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Empowering the Community through Household Waste Source Separation Education in Barengkok Village: A Pretest–Posttest Evaluation

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Abstract: This community service program aims to enhance the knowledge and skills of residents in Barengkok Village regarding household waste segregation at the source, particularly the separation of organic and inorganic waste, as well as basic on-site processing of organic waste at the household level. The implementation method employed a participatory educational approach through training sessions involving adult residents as the primary participants. The program integrated participatory instruction, hands-on demonstrations, including the establishment of a two-bin waste separation system and basic composting techniques, and pre- and post-assessments consisting of seven waste literacy items. Descriptive statistics indicated consistent post-session improvement across all items, with the most substantial gains observed in waste categorization and organic waste management skills. Participant surveys revealed very high perceived relevance and satisfaction, suggesting that the program was well received by the community. This initiative provides a practical and cost-effective model that combines clear procedures with simple supporting tools, including designated two-bin kits and a laminated kitchen guide, enabling households to operate more independently despite downstream collection limitations. The findings also suggest the need for a brief 4–6-week follow-up period, including bin placement monitoring, contamination assessment, and initial compost trials, as well as a strategy for village-level institutionalization through community advocates and a regular buy-back schedule for clean recyclables.

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Introduction

Globally, the World Bank estimates that the world generated 2.01 billion tons of municipal solid waste in 2016 and will rise to 3.40 billion tons by 2050 without any urgent actions (World Bank, 2018). Figure 1 (a) shows that Indonesia is ranked fifth globally as a country with the most produced waste in 2024. Whereas nationally, West Java is the largest provincial contributor to waste generation compilations for 2024, as seen in Figure 1 (b) (Ministry of Environment and Forestry (KLHK), 2024). In a populous country such as Indonesia, this massive scale of waste production makes household-level interventions very decisive.

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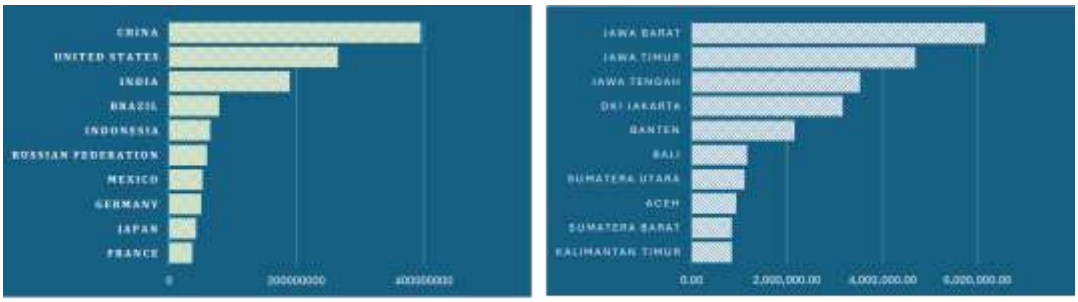

(a) (b)

Figure 1. Total Waste Generated (a) Globally, and (b) Nationally in Tons

There are seventeen cities/regencies in the West Java Province where waste productions were recorded in the Ministry of Environment and Forestry (KLHK) database. Among these cities/regencies, Bogor Regency produced the most household waste in 2024, as seen in Figure 2 (Ministry of Environment and Forestry (KLHK), 2024). The western service area, managed by Waste Management UPT Region VII, centred in Jasinga, frequently appears in clean-up operations and enforcement against informal dumping sites. Informal dumping sites have been a major issue in waste management, usually found in small communities in this area. This urges immediate actions for source separation (organic and inorganic) and local processing.

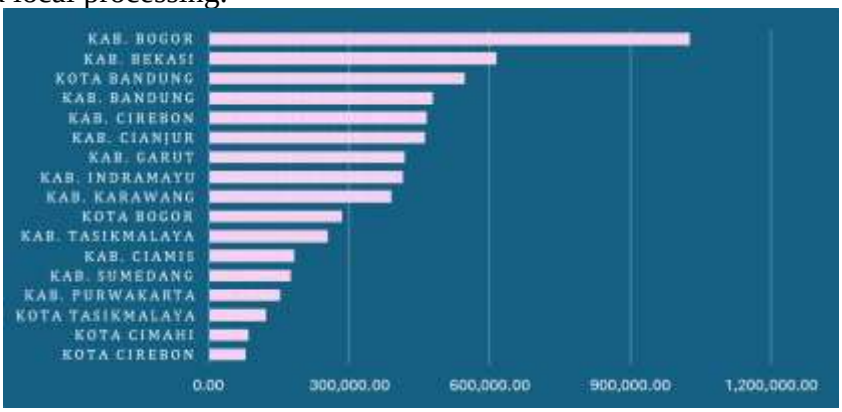

Figure 2. Total household waste produced in West Java in 2024

Household waste has remained a persistent environmental challenge across Indonesia. Recent community service program reports converge on a common cause. Communities in rural areas are lacking knowledge and awareness on how to properly sort and manage their household waste (Angin et al., 2024; Joleha et al., 2024; Khoirunnisa Apriyani et al., 2023; Mahadewi et al., 2022; Mubarok et al., 2022; Mustofa et al., 2025; Sumahiradewi et al., 2021; Wahyuningsih et al., 2023). Although local authorities have been promoting the importance of the 3R (Reduce, Reuse, Recycle) principles, the appropriate infrastructures to support this program are sometimes nonexistent (Joleha et al., 2024). This causes scattered piles of waste in the entire community. Thus, it increases the risk of health and environmental issues in the surrounding area, too.

The bottleneck of waste management is not only the volume of waste itself, but also the low level of source separation and the limited processing that could convert waste into local value. This issue in managing waste also decreases air quality in the surrounding community. The lack of public understanding of how to utilise waste, and people's reluctance to make use of it, contribute to the increase in environmental pollution (Wedowati et al., 2025). Thus, active community participation and adequate knowledge supported by the

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provision of waste bins and waste processing facilities are keys to realising a healthy community environment (Hamdani et al., 2025; Prihanta et al., 2023). Combining these resources, an educational program is imperative to increase awareness and knowledge of the community to properly sort and manage their household waste.

Barengkok is a small community in Jasinga that is also struggling to face a familiar rural waste challenge. Most household waste is mixed in a single container, after which part of it is open-burned or dumped informally. Collection to formal *Tempat Pembuangan Sampah* (TPS) or even *Tempat Pembuangan Akhir* (TPA) are intermittent and distant. This has been causing waste piles to form in many parts of the village. This means waste piles often remain for days, and during the rainy season, they are washed into waterways. This causes clogging of culverts and aggravates local flood risk. The organic waste dominates, and when mixed and left unprocessed, it will produce odours, leachate, and flies. These technical constraints also intersect human factors. People in rural areas, especially in Jasinga, tend to think that waste sorting is pointless. Together, these conditions keep Barengkok in a zore-mix gap. This means that Barengkok has high organic potential and rising plastic, but lacks in segregation and minimal on-site processing. Thus, Barengkok Village was chosen as the intervention site for four major considerations. First, it is a priority area in the western service region of Bogor Regency, which, based on field observations and local waste management reports, is still often considered a place for informal dumping and open burning. Second, the village has definite constraints in terms of formal waste management infrastructure, including intermittent collection services and limited access to temporary disposal sites (TPS). Third, the community shows a moderate level of readiness for intervention, as indicated by the willingness of local leaders and household representatives to participate in environmental programs. Fourth, direct observation of unmanaged organic waste build-up, resulting in odour, presence of vectors and blockage of drainage during the rainy season, underscores the need for intervention. These factors together make Barengkok a representative rural case where simple, source-based interventions can have immediate and scalable impact.

The community development initiative is designed to close this gap at the source by combining education with practical, household-scale tools. Rather than positioning sorting as a purely environmental duty, this program frames it as a value-creating initiative (Yunisvita et al., 2025). This is important in rural areas such as Barengkok, where small savings and visible yields are persuasive. This approach also decouples progress from downstream constraints. Even if municipal collection remains mixed, residents still benefit because organics can be processed onsite and recyclables are stored clean for a period of sale or community exchange. This program is different from other community-based waste education programs in three ways. It first combines knowledge transfer with immediate behavioural tools by giving a two-bin starter kit and a laminated operational guide, so that learning is translated directly into practice. Second, it uses a structured pretest-posttest design for quantitative measurement of learning outcomes, which is still an underused tool in many community service reports. Third, it views waste sorting as an environmental duty and as a value-adding activity by considering the potential use of organic waste for composting and the economic retention of clean recyclables. This triangulation of behavioural framing, practical tools and measurable evaluation provides a more holistic intervention model than conventional awareness-based approaches.

The purposes of the initiative are therefore threefold. First, it aims to raise literacy and practice of household sorting between organic and inorganic waste. This will be delivered using a short and structured learning cycle. It involves a pre-test, a short lecture, an

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interactive discussion and a post-test. This cycle allows the quantification of immediate knowledge gains and captures practical barriers raised by the community residents. Secondly, to seed the habit with tangible support, several sorting bins are introduced to segregate household waste into organic and inorganic waste. Lastly, the effectiveness of the proposed program is evaluated using statistical analysis. In sum, Barengkok's challenge is not merely the amount of waste but also the absence of simple, credible routines that keep organic and inorganic from mixing. By pairing clear instruction with ready-to-use tools and a follow-up check, this initiative aims to convert sorting from a good intention into a daily, value-creating habit for all residents of Barengkok.

Method

This community development program was conducted in Desa Barengkok, Jasinga, to increase residents' knowledge and practice of household waste sorting and basic on-site processing. The approaches used in this initiative are: 1.) delivering interactive educational materials on source separation and simple composting, 2.) moderated discussion, and 3.) evaluating participants' knowledge before and after the session. The activity concluded with a symbolic handover of a couple of labelled two-bin starter kits to seed daily habits among residents.

Participants were adult residents of Desa Barengkok who consented to join the session. These participants were also selected based on their roles in the community. Most of the participants were household decision-makers and representatives of local groups. Inclusion criteria were residence in the village and availability for the full session. The session was held in the village hall with basic audiovisual support. A group of 27 participants were gathered during the program.

Before any instructions were given to participants, a short paper-based pre-test was introduced to capture the baseline knowledge related to household waste sorting and basic processing. The instrument contained seven questions that captured several question classifications: 1) waste categories, 2) waste management, 3) impacts of waste mismanagement, and 4) efforts needed in the community. Total scores were scaled 0-100%. A facilitator explained that the test was diagnostic and anonymous, and no teaching cues were given during completion. The pre-test took ten minutes and was collected before any materials were shown to avoid contamination. Where literacy was a constraint, facilitators read items one-to-one without leading the answer.

The instructional material focused on three main household waste groups: organic waste, inorganic waste, and hazardous household waste/B3. Organic waste included food scraps, vegetable residues, fruit peels, and leaves that can be processed into compost. Inorganic waste included plastic, paper, cans, bottles, and glass that can be cleaned and stored for recycling or sale. Hazardous household waste/B3, such as used batteries, lamps, expired medicine, and chemical containers, was briefly introduced as waste that must not be mixed with other household waste because it requires special handling.

Following the instruction, a 15–20-minute moderated discussion aimed to convert content into practical, household-level plans. Participants shared existing questions and practices. The instructor then answered all the questions from the participant and concluded the discussion at the end.

After the interactive discussion, participants completed a post-test with the same items as the baseline. Seven questions were asked in ten minutes. No instructional prompts were provided during completion. The primary outcome was knowledge gained from the structured

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lecture. Secondary items captured self-efficacy and intention to place bins within the week. Collected sheets were checked for completeness, and any missing fields were resolved immediately with the participant.

The session concluded with a symbolic handover to seed new habits and make commitments visible. The representatives formally handed over several sorting bins to the village head. These bins had been properly labelled. A photo record of the handover served as a community prompt and documentation for the program report.

Statistical Analysis: Descriptive and Inferential

Learning outcomes were analysed using statistical approaches. Descriptive statistics were used to present the pre- and post-test distributions as percentages and simple charts. Bar charts were used to compare the number of correct answers from pre- and post-test, while pie charts were used to show the level of satisfaction of the program rated by all participants.

Inferential statistics were used to investigate whether the session was associated with improved knowledge. A Chi-square test of homogeneity was selected to answer the hypothesis. This test is a nonparametric test that compares whether the distribution of a categorical variable is the same across two different groups (Agresti, 2002; Montgomery & Runger, 2018). In this paper, the data from two groups were obtained from the total score of each participant. Computationally, the chi-square test is identical to the independence test on an $r \times c$ contingency table as seen in Equation 1.

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij} - E_{ij})^2}{E_{ij}} \qquad \text{Eq. 1}$$

where,
O_{ij} is the observed frequency
E_{ij} is the expected frequency
c is the number of columns
r is the number of rows

In addition to the chi-square test, Cramer's V is also used to understand the effect size for χ^2 tables (Cramér, 1946; Kearney, 2018). A scale-free effect size (0-1) for association in an $r \times c$ contingency table, often reported alongside χ^2 is written in Equation 2.

$$V = \sqrt{\frac{\chi^2}{N \,.\min(r-1, c-1)}} \qquad \text{Eq. 2}$$

Result and Discussion

To capture the baseline understanding and the improved knowledge of all participants, a list of pre- and post-test questions was formulated. The list comprised seven structured questions and sampled three core domains of household solid-waste literacy: 1) waste categories (Questions 1-4), 2) waste management (Question 5), and 3) impacts and effort (Questions 6-7). The full list of these questions, along with the number of correct answers in the pre- and post-test, can be seen in Table 1. The distribution of question categories reflects the intervention's learning objectives. They are: 1) correctly distinguish organic from inorganic fractions, 2) identify the appropriate handling pathway for organic waste, and 3)

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articulate both the consequences of mismanagement and feasible household-level actions to mitigate them.

Questions 1-4 assess the foundational recognition and cues for source separation: identifying the two principal categories (Question 1), recognising organic waste characteristics (Question 2), understanding inorganic characteristics (Question 3), and interpreting the green bin as an operational signal (Question 4). All these questions were aimed to illustrate the minimum knowledge necessary to execute a two-bin routine with low contamination among participants. Questions 5-7 extend from recognition to application and relevance: selecting the correct management pathway for organic waste (Question 5), identifying the impact of mismanagement (Question 6), and naming the most appropriate way to solve household waste (Question 7).

Table 1. List of pre- and post-test questions

Question No.	Description	Classifications	The number of correct answers	
			Pre-Test	Post-Test
No 1	Two main categories of household waste	Waste Categories	20	25
No 2	The examples of organic waste	Waste Categories	19	25
No 3	The characteristics of inorganic waste	Waste Categories	18	20
No 4	The meaning of green-colored bins	Waste Categories	21	26
No 5	The correct way to manage organic waste	Waste Management	20	25
No 6	The impact of waste mismanagement	Impacts	24	27
No 7	An example of an effort to manage waste	Effort	25	26

Figure 3 shows the number of correct answers from participants in both pre- and post-test. This figure clearly shows an upward shift across all seven questions, with post-test counts exceeding pre-test counts in every question. These improvements could also be related to the Theory of Planned Behaviour that behaviour is influenced by attitude, subjective norms and perceived behavioural control (Ajzen, 1991). The educational session helped the residents to understand the importance of sorting, and the group discussion and starter-kit demonstration helped to build social support and practical confidence. Therefore, the knowledge gained in Figure 3 might be an early indication of a higher intention to perform household waste separation. These results also show that the session effectively improved participants' understanding and knowledge of the household waste topic. Gains are most pronounced in the waste categories questions, clearly showing a significant rise in the number of correct answers. However, Question 3 improves more modestly compared to other questions in waste categories. This implies that participants may still need reinforcement on what makes materials non-biodegradable and how those properties guide sorting.

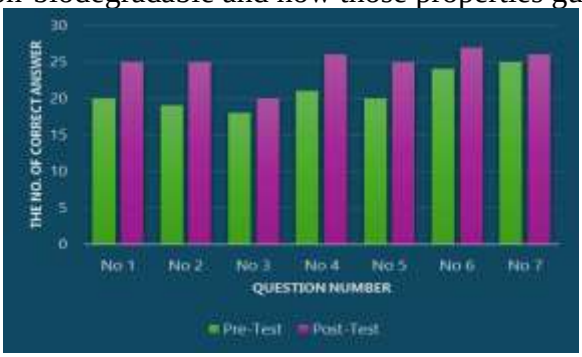

Figure 3. The number of correct answers in the pre- and post-test

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Question 6 and Question 7 show smaller but positive gains because the baseline performances during pre-test were already high. This ceiling effect suggests that many residents arrived with a general awareness of environmental impacts and actionable steps. While the lecture session still primarily added precision and confidence rather than entirely new concepts for the residents. These patterns support the intervention's theory of change: the largest improvement occurred where the foundational sorting, literacy, and routine steps were targeted. While domains with high prior awareness moved incrementally toward near-ceiling performance.

To evaluate whether the distribution of comprehension levels differed between the pre- and post-test, a chi-square test for homogeneity was conducted with a significance level of 0.05. Table 2 categorizes the total scores obtained by participants during the pre- and post-test. Scores of 10% - 55% are categorized low, 56%-74% are categorized medium, and 75%-100% are categorized high (Stiani et al., 2025). Because only marginal totals were available, the pre- and post-samples were assumed to be independent groups. Expected frequencies under the null hypothesis of identical distributions were computed as $E_{ij} = \frac{row_i \times column_j}{N}$. Here are the hypothesis statements tested using the considered test statistics:

H_0: *the distribution of comprehension levels is identical in pre − and post − test*

H_1: *the distribution of comprehension levels differs in pre − and post − test*

The test statistic (χ^2) was computed using Equation 1 and it was found out that the test is 7.37 which corresponds to p-value of 0.025 with the degree of freedom is equal to 2. Thus, the null hypothesis was rejected, indicating a statistically significant redistribution of participants across comprehension categories after the intervention. Equation 2 is then used to estimate the index of magnitude. Cramer's V was calculated as *V = 0.37*, which is typically interpreted as a small to medium association. This magnitude of change indicates a clear and meaningful improvement in comprehension. Descriptively, the proportion classified as High increased from 16/27 at pre-test to 23/27 at post-test. A gain of 25.9%, while the proportion in Low decreased from 22.2% to 0%. These shifts accord with the inferential results obtained using the chi-square test and Cramer's V. Thus, this suggests that comprehension improved following the structured lecture given before the post-test took place.

Table 2. The categories of total scores in the pre- and post-test

Score	Categories	Pre-Test	Post-Test
10% - 55%	Low	6	0
56% - 74%	Medium	5	4
75% - 100%	High	16	23
Total		**27**	**27**

Figure 4 shows the survey results of participants towards the proposed initiative. This survey was conducted to assess whether our initiative was accepted by the community and whether all participants were satisfied or not. Figure 4 (a) shows a very strong perceived need for the program, with 77.78% of respondents strongly agree and 18.52% agree that the community needs the activity, with only a small minority disagreeing. According to this distribution, participants' perceived priorities and the intervention's focus (household sorting and basic processing) are broadly aligned, which is crucial for uptake and the subsequent development of habits. With no negative ratings, Figure 4 (b) demonstrates similarly high levels of satisfaction with the session itself, with 51.85% very agree and 48.15% agree with

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the overall experience. When combined, high perceived need and almost universal satisfaction suggest a social environment that is conducive to ongoing interaction and follow-up. These perceptual results can be connected to observed knowledge gains in reporting to support the claim that the materials, content, and delivery were appropriate and pertinent to the participants.

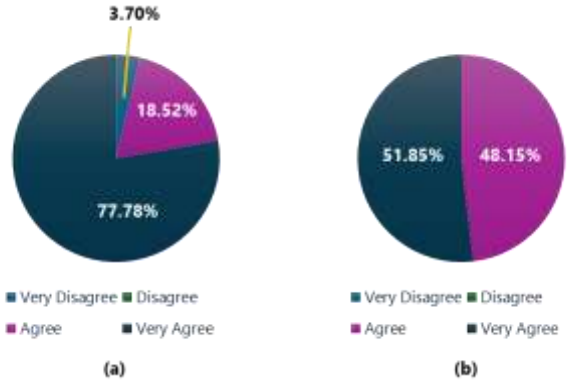

Figure 4. The results of participants' surveys (a) on whether the program is needed by the community, and (b) on the overall satisfaction rate

The socialisation and lecture took place in the village hall, which had a simple classroom layout that made it easy for the facilitator and participants to talk to each other all the time. The session started with a brief overview of the state of waste in the area, followed by a structured explanation of how to separate household waste at the source and do basic processing. There were visual aids throughout the presentation, such as slides and a poster (Figure 6) that showed how to sort things in the kitchen, store them, and compost them on-site. The high level of participation during the lecture and discussion period is depicted in Figure 5. Participants were not passive recipients. Several residents provided helpful advice that was documented on a flipchart, and brief call-and-response surveys were utilised to uncover common practices. The closing handover, as seen in **Error! Reference source not found.**, was a public commitment to new routines as well as a provision of facilities. A laminated guide and a set of labelled bins were given to each participating household, and group representatives signed a brief commitment to set up and utilise the bins at home. In addition to positioning the new equipment as communal village resources rather than discrete household purchases, the handover made the transition from learning to implementation evident.

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Figure 5. Active class participation during the lecture and discussion

The goal of this community-based intervention in Desa Barengkok was to transform the practice of sorting household waste from a suggestion into a useful, value-adding habit. We were able to measure immediate learning while recording contextual barriers and adoption cues thanks to the one-group pretest–posttest design, which was suitable for a first implementation in a rural setting with limited infrastructure.

All things considered, this initiative is best viewed as a success in delivering an educational purpose for all participants. The organised lecture transformed broad concepts into manageable practices that attendees could implement at home, using examples and facilitated discussion. Throughout the session, there was a high level of engagement; residents shared useful solutions, asked targeted questions, and confirmed that the program truly addressed a need. Consistent improvement in organic handling and classification was observed in both pre- and post results, suggesting that a well-structured learning arc can rapidly hone practical knowledge. In addition to designating community champions, the final handover of pairs of labelled bins and a kitchen guide helped turn intention into action and demonstrated collective ownership. Most importantly, the program established a basic routine that people liked, could recall, and were eager to practice with one another, laying the groundwork for cleaner homes and clear community benefits.

Figure 6. A poster of our educational program

These findings are in line with previous publications that have indicated that participatory education, along with practical tools, has a significant effect on household waste management behaviour. Joleha et al. (2024) stated that structured waste education programs can increase community participation, while Hamdani et al. (2025) stated that the integration of circular economy principles can improve knowledge and implementation. Moreover, Nurhayati & Nurhayati (2023) found that community-based waste education can encourage a paradigm shift in which people view waste as an economic resource, not just a burden that needs to be disposed of.

Conclusion

This community-based education successfully improved procedural knowledge and literacy related to household waste sorting. All seven test items demonstrated steady improvements, according to descriptive results, with the biggest gains occurring in categories (organic–inorganic, colour-coding) and organic-handling competencies. These are exactly the abilities

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that the session was designed to target. For these domains, inferential tests (χ^2 with Cramer's V) showed modest to moderate, significant effects. Surveys of perception supported the learning data. It was found that participants expressed near-unanimous satisfaction and a very high perceived need, indicating strong social acceptability and readiness to adopt the two-bin routine that the starter kits provided. The one-group design and immediate post-test timing limit interpretation and may overstate persistence because of testing effects and brief observation windows. In addition to knowledge improvement, this intervention catalysed a paradigm shift among residents from seeing waste as a burden to perceiving it as a manageable and potentially valuable household resource. Provision of the two-bin starter kit was key to this transition, facilitating immediate practice, improving household-level facility readiness and reducing the knowledge-action gap.

Recommendation

To maintain the effectiveness of this program and further develop its scale, it is suggested that the results of this activity be reported to the village council about the creation of Perdes (Village Regulation) for waste management. The development of Perdes will enable the practice of source separation to become an institutionalised process, and it will provide funding from Dana Desa (Village Funds) to purchase waste facilities as well as conduct further educational activities within the community. Operationally, it would be advisable to develop an appropriate follow-up program, which includes regular control from the community leaders, assessment of the use of the bins, and initial implementation of composting techniques.

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