e-ISSN 2581-0405
Asian Journal of Applied Research for Community Development and Empowerment
Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Community Convergence Framework for Solid Waste Management

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ARTICLE INFO

Article History:
Received: 2 November 2024
Final Revision: 3 December 2024
Accepted: 30 December 2024
Online Publication: 13 January 2025

KEYWORDS

Solid Waste Management, Framework Convergence, Sustainability, Community, Organic Processing Center, Organic Fertilizer.

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ABSTRACT

The Community Convergence Framework for Solid Waste Management is a sound management plan to address the solid waste problem for the Tangkas Organic Fertilizer Facility in Bali, Indonesia and for private and government institutions worldwide. The framework's components are based on the principle that solid waste management should be a collective effort between local governments, communities, and organic waste processing centres. The management plan is structured so that there is a convergence between these three components. In this way, communities can strive to create a cleaner and healthier environment for current and future generations. This research will guide understanding of waste management's importance and community convergence's role in achieving sustainable solutions.

Contribution to Sustainable Development Goals (SDGs)
SDG 3: Good Health and Well-being
SDG 4: Quality Education
SDG 6: Clean Water and Sanitation
SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 13: Climate Action
SDG 17: Partnerships for the Goals

1. INTRODUCTION

1.1. Background

Around the world, waste generation rates are rising. In 2020, the world was estimated to generate 2.24 billion tonnes of solid waste, amounting to a footprint of 0.79 kilograms daily. With rapid population growth and urbanization, annual waste generation is expected to increase by 73% from 2020 to 3.88 billion tonnes in 2050 [1]. The problem of solid waste management is considered a pressing global issue that calls for an immediate response from the government and its people.

The Philippines, for example has a continuously rising amount of waste which is expected to increase further in the succeeding years. As reviewed, associated problems with solid waste management in the country include increasing solid waste, weak law implementation, scarcity of sanitary landfills, and improper disposal. The ultimate solution in the country is the RA 9003 or the Ecological Solid Waste Management Act of 2000, which highlights segregation practices, proper disposal, and waste diversion. The importance of envisioning a trash-free

Philippines and encouraging people's participation and awareness is also emphasized. Another possible solution to solid waste management is valorization, which can address other environmental problems, such as the depletion of natural resources. These solutions enumerated will only be possible with good governance, active participation of the country's people, and the cooperation of all constituents and agencies in the Philippines [2].

Meanwhile, "Indonesia faces significant challenges related to solid waste management. With increasing urbanization, major urban centers in Indonesia produce up to 8 million tons of waste daily. Unfortunately, open dumping remains a widespread practice for waste disposal, leading to pollution and health issues [3]. Moreover, according to the above-cited reference, over half of Indonesia's population lives in urban areas. While cities and municipalities generate an estimated 105,000 tons of solid waste a day, expected to increase to 150,000 tons per day by 2025 – 40 per cent of the country's 142 million urban residents still do not have access to basic waste collection services.

Indeed, the problem of solid waste management is a global problem. The majority of countries worldwide face such difficulty, which is why UN Member States in 2015 agreed that by 2030, the seventeen (17) Sustainable Development Goals (SDGs) will be collectively achieved to improve the quality of life of the people around the world. Among these, SDG No. 11 Sustainable Cities and Communities, SDG No. 12 Responsible Consumption and Production, SDG No. 13 Climate Action, and SDG No. 17 Partnership for the Goals are all inclined to address the problem of solid waste worldwide [4-5].

On the local scale, in the smallest regency of Bali, Indonesia, in Tangkas Village, an individual devised the initiative to establish a facility producing organic fertilizer from collected biodegradable waste materials generated by households. This individual establishes the researchers' partner organisation, the Tangkas Organic Fertilizer Center.

One way to reduce waste disposed of at landfills is by implementing Bali Governor Regulation No. 47 of 2019 [6], which encourages the public to separate waste at its source, such as from households, offices, schools, and places of worship. According to data from the Klungkung Regency Environmental Office, waste volume from the four districts (Dawan, Banjarangkan, Klungkung, and Nusa Penida) exceeds 115,000 kg per day, with 68% consisting of organic waste [7-8]. However, public compliance with waste separation in Semarapura City still needs improvement [9-10].

The waste management stages in Klungkung Regency include direct handling in commercial areas and indirect handling in rural areas. Currently, direct service coverage reaches 41% with short-term targets of 45% and medium- to long-term targets of 50%. Meanwhile, indirect service coverage in rural areas is 27.4%, with short-term targets of 35%, medium-term 40%, and long-term 50%. Waste management is divided into three zones: Zone I, which aims for full coverage in the short term; Zone II, with indirect handling from households to temporary collection sites (TPS) and final disposal sites (TPA); and Zone III, designated for long-term service [11].

Before, Tangkas villagers, like people throughout Indonesia, tossed their household wastes into the river because they had no other option. There were no government or private waste management alternatives. To resolve the problem of poor solid waste management, Mr. Ketut Darmawan established the Tangkas Organic Fertilizer Center.

The Tangkas Organic Fertilizer Center is the brainchild project of Mr Ketut Darmawan; the idea first came to him in 2013. After three years of conceptualization and planning on how to run the facility, in 2016, with the funding support of the local government of Klungkung, it started its operation.

The centre collects biodegradable waste materials daily from over 1,000 households in Tihingan, Pesinggahan, Gel-gel, Tangkas, and Akah/Selat. The collected biodegradable waste materials are then processed into organic fertilizers by combining them with animal manure and coco peat. The non-biodegradable materials included in the waste collected by the facility are sold to junk shops.

The facility can produce organic fertilizers which comply with the standards set forth by the government. To comply, it must be regulated by The Ministry of Agriculture Provisions No. 1 in The Year 2019 concerning the Registration of Organic fertilizers, Livestock fertilizers, and Land fillers. According to the regulation, organic fertilizers are fertilizers originating from dead plants, animal manure and/or animal parts, and/or other organic wastes that have been through engineering processes in the form of solid or liquid, enriched with mineral and/or microbial materials, and helpful in increasing nutrient content and soil organic matter improving physical, chemical and biological properties of the soil [12].

The facility's end products are distributed to its partner stores in Tabanan, Buleleng, Karangaseng, Klungkung, and Denpasar. These stores re-sell organic fertilizers to farmers and other stores whose main customers are land cultivation and other related fields.

Further, the facility is well-maintained. It is clean and has designated areas for each process involved in producing the organic fertilizer. The smell from the compost materials is controlled; however, a minimal trace of stench is present in the area of the facility where the waste materials are decomposed. It was also noted upon the actual site visit of the researchers that insects such as flies mosquitoes and other pests were absent in the facility.

Among the notable practices of the facility is that its present organizational structure is proof that it implements a non-discriminatory principle in hiring its employees. Women and men and the young and old are given equal chances to work in the facility.

Communities must adopt sustainable waste management practices to minimize future negative impacts. That is why the researchers came up with the relevant solution of devising a framework for solid waste management and then crafting a management plan to strengthen the relationship between the local government, the community and the organic fertilizer processing centers [13-14]. Through this, the researchers can introduce solid waste management branding, which originated at Tangkas Organic Fertilizer Center.

1.2. Objective

This research aims to devise a solid waste management framework and craft a management plan to strengthen collaboration between local governments, communities, and organic fertilizer processing centers. This plan addresses global and local solid waste challenges by introducing sustainable practices, improving waste management systems, and promoting

the model developed at the Tangkas Organic Fertilizer Center as a scalable and replicable solution. The ultimate goal is to contribute to achieving relevant Sustainable Development Goals (SDGs) and foster sustainable waste management in Tangkas Village and beyond.

2. Methodology

2.1. Place and Time of Implementation

Community service was implemented at the Tangkas Organic Fertilizer Center, Tangkas Village, Klungkung District, Klungkung Regency, Bali Province, at an altitude of 27 m above sea level. Took place in June 2024.

2.2. Method

This study used a qualitative data analysis to identify the major issues/concerns experienced by the Tangkas Organic Fertilizer Center, the researchers' partner organization. The researchers visited the Tangkas Organic Fertilizer Center at Tangkas Village in Klungkung Regency, Bali, Indonesia, on 20 June 2024. During the onsite visit, Mr. Ketut Darmawan, the owner, and his employees were present at the facility. To facilitate translation from Balinese to English and vice-versa, a local Balinese translator named Mr. Komang was sought. Mr. Komang's presence is an integral part of the data gathering process as he served as the medium that made it possible to break the language barrier between the researchers, who are Filipinos, and members of the partner organization, who are Balinese. The translator further allowed an understanding of the messages the researchers and partner organization members gave.

More so, the researchers were first given an orientation by the partner organization through a recount of the facility's brief history to provide them with in-depth detail and to show them the actual process of how organic fertilizer is made. They requested that Mr. Darmawan take them to the different areas of the facility. It was explained to the researchers that each region corresponds to a specific process with its expected output. This enabled the researchers to fully grasp how the facility operates and what kind of end product it offers the local community.

The researchers opted for a non-directive interview to allow a more spontaneous way of asking questions and follow-ups on the facts and/or details given by Mr. Darmawan. As such, the interview generated facts, figures, and narratives, which helped the researchers devise a framework for solid waste management whose components were strategically chosen to derive a management plan. Then, out of the data gathered from the non-directive interview, the researchers used prescriptive data analysis to determine the appropriate intervention and/or most relevant solution to the organization's problem.

3. RESULT AND DISCUSSION

3.1. Results

This research focuses on assessing the operational challenges and identifying opportunities for improvement at the Tangkas Organic Fertilizer Center through onsite visits and interviews with key stakeholders, including Mr Ketut Darmawan and staff members. The findings are categorized into several key areas of concern, each accompanied by recommendations to enhance the centre's effectiveness and sustainability in organic fertilizer production and waste management.

3.1.1 Funding and Financial Sustainability

Issue: Securing consistent and adequate funding for ongoing operations is a significant challenge. Finding: Current funding sources are unreliable, leading to financial instability and potential disruptions in operations. Recommendation: Develop a diversified funding strategy that includes grants, partnerships with local businesses, and sustainable revenue generation models through product sales and community services.

3.1.2 Technology and Equipment

Issue: Access to appropriate technology and equipment hinders efficient organic fertilizer production. Finding: Outdated equipment and insufficient technological infrastructure limit production capacity and quality. Recommendation: Invest in modernizing equipment and technology to optimize production processes and improve product quality. Explore partnerships with technology providers or agricultural research institutions for technological support.

Figure 1. Location of organic fertilizer production in Tangkas Village

3.1.3 Community Engagement and Support

Issue: Gaining community support and involvement in the project is challenging. Finding: There is varied community perception and understanding of the benefits of organic fertilizer production. Recommendation: Implement targeted community engagement programs that educate residents about the benefits of organic fertilizer, involve local leaders in decision-making processes, and foster a sense of ownership and pride in the project.

3.1.4 Manpower Deficiency

Issue: Difficulty in finding workers with the necessary skills and expertise. Finding: The local labour pool lacks trained individuals familiar with organic fertilizer production techniques. Recommendation: Establish training programs in collaboration with vocational institutions or agricultural experts to develop local talent. Offer competitive wages and benefits to attract skilled workers.

3.1.5 Safety and Infrastructure

Issue: Absence of proper safety equipment and inadequate infrastructure. Finding: Workers lack necessary protective gear, and storage facilities are not weatherproof, leading to potential damage to products. Recommendation: Prioritize worker safety

 https://doi.org/10.29165/ajarcde.v9i1.565

by providing adequate safety equipment and training. Improve storage facilities to ensure product quality and longevity.

Each finding is directly linked to actionable recommendations addressing the identified challenges. These recommendations emphasize the importance of community engagement, technological advancement, sustainable funding strategies, workforce development, and infrastructure improvement to enhance the operational efficiency and sustainability of the Tangkas Organic Fertilizer Center.

3.2. Discussion

The Community Convergence Framework for Solid Waste Management is a holistic approach that recognizes the importance of community involvement in waste management. By working together, communities can create sustainable solutions that reduce waste and contribute to the overall well-being of the environment and community.

Figure 2. Community Convergence Framework for Solid Waste Management in Tangkas Village.

By fostering collaboration and active participation, this framework seeks to create a holistic approach to solid waste management tailored to the specific needs and characteristics of each of the three components: local government, community, and organic fertilizer centers. Further, the community convergence framework for solid waste management aims to address challenges by bringing together various stakeholders, such as agencies and environmental organizations.

The framework reflects the empowerment of organic fertilizer processing centers, such as the researchers' partner organization, which is the lead initiator of this specific solid waste management practice. The convergence among the components will enable the organic fertilizer centre to continue its operation and to fulfil its initiative of converting biodegradable waste materials into something valuable, such as fertilizer. More so, by expounding the roles and obligations of these components in the management plan, the organic fertilizer center is expected to strive and even become an influential entity in the community. Out of the above framework, the researchers crafted a management plan to resolve the challenges of the Tangkas Organic Fertilizer Center.

3.2.1 The Management Plan

Waste Collection: Tangkas Organic Fertilizer Center should be strict in only collecting garbage from properly segregated households to lessen their staff's workload.

The local government must be strict in collecting garbage from properly segregated households. A materials recovery facility may also be established in each village to lessen the non-biodegradable materials still collected by the government. Establishing a collection point where these waste materials shall be stationed before pick-up by the government-owned dump trucks may also instil discipline among the people.

People in the community must abide by the local government's existing laws and regulations. They must also be considerate of the facility that collects their biodegradable waste materials and practice proper segregation.

3.2.2 Facility Operation

Tangkas Organic Fertilizer Center may forge other linkages with other government and non-government agencies that can provide them with additional machinery and equipment to increase the volume of their end product.

The local government may provide further assistance to the organic processing center by providing new equipment and types of machinery, which may help double the facility's production. This equates to more biodegradable waste materials to be processed as organic fertilizers.

The local community may help strengthen and sustain the facility's operation by giving them biodegradable waste materials.

3.2.3 Waste Management Policies

Tangkas Organic Fertilizer Center should provide additional human resources to produce organic fertilizers. Their employees should be equipped with proper safety gear to protect them from the possible health hazards of the production process. With the additional workforce, the organization may increase the four villages collected with biodegradable wastes to cover 50% of the total villages in the Klungkung Regency.

The local government must strictly implement the "Yes Segregation, Yes Collection Policy". They must not collect solid waste materials that are not adequately segregated and should limit only the collection to residual and hazardous wastes. IEC's campaign on the "Yes Segregation, Yes Collection Policy" must be intensified in each village to increase people's awareness of proper solid waste management. Local legislation must regulate the business establishments' use of single-use plastics. The local government may enter into a Memorandum of Agreement (MOA) with junkshops/ scrap dealers, who may be buyers of the reusable and recyclable materials sorted by each household.

Each household and business establishment must take their part in seriously abiding by proper solid waste management in the community to ensure that waste materials are collected and taken care of by the appropriate entities (i.e. Tangkas Village Organic Fertilizer Center; biodegradable wastes, Klungkung Regency; residual and hazardous wastes, junkshops/scrap dealers; reusable and recyclable materials.

Proper waste segregation must also be incorporated into the curriculum of schools to instil in the children the value of discipline and care for the environment. Business establishments should encourage customers to bring their eco-bags/paper bags when shopping to lessen the use of single-use plastics.

3.2.4 Training and Advocacy Campaign

Tangkas Organic Fertilizer Center must provide capacity enhancement training for their employees and may also provide training on organic fertilizer production for interested entities or individuals.

The local government must provide training on composting for community members and organic fertilizer production for the

Tangkas Organic Fertilizer Center and other interested entities or individuals. Garbage waste collectors must also be trained in handling residual and hazardous wastes collected from the community. The local government must also instil proper waste segregation in their respective offices.

People in the community must actively participate in the training provided by the local government and deliver re-echoing sessions to the community for interested individuals who would also want to learn new skills from the conducted training but cannot do so due to time constraints and other hindrances. Initiate the organization of volunteer groups whose primary goal is to advocate for preserving the environment through proper waste management.

Figure 3. Explanation of the organic fertilizer-making process in Tangkas Village

The researchers of this study further recommend the following for the management plan to be efficiently and effectively implemented in local communities:

3.2.5 Recommendations

Community Engagement. The study underscores the importance of involving residents, community leaders, and stakeholders in the decision-making process regarding waste management initiatives. It aims to promote sustainable behaviors such as waste reduction, segregation at source, and proper disposal practices by fostering a sense of ownership and responsibility among residents.

Educational Campaigns. Implement awareness programs to educate residents about the environmental and health impacts of improper waste disposal. This campaign promotes behavioural change and encourages residents to adopt sustainable practices.

Infrastructure Development. Enhancing the waste collection and disposal infrastructure, including establishing designated collection points, the recycling center itself, and the composting facilities. This improvement is essential for ensuring efficient waste management within the community.

Policy and Regulation. Introducing local policies and regulations to enforce waste segregation, recycling initiatives, and penalties for non-compliance. Clear guidelines and incentives can motivate residents and businesses to participate actively in waste management efforts.

Sustainability and Long-Term Implication. The sustainability of the convergence framework hinges on its ability to foster lasting changes in community behavior and infrastructure. The framework aims to create a self-sustaining system where residents take ownership of waste management practices by emphasizing education, infrastructure development, and policy implementation. Long-term implications include reduced environmental pollution, improved public health outcomes, and enhanced community resilience against waste-related challenges.

Comparison with existing frameworks and best practices. Comparative analysis with existing frameworks and best practices in waste management highlights the innovative aspects of the proposed convergence framework. Drawing insights from successful case studies, such as community-led initiatives in other regions, provides valuable lessons for adapting and refining the framework in Tangkas Village. By leveraging global and local knowledge, the framework can be tailored to suit the specific needs and context of the community.

Limitation and Future Research. Despite its potential benefits, the convergence framework may face several challenges, including funding constraints, resistance to change among residents, and logistical barriers to implementation. Addressing these limitations requires ongoing collaboration with local authorities, continuous monitoring, and adaptation of strategies based on community feedback.

Future research should focus on evaluating the long-term impact of the framework on waste management practices and community well-being. Additionally, studies exploring innovative technologies, community engagement models, and policy interventions can further enhance the effectiveness and sustainability of solid waste management systems in rural communities like Tangkas Village. Through ongoing collaboration, continuous efforts, and adaptive strategies, Tangkas Village can achieve significant improvements in expanding recycling initiatives and waste management practices, contributing to a cleaner environment and healthier community for generations to come.

4. CONCLUSION

The active participation of community members is crucial to the success of the management plan. Community members should be encouraged to actively participate in waste management activities such as segregation, composting, and recycling. This can be achieved by forming community-based organizations or waste management committees.

Collaboration with local authorities and waste management organizations will ensure that all stakeholders coordinate and support the implementation of waste management initiatives. Local authorities can provide the necessary resources and support, while waste management organizations can offer technical expertise and guidance.

Monitoring and evaluating waste management initiatives are essential to measure their effectiveness. This helps identify areas of improvement and make necessary adjustments to the framework. Community members can actively monitor and evaluate activities to ensure transparency and accountability.

ACKNOWLEDGMENT

We would like to express our deepest gratitude to the Dean of the Postgraduate Faculty, students, and teaching staff who were directly involved in this community service program. Their participation has had a significant impact and benefited the community. We would also like to express our deepest gratitude to the Manager of the Organic Waste Processing Center of

 https://doi.org/10.29165/ajarcde.v9i1.565

Tangkas Village, Klungkung Regency, for their extraordinary cooperation. Thanks to all parties' dedication and active involvement, this program has become the key to success, providing significant benefits to the local community and strengthening the relationship between academics and the community.

REFERENCE

[1] World Bank Group (2022). *Solid Waste Management*. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management.

[2] Coracero, E. E., Gallego, R. J., Frago, K. J. M., & Gonzales, R. J. R. (2021). A Long-Standing Problem: A Review on the Solid Waste Management in the Philippines. Indonesian *Journal of Social and Environmental Issues (IJSEI*), 2(3), 213-220. https://doi.org/10.47540/ijsei.v2i3.144.

[3] World Bank Group. (2019). *Cleaning up Indonesia's urban solid waste. World Bank*. Retrieved from https://www.worldbank.org/en/news/press-release/2019/12/05/cleaning-up-indonesias-urban-solid-waste.

[4] Adams, C. (2017). *The Sustainable Development Goals, integrated thinking, and the integrated report*.

[5] Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the sustainable development goals. *Nature Sustainability*, 2(9), 805-814.

[6] Peraturan Gubernur Bali Nomer 47 Tahun 2019 Tentang Pengelolaan Sampah Berbasis Sumber. https://jdih.baliprov.go.id/produk-hukum/peraturan/abstrak/24822

[7] Badan Perencanaan, Penelitian dan Pengembangan Kab. Klungkung, (2020), *Hasil Analisis Hasil Survei Pemilahan Sampah di Kab. Klungkung*.

[8] Dinas Lingkungan Hidup dan Pertanahan Kabupaten Klungkung (2020), https://dlhp.klungkungkab.go.id/?cat=-1

[9] Darmawan, I. K., Kusnanda, I. K. E., Labantari, N. N. S., Situmeang, Y. P., & Sudita, I. D. N. (2021). Level of Community Participation in Conducting Waste Sorting in Semarapura City. *Agriwar Journal*, 1(1), 1-5.

[10] Darmawan, I. K., Situmeang, Y. P., & Sudita, I. D. N. (2022). *Pengelolaan Sampah Organik*. Scopindo Media Pustaka.

[11] Suhardono, S., Septiariva, I. Y., Prayogo, W., Suryawan, I. W. K., & Sari, M. M. (2023). Current Situation of Solid Waste Management to Archive Sustainability in Klungkung Regency, Bali. *Journal of Sustainable Infrastructure*, 2(1).

[12] Zawierucha, K., Zmudczyńska-Skarbek, K., Guil, N., & Bogdziewicz, M. (2019). Seabirds modify trophic groups, while altitude promotes xeric-tolerant species of Tardigrada in the high Arctic tundra (Svalbard archipelago). *Acta Oecologica*, 98, 50-58.

[13] Adekola, P. O., Iyalomhe, F. O., Paczoski, A., Abebe, S. T., Pawłowska, B., Bąk, M., & Cirella, G. T. (2021). Public perception and awareness of waste management from Benin City. *Scientific Reports*, 11(1), 306.

[14] Lamprea, L. L. G. (2023). Awareness, Attitude, and Practices on Solid Waste Management: Bases for an Enhanced Environmental Management System. *International Journal of Open-Access, Interdisciplinary & New Educational Discoveries of ETCOR Educational Research Center (iJOINED ETCOR).*