

Examine the Existing Solid Waste Management Practices for Developing a ISWM's Framework at Jahangirnagar University

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ABSTRACT

Bangladesh's first residential university is Jahangirnagar University. Each student is assigned to a residential hall at the institution. Because there is no adequate solid waste management plan in place, residents in the study region have been enslaved by the rubbish they create daily. Solid waste management is still important in formal settlements, even if they have a good solid waste management policy. It has a negative influence on their social and economic well-being. The goal of this research was to evaluate the integrated solid waste management system at Jahangirnagar University. A cluster randomly chosen sample of 397 respondents from Jahangirnagar University's 20,000 total population was used in the research technique. Questionnaire interviews, several types of observations, in-depth interviews, focus group talks, and documentary assessment were all used to gather data for the study. To investigate variables, the researchers utilized cross tabulation and descriptive analysis. The data show that Jahangirnagar University has failed to achieve substantial ISWM for several reasons (Integrated Solid Waste Management). The absence of proper community empowerment, as well as adequate mobilization, organization, and coordination of local resources, was the first difficulty. According to the results, the university administration lacked commitment to implementing the plan, resulting in inefficient solid waste management integration. This study also identifies challenges and produces guidelines and suggestions to improve the study area's integrated solid waste management.

Keywords:- Solid Waste Management, Framework, ISWM, Jahangirnagar University.

INTRODUCTION

In Bangladesh's context, solid trash is one of the most visible environmental issues. Because of this lack of action, the situation has lately become more wasteful. Jahangirnagar University is known for its lovely green campus. It contains 464 different kinds of flats, 16 different student halls, a medical center, two administrative buildings, four institutions, and 34 departments. The university area is home to almost 15,000 individuals. However,

garbage is found scattered over the open area due to a lack of an appropriate waste management policy. Floods, vector breeding, and disease transmission are all common results of open garbage disposal mixing with animal excreta [1]. Occasionally, these toxins are poured directly into surface water. As a result, the aesthetic and environmental condition of the campus has degraded. Furthermore, haphazard solid waste management or disposal has been demonstrated to

contribute to global warming. Therefore, a methodical approach to managing the campus's solid waste has become important. A specific solid waste management strategy and practice must be adopted to safeguard the environmental quality and recreational potential of the Jahangirnagar University campus [28].

Integrated solid waste management (ISWM) is a broad term that encompasses a variety of actions and behaviors that describe the undesired remnants of any civilization. All forms of human activity generate trash, which may cause environmental changes as well as harm to animals, plants, and ecosystems. Only prudent management, on the other hand, can limit environmental harm and safeguard limited resources. ISWM is an important part of sustainable development for all countries, and worldwide initiatives strongly encourage ISWM to be prioritized.

AIM AND OBJECTIVES

The primary goal of this research is to examine current solid waste management practices to establish a framework that can be integrated with ISWM's framework and to identify gaps in current practice to provide recommendations at Jahangirnagar University. To fulfil the aim, the specific objectives are being set for this study includes: 1) to explore existing solid waste management system of the study area, 2) to develop a framework for solid waste management in the study area functional elements, 3) to identify the problem and recommend some suggestion for better improvement.

METHODOLOGY

This study adopted both qualitative and quantitative approaches. Relevant data were collected from both primary and secondary sources. Secondary data will be collected from library sources, journals, magazines, published and unpublished

research papers, databases, the internet, and other sources. Both published and unpublished documents related to the topic were reviewed to examine the existing solid waste management system of the study area. The primary data were collected during June 2021. Stratified random sampling method has been used to conduct questionnaire survey for the respondent of this study area. An in-depth interview with the personnel experience in existing solid waste management were conducted to find out problem and possible solution for better improvement. The core data for this study will be obtained from communities on the campus of Jahangirnagar University who are active in solid waste generation and management for various reasons. According to the research's goal, the data was sorted, summarized, calculated, revised, formatted, tabulated, classed, and analyzed. Based on a mixed method approach, the acquired data was processed systematically in different study ways according to preset variables. Data has been edited, coded and computerized. Quantitative analysis will be done using statistical and mathematical tools such as MS Word, MS Excel, SPSS and ArcGIS.

RESEARCH DESIGN [Table 1]

Three objectives have been devised to conduct this study where major variables are amount of generated waste, collection and disposal, frequency of collection, management and disposal method, number of engaged workers, cost of equipment and the behavioral practice. To pursue this research, variable identification and data collection was required based on the objectives. Both qualitative and quantitative approaches have been applied to data processing. This research involves a mixed method approach that incorporates in a single study both qualitative and quantitative approaches, to illustrate and describe metrics. This research employed an exploratory descriptive technique based on quantitative knowledge to investigate

and analyze the existing solid waste management system's phenomena, challenges, and impacts, which are still little understood. This study used phenomenological research methodology to create a framework based on the ISWM

concept and solid waste management experiences in order to better understand the current state of the existing solid waste management system and its impact on the environment and human health in the study area [2].

Table 1: -Research Design

Objective-Variable Matrix Table for Data Collection

Research Objective	Research Approach	Research Instrument	Data Parameter
To explore the existing framework of integrated solid waste management in the study area.	Mixed Approach	Questionnaire interview And Observation	-Characteristics Analysis -Frequency Analysis
To develop a framework for solid waste management in the study area functional elements	Mixed Approach	Secondary Data Analysis Observation	-Element Linkage Analysis
To identify the problem and recommend some suggestion for better improvement.	Mixed Approach	Secondary Data Analysis Observation	-Problems and Solution Identification

The variable matrix table for data collection is as following in Table 2:

Table 2: -Objective-Variable Matrix Table

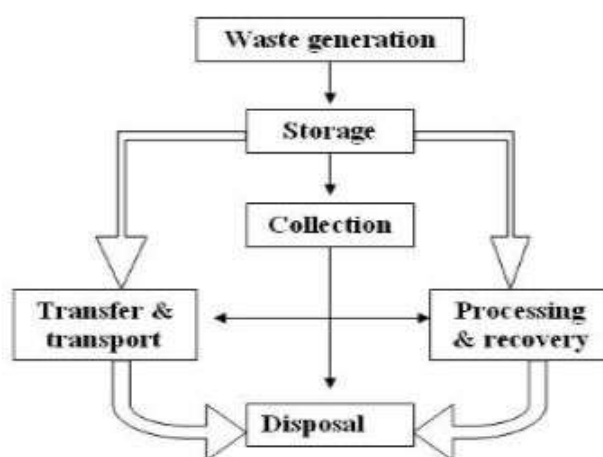
Objectives	Variables	Source
To explore the existing framework of integrated solid waste management in the study area.	<ul style="list-style-type: none"> Amount of solid waste produced daily. Types of solid wastes. Waste disposal points. Collection method of solid wastes. The kind of truck used to collect solid waste. Frequency of collection. Frequency and rate of dumping of solid waste. Practiced dumping methods. Number of workers. 	<ul style="list-style-type: none"> ❖ Observation survey ❖ Questionnaire survey ❖ Secondary sources
To develop a framework for solid waste management in the study area functional elements	<ul style="list-style-type: none"> Presence of functional elements of ISWM. Linkage among different functional elements of ISWM. 	<ul style="list-style-type: none"> ❖ Observation survey ❖ Questionnaire survey ❖ Secondary sources
To identify the problem and recommend some suggestion for better improvement.	<ul style="list-style-type: none"> Available facilities for specific waste segregation. Waste Segregation system. Disposal method. Description of the waste disposal area. Environmental quality of disposal area. Cost of equipment's used for waste management. Number of persons involved in collection and disposal. Responsible authority or people and their performance in waste disposal. Proper rules and regulation Adequate instrument. Appropriate dumping location Overall waste management proses. 	<ul style="list-style-type: none"> ❖ Interview survey, ❖ Visual survey and ❖ Secondary sources

Source: Author, 2021

Functional Elements of Integrated Solid Waste Management Concept [Figure 1]

A complete waste management system that includes efforts to minimize trash generation and enhance waste recycling, as well as a full waste management system for proper waste collection, transportation, and disposal, may help to solve a range of solid waste management issues. An ISWM strategy provides for the formulation of an appropriate blend of existing waste

management strategies for the most effective waste management. ISWM is divided into four sections. Source reduction, recycling and composting, waste transportation, and landfilling are the four practical aspects of ISWM. These waste management tasks may be carried out in a hierarchical or interactive manner [15]. The Asian Development Bank (2017) states that the practical elements of ISWM:



*Fig.1: -Functional elements of integrated solid waste management system
Source: Ques10*

STUDY AREA [Figure 2]

Geographically, the area lies between the latitudes of 24° 2'N and 23° 46'N, and the longitudes of 90 11 22"E and 90 21'41"E, with a height of about 10.04m. The area is in the south section of the Madhupur tract, which is thought to have risen during the Pleistocene epoch. As a result, the area has a natural proclivity for plant development [2]. The institution lies 32 kilometers west of the city on the Asian Highway, often known as the Dhaka-Aricha Road.

The campus, which is flanked to the north by the National Monument, is located between the Bangladesh Public Administration Training Centre (BPATC) and the Savar Cantonment (Jatiyo Smriti Soudho). It covers 697.56 acres (2.8 km²) of land, which was once 748.14 acres. Bangladesh Public Administration

Training Centre was allocated 50.58 acres of land by the government in 1984, according to a government notice [3]. The campus is currently stretched throughout Chhalia, Dakshin Krok, Boro Oalia, Gerua, Uttor Krok, and Senoalia mauza, with undulated red soil, natural aesthetic views, red ceramic constructions, and vegetation [4].

There are two types of residential units: residential unit for teacher and residential unit for employee. Teachers' resident is located near Prantic gate which is on the middle eastern part of the campus. Employee's resident is located near Bishmile gate which is on the northern part of the campus. Female hostels are located between Prantic and dairy gate. On the other hand, male hostels are located

western part of the campus except Mir Mosharraf Hossain Hall which is located southern part of the campus. Academic and administrative structure are

constructed on the middle portion of campus area.

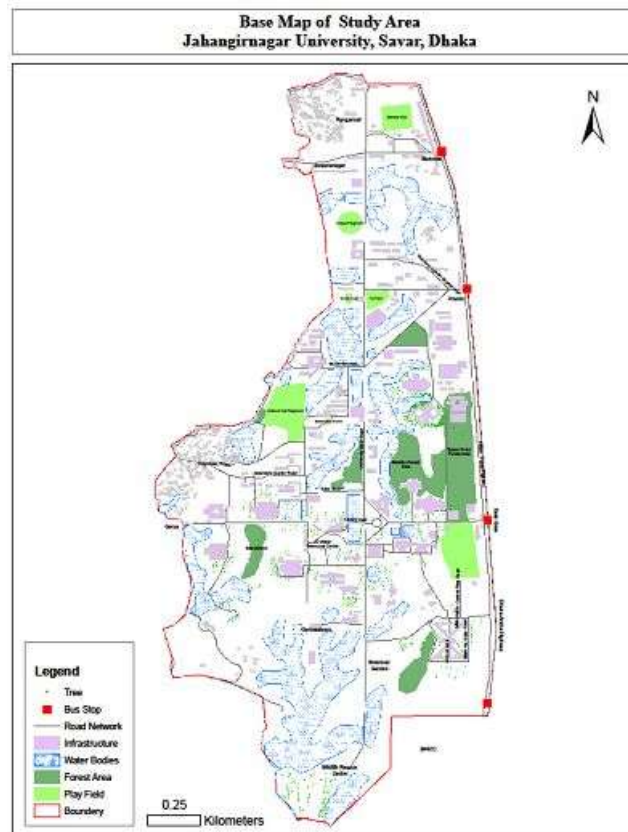


Fig.2:-Study Area Map
Source: Compiled by authors, 2021

RESULT AND DISCUSSION

Existing waste management in Jahangirnagar University

To accomplish the first aim, information was collected from a variety of sources, and an observation survey was conducted to reveal the existing framework of integrated solid waste management in the study region. In this case, secondary data has shown to be valuable. This chapter describes the current state of integrated solid waste management in the study region, the total amount of solid waste generated in the study area, and the management systems in use [5]. The estate office is the single agency responsible for the solid waste management system, and

their operations and actions in the study area are also covered. Among the university administration and garbage collectors, questionnaire surveys and personal interviews were also conducted.

Present Status of Waste Generation

The study area contains a variety of landuses, which are the primary factors influencing waste generation. The largest contributors to overall waste generation are residential units and student hostels [6-8]. Waste is also generated in commercial areas, with most of the commercial waste coming from hotels located across the study area. Apart from academic units, administrative offices, and various

communal areas also generate waste daily. A portion of combustible waste is generated by street sweeping and drain

cleaning, while hazardous waste is generated by the medical facility as shown in Table 3 below.

Table 3: -Amount of solid waste generation in Jahangirnagar University

Sources	Volume of waste generated per day (in kg)				Total Organic (in Kg)
	Organic	Inorganic		Hazardous	
		Combustibles	Non-combustibles		
Residential units	1655	357	250	2	2264
Student hostels	1534	239	68	17.5	1858.5
Administrative offices	-	16.5	-	-	16.5
Academic units	16.5	34.5	4.5	0.002	55.502
Commercial places	229	29	5	2	265
Medical	-	0.5	-	1	1.5
Other Common places	83.5	31	7	-	121.5
Street sweeping and drain cleaning	72	101	2	-	175
Total	3590	808.5	336.5	22.502	4757.502

Source: Estate Office, 2021

Every day, approximately 4757 kg of solid waste (Table 3) is produced from different locations and dumped in the open area, according to the research. The most waste is generated by residential flats, student hostels, and commercial enterprises [9-11].

Organic waste accounts for 75.5 percent of these wastes, whereas combustible, non-combustible, and hazardous waste account for 17 percent, 7.1 percent, and 0.5 percent, respectively. Food waste makes up most of the organic waste, whereas plastics, glass, and tin make up the majority of inorganic waste.

Medical waste, used sanitary pads, and other hazardous wastes are among the hazardous wastes, however they are little in comparison to other wastes.

Waste Collection and Transportation Facilities [Table 4]

Waste is primarily stored by the different institutional unit. Plastic bucket, paper or polyethene bag, bamboo case and communal bin are used for initial storage of the waste. Only residential units partial segregated kitchen waste. Rest of the institutional unit are hardly seen to practice waste segregation. Residential units, administrative offices, academic units have waste collection and transportation facilities. Primary collection is the responsibility of those mention unit. Secondary collection is done by Estate Office.

Human powered and motorized vehicle are used for waste transportation. Rest of the units don't have any formal collection and transportation facilities [12]. Student hostels, Commercial places and medical

center are responsible for their own waste collection and transportation. They collect

waste and dispose it nearby low land, adjacent area or communal pits.

Table 4:-Waste Collection and Transportation

Institutional Unit	Availability of services	Frequency (Average)	Methods of collection	Types of transportation
Residential units	Available	Everyday	House to House	Human powered
Student hostels	Available only for kitchen waste	Everyday	Communal	Human Powered
Administrative offices	Available	Once in three days	Communal	Motorized
Academic units	Available	Everyday	Block	Motorized
Commercial places	Not available	-	-	-
Medical	Not available	-	-	-
Other Common places	Partially Available	Irregularly	Communal	Human powered
Street sweeping and drain cleaning	Partially Available	Irregularly	Communal	Human powered

Source: Estate Office, 2021

Waste Disposal Facilities

Both on-site and off-site disposal are practiced at the study area. Residential units, administrative offices and academic units practice off-site disposal system. Landfill methods are used for off-side waste disposal system. On the other hand, Student hostels, Commercial places,

medical places and other commercial places practice on-site disposal system. Waste is thrown directly adjacent lowland or vacant land in this case. Burning and incineration is often used for the off-side waste disposal for combusting waste and is shown in Table 5.

Table 5:-Waste disposal system

Institutional Unit	On-Site Disposal System			Off-Site Disposal System		
	Availability	Frequency	Methods	Availability	Frequency	Methods
Residential units	Available	Irregularly	Direct Throw	Available	Everyday	Landfill
Student hostels	Available	Everyday	Burning/L andfill	Available	Everyday	Landfill
Administrative offices				Available	Once in three days	Landfill
Academic units				Available	Once in three days	
Commercial places	Available	Irregularly	Seldom Burning	-		
Medical	Available	Every day	Open Throw	-		
Other Common places	Available	Once three days	Burning	-		
Street sweeping and drain cleaning	Available	Irregular	Landfill			

Source: Estate Office, 2021

Waste Segregation Scenario

Although there are no specific rules for waste segregation in the study area, there is some amount of waste segregation that is negligible compared to the need.

This is known from the questionnaire survey, observation survey and information collected from Estate Office. This segregation of Solid Waste of the University takes place in three stages.

In the first stage, the study area community segregates some solid waste in their residents at an early stage [13-15]. This practice is more prevalent among teachers and other residential staff than in student or visitor groups.

Experts say they have lived in the same place for a long time and have done so out of public awareness. The housekeeper also helps them in this matter. In this they are often economically benefited by segregated waste.

Many people set aside kitchen waste for fertilizer for the garden next to their house. These practices are not found within the student or visitor group.

In the second stage, informal labor who are locally named as Tokai engaged in recycling of solid waste for their livelihood at the on-site waste disposal point. Papers, plastic and metallic waste are segregated by those informal labor.

It is an informal labor initiative run by the poor people. They collect this waste and sell them Feriwalla or Vangari which make them economically benefited [16-18].

In the third stage, The Estate Office collects kitchen waste from the teacher or staff quarters and residential hall unit

mainly for biogas plants. Apart from kitchen waste, there are other kinds of solid waste.

The primary cause for this is a lack of community involvement. Estate Office workers separate kitchen waste from different types of solid waste for the biogas plant and the rest of the waste is dumped in the dumping zone for landfilling.

Manpower

It is estimated that more than three hundred employees are engaged in waste management system in Jahangirnagar university [19-20]. The major solid waste management in Jahangirnagar University is operated through Estate Office.

All the other units have their own staffs for solid waste management. Assists and coordinates the work of other office cleaning units by Estate Office when required for various occasions.

The estate office has only 25 employees for this work. But around 263 employees are engaged in Solid Waste Management except Estate office who are word both permanent and temporary basis are also supervised by the Estate Office.

Supportive Facilities for Waste Management

There are no suitable infrastructure amenities. Physical infrastructure refers to various communal pits, biogas plants, waste disposal zones, and bamboo-made dustbins in various public areas as shown in Figure 3.

During street cleaning of the area, waste from the waste along the lakeside accumulates.



Fig.3:-Dustbin (Bamboo made)



Fig.4:-Communal pit (on-site)



Fig.5:-Uncovered Van

A waste transportation system is partially available for transferring waste from on-site to off-site disposal [21-23]. Waste is usually disposed to different adjacent area, lake side low land and communal pit and limited option for collection and transportation as shown in Figure 4. If solid waste stores become out of their holding capacity at on-site disposal points, then only the estate office collects them and arranges for off-site dumping. Also, kitchen waste is collected from different teacher or staff quarter and student's hall that is transferred to biogas plant station. Metallic trolley, human powered or

motorized uncovered van are used for transportation purpose as shown in Figure 5 and 6. But these are very insignificant compared to the need.

For the collection of solid waste, there are plastic bins, small or big containers, shallow pits, and bamboo manufactured bins placed near various common areas, academic and administrative units, and residential units as shown in Figure 7 and 8. Residents in the research area also store their solid waste in plastic cases, shopping bags, polythene bags, and even paper bags.



Fig.6: -Metallic Trolley



Fig.7: -Large container



Fig.8: - Small container

Waste Dumping Station and Biogas Plant [Figure 9 & 10]

There are only one dumping area for solid waste of Jahangirnagar University. This one is located at northern part of the campus boundary which is locally known as "Rangamati", where Estate Office dumped their solid waste specially kitchen

waste [24]. There is also a biogas plant located here which is managed by the estate office. Solid waste is collected and brought here from different student halls of the campus, teachers and staff quarters and other places. Some of the waste from the BPATC area adjacent to the campus also comes here in their own transport

system. Biodegradable waste is segregated here before the waste is dumped [25]. They are then delivered to the gas plant and in return gas is generated. According to Estate Office the gas plant was

operational during the recent Corona period, it is operating on a limited scale but Infect inspection has shown abundant gas generation plant.



Fig.9: -Waste dumping zone



Fig.10: - Biogas plant

Onsite and Off-site Waste Dumping Station [Figure 11 & 12]

Here, both on-site and off-site disposal systems are used. The amount of waste that is disposed of off-site is a smaller percentage of overall waste [26-28]. For Jahangirnagar University's solid waste, there is only one dumping location. This one is on the northern university boundary, in a neighborhood known as "Rangamati,"

where the Estate Office dumped their solid waste, particularly kitchen waste. According to the Estate Office, there are 65 waste disposal points (WDS) that are used as on-site disposal points where burning disposal methods are used infrequently or regularly. The following two maps shows the geographical location of on-site and off-site waste dumping station.

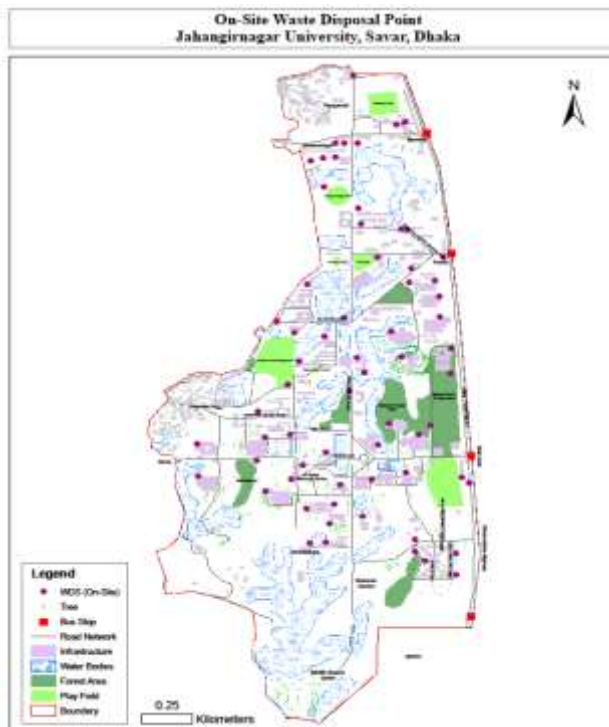


Fig.11: -Waste Dumping Zone (Off-Site)

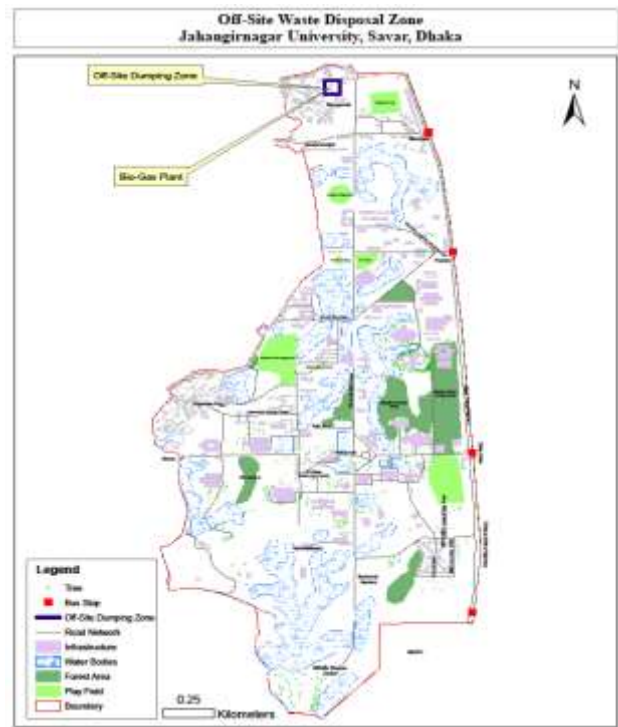


Fig.12: - Waste Dumping Sites (On-Site)

Existing Integrated Solid Waste Management System of Jahangirnagar University [Figure 13]

Solid waste management system has become increasingly complicated and considered as pressing problem of developing country. The waste management system of study area is also complex [29]. Jahangirnagar University consists of no proper waste management system except few contributions of Estate Office which manages only few portions of the total waste generate per day. Both one site and off-site disposal system are

practiced here. Off-site disposal method covers smaller portion of total waste. There are also a shortage of manpower and equipment for solid waste management at Jahangirnagar University. According to Estate Office, there are 65 waste disposal point (WDS) which is used as on-site disposal point where seldom or regular burning disposal methods are practiced [30-31]. Aside from the lakefront lowland and open area around the hall/resident units, most waste disposal sites are situated.



Figure 13: Existing waste management system

Source: Developed by Author, 2021

There is just one dump site on campus, which is situated in the northern portion of the university and is referred to as "Rangamati" by locals. After segregation, the estate administration collects kitchen garbage and dumps it here. Other separated garbage is thrown straight into the disposal facility, while kitchen waste is utilized to make gas [32]. However, a significant portion of the garbage is not properly treated.

When putrescible organic wastes are mixed with lake water, the resultant wastes not only degrade the aesthetic value of the campus, but also induce a range of ailments in the residents. Due to the lack of a waste management strategy, the university authority confronts several issues in trash management.

General Facilities of Integrated Solid Waste Management at Jahangirnagar University

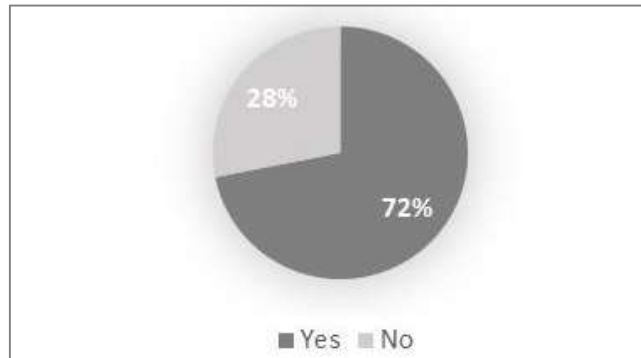
Availability of Storage Facilities [Figure 14]

Respondents were asked whether they have storage facilities. The answers are reflected in the following pie diagram. As can be seen here, 80 percent said they have storage facilities, and the remaining 20 percent have no storage facilities.

Hence, as far as storage facility is concerned, at individual level, its existence is widely found. Thus, respondents are not unaware of storing waste - which crafts the first base of waste management – that is scope of organized waste collection.

The above finding confirms the idea of waste storage facilities embedded in the ISWM concept. That indicates, contextual imprint of storage idea of IWSM. Source reduction is one of the fundamental elements of ISWM where well design

waste storage facilities play an important role here to help people store both recyclable and not recyclable waste which can reduce volume of waste.

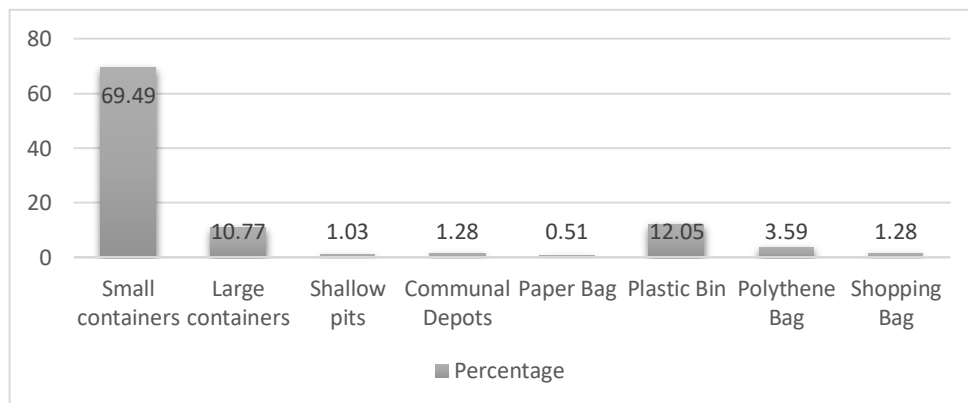


Source: Field survey 2021
Fig.14: -Availability of Storage Facilities

Type of Storage Facilities

Eight types of storage facilities mainly been found in the campus. These are – small containers, large containers, shallow pits, communal depots, paper bag, plastic bin or cage, polythene bag and shopping

bag as shown in Figure 15. Majority of the respondents use small container to store their waste, which is almost 70% of 397 respondents. 11% respondents use large container and 12% respondent use plastic bin or cage to store their waste as well.



Source: Field Survey 2021
Fig.15: -Types of Storage Facilities

According to the FGD and observation survey, most respondents have small containers for waste storage but do not have separate containers for segregation [32]. Also, the informal equipment such as paper bag, polythene bag, shopping bag and plastic case or bin that is used for

storing waste is used as an alternative as there is no formal storage equipment.

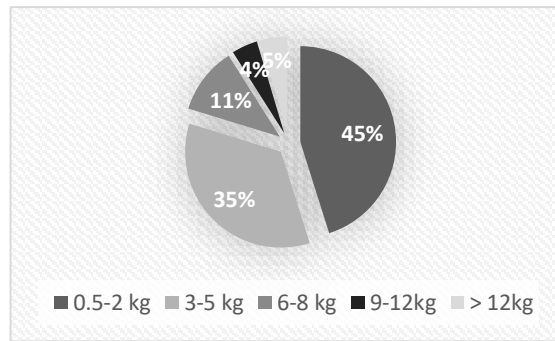
Quantity of Storage Facilities

The quantity of storage facilities has been divided into five categories: 0.5-2 kg, 3-5 kg, 6-8 kg, 9-12 kg, and more than 12 kg. Most of the respondents have 0.5-2 kg

storage facilities of the study area, they are 45% of 397 respondents. 35% of the respondent have 3-5 kg storage facilities as shown in Figure 16.

Most of the field survey respondents are students who live in different student halls

and most of them have a household size of 3 to 4 people. Again, it is seen that most of the residents have storage volume up to 2kg and the second majority group has up to 5kg. This is sufficient according to the population distribution in the campus area.



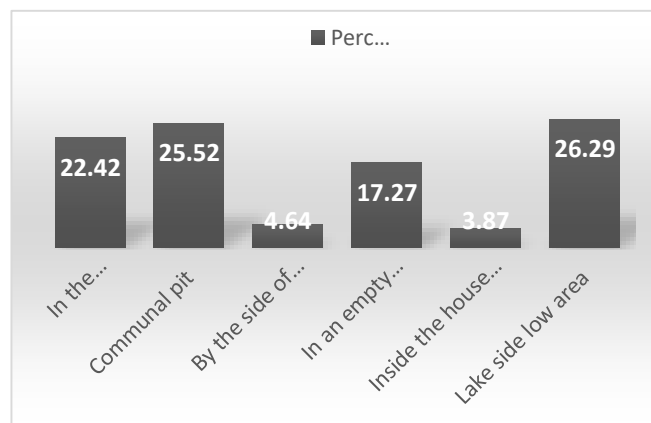
Source: Field Survey 2021

Fig.16:- Quantity of Storage Facilities

6.4 Household Waste Disposal Point (On Site)

Figure 17 shows the household on-site waste disposal point according to respondents’ practice. 26.29% disposes their waste at lake side low area, followed by 25.52% disposing at communal pit.

22.42% respondent uses communal bin, 17.27% respondent disposes at an empty space near their house [33]. In general, the results showed that 4.64 % dispose of their waste by the side of the road, while 3.87 percent utilize their home as an on-site waste disposal location.



Source: Field Survey 2021

Fig.17: - On-site household waste disposal point

According to the FGD and observation survey, due to the lack of adequate communal bins or pits, most of the waste primarily disposed in lowlands and open spaces around roads or residential areas where there is no treatment for waste but

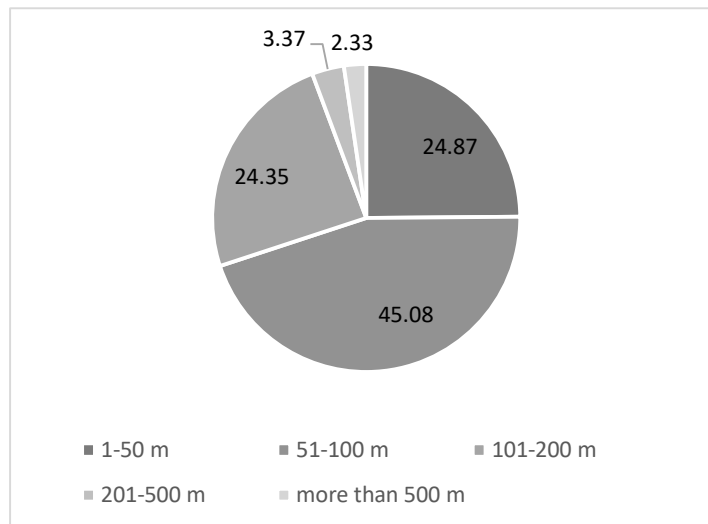
only seldom burning that is harmful to the environment and health [34].

Maximum Walking Distance (m) of On-site Waste Disposal [Figure 18]

There are five types of walking distance for on-site waste disposal points mainly

have been categorized. 1-50m, 51-100m, 101-200m, 201-500m, and more than 500m are the categories. Majority of the respondents must walk 51-100 m for on-site waste disposal, which is almost 45%. 24% respondent must walk 1-50m or 101-150m distance to dispose their waste.

According to ISWM, the walking distance for on-site disposal should not be too low nor too high. Too close can spread bad odors or germs in the residential area, and too far can lead to reluctance to walk [35]. According to the results of the field survey, most the study area's on-site disposal sites are near together.



Source: Field Survey 2021

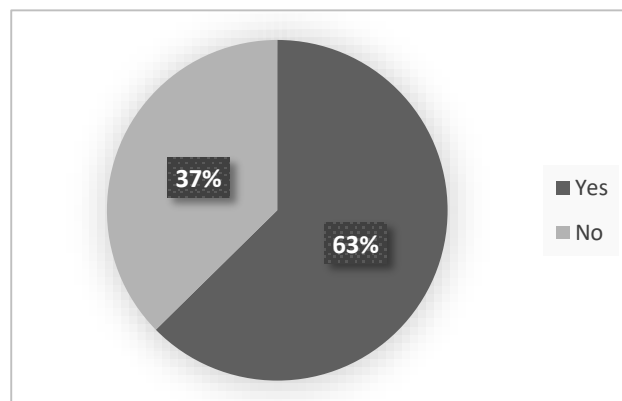
Fig.18:-Maximum walking distance for on-site disposal (m)

Availability of Secondary Waste Collection Service [Figure 19]

Respondents were asked if they have secondary waste collection facilities that are reflected in the following pie diagram. As can be seen here, 63 percent said they have secondary waste collection facilities, and the remaining 37 percent have no

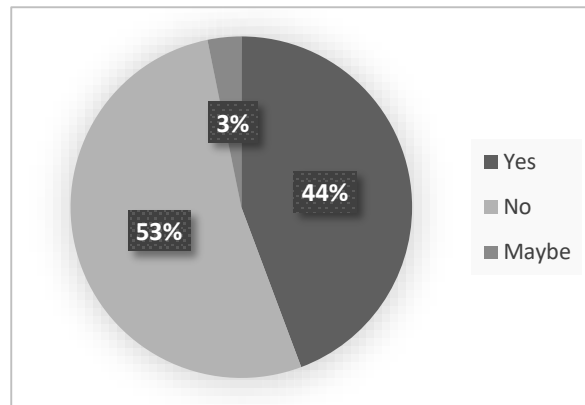
secondary collection facilities.

Findings from FGD and secondary data analysis follows a pattern like above. The study area has secondary collection facilities only in residential units, but this is limited to kitchen waste only. It is also hardly seen that waste is collected and taken away from the on-site disposal point.



Source: Field Survey 2021

Fig.19: -Availability of secondary waste collection service



Source: Field Survey 2021

Fig.20: -Availability of waste transportation services

Availability of Waste Transportation Service [Figure 20]

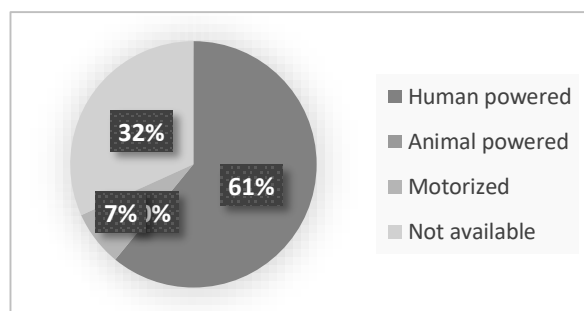
Respondents were asked if they have waste transportation facilities that are reflected in the following pie diagram. As can be seen here, 44 percent say that they have waste transportation facilities and 53 percent have no transportation facilities. The remaining 3 percent respond don't have any idea about waste transportation.

The results of the FGD follow a pattern like the one described above. Only residential units in the study area have secondary transportation facilities, which are limited to kitchen waste [36]. As a result, most of the waste is disposed of at on-site waste disposal sites.

Types of Waste Transportation Facilities [Figure 21]

From the survey period there are four types of waste transport facilities are categorized, they are – human powered (non-motorized), animal powered, motorized and without vehicle. Majority of them are human powered (non-motorized), which is almost 61%.

Findings from FGD and follows a pattern like above. Almost all waste transport vehicles in the study area are non-motorized uncovered vans. Although motorized vehicles are not allowed on campus, several motorized vehicles can be seen for waste transportation purpose.



Source: Field Survey 2021

Fig.21: - Types of waste transportation services

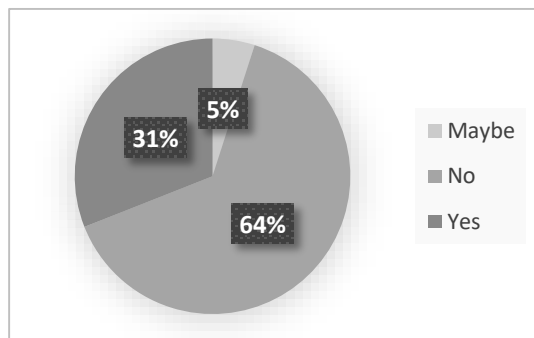
Availability of Waste Disposal Facilities (Off Site)

Respondents were asked whether they have off-site waste disposal facilities. 31 percent said that they have off-site waste

disposal facilities and 64 percent have no off-site waste disposal facilities. The remaining 5 percent respond don't have any idea about off-site waste disposal facilities as shown in Figure 22.

Findings from FGD and secondary data do not follow a pattern like above. There is a secondary waste dumping point (off-site) on campus that is much smaller than

needed and many of the respondents are unaware of this. This dumping station was originally built for the biogas plant project here for landfilling's.



Source: Field Survey 2021

Fig.22: - Availability of off-site waste disposal facilities

Respondent’s Satisfaction Level on Existing Solid Waste Management

When participants were asked whom, they know about the integrated solid waste

management at Jahangirnagar University, the responds as follows in Table 6.

Table 6: -Respondent’s Satisfaction Level on Existing Solid Waste Management

Satisfaction Level	Frequency	Percentage
Highly satisfied	23	5.8
Satisfied	85	21.4
Undecided	37	9.3
Dissatisfied	182	45.8
Highly dissatisfied	70	17.6
Total	397	100.0

Source: Survey Data, 2021

Note: 1= Highly satisfied, 2= Satisfied, 3= Undecided, 4= Dissatisfied, 5=Highly dissatisfied

In this statement, from descriptive statistics the mean value is 3.48 found. That means that the majority of respondent reported dissatisfied with the statement of satisfaction level with the waste management system at Jahangirnagar University as is seen in the mean of 3.48. Satisfaction with a management system also increases the tendency for the community to participate. Respondents in this study area are not satisfied with the present waste management that will demote them in terms of participation in integrated solid waste management.

Problem Associated with Waste Management of the Study Area

FGD, observation survey, and secondary data analysis can reveal solid waste-related issues in the research area. This not only throws a wrench in the integrated waste management process, but also has a detrimental influence on community participation.

Segregation of Waste

Wastes are dumped in dumping area without following any segregation method.

Sometimes housemaid of teachers and employ segregates the waste as kitchen waste and general waste, but waste collector collects them and dump them together. There are no waste segregation bins in the study area. Except from household waste are segregated by informal workers (tokai) at on-site dumping zone and kitchen waste are segregated by formal employ which is supervised by Estate office at waste dumping zone or landfill site of the study area [37]. But awareness and waste segregation practice are hardly seen by the student's community of the study area.

Uncovered Vehicle for Waste Transportation

University authority use uncovered vans for transferring the waste from collection point to disposal point. Wastes can be easily spread beside the when these are transferred. Human powered van is uncovered, for these various types of wastes are easily spread beside the transportation route and odor also spread.

On-site Waste Dumping

For on-site waste dumping practice, waste is dumped beside the roadside open space, lakeside lowland, open premise of the house, in an empty space near house and communal pit by university worker. Regular or seldom burning method are used which hamper the environment heavily as well as human health.

No Treatment Method for Waste Management

Solid wastes are disposed of in an open manner with no treatment. Solid waste is composted in holes dug near certain halls and botanical gardens, while some waste is recycled at the Rangamati dumping zone. In some cases, it is burned seldomly. But very insignificant compared to a need. Without any treatment the wastes are

serious risk for water, soil, and air quality of the dumping area.

Absence of Waste Management Future Plan

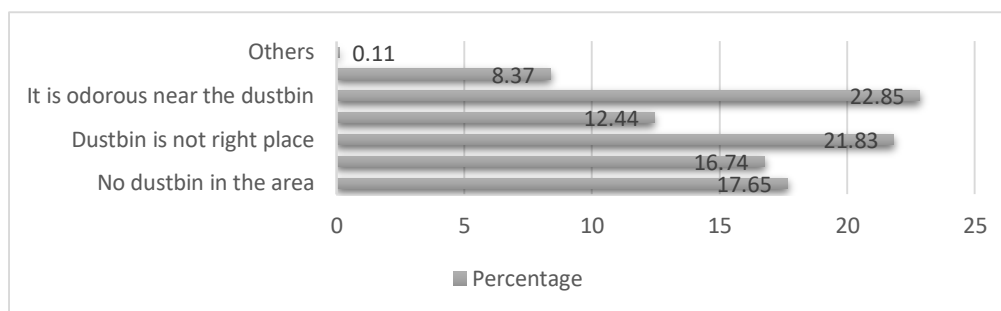
University authorities don't have any fixed dumping station for long term and don't have any proper waste management system now. But they don't have any future also about this issue. University authority should take initiative immediately about this process, but they don't do that even now.

Problems Facing for Disposing Solid Wastes on Dustbin [Figure 23]

This analysis displays those problems facing for disposing solid waste on dustbin within the study area. 22.85% of the surveyed peoples said that there is odor near the dustbin where 21.83% of the people claimed that dustbin is not right place. And 17.65% of the total respondent don't find any dustbin facilities. 16.74% respondent said that dustbin is far away from their area and 8.37% of the respondent said that capacity of the dustbin beyond the volume of waste.

The same picture can be seen from the data obtained from FGD. There is a crisis of public dustbins on campus which has resulted in many people being seen dumping waste everywhere. This pollutes the surrounding environment.

Also, dustbins are often overflowing due to lack of regular waste collection, which gives off a strong odor. The above finding contradicts the concept of ISWM embedded in the TF. According to ISWM, there should be adequate dustbin or regular collection system for waste collection which was not seen in the above discussion.



Source: Field Survey 2021

Fig.23: - Problems facing for disposing solid waste on dustbin

RECOMMENDATION

For the Jahangirnagar University Authority

- The University Authority should take the required efforts to collect money from all inhabitants to enhance the management system, as most of them are prepared to pay.
- To guarantee proper operation of the services, the authority shall have a vehicle specialized for solid waste collection, as well as other essential equipment and protective clothing for solid waste collectors.
- Every Friday morning, the University Authority should establish/revive a cleaning day operation for the entire community to guarantee that everyone is participating.
- All stakeholders should collaborate to ensure that solid waste management rules and regulations are properly organized and coordinated.
- The Estate Office will develop the Students Hall Cleaning Unit to the point where it can deliver community-satisfying solid waste management services while following to all applicable rules and regulations.
- The University Authority should devise techniques for instilling in the community the value of solid waste collection, storage, and disposal.
- Some steps should be made to enhance solid waste management choices based on necessity. Solid waste management in the study area is something that has to be properly considered. The system encompasses all operations related to solid waste collection, transportation, processing, and disposal.
- A disposal site must consider all socioeconomic, environmental, and land use issues as well as people's safety inside the research area.
- On a regular basis, all the study area's personnel and solid waste collectors should be actively and intensively taught on all elements of waste management and its consequences. There is a need to concentrate on waste segregation at the point of generation.
- The University Authority should collaborate with the community, micro or small businesses, and community-based organizations to develop an appropriate payment mechanism for solid waste services to enroll all households within the jurisdiction and ensure that services are delivered effectively.
- The budget for solid waste management services at the university should be increased, which would include the acquisition of adequate solid waste collection and disposal trucks, as well as garbage collector safety equipment.

- Solid waste management should also use appropriate treatment procedures. Waste deposited in the lake near to the campus medical center has the potential to harm the lake's ecosystem. Before being disposed of, this medical waste should be treated properly.

Co-operation Among University Authorities, Estate Office and Residential Hall Units

The university administration, estate office, and all residential hall unit healthcare departments must work together to create solid waste management rules and regulations that are applicable to all students in the study area and take social and environmental concerns into account. These solid waste rules should take into consideration the university's apartheid heritage, which continues to exist and has had severe environmental and waste management implications. Therefore, to create an integrated system, it is vital that all of the components work together. The estate office and the residential hall unit must collaborate and be transparent to maintain great working relationships, particularly when it comes to solid waste management.

CONCLUSION

This research found that in the study area, effective integration of solid waste management, mostly in formal settlements, has yet to be realized. This is due to a mix of factors that may be classified into two groups. First, there is a lack of authority commitment to the plan's implementation. Second, both authority and resident of the study area either partially or not at all adhere to existing standards and rules. Meanwhile, most households are aware of the laws and regulations and can afford the solid waste collection service fee. Despite this, the authority has taken no measures to collect payment for future solid waste management development. The university administration has shown a lack of

attention in enforcing existing rules and standards. The university's refusal to embrace contemporary solid waste management technology, mobilize, organize, and coordinate local resources, and enforce laws and regulations has hurt the solid waste management plan. It illustrates the university administration's aversion to implementing the strategy. Residents in the study area face serious health and environmental hazards if the waste management system is not effectively maintained. Waste segregation, collection, transportation, and ultimate disposal all require careful thought. The regulations for managing solid wastes must be appropriately updated. It is critical to identify recyclable waste and separate it from general waste at the site of solid waste generation. Solid waste treatment facilities that are contextually suitable are badly needed. To solve the problem of influencing the built environment, an appropriate solid waste disposal system should be implemented. Due to a lack of effective management and coordination, efforts to produce biogas from waste on campus were unsuccessful. Many methods can create energy from waste, thus the government, as well as numerous NGOs, CBOs, and micro or small businesses, should be given a chance. This will also increase the interest and participation of the community of the study area.

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