

## **Municipal Solid Waste Management and Environmental Awareness: Household Survey Study on Dhamrai Municipality**

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### **ABSTRACT**

*Bangladesh is a developing country. With the time period of the development, the amount of waste is increasing and the effective management and legislation of this waste has become an important issue. Every year, this solid waste tends to increase; it will inevitably create a great solid waste management (SWM) burden for local administrations. Solid waste is becoming a major problem in Dhamrai Municipality. The study is to looking for the existing solid waste management practices, analyze the present waste management system and find out some basic problems related to solid waste management system in Dhamrai Municipality. This study reveals that ward 5 and ward 6 in Dhamrai Municipality represent a different scenario of solid waste management. Primary data collection includes questionnaire survey, observation survey, photographs taking, interview of the officials, etc. was made for find out an overall perception of the study area. This study finds out that almost 50% solid wastes dump on a roadside and 30% dumping in vacant land. 30% waste used to recycle process. Almost 45% wastes are responsible for environment pollution. That's why people suffered from different kinds of diseases like fever, dysentery, malaria, skin diseases, etc. Unfortunately, the conventional disposal method employed by most local administrations is open dumping without considering health, hygiene and environmental issues. This study reviews the storage, collection, disposal, management, and recycling policies for SWM in Dhamrai Municipality. SWM is related with tangible and intangible factors namely environment, health, community, education, finance, technology, governance, policy and regulation. If these factors are addressed properly, SWM can be sustainable and can enhance governments capabilities.*

**Keywords:-***Municipality; solid waste; management; disposal; suitable temporary storage location, recycling*

### **INTRODUCTION**

Solid Waste Management (SWM) is a significant facet of environmental hygiene and it urgent to be integrated with total environmental planning (WHO Expert Committee, 1971). Rapid urbanization, industrialization, population growth and changing consumption patterns are generating amounts of solid wastes. Solid waste is used to describe non-liquid waste

materials arising from domestic, trade, industrial, commercial, agricultural activities and from public services [22]. A solid waste management system is the framework by which the whole activities concerning solid waste come to pass. The ever-increasing global issue on environmental health demands that waste should be correctly guided and disposed of in the most friendly and acceptable way [7].

In developing countries most of the municipal solid waste (MSW) is dumped in an open space or roadside in an uncontrolled manner. These dumps make uneconomical use of the available space, allow free access to waste pickers, animals and flies sometimes produce unpleasant and dangerous smoke from slow-burning fires. About 90 percent of the collected waste finally ends up in open dumps or just burned in the back yards which are the most common disposal methods in developing countries, according to Cointreau, 2007 the rate of safe disposal is extremely low in developing countries as middle-income countries and low-income countries dispose 30% and 5% of collected waste respectively [14,38]. The water body is deteriorated day by day [25] by the haphazard dumping of the solid waste besides the water body and into the water the quality of water is degrading in a large scale [22] and contributing to create heat island [26]. The DO of canal, pond, drain fall water and tube well water are 2.3, 0.2, 0.1 and 3.4 respectively which is very low than the WHO standard [23]. These pollution increasing difficulties for the access of water for poor people [16]. Moreover the uneven dumping of waste in water creating negative impacts on wetland in Dhamrai municipality as their consequences [18]

It is simple in developing countries to send 20-50% through municipalities of their available recurrent budget on solid waste management. Yet, it is also normal that 30-60% of all the urban solid waste in developing countries is uncollected and fewer than 50% of the population is served. In some studies, as much as 80% of the collection and transport equipment is out of service or need of repair/maintenance. Open dumping with open burning is the norm in most developing countries [34]. In less economically developed countries, land pollution and solid waste generation have become main issues [1]. The possible reason of land pollution includes rising

standards of living, technological development, growing populations, increase in income per capita income. Moreover, municipal services be governed by suitable revenue collection [11] and some issues need to implement resilient city and community [3] for proper waste management and to implement master plan of the municipality [12]. Development of Municipality and service delivery as like as waste management has a significant with revenue collection [19] Proper management of waste helps to attributing amenity facilities as like as recreational and playground facilities also [27]. Solid waste mainly comes from domestic, industrial and social institutional activities [9,31]. Four major ways of solid waste disposal composting, incineration, land filling and recycling [2]. It is essential that storage facilities be as far as possible, animal proof, insect proof and weather proof, waste able and robust enough to decrease the transmission of diseases from the bins to people and breeding of mosquitoes within the nearby storage facilities. Furthermore, the proper waste management will be helpful for effective drainage plan of a municipality [24].

### **AIM AND OBJECTIVES**

The aim of the study is to looking for the existing solid waste management practices, analyze the present waste management system and find out some basic problems related to solid waste management system in Dhamrai Municipality. The main objectives are:

1. To explore the existing condition of solid waste management system of study area.
2. To evaluate each stage of waste management system including waste collection and disposal.
3. To quantify and characterize of solid waste generated and identify the problems related to solid waste management system within the study area.

**STUDY AREA**

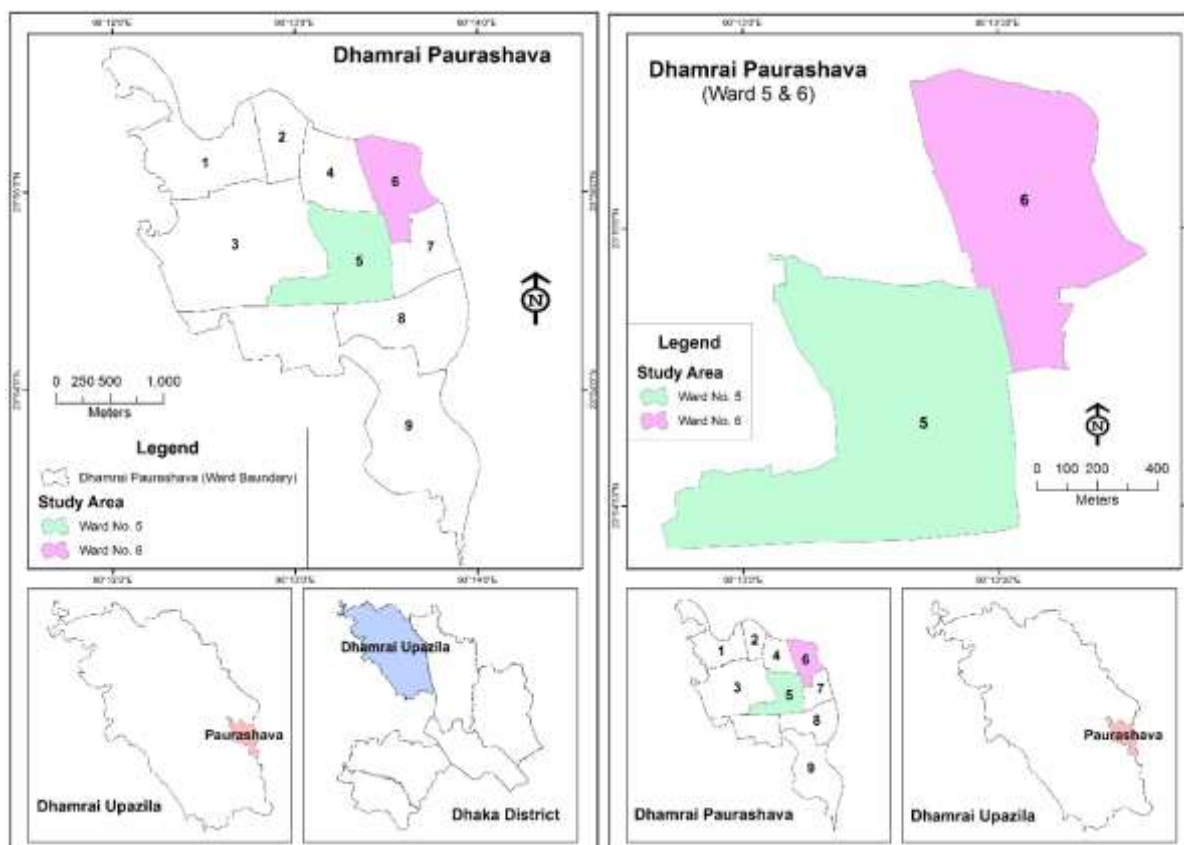
Dhamrai Municipality is located within the Dhaka Zila at a distance about 39 km from the District Town and on north-east part of Dhaka Zila. Dhamrai Municipality was

established in June, 1999 with consisting 9 Wards and 29 Mahallas. The area of Poura town is 6.98 sq.km. (Social Safe guard Assessment Report, 2018) as shown in Table 1.

*Table 1:-General Information About Dhamrai Municipality*

General Information	Number & Quantity
Date of Establishment	1999 (A category)
Total Area	6.98 sq. km.
Total Wards	09
Population	145390 (M: 75455 & F: 69935)
Number of Household	29500
Population density	2080/sq.km
Population Growth rate	1.92%
Major status	Local & Migrate peoples
Main Income source	Business, Silver necklaces, Service & Agriculture
Holdings number	6300 (Res.-6270 & commercial 13 and Govt 17)

(Source: [29])



*Fig.1:- Study area: Dhamrai Municipality (Ward no: 5 and 6)  
(Source: Developed by Author, 2020)*

**METHODS**

Primary data collection includes questionnaire survey, observation survey, photographs taking, interview of official

etc. In the questionnaire survey total 120 sample were collected from 5 and 6 no wards of Dhamrai Municipality. Interview of conservancy department of Dhamrai

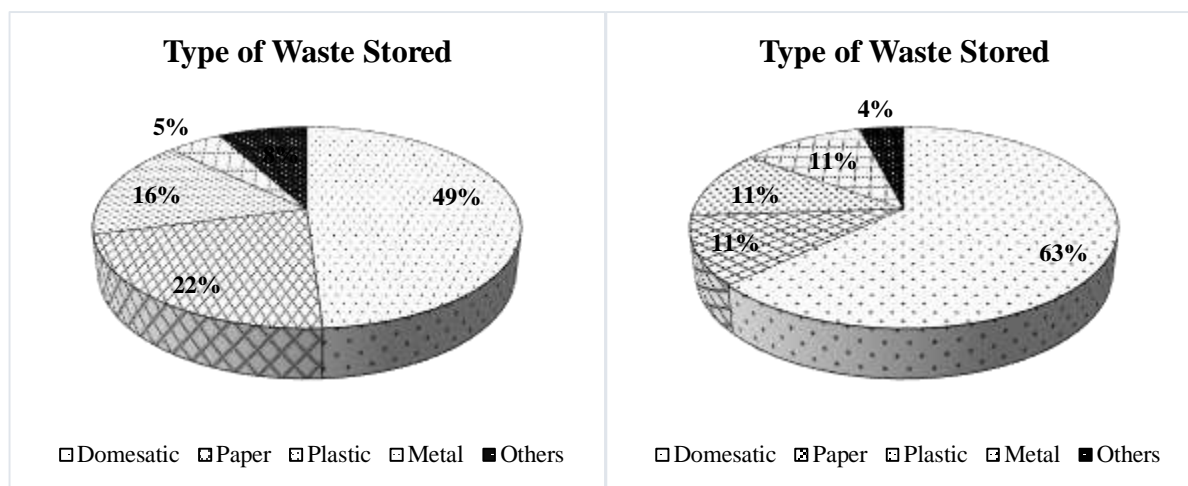
Municipality was done by some questions related to solid waste management. Observation survey was made for find out an overall perception of the study area which is related to solid waste management system in the study area. Secondary data were collected from Dhamrai Municipality, articles, journals, etc.

**OVERVIEW OF MUNICIPAL SOLID WASTE**

**Type of Waste**

Municipal Solid Waste (MSW) composition varies depend on the life style of municipal people, economic condition, industrial structure and waste management

regulations of the country. The quantity and the composition of the solid waste are critical to appropriate handing and managing. Different studies mentioned that the municipal solid waste is originated from the developing countries are mainly from households (55-80%), followed by market or commercial areas (10-30%). The later includes variable quantities generated from industries, streets, institutions and many others [21]. Their composition are domestic waste, plastics, metals, papers, rubbers, leather, batteries, demolishing and construction materials as well as many others that might be difficult to classify.



**Fig.2:-Types of waste (ward 5 & 6)**  
Source: Questionnaire Survey, 2019

In the study area domestic waste are stored more than other waste. The Figure 1 exposed that in the ward 5 paper waste more stored than ward 6 respectively 22% and 11%. In ward 6 papers, plastic, metal all of are stored at 11% where in ward 5 plastic and metal waste are stored respectively 16% and 5%. Domestic waste stored in both wards respectively 49% and 63%.

**Generation of Waste**

Solid waste generation is an issue of anxiety everywhere in the world, especially in all urban areas.

SWG and composition influenced by socioeconomic factors consisting of the average family size, number of room(s), monthly income, and employment status.

**Table 2:-Waste generation percentage**

Ward 05		Ward 06	
Waste generation per day	Percentage	Waste generation per day	Percentage
Below 1 kg	69%	Below 1 kg	45%
1-5 kg	25%	1-5 kg	55%
More than 5 kg	6%	More than 5 kg	0%

Source: Questionnaire Survey, 2019

In ward 5, everyday less than 1kg waste is generated by 69%, 1-5 kg by 25% and more than 5 kg by 6% respondents where in ward 6, people generate 45% below 1 kg, 55% between 1-5 kg. This is much different from ward 5 (Table 2).

### Population Distribution

In total, 14380 households are living in the Paurashava according to the Population

Census 2011. Highest number (2243 households) of households is found in the Ward No. 9. and second highest concentration of population is found in ward 8. Ward No. 2 and 4 are predominantly commercial area; Ward No. 7 are mostly using as agricultural area, so population concentration is lower in those wards than other Wards (Table 3).

**Table 3:-Household, population and density according to the Ward**

Ward No	Population	Household	Area (in acre)	Area (in sq.km)	Density per sq. km	Population 2020 (Present)
5	6181	1679	168.31	0.68	9,071	7534
6	6551	1730	105.70	0.43	15,308	7984

Source: BBS, 2011, Physical feature survey, 2019 and calculated by the Authors (Considering Urban growth rate 2.70, Municipal Master Plan)

### Determination of Solid Waste Generation in Dhamrai Pourashava

Base Year (2011) Population = 6181 for

ward 5 and 6551 for ward 6 (Source: BBS, 2011 and projected from Master Plan) (Table 4).

**Table 4:- Waste Generation Capacity**

Standard (LGED and UDD)	Ward 5	Ward 6
Domestic waste at 0.25kg/cap/day	1,884 kg/day	1,996 kg/day
Commercial waste at 8% of domestic waste	151 kg/day	160 kg/day
Market waste at 12% of domestic waste	226 kg/day	240 kg/day
Institutional waste at 3% of domestic waste	57 kg/day	60 kg/day
Hospital/Clinical waste at 1kg/bed (Considering 300 beds)	0 kg/day	0 kg/day
<b>Total</b>	<b>2,318 kg/day</b>	<b>2,456 kg/day</b>
	2.38 M.T./day	2.46 M.T./day

Note: Calculation is based on a survey conducted in Mymensingh Pourashava by LGED in collaboration with STIDP and ISP Consultants and other study reports.

Per Capita Waste Generation Capacity

= 2318/ 7534 = 0.3077 kg/day in ward 5

and = 2456/ 7984 = 0.3076 kg/day in ward number 6

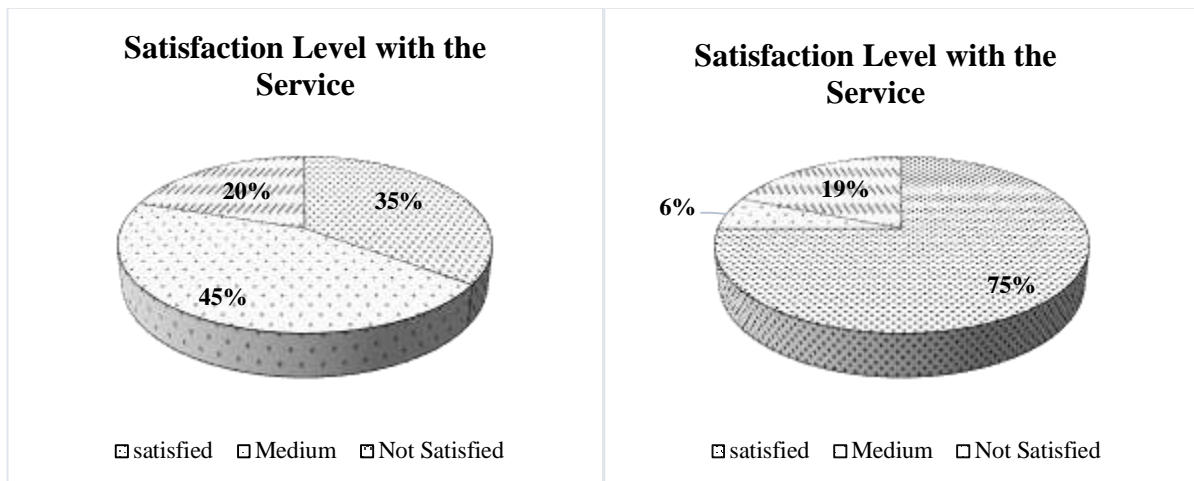
So, in ward no 5 and 6 totally more than 4.84 M.T./Day solid waste are generated.

### Services of Waste Collection

Different studies explained that solid waste collection, storage, generation and finally disposal are a major problem in urban areas as like as cities. There are some issues that affect the MSW management in most countries. These issues are socio-cultural, economical, legal/political environmental and available resources etc. affect the

management of MSW. In ward 5, People pay 53% below 60 tk., 41% above 60, and 6% below 30 for waste collection. In ward 6, people pay 60% below 60, 35% above 60, and 5% below 30. Though people have different percentage of money which they do pay but most of the people pay money above 60%.





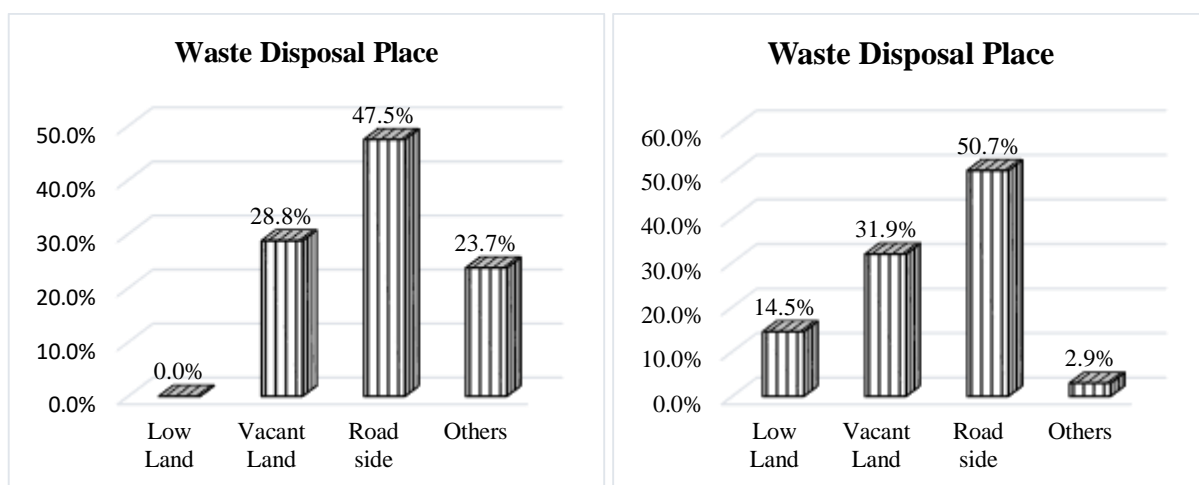
**Fig.2:-**Satisfaction Level of the Respondents about Waste Management (ward 5 & 6)  
Source: Questionnaire Survey, 2019

After analyzing the data, it observes that in ward 6, most of people are satisfied with existing service system (75%). The Figure 2 also focused that in ward 5, only 35% people are satisfied.

**SOLID WASTE DISPOSAL**

Inappropriate collection process, transfer system, improper bin collection has great effect on the management of solid wastes. Alongside, the poor planning, inappropriate solid waste collection knowledge, lack of vehicles for waste collection, poor streets system and insufficient infrastructure has also effect on management of municipal

solid wastes. Tadesse et al analyzed that there are some factors that has impact on household waste disposal. They explained that the supply of waste facilities directly affects the disposal choice of waste in most cases. Their result showed that insufficient supply of waste bins/containers alongside the long distance of transferring these bins enhances the possibility of waste dumping in roadside and open areas along the trip [30]. Inadequate financial resources, absence of legislation, well equipped landfills etc. affect the safe disposal of solid waste.



**Fig.3:-**Disposing Place for Domestic Solid Waste (ward 5 & 6)  
Source: Questionnaire Survey, 2019

As per the graphs, both the graph says that

wards 5 and ward 6 both places domestic

solid waste are mostly dumped at road side. The percentages of dumping at vacant land are almost same at ward 5 and 6. But in ward 5 wastes are less thrown at low lands than other places, whereas in ward 6 wastes are thrown less in other places than low land (Figure 3).

### **Disposal of Plastics Waste**

Amount of 50 million tons of post-consumer plastic waste is generated yearly by Europe, USA and Japan. Disposal of those plastic wastes in landfill is considered a non-sustainable from the environmental point of view. On the other hand, law is stringent worldwide. USA law and several European directives are concern with plastic wastes disposal and management [13].

As plastics are basically hydrocarbons, they possess a calorific values ranged between 30 and 40 MJ/kg. Thus, they may be annealed or incinerated in the municipal or other dedicated wastes with power and heat generation. They can also serve as an extra fuel to replace the fossil fuels in several production processes such as blast furnaces and cement kilns. A complete wreck of those plastics wastes can be achieved by such thermal applications. This also leads to one of advanced pollution control measures.

### **Disposal of Municipal Solid Waste**

Nearly 71% of Municipal solid waste are finally disposed in landfills worldwide [37]. Batteries, paints, pharmaceutical products, vehicle products and many other mercuries containing risky waste are includes in municipal solid waste. Almost 53% landfilled waste contain hard board paper, papers, yard waste and food waste that are mostly biodegradable through aerobic bacteria [10].

Most of MSW's in addition to many other solid wastes are disposed of in landfills. Thus, a basic information of the landfill

design is helpful. For example, in the USA, the layout and operation of landfills is regulated by the New Source Performance Standards of the Clean Air Act, and Subtitle D of the Resource Conservation and Recovery Act, also other related state regulations. Therefore, landfills have evolved from just open dumps to highly engineered facilities and site that are designed to include waste. A landfill site is designed as usually excavated and lined with a system that includes layers to protect groundwater by minimizing the migration of leachate to the ground layers and to collect such leachate for treatment.

### **Solid Waste Disposal Problem in Developing Countries**

Disposal of garbage as solid wastes is a stagnant and extensive problem in both urban and rural areas in several developing countries. Several Canals and drains as open places are broadly wont to dump sorts of garbage as a source of domestic organic and inorganic waste. Because of the inexistence of continuing waste collection system, suitable landfills, open drains as well as canals are being blocked by huge amount of solid waste dumping. These wastes are mainly containing plastic, papers and some toxic materials. This toxic hazardous material contributes to the environmental degradation through the breakdown of their degradable constitutions as well as adds some loads of the BOD to the local ecosystem.

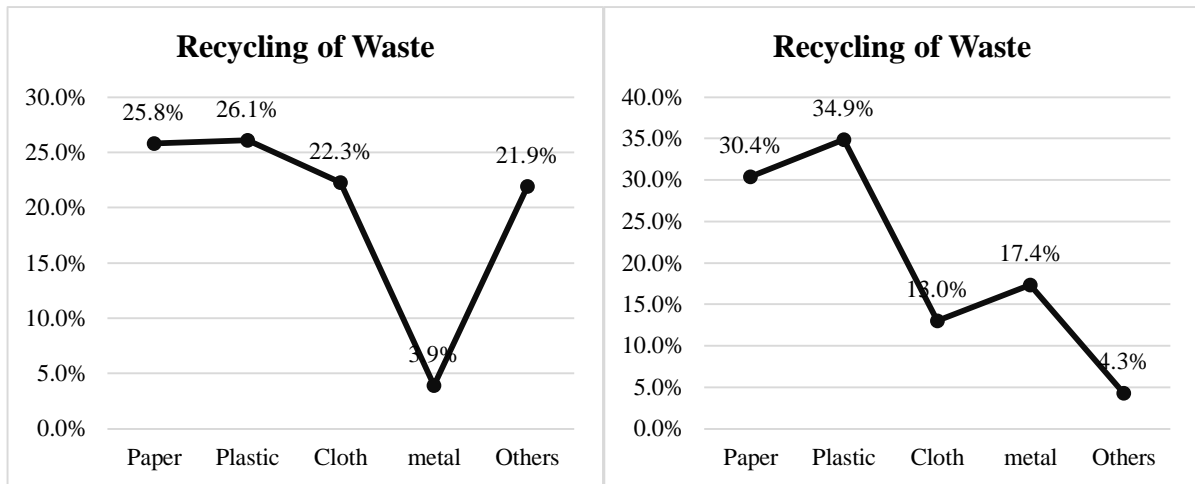
Disposal of garbage solid waste and of untreated flowing into the nearby drains by people is; thus; irresponsible and aren't conscious with the sequences of their health hazard. Individual see that the manner they dispose their wastes is effective and cheap. In fact, it is severe disaster for the surrounding communities and to the country. The large amount of water bodies is easily polluted by small amount of effluent. In the meantime, without taking

proper decision laws could not be effective to prevent the environment.

**MANAGEMENT AND RECYCLING OF SOLID WASTE**

Effective planning and techniques to quantify and categories of solid waste are importance for sustainable management of such waste. Management of MSW must be technically feasible, financially sustainable, socio-environmentally friendly and legally suitable through the appropriate planning and techniques. However, management of waste in an adequate way can surely lessen or save GHGs emissions via different ways including: energy production, application

of compost to soils as fertilizers, storing carbon in landfills, and by avoiding the initial materials through material recovery from waste. According to UNEP, the internationally recognized institutions recommended a future waste prevent focused on the 3R concept (Reduce, Reuse, and Recycle). These 3R are waste prevention, circular economy establishment, purifier productions, and valorization of the waste by transformation into a source of energy and materials [32]. The insufficient waste management cause alteration the ecosystems including air, water, and soil pollution; thus, it represents a real threatening to human health.



**Fig.4:-Recycling of Waste (ward 5 & 6)**  
Source: Questionnaire Survey, 2019

Here in both ward 5 and ward 6 there is no exact flow of the graph of recycling of waste part. The graph is upward or downward sloping only. In ward 5 paper and plastic are mostly recycled or sold. But in ward 6, plastic is mostly sold or recycled only. In ward 6, the percentages of recycling waste parts are too small amount (Figure 4).

Gonzalez-Torre and Adenso-Diaz stated that social influences, altruistic and regulatory factors are important reasons why certain communities can develop strong recycling habits [15]. The author additionally expressed that individuals who

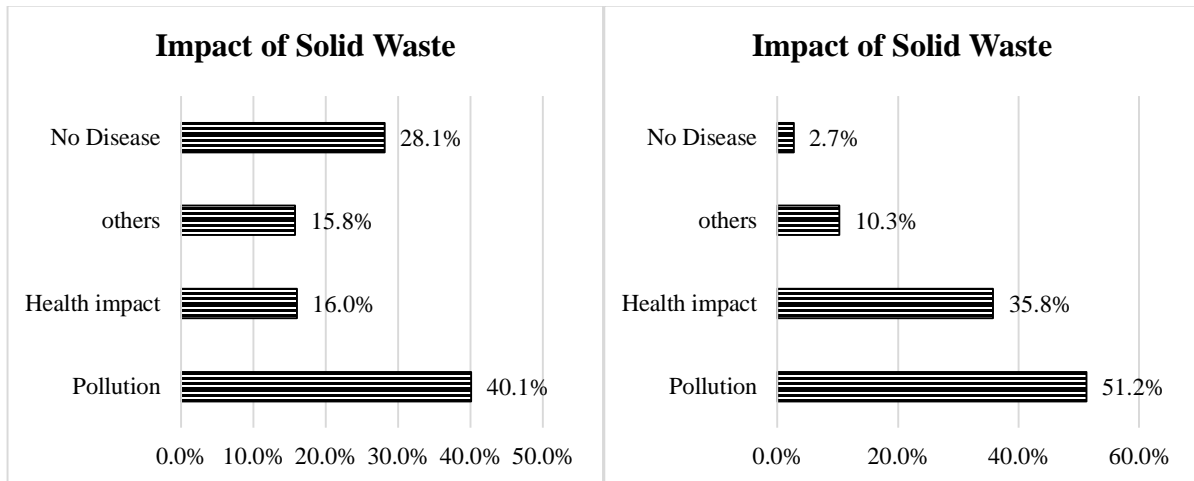
oftentimes move to dispose their refuse within the bins are more probably to recycle certain products at home. In most cases, as the distance to the recycling containers reduces, the number of fractions that people separate, sort and collect their solid waste at home rises. Minghua et al. added that with a view to extend the recycling rates, the local government must encourage the markets for the recycled materials and will increase the professionals in the recycling companies [20].



**Impact of Improper Solid Waste Management**

Lack of MSW control and disposal is leading to significant environmental problems. This consists of soil, air, water,

and aesthetic pollution. Such environmental problems are related to human health disorder, due to the increase in greenhouse gas emissions.

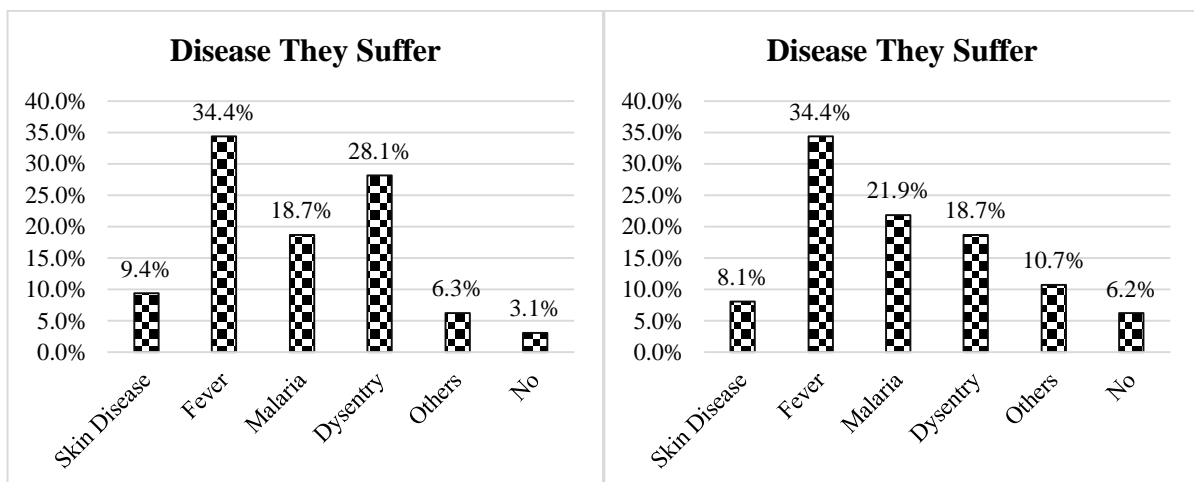


**Fig.5:-Impact of Solid Waste (ward 5 & 6)**  
Source: Questionnaire Survey, 2019

In ward 5 people mostly are affected by pollution (40.1%), health impact (16.0%), no disease (28.1%) and other disease (15.8%). Whereas ward 6 has a flow of affecting diseases. There is less percentage (2.7%) of no disease in ward 6 (Figure 5). Which means most of the people are affected by different kinds of diseases for the present solid waste management.

**Diseases for Improper Management**

Industrial waste contains more hazardous substances than household waste. The municipal household hazardous waste (HHW) is mostly disposed of in landfills as well as general household solid waste. It is assumed that the amount of household hazardous waste is small that's why risks of disposal are neglected by people.



**Fig.6:-Respondents Suffer from Different Disease (ward 5 & 6)**  
Source: Questionnaire Survey, 2019

In the Figure 6 reveals that people suffered from different kinds of diseases. In ward 5 most of the people suffered from 34.4% by fever, 28.1% by dysentery and 18.7% by malaria. In ward 6 people are about 34.4% in fever, 21.9% malaria disease, 18.7% in dysentery and 10.7% suffered in other diseases.

**Suitable Temporarily Solid Waste Storage Site Selection by GIS**

The speedy growth of urbanization diminishes the non-renewable resources and disposal of effluent and venomous waste indiscriminately, are the leading environmental issues disturbs threats to the existence of human being [5]. Disease transmission, fire hazards, odour nuisance, water and atmospheric pollution, aesthetic nuisance and financial losses are the most

general problems associated with inadequate solid waste management. There has been a significant increase in solid waste generation in Dhamrai Pourashava. Presently the municipal solid waste in Dhamrai Pourashava disposed unscientifically. Here we analyzed the temporary waste storage location from which the municipality will collect the waste daily after storage it from house to house.

**Procedure of suitable Dumping Site Selection**

Some criteria have been used in development of GIS database for suitable waste storage site selection in Dhamrai Pourashava. These criteria are given below in Table 5:

*Table 5:-Criteria for suitable waste storage site selection*

Physical Criteria	Slope
	Drainage
	Water Bodies
	Residential Areas
	Land Use
	Road
Social Economic Criteria	Distance from major roads
	Distance from drainage
	Distance from water bodies
	Distance from residential areas

Source: Developed by authors, 2019

Different types of Arc Toolbox have been used for selection of suitable storage site. These are Feature to Raster, Reclassify, Weight Overlay, Buffer, Raster to Polygon, Euclidian Distance, and Erase etc. At the early stage of this Procedure Feature to Raster, Reclassify and Euclidian Distance

have been done. Then fixed weight overlay of the criteria for selection of suitable waste storage site. Weightage of criteria for suitable waste storage site selection in ward number 5 and 6 of Dhamrai Pourashava are given below in Table 6:

*Table 6:-Weightages of criteria*

Criteria	Weightages
Water Body	30
Residential Area	30
Land Use	15
Road	10
Drain	10
Slope	5
Total	100

Source: Developed by authors, 2019

Most priority have been given to water body and residential area for the selection of suitable location of waste storage site in ward number 5 and 6 of Dhamrai Pourashava. There are different sub-criteria in land use including agricultural, residential, commercial, industrial, institutional recreational, transport (Transport and communication),

community service, government and non-government service, mixed use, water body, circulation activity etc. These criteria are not same importance for selection of suitable location for temporary waste storage site. So, there has been need to determine the scale value of land use as shown in Table 7 below:

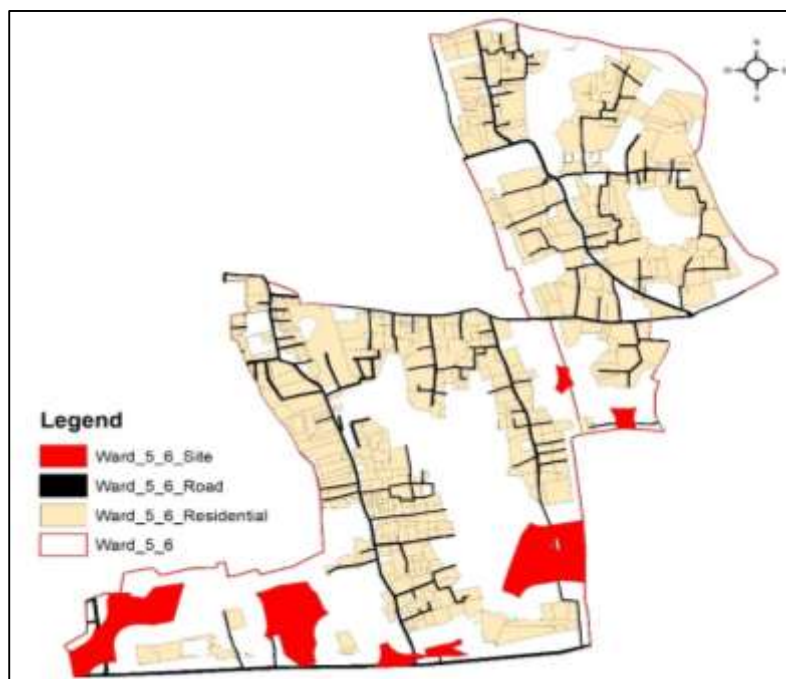
**Table 7:-Scale value of land use**

Land Use	Scale Value	Land Use	Scale Value
Agriculture	3	Vacant Land	4
Residential	1	Service Activity	1
Community Service	1	Mixed Use	1
Transport and Communication	2	Governmental Service	1
Manufacturing Industry	1	Non-governmental Service	1
Education and Research	1	Recreation facility	1
Commercial Activity	1	Water Body	1
Urban Green Space	1	Circulation Network	5

Source: Developed by authors, 2019

On the basis of above procedure, the suitable location of temporary waste

storage site for ward 5 and 6 in Dhamrai Pourashava has been selected (Figure 7).



**Fig.7:-Temporary waste storage suitable location for ward 5 and 6 in Dhamrai Pourashava**  
Source: Developed by authors, 2019

**Finding Problems Related to Solid Waste Management System in Dhamrai Municipality**

It is finding out that there are several problems and limitation in existing household solid waste practice and management in Dhamrai municipality.

Some problems related to municipal solid waste management practice in the Dhamrai municipality are given below:

- Inefficient and Unhygienic Collection Practices
- Delayed and inefficient refuse collection
- Absence of Resource Recovery Component
- Absence of dustbin
- Absence of Landfill for ultimate Disposal of Waste
- Insufficient Financial Resources and Inadequate Planning and Management
- Lack of awareness Raising Program
- People participation lacking's
- Lack of technology
- Lack of co-operation from public

### **THE ECONOMIC FEASIBILITY OF SOLID WASTE MANAGEMENT**

Man has the power to define an innovative idea to prolong the life cycle of valuable goods and products through the effective use of different waste with the help of research and technology. Proper valuation of waste increases the environmental efficiency and economic feasibility. The Enhanced Landfill Mining (ELFM) and Enhanced Waste Management (EWM) are the radical concepts because they intend to place land filling of waste in a sustainable context [28]. In the previous vision (i.e., ELFM); a landfill is considered a temporary storage places that should be valorized. ELFM offers a great opportunity to pick the most suitable materials to be valorized. These materials can be Waste-to-Energy (WtE) or Waste-to-Product (WtP) which is depends on the type and form of the waste stream and situation of an advanced technology. ELFM is an ecofriendly technique which is preventing CO<sub>2</sub> and other environmental hazardous pollutants through the valorization of landfill waste namely WtE (energy) and WtP (Product).

A relatively new waste management system technique is the "Integrated sustainable waste management" (ISWM). This ISWM permits municipalities and other similar activities to optimize local waste management and to maximize environmental and valorization benefits at the lowest economical possible cost[6].

### **Solid Waste Management in Developing Countries**

Because of the demographic's changes, consumer behavior, speedy urbanization, and fast-growing population municipalities in the developing countries, the decision makers are confronted with serious new challenges in solid waste management. Numerous cities have increased their efforts, over the past few decades, to discover sustainable solution in the solid waste management problem. Problems related to construction, operation, maintenance and management can be declined through the particular focus on strategies related to solid waste management. It was ascertaining that recycling and valorizing activities can be turned into a valuable income. It was identified that almost 50% of recyclable wastes which are produced by household, commerce and trade that yield a total amount of USD 50,000/day which is collected by scavengers and sell to middle men in Ankara, turkey [4]. Furthermore, in Delhi's waste management system at the smallest amount 150,000 waste pickers divert more than 25% of all waste generated into recyclables. This control system saves the municipal authorities substantial costs[33]. In low- and middle-income countries, organic waste still continues to cause a lot of problems as a result of no proper solution has yet been identified.

### **CONCLUSION**

The existing solid waste management system of Dhamrai Municipality is an average level. Now a day's solid waste management is an important issue for

enhancing environment. Our study explored that Dhamrai Municipality has its own organizational pattern, management approach and functional groups to accomplish the huge task of waste management. Government should develop mechanism for normal monitoring and supervision whereas local government authority should implement government rules and regulation properly. A planned area like Dhamrai Municipality required a proper solid waste management system to ensure a livable condition for the residents. For a proper solid-waste management system, the foremost important thing is the awareness of the general public. Integration of all resident and authority only can ensure a sustainable solid waste management in Dhamrai Municipality.

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