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# Biodegradable Waste Management at Institutional Site: An Overview

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**Abstract:**
A biodegradable waste is any waste that can break down through anaerobic or aerobic processes, including food scraps, cardboard etc. Biodegradable waste management play a crucial role in protecting public health and the environment. Every day, a significant amount of solid biodegradable waste is produced in institutional sites. Disposing of this waste by dumping or burning is unacceptable because it pollutes the environment and poses health risks. Thus, finding an effective method for managing biodegradable waste is crucial for sustainable development. This paper provides a comprehensive analysis of biodegradable waste management in the various institutions. It examines biodegradable waste categorization, collection, analysis, treatment and reutilization of the same in the form of a product in the same institutes. Potential hazards such as exposure to pathogens, gases, and handling challenges related to the biodegradable waste management are also being discussed. Additionally, the study explores various waste management methods which are highly sustainable and have cradle - to - cradle approach.

**Keywords:** Biodegradable Waste Management, Recycling, health hazards, Composting Techniques.

## 1. Introduction

### *1.1. Background*

Biodegradable waste includes compostable materials from gardens and parks, food and kitchen scraps from homes, restaurants, catering services, and retail outlets, as well as comparable waste produced by food processing plants.

In any institution, a large amount of solid waste is produced, with most of it being biodegradable. Merely dumping this waste in a landfill is unproductive and can result in the release of methane gas, unpleasant odors, and environmental pollution, ultimately harming public health. Therefore, it is essential to manage this issue properly. Biodegradable food waste is often discarded or sent to landfills. However, this waste can be recycled on-site to produce organic manure, thereby promoting sustainable living, which is crucially important. In educational institutions where daily activities produce biodegradable waste, there should be on-site facilities to treat this waste. This piece of work aims to address this by processing the waste on-site to create useful organic products, promoting sustainable living. This work supports several United Nations Sustainable Development Goals (SDGs), including Quality Education (SDG 4), Affordable and Clean Energy (SDG 7), and Sustainable Cities and Communities (SDG 11).

### *1.2. Key Areas Focused*

In particular, the paper will explore the **Biodegradable Waste Management in which** the waste generation and the management strategy will be taken into account. Also, the concept of composting and vermicomposting will be discussed. It will also look into the **Methodology for Municipal Solid Waste Management**, which will draw the attention on the methodology which can be opted for biodegradable waste management in the educational sector. Along with that, utilization of the biodegradable waste will also be taken into account in this section of work. Finally, **Role of Education and Educational Institutes will explain the** role of institutes in the environmental sustainability.

## 2. Literature Review

Municipal solid waste, often called trash or garbage, encompasses everyday discarded items [1]. Of the generated waste, about 47% is sent to landfills, 31% is recycled, and the remaining 22% is incinerated [2, 3, 4].

Improper disposal of MSW can result in severe water pollution, as it may include biological, chemical, and even radioactive materials. Furthermore, leaching of pathogens and heavy metals can pollute water sources. Composting is an efficient technique for breaking down and processing organic materials such as agricultural waste and sludge [5, 6].

Effective waste management is essential to maintain a sustainable and safe environment within educational institutions. [7, 8]. The growing number of students and residents in these higher education communities has undoubtedly resulted in a corresponding rise in waste production, bringing with it the challenge of effective management [9]. A key objective of sustainable development is to foster green university growth by enhancing the campus's safety, aesthetics, and environmental sustainability. [10-12]. Green university ranking serves as a tool to bolster universities in their endeavors to uphold a universally recognized eco-friendly environment. To gauge a university's progress towards sustainability, online surveys were carried out to provide performance metrics on the institution's initiatives and policies concerning environmental sustainability, encompassing aspects such as ecological frameworks, cost-effectiveness, and equity [13-16]. These days in the educational as well in fashion industry the goal is to advocate for the cradle - to - cradle design methodology, which involves aligning industrial models with natural systems. This approach entails transforming production processes by integrating materials that can regenerate naturally, as opposed to the existing cradle – to- grave system, which follows a linear path from creation to disposal [17].

The aim of education is to disseminate knowledge, educate, and motivate individuals to recognize their roles and responsibilities, as well as the advantages of adopting proper waste management practices. This strategy revolves around fostering awareness and incentivizing action. Its scope should encompass all communities, including schools, colleges, universities, and other educational institutions [18]. The present study also inculcates experiential learning which will be beneficial for the institutes as well as for environment.

## 3. Biodegradable Waste Management

A Waste Management System is an organized method for implementing waste management practices. It includes the effective processes that organizations use to manage and safely prevent, reduce, reuse, and dispose of waste. [19, 20].

In recent times, there has been extensive research on the use of compost for soil remediation, with it being identified as the most appropriate substance for eliminating pollutants. Composting has emerged as a recommended approach to mitigate the impact of landfills effectively. Composting is typically conducted as a form of aerobic biological treatment, resulting in a bio stabilized end product. The level of stability achieved determines its overall impact. However, throughout the composting process, certain environmental issues may arise, such as the formation of harmful or noxious gases and bioaerosols, posing potential occupational health risks or discomfort to nearby individuals. Composting is associated with various health concerns. These issues primarily manifest within or in the vicinity of composting facilities. Additionally, compost may introduce elevated concentrations of heavy metals from the waste into the soil [21]. Composting, a technology with a long history of use, has faced limitations that have hindered its widespread adoption and effectiveness. These drawbacks encompass issues such as detecting pathogens, low nutrient levels, lengthy composting and mineralization periods, and the production of odors. Consequently, chemical fertilizers manufactured through processes like the Haber-Bosch method have gained attention as alternatives to composting over time [22].
Vermicomposting is an eco-friendly method that utilizes earthworms to convert organic materials into organic fertilizer. The key feature of vermicomposting is its complete organic nature. It lacks any harmful chemicals and requires no additional mixing. Vermicomposting yields a product inherently tailored to enhance plant growth in various ways. Its primary advantage lies in the highly accessible nutrients that are readily absorbed by plant roots [23].

## 4. Methodology for Biodegradable Waste Management

This part of the paper focus on the simple methodology which can be adopted for biodegradable waste management and reutilization of the same within the institutes itself. It comprises of the following procedures sequentially:
Step 1: Categorization of the Biodegradable Waste: The Biodegradable Waste Management can be started by categorizing the waste on institutional site, identifying the types and sources of various biodegradable materials.
Step 2: Waste Segregation and Processing: Biodegradable waste will be sorted, gathered, and processed appropriately to produce compost or other organic products through various methods. An educational campus can be selected as the implementation site. Sound waves will also be utilized to aid in the composting process. Food waste will be gathered from the kitchen and placed in a designated pit. Additionally, horticultural waste can be included in the study along with the waste paper processing which involves the processing of the paper waste into new notebooks and utilizing these new notebooks by the students of the same institute.
Step 3: Analysis and Monitoring of waste: Progressing, the study will encompass the analysis of wastewater sourced from different areas of the campus. Through this analysis, it will be determined whether the wastewater can be repurposed for irrigating the campus lawns. Also, Air Quality monitoring can be done in this segment of the study. Figure 4.1 depicts the Waste Hierarchy and Figure 4.2 depicts the lap out of the methodology which can be adopted at institutional site.

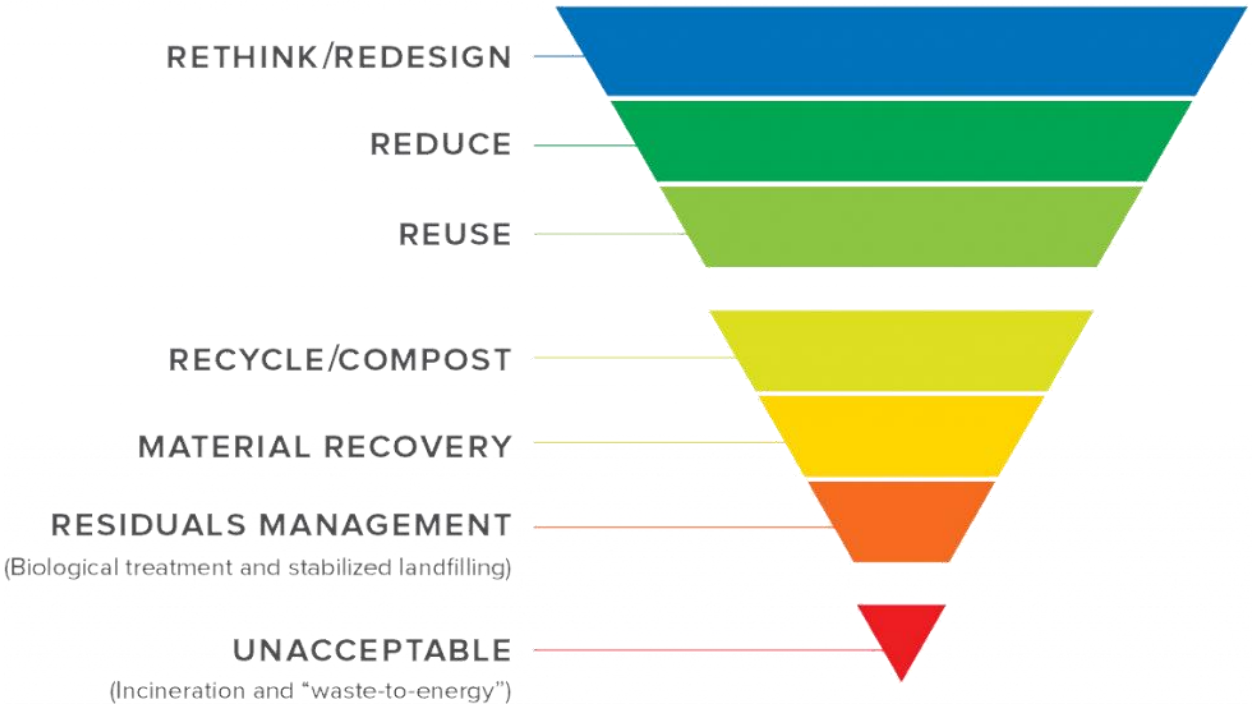


**Figure 4.1** Waste Hierarchy (Source: https://zwia.org/zwh/)

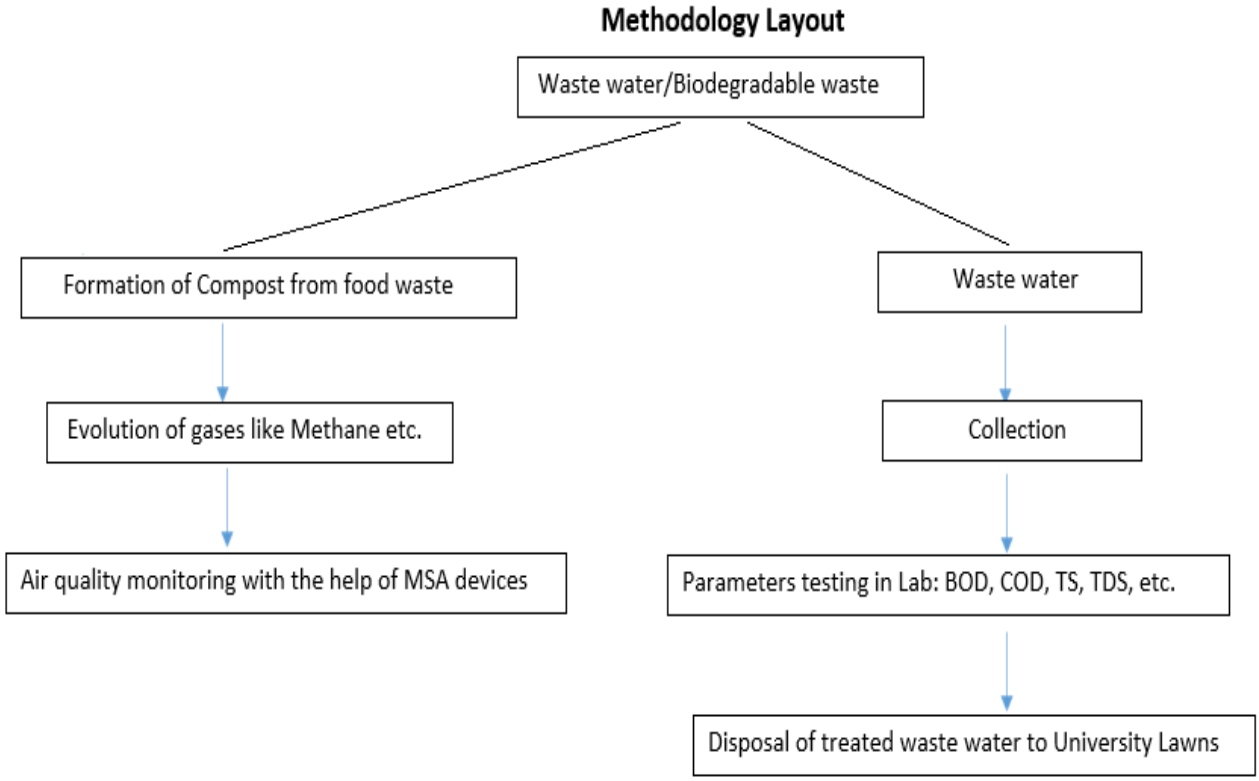


**Figure 4.2:** Flow chart of the Layout for Methodology

## 5. Role of Education and Educational Institutes

Education play vital role in imparting awareness among the people and the society. A successful waste management system cannot be achieved by focusing solely on techno-economic aspects while neglecting environmental education. Citizen participation is crucial for effective waste management, yet awareness is currently very low. Therefore, it is essential to implement consumer education and raise awareness about the importance of proper waste management. Stakeholders need to acknowledge the urgent crisis that waste presents [18].

## 6. Conclusion

The present work give an overview regarding the biodegradable waste management at institutional site. The layout plan for the same is also discussed in detail. Treating the waste on-site is an eco-friendly method for managing waste generated in an institutional setting. This approach prevents unnecessary greenhouse gas emissions from organic waste, produces organic manure following a cradle-to-cradle approach, and serves as a model for the younger generation to promote sustainable development. Although 5Rs is well known to all but this study specially, stress upon implementation of the 3Rs (Reduce, Reuse, Recycle), launch waste management initiatives, and conduct awareness campaigns in the educational sectors. This study also indicates that education plays a crucial role in waste management. Relying solely on technology is

insufficient; instead, a systematic approach and a wide array of educational methods are necessary, particularly in economically developing nations.

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