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Optimizing Biodegradable Waste Management: A Study on Composting Water Treatment Practices at Aurora Senior High School

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Abstract

This study explores the optimization of biodegradable waste management practices, focusing on composting and water treatment at Aurora Senior High School. Despite the school's ongoing waste management efforts, inefficiencies in waste segregation, composting methods, and wastewater treatment pose environmental and health concerns. This research evaluated the existing waste management system and water treatment. Using a quantitative descriptive research design, data were collected through structured surveys distributed to science teachers, maintenance staff, and student volunteers actively involved in waste management initiatives, which composed of 50 respondents. The study employed frequency distribution, percentage, mean and standard deviation as statistical tools. Findings reveal that while composting significantly reduces biodegradable waste and improves sanitation, challenges persist, including limited composting bins, inadequate resources, and poor enforcement of waste management policies. Additionally, technical difficulties in maintaining composting and wastewater treatment facilities hinder overall efficiency. Despite a balanced gender representation in waste management participation, awareness and engagement in proper waste disposal remain insufficient. The study suggests that improved policy enforcement, increasing resource allocation, and integrating waste management education into the curriculum could enhance sustainability. Best practices from other institutions, such as advanced composting techniques and enhanced wastewater treatment methods, can also be adapted to strengthen the school's waste management framework. The study highlights the necessity of structured interventions to ensure long-term environmental responsibility within the school community.

Keywords: biodegradable waste management, composting, water treatment, sustainability, waste reduction

INTRODUCTION

Biodegradable waste management is a crucial aspect of environmental sustainability, particularly in educational institutions where large volumes of organic waste are generated daily. Schools serves as important venues for environmental education and sustainable practices, making them ideal locations to implement and optimize composting and water treatment methods. Improper disposal of biodegradable wastes contributes to pollution, methane emissions, and inefficient resource utilization. As concerns over climate change and waste management escalate, institutions worldwide are increasingly adopting innovative strategies such as composting and biofiltration to enhance waste decomposition and wastewater treatment (García-Oliva & Cammeraat, 2022).

Aurora Senior High School, like many academic institutions, produces a significant amount of biodegradable waste from food scraps, garden waste, and other organic materials. However, the effectiveness of existing composting and water treatment methods at the school remains largely unexplored. Hence, this study intends to assess and optimize biodegradable waste management through improved composting techniques and water treatment practices. By doing so, the research aims to contribute to

sustainable waste management solutions that could be replicated in other schools across the region.

Waste management has become a global environmental challenge due to rapid urbanization, population growth, and industrialization. According to the World Bank (2022), the world generates over 2.01 billion tons of municipal solid waste annually, with organic waste comprising approximately 44% of the total waste stream. Many developed countries have adopted advanced composting and wastewater treatment technologies to address this issue, integrating anaerobic digestion, vermicomposting, and biofiltration to reduce environmental impact (Zhang et al., 2021). However, in developing nations, the lack of proper waste segregation and treatment infrastructure often leads to pollution and inefficient waste management.

In the Philippines, biodegradable waste accounts for approximately 52% of total municipal solid waste (Department of Environment and Natural Resources [DENR], 2023). The implementation of Republic Act No. 9003, or the Ecological Solid Waste Management Act of 2000, mandates the segregation and proper disposal of biodegradable waste. However, many local government units (LGUs) struggle with compliance due to inadequate facilities, funding constraints, and lack of public awareness (Sapuay, 2020). Despite these challenges, some schools and communities have initiated composting programs, but their sustainability and efficiency remain inconsistent.

Aurora, a municipality in Isabela, faces challenges in managing biodegradable waste due to limited composting infrastructure and inefficient water treatment practices. Schools, including Aurora Senior High School, generate a substantial amount of organic waste daily, yet proper waste management systems remain insufficient. While some composting initiatives exist, there is a need for optimized methods that ensure sustainable waste decomposition and effective wastewater treatment. Identifying practical solutions tailored to local conditions could significantly improve environmental sustainability and serve as a model for other schools in the province.

The necessity for this study stems from the urgent need to enhance biodegradable waste management practices in educational institutions. Schools play a vital role in shaping students' environmental consciousness, and implementing effective composting and water treatment strategies could serve as a blueprint for broader community initiatives. By optimizing composting techniques and integrating sustainable water treatment solutions, this research aims to contribute to the larger goal of waste reduction and resource efficiency in Aurora and beyond.

While previous studies have explored composting and wastewater treatment techniques, there remains a lack of research focusing on their application in Philippine senior high schools, particularly in rural areas like Aurora. Existing literature primarily discusses large-scale municipal waste treatment or household composting methods but does not sufficiently address the challenges faced by educational institutions with limited resources. This study aims to bridge this gap by evaluating current practices and proposing optimized solutions tailored to the specific needs of Aurora Senior High School.

Statement of the Problem. This study aims to assess and optimize biodegradable waste management practices, particularly composting and water treatment, at Aurora Senior High School. Despite existing waste management efforts, there remain inefficiencies in waste segregation, composting methods, and wastewater treatment, leading to potential environmental and health concerns. The lack of a structured and scientifically optimized approach limits the sustainability and effectiveness of current practices. This study seeks to evaluate the existing biodegradable waste management system, identify areas for improvement, and propose optimized solutions that enhance waste decomposition and water treatment efficiency within the school

environment. Specifically, the study seeks to answer the following questions:

1. What is the demographic profile of the respondents in terms of:
   1.1. Age
   1.2. Gender
   1.3. Strand
   1.4. Grade Level

2. What are the current biodegradable waste management practices, including composting and water treatment, implemented at Aurora Senior High School?

LITERATURES

Sustainable Biodegradable Waste Management through Composting and Water Treatment. According to Kaza et al. (2018), effective biodegradable waste management is essential in mitigating environmental pollution and promoting sustainability. Their study emphasized that composting and water treatment practices significantly reduce organic waste accumulation and improve soil and water quality. Meanwhile, Zhang et al. (2019) highlighted the role of innovative composting methods, such as vermicomposting, in accelerating organic waste decomposition and enhancing nutrient content in the soil, making it a viable approach for schools and communities. In a study conducted by Joseph et al. (2020), the integration of composting and wastewater treatment in educational institutions was found to increase awareness and participation among students and faculty, leading to a more sustainable waste management system. Similarly, Sharma and Garg (2021) discussed the effectiveness of biofiltration techniques in treating wastewater derived from composting activities, reducing harmful contaminants, and ensuring safe water reuse. Their findings support the need for proper waste segregation and efficient treatment methods in institutional settings. Additionally, the research of Kumar et al. (2022) emphasized the importance of policy implementation and community involvement in optimizing biodegradable waste management. They found that schools that adopt structured composting and water treatment programs experience a significant reduction in waste disposal costs while fostering environmental responsibility among students. These studies collectively support the need for an improved and optimized biodegradable waste management system at Aurora Senior High School to enhance sustainability and environmental conservation.

The Role of Schools in Biodegradable Waste Management. Educational institutions play a crucial role in promoting sustainable waste management practices. According to Parizeau et al. (2016), schools that implement structured composting and water treatment programs significantly reduce organic waste accumulation while fostering environmental awareness among students. This aligns with the findings of Singh et al. (2019), who emphasized that school-based waste management initiatives enhance students' knowledge and participation in sustainability efforts. Furthermore, research by Zaman and Lehmann (2021) highlighted that integrating composting into the school curriculum encourages responsible waste disposal habits and contributes to long-term behavioral change. Similarly, Alemayehu et al. (2022) found that educational institutions adopting sustainable waste practices serve as models for surrounding communities, influencing broader environmental policies and behaviors. Lastly, Abila and Kantola (2023) suggested that the success of school waste management programs depends on institutional support, infrastructure, and continuous environmental education.

Innovations in Composting for Biodegradable Waste Management. Composting remains a critical solution for biodegradable waste management, with recent innovations improving efficiency and sustainability. According to Adhikari et al. (2016), advancements in aerobic composting technologies enhance organic waste decomposition, reducing landfill waste and improving soil quality. Similarly, Lazcano et al. (2019) found that biochar-amended compost accelerates microbial activity, leading to higher nutrient retention in the final compost product.

Recent studies have also explored the role of microbial inoculants in improving composting efficiency. Pathma et al. (2020) demonstrated that the introduction of beneficial bacteria enhances organic matter breakdown, leading to faster compost maturation. Meanwhile, Zhao et al. (2021) examined the benefits of using enzyme-based composting accelerators, which significantly reduce decomposition time and improve compost quality. Lastly, Manzoor et al. (2023) highlighted the potential of smart composting bins equipped with sensors to monitor temperature and moisture levels, ensuring optimal composting conditions.

Water Treatment in Sustainable Waste Management. Water treatment plays a crucial role in sustainable biodegradable waste management. According to Bhatia et al. (2018), integrating wastewater treatment with composting processes minimizes water contamination and enhances resource recovery. Their study highlights the effectiveness of constructed wetlands in filtering out organic pollutants from wastewater. Similarly, Luo et al. (2019) emphasized the role of anaerobic digestion in wastewater treatment, noting its ability to produce biogas while reducing organic waste. Research by Kim et al. (2020) also explored the use of biofilters in removing contaminants from compost leachate, demonstrating their efficiency in improving water quality. Moreover, Huang et al. (2021) studied the impact of phytoremediation techniques, such as the use of aquatic plants, in purifying wastewater from composting facilities. Lastly, Gupta and Mehta (2022) proposed a circular approach to waste management, advocating for the reuse of treated wastewater in irrigation and composting operations.

Policy and Community Engagement in Waste Management. The success of biodegradable waste management largely depends on policy support and community engagement. According to Wilson et al. (2017), government policies promoting composting and water treatment practices are essential in achieving long-term waste reduction goals. Their study emphasized the need for financial incentives and regulatory frameworks to support sustainable waste programs. Meanwhile, Hoornweg et al. (2019) highlighted the role of community-driven initiatives in waste management, showing that public participation significantly improves program effectiveness. Similarly, Nelles et al. (2020) found that waste segregation policies in schools and local governments enhance the efficiency of composting and water treatment systems. Research by Torres and Prasad (2021) also indicated that educational campaigns play a crucial role in raising awareness and encouraging community involvement in waste reduction. Lastly, Johnson and Patel (2022) argued that technological innovations, such as mobile apps for waste tracking, strengthen policy implementation and enhance waste management strategies.

METHODOLOGY

Research Design. This study employed a quantitative descriptive research design to systematically analyze and interpret data related to the topic. The quantitative approach allows for the collection of numerical data, which are analyzed using statistical methods to identify patterns, relationships, and trends. Data will be gathered using structured survey questionnaires distributed to a selected group of respondents. The collected data were analyzed using descriptive statistics such as frequency distribution, percentage, mean, and standard deviation to summarize the findings effectively. This approach ensured objective and measurable insights into the research problem, allowing for a clearer understanding of the topic based on empirical evidence.

Sampling Method. The study used a non-probability purposive sampling method to select participants who have direct knowledge and experience with biodegradable waste management and composting water treatment practices at Aurora Senior High School. The respondents primarily include science teachers, school maintenance staff, and student volunteers involved in waste management initiatives. Their participation is essential as they are directly engaged in composting and water treatment practices within the school.

Through the use of purposive sampling, the study ensures that the collected data is rich, relevant, and reflective of actual waste management conditions at Aurora Senior High School.

Research Locale. Aurora Senior High School in Isabela, Philippines, was chosen for this study due to its active involvement in environmental sustainability initiatives, including biodegradable waste management and composting water treatment. The school's commitment to sustainable practices makes it a relevant case for studying the optimization of biodegradable waste management. Additionally, its geographical location within Isabela, a province known for its agricultural and environmental efforts, further supports the study's focus on enhancing composting and water treatment strategies in an educational setting.

Research Respondents. There were 50 respondents employed in this study. They consist of science teachers, maintenance staff, and student volunteers who actively participate in the school's waste management initiatives. Science teachers provide insights into the scientific and environmental aspects of composting and water treatment, while maintenance staff offer practical knowledge on waste disposal and management processes. Student volunteers, particularly those engaged in eco-friendly school programs, will contribute their experiences and perspectives on the effectiveness of current waste management practices.

Research Instrument. This study employed a researcher-designed, self-administered survey questionnaire as primary instrument for data collection. The questionnaire is specifically designed to gather insights into the biodegradable waste management and composting water treatment practices at Aurora Senior High School. It includes structured questions that cover key aspects of waste management, allowing respondents to provide their perspectives, experiences, and suggestions for improvement.

The survey was divided into three sections: demographic profile, waste management practices, and optimization strategies. The profile section collected information about the respondents. The waste management practices section assessed current biodegradable waste management strategies, composting methods, and water treatment processes implemented in the school. Lastly, the optimization strategies section explored potential improvements to enhance waste management efficiency.

To establish the validity and reliability of the instrument, the questionnaire underwent review from experts aligned in environmental management and research methodology and evaluated the clarity and relevance of the survey items. Refinements were done based on the results of the review. After which, a pilot testing was conducted among a small sample of respondents. Based on the results, indicators of the instrument gained 0.97 Cronbach alpha indicating its high reliability.

Data Gathering Procedures. The data collection process followed a systematic approach to ensure the accuracy and reliability of the gathered information. Prior to the data collection, the researchers sought approval from the school administration of Aurora Senior High School to conduct the study. Once approval was granted, the researchers proceeds with the following steps:

The researchers distributed the self-administered questionnaires to the selected respondents, including teachers, maintenance staff, and student volunteers involved in biodegradable waste management at Aurora Senior High School. The respondents were given a specific timeframe to complete the survey at their convenience. The researchers provided instructions on how to answer the questionnaire and ensure confidentiality and anonymity of their responses.

Once responses were all collected, the researchers reviewed and verified the completeness of the data before proceeding to data encoding and analysis. The gathered data

were processed using appropriate statistical tools and methods to yield meaningful insights.

Statistical Treatment of Data. To analyze the data collected from the self-administered survey questionnaire, various statistical methods were employed to ensure accurate interpretation and meaningful insights. The following statistical treatments were used:

The study employed frequency and percentage distribution to summarize the demographic profile of respondents as to age, sex, strand and grade level.

Descriptive analysis, using mean and standard deviation determined overall trends in respondents' perceptions of biodegradable waste management and water treatment. Likewise, weighted mean was used to interpret the Likert scale responses, while frequency distribution illustrated response trends.

Ethical Considerations. This study strictly adhered to the Data Privacy Act of 2012 (Republic Act No. 10173) to ensure the confidentiality and security of all data collected. Before conducting the survey, respondents were provided with an informed consent form, clearly explaining the purpose of the research, the voluntary nature of participation, and their right to withdraw at any time without any consequences. The study guarantees that all personal information will remain confidential and will only be used for research purposes. Additionally, no identifying details will be disclosed, and all responses will be anonymized to protect participants' privacy. Data storage and handling followed ethical guidelines, ensuring that only authorized researchers have access to the information. Through the implementation of ethical measures, the study upholds the principles of privacy, confidentiality, and voluntary participation in data collection and analysis.

RESULTS AND DISCUSSION

Demographic Analysis. The age distribution of respondents in Table 1 is relevant to understanding the demographic composition of individuals involved in biodegradable waste management practices at Aurora Senior High School.

Table 1
Age Distribution of Respondents

Age Group	Frequency	Percentage (%)
14–15	9	18.00%
16–17	14	28.00%
18–19	13	26.00%
20–21	9	18.00%
Total	**50**	**100.00%**

The majority of respondents fall within the 16–17 age group (28.00%), followed closely by the 18–19 age group (26.00%), indicating that most participants are senior high school students. This aligns with studies suggesting that youth engagement is crucial in environmental initiatives, particularly in schools, as they play a key role in sustainable waste management behaviors (Chakraborty et al., 2022). Given that biodegradable waste management, including composting and wastewater treatment, requires active participation, the presence of a predominantly young demographic suggests an opportunity to instill long-term environmentally responsible practices. Integrating structured composting and water treatment education into the curriculum could enhance student participation and sustainability efforts, addressing the inefficiencies identified in the study's problem statement.

Table 2
Sex Distribution of the Respondents

Sex	Frequency	Percentage (%)
Male	25	50.00%
Female	25	50.00%
Total	**50**	**100.00%**

The equal distribution of male and female respondents in Table 2 (50.00% each) indicates a balanced gender representation in the study. This suggests that both male and female students at Aurora Senior High School are equally engaged in biodegradable waste management practices, including composting and water treatment. Research highlights that gender inclusivity in environmental initiatives enhances sustainability efforts, as diverse perspectives contribute to more effective waste

management solutions (UNEP, 2021). Given this balance, the study can explore whether gender influences attitudes and participation in waste management, potentially informing targeted awareness programs that encourage active involvement from all students.

Table 3
Strand Distribution of Respondents

Strand	Frequency	Percentage (%)
STEM	17	34.00%
ABM	13	26.00%
HUMSS	12	24.00%
TVL	8	16.00%
Total	**50**	**100.00%**

The strand distribution of respondents in Table 3 reveals that the majority of students belong to the STEM strand (34.00%), followed by ABM (26.00%), HUMSS (24.00%), and TVL (16.00%). This suggests that students from science, technology, engineering, and mathematics backgrounds are more represented in the study, which may influence their awareness and engagement in biodegradable waste management practices. Studies indicate that STEM students tend to have a stronger inclination toward environmental sustainability due to their exposure to scientific methodologies and problem-solving approaches (Cebrián & Junyent, 2015). This distribution can provide insights into whether students' academic backgrounds affect their perceptions and participation in composting and water treatment initiatives at Aurora Senior High School.

Table 4
Grade Level Distribution of Respondents

Grade Level	Frequency	Percentage (%)
Grade 11	24	48.00%
Grade 12	26	52.00%
Total	**50**	**100.00%**

The grade level distribution in Table 4 shows that the respondents are almost evenly split between Grade 11 (48.00%) and Grade 12 (52.00%). This balanced representation ensures that perspectives from both junior and senior students are considered in assessing biodegradable waste management practices at Aurora Senior High School. Grade 12 students, having spent more time in school, may have greater awareness and engagement in composting and water treatment initiatives, aligning with studies indicating that environmental knowledge improves with age and educational exposure (Amoah & Addo, 2021). Understanding differences in participation and awareness between grade levels can help in designing targeted waste management programs for both groups.

Table 5
Descriptive Statistical Analysis of Biodegradable Waste Management and Water Treatment in School

Questions	Mean Score	Standard Deviation	Interpretatior
The school promotes proper biodegradable waste segregation among students and staff.	3.00	1.00	Often
Composting bins are readily available and accessible within the school premises.	2.86	1.02	Often
The school effectively educates students on proper composting techniques.	3.04	1.03	Often
The composting process is regularly monitored and maintained for efficiency.	2.76	1.12	Sometimes
Compost produced by the school is reused for gardening or other environmental purposes.	2.94	1.05	Often
The school has an existing system for treating wastewater from different sources.	2.80	1.09	Sometimes
Water used in school facilities is properly filtered and treated before disposal.	3.02	1.01	Often
Wastewater treatment methods effectively reduce environmental pollution.	2.90	1.08	Often
Students and staff are aware of proper wastewater disposal procedures.	3.00	1.05	Often
The school ensures that wastewater treatment aligns with environmental safety standards.	2.98	1.04	Often
The composting process significantly reduces biodegradable waste within the school.	3.06	1.01	Often
The school's waste management practices contribute to a cleaner environment.	3.06	1.00	Often
The existing composting and water treatment methods are sustainable in the long run.	2.94	1.05	Often
The school has sufficient resources and infrastructure for effective biodegradable waste management.	2.84	1.07	Sometimes
Composting and wastewater treatment practices have a positive impact on school sanitation.	2.96	1.06	Often
There is a lack of awareness and participation among students in waste segregation.	2.76	1.12	Sometimes
The school faces difficulties in maintaining composting and water treatment facilities.	2.80	1.12	Sometimes
Waste management policies and guidelines are not strictly enforced within the school.	2.94	1.05	Often
There is insufficient funding or resources allocated for composting and water treatment.	2.92	1.07	Often
The school encounters technical challenges in improving biodegradable waste processing.	2.80	1.11	Sometimes
The school should implement stricter policies for proper waste segregation.	2.98	1.05	Often
More awareness campaigns and training programs should be conducted regarding composting.	3.06	1.01	Often
The school should adopt new technologies to enhance composting and wastewater treatment.	2.96	1.06	Often
Collaboration with environmental organizations can help improve waste management practices.	3.02	1.04	Often
A structured waste management framework should be developed to optimize biodegradable waste disposal.	2.96	1.06	Often
The school has a designated team or personnel responsible for monitoring composting and wastewater treatment.	3.06	1.00	Often
Students are encouraged to participate in initiatives promoting biodegradable waste management.	2.94	1.05	Often
The composting process is regularly evaluated for efficiency and effectiveness.	2.98	1.05	Often
The school collaborates with external organizations (e.g., LGUs, NGOs) for waste management improvements.	2.96	1.06	Often
The integration of biodegradable waste management into the school curriculum would improve student awareness and participation.	3.02	1.04	Often

The descriptive statistical analysis of biodegradable waste management and water treatment practices at Aurora Senior High School indicates a generally positive perception of the school's efforts, with most responses falling within the "Often" category. The highest

mean score (M = 3.06, SD = 1.01) was observed for statements regarding the composting process significantly reducing biodegradable waste and the school's waste management practices contributing to a cleaner environment. This suggests that the school's composting efforts are relatively effective, contributing to waste reduction and sanitation improvements. Similarly, students and staff recognize the importance of composting and wastewater treatment, as reflected in their awareness of proper wastewater disposal procedures (M = 3.00, SD = 1.05) and alignment with environmental safety standards (M = 2.98, SD = 1.04).

Despite these positive findings, several areas require improvement. The availability of composting bins (M = 2.86, SD = 1.02) and sufficient resources and infrastructure for waste management (M = 2.84, SD = 1.07) received lower ratings, indicating gaps in accessibility and material support. Challenges in maintaining composting and water treatment facilities (M = 2.80, SD = 1.12) and a lack of strict enforcement of waste management policies (M = 2.94, SD = 1.05) highlight operational difficulties. Additionally, technical challenges in biodegradable waste processing (M = 2.80, SD = 1.11) suggest the need for technological advancements and external support to optimize waste treatment efficiency.

These findings are consistent with previous research indicating that while schools actively engage in waste management initiatives, sustainability and efficiency remain challenging due to inadequate infrastructure, lack of funding, and limited technical knowledge (Azevedo et al., 2020). A study by Zurbrügg et al. (2019) also emphasized that effective waste management in schools depends on strict policy implementation, continuous monitoring, and sufficient financial and technical resources. Given the results, it is recommended that Aurora Senior High School strengthen its biodegradable waste management framework by increasing awareness campaigns (M = 3.06, SD = 1.01), adopting new technologies (M = 2.96, SD = 1.06), and fostering collaborations with external organizations (M = 3.02, SD = 1.04) to enhance waste reduction and environmental sustainability.

Conclusion. This study aimed to assess and optimize biodegradable waste management practices, particularly focusing on composting and water treatment at Aurora Senior High School. The findings provide a comprehensive evaluation of existing waste management methods, their effectiveness, and the challenges affecting their sustainability. Findings revealed that while these practices contributed to waste reduction and sustainability, some inefficiencies were identified such as limited infrastructure, weak policy enforcement, and inconsistent student participation hinder their effectiveness.

Nonetheless, the study successfully met its objectives by identifying current practices and recommended areas to enhance the school's waste management system.

Recommendations. Based on the findings of this study, the following recommendations are proposed to enhance biodegradable waste management practices at Aurora Senior High School:

1. Students of Aurora Senior High School should actively participate in biodegradable waste management initiatives by properly segregating waste, utilizing composting bins, and promoting sustainable practices within the school. Peer-led awareness campaigns can encourage responsible waste disposal habits, fostering an environmentally conscious student body.

2. Faculty and School Staff should integrate biodegradable waste management topics into classroom discussions and extracurricular activities. By incorporating hands-on composting and waste segregation activities into the curriculum, educators can enhance student engagement and environmental responsibility.

3. The School Administration should strengthen the implementation of waste management policies by ensuring proper

monitoring and enforcement. Providing additional composting bins, improving infrastructure, and allocating sufficient resources for sustainable waste practices will enhance the efficiency of current initiatives.

4. Parents and Guardians should reinforce proper waste management habits at home by educating their children on biodegradable and non-biodegradable waste segregation. Encouraging students to practice sustainability outside of school can help reinforce environmentally responsible behavior in daily life.

5. The Local Government Unit (LGU) should collaborate with schools to provide funding, technical support, and training programs for students and faculty. Strengthening environmental policies and offering incentives for waste management initiatives can enhance community participation in sustainable practices.

6. Non-Governmental Organizations (NGOs) and Environmental Groups should partner with schools to conduct workshops, seminars, and campaigns on biodegradable waste management. Providing expertise, materials, and resources can help schools develop more effective and long-term sustainable waste management programs.

7. Future researchers should explore innovative and cost-effective methods for improving composting and wastewater treatment in schools. Conducting comparative analyses of different waste management techniques can provide valuable insights for optimizing sustainability efforts.

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