A Model to Increase Community Participation in Waste Reduction in the Naimata and Penfui Sub-districts

Enni Rosida Sinaga[1*], Albina Bare Telan[1], Siprianus Singga[1] , Yusmidiarti[2]

[1] Program Study of Sanitasi, Poltekkkes Kemenkes Kupang, Indonesia.
[2] Program Study Sanitasi, Poltekkes Kemenkes Bengkulu, Indonesia.

Abstract: Community participation played an essential role in reducing household waste in Kupang City, where waste management had remained poor and piles of garbage were common along the streets. This study aimed to enhance community involvement in managing and reducing household waste. A descriptive method was applied, involving 72 households from housing complexes in Naimata and Penfui villages. Data was collected through interviews, observations, and community-based interventions such as Focus Group Discussions (FGD), education, and assistance from local leaders. The treatment significantly improved community participation: households with good waste management practices increased from 8 to 52, while those with poor management decreased from 64 to 20. The number of households utilizing waste rose from 22 to 62, and those processing organic waste into compost increased from 7 to 68. Organic waste generation dropped from 72 liters/day to 13 liters/day, and inorganic waste from 239 to 215 liters/day. The study concluded that community-based education and support effectively enhanced waste reduction behaviors, highlighting the need for continued government and community collaboration to sustain these practices.

Keywords: Drone; Efficiency; Labour; Pre planting spraying; Productivity.

Introduction

Urban waste continues to increase in line with population growth and lifestyles. Waste production in Kupang City has increased annually, reaching 214 tons per day in 2020 and 218 tons per day in 2021. Therefore, proper waste management is required to keep pace with this, as it can become a city cleanliness and environmental health issue. Efforts are being made to raise awareness of environmental issues, particularly waste management, and to create a clean and environmentally friendly residential environment by reducing waste volume at the source through sorting or processing with simple technologies such as household composting (Cheng et al., 2022; Manea et al., 2024; Senadheera et al., 2024).

Field observations indicate poor waste management, evident along the streets, with piles of trash and litter scattered everywhere. Within the family environment, household waste is often not managed wisely. Many people still litter, mix organic and inorganic waste, and burn it in their yards, which can produce harmful air pollution (Bano, 2025; Budjav, 2022; Siddiqua et al., 2022). In fact, household waste should be managed according to the 3R principle (Reduce, Reuse, Recycle) (Arenibafo, 2023; Mahartin, 2023; Usman et al., 2021). It can even be used to make compost for agriculture and reforestation (Mallick et al., 2025; Sumbodo et al., 2023; Ugwu et al., 2021).

Residential housing developments by developers are increasingly common in Kupang City, with plots measuring 90, 100, and 120 meters. There are no landfills in the Baumata and Penfui sub-districts, so residents

dispose of waste in unsanitary areas, creating a dirty, smelly environment, and breeding grounds for vectors and disease carriers. Waste that is not properly managed can become a breeding ground for disease-transmitting vectors such as flies, rats, cockroaches, mosquitoes, and other animals (Martinawati et al., 2016).

One way to address waste in residential areas is for residents to manage and reduce the amount of waste they produce. Reducing the use of single-use items like plastic and Styrofoam is also necessary as a form of environmental awareness (Borg et al., 2022; Pearson et al., 2022). Additionally, residents can manage their own waste through activities such as composting, using biopore holes, or processing organic waste into eco-enzymes (Sarminingsih et al., 2023). Participation in environmental programs such as waste banks, community service programs, and waste awareness communities contributes to the creation of a clean and healthy environment.

The purpose of this research was to identify an appropriate model for waste management and household waste reduction. This survey method involved data collection through interviews and measurements of waste volume, as well as observations and waste reduction efforts. The results of the data collection were disseminated to the community, the village government, and community leaders. Problems identified from the collected data were discussed and solutions were developed through education, followed by focus group discussions (FGDs). Waste management methods were implemented based on the FGD results. This led to the identification of an appropriate waste management model for the Naimata and Penfui housing complexes. Waste generated from residential areas can be managed, resulting in a clean, healthy environment, a healthy community, and reduced operational costs for municipal waste management.

Method

This research used a descriptive approach, a method aimed at systematically and factually describing the conditions, characteristics, and changes in community behaviour regarding household waste management. The research focused on comparing waste management behaviour before and after the implementation of interventions in the form of Focus Group Discussions (FGDs) and environmental education (Nidhom & Nurcahyani, 2025). This intervention included providing information on the importance of using appropriate household waste containers, waste utilization techniques, and efforts to reduce waste at the source. With this approach, the research attempted to capture the dynamics of community participation more clearly and comprehensively.

The study subjects were adult household members selected from 72 households residing in housing developments build by developers in the Naimata and Penfui Districts. This household selection took into account similar characteristics of the residential environment, ensuring that the data obtained could represent community behavior in a representative manner (Gajdzik et al., 2023). Respondents were actively involved in all research activities, from interviews and observations to training, to ensure that the information obtained reflected actual conditions on the ground.

Data collection was conducted through three main techniques: structured interviews, field observations, and training. Structured interviews were used to obtain data on household waste management habits, prior knowledge of waste sorting, and levels of participation in waste utilization and reduction efforts. Field observations were conducted to observe actual community waste management practices, including the types of waste containers used, waste disposal methods, and the cleanliness of the home environment. Training was provided to improve community skills in implementing better waste management practices, particularly regarding the separation of organic and inorganic waste and the utilization of organic waste into compost.

Furthermore, household waste production volume measurements were conducted to obtain quantitative data on waste generation from each household. These measurements followed the SNI 19-3964-1994 standard, which includes procedures for collecting and measuring waste volume accurately. The data obtained were used to compare waste generation before and after the intervention, thus determining the extent to which changes in community behaviour contributed have contributed to the reduction in household waste volume.

The FGD was a crucial part of this research, as it explored community perspectives, experiences, and needs regarding waste management. In the FGDs, participants discussed the various problems they faced and explored possible solutions. The FGD results indicated a consensus that organic waste should be processed into compost as the most feasible waste reduction measure implemented in the household environment. This agreement was then followed up with technical training on how to make compost using simple methods tailored to the community's circumstances.

All data obtained from interviews, observations, waste volume measurements, and FGD results were analysed descriptively. This analysis was conducted to illustrate changes in community knowledge, attitudes,

and practices toward waste management after participating in a series of interventions. Thus, the research results not only provide a picture of the initial and final conditions of waste management behaviour but also demonstrate the effectiveness of the FGD approach and environmental education in increasing community participation in household waste reduction and utilization efforts.

Results and Discussion

Prior to treatment, community participation in household waste management in the Naimata and Penfui housing complexes was categorized as good (8 households) and 64 households as poor (64 households). Community participation in waste management, including providing trash bins, processing waste, disposing of waste at the waste disposal site, and keeping yards clean and free of waste, was not yet evident. Residents still disposed of waste in vacant lots or behind their homes.

This community participation was addressed through focus group discussions (FGDs) and education on resolving waste management issues by increasing community participation. Prior to the FGDs, education was provided on proper household waste management, noting that improper waste management can impact public health and the environment. The FGDs in the Naimata and Penfui housing complexes agreed that all households should have trash bins or receptacles at home, and that organic waste generated should be processed into compost. Researchers conducted training on simple composting using a composter. Changes in community participation are shown in Table 1.

Treatment: Community Participation in Waste Management
The results of the study on community participation in household waste management before and after treatment are as follows:

Table 1. Community Participation in Waste Management Before and After Treatment with Education and FGDs in Naimata and Penfui Sub-districts

Categories	Before	After	Conclusion
Good	8	52	Increase
Not good	64	20	Decrease

Table 1 shows that community participation before the treatment was in the good category with 8 families, and after the treatment, it increased to 52 families, while community participation in the poor category decreased after the treatment.

Treatment: Community Participation in Waste Utilization
Prior to treatment, community participation in waste utilization through education and focus group discussions (FGDs) was shown in Table 2. Prior to treatment, 50 families participated in household waste utilization, while 22 families utilized household waste. After the treatment, education and FGDs were conducted, and they discussed how to utilize useful waste, such as refillable cooking oil containers, which can still be used as flowerpots. Community participation in waste utilization is shown in Table 2.

Table 2. Waste Utilization Before and After Treatment with Education and FGDs

Variable	Before	After	Conclusion
Useful	22	62	Increase
Not use	50	10	Decrease

Table 2 shows that community participation in utilizing household waste increased after treatment, while the number of people who did not utilize waste decreased after treatment.

Treatment: Community Participation in Waste Processing
Prior to treatment, community participation in processing organic waste into compost through focus group discussions (FGDs) and education included only 7 households processing waste, while 65 households did not. After education and FGDs, there was an increase, as shown in Table 3.

Table 3. Community Participation in Waste Processing Before and After Education and FGDs

Variable	Before	After	Conclusion
Processing waste	7	68	Increase
Not processing waste	65	4	Decrease

The community participation treatment, which involved education and focus group discussions (FGDs), focused on waste management, as shown in Table 5. Before the treatment, 7 households participated in waste management, increasing to 68 after the treatment. The number of households who did not manage waste before the education and FGD treatment was 65, decreasing to 4 households after the treatment.

Waste Generation Volume after Community Participation Treatment
The daily volume of household waste generated in the Naimata and Penfui housing complexes, Maulafa District, Kupang City, is presented in Table 4.
Table 4 shows that organic waste generation before community participation treatment was 72 liters/day, and after treatment, this figure decreased to 13 liters/day. Inorganic waste before community

participation treatment was 239 liters/day, and after treatment, this figure decreased to 215 liters/day.

Table 4. Volume of Organic and Inorganic Waste Generation Before and After Education

Waste Composition	Waste volume/liter/day		Percentage %
	Before	After	
Organic	72	13	87
Inorganic	239	215	47

Discussion

Community participation in waste management, from providing household waste containers, sorting waste, processing waste, and disposing of waste at the Waste Management Facility is the responsibility of families as waste producers. Aspects of community participation in waste management include waste sorting at source and implementing the 3R waste management approach, which generally refers to efforts to reduce waste disposal through reuse, reduce, and recycle programs (Mostaghimi & Behnamian, 2023; Zamroni et al., 2020). Reuse is the direct reuse of waste, either for the same purpose or for a different purpose. Reduce is the elimination of everything that causes waste generation. Recycle is the reuse of waste after processing. Reducing waste from the source requires efforts to reduce waste from upstream to downstream.

Increasing community participation in waste management is an effort to reduce household waste. Increasing community participation through treatment with Focus Group Discussions (FGDs) and community education on waste management resulted in low levels before the treatment, and increased community participation after the treatment. The education provided covered proper waste management, from generation to collection, processing, and disposal to temporary waste disposal sites. Poorly managed waste can impact family health. Waste disposed of indiscriminately can become a breeding ground for disease vectors such as flies, rats, cockroaches, and other pests (Gelbert et al., 1996).

Community participation was increased through focus group discussions (FGDs). The research team addressed the waste management issues identified in the community, including the lack of waste receptacles, the lack of waste sorting, and the dumping of waste in vacant lots, rivers, and residential areas. The community discussed these issues and reached an agreement that each household should have a trash receptacle and separate organic and inorganic waste. Organic waste was processed into compost, while inorganic waste with economic value was given to scavengers (Farras et al., 2022). Each family composts at home, and researchers conducted composting training for the community and distributed composters to each family.

Community participation increased after education and FGDs, with the community disposing of waste in trash receptacles and separating organic and inorganic waste. The waste management strategy agreed upon in the FGDs was to process organic waste into compost at home. The community received training on composting using a simple, easy-to-use composting method. The training materials included household waste sorting and organic waste processing into compost.

Field monitoring results in the homes of housewives showed that every activity that produces waste was immediately separated into organic and inorganic waste. Housewives who cook in the kitchen immediately separate organic waste from inorganic waste. Vegetable scraps after cooking were immediately chopped and mixed with the finished compost, then placed in a composter tube and covered (Wang et al., 2022). To moisten the compost material, fish washing water or rice washing water was added, mixed with the waste material and added to the compost. Humidity plays an important role in the microbial metabolism process and indirectly affects the oxygen supply. Microorganisms can utilize organic material if it is soluble in water. Humidity of 40-60% is the optimum range for microbial metabolism. If humidity is below 40%, microbial activity will decrease and will be lower even at 15% humidity. If humidity is greater than 60%, nutrients will be leached and air volume will be reduced, resulting in decreased microbial activity and anaerobic fermentation that produces an unpleasant odor (Xing et al., 2025).

This was done daily. The ongoing involvement of the community requires monitoring from community leaders and village officials to ensure its smooth operation. Waste processing from the source, with community participation in processing organic waste into compost using the composter method, accompanied by village officials and community leaders, can be carried out effectively. According to Minister of Agriculture Regulation No. 70/Permentan/SR.140/10/2011, organic fertilizer is derived from dead plants, animal manure, and/or animal parts, and/or other organic waste that has undergone an engineering process. It can be in solid or liquid form and enriched with minerals and/or microbes that are beneficial for increasing the nutrient and organic matter content of the soil and improving its physical, chemical, and biological properties (Mondol et al., 2025).

After treatment, waste processing into compost reduces the amount of waste disposed of at the landfill (TPSS), from 72 liters per day to 13 liters per day. In this case, processing waste into compost helped reduce the amount of waste disposed of at the TPSS and eliminate

odors at the TPSS. Increasing community participation is crucial for solving the waste problem in the community.

This is supported by data on the 10 most common diseases in Kupang City: acute respiratory infections (ARI), skin diseases, and diarrhea. Astri Amelya's research indicated that the most common symptoms linked to waste management include diarrhea, skin disorders, worm infestations, malaria, and acute respiratory infections. Data from Kupang City in 2023 showed the most common diseases, diarrhea, and tuberculosis. Both were linked to poor waste management.

Community participation in waste management is the community's willingness to contribute to the success of waste management development programs according to everyone's abilities without sacrificing their own interests. Without community participation, all planned waste management programs will be in vain. One approach to assisting government programs in their success is to encourage the community to behaviors consistent with waste management programs. This involves changing public perceptions of orderly, smooth, and equitable waste management, changing poor waste management habits, and addressing local social, structural, and cultural factors (Wibowo & Djajawinata, 2012).

Low community participation in waste reduction needs to be encouraged, motivating them to take responsibility for the waste they produce. Encouragement or motivation can be provided by involving the community in resolving existing waste management problems. Strategies for increasing community participation include communicating research findings to the community-on-community participation in waste management.

Conclusion

Participatory treatment in household waste management has increased. Community participation in waste reduction has increased. The number of people reducing waste into compost has increased, and the number of people selling waste with economic value has increased. Collaboration with the sub-district office and community leaders must be strengthened. Community health centers routinely provide outreach and education on waste management to the community. Sub-district offices or community leaders should prepare land for communal composting. Continuous monitoring should be carried out by the sub-district office and community leaders.

Conflicts of Interest
The authors declare no conflict of interest.

References

Arenibafo, F. E. (2023). The 3Rs (reduce, reuse, recycle) of waste management--An effective and sustainable approach for managing municipal solid waste in developing countries. *Proceedings of the International Conference of Contemporary Affairs in Architecture and Urbanism-ICCAUA*, *6*(1), 383–398. https://doi.org/10.38027/iccaua2023en0108

Bano, A. (2025). Direct environmental pollution from solid waste. In *Waste-to-Energy* (pp. 249–269). Elsevier. https://doi.org/10.1016/B978-0-443-22356-3.00011-7

Borg, K., Lennox, A., Kaufman, S., Tull, F., Prime, R., Rogers, L., & Dunstan, E. (2022). Curbing plastic consumption: A review of single-use plastic behaviour change interventions. *Journal of Cleaner Production*, *344*, 131077. https://doi.org/10.1016/j.jclepro.2022.131077

Budjav, B. (2022). Evaluation of environmental pollution and waste management strategies on the ecosystem. *Journal of Enterprise and Business Intelligence*, *2*(4), 223–234. https://doi.org/10.53759/5181/JEBI202202022

Cheng, J., Yin, R., Luo, W., Li, Y., Wang, L., & Chang, R. (2022). Home composting for onsite treatment of household organic solid waste: a review. *Current Pollution Reports*, *8*(4), 395–408. https://doi.org/10.1007/s40726-022-00233-8

Farras, J. I., Sarasi, V., Chaerudin, I., Primiana, I., & Yunani, A. (2022). Implementation of lean process to solid waste management in Bandung, Indonesia. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan (Journal of Natural Resources and Environmental Management)*, *12*(2), 210–227. Retrieved from https://journal.ipb.ac.id/index.php/jpsl/article/view/37030

Gajdzik, B., Jaciow, M., Wolniak, R., Wolny, R., & Grebski, W. W. (2023). Energy behaviors of prosumers in example of polish households.

Energies, *16*(7), 3186. https://doi.org/10.3390/en16073186

Gelbert, M. al, Prihanto, D., & Suprihatin, A. (1996). *Konsep pendidikan lingkungan hidup dan" wall chart"* (Vol. 16). Malang: PPPGT/VEDC.

Mahartin, T. L. (2023). Waste management plan with reduce, reuse, recycle (3r) method. *Journal of Sustainability, Society, and Eco-Welfare*, *1*(1). https://doi.org/10.61511/jssew.v1i1.2023.181

Mallick, R., Dwivedi, K., Rai, S., Chakraborty, D., & Shukla, N. (2025). Pathways Towards Sustainable Waste Management Through Technological Innovations and Effective Policies to Achieve Healthy Agricultural Soil. In *Producing Healthy Food with Healthy Soils: Hazardous Waste Management* (pp. 169–177). Springer. https://doi.org/10.1007/978-3-031-82536-1_14

Manea, E. E., Bumbac, C., Dinu, L. R., Bumbac, M., & Nicolescu, C. M. (2024). Composting as a sustainable solution for organic solid waste management: Current practices and potential improvements. *Sustainability*, *16*(15), 6329. https://doi.org/10.3390/su16156329

Martinawati, M., Zahri, I., & Faizal, M. F. M. (2016). Partisipasi Masyarakat dalam Pengelolaan Sampah Rumah Tangga: Sebuah Studi di Kecamatan Sukarami Kota Palembang. *Jurnal Penelitian Sains*, *18*(1), 14–21. https://doi.org/10.56064/jps.v18i1.35

Mondol, M., Angon, P. B., & Roy, A. (2025). Effects of microplastics on soil physical, chemical and biological properties. *Natural Hazards Research*, *5*(1), 14–20. https://doi.org/10.1016/j.nhres.2024.02.002

Mostaghimi, K., & Behnamian, J. (2023). Waste minimization towards waste management and cleaner production strategies: a literature review. *Environment, Development and Sustainability*, *25*(11), 12119–12166. https://doi.org/10.1007/s10668-022-02599-7

Nidhom, M., & Nurcahyani, D. (2025). Community Perceptions of Waste Management Practices: A Qualitative Study in Urban Neighborhoods. *Acitya Wisesa: Journal of Multidisciplinary Research*, 34–44. https://doi.org/10.56943/jmr.v4i2.864

Pearson, M., Khare, E., & Tantawi, O. (2022). Addressing the single-use plastic proliferation problem. *MIT Science Policy Review*, *3*(1). https://doi.org/10.38105/spr.ro3uhoc2lz/

Sarminingsih, A., Sumiyati, S., Syafrudin, S., Andika, A. F., & Balqis, M. (2023). Effect of Variation of Eco-Enzyme Addition on Macro Nutrient Content of Compost with Biopore Infiltration Holes. *E3S Web of Conferences*, *448*, 3035. Retrieved from https://www.e3s-conferences.org/articles/e3sconf/abs/2023/85/e3sconf_icenis2023_03035/e3sconf_icenis2023_03035.html

Senadheera, U. E., Jayasanka, J., Udayanga, D., Hewawasam, C., Amila, B., Takimoto, Y., Hatamoto, M., & Tadachika, N. (2024). Beyond Composting Basics: A Sustainable Development Goals—Oriented Strategic Guidance to IoT Integration for Composting in Modern Urban Ecosystems. *Sustainability*, *16*(23), 10332. https://doi.org/10.3390/su162310332

Siddiqua, A., Hahladakis, J. N., & Al-Attiya, W. A. K. A. (2022). An overview of the environmental pollution and health effects associated with waste landfilling and open dumping. *Environmental Science and Pollution Research*, *29*(39), 58514–58536. https://doi.org/10.1007/s11356-022-21578-z

Sumbodo, B. T., Ma'rifah, A. N., Sardi, S., Setiawan, P., Sudrajat, I. S., Widagdo, A. K., Salsabila, A. N., & Ika, S. R. (2023). Waste Management in an Urban Village through Biopore Organic Waste and Composting Education: A Lesson from Giwangan Village, Yogyakarta. *Proceeding of the 10th International Conference on Management and Muamalah*. Retrieved from https://shorturl.asia/i71J4

Ugwu, C. O., Ozoegwu, C. G., Ozor, P. A., Agwu, N., & Mbohwa, C. (2021). Waste reduction and utilization strategies to improve municipal solid waste management on Nigerian campuses. *Fuel Communications*, *9*, 100025. https://doi.org/10.1016/j.jfueco.2021.100025

Usman, M., Lamangida, T., & Akbar, M. F. (2021). Implementation of Waste Management Policy with 3R Principles (Reduse, Reuse, Recycle) in the Gorontalo City. *Journal of Public Representative and Society Provision*, *1*(1), 29–37. https://doi.org/10.55885/jprsp.v1i1.36

Wang, L. K., Wang, M.-H. S., Cardenas Jr, R. R., Sabiani, N. H. M., Yusoff, M. S., Hassan, S. H., Kamaruddin, M. A., George, F. O., & Hung, Y.-T. (2022). Composting processes for disposal of municipal and agricultural solid wastes. In *Solid Waste Engineering and Management: Volume 1* (pp. 399–523). Springer. https://doi.org/10.1007/978-3-030-84180-5_7

Wibowo, A., & Djajawinata, D. T. (2012). *Penanganan Sampah Perkotaan Terpadu*. Retrieved from https://shorturl.asia/8Mtnj

Xing, Z., Fu, X., Huang, H., Xu, Y., Wei, L., Shan, C., & Du, Y. (2025). Recent advances in Lactobacillus plantarum fermentation in modifying fruit-based products: Flavor property, bioactivity, and

practical production applications. *Comprehensive Reviews in Food Science and Food Safety*, 24(2), e70160. https://doi.org/10.1111/1541-4337.70160

Zamroni, M., Prahara, R. S., Kartiko, A., Purnawati, D., & Kusuma, D. W. (2020). The waste management program of 3R (Reduce, Reuse, Recycle) by economic incentive and facility support. *Journal of Physics: Conference Series*, *1471*(1), 12048. https://doi.org/10.1088/1742-6596/1471/1/012048