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Community empowerment in the Coastal Area of Banda Aceh City by Introducing Organic Waste Management for Generating Biofertilizer

[1]Darwin*, [1]Ramayanty Bulan, [1]Bambang Sukarno Putra, [1]Muhammad Rizal
[1]Universitas Syiah Kuala, Indonesia
*Corresponding author
E-mail: darwin_ae@usk.ac.id

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Abstract

Purpose: This community service aims to introduce organic agriculture in Banda Aceh's coastal area by converting organic wastes into biofertilizer to remediate tsunami-affected lands with high salinity and low nutrients.

Method: The team designed and implemented a mobile bio-composter system capable of processing 150 kg of organic waste. Field observations and soil analyses were conducted to assess land conditions, followed by technology transfer to Gampong Pie community members.

Practical Applications: The mobile bio-composter processes household, municipal, and agricultural waste while enabling community members to produce their own microbial inoculants. This technology supports economic empowerment through fertilizer production and sales, addressing critical land issues while creating new business opportunities.

Conclusion: The initiative successfully produced a mobile bio-composter installation that converts organic waste into biofertilizer for remediating coastal critical lands, promoting sustainable organic agriculture development in tsunami-affected areas.

Introduction

This community service program involved community groups from Gampong Pie Village, Meuraxa District, Banda Aceh City. The primary target group for this service is the general public and those who are not yet economically productive but are planning to open and develop productive businesses. This product-based service program focuses on managing and processing organic waste in coastal tourism areas affected by the tsunami, utilizing technology transfer by the community service team.

The primary focus of this activity is on developing skills in organic waste processing and building entrepreneurial management through the production and marketing of organic fertilizers such as compost and bio digestate, as well as developing organic farming systems for small plots of land. This priority is given because the Gampong Pie community generally resides in a strategic coastal area, close to the Ulee Lheu Beach marine tourism area and the center of Banda Aceh City. However, the development of independent businesses and community groups remains difficult due to a reliance solely on fish and seafood catches. Furthermore, not all generations of community members possess skills in fisheries and aquaculture. Some residents are interested in farming, but the available land is unsuitable for cultivation due to the high cost of remediation.

Gampong Pie is a village in Meuraxa District, Banda Aceh City, which was severely impacted by the tsunami. Despite a decade and a half since the tsunami, much of the village's unused land remains unused. The village's coastal location and the impact of the tsunami on Gampong Pie have rendered the land unsuitable for farming. The existence of unused land in Gampong Pie provides opportunities for residents to develop the city's organic farming sector. However, much of this unused land is classified as critical. Field observations and interviews with residents revealed that villagers have attempted to cultivate unused land left by the tsunami, but the crops have not grown properly and are prone to crop failure.

Dormant and/or unused lands owned by the residents of Gampong Pie cannot be used for agricultural processes because the tsunami-affected soil has high salinity and alkalinity and has low nutrients (Velmurugan et al., 2015). Therefore, this problem requires serious attention and handling from various parties, especially universities, to provide solutions in carrying out the land remediation process through the provision of organic fertilizer production installations that residents can use to restore and remediate critical land affected by the tsunami.

The availability of organic waste processing infrastructure to produce biofertilizers and bio-remediators is a very urgent matter to be considered to stimulate the opening of new businesses in the field of urban organic farming systems (Haryanta et al., 2023). Urban organic farming has great potential to be developed in Gampong Pie, where urban organic farming (Urban Organic Farming & Hydroponic Systems) is not only beneficial in terms of organic vegetable production but also can add to the beauty of Banda Aceh City to become an environmentally friendly city. This community service program aims to introduce the practice of organic waste management for generating biofertilizer and/or soil conditioner in the coastal area of Banda Aceh, specifically Gampong Pie Village.

Method

Mechanisms of the dissemination of technology

The practice conducted during the community services is to establish and install an integrated mobile bio-composter unit system, or organic waste processing equipment. The community service team chose this technology because it is an effective, appropriate technology for processing organic waste from households, agricultural and livestock activities, and the food and restaurant industry. The advantages of this technology include processing organic waste and producing biofertilizer and digestate, which can be used as organic fertilizer and as a starter and/or inoculant for in-situ critical land remediation (Beni et al., 2012).

Procedure for Operating the Introduced Machine

To assist the Gampong Pie community in addressing critical land issues through land remediation and restoration, integrated mobile bio-composter unit equipment and installation technology are required. This equipment and technological system are capable of processing organic waste into biofertilizer. Furthermore, this equipment and technology can produce digestate from the anaerobic digestion of liquid organic waste, which can be used as a soil emulsifier and/or soil bio-remediator for critical land recovery (Walsh et al., 2012). This community service project will build equipment and an integrated mobile bio-composter unit installation system that integrates several organic waste processing technologies and systems. This unit consists of a screening unit, which separates organic waste from inorganic contaminants, and a composting unit, which processes solid organic waste into biofertilizer (Lim et al., 2016).

The composting process is also equipped with aerators to increase the efficiency of converting solid organic matter into biofertilizer (Karnchanawong and Nissaikla, 2014). The entire solid organic waste treatment system is integrated into a single, mobile organic waste treatment system, making it easy to operate and relocate. Therefore, this system is designed for easy use by the public and direct application of the fertilizer produced to organic farmland.

The integrated organic waste processing installation equipment is capable of carrying out the organic waste decomposition process effectively and efficiently. The composter is supported by the installation of an aeration system. Hence, the process of decomposition and nutrient recovery of organic waste into compost performs optimally (Cáceres et al., 2006; Jiang et al., 2015).

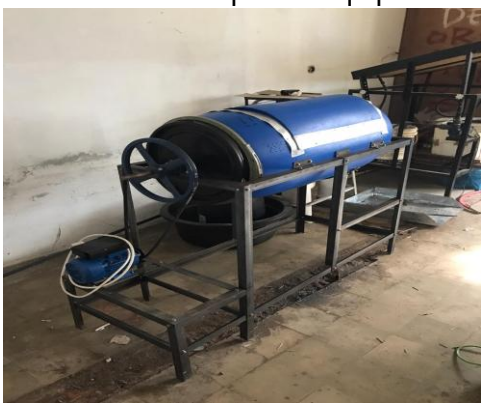
Implementation of the technology

This program is initiated with the setting up of the materials and equipment used for performing organic biofertilizer production by the society. Then, the team introduced the participants to the mechanisms of operating the machine. The participants were also educated on how to select the feedstocks for generating biofertilizer, such as removing some unexpected materials (i.e., gravels, plastics, sands) that may inhibit the composting processes. Finally, the participants were taught how to conduct the composting process by using the equipment and avoiding any accidents during performances.

Result

This community service program began with the design of mobile bio-composter equipment and systems. The equipment consists of a bio-digester, a power distribution system, a stirrer for mixing organic materials during the composting process, and a mobile holder. The design and construction results of the bio-composter equipment and systems are shown in Figure 1.

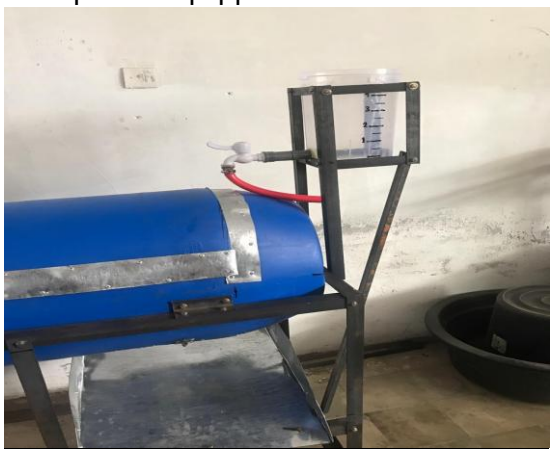
Figure 1. Mobile bio-composter equipment designed



Source: Private Documentation, 2025.

This mobile bio-composter equipment and system is equipped with an additional membrane unit, namely a microbial culture reactor unit or aerobic digester equipped with a water-air pump unit. This unit is needed for the microbial inoculant cultivation process, which can then be used as a starter that acts as a decomposer for the decomposition of organic waste into compost. This unit is very important because users of this mobile bio-composter tool can produce their starter or microbial inoculants for the composting process without having to buy an EM-4 starter. The results of the design of the mobile bio-composter equipment and system equipped with a microbial inoculant cultivation system can be seen in Figure 2.

Figure 2. Bio-composter equipped with a microbial culture chamber

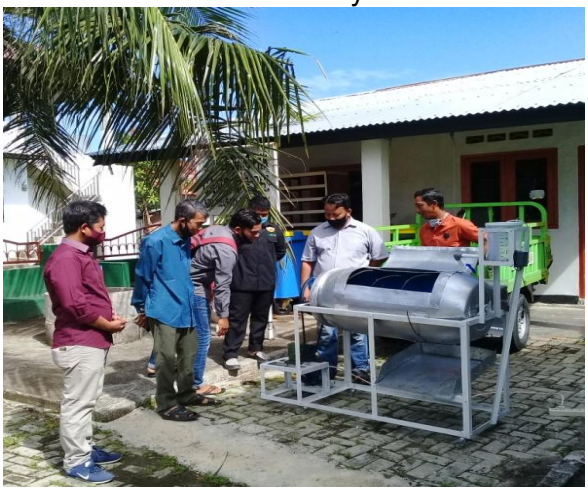


Source: Private Documentation, 2025.

This product-based community service activity received an excellent response from partners and the community. This was evidenced by the enthusiasm of partners and community members in participating in demonstrations and explanations of the organic fertilizer production process using a mobile bio-composter. During the community service activity, the implementation team received numerous questions about the organic fertilizer production process using the mobile bio-composter equipment (Figure 3).

In this program, the participants are also involved in the process of operating the machine and producing organic biofertilizer. In this activity, the feedstock used for generating the bio-composter is coconut pulp waste. They are taught how to operate the equipment and how to prepare and make organic fertilizer by using domestic organic wastes.

Figure 3. Introduction and demonstration of the operation of the mobile bio-composter to the community



Source: Private Documentation, 2025.

Discussion

After the design and manufacture of the equipment, its performance was tested. The performance test process of this tool was conducted by inserting raw materials for composting, including household and restaurant waste. For this test, the material used was 20 kg of coconut pulp. Before the feedstock was loaded into the digester, the first step was the process of cultivating the compost inoculum using cow manure. The cow manure was used as this contained various types of microbes, specifically cellulolytic bacteria, which may improve the degradation of lignocellulosic materials as substrates for composting processes (Nyonyo et al., 2014; Darwin et al., 2022)

The cow manure material was put into the inoculation reactor as much as 5 liters. During the inoculation process, the aerator water pump was turned on so that the cultivation process took place aerobically. This process is conducted to induce and activate the aerobic microbes, and thereby they could easily adapt to the aerobic condition during the composting process (Fu et al., 2023). After 5 days of the cultivation process, the inoculum can be used as a starter or decomposer in the composting process by opening the stop valve at the top of the digester so that the cultivated inoculum can flow evenly through the nozzle in the digester (Figure 4).

Figure 4. Composting process using bio-composter equipment

Source: Private Documentation, 2025.

This mobile bio-composter equipment and system is equipped with a microbial culture reactor unit, which is very useful for accelerating the integrated composting process. This unit is useful for cultivating microorganisms independently, eliminating the need to search for or purchase commercially available materials. Therefore, composting using this equipment can save on starter costs. Because the microbial inoculants produced are still highly active, they can increase the rate of organic waste decomposition, significantly shortening the compost production time.

The use and/or installation of a nozzle spray system on this mobile bio-composter equipment can also increase the effectiveness of the composting process, thereby increasing biodegradation efficiency. This system also improves the distribution of microbial inoculants in organic materials, enabling effective oxidation and mineralization processes with evenly distributed microbial inoculants (Oviedo-Ocaña et al., 2022). This system also makes it easier for mobile bio-composter users to determine the appropriate amount of starter for the composting process.

This mobile bio-composter is also equipped with an electrical stirrer/mixer, which is needed to mix the materials during the composting process, ensuring effective and efficient compost production. This electrical stirrer is equipped with a gearbox in its power transmission system. This ensures that the stirrer/mixer's rotation is not too high in the digester, ensuring even composting of organic materials or waste, resulting in compost with a uniform nutrient content (Núñez et al., 2022).

Conclusion

This product-based community service initiative has resulted in a mobile bio-composter installation that can be used to process organic waste and convert it into soil conditioner for addressing critical coastal land. This equipment is also equipped with a self-contained starter cultivation system, eliminating the need for a starter for the composting process, as it can be processed and produced independently in an aerobic reactor equipped with an aerator and nozzle.

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Reference

Beni, C., Servadio, P., Marconi, S., Neri, U., Aromolo, R. and Diana, G. (2012). Anaerobic digestate administration: effect on soil physical and mechanical behavior. Communications in Soil Science and plant analysis, 43(5), 821-834.

Cáceres, R., Flotats, X., & Marfà, O. (2006). Changes in the chemical and physicochemical properties of the solid fraction of cattle slurry during composting using different aeration strategies. Waste Management, 26(10), 1081-1091.

Darwin, Aldama, S., & Masturi. (2022). Effects of the different loading characters of cattle manure as inoculum towards the composting process of coconut pulp waste. International Journal of Design and Nature and Ecodynamics, 17(3), 475 – 479.

Fu, S., Lian, S., Angelidaki, I., & Guo, R. (2023). Micro-aeration: an attractive strategy to facilitate anaerobic digestion. Trends in Biotechnology, 41(5), 714-726.

Haryanta, D., Sa'adah, T. T., Thohiron, M., & Rejeki, F. S. (2023). Utilization of urban waste as liquid organic fertilizer for vegetable crops in urban farming system. Plant Science Today, 10(2), 120-128.

Jiang, T., Li, G., Tang, Q., Ma, X., Wang, G. and Schuchardt, F. (2015). Effects of aeration method and aeration rate on greenhouse gas emissions during composting of pig feces in pilot scale. Journal of Environmental Sciences, 31, 124-132.

Karnchanawong, S., Nissaikla, S. (2014). Effects of microbial inoculation on composting of household organic waste using passive aeration bin. International Journal of Recycling of Organic Waste in Agriculture, 3(4), 113-119.

Lim, S.L., Lee, L.H. and Wu, T.Y. (2016). Sustainability of using composting and vermicomposting technologies for organic solid waste biotransformation: recent overview, greenhouse gases emissions and economic analysis. Journal of Cleaner Production, 111, 262-278.

Núñez, F., Pérez, M., Leon-Fernández, L. F., Garcia-Morales, J. L., & Fernández-Morales, F. J. (2022). Effect of the mixing ratio on the composting of OFMSW digestate: assessment of compost quality. Journal of Material Cycles and Waste Management, 24(5), 1818-1831.

Nyonyo, T., Shinkai, T., & Mitsumori, M. (2014). Improved culturability of cellulolytic rumen bacteria and phylogenetic diversity of culturable cellulolytic and xylanolytic bacteria newly isolated from the bovine rumen. FEMS Microbiology Ecology, 88(3), 528-537.

Oviedo-Ocaña, E. R., Soto-Paz, J., Domínguez, I., Sanchez-Torres, V., & Komilis, D. (2022). A systematic review on the application of bacterial inoculants and microbial consortia during green waste composting. Waste and Biomass Valorization, 13(8), 3423-3444.

Velmurugan, A., Swarnam, T.P. and Lal, R. (2015). Effect of land shaping on soil properties and crop yield in tsunami inundated coastal soils of Southern Andaman Island.

Agriculture, Ecosystems & Environment, 206, 1-9.

Walsh, J.J., Jones, D.L., Edwards-Jones, G. and Williams, A.P. (2012). Replacing inorganic fertilizer with anaerobic digestate may maintain agricultural productivity at less environmental cost. Journal of Plant Nutrition and Soil Science, 175(6), 840-845.