, the absence of an integrated waste disposal site causes waste to pile up on the side of the road.

Our main difficulty is facing the community's habit of disposing of waste not in the final disposal site (TPA), so there is resistance to the habit of holding this waste management socialization activity. The main challenge of our research is in making a low-smoke waste incinerator. We have to find a professional blacksmith to make the tool. The high cost required also causes the resulting low-smoke waste incinerator to have a small waste storage capacity when compared to the waste that has piled up on the side of the road.

There is opposition to the practice of organizing this waste management socialization exercise since our biggest challenge is dealing with the community's habit of not disposing of waste at the TPA. Our research's primary obstacle is creating a low-smoke trash incinerator. To make the tool, we must locate a qualified blacksmith. When compared to the rubbish that has accumulated on the side of the road, the resulting low-smoke waste incinerator has a limited capacity for storing waste due to the high expense involved.

The habit of disposing of waste not in the final disposal site is not only done by local residents, but also from outside the Kalibaros sub-district. The uncontrolled accumulation of waste is caused by two things. First, the piled up waste is not transported. Second, the waste is not disposed of at the final waste disposal site (TPA). Third, there is no cooperation between the local government's environmental service and the sub-district government. Character education to throw garbage in its place needs to be instilled from an early age. The most important factor in the uncontrolled accumulation of garbage is public awareness of the environment. Character is an important thing to change the mindset, from an attitude for personal interests to an attitude for the needs of many people. The government is only able to control from the external side, personality is returned to each individual.

Using a low-smoke waste incinerator is a really easy process, we had no major problems because the waste is just collected and burned in the device. Gathering trash that has already been dumped on the side of the road is the biggest challenge. If the city administration and the sub-district government work together, this obstacle can be solved. The municipal administration provides the necessary instruments, while the sub-district government acts as the implementer.

The technique of using a low-smoke waste incinerator is quite simple, we did not face any significant difficulties, because the waste is simply collected in the device, then burned. The main obstacle is collecting and collecting waste that has already been scattered on the side of the road. This challenge can be overcome if there is cooperation between the sub-district government and the city government. The sub-district government as the implementer, the tools needed are provided by the city government.

Community service students from batch 60, group 20 have several excellent programs in Kalibaros, namely Seminar and Education on Stunting Prevention, Seminar and Education on Bullying Prevention, Socialization and education on sorting organic and inorganic waste and introduction of low-smoke waste burners and making compost bins from used gallons, Optimization and education on door-to-door digital

marketing to Krupuk entrepreneurs, and Productive food security program through polybag planting media.

The expected outputs of the flagship program are increasing parents' understanding of stunting prevention with a balanced menu, increasing students' understanding of bullying, increasing understanding and motivating residents regarding waste sorting, increasing digital marketing skills and optimizing digital-based marketing strategies, and increasing public knowledge about farming techniques on limited land.

Education and optimization of digital marketing for SME crackers door to door, through Tiktok Shop, Shopee, Tokopedia, etc. This program is to improve digital marketing skills and optimize digital-based marketing strategies. Planting productive plants using polybags to increase public knowledge about farming techniques on limited land. Introduction to low smoke waste incinerator to increase understanding and motivate residents regarding waste sorting. Making composter from reused gallons to empower agriculture from reused goods. Socialization and education on sorting organic and inorganic waste as well as introduction of low-smoke waste incinerator and making compost bins from used gallons are included in the leading work programs organized by group 20 Community service 60 UIN K.H. Abdurrahman Wahid Pekalongan.

Community service 60 UIN Gus Dur group 20 on 1 December 2024 held the next work program activity, namely educating the Kalibaros community about sorting organic and inorganic waste, which was given by the coordinator of TPS 3R Pekalongan City, Mr. Abdul Mukti. In this activity, we also introduced innovations in waste management tools, namely a low-smoke waste incinerator and making compost bins from two used gallons, for the target community in this activity we invited the RW and RT heads, community leaders, and PKK members. With this education and socialization, we hope that the community's members would wish to spread the word about waste sorting and waste management advances to other communities.

The compost produced is then used as a planting medium. Productive food security program through polybag planting media used compost as fertilizer. Community service 60 UIN Gus Dur group 20 on 5 December 2024 held a vegetable planting program using polybag media in the sub-

district. This program collaborates with the village/sub-district development Bintara and the city Agriculture Service. The vegetables that we planted in this program include caisim, chili, kale, and spinach. The aim of this program is for the Kalibaros sub-district to have food security such as vegetables that can be processed and eaten after harvest. As for the sustainability of the program, it will be continued by the village and sub-district development Bintara.

Many areas, both urban and rural, face limited land for farming, especially for household-scale farming activities. Polybags as an alternative planting medium allow people to plant various types of plants, such as vegetables, medicinal plants, or even ornamental plants, even though they only have a little space.

By using polybag media, people can learn and develop farming skills that can be done in their yards, gardens, or even inside their homes. This Community service program aims to provide education to the community about more practical and effective farming techniques, which can help them meet their family's food needs independently.

Polybag media can optimize the use of existing resources, such as water and fertilizer, so that it is more efficient and environmentally friendly. This technique can also reduce land and water waste, which is important amidst the challenges of climate change and the need for sustainable agriculture.

One of the main objectives of this activity is to improve family food security. By planting various easy-to-care-for plants in polybags, people can meet their family's nutritional needs, such as fresh vegetables, which can reduce dependence on the market and save household expenses.

Planting with polybag media is an environmentally friendly method because it reduces the conversion of agricultural land to non-agricultural land and is more efficient in water use. Education about environmentally friendly agriculture is expected to encourage people to be more aware of the importance of preserving nature.

This activity provides an opportunity for students to apply the knowledge they have learned in the fields of agriculture, the environment, or social entrepreneurship to directly contribute to the

community. In addition, this activity also plays a role in strengthening the relationship between students and the community in building practical solutions to existing problems.

Another flagship program is sustainable waste management. Waste management is a global issue that continues to increase along with population growth and human activities. Waste that is not managed properly can cause various negative impacts, such as environmental pollution, health problems, and decreased quality of life for the community. In Indonesia, the challenges in waste management are becoming increasingly complex with high domestic waste production, limited capacity of final disposal sites (TPA), and low public awareness of the importance of sustainable waste management.

Community service activities provide opportunities for students to contribute directly to solving this problem through a participatory and educational approach. In the context of sustainable waste management, the Community service program aims to increase community awareness and capacity in managing waste independently, creatively, and environmentally friendly. Students can become agents of change by educating the community about the principles of 3R (Reduce, Reuse, Recycle), simple waste processing technology, and developing the economic value of household waste.

Sustainable waste management is expected to create a cleaner and healthier environment, while providing economic benefits to the community. With this background, Community service activities that focus on sustainable waste management are relevant to support sustainable development and improve the quality of life of local communities.

Technically, the incinerator uses a used oil container with holes in the bottom. The holes are used as access for the smoke from burning waste which is directly burned again by the fire. This is what reduces the level of smoke coming out of burning waste.

5 Conclusion

Community service activities in the form of waste sorting education, innovation of low-smoke waste incinerators, and making gallon compost in Kalibaros Village have positively impacted the community. The education has increased public awareness of the importance of sorting waste based on its type (organic and anorganic) and environmentally friendly waste management. The innovation of low-smoke waste incinerators is a solution to reduce the impact of air pollution due to traditional waste burning. In addition, the application of gallon compost technology provides dual benefits, reducing organic waste while producing natural fertilizer that can be used to support home gardening activities. The success of this activity was supported by the high enthusiasm of the community, cooperation with village institutions, and the involvement of community groups such as PKK, Karang Taruna, and LPM.

This activity has a positive impact on the people of Kalibaros Village, Pekalongan City, 95% of them are awareness of the importance of dealing with piling up waste. Recycling waste into organic fertilizer, according to 90% of the community is more beneficial than burning it. Our dedication has several limitations, firstly due to the short time constraints related to the scheduled program. Secondly, limited funds resulted in the low-smoke waste incinerator being made too small, while the amount of waste is too much. It is necessary to make a low-smoke waste incinerator with a larger capacity.

The recommendation for the future in the long term is the need for cooperation between the city government and the sub-district government to overcome the waste problem. Kalibaros Sub-district can be used as a pilot sub-district for other sub-districts in implementing waste management by the Pekalongan City Government. Synergy and collaboration are needed between the Environmental Service of the Pekalongan City Government and the Public Works Service of the Central Government to develop this innovation. Waste sorting education can be started early from oneself, starting from well-managed household waste, village or sub-district waste that can be overcome, up to waste at the

district or city government level, provincial government and central government for which the best solution can be sought.

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