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Sustainable Campus Through Organic Waste Management Program Implementation

Ellen J Kumaat[1], Indry S Manembu[2], Susan Marlein Mambu[3], Glanny M C Mangindaan[4]*

[1]*Faculty of Engineering, Depatment of Civil Engineering, Sam Ratulangi University, Manado, Indonesia*

[2]*Faculty of Fisheries and Marine Science, Department of Aquatic Resources, Sam Ratulangi University, Manado, Indonesia*

[3]*Faculty of Mathematics and Natural Sciences, Department of Biology, Sam Ratulangi University, Manado, Indonesia*

[4]*Faculty of Engineering, Department of Electrical Engineering, Sam Ratulangi University, Manado, Indonesia*

*corresponding author: ekumaat@unsrat.ac.id

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Abstract. Implementing an organic waste management program is a crucial step in realizing a sustainable campus. Organic waste management such as yard waste management program in Sam Ratulangi University, Manado, is crucial to maintaining a sustainable environment. The university's efforts to implement sustainable waste management practices, such as recycling and create an alternative energy sources like biodigester, have significantly reduced the amount of waste sent to landfills and creates valuable resources such as heat and liquid organic fertilizer. The application of liquid organic fertilizer from a biodigester on the university's green house resulted in an increased Pakcoy growth parameters and productions. By using liquid organic fertilizer from a biodigester is a sustainable and effective way to fertilize green areas at Sam Ratulangi University. By implementing this practice, the university can reduce waste and support healthy plant growth while also promoting environmental stewardship.

Keyword:
Biodigester, Liquid Organic Fertilizer, Organic Waste, Sustainability, Waste Management

1. Introduction

Organic waste management has become a critical issue worldwide due to its adverse impacts on the environment and public health. Universities, as significant generators of organic waste, have a responsibility to implement sustainable waste management practices. Organic waste management in Sam Ratulangi University (UNSRAT), Manado, is crucial to maintaining a sustainable environment. Organic waste, which includes a yard waste such as

grass, leaves, and branches is produced in UNSRAT, can contribute to environmental degradation if not managed properly and constitutes a significant portion of the waste generated in the university. The accumulation of organic waste poses a threat to the environment, leading to pollution and greenhouse gas emissions. To mitigate this issue, Sam Ratulangi University need to implement various organic waste management strategies, such as composting, recycling, and waste segregation.

Waste management involve the following processes such as reduction, reuse, recovery, or disposal of waste, with practices and technologies differing according to different economic and social circumstances [1,2]. In this paper will discuss about the environmental management program at UNSRAT has implemented for environmental management of its campuses, with particular emphasis on the integrated management of waste generated. Biogas technology with zero waste concept that turning organic waste into a valuable resource, expected to be the alternative energy and and valuable nutrients in the organic waste would be recycled for use as liquid organic fertilizer [3,4,5].

2. University Environmental Management Program

Efficient waste management constitutes a pivotal concern encompassing diverse workplace environments, including tertiary institutions, thereby engendering substantial financial implications. The efficacy of a waste management program hinges upon the conduct of each individual, the formulation of strategies for the management of waste across all classifications as ascertained through the waste audit process, in addition to the configuration of accessible facilities and the degree of consciousness prevailing among the stakeholders [6]. Sam Ratulangi University has recently implemented an organic waste management program to achieve a more sustainable campus. This program entails the systematic collection, segregation, and composting of organic waste derived from the campus environment. Subsequently, the resultant compost is employed to nourish and enhance the ecological vitality of the university's green spaces. The goal of this program is to reduce the amount of waste sent to landfills and promote sustainable practices among students, staff, and faculty. The program was initiated by the university's sustainability committee, which is composed of representatives from various departments and stakeholders. The committee conducted a waste audit to assess the amount and types of waste generated on campus, which informed the design of the organic waste management program. The program includes the installation of composting facilities and the provision of training and education on waste reduction and composting techniques. Here are some steps that be taken to implement an effective organic waste management program on campus:

Figure 1. Implementation steps management organic waste

1. Before implementing a waste management program, it is important to understand the composition and quantity of the organic waste generated on campus. Conducting a waste audit will help identify the types of organic waste generated and the potential for diversion.

2. Based on the waste audit, develop a comprehensive plan for managing organic waste on campus. This plan should include strategies for reducing waste at the source, such as composting yard waste, as well as for diverting waste from landfill through recycling and other waste reduction initiatives.
3. Collaborate with government, local organizations or municipalities that have established organic waste management programs to identify opportunities for shared services, equipment, or expertise. Such partnerships can also help in promoting the program and reaching a broader audience.
4. It is essential to educate students, staff, and faculty about the benefits of the organic waste management program and how they can contribute to its success. Training sessions and educational materials can be provided to ensure that everyone understands how to separate organic waste from other types of waste.
5. Regularly monitor and evaluate the program's effectiveness, including the volume of organic waste diverted and the associated greenhouse gas emissions reduction. This information can help identify areas for improvement and further optimize the program.

3. Implementation Waste Management Program

Implementing an organic waste management program is an important step towards realizing a sustainable campus. By diverting organic waste from landfills and turning it into a valuable resource, a campus can reduce its environmental impact and create a more resilient and sustainable community.

3.1. Organic Waste management - Biogas Technology

The decomposition of organic waste additionally gives rise to substantial quantities of methane. Notably, methane functions as a potent greenhouse gas, exhibiting an 86-fold greater heat absorption capability over a span of two decades compared to carbon dioxide, thereby emerging as a significant catalyst in the realm of global greenhouse gas emissions. [7]. To reduce greenhouse gas emissions and the risk of pollution to waterways, organic waste can be removed and used to produce biogas, a renewable source of energy. Methane, carbon dioxide, hydrogen sulfides, hydrogen, ammonia, and other gases such as oxygen and nitrogen in Anaerobic Digestion (AD) from organic waste can replace fossil fuels in various applications such as heat and a valuable fertilizer [8,9,10].

Alternative energy sources like biofuels and biogas are becoming necessary. Anaerobic digestion extensively used in not only the treatment of sewage sludge but also the biogas production from other organic wastes. Biogas is a combustible gas produced through the anaerobic or fermentation process of organic materials including a yard waste that is biodegradable under anaerobic conditions. In general, all types of organic matter can be processed to produce biogas. The process of producing biogas from organic waste, a too is needed, namely the Biogas Digester or Biodigester, which works with the principle of creating a reservoir of organic material in anaerobic condition, so that the organic waste can be fermented by methanogenic bacteria to produce biogas [11].

The type of biodigester we use in UNSRAT is a Fixed Dome Biodigester, where consists of a digester that has a gas reservoir at the top of digester. When the gas starts, it presses the fermented sludge into the slurry basin. If the input of organic waste is continuous, the gas will continue to press the slurry out of the slurry basin. The slurry or waste from the biodigester can be used as liquid organic fertilizer.

Figure 2. Biogas Digester Project at Sam Ratulangi University Manado

3.2. Implement an Effective Organic Waste Management Program on Campus

Liquid organic fertilizer from a biodigester can be a great option for fertilizing green areas at Sam Ratulangi University. Using POC from a biodigester has several advantages. Firstly, it is an eco-friendly way to dispose of organic waste, as it reduces the amount of waste going into landfills and produces a valuable fertilizer. Secondly, organic fertilizers are better for soil health and plant growth compared to synthetic fertilizers, as they provide a slow release of nutrients and improve soil structure. Liquid organic fertilizers from biodigesters are rich in nutrients such as nitrogen, phosphorus, and potassium, as well as micronutrients like iron, zinc, and copper. The organic matter in liquid organic fertilizers can improve soil structure and fertility, increase soil microbial population, leading to healthier plants and increased yields [12, 13].

For the utilization of liquid organic fertilizer derived from a biodigester within the university's botanical zones, meticulous attention must be given to the appropriate storage and application procedures. Ensuring the fertilizer's optimal preservation necessitates its containment within a cool and dry environment to forestall bacterial proliferation, coupled with a requisite dilution with water prior to application to avert potential plant scorching. Given the concentrated nature of liquid organic fertilizers, adherence to endorsed application rates is of paramount importance to avert the detrimental consequences of excessive fertilization, which encompasses plant impairment and the propagation of nutrient contamination within aquatic ecosystems. It's important to ensure that the fertilizer provides a balanced mix of nutrients for the specific plants being grown. The recommended application rate will depend on the type of plants and soil conditions, so it is important to determine the optimal amount to use [14,15].

To see the effect of liquid organic fertilizer produced from the biodigester on plants, we conducted a greenhouse-scale study on Pakcoy (*Brassica rapa* L). This study aims to analyze the effect of liquid organic fertilizer application on the growth and production of pakcoy. The research stages include preparing plant seeds, liquid organic fertilizer treatment and observations using several plant parameters, namely measurement of height, leaf width, number of leaves, dry and wet weight. The results showed that the administration of liquid organic fertilizer had a significant effect on all observation parameters (K = control/without liquid organic fertilizer; P1 = 50mL; P2 = 75mL; P3 = 100mL; P4 = 50mL NASA Fertilizer). P3 treatment with 100 mL liquid organic fertilizer concentration had a significant effect on plant height, leaf width and wet weight. P1 treatment with a concentration of POC 50mL had a

significant effect on dry weight. While the NASA POC treatment showed a significant effect on the number of leaves parameters. Overall, liquid organic fertilizer from biodigesters can be a great option for providing nutrients to plants in a sustainable way. However, it's important to carefully consider application rates, nutrient balance, storage and handling, and potential odor issues.

Figure 3. The Growth of Pakcoy (Brassica rapa L.) Application with Liquid Organic Fertilizer Produced from the Biodigester

4. Conclusion or Concluding Remarks

In conclusion, the organic waste management program has been a positive step towards realizing a more sustainable campus at Sam Ratulangi University. Using liquid organic fertilizer from a biodigester is a sustainable and effective way to fertilize green areas at Sam Ratulangi University. Continued efforts to improve and expand the program will be necessary to achieve long-term sustainability goals. The implementation of the program has had several benefits for the university, including a reduction in waste sent to landfills, improved soil health and plant growth, and increased awareness and participation in sustainable practices among the campus community. There have also been challenges, such as the need for ongoing maintenance of the biodigester facilities and the need to continuously educate and engage the campus community in the program. However, there is still room for improvement, and the university should continue to explore innovative waste management solutions to achieve long-term sustainability goals.

References

[1] Adedipe, N.O., Sridhar, M.K.C., Baker, J., Verma, M., 2005. Ecosystems and Human Well-Being. (3), Millennium Ecosystem Assessment

[2] Watson, M. 2020. Waste Management International Encyclopedia of Human Geography (Second Edition), Elsevier. 225-231

[3] Latifah, R.N., Winarsih., Rahayu, Y.S., 2012. Pemanfaatan Sampah Organik sebagai Bahan Pupuk Cair untuk Pertumbuhan Tanaman Bayam Merah (Alternanthera ficoides). LenteraBio. 1 (3), pp. 139-144.

[4] Nurdiyanti, D., Utami, A. S., Bastian, N. & Johan. 2017. Pemanfaatan Limbah Organik Pasar Sebagai Bahan Pupuk Kompos Untuk Penghijauan Di Lingkungan Masyarakat Kota Cirebon. THE 5 TH URECOL PROCEEDING, UAD. Jogjakarta.

[5] Mambu, S.M., Mangindaan, G., Tangapo, A.M., Kolondam, B.J., 2023. Growth Responses of Brassica rapa L. to Different Levels of Liquid Organic Fertilizer from Anaerobic Digestion Effluents. AIP Conf. Proc. 2694, 080008-1–080008-5.
[6] Purcell, M., 2007. How to green your campus or workplace – A step by step guide., CIT Press, Cork Institute of Technology, Bishopstown, Cork.
[7] Anthropogenic and Natural Radiative Forcing. Myhre, G., D. et. al, 2013. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Stocker, T.F., et al. (eds)
[8] Atelge, R., Krisa, D., Kumar, G., Eskicioglu, C., Nguyen D.D., Chang, S.W., Atabani, A.E., Al-Muhtaseb, a., Unalan, S., 2020. Biogas Production from Organic Waste: Recent Progress and Perspectives. Waste and Biomass Valorization. (11), pp. 1019–1040
[9] Abbasi, T., Tauseef, S., Abbasi, S.A. 2011. Biogas Energy, Springer, New York. 2
[10] Favoino E, Hogg D. 2008. The potential role of compost in reducing greenhouse gases. Waste Manage Res, 26(1): 61–69.
[11] IEA 2020, World Energy Outlook Special Report Outlook for Biogas and Biomethane Prospects for Organic Growth. Available online at https://www.iea.org/reports/outlook-for-biogas-and-biomethane-prospects-for-organic-growth (direct link), accessed on 7 April 2023
[12] Wua E.C., Mambu S.M., Umboh, S., 2022. Pengaruh Aplikasi Berbagai Dosis Pupuk Organik Cair Terhadap Pertumbuhan vegetatif Sawi Hijau (Brassica juncea L.). Journal of Biotechnology and Conservation in Wallacea. 2 (2), pp. 99-106
[13] Fayaz A., Patil S.V., Swamy G. S. K., Shankarappa T. H., Premalatha B. R., 2020. Effect of Bio-fertilizers and Organic Amendments on Nutrient Uptake and Soil Microbial Population of Pummelo Seedlings (Citrus maxima L) under Nursery Condition. Int.J.Curr.Microbiol.App.Sci. 9 (10), pp. 1592-1599
[14] Martı´nez-Alca´ntara B., Martı´nez-Cuenca M., Bermejo A., Legaz F., Quiñones A., 2016. Liquid Organic Fertilizers for Sustainable Agriculture: Nutrient Uptake of Organic versus Mineral Fertilizers in Citrus Trees. PLoS ONE 11 (10), pp. 1-20
[15] Baldi E, Toselli M, Marcolini G, Quartieri M, Cirillo C, Innocenti A. 2010. Compost can successfully replace mineral fertilizers in the nutrient management of commercial peach orchard. Soil Use and Manage. 26(3), 346–353