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Solid waste management and minimization approaches in Faculty of Technology-University of Sri Jayewardenepura - Sri Lanka

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Abstract: As environmental issues become more pressing, waste minimization and utilization have become crucial concerns for society. Waste minimization seeks to decrease the amount of waste generated, while waste utilization involves repurposing waste for practical uses. This article thoroughly examines waste minimization strategies and waste utilization technologies, including recycling, composting, and energy recovery. Additionally, it highlights successful waste minimization and utilization programs through various case studies. The benefits of implementing these practices are numerous and include reduced environmental impact, conservation of natural resources, and economic advantages. Therefore, it is necessary for businesses, universities, governments, and individuals to prioritize waste minimization and utilization in order to sustain the future.

Index Terms: Biogas, Bioplastic, Compost Production, food waste, Waste Minimization

1 INTRODUCTION

The environment and waste are closely related, as waste can have significant impacts on the environment. When waste is not properly managed, it can pollute soil, water, and air and can harm wildlife and ecosystems. This can have long-term effects on the health and well-being of the population, as well as the economy. Waste is a major issue for any country for several reasons [1, 2]:

Environmental Impact: When waste is not managed properly, it can have a significant negative impact on the environment. Improperly disposed of waste can pollute soil, water, and air and can harm wildlife and ecosystems. This can also have long-term effects on the health and well-being of the population.

Health Risks: Improperly managed waste can lead to public health risks. When waste is not collected and disposed of appropriately, it can attract pests, such as rats and flies, which can spread diseases. Open burning of waste can release harmful pollutants into the air, which can cause respiratory illnesses and other health issues.

Resource Depletion: The production and disposal of waste consume valuable resources, such as energy and materials. Improperly disposing of waste can also result in the loss of valuable resources that could be recycled or reused.

Economic Costs: The management of waste can be expensive for countries. The costs associated with the collection, transportation, treatment, and disposal of waste can be significant. Improperly managed waste can also lead to the loss of tourism and other economic opportunities due to the negative impact on the environment.

Legal and Regulatory Compliance: Many countries have laws and regulations in place to manage waste. Non-compliance with these laws and regulations can result in fines and other penalties.

Overall, proper waste management is essential for the health and well-being of the population, the environment, and the economy. Waste generation in the university refers to the production of various types of waste materials, such as food waste, paper, plastic, glass, and hazardous materials by the university community, including students, faculty, and staff [3].
There are various types of waste generated in universities, including [4]:

Food waste: This includes leftovers from dining halls, cafeterias, and other food service areas.
Paper waste: This includes used papers from offices, classrooms, and other administrative areas.
Plastic waste: This includes plastic bottles, bags, and other disposable plastic items used on campus.
Glass waste: This includes glass bottles and other glassware used in laboratories or other areas.
Hazardous waste: This includes chemicals, batteries, and electronic waste generated in laboratories, workshops, and other areas.
Electronic waste: This includes obsolete electronics, such as computers and printers, which are replaced by newer technology.
Construction waste: This includes waste generated during construction and renovation activities on campus, such as bricks, concrete, and other building materials.
Green waste: This includes plant and yard waste from landscaping and gardening activities on campus.

2 Methods and Methodology

Several types of waste are generated daily by the technology faculty at the University of Sri Jayewardenepura. But this study only considered the generation of food waste, paper waste, and plastic waste. Faculty have several places and sections, such as the student canteen, academic complex, laboratory complex, staff canteen, hostel canteen, and administrative complex, that generate waste. Already in the faculty, Food, paper, and plastic waste were excluded into separate bins shown in Fig. 1. Daily generated waste from different places was collected in one place. The weight of the food, paper, and plastic waste was measured and noted at the end of the day. This process was repeated for a week, and finally, the average waste generation per day and total waste generation was calculated.

Fig. 1. Waste bins

3 Results and Discussion

According to the study, the variation of food, paper, and plastic waste generation for a week is shown in Fig. 2., Fig. 3., and Fig. 4. According to Fig.2, Fig. 3, Fig. 4 waste generation is low at the weekend. The reason is that academic activities are only happening on weekdays.

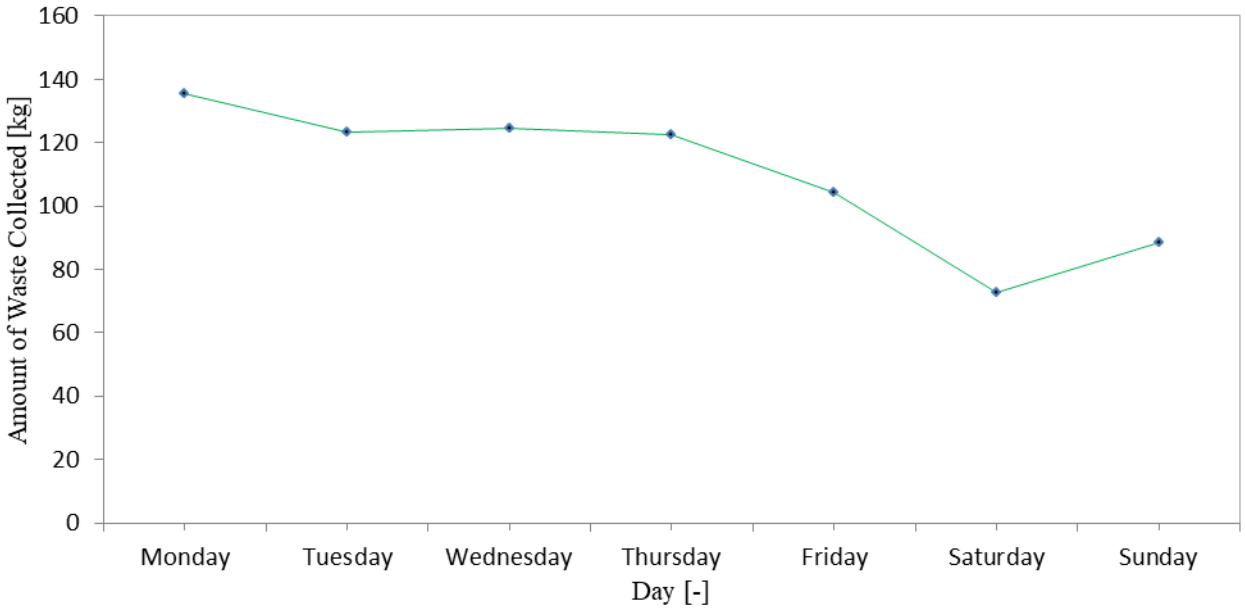

Fig. 2. Variation of the food waste generation for a week of study at the Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

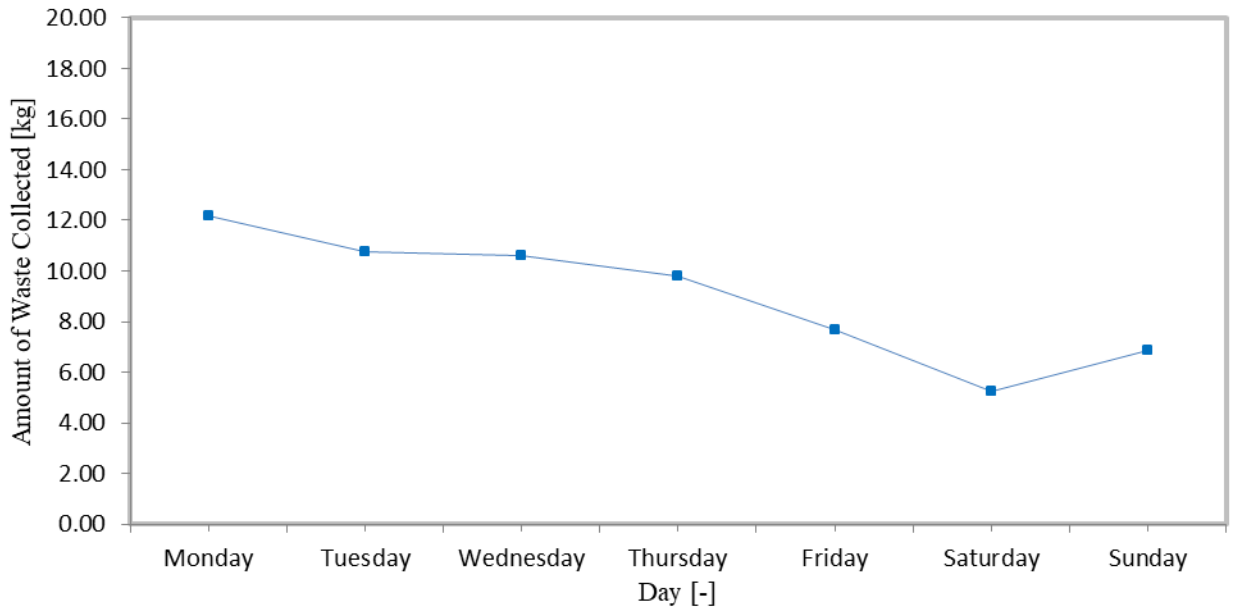

Fig. 3. Variation of paper waste generation for week of study at the Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

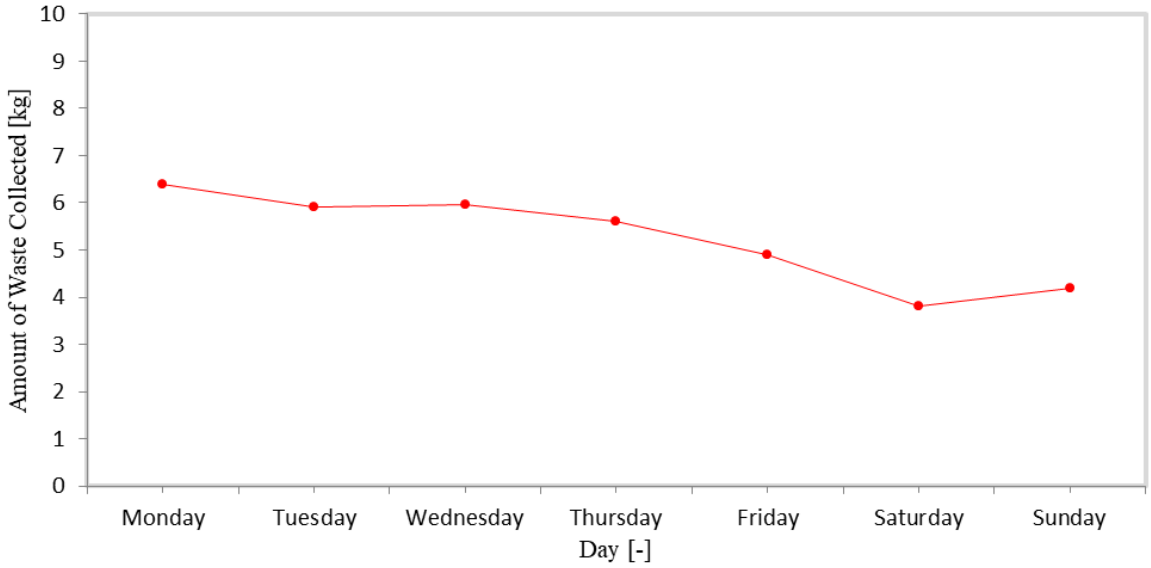

Fig. 4. Variation of plastic and polythene waste generation for week of study at the Faculty of Technology, University of Sri Jayewardenepura, Sri Lanka

Table. 1. Average waste generation per day and total waste generation per month

Waste type	Average waste generation per day (Kg)	Total waste generation for a month (Kg)
Food waste	110.21	3306.15
Paper waste	9.02	270.68
Plastic waste	5.25	157.50

Table 1 shows the average waste generation per day and total waste generation per month for different waste types. It shows that more than 100 kilos of food waste generate daily. But Plastic and polythene waste generation below 10 kg.

3.1 Present Waste Management Method in Faculty.

Within the faculty, there are designated bins for food, paper, and plastic waste, which are stored separately after being filled. The food waste is taken to the animal farm for feed, while the paper and plastic waste are collected by Homagama Municipal Council waste collectors on a weekly basis to be recycled. However, the faculty does not have its own recycling process, so proper management of the separated waste is necessary.

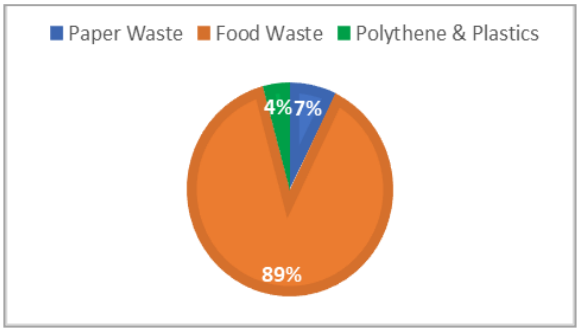

Fig. 5. Waste generation for month.

3.2 Waste Minimization and Utilization.

As shown in a Fig. 5 from waste generation, 89% is food waste, meaning more than 3000 kilograms per month are put away without taking any benefit. These Food waste mainly consists of carbohydrates, proteins, lipids, and traces of inorganic compounds. Carbohydrates, proteins, lipids, and trace amounts of inorganic substances compose most food waste. The composition changes depending on the sort of food waste and its constituents. Carbohydrates abound in rice and vegetables, while proteins and lipids abound in meat and egg waste [5]. These Food waste can be a significant contributor to landfills, where it can generate harmful greenhouse gases. Even if food waste goes to animal farms in the faculty, there is no benefit to the faculty. Several methods can use to reduce food waste, such as Compost production, Biogas production, and Bioplastic production, while getting benefits.

3.2.1 Compost Production

Food waste composting entails breaking down food scraps and other organic materials to produce a nutrient-rich soil amendment. Food waste can contribute significantly to landfills, where it can emit harmful greenhouse gases. Instead, composting food waste enables it to be repurposed as a valuable resource. Composting food waste is comparable to other types of composting. Proper carbon-rich and nitrogen-rich material ratios, such as shredded leaves and food scraps, must be kept. The materials are layered and mixed to promote microbial activity, breaking organic matter into a more stable form. Temperature, moisture levels, and aeration must all be appropriately managed to guarantee proper composting. Composting food waste can be done in various ways, including backyard composting and large-scale commercial composting sites. Some commercial sites use systems that can process food waste faster, reducing odors and attracting fewer pests. Compost from this process can improve soil health, encourage plant development, and reduce the need for synthetic fertilizers[6]. In the faculty, there are vast amounts of food waste generated daily. This food waste can be converted into compost and introduced to the market can make some income. Composting food waste is an ecologically friendly method of waste management that also produces a valuable resource for gardening and agriculture.

3.2.2 Biogas Production

Biogas production is an antibiotic-digesting method that can be used for waste minimization. This produces methane, which is a valuable energy source. When done under controlled conditions, this process can also create a nutrient-rich residue that can be used as fertilizer[7]. Biogas can be used to produce heat, electricity, or vehicle fuel. Different reactor technologies are available depending on the type of substrate used. Food waste generated in the faculty can use for biogas production. The biogas that produces can use as fuel for cocking purposes in canteens or use for laboratory needs. The residue produced in biogas production can be used as a fertilizer for the plants in the faculty.

3.2.3 Bioplastic Production

Using biomass to replace fossil resources in the production of plastics is a generally accepted sustainable development approach. In reality, by doing so, nonrenewable energy consumption and carbon dioxide emissions are significantly reduced. Bioplastic is also biodegradable and compostable. Cellulose, Starch, sugar, and wood are major biomass used to produce bioplastics[8]. Bioplastic has a wide range of uses, including in packaging, textiles, and consumer goods.

The food waste generated in the faculty can be used to produce bioplastics. The first step is to extract the raw materials. Then the raw material is fermented, and the lactic acid is generated from the sugar in the raw materials. Next, the lactic acid is polymerized into polylactic acid (PLA). After that, the PLA is moulded into the desired shape. Thermoforming, injection moulding, or blow molding can be used for that. Then the excess materials must be trimmed, and the edges must be smoothed and finished.

Other than food waste, some amounts of paper and plastic waste are generated in the faculty. Paper waste mainly contains letters, question-and-answer papers, reports, and cardboard boxes. Still, papers are used by the faculty to write letters, assignments, and reports. Using soft copies for these things, paper waste generation can be reduced. And also, by upcycling, paper waste can be minimized while making some money.

Plastic and polythene waste produced in the faculty is already recycled. However, all plastic waste is disposed of in one bin. Some polythene, such as lunch sheets and food packaging, can mix with food waste, and there may be non-recyclable plastic. So, it would be better if there were separate bins for recyclable, non-recyclable, and plastic mixed with other waste.

4 Conclusion

To sum up, waste reduction and repurposing are vital for ensuring a sustainable future. By minimizing waste and identifying ways to use it, we can save resources, diminish pollution, and generate economic prospects. These advantages reach beyond the immediate environmental and economic aspects and affect social and health factors. Therefore, individuals, companies, universities, governments, and communities must take appropriate measures to guarantee that waste is minimized and used effectively and efficiently.

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