Solid Waste Volume and Waste Management for Restaurant Near by Dhanmondi and Determination of Recycle Potential.

Course Code: CE 400

Course Title: Project and Thesis

Submitted By: Titu Chandra Das
ID 172-47-409

Md. Khayrul Islam
ID 172-47-410

Supervised By: Mardia Mumtaz

Lecturer
Department of Civil Engineering
Daffodil International University

This report is submitted to the Department of Civil Engineering, Daffodil International University, and Dhaka in partial fulfillment of the requirements for the Bachelor of Science (B.Sc.) degree in Civil Engineering.

DEPARTMENT OF CIVIL ENGINEERING

FACULTY OF ENGINEERING

DAFFODIL INTERNATIONAL UNIVERSITY

September 2023

DECLARATION

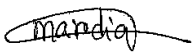
We hereby declare that this project has been done by us under the supervision of **Mardia Mumtaz, Lecturer, Department of Civil Engineering Daffodil International University**. We also declare that neither this project nor any part of this project has been submitted elsewhere for the award of any for any other purpose (except for publication).

Titu Chandra Das
ID 172-47-409

Md. Khayrul Islam
ID 172-47-410

CERTIFICATION OF APPROVAL

This is to certify that the research paper entitled "**Solid Waste Volume and Waste Management for Restaurant Nearby Dhanmondi and Determination of Recycle Potential**" by Titu Chandra Das (ID: 172-47-409), Md. Khayrul Islam (ID_172-47-410) Session Summer 2017, has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science in Civil Engineering on _____ 2023



Mardia Mumtaz

Lecturer
Department of Civil Engineering
Daffodil International University

The thesis titled **"Solid Waste Volume and Waste Management for Restaurant Nearby Dhanmondi and Determination of Recycle Potential"** submitted by Titu Chandra Das (Student ID 172-47-409), Md. Khayrul Islam (Student ID 172-47-410) Session Summer: 2017, has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of science (B.Sc. in civil engineering)

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Padma Associates and Engineers Limited

ACKNOWLEDGMENTS

First and foremost, we would want to thank God for providing us with the strength to persevere in our effort to accomplish this research.

Second, we'd like to thank our supervisor, **Mardia Mumtaz**, for her wisdom, patience, and direction during the study process. Also grateful to the Department Chairman, **Dr. Mohammad Hannan Mahmud Khan**, for his kind assistance and support, as well as to all of our professors at **Daffodil International University**, for all of your expertise and advice.

We would also want to thank our valued family members. Their assistance was required for the effective execution of this exploratory design.

We are eternally thankful to each and every one of them.

ABSTRACT

The neat lines of Dhaka city have been severely degrading because of the abundance of mountains of trash and insufficient waste management. The study's goal is to investigate Bangladesh's current solid waste management situation. The state of waste creation, trash management, and barriers to effective waste management are highlighted in this article. Finally, it makes some recommendations for good waste management practices. The researcher selected a restaurant in the Dhanmondi neighborhood for this investigation. This study shows that the two main sources of solid waste in Dhaka are restaurants and solid trash. In order to find out the actual amount of Solid Waste, the researcher took different Restaurants like Star-kabab, Kashbon, the café Rio, Sultan’s Dine, Tehari Gohar, KFC-Dhanmondi, Shampan Mughal Kabab House, Pinewood-Café & Restaurant, Pizza Hut, Chillox-Dhanmondi, XinXian Restaurant, Buffet-Stories Restaurant. This research paper recommends some ways and eco-friendly systems for Solid Waste Management.

সারাংশ

ময়লা-আবর্জনার স্তূপ এবং অনুপযুক্ত বর্জ্য ব্যবস্থাপনার কারণে ঢাকা মহানগরীর পরিচ্ছন্ন লাইনগুলো মারাত্মক অবনতির মুখে পড়েছে। এই গবেষণার লক্ষ্য বাংলাদেশে কঠিন বর্জ্য ব্যবস্থাপনার বর্তমান পরিস্থিতি অন্বেষণ করা। এই গবেষণাপত্রে বর্জ্য উৎপাদন ও এর ব্যবস্থাপনার অবস্থা এবং সঠিক বর্জ্য ব্যবস্থাপনার প্রতিবন্ধকতা তুলে ধরা হয়েছে। অবশেষে, এটি সঠিক বর্জ্য ব্যবস্থাপনার পথে কিছু নির্দেশিকা প্রস্তাব করে। এই গবেষণায় গবেষক ধানমন্ডি এলাকার একটি রেস্টুরেন্ট বেছে নেন। এই সমীক্ষাটি প্রকাশ করে যে ঢাকায় কঠিন বর্জ্য এবং খাদ্য বর্জ্য হল কঠিন বর্জ্যের মূল খাত। কঠিন বর্জ্যের প্রকৃত পরিমাণ খুঁজে বের করার জন্য, গবেষক বিভিন্ন রেস্তোরাঁ যেমন স্টার-কাবাব, কাশবন, ক্যাফে রিও, সুলতানস ডাইন, তেহারি গোহর, কেএফসি-ধানমন্ডি, শম্পান মুঘল কাবাব হাউস, পাইনউড-ক্যাফে নিয়ে যান। রেস্টুরেন্ট, পিজ্জা হাট, চিলোক্স-ধানমন্ডি, XinXian রেস্টুরেন্ট, বুফে-স্টোরি রেস্টুরেন্ট। এই গবেষণাপত্রটি কঠিন বর্জ্য ব্যবস্থাপনার জন্য কিছু উপায় এবং পরিবেশ বান্ধব ব্যবস্থার সুপারিশ করে ।

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Chapter 1

Introduction

Solid waste management is a critical issue in urban areas, particularly in densely populated regions like Dhanmondi, Dhaka. This paper aims to provide an overview of the challenges and opportunities in managing solid waste generated by restaurants in the area of Dhanmondi. By examining the existing literature, regulations, and practices, this study seeks to identify gaps in waste management and propose recommendations for sustainable solutions.

Garbage is an inevitable byproduct of mortal conditioning, and economic growth, urbanization, and the advancement of living standards in metropolises have increased the quantity and complexity of garbage created. Rapid population increase and industrialization deteriorate public spaces and put considerable strain on the environment, undermining development that is both indifferent to the environment and sustainable. Most metropolises in the developing world have declining terrain due to inefficient solid waste management and disposal. External garbage containers in developing nations are unable to manage increasing waste loads, which leaves uncollected rubbish on the streets and in other public areas. The development of a sustainable waste management system is necessary since it calls for institutional, financial, economic, and social sustainability.

1.1 Background of the Study

In metropolitan areas, especially in highly populated districts like Dhanmondi, Dhaka, solid waste management is a crucial problem. An overview of the potential and problems associated with managing the solid waste produced by restaurants in the Dhanmondi area is what this article seeks to present. This research aims to identify waste management gaps and make recommendations for sustainable solutions by reviewing the body of literature, laws, and practices already in use.

The management of solid waste is a significant concern in municipal settings all throughout the world, but especially in the rapidly expanding metropolises of the developing world (Foo, 1997). A tremendous amount of solid garbage has been produced as a result of rapid population increase and rising per capita income, posing major threats to environmental quality and human health (Snigdha, 2003). Therefore, it is believed that having access to sanitary facilities and safe, clean water is essential for human health and welfare. The inevitable issue of garbage management follows cities as they continue to industrialize. The forms and sorts of solid waste are now significantly varied, and their operation is considerably more complicated as a result of technological and commercial improvement. This fact is supported by the complexity of complaint epidemics, current cholera cases, and instances of other diarrheal diseases. Similar to developed countries, solid waste management (SWM) in emerging nations is made more difficult by shifting economic patterns and growing urbanization. Therefore, solid waste is not only becoming more diverse in content but is also changing in amount recently, going from several kilos to substantial proportions (Bartone, 1993). Despite the size of the issue, our nation has coordinated a tiny fraction of the exploratory effort required. This investigation paper will provide a thorough grasp of the relevance of solid waste operations in this scenario as well as potential solutions to this enormous

challenge. This exploratory article is intended to support and suggest more research into solid waste operations in other regions.

In conclusion, there are serious issues with the management of solid trash produced by restaurants close to Dhanmondi that need to be addressed right now. Stakeholders may create sustainable waste management solutions that preserve the environment, public health, and community well-being by addressing the root causes of poor infrastructure, ignorance, and lax enforcement. To achieve long-lasting changes in waste management methods, cooperation between corporations, civil society organizations, and government agencies is important.

1.2 Justification of the Study

Dhanmondi, a highly populated region, generates a lot of solid garbage from its many eateries, which poses serious environmental problems. Restaurant garbage that is not properly disposed of pollutes the air, water, and soil, which has a negative impact on the local ecology and public health. In this context, it is important to investigate solid waste management strategies in order to promote sustainability and mitigate environmental deterioration.

Bangladesh's capital city, Dhaka, is rapidly growing, becoming a super megacity with a huge population increase at a pace of about 6% each year. A severe operation problem is caused by the increased production of solid waste. The main obstacles to managing solid waste in Dhaka's quickly expanding megalopolis are the lack of financial resources, the lack of a willing workforce, the unsatisfactory technology, and the lack of community awareness. As the megacity is often supported for solid waste services from an external responsibility system for trash collection and disposal, healthier living, a cleaner megacity, and better terrain are the obvious requests for megacity residents.

It has been challenging for the megacity to guarantee the efficient and appropriate supply of solid waste collection and disposal services to the whole population due to limited financial resources and organizational capabilities.

Businesses and the local government may incur large financial losses as a result of ineffective waste management techniques. Financial responsibilities include clearing up trash regions, treating polluted water, and paying medical bills for diseases linked to garbage. The goal of this study is to lower expenses and improve Dhanmondi's overall economic sustainability through waste management process optimization.

Because of the consequences for the environment, public health, urban aesthetics, resource conservation, policy, and economy, it is justified to look at the volume of solid waste generated and the waste management strategies used by restaurants close to Dhanmondi. Through tackling these problems, this research can aid in the creation of environmentally and socially beneficial sustainable waste management strategies.

1.3 Objectives of the Study

The study's major goal is to comprehend the current solid waste management system and create compact solid waste management that is both environmentally friendly and protective of human health. Reducing and eliminating harmful effects of waste materials on human health and the environment is the main objective of solid waste management, which supports economic growth and a higher standard of living. In order to keep expenses down and avoid waste accumulation, this should be completed as effectively as possible. The following goals have been specified in this respect.

1. To evaluate and calculate the volume of solid trash produced by restaurants close to Dhanmondi.

2. To investigate and assess the present solid waste management system.

3. To learn more about the challenges the restaurant's waste management system has encountered at various phases.

4. To evaluate the effects of ultimate solid waste disposal, paying particular attention to the amount of land needed, the production of landfill gas, and the influence of landfill placement on transportation costs. Additionally, provides some effective techniques for solid waste management collection and systems.

1.4 Scope of the study

The study focuses on solid waste management procedures used by Dhanmondi's restaurant industry. In order to fully reflect the wide range of waste generation patterns and management issues, it takes into account several sorts of restaurants, including fast-food chains, cafés, fine dining places, and street food sellers.

The study looks at the environmental operating system in relation to restaurant solid waste management. It looks at the methods, techniques, and systems used by restaurants to manage, store, gather, transport, and get rid of solid waste, with a focus on efficiency and sustainability for the environment.

The study looks at how solid waste management procedures at restaurants close to Dhanmondi use the three (3R): reduce, reuse, and recycle. In order to reduce environmental effect and encourage resource conservation, it evaluates how much these concepts are used in waste reduction methods, material reuse, and recycling programs.

In order to build sustainability built on the "reduce," "reuse," and "recycle" (3R) principles, solid waste operating procedures have been changed into a more useful and effective solution.

Summary

Urban regions like Dhanmondi, Dhaka, where garbage creation has expanded due to fast population expansion and economic development, provide considerable issues for solid waste management. In order to find weaknesses in waste management procedures and suggest long-term

fixes, this study gives a general overview of the difficulties and opportunities in handling solid waste produced by Dhanmondi restaurants.

The study focuses on the restaurant industry, which generates a substantial amount of solid trash in Dhanmondi. Through a review of current literature, rules, and practices, the study aims to comprehend the intricacies involved in waste management within this particular environment. It draws attention to the necessity of an institutional, financial, economic, and socially conscious sustainable waste management system.

This research examines the financial effects of inadequate waste management. The costs of treating water, cleaning up trash, and treating illnesses linked to garbage result in large financial losses for businesses and the local government. Therefore, improving Dhanmondi's economic sustainability and cutting costs need optimizing waste management procedures.

The report emphasizes how urgently Dhanmondi's solid waste management problems need to be resolved. Through a shared awareness of the obstacles and possibilities associated with waste management, stakeholders may collaborate to create long-term solutions that safeguard public health, maintain the environment, and improve community wellbeing. Dhanmondi may attain a more sustainable, healthier, and greener future by working together and embracing innovation.

Chapter 2

Literature Review

Introduction

Since waste creation is an unavoidable component of life, it is necessary to watch the process from generation to disposal in order to identify the areas that need the most attention and address them in order to greatly reduce pollution and maintain excellent health. The control, generation, storage, collection, transfer and transport, processing, and disposal of solid waste are all done in accordance with best practices for public health, financial, administrative, legal, and environmental issues.

Solid waste management is the procedure of gathering, processing, and disposing of solid material since it is no longer needed, according to T. Srinivas (2005). Additionally, he stated that solid waste management is a procedure that "incorporates systematic, economical, and hygienic matter." Solids are materials that have been passed up for "further use," according to Moudud Hasan (2016). Dhaka was listed among the most polluting cities by the WHO in 2014. Bangladesh is identified as the "most polluted" nation by World Air Quality (2018). Dhaka's urbanization rate was 28.4%, according to the Bangladesh Bureau of Statistics (BBS) in 2001. Dhaka's population is anticipated to be 20,283,552 in 2019.

This involves the rapid increase of solid waste. Because it represents a turning point in the preservation of environmental sustainability, improper solid waste management has emerged as a problem for the government. Solid waste must be managed in a way that minimizes harm to both the environment and human health. Solid waste requires a "proper channel" of management, which involves "storage, collection, and proper disposal," according to Yasmin and I. Rahman (2017). Linzer and Lange (2013) and Alam and Sohel (2008) have shed light on the significance of the informal market as a crucial component of solid waste management in the framework of a solid waste management system. Choudhury (2007) examines the disparities in solid waste management between slum and non-slum regions in Dhaka.

2.1 Main Types of Solid Waste

Some of the major types of solid waste management are as follows:

A. Urban Solid Waste,
B. Hazardous Wastes,
C. Industrial Wastes,
D. Agricultural Wastes,
E. Bio-medical Wastes,
F. Waste Minimization.

The combined impacts of population growth and altering ultramodern living standards have resulted in an increase in the creation of a vast quantity of various sorts of garbage. Depending on its source, solid waste can be divided into several forms (Puja Mondal et.al, 2019)

2.1.1 Urban Solid Waste

The phrase "urban solid waste" refers to the majority of non-hazardous solid waste generated by a city, town, or village that requires routine collection and transportation to a processing or disposal location. Private dwellings, business enterprises and institutions, as well as industrial facilities, are sources of urban solid waste. However, industrial waste, building and demolition debris, sewage sludge, mining waste, and agricultural waste are not included in urban solid waste. Trash or rubbish are other words for urban solid waste. In general, the terms residential waste and urban solid waste are used interchangeably. Urban solid waste is made up of a wide range of substances. It can include food waste (such as vegetable and meat waste, leftover food waste, eggshell waste, etc.), which is categorized as wet scrap, as well as dry scrap, such as paper, plastic, tetra pack, plastic barrels, reviews, glass bottles, cardboard boxes, aluminum foil, meta details, wood pieces, etc. The table below shows the various residential waste kinds that are produced and how long it takes for them to degrade. (Puja Mondal et.al, 2019)

The type of litter we generate and the approximate time it takes to degenerate	
Type of litter	Approximate time it takes to degenerate
Organic waste such as vegetable and fruit peels, leftover foodstuff, etc.	A week or two
Paper	10-30 days
Cotton cloth	2-5 months
Wood	10-15 years
Woolen items	1 years
Tin, aluminum, and other metal items such as cans	100-500 years
Plastic bags	One million years
Glass bottles	Undetermined

Table 1: Types of waste approximate time takes to degenerate.

Composting, land-stuffing, incineration of waste, and waste-to-energy are the four components of urban solid waste management. Generating, collecting, classifying and separating, transferring, and disposing or applying are the basic methods.

1. The development of waste includes conditioning in which possessions are deemed to be of no longer use and are either thrown out or gathered for disposal.

2. The functional component of collection comprises not only acquiring recyclable and solid waste items, but also transporting those items from the collection site to the location where the collection vehicle is abandoned. This location might be a facility for processing materials, a transfer station, or a dumping site for waste.

3. Conditioning is a part of waste processing and separation, which occurs before the garbage is put in storeroom holders for collection. Moving loaded holders to the point of collection is included in the definition of handling. In order to manage and store solid waste at the source, it is crucial to

separate various waste elements. Curbside collection, drop-off, and buy-back centers are some of the methods and facilities that are presently utilized to recover discarded appliances that have been separated at the source.

4. There are two primary methods for transfer and transport. The first step involves moving the garbage from a smaller collecting truck to a bigger transport equipment. To a processing or disposal location, the waste is also transported, usually across considerable distances.

5. Whether they are domestic wastes that are collected and transported directly to a disposal site, leftovers from accouterments recovery facilities (MRFs), residue from the combustion of solid waste, compost, or other materials from diverse solid waste processing facilities, all solid wastes must ultimately be disposed of by land stuffing or land spreading.

2.1.2 Hazardous Wastes

It is necessary to conduct interdisciplinary research to clarify the origins, characteristics, and effects of hazardous wastes as well as to develop creative solutions for waste minimization, pollution prevention, and safe disposal practices, with a focus on emerging contaminants. Hazardous wastes are a broad category of materials that have the potential to cause significant harm to human health and the environment. They present complex challenges that call for multifaceted approaches for effective management, including strict regulatory frameworks, cutting-edge technologies, and comprehensive risk assessment methodologies. (Puja Mondal et.al, 2019)

Similar hazardous waste is continually being produced by humans. The output is determined by the influence of several forms of mortal conditioning, such as artificial, agricultural, and domestic. The problem is currently becoming more serious and affects not just local communities but also the entire planet. (Puja Mondal et.al, 2019)

❖ Classification of Hazardous Wastes

In order to facilitate efficient management, regulation, and disposal methods to minimize related dangers and consequences, hazardous wastes are classified according to their qualities, features, and possible concerns to human health and the environment. According to their physical, chemical, biological, and toxicological characteristics as well as their potential for harm, hazardous wastes are normally divided into a number of categories. Regulatory frameworks and international standards may determine different classifications for these categories, however they often consist of:

A. Toxic wastes

Waste that is toxic only in very tiny or trace amounts is considered poisonous. On mortals or monsters, certain impacts might be severe or instantaneous. Children of exposed humans and animals have natural alterations that are mutagenic or carcinogenic. Exemplifications Fungicides and powerful essence. (Jerry A. Nathanson et. al. 2020)

B. Reactive wastes

The term "reactive wastes" refers to wastes that frequently react violently with air or water, are unstable to shock or heat, cause noxious feasts, or explode during regular operation. Exemplifications Nitroglycerin as well as gunpowder. (Jerry A. Nathanson et. al. 2020)

C. Ignitable waste

These have the capability of robotic combustion during storeroom transfer or disposal and burn at relatively low temperatures (60 °C). Exemplifications alcohol, makeup removers, and gas. (Jerry A. Nathanson et. al. 2020)

D. Corrosive wastes

Corrosive wastes are an important class of hazardous materials that are distinguished by their capacity to deteriorate or erode surfaces upon contact, hence causing harm to biological tissues, materials, and the environment. These materials are usually very acidic or alkaline, and if handled, stored, or disposed of incorrectly, they can pose serious threats to ecosystems, infrastructure, and human health. Strong acids strong bases and specific chemical salts are typical examples of corrosive wastes. (Jerry A. Nathanson et. al. 2020)

E. Infectious wastes

A wide range of materials contaminated with potentially harmful microorganisms, such as bacteria, viruses, parasites, or fungi, are referred to as infectious wastes, also known as biomedical or biohazardous wastes. If not managed, treated, and disposed of properly, these materials pose serious risks to human health and the environment. These wastes come from places where infectious pathogens are handled, identified, or treated, such as hospitals, labs, and veterinary clinics.

In order to identify, characterize, and manage hazardous wastes in a way that protects human health, the environment, and the advancement of sustainable waste management techniques, categorization is an essential step in the process. Regulatory bodies, businesses, and communities can create focused interventions and policies to reduce risks, lessen environmental contamination, and guarantee the safe and responsible handling, treatment, and disposal of hazardous wastes by classifying wastes according to their characteristics, sources, and risks. (Jerry A. Nathanson et. al. 2020)

2.1.3 Industrial Wastes

Without question, "industrial waste" is an overarching term that includes any materials or substances that, following the end of an industrial manufacturing process, are no longer needed or valuable. The composition, volume, and properties of these materials might differ significantly based on the particular industry and production processes involved. Byproducts that are produced during manufacturing, processing, packing, or other industrial processes can be classified as industrial waste, whether they are solid, liquid, or gaseous. (Puja Mondal et.al, 2019)

Industrial waste can include:

Solid waste: Such as scrap metal, packaging materials, construction debris, and manufacturing residues.

Liquid waste: Including wastewater, chemical effluents, and contaminated runoff from industrial activities.

Gaseous waste: Such as emissions from combustion processes, industrial stacks, or chemical reactions.

❖ Source of Industrial Wastes

Breweries, sugar factories, paper and pulp diligence, toxin and venom diligence, metallurgical chemical and pharmaceutical units, and food processing sectors are some of the main bones that release hazardous waste. Acids, discarded tools, and other materials are used in processing.

❖ Effects of Industrial Wastes

The most frequent finding is that the health of those who live close to dumping sites is significantly impacted. As well as cancer, inheritable abnormalities, skin disorders, and illnesses of the neurological system, exposure can also cause these things. As a result of the inorganic and organic adulterants that are present in the liquid backwaters that companies discharge into water bodies, fish are killed, silt is formed, groundwater is contaminated, and unpleasant aromas are released.

❖ Control of Industrial Wastes

Technologies for reducing waste must be created. There has to be widespread source reduction, recycling, and equipment recycling. General garbage shouldn't be mixed with hazardous waste. To minimize the quantity and toxicity of accessories that are thrown down, source reduction entails changing the design, production, or usage of items and accouterments.

2.1.4 Agricultural Wastes

Agricultural waste is made up of plant byproducts. Arable land and horticulture are the sources of these waste streams. All components of crops that are not utilized for human or animal nourishment are considered agricultural waste. Stems, branches (after pruning), and leaves make up the majority of crop leftovers. According to estimates, agricultural waste makes up on average 80% of the plant in these crops. (Puja Mondal et.al, 2019)

The most common types of wastes from agriculture include:

1: Crop residues are the leftover stalks, leaves, husks, and stems from the harvest of crops like soybeans, corn, wheat, and rice.

2: Animal manure is the waste that comes from animals including sheep, pigs, chickens, and cattle. It contains nutrients, organic matter, and bacteria.

3: food processing byproducts these are made up of fruit and vegetable pulp, seeds, peels, and shells that are left over after milling, canning, and juicing.

4: Runoff from the silage the liquid waste that remains after the fermentation of fodder crops, such as maize, grass and Lucerne, for use as animal feed.

5: Agricultural chemicals include any leftover insecticides, herbicides, fertilizers, and other agrochemicals that could degrade or expire.

❖ Sources of Agricultural Wastes

Crop and animal waste are both included in the agricultural waste stream. Since the majority of it is utilized, this waste doesn't constitute a significant concern in developing nations. Straw is utilized as feed, while soil is used for cultivation. There is waste from some agricultural practices. The manufacture of tobacco, tea, and milled rice. Rice cocoon degasses, pulverized nut shells, sludge cobs, cereal straws, etc. are examples of agricultural wastes.

❖ Effects of Agricultural Wastes

The effects of agricultural wastes on the environment, public health, and ecosystems are significant and multifaceted, with both positive and negative implications depending on how these wastes are managed and utilized. Understanding these effects is crucial for developing sustainable agricultural practices and waste management strategies. If not properly sloped, it takes up a lot of ground.

2.1.5 Bio-Medical Wastes

Bio-medical waste is any waste that is produced during the conclusion, treatment, or immunization of humans or other living things, or in research activities related to those processes, or in the production or testing of natural. (Puja Mondal et.al, 2019)

❖ Segregation, Packaging, Transportation and Storage

Effective waste management techniques include segregation, packing, transportation, and storage, especially for hazardous and industrial wastes. In order to ensure the safe processing, containment, and disposal of waste materials while minimizing threats to the environment and public health, each component is essential. Let's examine each of these components in further depth:

Segregation: Segregation is the process of systematically dividing various waste products according to their attributes, dangers, and qualities. This procedure assures regulatory compliance, facilitates recycling and treatment, and helps prevent contamination. For example, to reduce hazards during handling and disposal and to avoid cross-contamination, hazardous and non-hazardous wastes should be kept apart. Furthermore, segregation makes it possible to identify particular waste streams that call for particular forms of treatment or disposal. (Article healthcare risk waste 3rd Edition, April 2004)

Packaging: Waste products must be safely contained during handling, transit, and storage, which requires proper packaging. Depending on the kind of trash, its physical and chemical characteristics, and legal requirements, different packaging requirements may apply. In order to

avoid spills, leaks, or exposure to dangerous materials, packaging for hazardous wastes needs to fulfil certain requirements. Using leak-proof containers, robust packing materials, and suitable labelling to identify the waste's contents and risks are a few examples of how to do this. (Article healthcare risk waste 3rd Edition, April 2004)

Transportation: Choosing suitable trucks, containers, and handling techniques is essential for safe trash transportation since they reduce potential hazards while in route. Regulations controlling emergency response procedures, route planning, driver education, and vehicle design are strictly enforced while transporting hazardous materials. When carrying hazardous or large-volume wastes, specialized carriers could be needed. Extra safety measures would also be implemented to avoid mishaps, spills, or releases that would threaten the environment or public health. (Article healthcare risk waste 3rd Edition, April 2004)

Storage: To temporarily keep waste materials until treatment, recycling, or disposal, proper storage facilities are necessary. Storage spaces need to be built and kept up to date to avoid spills, leaks, and unwanted access. They also need to have sufficient containment methods in place to handle any possible releases. To reduce dangers to employees, neighboring communities, and the environment, hazardous wastes should be kept in places designated for that purpose and outfitted with emergency controls, spill response equipment, and secondary containment systems.

Entire waste management systems depend on efficient waste material sorting, packaging, transportation, and storage. Businesses, industries, and regulating bodies may reduce environmental pollution, safeguard public health, and guarantee legal and regulatory compliance by putting strong policies and protections in place at every stage of the waste management process. (Article healthcare risk waste 3rd Edition, April 2004)

For example: 1. Bio-medical waste must never be combined with other types of trash.

2. At the moment of creation, bio-medical waste must be divided into holder bags before being stored, transported, treated, and disposed of. The holders must have the proper labels.

3. Undressed biological waste may only be carried in such vehicles that may be approved for the purpose by the competent authority as defined by the government, notwithstanding any other provisions of the Motor Vehicles Act, 1988, or rules there under.

❖ Categories of Bio-medical Wastes

Option	Treatment and Disposal	Waste Category
Category no. 1	incineration/deep burial	Human anatomical waste (body parts, organs, and tissues)

Category no. 2	incineration/deep burial	Wildlife Wastes animal organs and napkins. Body zone (cadavers, bleeding corridor, liquid, blood, and research animals employed in experiments, as well as trash produced by veterinary clinics and their facilities, hospital discharge, and animal kennels)
Category no. 3	Local autoclaving/microwaving/ incineration	Waste from microbiology and biotechnology includes waste from laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, infectious agents from research and industrial laboratories, waste from the production of biological, toxins, dishes, and devices used for transferring cultures, among other things.
Category no. 4	Disinfection (chemical treatment /autoclaving/ microwaving and mutilation shredding	Waste Sharps (glass, scalpel blades, syringes, needles, etc.) that might cut or pierce someone. Both used and unused sharps are included here.)
Category no. 5	Incineration/destruction and drug disposal in secured landfills	abandoned medications and cytotoxic substances (waste made up of abandoned, tainted, and obsolete medications)
Category no. 6	Incineration, autoclaving/microwaving	Solid Waste (the items polluted with blood and bodily fluids, such as blood-infected cotton, dressings, dirty plaster casts, line beddings, and other items)
Category no. 7	Disinfection by chemical treatment autoclaving/ microwaving and mutilation shredding	Solid waste (waste produced by consumable items other than waste, such as tubing, catheters, intravenous sets, etc.)
Category no. 8	Disinfection by chemical treatment and discharge into the drain	Waste created by washing, cleaning, maintaining the home, disinfecting, and conditioning liquids
Category no. 9	Disposal in municipal landfill	Ash from incinerating biomedical waste (incineration ash)

Table 2: Categories of Bio-medical Wastes

2.1.6 Waste Minimization

Waste reduction, which may be summed up as "reduce, reuse, recycle," is a key tactic in contemporary waste management techniques meant to lessen the negative effects on the environment, save resources, and promote sustainable growth. The three pillars of reduce, reuse, and recycle serve as the foundation for waste reduction initiatives in a variety of industries and situations. They highlight the significance of reducing waste output, optimizing resource efficiency, and advancing the ideas of the circular economy. We explore each of these ideas and how important they are to waste management measures in this section:

A. Reduce the amount of junk and rubbish you throw, as well as their pollutants.

B. Try to fix damaged effects and reuse holders.

C. Recycle things wherever you can, which includes purchasing recycled goods like paper books, paper bags, etc. Integrated waste management (IWM) methods are used in these procedures. They can cut the amount of garbage produced by about 50%.

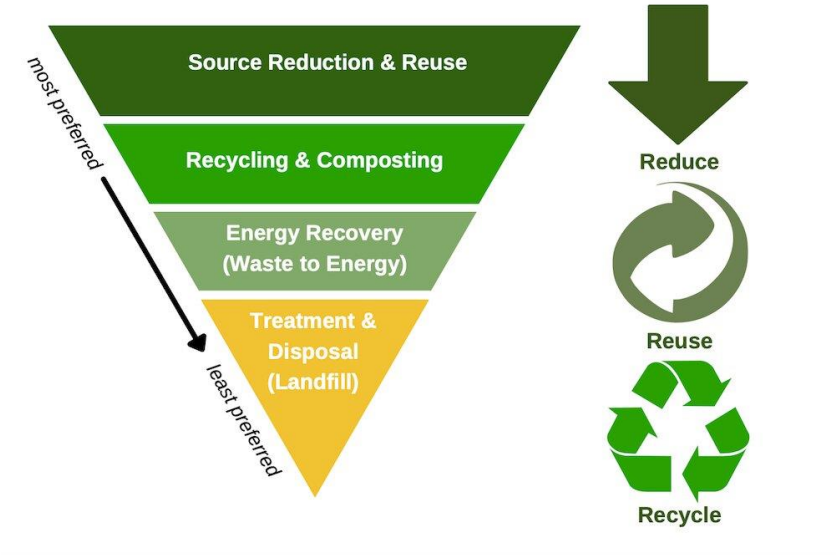


Figure 1: Types of waste minimization

❖ Reduce

A successful method of lowering waste creation is waste avoidance, often known as "source reduction," which refers to consuming and disposing less. Composting in the local area, copying documents on both sides, buying durable, long-lasting environmentally friendly goods, packaging free of toxics, redesigning goods to use fewer raw materials, and reducing the amount of packaging used for shipping are common practices that have produced significant environmental advantages. Source reduction reduces the requirement for adulterants, reduces waste for new tips and combustors, and eliminates the emigration of several hothouse feasts. It also saves energy and funds. It significantly contributes to the preservation of the environment since it reduces trash production. (earthhow.com/The 3 R's et.al, Nov3 2020)

❖ Reuse

Reuse is a procedure that entails fixing, donating, or otherwise dealing with specifics in order to reuse them. Because an item doesn't need to be reused more than once, recycling is a choice made by the consumer. Utilizing sturdy crockery, picking refillable pens and pencils, recycling bottles and boxes, using cloth towels or napkins, and utilizing cloth towels or sheets are all recommended. (earthhow.com/The 3 R's et.al, Nov3 2020)

❖ Recycling

There have been many million tons of materials saved from disposal through recycling and composting. Battery reclamation rates are 93, paper and paperboard reclamation rates are 48, and yard plastering reclamation rates are 56. Through drop-off points, buy-back schemes, and deposit systems, these accessories as well as others may be recovered. Recycling reduces the need for new tips and combustors, saves energy, stocks up on valuable raw materials for industry, fosters the development of greener technologies, and stimulates the reduction of greenhouse gas emissions that have a negative impact on the climate. It also reduces the need for water-tainting substances. For instance, in 1996, the United States prevented the emission of 33 million tons of carbon dioxide into the atmosphere by recycling solid waste. This is equivalent to the amount generated yearly by 25 million buses. The benefits of recycling include preserving resources for future generations, preventing greenhouse gas and adulterant emigrations, saving energy, stockpiling priceless raw materials, assisting with diligence, promoting the development of greener technologies, and reducing the need for new landfills and incinerators.

"Reduce, reuse, recycle" is a core tenet of waste minimization techniques, providing workable solutions for reducing environmental impact, preserving resources, and advancing sustainable development. Stakeholders may strive towards a waste management system that is more resilient, efficient, and eco-friendly for both the current and future generations by implementing these principles into waste management practices across many industries and situations. (earthhow.com/The 3 R's et.al, Nov3 2020)

2.2 Various Sources of Solid Waste

Tons of solid garbage are dumped daily at eye-catching landfill locations. This garbage is generated by residences, businesses, restaurants, laboriousness, and other vibrant agrarian-related conditions. If garbage isn't properly kept and handled, these dump locations emit an unpleasant odor. It might contaminate the surrounding air, endanger wildlife and humans, and have a negative impact on our climate. Solid waste comes from the following principal sources:

2.2.1 Residential

The majority of the solid garbage on our planet comes from residences and homes where people live. The garbage from these locations consists of food scraps, plastics, paper, glass, leather, cardboard, raw materials, yard debris, ashes, and unique wastes such as major household items like electronics, tires, batteries, old mattresses, and discarded oil paintings.

Figure 2: Stuff collecting residential waste

The majority of residences have scrap bins where residents may dispose of their solid garbage before having the caddy removed for processing by a scrap collection business or individual. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

2.2.2 Industrial

One of the main sources of solid waste is recognized to be industrial. In addition to fabrication, canning, and power and chemical businesses, they also contain light and heavy manufacturing enterprises. These industries generate solid waste in the form of ashes, special wastes, medical wastes, food wastes, packaging wastes, obliteration aids, and other harmful wastes. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

Figure 3: Stuff collecting Industrial waste

2.2.3 Commercial

Another source of solid waste at present are commercial installations and buildings. The hospices, requests, cafes, shops, and office buildings in this scenario are considered marketable structures and installations.

Figure 4: Stuff collecting commercial waste

Among the solid wastes produced in these locations are plastics, food scraps, essence, paper, glass, wood, cardboard utensils, special wastes, and other hazardous pollutants. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

2.2.4 Institutional

Institutional facilities including seminaries, sodomies, prisons, military barracks, and other government facilities also generate solid garbage. Glass, rubber, plastics, food waste, wood, paper, metals, cardboard utensils, electronics, and colored toxic wastes are a few of the usual solid wastes collected from these locations. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

Figure 5: Storages institutional waste at warehouse.

2.2.5 Construction and Demolition Areas

The issue of solid waste is exacerbated by construction and demolition sites. Road form locations, building addition spots, building obliteration spots, new construction spots for buildings and roads, and construction spots are all included.

Figure 6: Construction and demolition areas waste

Sword accouterments, concrete, wood, plastic, rubber, bobby wires, dirt, and glass are a few of the solid wastes generated in these locations. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

2.2.6 Municipal Services

The extreme solid waste problem in the majority of the world's countries is also greatly exacerbated by metropolitan areas. Road cleaning, premises and strand wastes, wastewater treatment shop wastes, landscaping wastes, and trash from leisure places, including sludge, are a few examples of the solid waste generated by outside services. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

Figure 7: Stuff collecting municipal waste

2.2.7 Treatment Plants and Sites

Solid waste is produced by both heavy and light manufacturing facilities. Refineries, power plants, recycling facilities, industries that create minerals, and chemical plants are some of them.

Figure 8: Treatment Plants and Sites solid waste

These facilities create a variety of wastes, including artificial process wastes, undesirable specification goods, polymers, and material components, to name a few. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

2.2.8 Agriculture

Another source of solid waste is crop farms, along with residences, dairies, stations, and ranches. Farming trash, rotten food, fungicide holders, and other potentially harmful equipment are some of the wastes they create. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

Figure 9: Stuff collecting agricultural waste

2.2.9 **Biomedical**

These are the businesses that produce chemicals and biomedical equipment for the hospital. The solid waste produced in hospitals comes in many different forms. Among these solid wastes are things like bandages, used gloves, hypodermic needles, paper, plastic, food scraps, chemicals, and used bandages. All these difficulties must be handled properly to avoid creating major issues for the local population and the environment. (Conserve-energy-future.com/Sources and Methods of Solid Waste Management et.al.2024)

Figure 10: Stuff collecting hazardous biomedical waste.

Summary

Solid waste management, which includes a wide range of waste kinds, classifications, and sources, is an important problem that poses serious obstacles to public health and environmental sustainability. An overview of the main elements of solid waste, such as its sorts, biomedical waste classifications, and sources, is given in this summary.

There are several categories for solid waste, each having unique traits and effects on waste management. The most prevalent kind of garbage is known as municipal solid waste (MSW), which is made up of ordinary objects that are thrown away by individuals, companies, and organizations. Paper, plastics, glass, metals, and organic garbage are among the materials that comprise a significant amount of the waste stream. Another important category is hazardous waste, which includes substances that are reactive, combustible, corrosive, or poisonous. Chemicals, batteries, electronic trash, and medical waste are a few examples of materials that, if improperly managed, represent major threats to both human health and the environment.

In summary, managing solid waste is a complex issue that calls for all-encompassing approaches to properly handle its different forms, classifications, and sources. Stakeholders may attempt to lessen the negative effects of trash creation on the environment, human health, and the economy by comprehending the complexity of solid waste and putting holistic methods to waste management into practice. We can work together to create a cleaner, healthier environment for both the current and next generations via focused initiatives.

Chapter 3

Methodology

Introduction

For the purpose of classifying solid wastes into orders based on diminishing minimal incremental information, a methodology is devised for calculating the number of waste feathers. These results show that additional waste feather counts that are not included in those calculated using the suggested methodology do not significantly reduce the estimate's confidence interval or contribute borderline information. Waste feathers are investigated as part of the methodology's demonstration utilizing trash composition studies from the Greater Vancouver Regional District. The suggested methodology is straightforward, and it may be used in the field to estimate the quantity of discarded feathers using a handheld calculator.

3.1 Waste generation

The amount of garbage produced in urban areas is proportional to the population and the average income of the residents. The quantity and makeup of garbage may also be influenced by various variables, like the climate, educational level, and social and public station. The amount of rubbish generated in Dhaka is growing as a result of the city's recent rapid population increase. Some sources classify trash into the following categories: household waste, marketable waste, institutional waste, artificial garbage, road sweepings, clinical waste, and building and demolition waste. The contributions made by various industries to the total garbage produced in the megacity of Dhaka, where roughly 76 percent of the waste was household, 22 percent was marketable, one percent was institutional, and the remaining 30 percent came from other industries. 4,634.52 tons of trash are produced every day in the Bangladeshi metropolis of Dhaka. The per capita trash generation rate is calculated at 0.56 kg/capita/day based on the entire expected city population in 2005. In Dhaka, the amount of garbage produced fluctuates typically between the dry and rainy seasons. The bulk of the garbage weighs more during the rainy season than during the dry because organic and perishable wastes retain more dampness. According to estimates, the solid waste population of 7 million generates between 3000 and 4000 tons of rubbish per day. The DCC is forthright about the fact that its collection system is unable to handle the massive amounts of rubbish that the ever-increasing population of megacities produces and that only 40 to 50 percent of the solid waste generated is being collected. DCC is in charge of secondary garbage collection, which involves gathering waste from its stakeholders and transporting it to final disposal locations. Residents are responsible for transporting their rubbish to DCC's waste collecting locations, which are home to shareholders. In order to provide door-to-door rubbish collection services in all wards, the DCC implemented a favorable system of NGOs, CBOs, and commercial organizations in 2002. For secondary garbage collection, DCC sends out installations and troops. In the megacity, 50 percent of the daily produced garbage reportedly goes uncollected and is dumped at authorized disposal sites. Solid waste operations only require 14–17 of the total external budget, or about 0.5 USD per person, each time. Because of this, uncollected garbage is typically illegally dumped in neighborhood thoroughfares, wastewater rainspouts, ponds, lakes, etc., or is handled informally. Uncollected trash has earned the distinction of being the source of poor landscape, alongside

dispersed trash, offensive odor, drain blocking, water pollution, and mosquitoes. Even though Dhaka City Corporation lacks confidence in its ability to solve the problem of uncollected garbage, the amount of rubbish is continually growing as the megacity expands. The state of garbage collection as a whole is not quite good. The native landscape is quickly polluted by a significant amount of uncollected garbage.

3.2 Data Collection Methods

For the objective of this study, a primary survey was conducted on 12 restaurant owners in various Dhanmondi locales. The Dhanmondi regions of Dhaka City were chosen as example locations since they are home to the majority of restaurant hubs. The seating capacity of the 12 participating restaurants ranged from 35 to 300 seats, with staff numbers ranging from 5 to 40, including both kitchen and front-of-house personnel. The goal was to achieve outcomes that were as near to an average restaurant as possible by focusing on a range of restaurant kinds.

It was thought that doing the restaurant food waste survey during the middle of the week for one day would be preferable over Friday, Saturday, or Sunday. This insured that the restaurant would not be at its busiest, giving them the time to segregate and measure food waste on their less-busy days, as well as regularly capturing consumer patterns of a working lunch and supper. Research on solid waste management in restaurants around Dhanmondi needs the careful selection of data collection methods in order to gather insights into garbage creation, disposal procedures, and issues experienced by local companies. The following are some of the methods we applied to acquire data collection on this topic:

Surveys and Questionnaires

Dhanmondi, a bustling neighborhood in the center of Dhaka, is a thriving culinary hotspot with a plethora of eateries catering to a wide range of tastes and preferences. Solid waste management arises as a crucial problem within the hustle and bustle of this vibrant sector, considering the restaurant industry's large trash creation. As a result, this study seeks to dive into the complexities of waste management procedures within these venues, with a special emphasis on understanding the problems and possibilities encountered by eateries around Dhanmondi.

The decision to use surveys and questionnaires as our primary data gathering approach stems from its adaptability and effectiveness in capturing a wide range of opinions within a controlled context. By utilizing these tools, we hope to collect comprehensive data that not only explains the current waste management landscape in restaurants near Dhanmondi, but also serves as a foundation for informing targeted interventions and policy recommendations aimed at promoting sustainability and environmental stewardship in the local restaurant industry. And here some questionnaires we use to collected our data for our research paper:

- What kind of garbage does your restaurant create on a daily basis and how do you presently manage waste in your restaurant, such as food, packaging, and solid waste?
- Do you have separate containers bins for various sorts of garbage (such as organic waste, recyclables, and non-recyclables)?
- What are your trash disposal techniques for various sorts of garbage?

- Do you have any special issues when it comes to managing restaurant waste?
- Have you started any recycling activities at your restaurant? If so, please provide specifics.
- Are you aware of any waste management standards that govern your restaurant?
- How do you guarantee that waste management regulations are followed?
- Have you trained your employees on proper waste management practices?
- What are your future plans or objectives for trash management at your restaurant?
- Overall, how satisfied are you with the current waste management practices in your restaurant?

Observations and Restaurants Audits

Given the significant quantity of trash created everyday by food preparation, packaging, and client consumption, restaurant solid waste management is a vital challenge. To successfully address this problem, restaurants can conduct trash audits as a proactive step to examine waste generation trends, identify areas for improvement, and optimize waste management systems. Waste audits are the systematic quantification and analysis of a restaurant's waste kinds and volumes, which provide useful insights into prospects for waste reduction, recycling, and sustainability activities inside the institution. Here some discussion are given below:

- What forms of garbage do you usually come across throughout your regular responsibilities at the restaurant?
- Can you estimate how much garbage is created in different parts of the restaurant, such as the kitchen, dining area, and storage spaces?
- How do you currently segregate waste in the restaurant? Are there separate bins for recyclables, food waste, and non-recyclable items?
- What challenges do you face when sorting and segregating waste?
- What are some viable ways to reduce waste output in the restaurant, in your opinion?
- Are there any particular techniques or projects you would recommend using to enhance waste management practices?
- What are your personal aims or aspirations for waste management and sustainability at the restaurant?
- How do you anticipate workers' roles in meeting the restaurant's long-term waste reduction goals?

By asking staff these questions, we may gather useful insights into the restaurant's present waste management procedures, suggest areas for improvement, and encourage employee participation in sustainability programmers. These findings can help guide the development of focused interventions and initiatives to improve waste management practices and encourage environmental stewardship in the restaurant business.

3.3 Data Analysis Methods

The successful management of solid waste in restaurants around Dhanmondi requires a diverse approach that combines quantitative and qualitative data analysis techniques. As we attempt to investigate the complexities of waste management processes inside these facilities, comprehensive data analysis approaches become essential. This section explains the methodology used to interpret the vast amount of data gathered through trash audits, interviews, observations, and other research instruments. Using both quantitative and qualitative analysis, we want to gain nuanced insights into the complexity of solid waste management in the changing setting of restaurant operations.

Quantitative Analysis

Our inquiry centers on a quantitative analysis of garbage creation rates, content, and trends. We quantified the amounts of garbage created at numerous eateries around Dhanmondi and classified them into diverse groups, including organic, recyclable, and non-recyclable items. Statistical methods show trends and relationships, allowing comparisons across different types of restaurants and discovering factors that influence trash creation. Here some example are giving below:

Waste Audit Analysis:

- Calculate the total quantity of garbage produced by each restaurant during a set time period.
- Determine the waste composition (e.g., organic, recyclable, and non-recyclable) and compute the proportion of each kind.
- If numerous audits were completed, examine the trends in waste generation and composition over time.

Statistical Analysis:

- Statistical tests can be used to assess waste generation rates between different types of restaurants (for example, quick food vs. fine dining) or restaurants with varying waste management procedures.
- Evaluate the relationships between waste creation and restaurant factors such as size, customer traffic, and menu options.

Qualitative Data Analysis

Our focus is around a quantitative analysis of garbage generation rates, composition, and trends. We quantify the amounts of garbage created at several restaurants around Dhanmondi and categories them into separate classes, such as organic, recyclable, and non-recyclable items, using careful waste audits. Statistical analysis reveal further patterns and connections, allowing for comparisons between different types of restaurants and discovering factors that influence trash creation.

Survey Analysis:

- Transcribe and code interview replies from restaurant owners, managers, and staff on their perspectives and experiences with waste management.
- Identify common themes and patterns in obstacles, accomplishments, and attitudes towards trash reduction and recycling projects.

Observational Analysis:

- Analyze observational data gathered during restaurant visits, concentrating on waste management techniques, segregation methods, and general cleanliness.
- Make a note of any creative waste management solutions or opportunities for improvement that we see during our task.

As we begin on the data analysis the process, inspired by a dedication to rig our and honesty, we hope to unearth actionable insights that will influence evidence-based initiatives for improving sustainability and fostering environmental stewardship in eateries around Dhanmondi.

3.4 Solid Waste Management

The primary goal of solid waste management is to reduce the negative environmental consequences brought on by the careless disposal of solid waste. By having a better grasp of the underlying features and interrelationships of the waste management system's component parts, solid waste management may be tackled in an effective and systematic way to meet this goal. However, it must be acknowledged that there are complicated issues with solid waste management, particularly in developing nations. This is due to the expanding and diversified nature of waste, the growth of large metropolitan areas, the budget constraints for public services, and the scarcity of energy and raw resources.

Functional Elements	Description
Waste generation	Those circumstances in which materials are identified as no longer being of value and are additionally thrown down or gathered for disposal.
On-site handling and storage	Those circumstances are connected to the processing, storing, and operating of solid waste wastes at or close to the place of generation.
Collection	This conditioning is related to the collecting of solid wastes and the transportation of wastes from the point of collection to the location where the collection vehicle is ejected.

Transfer and Transportation	These circumstances are related to the movement of garbage from the smaller collecting vehicle to the bigger transport apparatus and the subsequent transportation of the waste, typically over a considerable distance to the disposal destination.
Processing and Recovery	The other functional rudiments are made more effective with the help of these methods, tools, and installations, which are also utilized to recover useful items, goods for conversion, or energy from solid waste.
Final disposal	These conditions relate to the final disposition of solid wastes, such as waste that is collected and transported directly to the landfill, extra waste from wastewater treatment facilities, incinerator ash, compost, or other useless materials from diverse solid waste processing factories.

Table 3: Solid waste management

Summary

The production, handling, processing, and disposal of waste are essential components of public health and environmental sustainability. In addition to addressing procedures, waste generation, solid waste management practices, treatment and disposal techniques, dumps and landfills, and biological waste treatment, this brief offers a succinct overview of important waste management topics.
To properly understand trash generation trends and sources, methodology uses a multidimensional approach that includes surveys, interviews, and data analysis. Also, waste generation includes a wide range of waste products from institutional, commercial, industrial, and domestic settings. Examples of these products include industrial waste, hazardous waste, municipal solid waste, and biomedical waste.

The goals of solid waste management techniques are to reduce the amount of garbage produced, encourage recycling and reuse, and guarantee correct disposal by source separation, collection, transportation, and treatment.

Among the techniques used for treatment and disposal include mechanical sorting, composting, anaerobic digestion, incineration, and landfilling; contemporary landfills are built with designed designs to reduce their negative environmental effects. Although landfills and dumps are the main places for disposal, other waste management techniques are required due to sustainability and environmental impact issues. Utilizing microorganisms to break down organic waste, biological

waste treatment techniques like composting and anaerobic digestion provide environmentally friendly substitutes for traditional waste management techniques.

In summary, waste management is a complicated and intertwined process that necessitates integrated methods to successfully address socioeconomic, health, and environmental issues. In order to improve waste management procedures and provide sustainable waste solutions, research and innovation must go on.

Chapter 4
Data Collection and Analysis

Introduction

This study primarily focused on how restaurants are currently managing their solid waste. Solid waste creation, waste processing procedures, solid waste collection, solid waste storage, and landfilling were all included by the data collection. This study seeks to define the absence of waste management and to provide an appropriate waste management strategy. Both qualitative and quantitative methodologies are employed by researchers while gathering data. Direct field observation while gathering data. Articles, books, magazines, etc. are used by researchers to obtain secondary data. Primary data was gathered from a variety of classes of people who were randomly chosen in order to learn about solid waste management procedures. Visits to the selected disposal site and garbage collecting procedure were also used to gather primary data.

4.1 Validity and Reliability of the Study

The researcher gathered data from various restaurants and a randomly chosen dump due to time constraints. Because a large-scale survey would have required a lot of resources (time and money), the researcher maintains the validity and reliability of the data. These resources are not accessible for an undergraduate study like the one being conducted here. In order to increase the credibility of the data, the researcher consciously selects certain sample units.

4.2 Study Area

In this section, the researcher visits various restaurants and uses garbage containers that were chosen at random. There are numerous restaurants that we have visited, and we have carefully observed what they do and how they reduce solid waste. And toss to trash transporter winners.

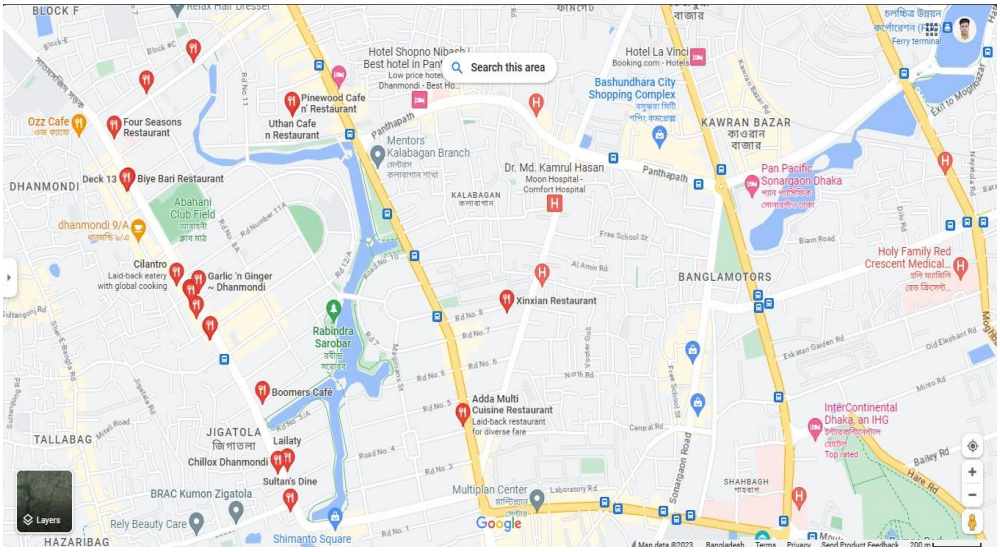


Figure 11: Restaurants map near Dhanmondi

4.3 Questionnaire

Performances of Restaurants of Dhanmondi according to the questionnaire are presented below.

- **General Question's**

1. What is Restaurant waste?
2. What are the main reasons for food waste in restaurants?
3. Types of restaurant use collecting waste?
4. What are the types of waste from restaurants?
5. How do you measure my food waste?
6. For per occupant in each table of the restaurant inside and 1 waste bin per square meter, and there is 1 "Bon plate" for pre-table?
7. Is there waste cleaning at the proper time?
8. Is there any split for different wastage?
9. Bins are different for different wastage or combined?
10. How do they clean portion our dishes?
11. How does a restaurant dispose of food waste?
12. How does a restaurant compare to other restaurants when it comes to food waste?
13. Are there any other ways that consumers can participate in lowering food waste at get restaurant?
14. What impact do you have in place to reduce food waste?
15. Is there any composting program in any restaurant? If not, how do we manage this system?

- **Answer of Questionnaire**

1. Restaurant waste is by using different primary necessary to short to the ones that can be recycled, such as food packaging, glass, paper, plastic, plastic bottles or organic waste from the kitchen, and food scraps that consumers did not eat. Those main categories can be further divided into sub-categories such as meat, fresh food, vegetables, large plastic bottles, tissue paper, etc.
2. This results in a substantial loss for the restaurant industry, according to the United Nations Department of Agriculture (USDA). Overproduction, lack of observation, indecorous worker training, indecorous food storehouses, and lack of access to composting installations are some of the reasons for this waste.
3. Food waste in restaurants such as prep waste, plate waste, and spoilage can go to an anaerobic digestion plant. Organic waste is collected from restaurants and delivered to a handling system.
4. Typically, there are many types of waste a restaurant can generate- solid waste, liquid waste, organic waste, recyclable waste, etc.
5. Collect from the bins and separate in organic, metallic, liquid, and solid in different bags then measure on weight scale.

6. For per occupant in each table of the restaurant inside and 1 waste bin per square meter isn’t found, but there was 1 "Bon plate" for pre-table.
7. Different restaurants are cleaning food waste popper time but a few restaurants can’t provide this service on time.
8. There are some splits for different wastes like solid waste, liquid waste, organic waste, recyclable waste, and hazardous.
9. There is not any restaurant we can see that bins are different for different wastage. All restaurant uses their waste bins for combined waste.
10. They clean portions of our dishes at different times by using dish cleaners, water, and tissues.
11. The restaurant disposes of food waste in the waste collecting van and throws it into the dump truck.
12. A restaurant compares to other restaurant initiatives day by day throw a new set menu, buy one get one offers, and giving some discounts to save the food wastage.
13. Customers can participate in lowering food waste by giving their food to some organization, street children, or street beggars.
14. We get in place to reduce food waste by ordering limited and likely food.
15. There is not any composting program in any restaurant we can see. If we start with this system we need an organization that provides this system and also needs to place every restaurant.

Administrative Area of Dhanmondi	Consumer's Regular	Consumer's Holi Day	Estimated waste generation rate	Estimated waste generation (Regular)	Estimated waste generation (Holiday)	Estimated waste generation Month	Estimated waste generation Year
	Count per Day (average)	Count per Day	gm/cap/ day	Kg/day (Rate*count)	Kg/day (Rate*Count)	Ton/month	ton/year
Kashbon	1200	1300	100	120	130	3.64	43.68
Cat cafe	600	800	70	42	56	1.47	17.64
Tehari Ghor	800	950	75	60	71.25	1.85	22.2
KFC-Dhanmondi	650	800	90	58.5	72	1.80	21.6
Shampan Mughal Kabab House	560	700	115	64.4	105	2.09	25.08
Pinewood-Café & Restaurant	750	820	103	77.25	84.46	2.34	28
Pizza Hut	600	820	55	33	45.1	1.38	16.56
Chillox-Dhanmondi	700	850	60	42	51	1.29	15.48
					Total =		190.24 (ton/year)

Table 4: Some Restaurant's estimated quantities of solid wastes generated at Dhanmondi in 2023

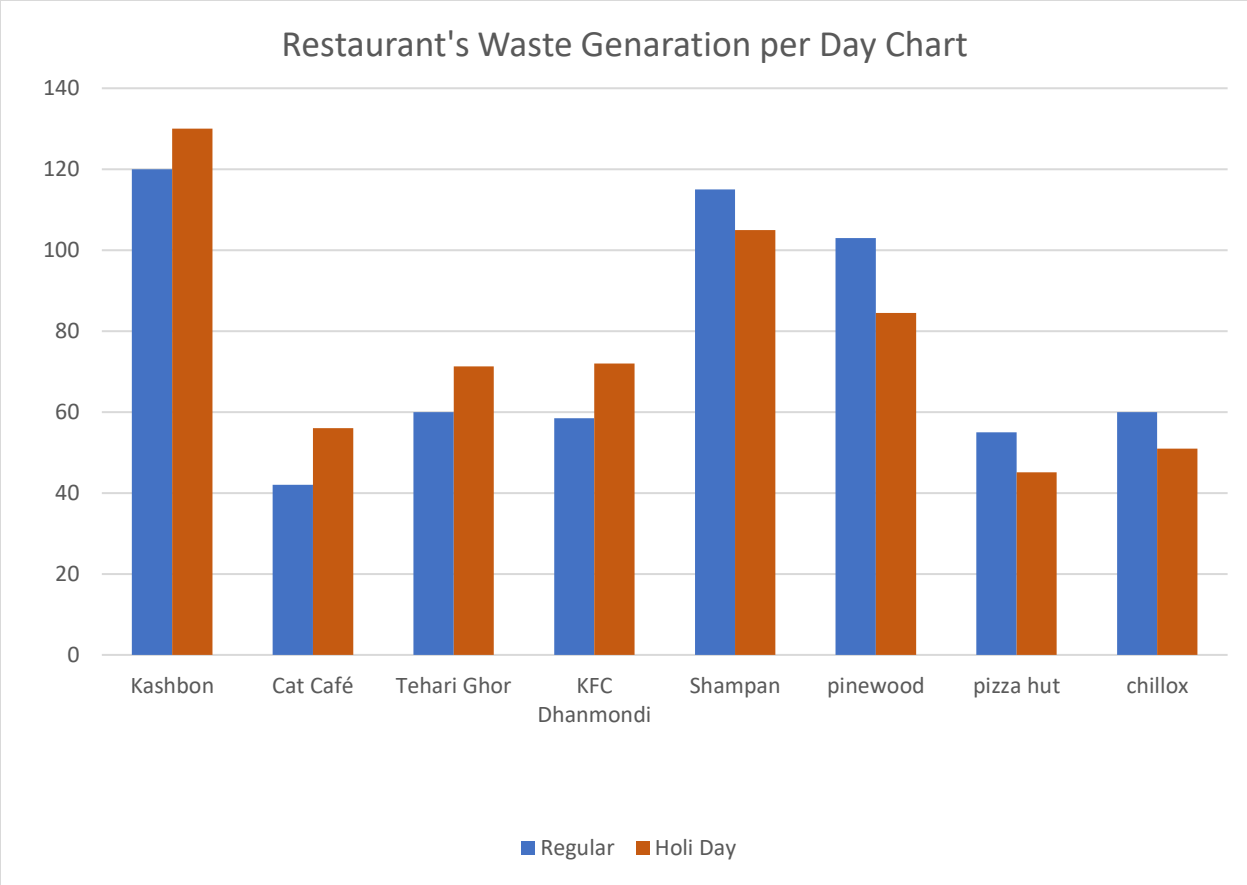
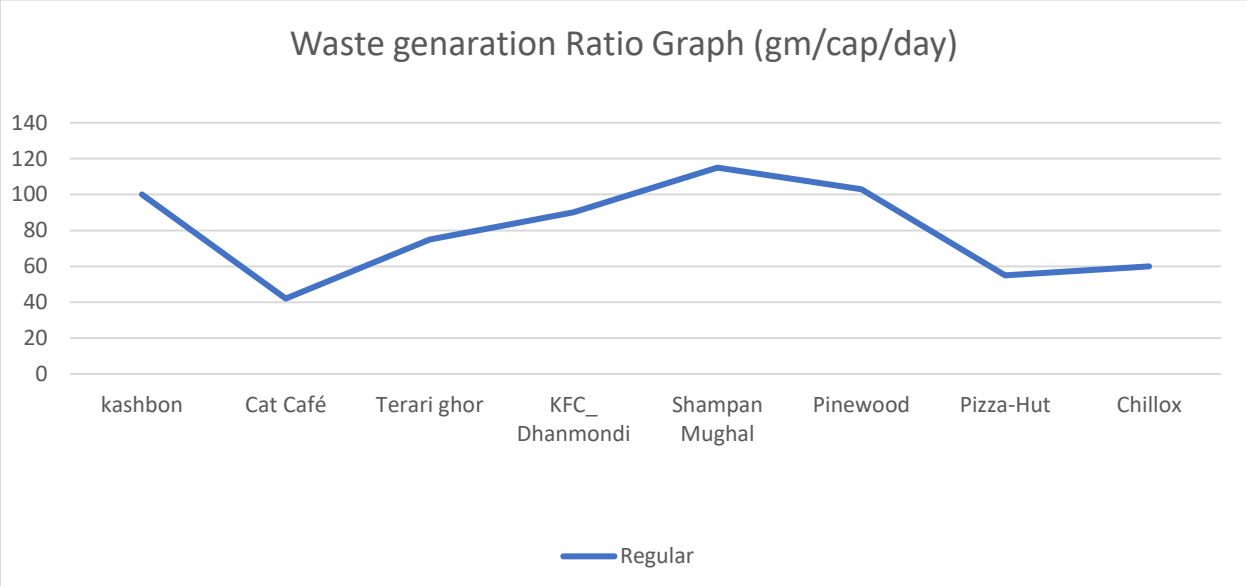


Chart 1: Restaurants waste generation per day chart



Graph 1: Waste generation ration graph

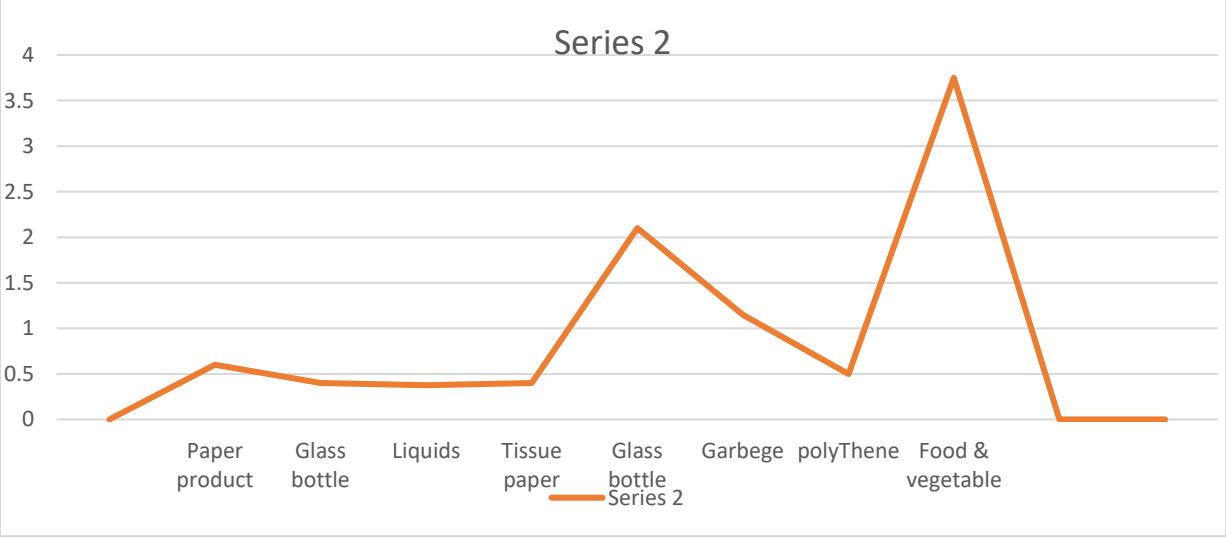
4.4 Restaurant Waste Separation

Utilizing several containers, or pails, for various sorts of garbage is the easiest approach to separate waste. It is important to classify garbage into categories that can be reused, such as food packaging, glass, paper, plastic bottles, organic kitchen waste, food scraps that your guests didn't consume, and all green food that can be composted. These primary orders can be further broken down into subcategories like meat, fresh fruit and vegetables, large plastic bottles, tiny plastic bottles, etc. A high number of types and subcategories increases the amount of recycling possibilities while also giving a clearer picture of the type and volume of garbage.

4.5 Restaurants Average Wastage for 100 Consumers

Food and vegetable wastes	3.7kg
Paper products	0.6 kg
Glass and ceramics	400 gm
Liquids	375 gm
Tissue paper	400 gm
Glass bottle	2.1 kg
Garbage	1.15 kg
Polythene bags	50 gm
Total waste weight	9.225kg

Table 5: Restaurant's Average Wastage for 100 Consumers Graph



Graph 2: Restaurants Average Wastage for 100 Consumers Graph.

Figure 12: Some pictures of restaurant waste bins

4.6 Restaurants estimation formulas

- If a full-service restaurant serves 2,000 meals per week, then 1 pound each meal multiplied by 2,000 meals per week is 2,000 pounds, or 1 ton of food waste every week.
- If a limited-service restaurant provides 4,000 meals per week, then there will be one ton of food waste every week since there will be 0.5 pounds of food waste for every 4,000 meals provided.
- 3,000 pounds per employee per year multiplied by 35 full-time workers equals 105,000 pounds of food waste produced annually at a full-service restaurant with 35 staff. 1 ton of food waste each week equals 2,019 pounds per week or 105,000 pounds per year divided by 52 weeks.
- If a limited-service restaurant has 48 employees, then the amount of food waste produced year is 2,200 pounds per employee time's 48 full-time employees. 1 ton of food waste every week is equal to 105,600 lbs. per year divided by 52 weeks, or 2,031 lbs.
- If a full-service restaurant fills a trash container with 8 cubic yards of garbage twice a week, the math breaks down as follows: 2501 lbs./yd3 * (1 trash container * 8 yd3 * 2 pickups/week) = 4,000 lbs. of total waste/week 4,000 lbs. *66% of total waste = 2,640 lbs./week = 1.3 tons of food waste in a week.
- If a fast-food restaurant fills a single trash container with 8 cubic yards of waste twice a week, the math breaks down as follows: 2501 lbs./yd3 * (1 trash container * 8 yd3 * 2 pickups/week) 4,000 pounds. Of total waste/week; 4,000 lbs. * 51% of total waste = 2,040 lbs. /week; 1.0 ton of food waste in a week.

N.B: Restaurant estimating guidance for the Commercial Food Waste Disposal Ban threshold. (Source: Google.)

Summary

Data collection and analysis play a crucial role in understanding and managing solid waste near Dhanmondi effectively. This summary provides a concise overview of the methodologies and processes involved in collecting and analyzing data for solid waste management in the Dhanmondi area.

Data collection for solid waste management near Dhanmondi involves several key steps. Firstly, defining the scope and objectives of the study is essential to guide data collection efforts. This may include identifying the types of waste generated, sources of waste, and relevant stakeholders involved in waste management. Secondly, selecting appropriate data collection methods, such as surveys, visits Restaurant, talk with staff, observations, and helps gather relevant information from households, businesses, industries, and waste management facilities in the area. Thirdly, ensuring the reliability and validity of the collected data through rigorous quality control measures, such as standardized protocols, Solid waste weight measure, and data validation techniques, enhances the accuracy and credibility of the findings.

Once the data is collected, it undergoes rigorous analysis to derive meaningful insights and inform decision-making processes. Data analysis for solid waste management near Dhanmondi involves several analytical techniques and tools. Descriptive statistics, such as mean, median, and standard deviation, provide summary measures of waste generation, composition, and characteristics. Inferential statistics, such as regression analysis and correlation analysis, help explore relationships and trends between different variables, such as waste generation rates and demographic factors. Spatial analysis techniques, such as Geographic Information Systems (GIS), enable mapping and visualization of waste generation hotspots and spatial patterns, aiding in targeted interventions and resource allocation.

In conclusion, gathering and analyzing data is a crucial part of managing solid waste in the Restaurant are of Dhanmondi. Through the use of rigorous methodology and analytical tools, stakeholders may acquire significant insights into trash creation patterns, pinpoint areas requiring enhancement, and formulate evidence-based plans to tackle the obstacles associated with solid waste management in the region. Maintaining sustainable waste management methods and encouraging environmental stewardship in the Dhanmondi community requires sustained efforts in data collecting and analysis.

Chapter 5

Discussion and Recommendation

Introduction

In this survey, there were several issues with eateries. The subject under investigation is first reviewed, together with the theoretical framework that guided the study. The numerous types of participant management tactics are then classified into their corresponding groups. The most important discoveries and their magnitude are then emphasized. The discursive and non-discursive activities that inform restaurant food waste as a thought-provoking topic are also examined. The study's limits, consequences, some views on the importance of the findings, and suggestions for more research are then recognized.

5.1 Discussion

Restaurant waste management discusses how to effectively manage waste disposal in restaurant. We had issues with the restaurant's owner and management since they wouldn't let us measure how much waste the establishment produces each day or enter the cooking area for solid waste collection. Additionally, when we looked into solid waste collection, we encountered a lack of happiness in their response. The majority of restaurant owners treat us with kindness, assist us with measuring and collecting solid waste, answer our questions appropriately, and have conversations with us about proper waste disposal.

5.2 Recommendation

Waste reduction is seen as a natural place to start for sustainable solid waste management since it lowers the amount of garbage that has to be collected and disposed of (UNEP, 1996). It is crucial to keep in mind that source waste is primarily organic. By composting this putrescible portion of the garbage, less waste will need to be disposed of, and the compost itself will turn into a toxin that may be utilized in local theaters or as a raw ingredient in companies that make organic toxin blends. The system also hasn't produced the best financial and environmental results to yet and hasn't given itself enough leeway to adjust to challenges in the future (increases in waste volume and composition variety). Therefore, cost recovery might also be considered on a broad scale. Most households utilize waste boxes to dispose of all types of created garbage, thus it is wise for the TMA to establish and implement a system that is successful in gathering the junk that is now mentioned everyday as well as a program that isolates and recycles waste.

5.2.1 Recommendations to be adopted.

- Calculate the amount of solid waste generated by a few restaurants near Dhanmondi. You can utilize data from several restaurants to do this type of research.
- We observe how solid waste is disposed. Future research can be conducted using the topic of how to dispose of solid waste in an environmental eco-friendly way.

- This study's focus is on various forms of solid waste in restaurants. Solid waste from residential areas may be used for research in the future.
- Restaurant waste with solid waste components can be used for research.

Summary

For food service businesses to remain hygienic, clean, and environmentally sustainable, waste management is essential. However, as our study showed, there might be difficulties when doing research on restaurant trash disposal techniques. The bulk of restaurants demonstrated cooperation and willingness to participate in waste management initiatives, despite opposition from some restaurant owners and management who were hesitant to allow measurements of waste production or access to cooking areas for solid waste collection.

Some restaurant owners' didn't allow to access cooking rooms and the monitoring of trash output points to possible obstacles to efficient waste management techniques. This opposition might be the result of worries about privacy, operational interruptions, or embarrassment at disclosing excessive waste production. By addressing these issues and providing clear communication, education on the advantages of waste reduction, and confidentiality assurances, it may be possible to get restaurant owners to cooperate more in future study projects.

On the other hand, the majority of restaurant owners' affirmative reaction indicates a readiness to participate in waste management initiatives and work with researchers. Their collaboration makes it easier to gather important information on garbage production, disposal methods, and areas for development. Building rapport and trust with restaurant owners, outlining the goals of the research in detail, and highlighting the advantages of involvement may all help to ensure that waste management programs continue to get support.

All things considered, the experiences we had while doing our research highlight how crucial it is for academics and restaurant partners to have good communication, collaboration, and mutual understanding. Through tackling obstacles and fostering cooperative connections, scholars may get crucial understanding of restaurant waste management methodologies, pinpoint domains for intervention, and endorse enduring resolutions for waste minimization and elimination in the food service sector.

Chapter 6

Conclusion

Introduction

The main causes of the rising rate of solid waste creation in Bangladesh are urbanization, industrialization, and population expansion. Each day, Bangladesh's six largest municipalities produce over 8000 tons of solid trash, of which roughly 70 tons come from the Dhaka megacity alone. Approximately 400 g of garbage are produced daily per person. The garbage management system isn't great. The system of collecting, transportation, recycling, burning, and landfilling is being worked on. Even yet, the government's ability to guarantee the efficient and appropriate supply of solid waste collection and disposal services to the whole population has been extremely precarious due to insufficient resources and organizational capability.

Conclusion in summary

The environment and human health both benefit greatly from an effective waste management system. The solid waste management, however, has several challenges. Everyone desires a society that is orderly, clean, and devoid of poverty. Demonstrates some effective management strategies for SW. Only authority cannot carry this burden. It is up to us to collaborate in order to turn our aspirations into reality. People should be made aware of the drawbacks of ineffective waste management practices, and the advantages of trash recycling should be highlighted. Most individuals in our nation are unaware of the concepts of biodegradable and non-bridgeable trash. People combine both biodegradable and no biodegradable debris before throwing it into the trash cans. This makes the process of desecrating these wastes exceedingly time-consuming. The least amount of S.W. management expertise should thus be held by everyone. However, recycling trash also helps to cut down on greenhouse gas emissions. Waste recycling initiatives are started in several nations to control S.W. This is a serious concern in Bangladesh. A researcher was constrained by time and was unable to identify all the management issues with SW. Extensive study is required to determine the true nature of the issue and to advance an environmentally friendly S.W. management system. Future generations will enjoy a better environment if individuals can put the right S.W. management practices into practice.

1. The amount of solid waste generation in Restaurants near Dhanmondi is estimated and collected wastes from restaurants are separated very carefully and taken waste weight by weight scale. The data was taken from weight scales in different restaurants. Also known how many meals are served on a regular day and on holiday for analysis of the data by restaurant and estimated formula.

2. Waste generation, on-site handling and storage, collection, transfer, and transportation, processing, as well as final disposal were all examined and evaluated in detail.

3. The challenges that the restaurant's waste management system has faced at different phases. Separating trash from restaurants, such as organic materials, plastics, bottles, glass, and ceramics, rubbish, and polyethylene bags, is one of the biggest issues.

4. The impact of final disposal of solid waste focusing on a landfill because the landfill location is too far the transportation cost is very high also creates a risk for restaurant management's solid waste collecting system. And also needed waste collected in the day 2 times properly.

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