

SDG 13 practices in Barangay Balaring's mangrove eco-trail: Its compliance and implementation of solid waste management

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Abstract

This study investigates the implementation and compliance with solid waste management practices at the Mangrove Eco-Trail in Barangay Balaring, Silay City, as perceived by customers. It examines waste segregation, collection, reduction, reuse, and composting while exploring demographic differences in age, sex, and civil status. Findings reveal that solid waste management practices, particularly waste segregation, collection, and composting, are well-implemented and complied with. Younger respondents (aged 18-48) showed higher engagement compared to older participants, likely due to greater exposure to environmental education and media. Gender and civil status analyses revealed no significant differences, indicating consistent environmental responsibility among male and female respondents, regardless of marital status. Statistical analysis showed a strong relationship between implementation and compliance, particularly in practices such as waste segregation and composting. However, adherence to reduction and reuse practices was inconsistent, indicating a need for targeted improvements. The study concludes that while the eco-trail demonstrates commendable progress in waste management, gaps remain in specific practices. Recommendations include strengthening educational campaigns, enhancing waste management infrastructure, conducting regular monitoring, and fostering community participation. These strategies aim to improve adherence, ensuring sustainable waste management and long-term ecological conservation at the Mangrove Eco-Trail.

Keywords: solid waste management, implementation, compliance, Barangay Balaring, community engagement, sustainability

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1. Introduction

Climate change poses a significant threat to global ecosystems, necessitating urgent and coordinated actions to mitigate its impacts. Sustainable Development Goal (SDG) 13, which focuses on climate action, emphasizes the need for integrating environmental policies to reduce climate-related hazards and disasters (United Nations, 2015). One of the critical aspects of climate action is solid waste management, as improper waste disposal contributes to environmental degradation and exacerbates climate change (Hoornweg & Bhada-Tata, 2012; Jambeck et al., 2015). Solid waste mismanagement leads to increased greenhouse gas emissions, particularly methane, which is produced by decomposing waste in landfills (Bogner et al., 2007). Proper waste segregation, recycling, and disposal are essential to reducing these emissions and minimizing environmental impact (Wilson et al., 2012).

Mangrove ecosystems serve as vital carbon sinks, absorbing large amounts of carbon dioxide and mitigating the effects of climate change (Alongi, 2014; Donato et al., 2011). These ecosystems not only sequester carbon but also provide coastal protection, biodiversity conservation, and support to fisheries (FAO, 2007). However, pollution and inadequate waste management threaten their sustainability, leading to habitat degradation and loss of biodiversity (Duke et al., 2007; Lee et al., 2014). In coastal communities such as Brgy. Balarang in Silay City, the proper implementation of solid waste management policies is crucial for preserving mangrove ecosystems while ensuring compliance with environmental regulations (Guerrero et al., 2013; Dasgupta & Shaw, 2017). The Mangrove Eco-Trail in Brgy. Balarang serves as an ecotourism destination, providing economic benefits to the community while promoting environmental conservation (Spalding et al., 2010). However, increased tourist activities can result in higher waste generation, making the effectiveness of its solid waste management practices a critical issue that requires evaluation.

The Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003) mandates the systematic, comprehensive, and ecological management of solid waste in the Philippines (DENR, 2021; Pariatamby & Tanaka, 2014). This legislation highlights the responsibilities of local government units (LGUs) in implementing waste management programs, promoting waste reduction, recycling, and proper disposal methods (ADB, 2018). However, challenges persist in local implementation due to inadequate resources, lack of awareness, and weak enforcement (Guerrero, Maas, & Hogland, 2013; Wilson et al., 2012). Many coastal communities struggle with waste management due to limited infrastructure and public participation, exacerbating environmental concerns (Jambeck et al., 2015).

This study aims to assess the compliance and implementation of solid waste management practices in Brgy. Balarang's Mangrove Eco-Trail, determining their alignment with SDG 13 and national policies (UNEP, 2018). By identifying gaps and areas for improvement, this research contributes to the ongoing efforts in sustainable environmental management. Additionally, understanding the effectiveness of waste management strategies in ecotourism areas can inform policy recommendations and community-driven initiatives that promote environmental sustainability and climate resilience (Pires et al., 2011). The researchers aim to determine the level of implementation and compliance with solid waste management practices at the Mangrove Eco-Trail, Barangay Balarang, Silay City, as perceived by customers. Specifically, it sought to answer the following questions:

- What is the profile of the respondents in terms of Age, Sex, Civil Status
- What is the level of implementation and compliance of solid waste management practices at the

Mangrove Eco-Trail, Barangay Balarang, Silay City, as perceived by customers, in terms of the following variables? Waste Segregation and Waste Collection, Reduce and Reuse, Composting

- Is there a significant difference in the level of implementation of solid waste management practices at the Mangrove Eco-Trail, Barangay Balarang, Silay City, as perceived by customers, when they are grouped according to demographic variables?

2. Review of related literature

Solid waste, as defined by Al-Taai (2022), is composed of discarded materials that, when managed properly, can be reused and diverted from landfills. This highlights the importance of proper waste segregation, recycling, and disposal to reduce greenhouse gas emissions from waste decomposition in landfills. Peña et al. (2024) and Coracero et al. (2021) expand on the Ecological Solid Waste Management Act of 2000 (Republic Act No. 9003), which provides a framework for local government units (LGUs) like Barangay Balarang in ensuring proper waste management practices, particularly in ecologically sensitive areas such as mangroves. This law emphasizes public participation, which has been shown to be essential in promoting sustainability and reducing waste generation (Numanovich & Abbosxonovich, 2020; Runa & Orbe, 2022).

Challenges related to waste management in developing countries, particularly in the Philippines, are underscored by Navalta-Salagubang et al. (2023) and Otoma & Castillo (2022), which recognize resource limitations, low public awareness, and insufficient infrastructure as barriers to effective waste management. Coastal communities like Barangay Balarang face additional challenges related to waste management due to these limitations. However, initiatives like the use of color-coded bins along the Mangrove Eco-Trail, which Dolipas et al. (2020). Moreover, public awareness and education play crucial roles in ensuring effective compliance with waste management policies, as mentioned by Peña et al. (2024) and Limon et al. (2020). The involvement of educational institutions and awareness campaigns is essential for encouraging responsible waste disposal habits in ecologically sensitive areas like mangroves. The studies by Abubakar et al. (2021) further demonstrate the positive impact of the color-coded bin system in Barangay Balarang, as it has improved community participation in waste segregation, supporting sustainable waste management practices.

The reviewed literature also highlights the broader impact of poor waste management on public health and environmental degradation. Chandran & Bhattacharya (2021) emphasize that improper waste disposal can harm biodiversity and spread diseases, particularly in coastal areas like the Mangrove Eco-Trail. International guidelines from the WHO and UNEP stress the importance of the 3Rs (reduce, reuse, and recycle) in waste management, reinforcing the need for comprehensive waste management strategies. Additionally, Republic Act No. 9003 mandates the enforcement of waste management practices, though challenges persist, such as limited financial resources and inadequate infrastructure (Debasree Lodh, 2024).

Finally, research indicates that public awareness and perception are critical in ensuring compliance with waste management practices (Debrah, 2021). Engaging both the local community and tourists in these efforts is essential to achieving sustainability and protecting vulnerable ecosystems, contributing to the protection and ecological preservation of mangrove ecosystems in the region (Tiwari Shankar Marahatta et al., 2024). This study, therefore, aims to address the gaps in waste management practices and enhance the ecological preservation of mangrove ecosystems in Barangay Balarang's Mangrove Eco-Trail.

3. Methodology

This study employed a quantitative approach to assess the compliance and implementation of solid waste management practices in Brgy. Balarang's Mangrove Eco-Trail, focusing on SDG 13 related to climate action. Data was collected through surveys and observations, which were statistically analyzed to evaluate the

effectiveness of waste segregation, recycling, and disposal strategies in the area.

Research Design - This study systematically assesses customer perceptions of solid waste management practices at the Mangrove Eco-Trail in Barangay Balarang, Silay City Negros Occidental 6116. A quantitative descriptive research design was chosen to gather numerical data on the effectiveness of waste management strategies without manipulating variables. This approach is ideal for identifying patterns, attitudes, and behaviors within a population (Ishtiaq, 2019; Siedlecki, 2020; Anokye, 2024).

Locale - The research was conducted in Barangay Balarang, Silay City, Negros Occidental, 6116. a coastal community rich in mangrove ecosystems, attracting local and out-of-town visitors for recreational activities and environmental awareness. This study explores customer perceptions of waste management in this ecologically sensitive area, identifying strengths and areas for improvement.

Respondents - The target respondents include visitors and customers, who evaluate the impact of waste management practices on their experience at Brgy. Balarang's Mangrove Eco-Trail. A random sampling technique was used, ensuring every visitor had an equal chance of selection, minimizing bias, and enhancing the validity and reliability of results. A total of 292 respondents were involved.

Instrument - A structured survey questionnaire was developed to evaluate the implementation and compliance of solid waste management practices. It focused on waste segregation, collection, reduction, recycling, reuse, and composting practices. A four-point Likert scale was used:

Validation - The survey was validated by three experts. Using Good and Scates' standards, the instrument achieved an average validity score of 4.39, indicating strong alignment with research objectives and relevance to the study's needs.

Reliability - The questionnaire's reliability was tested using Cronbach's Alpha with 30 respondents at the Mangrove Eco-Trail. A Cronbach's Alpha score of 0.939 indicated very high reliability, confirming the instrument's internal consistency and ability to measure perceptions accurately.

Data Gathering Procedure - A structured survey was developed and refined with input from waste management experts and local leaders. Data collection involved convenience sampling of at least 50 visitors during peak times. Participants could complete the survey in paper format. Responses were logged and analyzed using statistical tools for quantitative data, while open-ended responses underwent thematic analysis.

Ethical Considerations - Ethical principles were strictly observed, including informed consent, privacy, and confidentiality. Participants were informed of the study's purpose and had the option to withdraw at any time. Data protection measures ensured anonymity and integrity throughout the research process.

4. Results and discussion

Table 1

SOP No. 1- Profile of the Respondent

Category	f	%
Entire Group	292	100
a. Age		
20 - 35 years old	186	63.7
36 - 50 years old	85	29.1
50 years old and above	21	7.2
b. Sex		
Male	96	32.9
Female	196	67.1
c. Civil Status		
Single	126	44.38
Married	110	38.73
Annulled	9	0.33
Widowed	47	16.57

The data presents the demographic profile of a group of 292 respondents. In terms of age, the majority (63.7%) fall within the 20-35 years old category, followed by 29.1% in the 36-50 years old range, and only 7.2% aged 50 years old and above, indicating a predominantly younger population. Regarding sex, most respondents are female, comprising 67.1% of the group, while males make up 32.9%. For civil status, a significant portion (44.38%) are single, followed by 38.73% who are married. A smaller percentage of the respondents are widowed (16.57%), while a minimal portion (0.33%) reported being annulled. This demographic breakdown provides insight into the age, gender, and marital distribution of the surveyed population, which can help understand the group's diversity and possible influences on the study's findings.

Table 2

SOP No. 2- The level of Implementation and Compliance of the respondents in terms of:

STATEMENTS	Mean	SD	Interpretation
2.0 OVER ALL MEAN	4.15	0.14	HIGH
2.1. Waste Segregation and Waste Collection	4.14	0.22	HIGH
1. How is sustainability emphasized in waste segregation and collection within the mangrove eco-trail?	4.07	0.46	HIGH
2. How effectively are sustainability practices integrated into waste segregation and collection?	4.17	0.39	HIGH
3. To what extent do sustainability practices contribute to waste management in the mangrove eco-trail?	4.13	0.37	HIGH
4. How well do individuals and communities implement sustainable waste segregation and collection?	4.16	0.39	HIGH
5. Is current awareness sufficient for effective waste segregation and collection	4.16	0.37	HIGH
2.2. Reduce and Reuse	4.15	0.20	HIGH
1. How do sustainability practices support economic growth through reduction and reuse?	4.16	0.41	HIGH
2. How effectively do reduced production costs and material usage benefit the mangrove eco-trail?	4.14	0.35	HIGH
3. How well do sustainability efforts balance economic growth with environmental protection?	4.16	0.36	HIGH
4. How is responsible consumption and production integrated into the local economy?	4.16	0.41	HIGH
5. How do sustainability practices foster innovation and economic opportunities?	4.14	0.36	HIGH
2.3. Reduction of Waste	4.17	0.24	HIGH
1. How effectively does composting reduce waste and promote resource efficiency?	4.14	0.35	HIGH
2. How well does composting minimize waste generation? HIGH	4.18	0.42	HIGH
3. To what extent does composting address landfill and waste disposal challenges?	4.16	0.44	HIGH
4. How successfully are individuals and businesses adopting composting practices?	4.20	0.47	HIGH
5. Are educational programs on composting effectively implemented?	4.16	0.55	HIGH

The findings indicate a high level of compliance and implementation of solid waste management practices in Brgy. Balarang's Mangrove Eco-Trail, aligning with SDG 13 (Climate Action). With an overall mean of 4.15 (SD = 0.14), the community demonstrates strong engagement in waste segregation, reduction, reuse, and composting. Waste segregation and collection (4.14) are effectively integrated, though continued awareness efforts may enhance participation. The reduce and reuse approach (4.15) supports both economic and environmental sustainability, fostering innovation and resource efficiency. Composting (4.17) emerged as the most effective waste reduction method, with high community adoption (4.20) and positive impacts on waste minimization (4.18). Overall, the eco-trail successfully implements sustainability-driven waste management, reinforcing its role in climate action and environmental conservation.

The ANOVA results across the various categories indicate that there are no statistically significant differences between the groups. For the overall analysis (3.0), the F-ratio is 0.02 with a p-value of 0.99, which is well above the 0.05 significance level, suggesting no significant difference in age among the groups. In the analysis of waste segregation and waste collection (3.1), the F-ratio of 1.30 and p-value of 0.28 also show no significant differences in the groups' practices. Similarly, for the "Reduce and Reuse" category (3.2), the F-ratio of 0.26 and p-value of 0.77 further support the conclusion that no significant differences exist among the groups. Lastly, the composting category (3.3) shows an F-ratio of 0.20 and a p-value of 0.82, again indicating no significant differences between the groups' composting practices. Overall, all p-values exceed the 0.05 threshold,

confirming that there are no significant variations in any of the factors analyzed.

Table 3*SOP No. 3-ANOVA Results in AGE*

Sources of Variations	df	Sum of Squares	Mean Square	F-ratio	P	Interpretation
3.0 Taken as a whole						
Between Groups	2	0.00	0	0.02	0.99	Not Significant
Within Groups	289	5.84	0.02			
Total	291	5.84				
3.1. Waste Segregation and Waste Collection						
Between Groups	2	0.12	0.06	1.30	0.28	Not Significant
Within Groups	289	13.36	0.046			
Total	291	13.48				
3.2. Reduce and Reuse						
Between Groups	2	0.02	0.011	0.26	0.77	Not Significant
Within Groups	289	11.77	0.041			
Total	291	11.79				
3.3. Composting						
Between Groups	2	0.02	0.012	0.20	0.82	Not Significant
Within Groups	289	17.34	0.06			
Total	291	17.36				

Table 4*SOP No. 3- t-test Results in SEX*

Compared Group	Mean	SD	df	t-ratio	P	Interpretation
4.0 Taken as a whole						
Male	4.15	0.13	290	1.39	0.24	Not Significant
Female	4.15	0.15				
4.1. Waste Segregation and Waste Collection						
Male	4.13	0.22	290	0.41	0.52	Not Significant
Female	4.14	0.22				
4.2. Reduce and Reuse						
Male	4.15	0.20	290	0.00	0.95	Not Significant
Female	4.15	0.20				
4.3. Composting						
Male	4.17	0.23	290	0.61	0.43	Not Significant
Female	4.16	0.25				

The t-test results for the comparison between males and females in various categories reveal no significant differences between the two groups. In the overall analysis (4.0), both male and female participants have nearly identical means (4.15 for both), with a t-ratio of 1.39 and a p-value of 0.24, indicating no significant difference. Similarly, for the category of waste segregation and waste collection (4.1), males have a mean of 4.13 and females 4.14, with a t-ratio of 0.41 and a p-value of 0.52, which also shows no significant difference. In the "Reduce and Reuse" category (4.2), both males and females have the same mean of 4.15, with a t-ratio of 0.00 and a p-value of 0.95, confirming no significant difference. Lastly, in composting (4.3), males have a mean of 4.17 and females 4.16, with a t-ratio of 0.61 and a p-value of 0.43, again showing no significant difference between the sexes. In conclusion, all p-values exceed the significance threshold of 0.05, confirming that there are no significant differences between males and females in any of the categories tested.

The ANOVA results for the analysis based on civil status show no significant differences across the groups in any of the categories. In the overall analysis (5.0), the F-ratio is 0.95 with a p-value of 0.43, which is greater than the typical significance level of 0.05, indicating no significant difference based on civil status. In the analysis of waste segregation and waste collection (5.1), the F-ratio of 1.29 and p-value of 0.28 also suggest no significant differences among the civil status groups. For the "Reduce and Reuse" category (5.2), the F-ratio of 0.94 and p-value of 0.44 further confirm the lack of significant differences. Similarly, in the composting category (5.3), the F-ratio of 1.28 and p-value of 0.28 show no significant differences between the groups. Overall, all

p-values are greater than 0.05, indicating that civil status does not have a significant effect on the factors analyzed.

Table 5*SOP No. 3 -ANOVA Results in Civil Status.*

Sources of Variations	df	Sum of Squares	Mean Square	F-ratio	P	Interpretation
5.0 Taken as a whole						
Between Groups	4	0.08	0.019	0.95	0.43	Not Significant
Within Groups	287	5.76	0.02			
Total	291	5.84				
5.1. Waste Segregation and Waste Collection						
Between Groups	4	0.24	0.059	1.29	0.28	Not Significant
Within Groups	287	13.24	0.046			
Total	291	13.48				
5.2. Reduce and Reuse						
Between Groups	4	0.15	0.038	0.94	0.44	Not Significant
Within Groups	287	11.64	0.041			
Total	291	11.79				
5.3. Composting						
Between Groups	4	0.30	0.076	1.28	0.28	Not Significant
Within Groups	287	17.06	0.059			
Total	291	17.36				

Table 6*SOP No. 3 The relationship between the level Implementation and Compliance of the respondents and their Age*

Compared Groups	F - ratio	P	Interpretation
The level of implementation and compliance of the respondents in terms of their Age.	0.001	0.993	

In this table, the F-ratio is 0.001, and the p-value is 0.993. Since the p-value is significantly greater than the common significance threshold of 0.05, the result suggests that there is no statistically significant relationship between the level of implementation and compliance and the respondents' age. The F-ratio, being very close to zero, further supports this conclusion, indicating that the age of the respondents does not have a notable effect on their level of implementation and compliance. Essentially, age does not appear to influence how well the respondents are implementing and complying with the relevant practices or policies.

Table 7*SOP No. 3- The relationship between the level of Implementation and Compliance of the respondents and their Sex*

Compared Groups	F - ratio	P	Interpretation
The Level of Implementation and Compliance of the Respondents and their Sex.	0.008	0.893	Not Significant

In Table 7, the F-ratio is 0.008, and the p-value is 0.893. As the p-value exceeds the typical significance threshold of 0.05, this result indicates that there is no statistically significant relationship between the level of implementation and compliance and the sex of the respondents. With such a high p-value, it is evident that the sex of the respondents does not play a significant role in influencing their level of implementation and compliance. Whether a respondent is male or female does not seem to affect their ability or willingness to adhere to the prescribed implementation and compliance guidelines.

Table 8*SOP No. 3-The relationship between the level of Implementation and Compliance of the respondents and their Civil Status*

Compared Groups	F - ratio	P	Interpretation
The level of Implementation and Compliance of the Respondents and their Civil Status.	-0.063	0.286	Not Significant

In this table, the F-ratio is -0.063, and the p-value is 0.286. Since the p-value is much greater than 0.05, the results show that there is no statistically significant relationship between the level of implementation and compliance and the respondents' civil status. The negative F-ratio further emphasizes the lack of a meaningful connection between civil status and the respondents' compliance or implementation levels. In conclusion, civil status (whether a person is single, married, etc.) does not seem to have any significant impact on the level of implementation and compliance among the respondents.

5. Conclusion

The demographic profile of the respondents shows that most are between twenty and thirty-five years old, with females making up the majority of the sample. In terms of civil status, many are single, followed by those who are married, and a smaller portion are widowed. These figures provide a snapshot of the age, sex, and marital status distribution of the group. Regarding waste management practices in the Mangrove Eco-Trail, the overall results indicate high implementation and compliance with sustainable practices like waste segregation, reduction, reuse, and composting. Specifically, composting was identified as the most effective method, reflecting the community's commitment to sustainable waste practices, in line with climate action goals. Statistical tests show no significant differences in the level of implementation and compliance across age, sex, and civil status. These factors do not appear to influence waste management practices. Additionally, the relationship between implementation and compliance with demographic factors, such as age and sex, was also not significant, indicating that the community's efforts are universally applied, regardless of these variables.

In conclusion, the study on solid waste management practices at the Mangrove Eco-Trail in Barangay Balarang, Silay City, highlights significant progress in the implementation of waste segregation, collection, and composting. These practices have been well-adopted by the community, aligning with climate action goals and promoting sustainability. However, inconsistencies in the adherence to waste reduction and reuse practices suggest areas for further improvement. Demographically, age was the only significant factor influencing engagement, with younger participants showing greater involvement, likely due to better environmental education and media exposure. Gender and civil status had no impact on the implementation or compliance levels, reinforcing that environmental responsibility is widespread across different social groups. The study's findings support the need for enhanced educational campaigns, improved waste management infrastructure, and continuous community engagement. By addressing these gaps, the Mangrove Eco-Trail can further strengthen its waste management efforts, ensuring long-term ecological conservation and fostering sustainable practices for future generations.

5.1 Recommendations

Awareness and Education: While the overall implementation of sustainability practices is high, further education and awareness programs could be beneficial to address the gaps in knowledge about sustainability, particularly in resource preservation. These programs should target younger individuals who might benefit from additional insights into the long-term benefits of sustainability.

Community Engagement: It is important to increase community participation in sustainability initiatives, particularly in composting and waste reduction, where the highest scores were recorded. Greater community involvement can help maintain the momentum for sustainable practices and improve overall environmental outcomes.

Continual Monitoring and Feedback: Regular monitoring and feedback mechanisms should be implemented to track the continued effectiveness of sustainability practices. This will help identify any areas that require improvement and reinforce the importance of adherence to sustainability guidelines.

Inclusive Strategies: Given that demographic factors such as age, sex, and civil status did not show a significant influence on sustainability practices, efforts should focus on fostering inclusivity in sustainability initiatives. Engaging people from all demographic categories equally can ensure the broad-based success of

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