Solid Waste Management System of Savar *Pourashava*-A Case Study

A Dissertation
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Student ID No: 12172014

Submitted To:
Institute of Governance Studies
BRAC University
Dhaka

In Partial Fulfillment of the Requirements for the degree of

Masters in Governance and Development (MAGD)

Date of Submission: 2 March, 2013

Institute of Governance Studies

BRAC University, Dhaka

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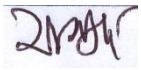
DECLARATION

In accordance with the requirements of the degree of Master in Governance and Development in the Institute of Governance Studies, I am presenting the following dissertation titled *'**Solid Waste Management System of Savar Pourashava-A Case Study'***. This work has been performed under the supervision of Dr. Rizwan Khair.

I hereby declare that the work submitted in this dissertation is own and based on the results found by the field survey. Materials of works are used from other researcher that is mentioned in reference.

It is hereby declared that this dissertation or any part of it has not been submitted elsewhere for the award of any degree or diploma.



02 March, 2013

A.K.M. Masud

ID No. 12172014

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ACRONYMS

ADB	Asian Development bank
AIT	Asian Institute of Technology
BBS	Bangladesh Bureau of Statistics
BMDF	Bangladesh Municipal Development Fund
CBO	Community Based Organization
CDM	Clean Development Mechanism
CWG	Collaborative Working Group
DCC	Dhaka City Corporation
DPHE	Department of Public Health Engineering
EPA	Environment Protection Agency
GOB	Government of Bangladesh
GOI	Government of India
IETC	International Environmental Technology Centre
ISSWM	Integrated Sustainable Solid Waste Management
ISWA	International Solid Waste Association
JICA	Support Equipment Recommendation Data
KCC	Khulna City Corporation
LFG	Landfill Gas
LGD	Local Government Division
LGED	Local Government Engineering Department
MoA	Ministry of Agriculture
MoE	Ministry of Energy
MoEF	Ministry of Environment and Forest
MoF	Ministry of Finance
MoI	Ministry of Information
MoLGRD&C	Ministry of Local Government, Rural Development & Cooperatives
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
MWH	Municipal Waste Handling

NEMAP	National Environment Management Action Plan
NGO	Non Government Organization
PPP	Public-Private Partnership
SAARC	South Asian Association for Regional Cooperation
SMA	Statistical Metropolitan Area
SW	Solid Waste
SWM	Solid Waste Management
UK	United Kingdom
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFPA	United Nations Population Fund
UN-HABITAT	United Nations Human Settlement Programme
US	United States
WHO	World Health Organization
WSD	Waste Storage Depots
WTE	Waste to Energy

ACKNOWLEDGEMENT

All praises to Allah, the benevolent and the merciful.

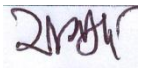
I would like to take this opportunity to thank those who have supported me throughout the course of my studies and contributed towards this thesis .Without them this thesis would not have been possible.

I would like to pay my gratitude to my thesis supervisor, Dr. Rizwan Khair, Director, Institute of Governance Studies, BRAC University for providing me continuous support and guideline to perform this research work and to prepare this concerted dissertation. His contribution to me can only be acknowledged but never be compensated. His consistent inspiration helped me to work diligently throughout the completion of this research work and also contributed to my ability to approach and solve a problem. Without his continuous guidance this dissertation would not be materialized.

I would like to express my deepest gratitude to the Institute of Governance Studies (IGS), BRAC University, the Academic coordinator of IGS and all the teachers and staffs for giving me such a great opportunity of doing my Masters and this contemporary research work.

I am indebted to my parents for their continuous encouragements, cooperation and mental support. I am also expressing my deepest gratitude to my family members, especially to my spouse Ms. Munira Sultana, UNO Gabtoli, Bogra for her wholehearted supports and inspirations and even her scholastic suggestions throughout the course and also for this dissertation. Their supports and cooperation were indispensable. I will never forget my batch mates' and colleagues' for their persistent cooperation during staying in Centre for Development Management (CDM) at Khagan.

At last, I want to thank once again to my supervisor, Dr. Rizwan Khair for giving me such an opportunity, which has obviously enhanced my knowledge and skills to a great extent and I shall be able to contribute to my nation as well.



2 March 2013 A.K.M. Masud

ABSTRACT

Recent decades have experienced migration of population from the rural to urban areas due to urbanization as a consequence to rapid industrialization round the globe. Since Bangladesh is a third world developing country, its industries are flourishing over time and due to this rapid industrialization, urban areas are facing great pressure of huge population who has migrated for better civic amenities, job opportunities and improved quality of life. In order to manage these urban cities, concerned authorities are exploring new ideas and trying firmly to minimize human hazards and ensure a better, safer and cleaner and healthier city for living and enjoying their stay over multifarious business. However, waste management has turned to be one of the major concerns for the authorities. It is also an important facet of environmental hygiene and it needs to be integrated with total environmental planning and management. A solid waste management system is the framework by which the entire activities concerning solid waste come to pass. The ever increasing global concern on environmental health demands that wastes should be properly managed and disposed of in the most friendly and acceptable way. This is to minimize, and where possible, eliminate its potential harm to humans, plants, animals and natural resources.

In Bangladesh, Municipalities/Urban centers are called *Pourashavas* and they are the sole authorities to collect, manage and dispose municipal solid waste. Solid waste management is regarded as one of the most immediate and serious issues for *Pourashavas*/Municipalities. According to the process of functioning and/or administering by the authorities concerned, solid waste management is meant as collection, transportation and disposal of solid wastes. The related activities are generation, storage, collection, transfer and transport, processing and disposal of solid wastes. In developed countries, waste management has changed from relatively passive management of waste arising to an active management integrating economic and environmental concerns. It reduces or eliminates adverse impacts on the environment and human health and also supports to achieve economic development and improved quality of life. Henceforth, SWM is related with other 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 urban government's capabilities.

However, the study area has unveiled a very depressing scenario of Solid Waste Management. The city authority is supposed to look after all the aspects of waste

management and should develop a system where every components of waste management can run properly and smoothly. In Savar *Pourashava*, wastes are generated from multifarious sources, stored and collected in unplanned manner, carried in the same way. The most devastating situation is that these wastes are dumped in open places without considering health, hygiene and environmental issues. Even no specific dumping zone is declared and maintained, only disposed road side and other open spaces imposing great threat to human health and environment. Everywhere in the waste management system and in the community, proper planning and due care is mostly required in order to reshape the waste management system. Collection, dumping and disposal capacity of the Pourashava should be increased which needs regular and proper collection of municipal tax. Moreover, city dwellers' awareness should be built and developed in order to reduce waste generation at the sources. The *Pourashava* should develop recycling mechanism to ensure reuse of a particular thing. Finally a two way communication, cooperation, contribution and partnership of both the authority and community people can ensure a very delicate and proper management of waste management of Savar *Pourashava*.

CHAPTER 1
INTRODUCTION

Basically peoples' aspirations in resources consumption govern the waste generation capacity. Human activities create waste, and the way these wastes are handled, stored and collected pose risks to the environment and to public health. Therefore the quantity and composition of municipal solid waste in mainly urban areas depend on population density, source diversity and the income of the people of a particular locality. The growth of the world's population, rapid urbanization, improved standards of living, and gradual developments in technology have all contributed to an increase of both the amount and the variety of solid wastes generated by industrial, domestic and other activities (UNEP, 1991). These multifarious development activities tend to increase in generation of municipal solid waste in the form of organic and inorganic mass. The nature and characteristics of these wastes challenge the municipal authorities in managing, collecting, and disposing such wastes and often leads to efforts to seeking additional resources and technological support.

In developing countries, it is common for municipalities to spend 20-50 percent of their available recurrent budget on solid waste management. Yet, it is also common that 30-60 percent of all the urban solid waste in developing countries is uncollected and less than 50 percent of the population is served. In some cases, as much as 80 percent of the collection and transport equipment is out of service, in need of repair or maintenance. In most developing countries, open dumping with open burning is the norm (World Bank, 2011).
Bangladesh as a developing country, where resources and capacity are often constrained, the challenges thus become even more serious. Under this circumstance, in this study an effort is made to study the solid waste management system of a typical urban local government institution named Savar *Pourashava* (Municipality). This municipality has been endowed with the core responsibility of collecting and disposing these wastes efficiently under the mandate from 'The Pourashava Ordinance 1977'. The municipality has also been made responsible to keep the overall environment clean and free from pollution hazards. Savar *Pourashava* is one of the rapid growing peri-urban centers which are heavily burdened with an increasing and huge population. This huge population generates a large amount of waste every day. Besides hundreds of garments industries and other small scale factories and business communities under the *Pourashava* generate waste which creates tremendous pressures for the *Pourashava*. In this study, it is intended to explore the existing Municipal Solid Waste (specially, the organic and inorganic non hazardous solid waste that are mostly

generated from households and commercial and institutional sectors) under Savar *Pourashava*.

1.1. Background

Recent decades have experienced migration of a large population from the rural to urban areas due to rapid industrialization round the globe. Since Bangladesh is a developing country, its industries are growing over time. Due to this rapid industrialization, urban areas are facing great pressure of huge population who has migrated for better civic amenities, job opportunities and improved quality of life. While the country's total population has been increasing at about 1.4 percent per annum; its urban population has been growing at about 3.27 percent per annum.[1] The Urban population in Bangladesh was reported at 41782488.81 in 2010 and the Population density (people per sq. km) was 1142.29.[2] The UN (2004) projection for urban population of Bangladesh for 2030 was 86.5 million. Urban centers in Bangladesh matches with 7 size classes (Islam & Hossain, 1976)- the classification given by the Bangladesh Census Commission is a combination of population size and administrative or governance structure. The Commission has classified the urban centers into four categories; such as the Megacity, Statistical Metropolitan Areas (SMAs), *Pourashavas*[3] and Other Urban Areas. It recognized some 522 urban centers in the country in 2001.

During the Census of 2001, there were 223 *Pourashavas* in the country; of them 11 *Pourashavas* were parts of the four largest cities-Dhaka, Chittagong, Khulna and Rajshahi. The remaining *Pourashavas*, 212, had a total population of about 9 million, or 31 percent of the national urban population. At present there are 310 *Pourashavas* in Bangladesh (BBS, 2011). In this context, *Pourashava* occupies an important position in the overall system of administration and governance in Bangladesh as key local government bodies with the status of statutory bodies constituted under law and function as autonomous self-governing units for urban areas of the country; and as agencies rendering important public services to the people of urban areas. Along with population explosion, municipal expansion, economic development and improvement of people's living standards, the amount of municipal solid waste has been increasing rapidly and its composition has become more multidimensional and complex. Therefore, this study wants to examine the state of solid waste management in

[1]Study on Municipal Solid Waste Management, Final Report: Bangladesh Municipal Development Fund (BMDF), 21 June 2012.

[2] World Bank report, 2012

[3] Smaller cities and towns are known as Pourashavas or Municipalities. The Pourashava areas declared by the Ministry of Local Government, Rural Development and Cooperatives as Municipal Towns or Pourashavas have the formal urban status with local government.

a semi urban municipal as in such as Savar *Pourashava* which is situated near Dhaka metropolitan city.

1.2. Problem statement

Municipal Solid Waste Management is an issue of renewed focus and no longer to be neglected. In our country this problem is becoming very acute with growth of urban centers across the country. Extensive research work is needed in this field to find ways to handle the problems arising from improper solid waste management system. Although number of studies have been conducted in Bangladesh till date, but there is no study have been carried out in Savar *Pourashava* area on the issue of solid waste management system. So, an integrated study enveloping manifold aspects of waste management like waste generation, collection and disposal process reasons behind seemingly improper waste management system of Savar *Pourashava*. This huge research opportunity has created inclination in present researchers to conduct a research on the issue.

1.3. Rationale of the study

This research will identify the present status of solid waste generation and the existing methods of waste management in Savar *Pourashava*. It traces out some loopholes in the existing practices and obstacles to the way of effective waste management system in the study area. On the light of the findings of the study the researcher will try to provide some recommendations to uplift the poor condition of solid waste management (SWM) system of Savar *Pourashava*. These suggestions will assist the decision makers both at micro and macro levels to formulate right management system, the professionals to design and implement effective method to manage the wastes.

1.4. Objectives

The specific objectives of this study are-

(i) To explore the present municipal solid waste management system of Savar *Pourashava*.

(ii) To identify the constraints and the potential options to enhance the present SWM system there.

1.5. Research Questions

The following research question will guide the whole study-

(i) What is the current solid waste management system of Savar *Pourashava*?

(ii) What are the potential solutions to enhance solid waste management system of the *Pourashava*?

1.6. Methodology

The study is the combination of two methods, i.e. ***empirical analysis*** for primary data collection to find out the existing practice of the *Pourashava* and also the citizens' expectations as well as their practice, and ***content analysis*** as well from different secondary sources to understand the relevant practice and analysis. Yet, Content analysis is a tiresome process due to the requirement that each data source has to be analyzed along a number of dimensions. It may also be inductive (identifies themes and patterns) or deductive (quantifies frequencies of data). The results are descriptive, but will also indicate trends or issues of interest.

Both quantitative and qualitative methods have been used to collect data for the empirical study. The sources of primary data are households and the staffs and executives of the Savar *Pourashava* and also the elected officials who are responsible for this essential service. For conducting field survey on Household category Simple Convenience Sampling method has been used. In the fourth chapter it has been described more elaborately.

1.7. Limitations

There are many limitations while doing the research work; especially to gather information and data from the *Pourashava* side. At the same time, the researcher also faced some obstacles to conduct the household survey due to time and resource constraints. Even the secondary data of Savar Pourashava is not available in good form for study purposes. Moreover, even *the information regarding its solid waste management and allocation of resources within Pourashava* was not readily available. The responsible personnel of the *Pourashava* seem to be so busy that they do not want to share enough of their experience and knowledge about this issue. On the contrary, the stakeholders are not so much interested about the research work. Moreover, this has not been able to address most of the stakeholders to conduct field survey due to time constraints. Furthermore, the researcher does not able to consider the entire waste category to reflect in this research work. It has therefore more concentrated only non-hazardous solid waste generated from different sources especially the household solid waste in Savar *Pourashava* area. Moreover, there is also scarcity of information and work so far regarding solid waste management system of Savar *Pourashava* that could be helpful to manufacture a quality work.

1.8. Organization of the study

There are five chapters of the study comprising different contents.

The first chapter is the introductory chapter that has a general introduction to explain the importance of the issue and its relevance. A background in this chapter elaborated the urbanization process in Bangladesh and thus Municipality as the emerging urban local government unit which has shaped with divergent challenges like Solid Waste Management.

In **the second chapter**, theoretical concept and issues of waste, solid waste & municipal solid waste and the management of the SW including with some approaches of solid waste management (SWM) is discussed and analyzed and also discussed about the current practice of municipal solid waste management in some developing countries of Asia for the better understanding of the practical-aspect.

The third chapter, current practice of municipal solid waste management in the Bangladesh experiences from national to local level is discussed and special focus is given on the existing practices of some *Pourashavas* (Municipalities). Analytical framework is developed based on the system thinking concept to explain the scenario of municipal solid waste management system of Savar *Pourashava*. According to the analytical framework, two sets of questionnaire (one for the *Pourashava* officials & staffs and another for the citizens') are prepared to show the existing scenario of current solid waste management system of Savar *Pourashava*.

In **the fourth chapter**, collected data are analyzed and the result is discussed.

Finally, in **the fifth chapter**, the existing gaps and loopholes that pointed out from the findings in the present municipal solid waste management system of Savar Pourashava are discussed. From the above theoretical discussion and also the findings, some recommendations are made with a potential option by showing a model for the sustainable and better solution to improve the current SWM system of Savar *Pourashava*. These are commonly practiced in some other developing countries in Asia and also relevant in some other urban centers in Bangladesh. Finally, a general conclusion is made based on the findings and recommendations.

CHAPTER 2

SOLID WASTE MANAGEMENT: CONCEPTS AND ISSUES

Introduction

This chapter focuses on some basic concepts and issues concerned with solid waste and urban solid waste and the management system with regard to generation, collection and disposal. Specific focus is given on the hazards produced everyday by consumers. This production tends to create huge health related problems and challenges of municipal solid waste frequently encountered by city dwellers in the regime of rapid urbanization. This chapter also discusses some popular approaches of municipal solid waste management such as conventional approach, public private partnership approach and integrated sustainable solid waste management approach. All these approaches are experimented in some developing countries of Asia and have produced significant results in the management process. In the later part of this chapter, experiences of some developing countries are discussed. This discussion covers solid waste management scenario and current practices of these countries.

2.1. Solid Waste: Definitions and Concepts

2.1.1. Definition of Waste and Solid Waste

Waste is a material, which is thrown away or kept aside as worthless element. As a concept waste is subject to the value judgment of the primary owner or potential consumer. Waste is viewed as a discarded material, which has no consumer value to the person abandoning it (Cointreau, 1982). In the German Waste Act of August 1993, waste is defined as "a portable object that has been abandoned by the owner" and also as an "orderly disposal garbage" (Bilitewski et al 1994: 21).

United Nations Environment Program defines waste according to the Basel Convention, as ***"****Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law."*[4] European Union under the Waste Framework Directive defines waste as, *"an object the holder discards, intends to discard or is required to discard."*[5]

United Nations Statistics Division defines-"*Wastes are materials that are not prime products (that is products produced for the market) for which the initial user has no further use in*

[4] Basel Convention, 1989
[5] European Directive 75/442/EC

terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded."[6]

However, the management of these wastes generated by various sources is the toughest task for the city authority. It requires adequate emphasis in order to make a city clean and user friendly for the city dwellers.

2.1.2. Solid Waste and Municipal Solid Waste

The definition of ***Solid Waste*** is not based on the physical form of the material, but hinges on the fact that the material is no longer usable. So, "solid" waste encompasses all those wastes, which are neither waste water discharges nor atmospheric emissions. According to the World Health Organization (WHO, 1976), solid waste can be defined as useless, unwanted or discarded materials arising from domestic, trade, commercial, industrial and agricultural as well as from public services. Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area.

According to the section 1004 (27) of Solid Waste Disposal Act which is popularly referred to as the Resource Conservation and Recovery Act (RCRA) enacted by United States Environment Protection Agency (EPA), solid waste is defined as "*any garbage, refuse, sludge..., and any other discarded material, including: solid, liquid, semisolid or contained gaseous material, resulting from industrial, commercial, mining, and agricultural operations and from community activities….*" [7]

Hence, the term Solid waste is applied to unwanted or discarded waste material from houses, street sweeping, commercial, industrial and agricultural operations, arising from human beings activities. In urban area it is called refuse; in the countryside it is called littering and in general, it is called solid waste. It is a conglomeration of dust, ash, vegetables and putrescible matter, paper and packing of all kinds, rags and other fabrics, glass and much other combustible and non-combustible debris. It is non-liquid, non-soluble materials ranging from municipal garbage to industrial wastes that contain complex and sometimes hazardous substances. Solid wastes also include sewage sludge, agricultural refuse,

[6] "Glossary of Environment Statistics", 1997. UNSD 1997
[7] www.epw.senate.gov/rcra.pdf, accessed on 17/02/2013

demolition wastes, and mining residues. Technically, solid waste also refers to liquids and gases in containers.[8]

On the other hand, ***Municipal Solid Waste (MSW)*** commonly known as trash or garbage (US), refuse or rubbish (UK) is a waste type consisting of everyday items that are discarded by the people. Municipal solid waste includes all domestic refuse and non-hazardous wastes such as commercial and institutional wastes, street sweepings and construction debris. MSW primarily comes from households, but also includes wastes from offices, hotels, shopping complexes/shops, schools, institutions, and from municipal services such as street cleaning and maintenance of recreational areas (cited from UNEP IETC).

2.1.3. Classification of Solid Waste

Wastes can be classified in various ways depending on their source of generation, nature of consumption, way of collection, transportation and disposal. They can also be classified according to their origin, content, characteristics, impact on the environment, hazard potential and so on. Typical classification of solid waste was suggested by Hosetti and Kumar (1998) and it is as follows.

Garbage	Putrescible wastes from food, slaughterhouses, canning and freezing industries.
Rubbish	Non-putrescible wastes either combustible or non-combustible. These include wood, paper, rubber, leather and garden wastes as comestible wastes whereas the non-combustible wastes include glass, metal, ceramics, stones and soil.
Ashes	Residues of combustion, solid products after heating and cooking or incineration by the municipal, industrial, hospital and apartments.
Large wastes	Demolition and construction wastes, automobiles, furniture's, refrigerators and other home appliances, trees, fires etc.
Dead animals	Households' pets, birds, rodents, zoo animals, and anatomical and pathological tissues from hospitals.
Sewage sludge's	These include screening wastes, settled solids and sludge's.

The following table classifies wastes according to their generation, characteristics and hazard potentials.

[8] http://www.njhazwaste.com/glossary.htm, accessed on 17/02/2013

Table-1: Solid Waste Category and Characteristics

Origin Specific	Characteristics	Hazard Potential
Household/ Solid Waste	- Includes rubbish, packing materials, kitchen waste etc. - Generated from households	Non-hazardous
Agricultural Solid Waste	- Includes food residues, animal dung, crop residues, grass and leaves. - Pesticide containers, herbicides	Non-hazardous and biodegradable Hazardous to health
Commercial Solid Waste	- Includes electronics, timber, wire, metals, plastic bags, tin cans, garbage etc. - Generated from business establishments, food and drink services, shops or open market places.	Non-hazardous waste
Industrial Solid Waste	- The solid waste produced could contain chemicals, wood, metal, ceramic or other components.	Hazardous or non-hazardous
Institutional Solid Waste	- Produced from public or government institutions, offices, schools, universities, religious institutions, sporting fields, etc.	Non hazardous in nature
Healthcare Solid Waste	- Produced from healthcare facilities such as Health Posts, health centers and hospitals.	Both hazardous and non-hazardous

Source: Prepared by Author

2.1.4. Solid Waste Management

Solid Waste Management (SWM) is an important facet of environmental hygiene and it needs to be integrated with total environmental planning (WHO Expert Committee, 1971). A solid waste management system is the framework by which the entire activities concerning solid waste come to pass. The ever increasing global concern on environmental health demands that wastes should be properly managed and disposed of in the most friendly and acceptable way (Ayotamuno & Gobo, 2004).

According to the process of functioning and/or administering by the authorities concerned, solid waste management is meant as collection, transportation and disposal of solid wastes. The related activities are generation, storage, collection, transfer and transport, processing and disposal of solid wastes. In developed countries, waste management has changed from relatively passive management of waste arising to an active management integrating economic and environmental concerns. It reduces or eliminates adverse impacts on the environment and human health and also supports to achieve economic development and improved quality of life. Henceforth, SWM is related with other tangible and intangible factors namely environment, health, community, education, finance, technology, governance,

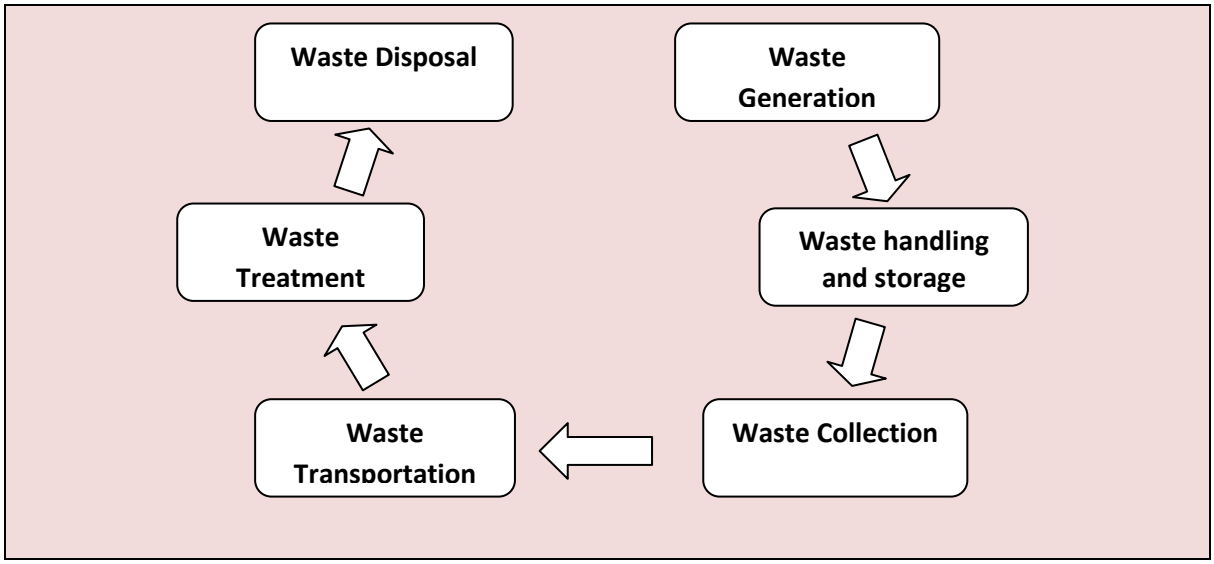
policy and regulation. If these factors are addressed properly, SWM can be sustainable and can enhance urban government's capabilities. The related factors are shown in following figure:

Figure-1: SWM related Factors

Source: (JICA 2005:34)

Therefore solid waste management is an intensive and integrated function which accommodates several components/factor for proper management. This includes- (i) waste generation, (ii) waste handling and storage, (iii) waste collection, (iv) waste transfer and transportation, (v) waste treatment, and (vi) waste disposal.

Figure-2: Solid Waste Management Cycle



Source: Prepared by author

Waste is generated by the consumption of different sources. These wastes are stored at the source accordingly. Some are stored in organized way, some are left here and there, and some

are dumped in open place and road sides. The collection procedure is also diverse. In some places, collection is made from door to door, in some areas collection is made from open places and dumped at the dumping zone. As regards to waste transfer and transportation, some open and covered vans are engaged to carry waste from collection points. These collection vans carry wastes to the dumping zone and dispose of. Disposal takes place only in some designated places, limited reuse or recycle happens thereafter.

2.1.5. Hierarchy in Solid Waste Management

The entire management process starts from consumption, collection and disposal which includes resource recovery, re-use, recycling. Resource recovery includes all activities of waste segregation, collection and processing which are carried out taking into consideration the economic viability of the material (Cointreau 1984:14). Re-use and recycling provide an opportunity to capture some of the values from the waste. Of these two techniques, reuse is a simpler process involving reutilization of material and recycling, on the other hand, involves processing waste through remanufacture and conversion of parts to recover an original raw substance**.** EPA has ranked the most environmentally sound strategies for municipal solid waste where source reduction (including reuse) is the most preferred method, followed by recycling, energy recovery, and treatment and disposal as the least.

Figure-3: Waste Management Hierarchy

Source: Environmental Protection Agency (EPA), USA

2.1.5.1 Source Reduction and Reuse

Source reduction, also known as waste prevention, means reducing waste at the source. It can take many different forms, including reusing or donating items, buying in bulk, reducing packaging, redesigning products, and reducing toxicity. Source reduction is also important for manufacturing. Light weighting of packaging, reuse, and remanufacturing are all becoming

more popular business trends. Purchasing products that incorporate these features supports source reduction.

(Source:http://www.epa.gov/osw/nonhaz/municipal/hierarchy.htm accessed on 18/02/2013)

2.1.5.2. Recycling/Composting

Recycling is a series of activities that includes the collection of used, reused, or unused items that would otherwise be considered waste; sorting and processing the recyclable products into raw materials; and remanufacturing the recycled raw materials into new products. Consumers provide the last link in recycling by purchasing products made from recycled content. Recycling also can include composting of food scraps, yard trimmings, and other organic materials. Recycling prevents the emission of many greenhouse gases and water pollutants, saves energy, supplies valuable raw materials to industry, creates jobs, stimulates the development of greener technologies, conserves resources for our children's future, and reduces the need for new landfills and combustors. (***Source: Ibid***)

2.1.5.3. Energy Recovery

Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas (LFG) recovery. This process is often called waste-to-energy (WTE). (***Source: Ibid***)

2.1.5.4. Treatment & Disposal

Landfills are the most common form of waste disposal and are an important component of an integrated waste management system. Landfills that accept municipal solid waste are primarily regulated by state, tribal, and local governments. EPA, however, has established national standards these landfills must meet in order to stay open. The federal landfill regulations have eliminated the open dumps of the past. ***(Source: Ibid)***

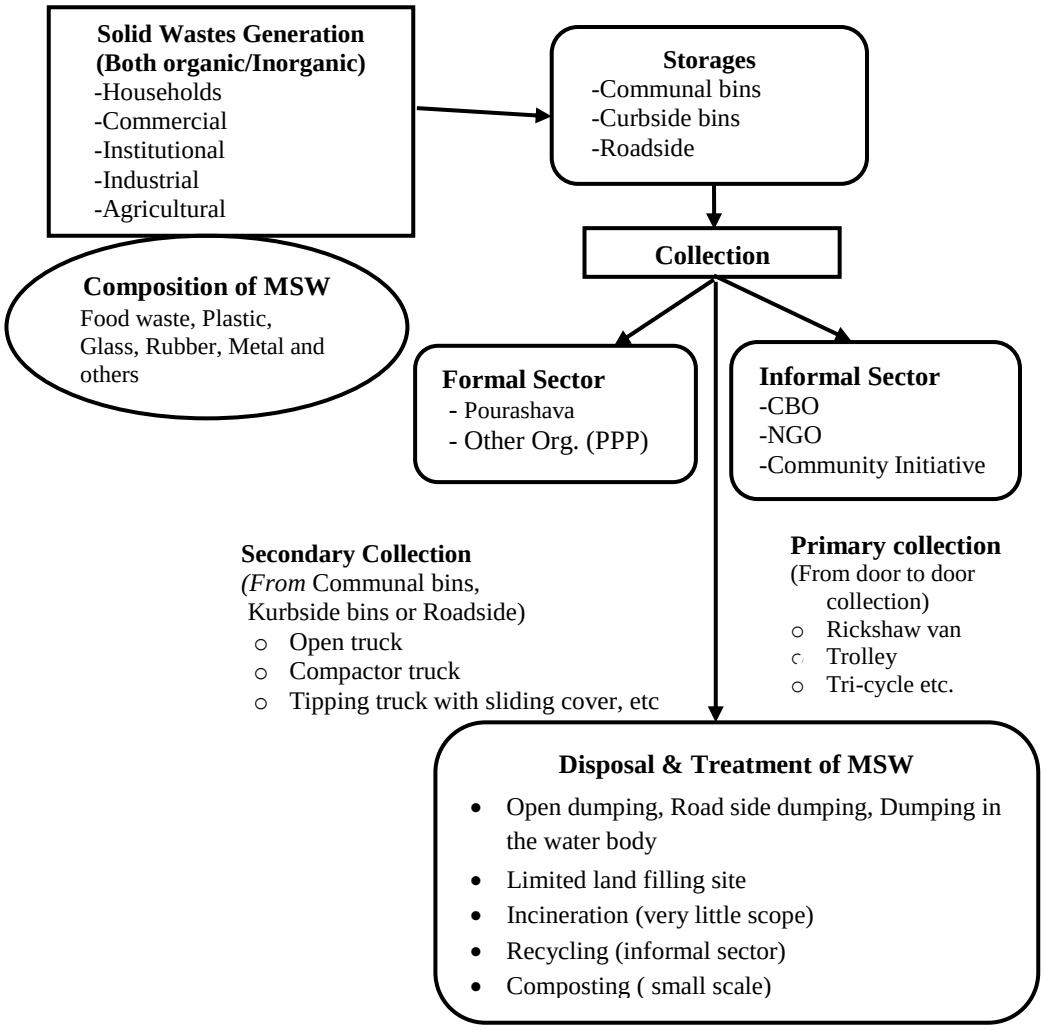
2.2. Municipal Solid Waste Management: Some Popular Approaches

2.2.1. Conventional Approach

Countries in general have implemented various measures in order to extend refuge collection, upgrade disposal facilities, and diminish the risk to human health and environment associated with inadequate waste management. The solutions that are commonly proposed to problems in municipal solid waste management in third world cities often do not distinguish the different needs and heterogeneity of neighborhoods within each city, and between cities. Sometimes these approaches prefer top down solutions, usually reached without or with little community participation. Even in some cases the approaches involve advanced technology

and equipment, frequently imported from industrialized countries. However, the conventional approach considers the formal sector, neglecting the existence and possible contributions of the informal sector that has developed around waste collection and recycling in many countries (Medina, ND)[9]. The following framework is mostly common as a conventional MSW management approach:

Figure-4: Conventional MSW Approach



Source: Prepared by Author

The above framework depicts that municipal solid waste management is an inclusive approach. It considers all the factors and sector separately and their management is done separately as well. All the common approaches are existent in the conventional MSWM approach. However, it takes significant number of player who are directly involved in the cycle with different roles and responsibilities. In order to harmonize all the players in a single channel, newer approach is necessary to coordinate properly and manage properly.

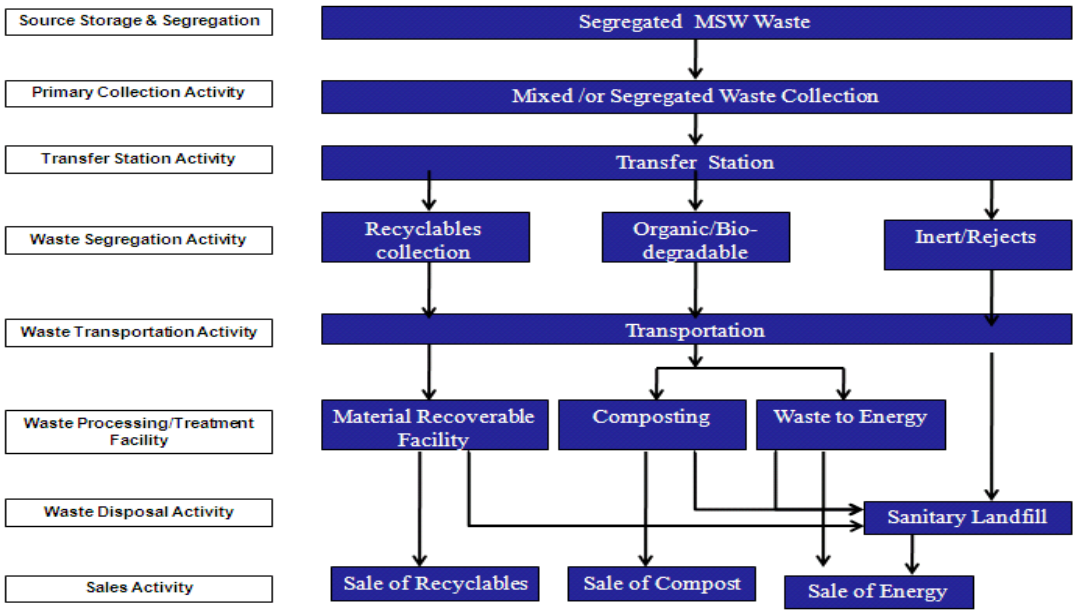
[9] http://www.eolss.net/Sample-Chapters/C14/E1-18-06-06.pdf, accessed on 18/02/2013

2.2.2. Public-Private Partnership Approach

Public private partnership is a long or medium term arrangement between the public and private sectors whereby public sector transfers part of its responsibilities to the private sector (World Bank, 2011). Due to increasing problem of municipal solid waste management in most cities in the developing countries, private sector participation in providing solid waste services started as a response to major failures of service delivery by the public sector (UNESCAP, 2011). Such a partnership, combines the private sector's dynamism with the public sector`s responsibility of public interest which makes it work better (Ahmad et al., 2006).

India adopted PPP of MSWM practice in January 2005. The municipal corporation of Delhi contracted the collection, transportation and disposal of municipal solid waste in different zones of Delhi with private sector. Among the contractors Metro Waste Handling (p) Ltd. (MWH) received the contract for the west zone of Delhi. With privatization, the collection and storage of waste has undergone a significant change (SERD, 2010). Prior to the privatization, waste from the waste storage depots was collected in open trucks. The problems such as waste spillage and odor were common. Moreover the staffs carrying out the collection of the waste without the provision of any safety equipment such as the masks, gloves, boots etc. was highly vulnerable to potential health hazards.

Figure-5: MSWM Value Chain – Generic Flow Chart



Source: Toolkit for Public Private Partnership frameworks in Municipal Solid Waste Management Volume I–Overview and Process, GOI-ADB PPP Initiative. www.pppindia.com

Before the partnership, the system was poorly managed as there was no proper segregation and scheduling or tracking of the waste collection vehicles (SERD, 2010). The partnership approach started bringing the wastes to the street corner bins by households themselves or in most cases the waste pickers hired by the people. So the responsibility of the waste conveying from generation point to the bins is up to the people (Garg et al., 2007).

There are also separate bins for biodegradable and non biodegradable waste. Then the compactor loaders collect the waste from the bins and transport them to the waste storage depots (WSD). Collecting waste with compactor loaders is a containerized mechanical loading and unloading which reduces spillage, ensures hygienic environment around the waste storage depots, thus reduces environmental and health risks (ICRA, 2008). Separate trucks are being used for biodegradable (Green trucks) and non biodegradable (blue trucks) and the biodegradable waste is transported to the composting facility which has also been established by the private sector. After arriving to the waste storage depots, the waste is being segregated by workers and the rest is taken to the disposal sites by the trucks.

2.2.3. The Integrated Sustainable Solid Waste Management Approach

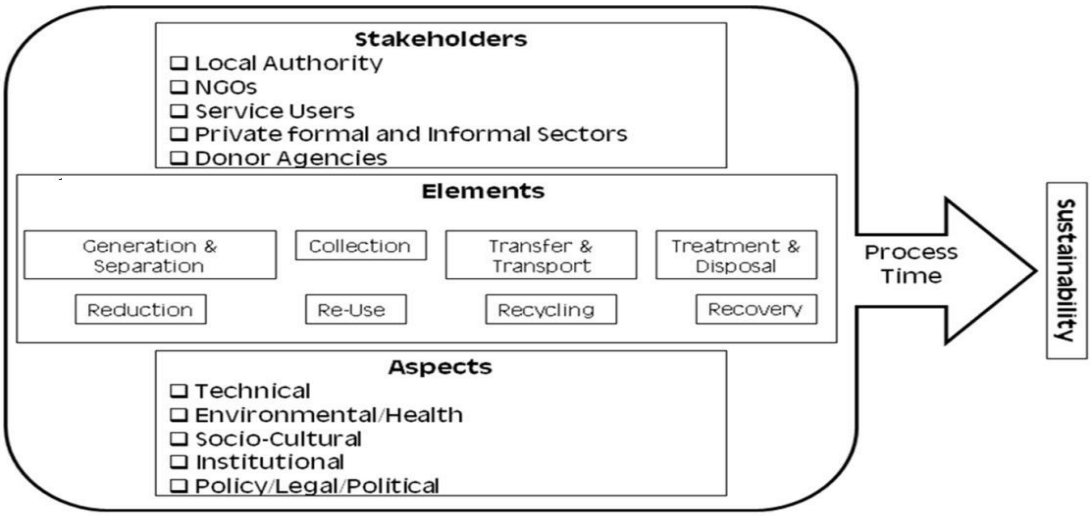
Another alternative approach for solid waste management is called Integrated Solid Waste Management (ISWM). According to the United States Environmental Protection Agency (US-EPA), Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment.[10] On the other hand, integrated solid waste management refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency (UNEP-IETC).

For the sustainable management of solid waste the integrated sustainable waste management (ISWM) approach (as shown in the framework, Figure-6) that was first developed in mid 1980s by WASTE, a Dutch Non Government Organization (NGO) and WASTE's South partner organizations and further developed by the Collaborative Working Group on Solid Waste Management in Low-and Middle-Income Countries (CWG) in the mid 1990s. Since then it has become as a norm for waste management. The ISWM is a system approach that

[10] http://www.epa.gov/climatechange/wycd/waste/downloads/overview.pdf , accessed on 20/02/2013

recognizes three main dimensions including stakeholders, elements, and aspects, which all need to be addressed when developing or changing a solid waste management system (UN-HABITAT, 2010:27). These dimensions are shown in the following figure-

Figure-6: Integrated Sustainable Waste Management Framework



Source: UN-HABITAT, 2010 (adapted from WASTE, Gouda, Netherlands)

The stakeholders are the people or organizations participating in solid waste management. This includes the waste generators who use the services, the service providers, the formal and informal private sector dealing with solid waste management, and other local or international institutions. Elements comprises the technical components of the waste management system starting from the generation of solid waste then the collection, transfer and transportation of waste to dumpsites or to treatment plant. Treatment ranges from reducing the size of the generated waste to recovery of the waste, in particular the biodegradable component that comprises more than 60% of the total municipal solid waste generated in urban areas of the developing countries (Khatib, 2011:43).

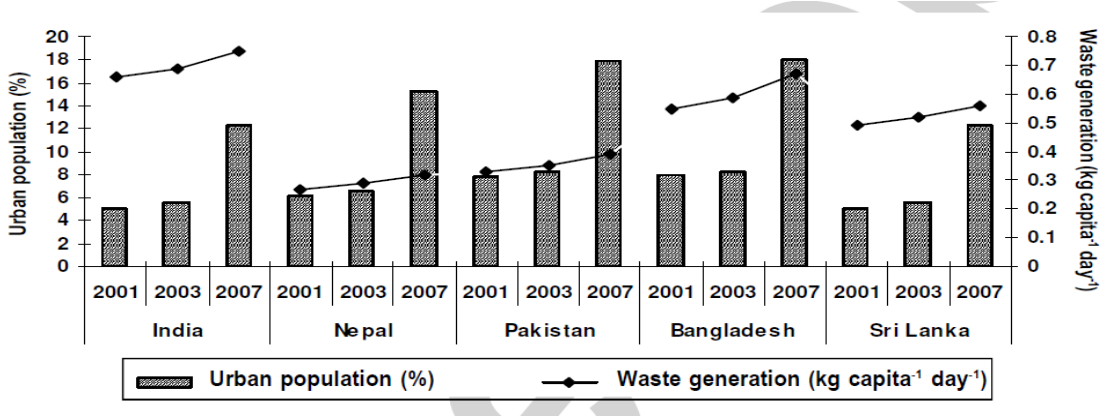
In order to that the integrated waste management be sustainable, all required aspects, such as financial, social, institutional, political, legal, and environmental that assesses the feasibility of the management should be addressed in a sustainable way. The different dimensions are interrelated and their linkages institutionally, legally, and economically enable the overall function of the system. It could therefore, be indicated that ISSWM considers MSW management not just a technological system with infrastructure and facilities that facilitate handling and disposal of MSW, but it is a management system that consider and deals with many other elements including the socio-economic settings, the physical environment and growth in public demands and management scenarios.

2.3. MSWM Scenario in Some Developing Countries of Asia

Urban centers/municipalities of many of Asian countries are challenged by extreme effect of urbanization and industrialization trends, population increase and increase in waste generation. These cities also face problems relating to human health and environmental pollution. Poor government policy, lack of political will, lack of appropriate economic and human resources, and weak local institutions result in poor waste management (especially in large cities). Although municipalities are increasingly involved in managing the solid waste, lack of resources, institutional and infrastructure facilities are hindering the efforts.

Sustainable waste management is an appropriate framework for not only the effects of improper waste management on human health and the natural environment but also the implications of current waste management practices for resource conservation and environmental sustainability (Schubeler 1996).

Figure-7: Relationship between urban population and waste generation in five Asian developing countries from 2001 to 2007



Source: Khajuria 2010.

World population reached seven billion in 2011 and continues to rise with projection nearing 9.3 billion by 2050 (UNFPA 2011). According to UNFPA Asia will remain the most populous area in the world during the 21st century and in 2011, 60% of the world population lived in Asia. Urban areas in developing countries are the most populous areas in the world where people migrate from rural areas in search for better life and employment (UNFPA 2011). As a result, the population of these areas grows more than 150,000 every day (UNDESA, 2005, Cointreau, 2007). In fact the number of urban population is going to become double between 1987 and 2015 and almost 90 percent of this increase happens in developing countries where growth rate exceed three percent a year which is three times more than industrialized countries (Medina 2010).

Since developing countries have acquired a startling dimension of problem in municipal solid waste management (MSWM), the quantity of solid waste generation increase notably and its characteristics has tainted as a result of the change in the peoples' lifestyles. Fast population growth and increase of economic activities combined with a lack of training in modern solid waste management practices complicate the efforts to improve the solid waste service (ISWA & UNEP, 2002). The urban populace of developing countries produces less per-capita solid waste compared to high income countries. As the capacity is limited to collect, process, dispose or reuse, the wastes generated by human settlements creates problems with variances between regions and locations based on geographic, socio-cultural, industrial, infrastructure, legal and environmental factors.

2.3.1. MSW generation

The amount of waste produced daily is significantly increasing in the cities of developing countries, while the capacity and effectiveness of municipalities in providing municipal solid waste services remains undesirably low, (UN-HABITAT 2003, Medina, 2010). A majority of Asian nations are experiencing an increase in waste generation per capita due to higher consumption of resources. The SW generation was high, because of the population and the main component of SW is decomposable organic. The following table illustrates per capita generation of municipal solid waste (MSW) in some of Asian countries.

Table 2: Solid-Waste Generation Rates of some Asian Countries

Country	Generation Rate (kg/cap/day)	Current Urban population (% of Total)	2025 Urban population (% of Total)	Generation Rate (2015) (kg/cap/day)
India	0.46	26.8	45.2	0.7
Nepal	0.50	13.7	34.3	0.6
Bangladesh	0.49	18.3	40.0	0.6
Myanmar	0.45	26.2	47.3	0.6
Vietnam	0.55	20.8	39.0	0.7
Mongolia	0.60	60.9	76.5	0.9
Lao PDR	0.69	21.7	44.5	0.8
Republic of China	0.95	30.3	54.5	0.9
Sri Lanka	0.89	22.4	42.6	1.0

Source: World Bank 1997b & UN 1995; Modified by author

In general, the solid waste contains more organic components than other materials. The average percentages of organic matter in the solid waste in major cities in Asian countries ranged from 50% to 70%. The urban per capita waste generation rate for most of the low income developing countries will increase by approximately 0.2 kg per day because these countries have relatively high annual GNP growth rates and urban population growth rates.

2.3.2. MSW Segregation

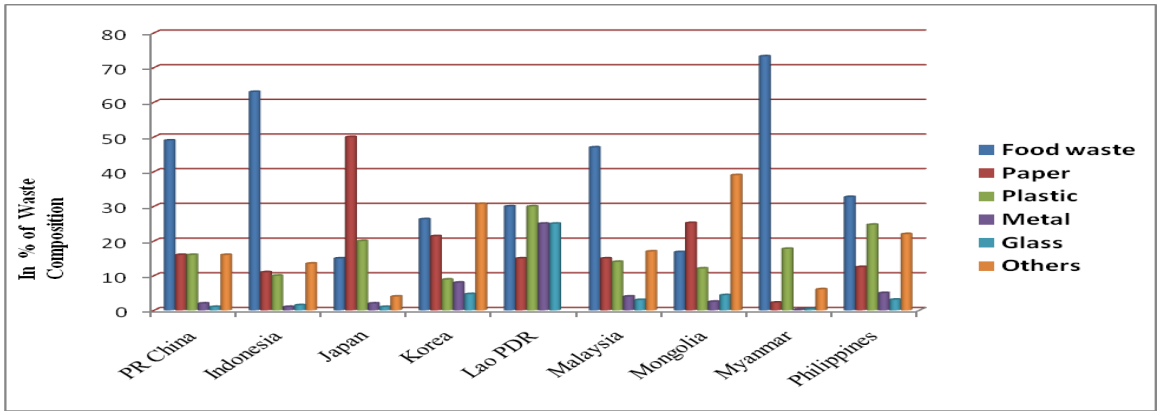
The common MSWM problem of developing countries, especially in Asia is that waste segregation is either not yet started or not optimized enough to allow proper waste treatment. Additionally, moisture level of the mixed waste is high. This is true especially in countries like India, Indonesia, Srilanka, Bangladesh, Malaysia and Thailand. However, the potential of these high moisture waste to be made into compost is ruined by the of hazardous waste which is included in the mixed waste, making it a lower quality, if not, toxic containing compost that farmers are reluctant to buy and apply it to their crops.

2.3.3. MSW Composition

Although countries sometimes use different categories for the physical characterization of solid waste, the categories listed in Table 1 can usually be distinguished in the various waste characterization studies. Not only wealth, but also consumer patterns significantly influences waste composition. The composition of MSW differs for different countries and regions, and developing countries have generally high food and yard wastes, whereas developed countries have a large fraction of paper and plastic content (Dhussa *et al*, 2000).

Figure 8, of municipal waste composition in Asian countries according to AIT/UNEP report 2010 shows that the three largest compositions are food waste, paper waste, and plastic waste. Food waste is as high as 73% in Myanmar, 63% in Cambodia and Indonesia, and 49% in China. The second largest percentage is paper waste, which shows a pattern where it is higher in advanced countries like Japan with 50% and Singapore with 22%. The third largest percentage is plastic waste where they are higher in Lao, Philippines, and Singapore with over 20%. The trend of percentage of plastic waste is increasing due to more plastic based packaging for commercial products. The following figure shows the feature.

Figure-8: **MSW compositions in some Asian Countries**



Source: AIT/UNEP 2010, modified by author

2.3.4. MSW Collection

In most cities of the developing countries, a significant portion of population does not have access to waste collection services and only a fraction of the generated waste is actually collected (Schubeler, 1996). The collection systems are relatively inefficient as the collection vehicles and containers are not fitted with compactors, necessitating transportation of loose waste and hence, creating a constraint on the capacity of the collection system. Handcarts, tractor-trailers and low level of mechanization are being employed to collect the waste from communal bins and other collection points. On top of that, financial constraints and the lack of technical expertise severely limit the effectiveness of solid waste collection and transportation along with shortage of storage bins, collection vehicles, non-existent or inadequate transfer stations and traffic congestion are the other technical factors affecting collection efficiency resulting in low waste collection rates. It was estimated that 20 - 50% of the solid waste generated in South Asia remains uncollected, even though more than half of the local operational expenditures often goes towards waste collection (UNEP, 2001b).

2.3.5. MSW Treatment and Disposal

The common practice in developing Asian countries for municipal waste treatment is land filling. Very limited numbers of these landfills are sanitary landfill and a small percentage of the recyclables are recycled.

MSW treatment

The following table shows the solid waste treatments in some developing countries of Asia.

Table -3: Waste treatments in Asian Countries

	China	India	Malaysia	Philippines	Indonesia	Thailand
Population	1.34 Billion	1.17 Billion	28.4 Million	93.3 Million	240 Million	69.1 Million
Waste generation	148,041,000 TPY*1)	42,000,000 TPY	5,781,600 TPY	10,000,000 TPY	38,500,000 TPY	14,000,000 TPY
Collection rate	71%	73%	70%	70%	60%	85%
Waste recycled	12%	10%	4%	28%	2%	2%
No. of landfill	344	Unknown	161	392	80	101
Sanitary landfill	20	Unknown	Unknown	19	10	20
Incineration	2%	5%	0	0	0	1%

*1) TPY: Ton per Year

Source: Inanc, B., et al. 2004, Indonesian domestic solid waste statistics 2008, Zhu, D., 2008. Adapted from: www.euij-waseda.jp/common/pdf/WP_Andante.pdf accessed on 22/02/2013

However, ***Incineration*** is gaining popularity in China, it was once existed in Delhi, India but faced technical failure and three are operating in Thailand. High content of moisture and organic waste are not suitable for incineration because it requires high calorific value. High calorific value can be gained when waste is high in petrol-based waste such as plastics and tires therefore often auxiliary fuels is necessary to be added to the plant. Theoretically, waste with high organic content is a suitable input for biological treatment such as ***composting*** and ***anaerobic digestion***, however the waste must be purely segregated and this is not the case in developing Asian countries.

Waste Disposal

In developing countries most of the municipal solid waste (MSW) is dumped in an open space or roadside dumping that is more or less uncontrolled manner. These dumps make very uneconomical use of the available space, allow free access to waste pickers, animals and flies and often produce unpleasant and hazardous smoke from slow-burning fires. About 90 percent of the collected waste ends up in open dumps or simply 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 (Cointreau, 2007, Zurbrugg 2003, Medina, 2010).

Final disposal in most of the economically developing countries is usually a matter of transporting the collected waste to the nearest available open space and discharging them. Composting is not carried out to the capacity that can be achieved though almost half of the MSW can be reduced thus. Other forms of disposal like animal feeding, ploughing into soil, open burning and dumping in water bodies or wetlands contribute to environmental hazards. Waste burning is practiced to reduce its volume and minimize the attraction of animals and vermin. Despite the degradation of valuable land resources and the creation of long-term environmental and human health problems, uncontrolled disposal systems are still prevalent in most of the developing countries (ISWA & UNEP 2002). Sanitary land filling or engineered land filling of MSW is often misinterpreted in the developing countries, especially when it comes to covering a dumpsite by soil. In simple terms, it can be defined as an engineered facility for the disposal of MSW designed and operated to minimize public health and environmental impacts, which requires monitoring of the incoming waste stream, placement and compaction of the waste and installation of varied liners for preventing leachate infiltration (Tchobanoglous *et al*, 1993).

Financial and institutional constraints are one of the main reasons for inadequate waste disposal. Introduction of SWM user fees cover only the collection and transportation costs leaving practically no resources for safe disposal of the waste. Moreover, other reasons for inadequate disposal are the mostly inappropriate guidelines for sitting, design and operation of new landfills as well as missing recommendations for possible upgrading options of existing open dumps. However, the only guide-lines for landfills available are those from high-income countries. Basically, these are based on technological standards and practices suited to the conditions and regulations of high-income countries and do not take into account for the different technical, economical, social and institutional aspects of developing countries.

Table-4: Disposal methods of MSW in selected countries of Asia

Country/Territory	Disposal Methods				
	Open Dumping (%)	Composting (%)	Land filling (%)	Incineration (%)	Others (%)
Malaysia	50	10	30	5	5
Indonesia	60	15	10	2	13
Philippines	75	10	10	0	5
Vietnam	70	10	0	0	20
Pakistan	80	5	5	0	10
Nepal	70	5	10	0	15
Mongolia	85	5	0	0	10

Source: Adapted from UN 2000

Summary

This chapter discusses on the basic concepts and issues, definitions related with waste, solid waste and the difference between solid waste and municipal solid waste. Effort is made to identify sources of waste generation, production and their characteristics. Besides, wastes have been classified according to their origin, nature and hazard potentials. This chapter also focuses on some of the issues on solid waste management. Special focus is made on the management pattern, the way solid wastes are being managed, and various steps engaged from generation, collection to disposal system as well as the hierarchy of solid waste management from source reduction to disposal. Some popular approaches and models are developed in the last couple of decades and being implemented in some countries successfully. Experiences of some of the Asian developing countries are discussed and the ways the approaches are followed and implemented are analyzed for better understanding of the MSW management system.

CHAPTER 3

SOLID WASTE MANAGEMENT PRACTICES IN BANGLADESH

Introduction

Solid waste management in Bangladesh is now a growing concern. Although some municipalities have started and developed practices in managing huge wastes generated by city dwellers, they are not managed in a uniformed way. In this chapter experiences and practices of solid waste management in Bangladesh are discussed. This discussion starts with solid waste management practices at the national level leading to divisional, regional and at the end local level. The fact is that every city center in Bangladesh is struggling for a safer environment for city dwellers. Municipal authorities therefore are trying to introduce newer approaches through which waste management become smoother. Even they are also offering alternatives for both the managers and clients so that clean and hazard free environment is ensured. This chapter also analyses SWM practices in different cities of the country and the approaches as well. At the end, the example of one of the populated municipalities of Dhaka division named Savar is studied and analyzed thoroughly. Existing legal basis (Acts, rules, regulations, policies, framework) of solid waste management is also considered for discussion. Finally, based on the discussion on the experiences and approaches, an analytical framework is developed. This framework helps to explore challenges of the existing system and leads to gather possible solutions for mitigating the challenges.

3.1. SWM Scenarios in Bangladesh

Bangladesh is one of the densely populated countries in the world (1,125 per sq km). Along with dense population, rapid urbanization is also a notable feature of the country. While the country's total population has been increasing at about 1.4 percent per annum, its urban population has been growing at about 3.27 percent per annum. The above comparison clearly depicts the scenario of rapid urbanization. This process has resulted in most of the urban local centers that are mandated to provide urban health and environment related services. One of the most important services includes solid waste management which is facing a severe strain in keeping up with the increased demand on its infrastructural facilities and urban services. To analyze the SWM system of the country it should be considered the waste generation volume, composition/characteristics of waste, its storage and collection process and the treatment & disposal activities.

3.1.1. Waste generation

In order to estimate the total waste generated in these urban centers, namely City Corporations and Municipalities/*Pourashavas* are considered separately according to the difference in per capita waste generation rates. The total waste generation rate is estimated considering individual waste generation rate of the city corporation, an average for all the *Pourashavas* and another average for all other urban centers. Total Waste generations in urban areas of Bangladesh are shown on the following Table[11]-

Table-5: Total Waste generations in urban areas of Bangladesh

City/Town	WGR* (kg/cap/day)	No. of City/Town	Total Population** (2005)	Average TWG***(Ton/day)
Dhaka	0.56	1	6,728,404	4,634.52
Chittagong	0.48	1	2,622,098	1,548.09
Rajshahi	0.3	1	468,378	172.83
Khulna	0.27	1	967,365	321.26
Barisal	0.25	1	437,009	134.38
Sylhet	0.3	1	386,896	142.76
Pourashavas	0.25	298	15,214,306	4,678.40
Other Urban Centers	0.15	210	9,217,612	1,700.65
Total	**0.41(Avg.)**	**514**	**36,042,067**	**13,332.89**

*Waste Generation rate ** Including 10% increase for floating population *** Total Waste Generation

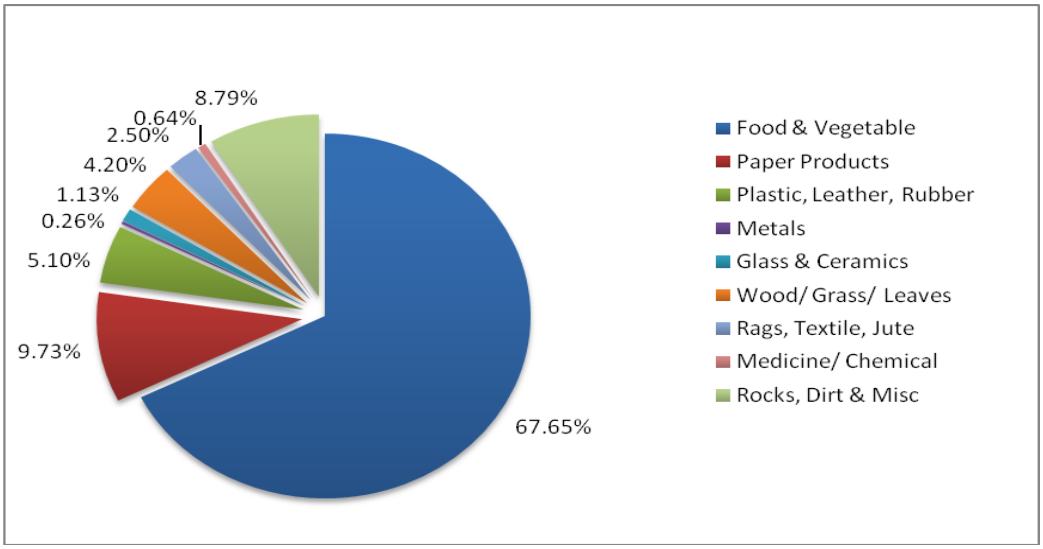
From the above Table-5, it is found that total waste generated in the urban areas of Bangladesh per day is 13,332.89 tons. Based on the total estimated urban population of the year 2005, per capita waste generation rate is computed as 0.41 kg/capita/day.

3.1.2. Solid Waste Composition

Composition of solid waste depends on a number of factors, such as food habit, cultural tradition, socio-economic and climatic condition. Composition of solid waste varies not only from city to city but even within the same city itself and also seasonally. Physical composition of solid waste from different urban areas of Bangladesh is given in the following figure that shows the average proportion of different components in urban solid waste of Bangladesh.

[11] Waste Concern Technical Documentation, June 6, 2005. Adapted from, Urban Solid Waste Management Scenario of Bangladesh: Problems and Prospects

Figure-9: Composition of Solid Waste (Average %) in 2005

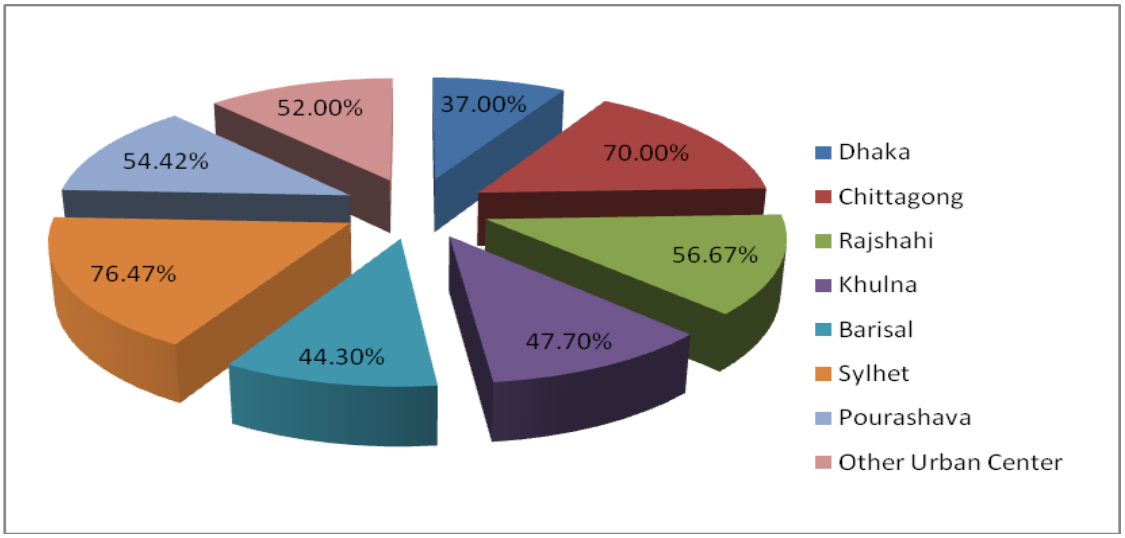


Source: ***Ibid, modified by author***

3.1.3. Solid Waste Collection

In Bangladesh, most of the urban areas are practicing community bin system for collection of waste. In some areas NGOs have introduced door-to-door collection of solid waste. But the coverage of neither communal dustbin system nor door-to-door waste collection system is sufficient yet. Moreover, no specific rule and criterion is followed while placing dustbins. The practice of widely spaced communal bins is usually a failure because the demand placed on the households goes beyond willingness of the residents to co-operate. Figure 10 shows the waste collection rate in different cities and urban centers.

Figure-10: Waste Collection rate in Urban Areas



Source: Ibid, modified by author

3.1.4. Recycling of Solid Waste

Recycling of waste tends to be a growing sector in many ways. Organic waste has already opened a new window for various private groups to utilize organic waste profitably. Informal sector is also playing a prominent role in collection of recyclable materials. Most of the buyers of the recyclable items belong to the informal sector and only a few formal manufacturers are involved in using recyclable items as raw material. Although recycling of solid waste as a resource is not included in the national environmental policy, waste has become the main source of income for several groups of the informal sector. It is seen that informal sector is responsible for recycling from 4% to 15% of the total solid waste generated in different cities and urban centers. It is estimated that informal sector has been able to save Tk. 10,705.5 million annually through recycling of the 4% to 15% of the total waste generated thereafter. According to the BMDF final report 2012, it is estimated that in Chittagong City Corporation area 12.41% of waste is recycled, while this figure stands at 4.71%, 4.84% and 4.55% for Rajshahi City Corporation, Rangpur Municipality and Patuakhali Municipality respectively (BMDF Final Report, GoB & WB, June 2012)[12].

3.1.5. Disposal of Solid Waste

In Bangladesh, the most common method of disposing solid waste is open dump. Some cities and towns have their designated dumping site. But the collected waste is dumped in unsanitary manner and waste segregation, waste compaction or daily top seal are not at all used in these dumpsites. The situation is even worse in some cities where they do not have specific dumpsite at all. The collected waste is disposed through crude dumping in low-lying areas, nearby water bodies or on a vacant lot. The waste which is not collected is also dumped unplanned, unsafe and unhygienic way.

3.1.6. The present SWM scenario in Savar *Pourashava*

Savar municipality has been facing rapid population growth, urbanization and industrialization. Solid waste generation had reached to the value 51, 016 kg/day on the basis of per capita waste generation 0.40 kg /day. Savar Municipal Authority is the only responsible organization for solid waste management (45% of total generated wastes) of its nine wards (17.15 km^2). Savar municipal authority has a small number of trucks (5 trucks) and waste collecting vans (50 vans) for collecting more than 50% of generated wastes in municipality. More than 90% of the total waste contains biodegradable materials, 5% of plastics and polythene, 0.5% glass and ceramics and 0.5% metals. Municipality collects waste

[12] www.bmdf-bd.org/images/frontImages/gallery/.../MSWM_Final_Report.pd... accessed on 26/02/2013

from 40 bins and from roadside illegal dumping areas and finally dumps the wastes in several areas, such as- Bank town (Ward 9), Ulail (Ward 6), Ganda, near Savar bus-stand (Ward 7) and Radio colony (Ward 3) along the Dhaka-Aricha highway. Maximum solid waste was generating in Ward 8, where the population was about 23,617 and total estimated waste generation was about 11808.50 kg/day on the basis of per capita waste generation rate of 0.5 kg/cap/day. The lowest solid waste generating rate was in ward 4, where the population is 3,519 and total estimated waste generation is 1161.27 kg on the basis of per capita waste generation of 0.33 kg/cap/day. Most of the waste bins and illegal roadside dumping were seen in Ward 7. Illegal roadside dumping was also seen in Ward 3, 4 and 5 in Savar Municipality Area (Rahman & Hossain, 2011).

3.1.7. Institutional and Legal analysis of SWM in Bangladesh

In this regard of solid waste management practices in Bangladesh the institutional and legal aspects should be discussed. The central government ministries and agencies as well as local government ministry and agencies are playing a vital role for solid waste management in Bangladesh. There are number of Ministries, divisions and departments at the central level i.e. LGD under MoLGRD&C is responsible for overall planning, identification of investment projects, monitoring & evaluation and observance of rules followed by urban local government authorities, i.e. city corporations, municipalities and other govt. agencies like DPHE, LGED and also the private sector as well as NGOs/CBOs. Nevertheless, some other ministries are also directly and indirectly linked with solid waste management activity. However, each organization is responsible for its own activities.

Table-6: Responsible Organizations and its Activities

Organization	Activities
DPHE	• It gives municipalities' technical assistance for water supply, sanitation, and drainage services except in Dhaka and Chittagong in accordance with the National Policy for Safe Water Supply and Sanitation 1998 and also provides technical support to city corporations and Municipalities on solid waste management. It also assists in projects at 19 cities and towns with technical assistance for solid waste management and pilot project on composting, improved waste collection and controlled land filling.
LGED	• LGED is currently responsible for a number of development projects throughout the country covering besides physical interventions, service oriented interventions in water supply, sanitation and solid waste management, socio-economic development of slum dwellers and other development activities in the city corporations and municipalities. It also Provided solid waste management support to several Municipalities through some donor driven projects.
MoEF	• MOEF is a nodal ministry responsible for preparing and enforcing a country's environmental rules and regulations including National 3 R

	strategy for waste management & draft municipal solid waste management rules.
MoA	• The MOA is the nodal ministry for developing and enforcing compost standards for soil application and registration and certification of compost. Department of Agricultural Extension (DAE) under the Ministry of Agriculture provides license for operation of compost plant as well as for selling of fertilizers.
MoE	• Waste to energy project has to take approval from Ministry of Energy and sign power purchase agreement in case electricity is sold to the grid.
MoF	• This ministry is deciding the levels of financial support and subsidy from the central government to be provided to develop waste recycling projects, waste treatment and composting plants.
MoI	• The MOI plays an important role in promoting source segregation of waste, positive impacts of compost application to crops, along with promoting the use of RDF or biogas via awareness campaigns in national media and telecasting or broadcasting in the media, the ministry can also instruct print media to provide factual information regarding source segregation, as well as encouraging the use of organic waste products as part of corporate social responsibility.
City corporations and Municipalities	• At present 10 city corporations and 312 municipalities are responsible for such functions as sanitation and environmental pollution control, solid waste management, water supply, public street, street lighting, traffic control etc according to 'The Local Government (City Corporation) Act, 2009' and 'The Local Government (*Paurashava*) Act, 2009 respectively'.

Source: Modified from BMDF Final Report 2012

To understand the SWM in Bangladesh, the legal framework from both the national level as well as local level is discussed in the following part. Different options for enforcement of the prevailing laws and rules are also discussed.

National Level Framework

There are some national level legal frameworks for managing solid waste in Bangladesh. The following paragraph summarizes the important national level legal frameworks[13]-

Environment Conservation Act, 1995

The Environment Conservation Act, 1995 requires that the establishment of industrial enterprises and undertaking of projects take environmental aspects into due consideration and obtain prior environmental clearance.

The **Environment Conservation Rules 1997** made under the Act have divided industries and projects into four categories depending upon the pollution load and likely impact on the environment. These categories are: 1) Green, 2) Orange-A, 3) Orange-B and 4) Red. All municipal landfills sites as well as installation of any kind of incinerators fall within red category and environmental clearance from DOE is mandatory.

[13] BMDF Final report, 2012 and Country paper, Bangladesh, "SAARC Workshop on Solid Waste Management", October 10-12, 2004.

National Environmental Management Action Plan (NEMAP) has been prepared for a 10-year period (1995-2005), by the Ministry of Environment and Forest (MoEF) of the Government of Bangladesh in consultation with people from all walks of life. NEMAP has identified key environmental issues and recommended measures to conserve, improve and reduce environmental degradation, promote sustainable development and generally raise the quality of human life. NEMAP has recommended for actions in the areas of sanitation, solid waste management, water supply and environmental awareness etc.

Urban Management Policy Statement, 1998, prepared by the Government of Bangladesh has clearly recommended the municipalities for privatization of services as well as giving priority to facilities for slum dwellers including provision of water supply, sanitation and solid waste disposal. The policy considers the interest of providing economic, efficient and reliable services; municipalities shall endeavor to contract out solid waste disposal, public sanitation, drain cleaning and road maintenance (GoB, 1998a).

National Policy for Water Supply and Sanitation 1998 prepared by the Local Government Division of the Ministry of Local Government Rural Development & Cooperatives gives special emphasis on participation of private sector and NGOs in water supply and sanitation in urban areas. Some solid waste and recycling related strategies under this policy are included:

- Local Government Bodies (City Corporations and municipalities) may transfer, where feasible collection, removal and management of solid waste to the private sector.
- Measures to be taken to recycle the waste as much as possible and promote use of organic waste materials for compost and bio-gas production.
- Private sector including NGO participation in sanitation is encouraged

Source: Cited in GoB, 1998b

National Clean Development Mechanism (CDM) Strategy 2004 prepared by the Ministry of Environment and Forest (MoEF) has identified waste sector as one of the potential sectors for attracting CDM finance in the country. CDM allows foreign direct investment (FDI) in projects, which reduces green house gas emissions.

National 3R Strategy for Waste Management, 2010

Department of Environment under the Ministry of Environment and Forest developed the National 3R Strategy for Waste Management in 2010. The 3Rs are meant to a hierarchy, in order of importance – ‘reduce’ followed by ‘reuse’ and then ‘recycle’, which classify waste management strategies according to their desirability.

Local Level Legal Framework

The Local Government (City Corporation) Act, 2009

The Local Government (City Corporation) Act, 2009 was incorporated under Bangladesh Gazette on October 15, 2009. The act contains only four sub-clauses under Third Tofsil (sub-clauses 1.4–1.7) regarding waste collection and management, which have been depicted as follows:

- City Corporation will take all necessary steps to collect and dispose waste from all the roads, toilets, drains, structures and areas under its jurisdiction.
- The occupiers of all the structures and spaces within the jurisdiction of the City Corporation will be responsible for removing waste from their possession under the control and supervision of the Corporation.
- Corporation will make arrangement for waste collection containers or other type of bins at different places of the city, and wherever such containers or bins are placed, the Corporation will ask the occupiers of the neighboring houses, structures and spaces to dump their wastes into these containers or bins through issuance of a general notice.
- All the wastes removed or collected by or under direction of the staff of the Corporation as well as the wastes stored in the containers or bins established by the Corporation will be treated as the property of the City Corporation.

The Local Government (*Paurashava*) Act, 2009

The Local Government (*Paurashava*) Act, 2009 was incorporated under Bangladesh Gazette on October 06, 2009. The act contains only four sub-clauses under Second Tofsil (sub-clauses 1–4 under clause 3) regarding waste collection and management. All these four sub-clauses are completely similar to the four sub-clauses as mentioned above regarding the Local Government (City Corporation) Act, 2009, in which the term *'Paurashava'* has been used instead of 'Corporation' or 'City Corporation'.

All these facts reveal that the entire process and practice of solid waste management in Bangladesh is very unplanned and unsafe. Although the Government of Bangladesh (GoB) has taken some initiatives in cooperation and coordination and some projects as well with various departments, development partners, private and non-government organizations. Moreover, in some city corporation like DCC and KCC are taking some initiatives to manage solid waste by making collaboration as a PPP (Public-Private partnership) with NGOs named Waste Concern in Dhaka and Waste Safe in Khulna. Furthermore, some municipalities are also implementing some projects to improve existing solid waste management system of the

particular municipality like Mymensing, Patuakhali. In each case, the approaches and methods are different as the location and demographic characteristics of those areas are also very distinctive. Some of these interventions are worked well whereas some failed due to poor planning and lack of community mobilization.

3.2. Municipal Solid Waste Management: Major challenges

Waste generation increases due to population growth and economic development. Improperly managed solid waste poses a risk to human health and the environment. Uncontrolled dumping and improper waste handling causes a variety of problems, including contaminating water, attracting insects and rodents, and increasing flooding due to blocked drainage canals or gullies. In addition, it may result in safety hazards from fires or explosions. Improper waste management also increases greenhouse gas (GHG) emissions, which contribute to climate change.

Major Challenges

Solid waste management is a vast, multidimensional, and expensive challenge. And it is growing the municipal solid waste streams will nearly double worldwide by 2025 (World Bank, 2010). Today, countries worldwide face a waste management crisis- an estimated 12.3 billion tons of wastes are collected worldwide in 2011- the increasing quantity and complexity associated with economic growth, industrialization, and urbanization creates serious problems especially for developing countries. The rate of municipal solid waste generation is faster than that of urban population growth due to increase in consumption that is growing world problem with dramatic social and environmental impacts.

- Waste disposal has serious environmental hazards; landfills are reaching capacity, consuming dwindling land space, and cause air, water and soil pollution including the emission of about 5% of global greenhouse gas emissions, while incineration results in emissions of dangerous air pollutants.
- Municipal solid waste landfills are the third largest source of global methane emissions, and open garbage burning emits black carbon and other air toxics as well as greenhouse gases. However, cities also face the challenge of balancing solutions with social, political, environmental, and financial considerations (Cited in CCAC-Fact sheet)[14]
- The Intergovernmental Panel on Climate Change estimates that waste management emits less than 5% of the global GHG emissions (and emits 9% of methane released

[14] http://www.unep.org/.../CCAC%20FACT%20SHEET-**SOLID**%20**WASTE**-EN-...Accessed on 26/02/2013

globally), but this estimate is uncertain and variable, as waste management can act as either a net source or sink of GHGs. Global trends in waste production—the increasing quantity and complexity of MSW—compound the challenge, making waste management "one of the biggest challenges of the urban world" (Vergara and Tchobanoglous, 2012).

- Political interference influences the management process as elected representatives often do not confine themselves to strategic planning, policy setting and oversight of performance, but instead become involved in daily operations.
- Finally, lacking skills of municipal workforces, whereby training is often reserved to senior staff and seen as a reward for good work and seen as a chance to break away from the daily obligations.

[Cited in C. Zurbrugg, February 2003, USWM-Asia]

3.3. Analytical Framework

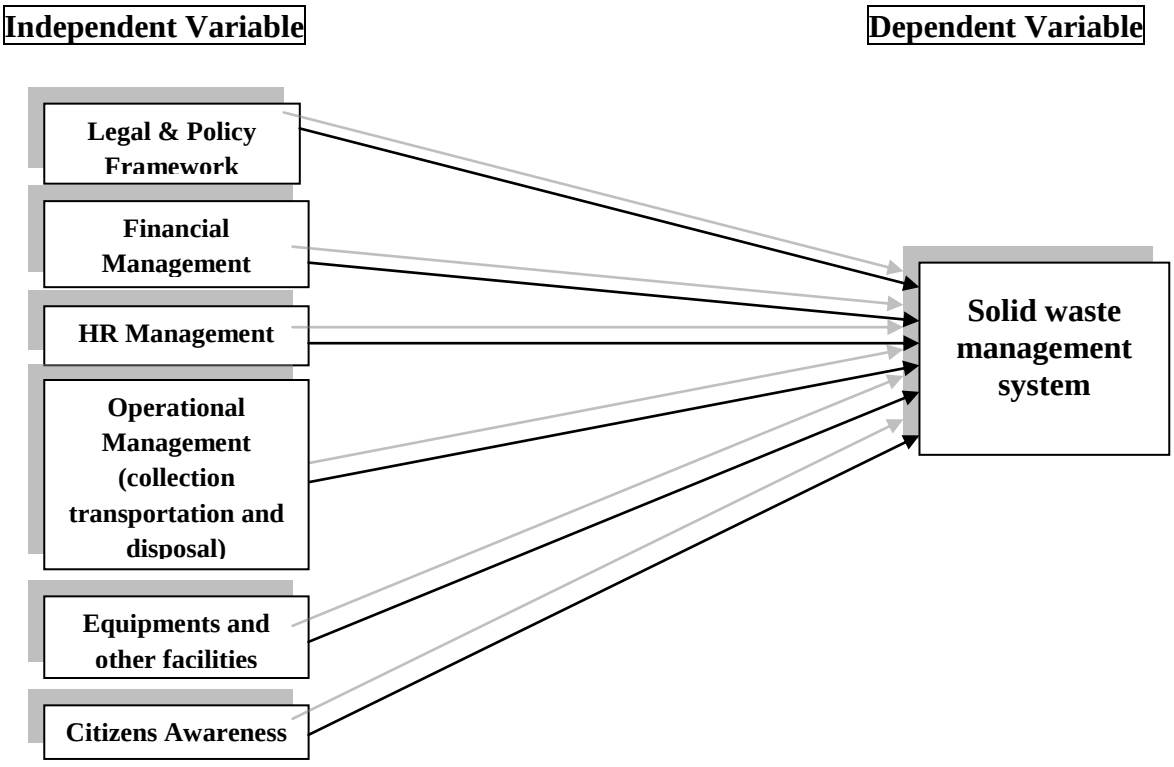
This study emphasizes on the conceptual framework of an integrated sustainable waste management system which includes social, environmental and economic aspects. According to Fiehn & Ball (2005) "Waste and the management thereof is a complex system of interrelated activities which require the input from a number of sectors, involves a wide spectrum of waste types and requires that collection, storage, handling, recycling, treatment and disposal be conducted in various different ways". Therefore, waste management is typically about more than technology, collection and disposal, it involves institutional, social, legal and financial aspects, and is dependent on both intra and inter-organizational collaboration, and engagement with civil society (Zurbrugg, 2002).

In the development of this analytical framework, system thinking concept plays an important role. System Thinking is defined as "a science that deals with the organization of logic and integration of disciplines for understanding patterns and relations of complex problems" (Haraldsson 2004). The practical application of system thinking, System Analysis, is explored understanding of the existing waste management system and the integration of sustainable solid waste management. "System Analysis is about discovering organizational structures in systems and creating insights into the organization of causalities. It is also about taking a problem apart and reassembling it in order to understand its components and feedback relationships" (Haraldsson 2004).

In this following framework, organizational structure is understood and studied and some factors (such as political, legal, financial, operational, technological and social) are identified

and considered to be crucial for the smooth functioning of the organizational system. These factors are intricately interrelated and dependent with each other. Hence solid waste management system of any organization is heavily dependent of each of the factors. To take an example, without considering a strong legal & policy framework, it is impossible to ensure the activities regarding SWM of any city and country as a whole. This is the basis of responsibilities and obligations both from the service providers and as well as stakeholders part. So, policy and legal frame work is the priority to the SWM system. On the other hand, a financial resource is required to run the activities efficiently for any organization. To manage the SW by the urban local government authority, financial resources are very much needed to operationalize the activities i.e. storage, collection and disposal. These activities require a large number of human resources. Moreover, various technologies are also needed for efficient disposal as well as treatment in a scientific manner, that is viable both environmentally and also the human health consideration. So, considering those factors the following analytical framework is developed to analyze the existing SWM system of Savar *Pourashava* that leads to identify the gaps and loopholes and pave a way to find out potential options for solution as well as betterment of the system.

Figure-11: Analytical Framework of SWM System of Savar *Pourashava*



Source: Prepared by author

Summary

This chapter discussed on the Solid Waste Management practices in Bangladesh. This discussion included existing practices at the national, regional (divisional) and local level. The main focus was the municipality which is the bottom line urban local government organization- the *Pourashava*. Legal & policy frameworks which include laws, rules, regulations, various strategies taken by the Government are also discussed. These rules and regulations strengthen the foundation of solid waste management of the country. The divisions and mega cities are managing solid waste on the basis of these frameworks. Existing SWM system of Savar *Pourashava* is also discussed in brief. Effort is made to identify challenges in the existing waste management system of Bangladesh from the literatures. For better understanding of the whole system, an analytical framework is developed based on the system thinking concept. The concept hence the framework will lead to the analysis of the organizational factors and their functions in managing solid waste at Savar *Pourashava*.

CHAPTER 4

DATA COLLECTION, ANALYSIS AND FINDINGS

Introduction

In this chapter initially researcher tried to discuss more in details on the research methodology which is important to explain to validate the use of research method, data collection technique, sampling, study area and its selection etc. As we know, research methodology is the system of collecting data for research works. On the other hand, research method is therefore, a planned and systematic approach of investigation the denotes the detail framework of the unit of analysis, data gathering techniques, sampling focus and interpretation strategy and analysis plan (Aminuzzaman, M.S., 2011). Moreover, in this chapter, data/information of the study is presented and analysis done on the collected data and information from primary and secondary sources.

4.1. Data Collection Method

Data collection is an important segment of a research. It might be done through administering different instruments, interview, observation, field survey through questionnaire or any other technique which is found suitable and purposive. There are two sources of data. Primary data collection uses surveys, experiments or direct observations. Secondary data collection may be conducted by collecting information from a diverse source of documents or electronically stored information that is content analysis.

According to Salauddin M. Aminuzzaman, 2011, "in actual practice there are different methods of data collection. However, there are four leading methods of data collection that are widely used in social research. This are-

- Survey of documents and other secondary sources;
- Observations;
- Questionnaires; and
- Structure schedule."

Without these, there are different methods are using in the social research. Of them, interview and case study methods are commonly used.

In this study, researcher tries to collect data and information from both the primary and secondary sources by considering these methods and techniques of data collection. As primary data collection, researcher uses questionnaire survey and interview methods for empirical analysis. And the secondary data collection it is used different books, articles,

journals and official documents related to SWM particularly to Savar *Pourashava* for content analysis to the better understanding of SWM system.

4.1.1. Questionnaire Survey

A questionnaire is a useful tool that facilitates to collect data from large, diverge and broadly sprinkled group of community. Brehob, 2001 defines a questionnaire to be "a form that people fill out, used to obtain demographic information and views and interests of those questioned". Kirakowski, 1998 also defines a questionnaire as "a *method* for the *elicitation*, and *recording* and *collecting* information". Questionnaire survey is very effective instrument to collect and gather information and data from the respondents about the targeted issues. The questionnaire can be mainly classified into two types-

i) *Structured questionnaire*-Contains definite, concrete and pre- ordinated questions.
ii) *Non-structured questionnaire*- It is not pre-ordinate and during the time of interview it is used as a guide.

Questionnaire might be- (i) *Open ended*- does not have limit the choice of expression, (ii) *Closed*- respondents choose the answer from a set of provided options; and (iii) *Mixed type*- consists of both close and open ended type question.

In this study researcher used this questionnaire survey method which is structured and closed type questions due to time constraints and also the variety of respondents. Two sets of questionnaire (Part-1 & 2 in Appendix-B) are used for this purpose, e.g. one for the households (service recipients) and another for the *Pourashava* officials (service providers). It is very essential to mention here that the respondents of the households' owner are diversified in nature. Moreover, researcher visited physically to the respondents' household to do the questionnaire survey that is different strategy than the theory determined. Because, it is not viable for the study area to collect data through email or telephone due to the respondents' less interest and time constraint and also their awareness is not up to the mark.

4.1.2. Personal Interview

A personal interview is a conversation between two or more people where questions are asked by the interviewer to elicit facts or statements from the interviewee. Interview is a very systematic method by which it is possible to enter deeply into even a stranger's life to bring out necessary information and data for the research purpose. Interview is a very popular research method because they are *flexible* and *participatory.* Interviews are flexible because

the interviewer has the freedom to change some questions or the asking order of the questions according to the reactions of the users. According to Aminuzzaman, 2011, it might be-

(i) *Structured*- in this type it is used pre-set questions and highly standardized techniques of recording.

(ii) *Unstructured*- interviewers do not follow a list of pre-set/determined question and also not follow the standardized techniques of recording.

Interview can be face to face or telephonic; face to face interview is treated as personal interview. In this study the researcher used unstructured and face to face (personal) interview method/technique to collect data and information from the personnel of the Savar Pourashava who are mainly responsible for SWM system of this institution. Unstructured personal interview method is chosen because the respondents' are so busy with their official tasks and at the same time they are not wanted to be guided to share the information.

4.1.3. Sampling

All the items under consideration in any field of inquiry constitute a 'universe' or 'population'. The method of selecting a few items from the universe for the study purpose to draw a conclusion about the universe or population, is technically known as a sample or sampling. Generally a researcher cannot be able to do communicate directly of every individual in the total population that is studying. Instead of this, data are collected from a subset of individuals or items which is treated as a *sample* and use this to make inferences about the entire population. Ideally, the sample corresponds to the larger population on the characteristic(s) of interest.

There are two general approaches to sampling are used in social science research-

(i) ***Probability sampling***: all elements (e.g., persons, households) in the population have some opportunity of being included in the sample, and the mathematical probability that any one of them will be selected can be calculated.

(ii) ***Non-probability sampling***: in contrast, population elements are selected on the basis of their availability (e.g., because they volunteered) or because of the researcher's personal judgment that they are representative. The consequence is that an unknown portion of the population is excluded (e.g., those who did not volunteer).

(Source: www.psychology.ucdavis.edu/rainbow/html/fact_sample.html)

One of the most common types of non-probability sampling is called a convenience *sampling*[15]–because such samples are not necessarily easy to recruit, but because the researcher uses whatever individuals are available rather than selecting from the entire population. (Cited from: psychology.ucdavis.edu/rainbow/html/fact_sample.html)

The researcher followed the *convenience sampling* technique which is one of the common types of non-probability sampling for this study purpose because a large number of population, time constraint, availability of respondents and also the nature of the issue that is equally affected all the portion of the population as well.

4.1.3.1 Sample size

Total sample size is 40 (forty) including both the service providers (Savar *Pourashava*) and service recipients (citizens' of the *Pourashava*). Out of 40 respondents, 30 are selected including both male and female from the demand side (service recipients) to considering the issues. In the sampling method simple convenience sampling method is followed. On the other hand, 10 respondents are considered including executives and elected officials of the Pourashava from the supply side (service providers) according to their roles and responsibilities of the SWM system of Savar *Pourashava*.

4.1.4. Profile of the Study area

The study area is Savar *Pourashava* (Map in Appendix-A), which is a rapid growing urban center under Savar Upazila of Dhaka district. It is located at a distance of about 26 Km to the northwest of Dhaka city. Ghoradia, Mallicker Tek, Madanpur, Dakkhin Krishnosolia, Deogao in the Northern part; Dhorenda mouza & Bangao union in the east; Karnapara Khal in the South and Bonshi river is situated in the western side of the *Pourashava*. Savar *Pourashava* is established in 1991 under the *Pourashava* Ordinance, 1977. It is an A-2 class *Pourashava* comprising of 9 wards, 57 mohallas (BBS, 2011). According to the general information book of the Savar *Pourashava*, total area is 14.08 Km^2 and the population is 1, 40,300 (BBS, 2001), but in 2011population census the population is increased and the present estimated population is 2, 96,851 and the total households are 75,902 (BBS, National Population and Housing Census, 2011); male 53.03%, female 46.97%.[16] 84% of the holdings are residential; 11% are commercial; only 1% is industrial and 4% are holdings are treated as others. So, Savar *Pourashava* can be said mainly a residential area. The natural growth rate is about

[15] A researcher chooses items in accordance with his own convenience. (Aminuzzaman, 2011)
[16] Wikipedia, the free Encyclopedia.

2.2% but the total population growth rate is about 5%. According to the Census Report 2001, the population density of the *Pourashava* is about 1,000 per square kilometers. In the central area this figure is about 1,800 (Satu, 2005).

4.2. Data Presentation and Analysis

Data are collected from 30 households of three wards and 10 employees & officials (both elected & appointed) of Savar *Pourashava*. From the data, answer to the research questions are examined and analyzed therefore. Certain parameters are used for each indicator. These parameters reflect the current and expected situation of solid waste management of the selected area by the respondents from both sides.

4.2.1. Basic features of the respondents

The total respondents are 40 (Male 33, Female7) from the both sides. The following figures and tables are shown the total respondent's basic features.

Figure-12: Male-Female Ratio of the Respondents

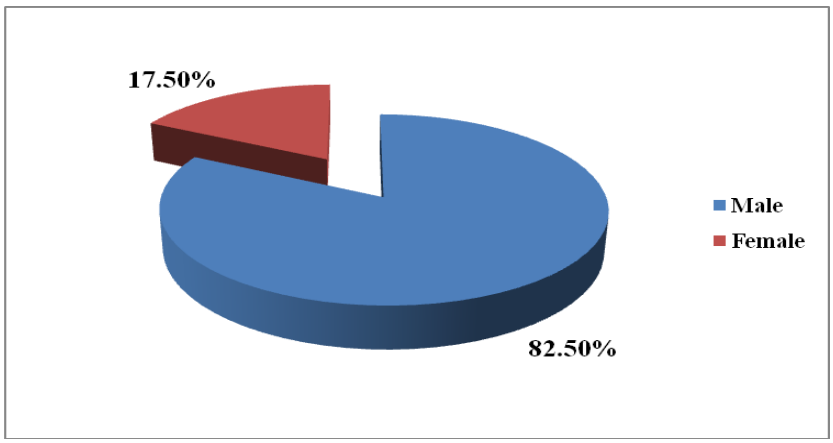


Table-7: Educational Qualification of the Respondents

Name of Degree	Number	Percentage
Below S.S.C.	2	5%
S.S.C.	6	15%
H.S.C.	3	7.5%
B.A.	10	25%
B.S.C.	1	2.5%
B.A. (Hons.) M.A.	6	15%
M.A.	5	12.5%
M.Com	3	7.5%
M.S.C.	1	2.5%
Dip. Eng.	2	5%
B.S.C. Eng.	1	2.5%

Table-8: Occupation of the Respondents

Occupation	Number	Percentage
Housewife	4	10%
Business	6	15%
Private Service	12	30%
Teacher	3	7.5%
Govt. Service	9	22.5%
Rtd.	3	7.5%
Others	3	7.5%

Table-9: Age of the Respondents

Age Limit	Number	Percentage
30 And Below	1	2.5%
31-40	13	32.5%
41-50	15	37.5%
51-60	8	20%
61>	3	7.5%

The above features are both of service provider and service recipients for the clear understanding about the respondents. In the following section it is shown the data analysis that is collected from the citizens of Savar Pourashava by the preset questionnaire (Questionnaire-Part: 2, for details see Appendix-B).

4.2.2. Citizens of Savar Pourashava

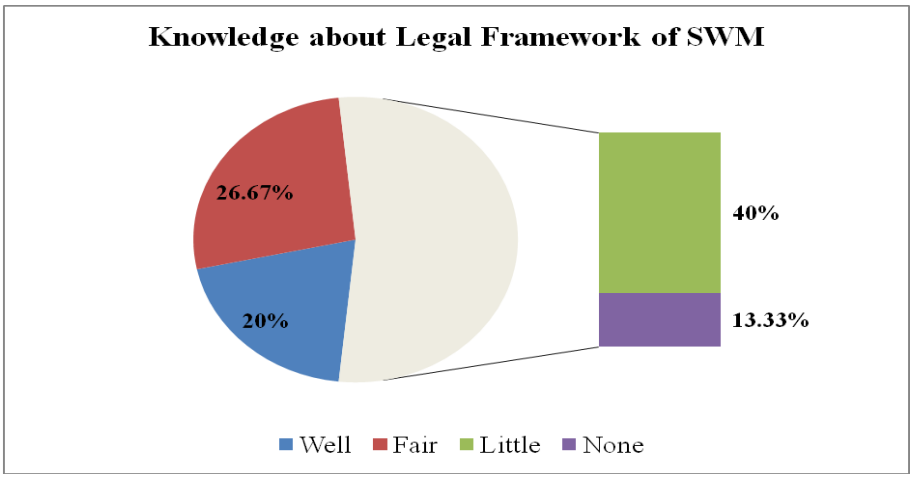
4.2.2.1. Legal & Policy Framework

According to the research questions and research objectives this independent variable is set in the analytical framework to collect data & information from the respondents by questionnaire survey to analyze the SWM system of Savar *Pourashava*.

(i) Knowledge about Policy and Legal Framework

The respondents were asked about their knowledge and idea about policy and legal framework for the *Pourashava* to manage solid waste. These include solid waste management Act, laws, rules, regulations and other policy papers. The respondents are expected to provide their idea and opinion regarding government's initiatives for proper management of solid wastes generated different sources. The data is presented in the following figure:

Figure-13: Knowledge about Legal Framework of SWM

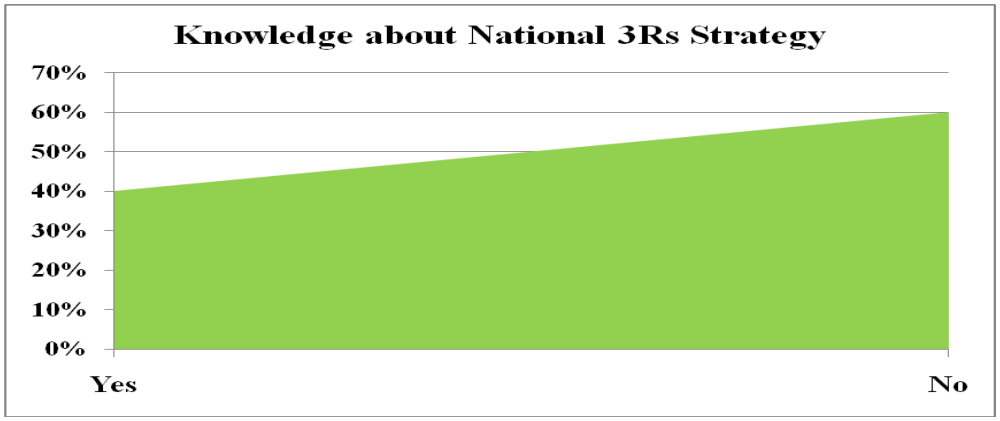


The above figure shows that only 20 percent of the respondents have very good idea about legal frameworks of SWM. Around 27 percent have fair and the large number 40 percent people have very little idea about solid waste management related legal and policy framework developed and practiced by the government.

(ii) Knowledge about 3Rs Strategy

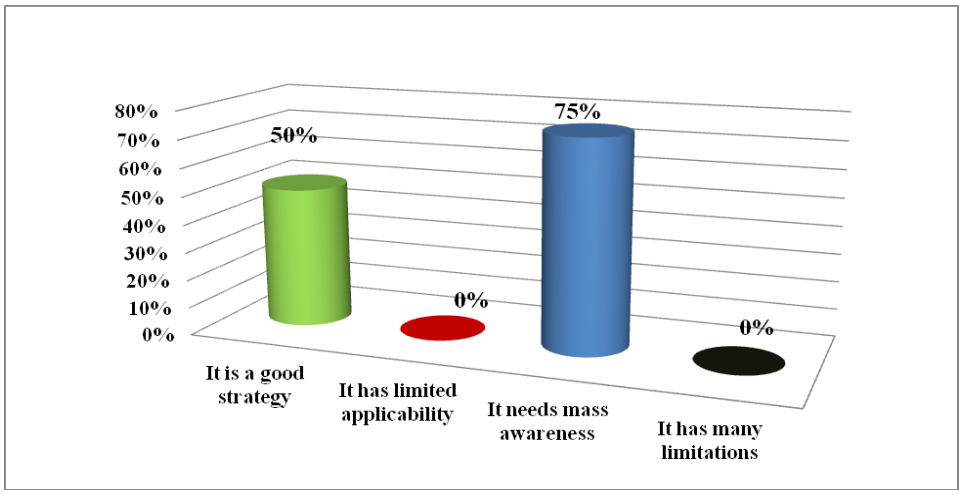
The respondents from citizen side are not that much aware of the new approach of the government called '3R' (Reduce, Reuse & Recycle) solely concerned with municipal solid waste management. In this regard, the following figure shows the real picture of their understanding of the said strategy:

Figure-14: Knowledge about 3Rs Strategy



The above graph shows that 40 percent of the total respondents know about the strategy whereas the rest 60 percent do not have much idea about the national 3R strategy. From among the 40 percent of the people who know about the strategy, they have the following extent of idea about the strategy:

Figure-15: Observation about 3Rs Strategy



The above bar graph shows that almost half of the respondents who know about the strategy think that it is a good strategy and two third of the respondents think that people's awareness is much required in order for the strategy to be implemented successfully.

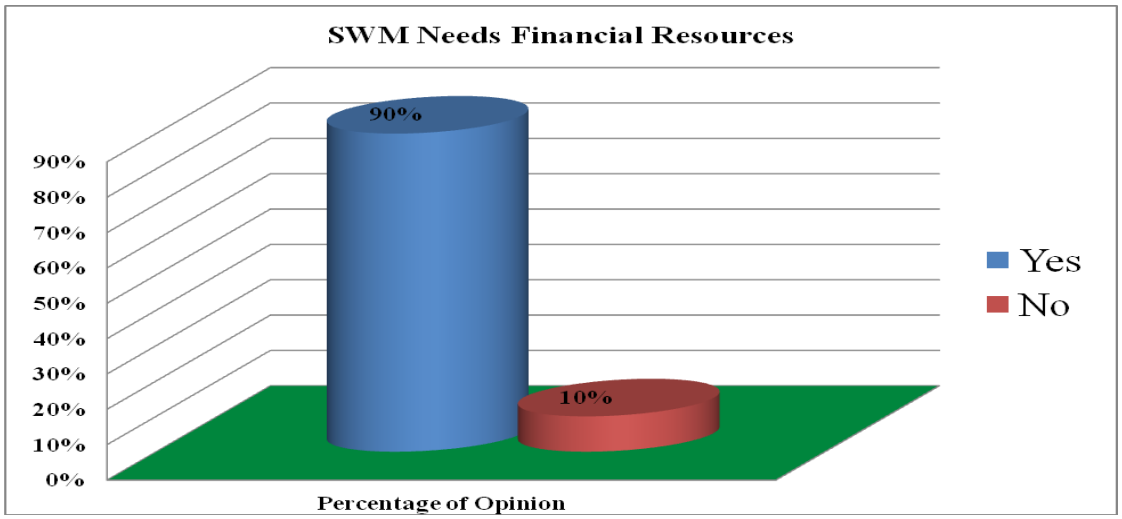
4.2.2.2. Financial Management

Financial resources are also very important factor to ensure the SWM system of Savar *Pourashava*. Considering this importance the respondents are asked to share their idea about the financial resources required for solid waste management in their area and the following data are collected.

(i) Opinion about Financial Resources to be needed for SWM

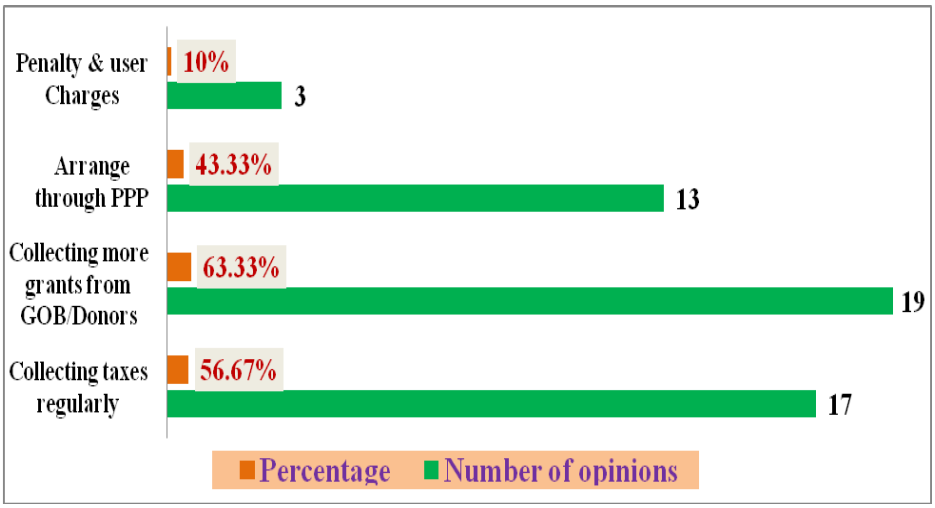
It is found that most of the respondents are aware that it needs a huge amount of financial resources to manage the municipal solid waste properly. The following figure shows:

Figure-16: Need of Financial Resources for SWM



The figure shows that around 90 percent of the respondents are aware of the involvement of financial resources in SWM. Of them 63 percent think that government should arrange more grants from donors and development partners for managing solid waste. However, 57 percent of the respondents think that regular collection tax can be another option for arranging finance for SWM. Hence a good number of respondents have opted for arranging public private partnership to arrange finance for solid waste management in their areas. This is shown in the following figure:

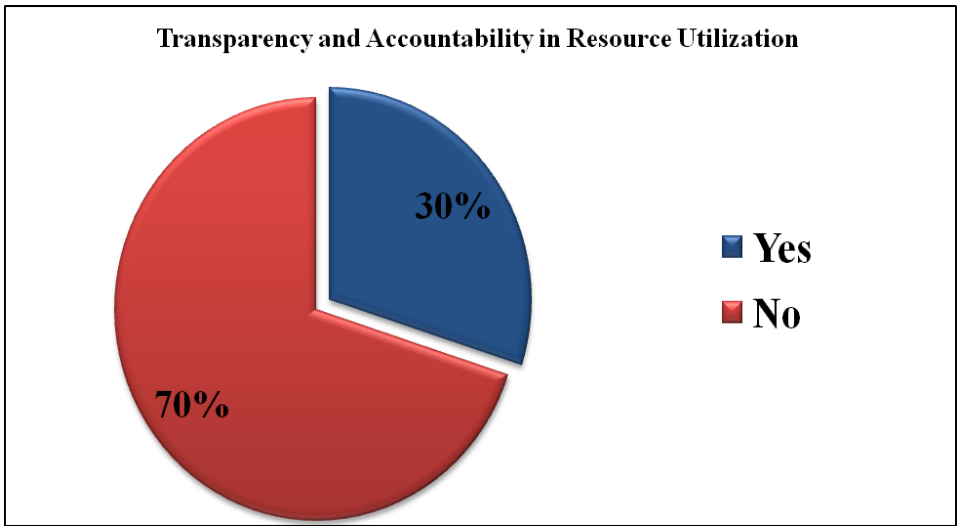
Figure-17: Financial Resources Arrangement Options



(ii) Opinion on transparency and accountability in resource utilization

The respondents are asked to give their opinion as regards to the transparency and accountability of the municipality authority in resource utilization. Since proper utilization of financial and other resources can play a crucial role in managing solid waste, people's have the right to know about the mechanism of resource utilization. The following figure shows their opinion:

Figure-18: Transparency and Accountability of Resource Utilization



The above pie chart shows that 70 percent of the total respondents think that transparency and accountability are not ensured in utilizing resources for Solid Waste Management. In this regard respondents thought that the specific allocations of the budget for SWM are not authenticated and transparent. Moreover, the responsible persons for utilizing the allocated

budget are not open to the citizens'. Therefore good governance to some extent is not existent the managing solid waste in Savar *Pourashava*.

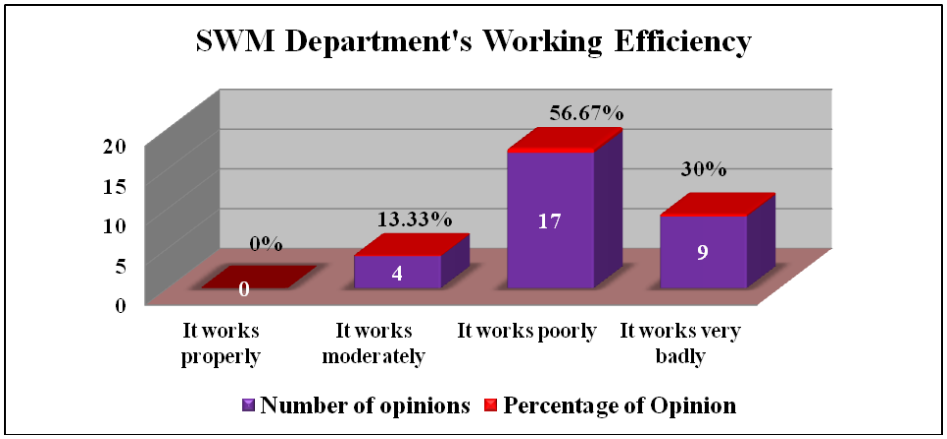
4.2.2.3. Human Resource Management

An organization is very much dependent on its human resources or work forces. Hence it is also needed proper management for the efficiency as well as the better performance. *Pourashava* is the solely responsible for ensuring SWM service to the citizen, so that it needs a large number of work force and also the very strong organizational structure like independent SWM department. In this connection, it is asked to the respondents to gather their knowledge and also the idea about present system from their real life experience.

(i) Opinion on working efficiency regarding SWM of Savar *Pourashava*

The working efficiency of solid waste management department of any municipality can lead to a very useful and effective management of resources on solid wastes. Respondents are expected to provide their opinion on the efficiency of solid waste department of Savar *Pourashava* in managing the solid wastes. The data is shown in the following figure:

Figure-19: Working Efficiency of SWM Department of Savar Pourashava



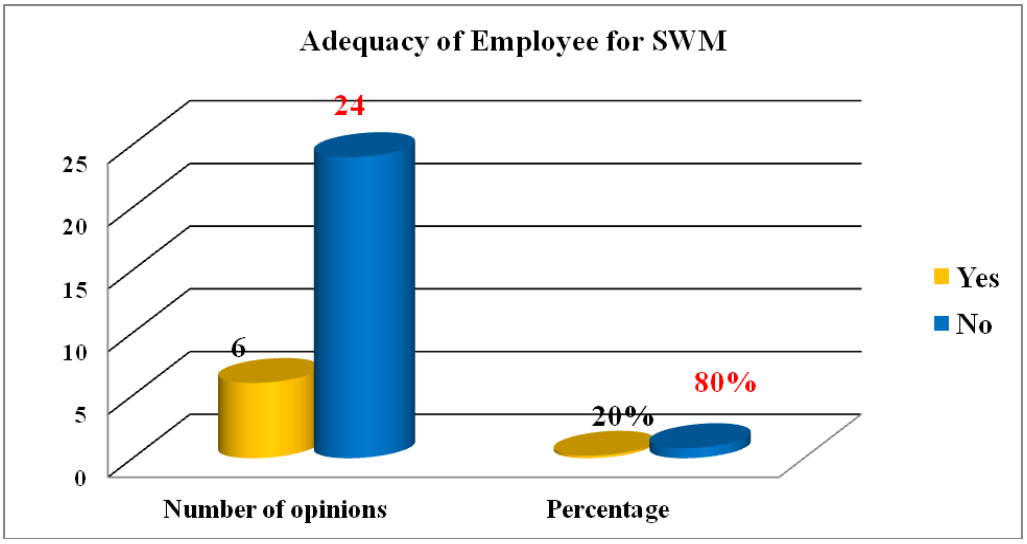
The above bar graph shows that people have a very depressing idea about the efficiency of solid waste department. More than half of the respondents think that the solid waste management department is poor in performing their tasks properly. Even thirty percent thinks that the concerned department is very bad in their working efficiency. According to their opinion, solid waste management department is not at all efficient in management of SWM in their area.

(ii)* Opinion on number of employee in Savar *Pourashava

In Bangladesh, employees play a vital role in accomplishing and implementing field level duties of an organization. If the number of employee is inadequate, the service quality will be

poor. Hence, limitation is there in the government and field level organizations are aware of this practice. This can be shown in the following figure:

Figure-20: Adequacy of Employee for SWM



According to their opinion, 80 percent think that the number of employee is inadequate to perform the huge task of solid waste management efficiently. Only 20 percent think that there are adequate numbers of employee engaged for SWM in their areas.

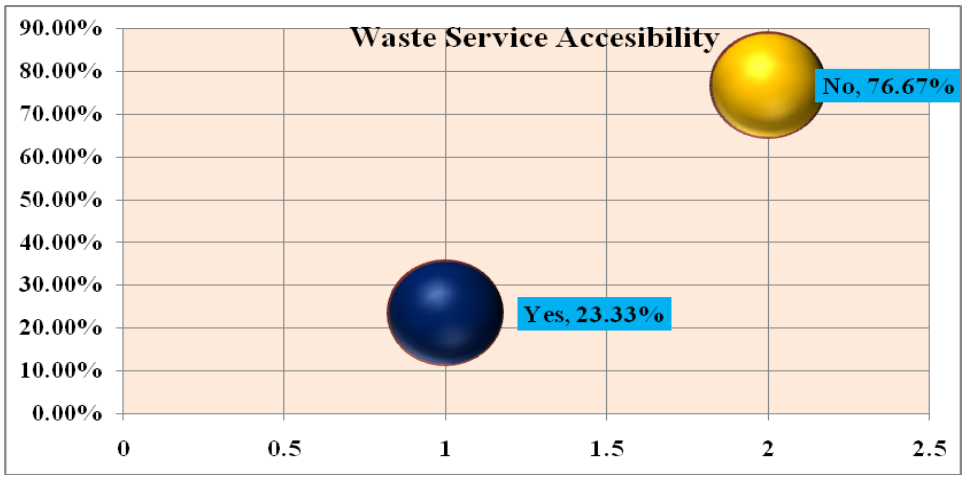
4.2.2.4. Operational Management (Collection, Transportation and Disposal) & necessary equipments for SW management

Solid Waste Management is a combination of different activities. According to the previous discussion in SWM theory and practice the major factor of SWM is operational management (collection, transportation & disposal) and as well as necessary equipments. It is asked to the respondents about this management system of Savar Pourashava that they are facing everyday life.

(i) Opinion on Waste Service Accessibility

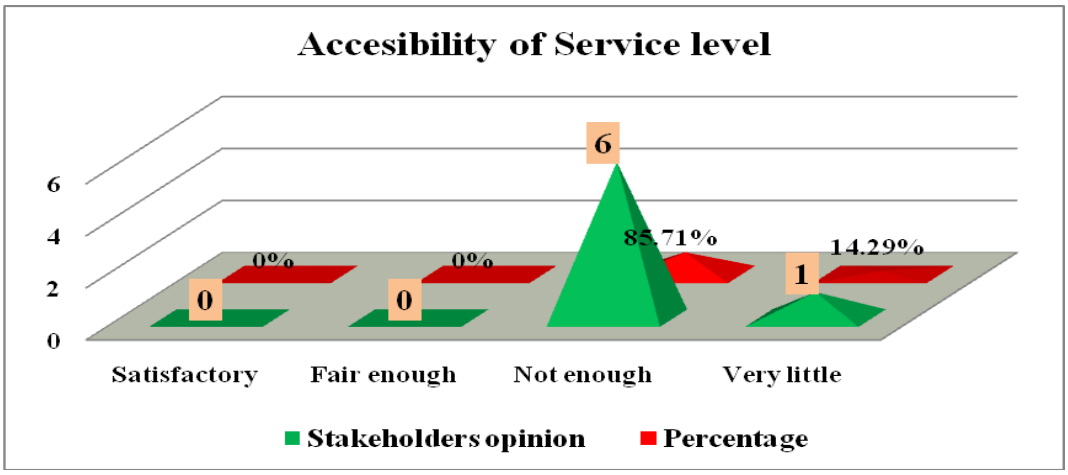
Accessibility to solid waste services helps the citizen to keep their neighborhoods clean and environmentally sound for all. People of Savar Pourashava think that they should have the access to get necessary services from the department since they are the tax payers of the area. The following figure shows the picture:

Figure-21: Accessibility of SW Service by *Pourashava*



The figure clearly depicts that only 23 percent of the respondents have accessibility to waste service whereas 76 percent think that they have no access to solid waste service from their municipality. The level of access is also different and varies from place to place. So is the difference in the opinion regarding the level of access of the people to that particular service. This can be shown in the following graph:

Figure-22: The Level of Accessibility of SW service



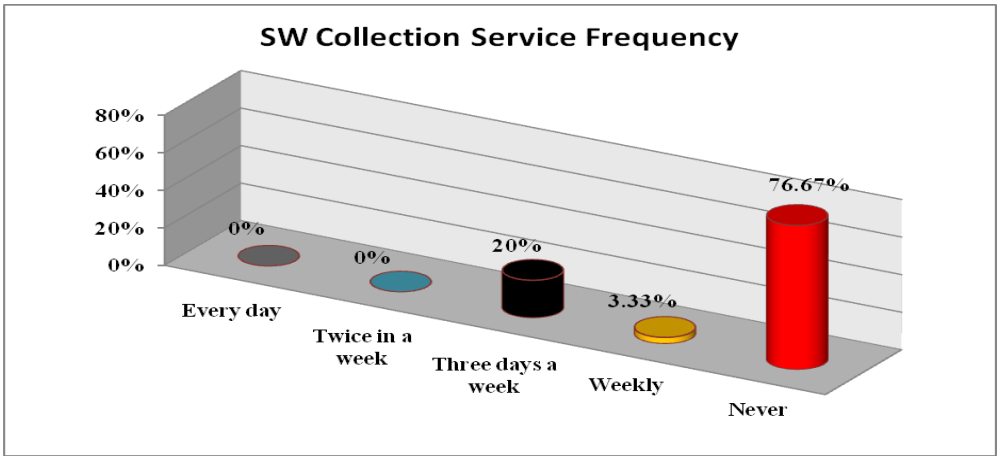
The figure shows that more than 85 percent of the people are not satisfied with the existing access level of solid waste management from their municipality. This means they have never received the expected level of services for solid waste collection and disposal at their generation level.

(ii) Opinion on the Frequency of Waste Collection

Regular collection of solid waste can ensure environment clean and safe health for the city dwellers. Collection can be done in various ways. In some places municipal authority

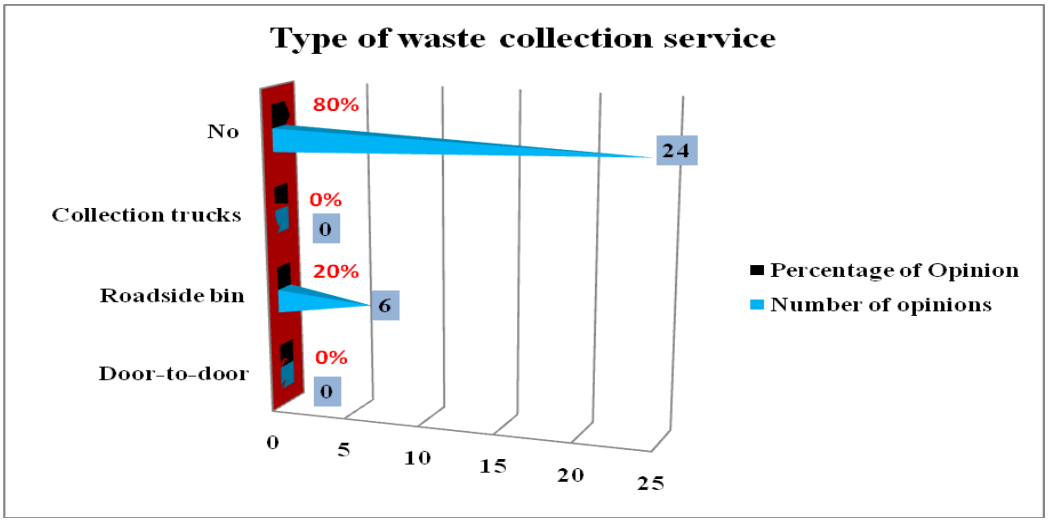
engages collection trucks and vans and some places, community organizations provide door to door collection from household and dispose in designated place. Collection trucks use to collect from those designated places and dump in the dumping zone. The situation in Savar reflects the following figure:

Figure-23: Frequency of SW Collection Service



The above diagram shows that in Savar Pourashava, in most cases collection is not made frequently by the *Pourashava*. Only 20 percent of the collection takes place thrice a week. The scenario is quite depressing where in 76 percent cases no collection is done at all. Therefore it creates hazards on environments and human health. The following figure shows that in Savar *Pourashava* in most cases (20%) collection is made from roadside bins and in other cases (80%) no collection is really made. Therefore wastes are dumped here and there and not collected. Often this creates huge environmental hazards and impact on human health.

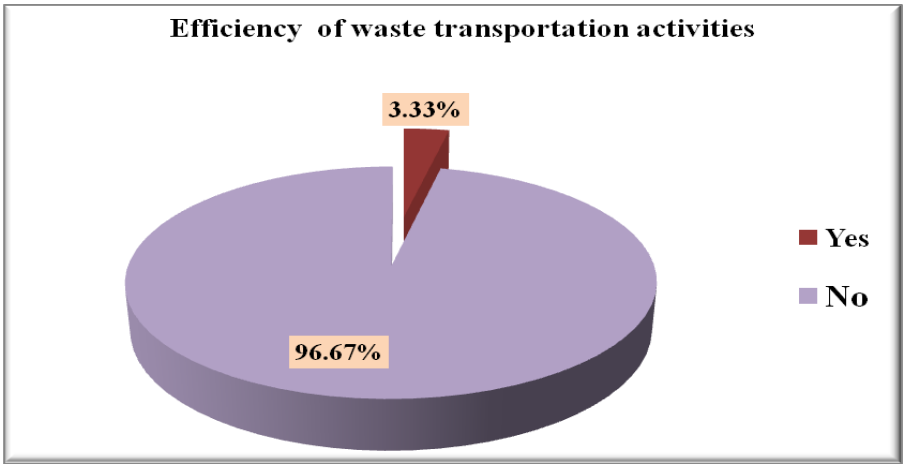
Figure-24: Type of SW Collection Service



(iii) Efficiency of waste transportation activities

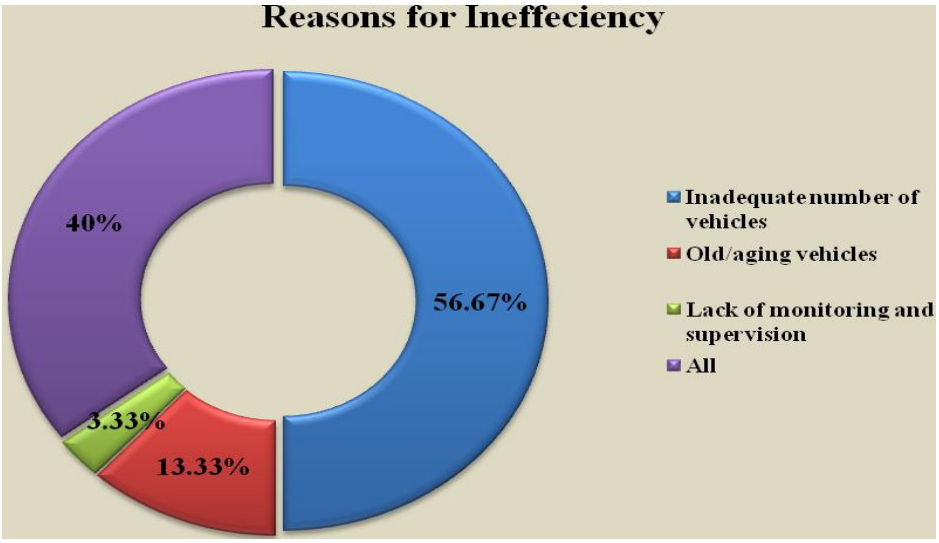
Respondents of the study area think that waste transportation activities of Savar *Pourashava* are not efficient. More than to 96 percent of the respondents think, municipality authority is not efficient in collecting and transporting wastes from door to door or household dumps. Even while they are transporting, they leave waste here and there on the way and use uncovered van leaving bad odor around the dump sites.

Figure-25: SW Transportation Efficiency



The reasons according to the respondents are mostly supply of inadequate number of vehicles. The other reasons are that some vehicles are old and outdated whereas lack of monitoring and supervision is another vital reason against the inefficiency of the municipal authority. The following figure shows that adequate supply of vehicle and collection trucks may be able to improve the efficiency of waste collection facilities and the system as well.

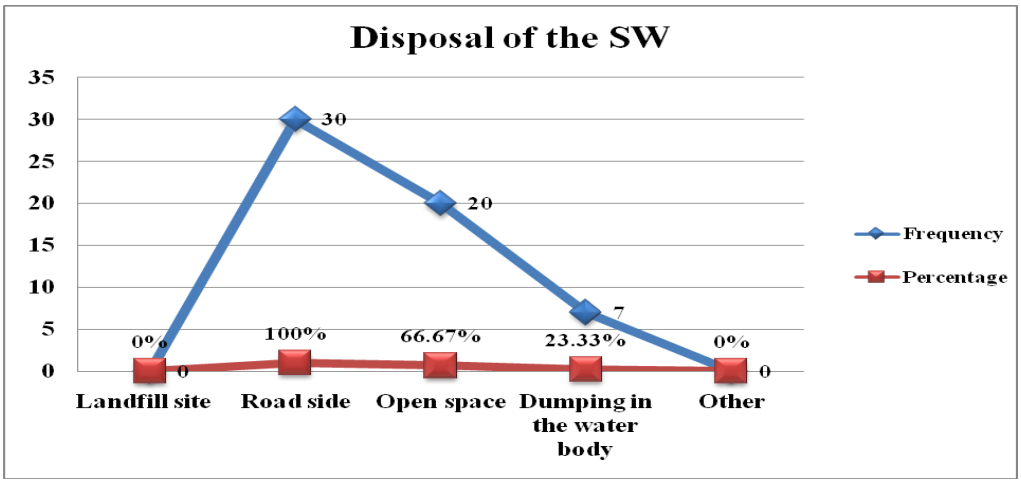
Figure-26: Reasons for Inefficiency



(iv) Location of Waste Dumping at Savar *Pourashava*

Dumping place is one of the important preconditions of solid waste management. If wastes are dumped according to proper planning and in proper place, hundreds of hazards can be avoided and addressed. Dumping sites of Savar *Pourashava* can be seen in the following figure:

Figure-27: SW Disposal by Savar *Pourashava*

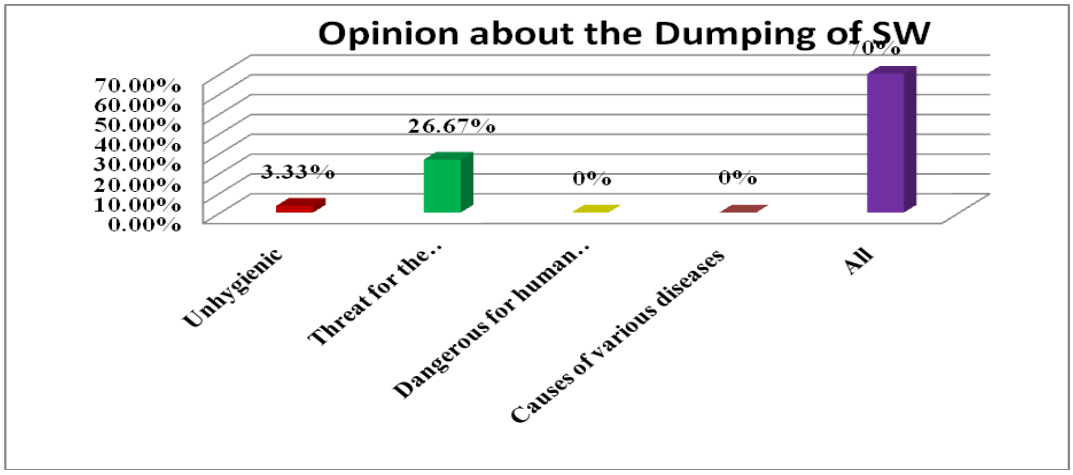


The above figure shows that in Savar Pourashava most of the wastes are dumped and disposed in beside the roads. Very often it is found to dispose in open place and water bodies. It seems that there is no specific dumpsite of the municipality to dispose wastes. Even some of the municipal trucks collect wastes from those sites, but they also dispose in open place nearby any streets or residential area. The ultimate result is the same, serious impact on health and environment.

(v) Dumping condition of solid wastes

The overall condition of dumps at Savar Pourashava is seen in the following figure. According to the respondent's opinion, impact on environment and health are the most serious issues of dumping in open places. The wastes are dumped in unhygienic manner and it contaminates water bodies and surroundings. Overall, the whole condition is unhealthy, unhygienic and environmentally threats for human health and nature as well. Following Figure shown the opinion of the respondents-

Figure-28: Citizens Opinion on SW Dumping by *Pourashava*



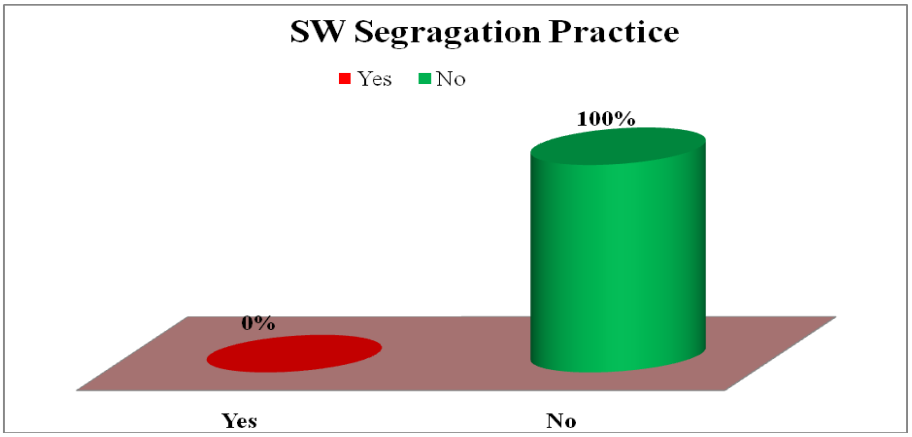
4.2.2.5. Citizens Awareness

Citizens' awareness is very important for ensuring this type of essential service. Because efficient SW management is not possible only by the service providers, citizens have crucial role to enhance this service. Considering this factor it is asked to the respondents' various question like waste segregation practice and also their thoughtful suggestion to improve this situation.

(i) Waste Segregation Practice

Waste segregation is an important part of SW management system. It is one of the preconditions of the waste treatment and disposal which will be environment friendly and safe for human health. Some SW can be reused and recycled and also for using energy recovery & composting. If citizens' are aware of it then it might be the resource, and waste management activities also become very easy to the Pourashava authority. So, considering these issues, what practice is done by citizens' the following figure shows the real situation.

Figure-29: SW Segregation Practice by the Citizens'

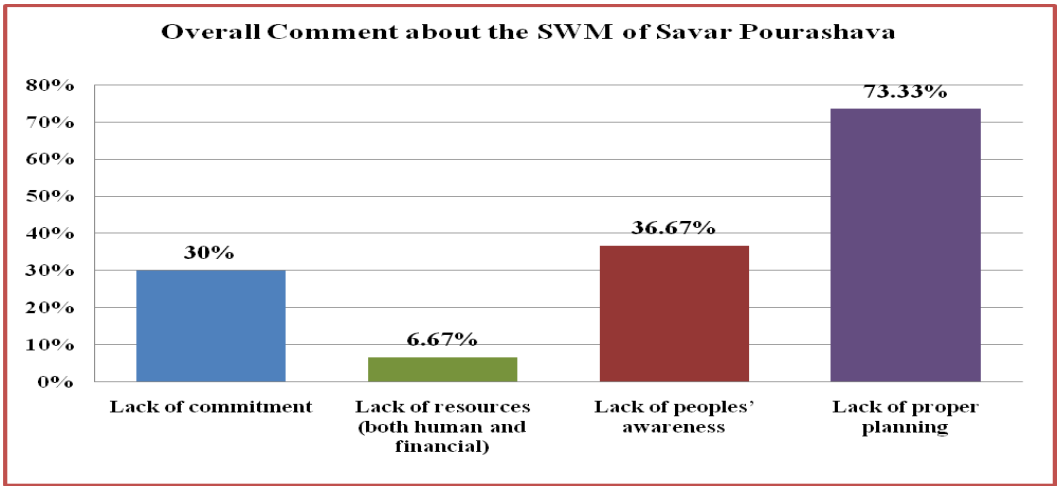


The above figure shows that no segregation practice at the source of waste generation is done by the citizens' in the study area. It seems that household wastes are gathered together and dumped or collected in the same way. People are not still aware of that and due to the reason SW disposed unhygienically in the dumping zone or disposal area.

(ii) Proposal for betterment of SWM system in Savar *Pourashava*

The respondents opined that the municipality should take some initiatives in order to enhance the existing solid waste management system. They think some reasons are causing this depressing scenery in SWM system of the *Pourashava*. They are made some comment and the following figure illustrate it:

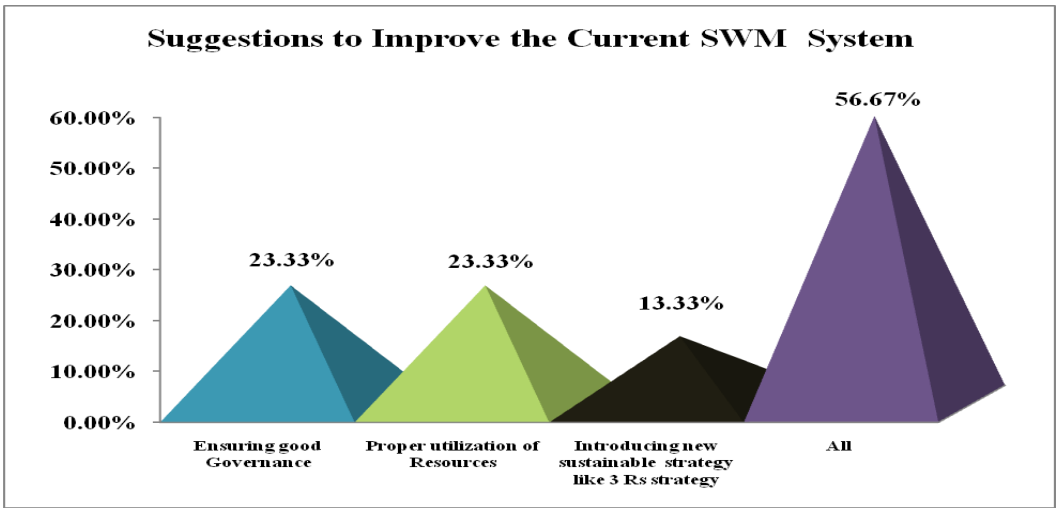
Figure-30: Overall Comment about SWM System



The above figure shows that 73 percent of the respondents of the study area believe that lack of proper planning is responsible for the existing solid waste management system of Savar *Pourashava*. Around 36 percent think that lack of awareness worsens the situation and finally 30 percent think, lack of commitment of the municipal authority and employees involved in the cleaning and management process hinders the management system which in fact is major constraint to provide quality waste management services at study area.

From this point of view people of the study area are giving some suggestions for the betterment of this poor SW management practice by the *Pourashava* authority, which reveals their interest and awareness about SWM system of Savar *Pourashava*. According to the respondent's opinion, proper utilization of resources, good governance and introduction of sustainable strategy like 3R are the suitable and preferred options for the municipality if the authority really wants to improve the existing situation. The following figure proves this argument:

Figure-31: Suggestions to Improve Current SWM System



On the other hand, the service providers Savar *Pourashava* officials and staffs are also asked question in the same issue with a preset questionnaire and personal interview is also done to explore the current SWM system of Savar *Pourashava*. In the following section it is presented and analysis is given based on collected data and information.

4.2.3. *Pourashava* officials and staffs

There are 10 officials and staffs are asked different questions following the questionnaire (Questionnaire Part-1, for details, see Appendix-B). It is also done personal interview of the management and policy level officials who are responsible to make management plan. In this connection it is also mentioned here that there are some official documents and reports are evaluated to understand the actions related to the SWM. Respondents are different level officials, elected officials and the personnel who are directly involved to do the work at field level. The basic information of the respondents is given in the following Table 10.

Table-10: Basic Information of the Respondents of Savar *Pourashava* Officials/Staffs

Sl.No.	Designation	Number	Male/Female
01	Mayor	01	Male
02	Counselor	02	Male
03	Executive Engineer	01	Male
04	Secretary	01	Male
05	Sanitary Inspector	01	Female
06	Conservancy Inspector	01	Male
07	Conservancy Supervisor	01	Male
08	Garbage Truck Driver	01	Mae
09	Garbage Cleaner	01	Male

The respondents were also asked questions following the analytical framework and the following factors are mostly important to gather knowledge about the present SWM system of Savar Pourashava.

4.2.3.1. Legal and Policy Framework

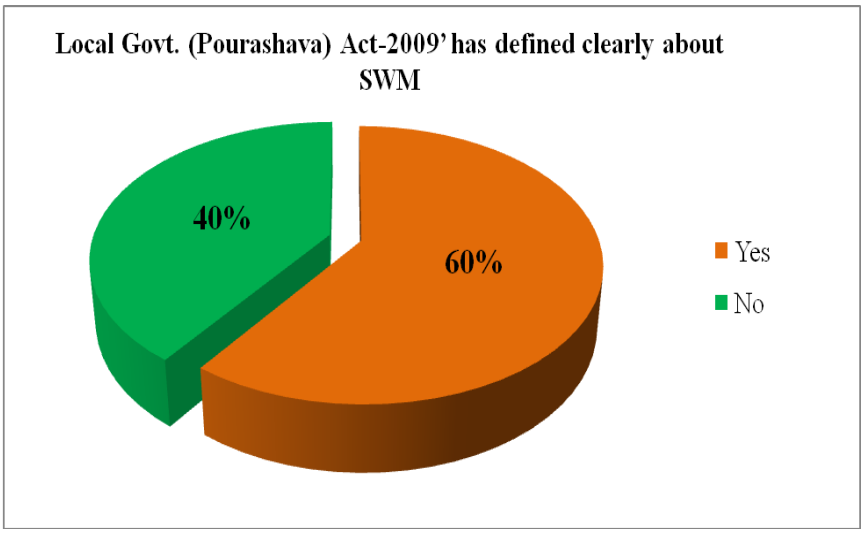
As, the Pourashava is obligated to perform the functions under 'Local Govt. (Pourashava) Act-2009' to ensure various public services including SWM service for the citizens' of the Pourashava, so it is asked to the respondents about their knowledge about the act.

Table-11: knowledge about 'Local Govt. (Pourashava) Act-2009'

knowledge about 'Local Govt. (Pourashava) Act-2009'	Number of opinion	Percentage
Yes	7	70%
No	3	30%

The above table shows that 70 percent of the total respondents have clear knowledge about the act and 30 percent have none. They also think that the act is clearly defined about the SWM service of the local government authority. In this regard 60 percent says it is clearly defined and 40 percent put their negative remarks. The following pie chart shows this-

Figure-32: SWM service defined in the 'Local Govt. (Pourashava) Act-2009'



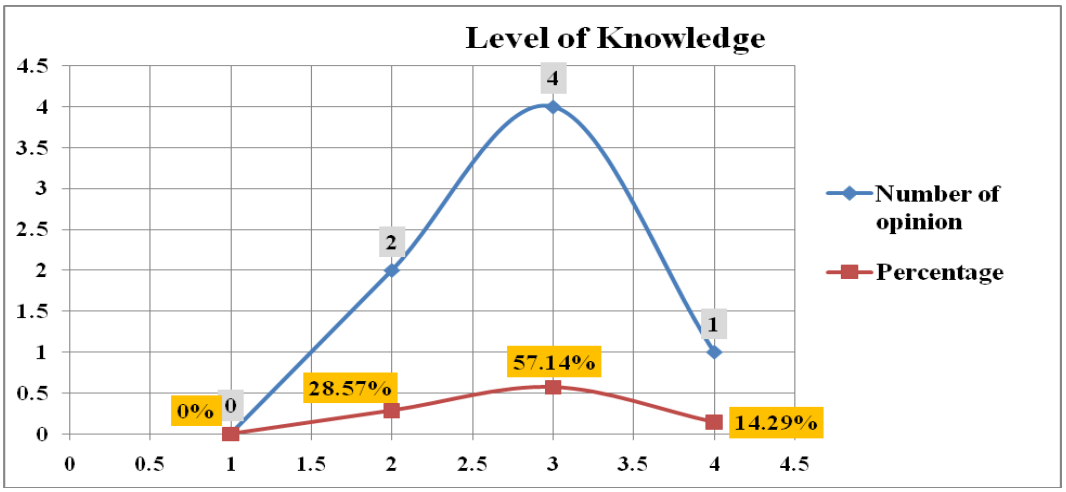
The respondents are also asked about other laws/regulations, acts or policies and strategies related to SWM and 70 percent given their opinion in positive and 30 percent have no idea on it. It depicts in the following Table-

Table-12: Knowledge about SWM related other Laws/Regulation, Acts or Policies

knowledge about SWM related other laws/regulation, acts or policies	Number of opinion	Percentage
Yes	7	70%
No	3	30%

The level of knowledge about this issue is also analyzed and it gives the information that 57 percent have fair knowledge, almost 29 percent have good and 14 percent have a little knowledge. Actually, this is very important, because of alternative thinking to manage this service efficiently under the legal bindings and different strategies. The following line chart illustrates the level of knowledge of the respondents about the issue.

Figure-33: Level of Knowledge about SWM related other Laws/Regulation, Acts or Policies



In this regard, it is also asked to the respondents about latest strategy which is named '3Rs' (Reduce, Reuse & Recycle) strategy to manage SW in other developing countries and Bangladesh is also formulated this in 2010. As it is treated a sustainable integrated strategy to manage SW with environmental friendly and ensure safety for public health, so it tries to learn about their knowledge on it. Only 40 percent have the knowledge on this and 60 percent have no knowledge.

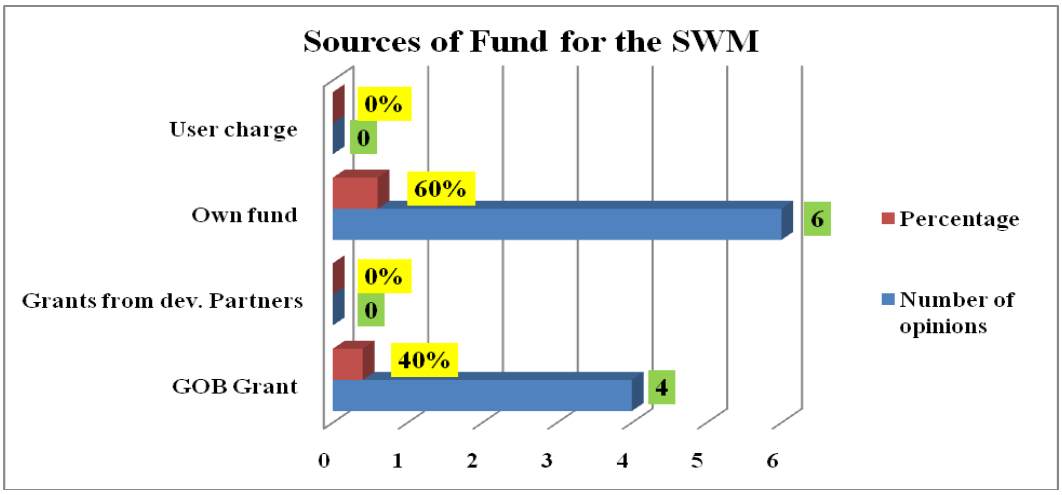
Table-13: knowledge about the National 3Rs Strategy-2010 of SWM

knowledge about the National 3Rs Strategy-2010 of SWM	Number of opinion	Percentage
Yes	4	40%
No	6	60%

4.2.3.2. Financial Management

Financial resources are essential to implement any functions of an organization. As we know SWM needs huge financial resources the respondents of the services provider's part were asked various questions on this issue. The very logical and valid question about FM of SW was-what are the sources of fund for the solid waste management of Savar *Pourashava*? The respondent's opinion is illustrated in the following bar charts-

Figure-34: Sources of Fund for SWM



The above bar chart depicts 60 percent of the respondents opined that Savar *Pourashava* manage SW by their own fund and rest 40 percent says it comes from GOB grant.

Respondent's opinion is analyzed through extensive assessment of the budget document of 2010-11 and 2011-12 of Savar *Pourashava* to get information and data of their source of income. According to the documents (21st Budget of Savar *Pourashava*), it is shown that the source of income is two types-one is revenue budget and another is development budget source. In revenue budget *Pourashava* earned fund from different taxes (holding tax, land tax, building construction & reconstruction, business tax, advertisement/signboard, transport, conservancy tax etc.); fees (driving license, contractor license, shop rent of Poura market, slaughtering etc.), lease of different hat-bazar, ghat, stand (bus, truck, taxi stand), schedule selling, public toilet, different forms & certificates etc.; and others (hall rent, space rent, community center rent etc,). On the other hand, from the development budget, *Pourashava* earned revenue/fund from GOB grant (special grant, development assistance fund etc.) and Donor/Development partner's grant under different projects. In the following Table it shows the summery of budget allocation of Savar *Pourashava* in 2010-11 and 2011-12:

Table-14: Budget allocation of Savar *Pourashava* of 2010-11 & 2011-12

Sl. No.	Fiscal Year	Revenue budget allocation		Development budget allocation	
		Income	Expenditure	Income	Expenditure
01.	2010-11	6,39,79,296.00	3,20,08,230.00	6,26,94,076.00	3,03,60,730.00
02.	2011-12	8,32,46,695.00	5,71,70,000.00	32,12,90,078.00	5,05,20,000.00

Source: Budget document, 21st Budget of Savar Pourashava (2011-12)

The allocated budget is distributed among different functions/activities. Our main concern is of SWM related budget allocation. But unfortunately, there is no specific data of distribution of allocation or percentage of total allocation in this purpose. The researcher tries to find out different sectors of expenditure and it is shown in the following Table-15:

Table-15: SWM related Expenditure of Savar *Pourashava*

Sl. No.	Name of the Sector	2010-11		2011-12	
		SWM related expenditure (head wise)	Percentage	SWM related expenditure (head wise)	Percentage
01.	Officers/Staffs salary & allowance (excluding water section)*	1,00,00,000	16.03	1,25,00,000	11.61
02.	Drain/Nala cleaning	30,50,250	4.90	55,00,000	5.11
03.	Refuge/Garbage & Waste cleaning	28,95,480	4.64	50,00,000	4.64
04.	Purchasing of Garbage & Waste cleaning equipments	1,00,000	0.16	20,00,000	1.86
05.	Van purchase/maintenance	1,00,000	0.16	25,00,000	2.32
Sub-total		**1,61,45,730**	**25.89**	**2,75,00,000**	**25.54**
Others		**4,62,23,260**	**74.11**	**8,01,90,000**	**74.46**
Total		**6,23,68,990**	**100.00%**	**10,76,90,000**	**100.00%**

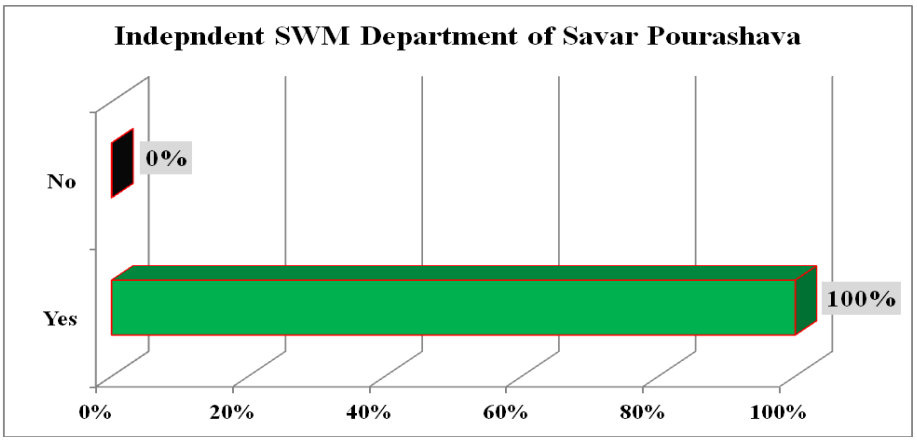
Not specified the SWM related officers/staffs* ***Source: Ibid*

From the following table, it depicts the clear information that, Savar *Pourashava* spent only 25.89 percent of the total expenditure (revenue+development) in 2010-11 and 25.54 percent in 2011-12 for SWM related activities. Out of these cost, maximum is spent for Officers/Staffs salary & allowance purpose in both the fiscal year. The second highest expenditure is in the 'Drain/Nala (canal)' cleaning purpose seen in both the fiscal year and then for the 'Refuge/Garbage & Waste' cleaning purposes. But, the real picture of Savar *Pourashava* is so hopeless (some photographs of SWM of Savar *Pourashava*, Appendix-C).

4.2.3.3. Human Resource Management

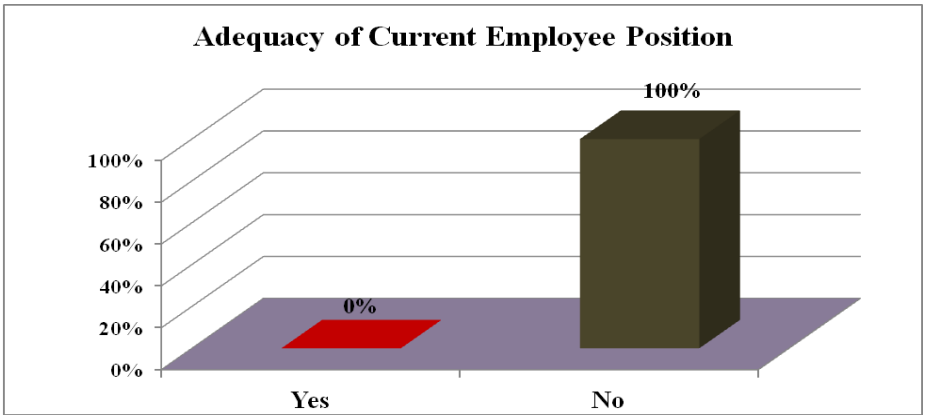
Human resource management (HRM or simply HR) is the management of an organization's workforce, or human resources. It is responsible for the attraction, selection, training, assessment, and rewarding of employees, while also overseeing organizational leadership and culture, and ensuring compliance with employment and labor law[17]. SWM needs huge workforce; so, Pourashava officials and staffs were asked and interviewed about the HRM practices of this organization. From this point of view, HR related issues of SWM were asked to the respondents that underpin the organizational capacity to manage this. The following figure shows the independent SWM department of Savar *Pourashava*-

Figure-35: Independent SWM Department of Savar *Pourashava*



The above figure shows 100 percent respondents opined Savar *Pourashava* has its independent SWM department. But this department is facing inadequate number of staffs who are working at the field level to perform SW related activities. In this issue 100 percent of the respondents put their negative opinion that the department has not adequate number of staffs. The following figure shows this-

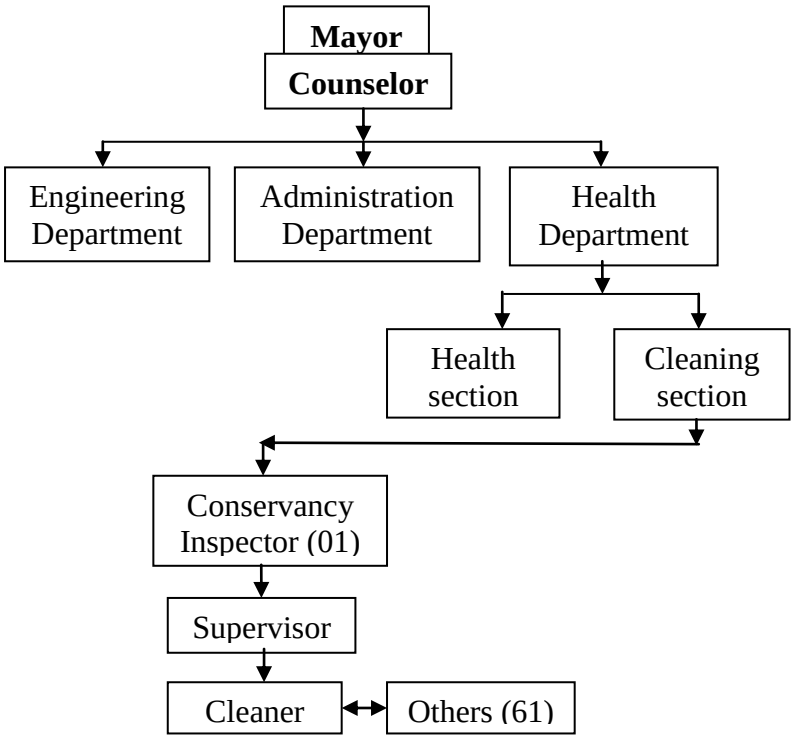
Figure-36: Adequacy of Current Employee Position of SWM Department



[17] Wikipedia, the free Encyclopedia

This opinion is tried to examine by assessing the official documents. According to the report (2012), preparing by the concerned authority of the Savar *Pourashava* for submitting it to the LGRD Ministry of Bangladesh, it is seen 5 positions (including conservancy inspector) are allocated, according to the organization's organogram. But only 1 person is there, he is conservancy inspector and the supervisors & cleaners are working as contractual basis. The present employees in this department are 161 (Pourashava Report, 2012). The organogram of the organization is shown in the following-

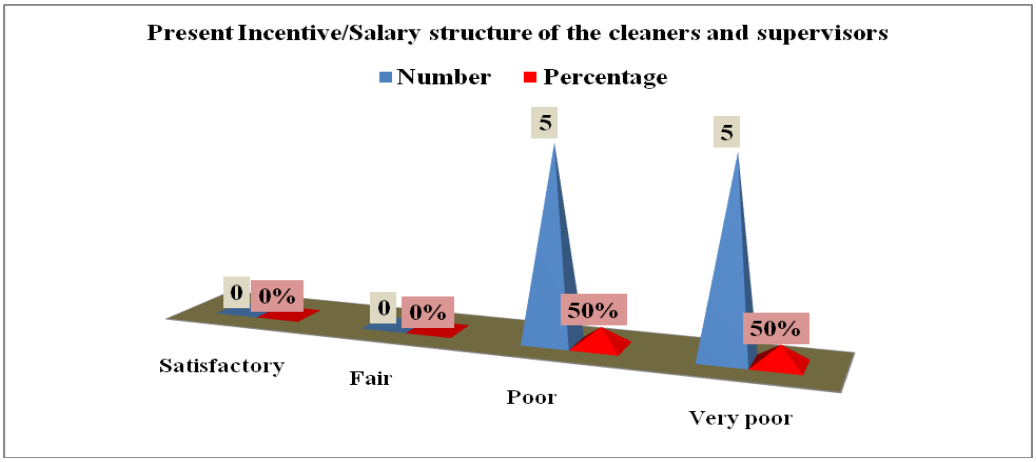
Figure-37: Organogram of the Savar *Pourashava*



Source: Modified from Savar *Pourashava* Annual Report 2012, prepared by author.

As per the organogram the total manpower of the *Pourashava* are 193, but currently working 225 (including permanent & contractual employees). And even most of the contractual workers are working in cleaning department. So, the respondent's opinion is not really valid that the current employee position is not adequate. But it is relevant that the employee's who are working in contractual basis, their salary & incentives are not much satisfactory. From the personal interview with the cleaners it is seen that a contractual basis cleaner drawn only 4800/= (four thousand eight hundred taka only) per month as monthly salary. Even, this information is very evident from the data collected from questionnaire survey.

Figure-38: Salary/Incentive Structure of the Cleaners & Supervisor



From the above chart it is shown, 50 percent of the respondents say the Incentive/Salary structure is poor and same percentage opined that it is very poor indeed.

4.2.3.4. Operations management (Storage, Collection, Transportation and Disposal)

According to the U.S. Department of Education, operations management is the field concerned with managing and directing the physical and/or technical functions of a firm or organization (cited in Wikipedia). Savar *Pourashava* deals different activities to SWM in a process from storage facilities to disposal of SW in the study area. In this regard, officials and staffs of the Pourashava have given their opinion.

As we have known from the earlier discussion and from the literature review, *Pourashava* does not collect SW from door to door rather secondary collections. So, it needs to ensure storage facilities for the citizens'. In this purpose, Savar *Pourashava* has established 30 dustbins (*Pourashava* Report, 2012). But, the conditions of the dustbins are not good and also the storage practice is horrific (Pictorial evidences from real life experience, Appendix-C).

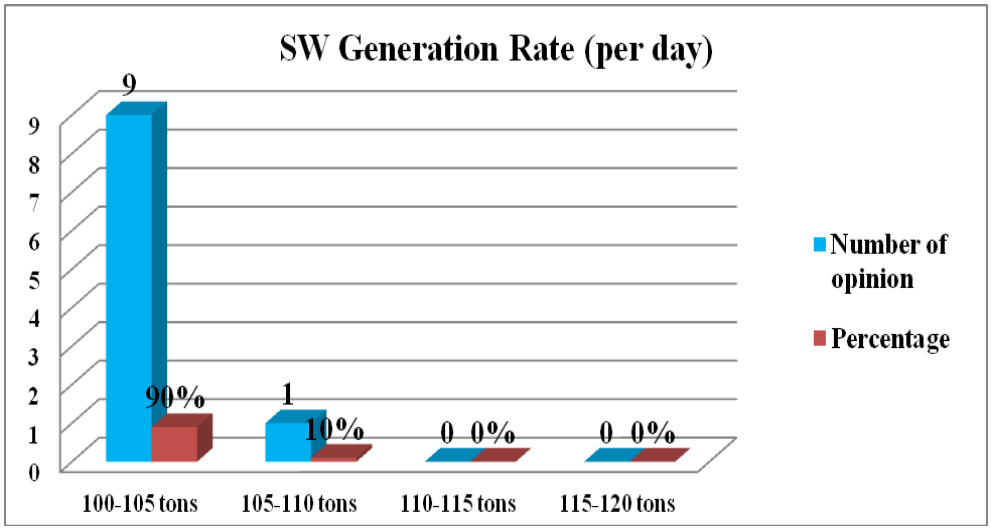
On the contrary, the collection process is not door to door rather secondary collection that is mentioned by the conservancy inspector during the personal interview. But, how frequent the secondary collection is done? In this regard 100 percent respondents opined that it is done regularly, shown in the following table:

Table-16: Frequency of SW Collection

Opinion	Number of opinion	Percentage
Every day	10	100%
Twice in a week	0	0%
Three days a week	0	0%
Weekly	0	0%
Never	0	0%

In the study area, huge solid wastes are generated everyday that is known from the respondent's opinion on it. The following figure illustrates it:

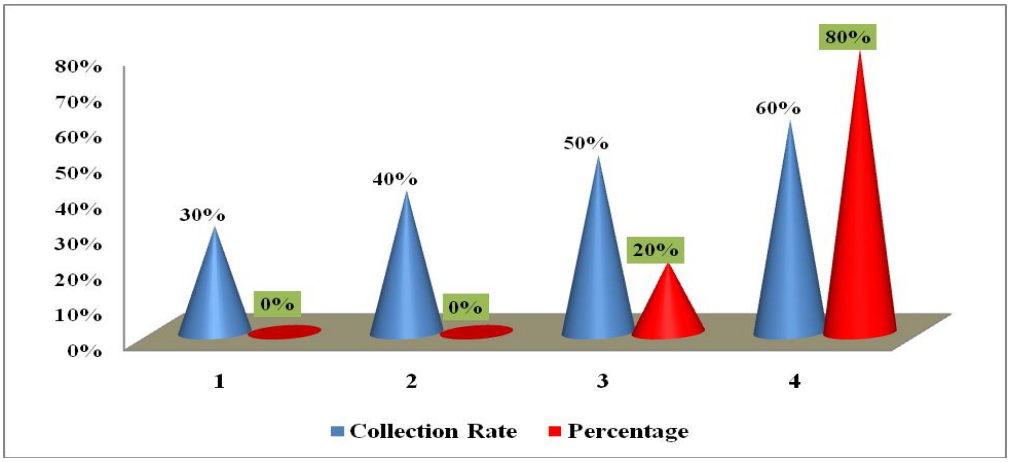
Figure-39: SW Generation Rate/per day



From the above bar chart it is seen that 9 respondents out of 10 that is 90 percent given their opinion that 100-105 tons waste generated per day in the study area, whereas, 10 percent (1 respondent) says 105-110 tons wastes are generated per day. Yet, in the *Pourashava* report 2012 it shows that only 30 tons solid wastes are generated per day.

In this connection, the respondents are asked another related question that is, how much wastes are collected per day by the Pourashava? In response, 80 percent of the respondents said sixty percent (60%) of the generated wastes are collected by the *Pourashava*, only 20 percent opined that fifty percent (50%) of generated wastes are collected by the *Pourashava*. Shown in the following figure-

Figure-40: SW Collection (in %) per day

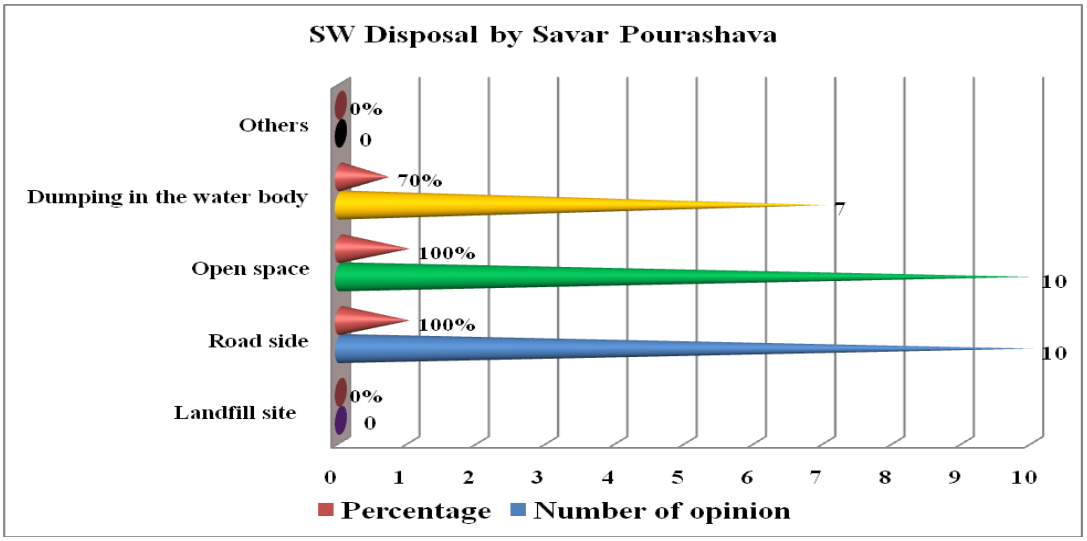


Besides this 10/12 CBOs are also engaging in door to door collections that are not counted in this regard.

In this consequence, collected solid waste might be transported for safe disposal, so the next question is related to transportation activities by the *Pourashava*. In this regard, 100 percent respondents said, it is used open truck to transport this SW; whereas 80 percent said rickshaw van is also used for this purpose. According to the Pourashava report and also from the personal interview, it is seen that there are 5 open trucks are transporting these SW. Out of 5 trucks 4 can contains 1.5 tons each and 1 truck contains 3.0 tons. Out of these 5 garbage trucks 3 are TATA made and 2 are KAMA brand. Moreover, 48 rickshaw vans are used for this purpose of SW transportation.

Aftermath of the collected SW, safe disposal can ensure the efficient management of SW. So, the relevant question raised in mind that is where does this SW disposed by the *Pourashava*? The respondents said that there is neither sanitary landfill of Savar *Pourashava* nor self solid waste disposal ground. So, it disposed in the Road side, open space and even in the water body. The following figure illustrates respondent's opinion-

Figure-41: SW Disposal by Savar *Pourashava*

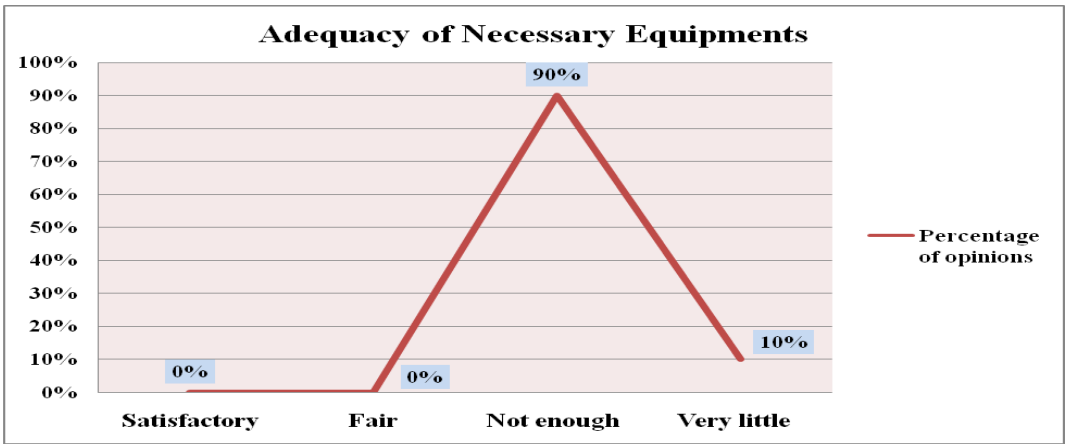


The above bar chart shows that, 100 percent respondents said, it is disposed in the road side and open space and 70 percent also said SW also dumping in the water body by the Pourashava. In addition, it should be logical to mention here that there is no formal recycling activity as well as incineration or any type of project for recovering energy and composting activities to use these huge SW by the *Pourashava*.

4.2.3.5. Equipments and other facilities

Furthermore, Savar *Pourashava* uses different equipments to collect and dispose the solid wastes. Information gathered from the conservancy inspector, it is seen that different type of equipments are needed for managing the SW. Among the equipments 54 belcha, 54 kata, 04 gaiti, 18 shafol are using in this purpose of SWM. Adequate necessary equipments are important to run the activities. Among the respondents 90 percent given their opinion that the adequacy of equipments are not enough, 10 percent put their opinion that it is very little adequacy. The following line chart shows the fact-

Figure-42: Adequacy of Necessary Equipments for SWM



From the above data analysis it is seen that the two sides given different opinion in different factors related to the SWM system of Savar *Pourashava*. The supply side who is service provider the Savar *Pourashava* officials and staffs tried to give information in favor of them. They tried to show their efficiency by giving unrealistic data and information, but in the reality it does not show any logical evidence. In appendix-C, there shown some picture collected from different places of the study area that reveals their incapacity to manage SW of the Savar *Pourashava* area.

On the other hand, the demand side the citizens' of the *Pourashava* are also focusing only their self interest not considering any logical reason in maximum time. In a civilized society, all side has its own responsibility to perform an activity efficiently.

As a result the above data analysis gives some space to open-up many findings regarding SWM system of Savar *Pourashava*. But, only some of the major findings can pave a way to put a logical, reasonable and sustainable option as recommendation to overcome the gaps and loopholes of the system and that can ensure an environmental friendly & safer place for the citizens' of the Savar *Pourashava.*

4.3. Discussion and Findings

The above information and data analysis leads to the following discussion and findings:

- SWM related laws, rules, regulations or policies are not much clearly defined about the specific roles of this local government institution. Yet, it is given common functional obligations in the 'Local Government (*Pourashava*) act, 2009', but the citizens' are not much informed and directed about their responsibilities. Moreover, there are no rules formulated by the *Pourashava* elaborately to perform this function. Even, national level new strategy for SWM like '3Rs' strategy is not known both the sides clearly and also not introduced by the responsible authority. Furthermore, all the rules, regulation, act or policy is formulated by the central authority of the Government and *Pourashava* is regulated by them.

- Financial resources are very much crucial for doing any function of an organization/institution. From the above data analysis it is clearly observed that both supply & demand side acknowledged that, SWM needs huge financial resources. Generally, financial management reveals accounting of income & expenditure, so it is a valid issue of arranging fund and spent this with accountable and transparent manner regarding SWM. It is found from the data analysis; the respondents of the citizens' side think the fund should be collected mainly from GOB grants and should be accountable & transparent to them. But, it is practical that this type of financial resource is arranged by the *Pourashava* from own fund (revenue head), raised and collected locally through different taxes & fees. In this connection it is evident that Savar *Pourashava* has strong position to arrange the fund, but question is their management capability, transparency, accountability and as well as their budget planning for SWM which is clearly depicted in the allocated budget. To summarize, the financial management of SWM system of Savar *Pourashava* is very week and inefficient.

- Human Resource Management as regards to SWM of Savar *Pourashava* is very poor. Respondents' opinion reveals the actual scenario and current practices. Specially, the required number of working personnel is not adequate, their salary structure is poor, and even they are not well educated or well trained. In addition, the organizational structure related to SWM is not well defined. The number of official is inadequate (1 person is working in place of 5). Even the working 'conservancy inspector' is not

well trained to plan and manage the subordinates in the field. Moreover, all the supervisors and cleaners are working on daily payment basis. As a result, poorer monitoring and supervision leads to higher degree of negligence in field work.

- Operational management of SWM is very important for the *Pourashava*. But, the study reveals that Savar *Pourashava* does not perform it efficiently & effectively. They do not collect waste from door to door, although they are obliged to collect and dispose wastes in an efficient manner. Since direct collection is not done, they should arrange available storage bin in the community. The study explored that only 30 fixed dustbins exists in the community for around 3,00,000 people. Therefore community people dump garbage here and there.

- Collection is limited due to inadequate number of collection vehicles and trucks. In the operations management, disposal is also very important. However, Savar *Pourashava* has no sanitary landfill and even specific disposal area. In consequence, wastes are disposed in open space, road side and even water body, causing environmental degradation and health hazards to community people. Only CBO is working in a small scale, no partnership arrangement in between *Pourashava* and NGO or CBO is prevailing. Moreover, there are no formal recycling, composting and energy recovery functions by the *Pourashava*, but informal sector is hugely active here for recycling of the SW. In addition, incineration is not seen here for hazardous wastes.

- Uses of modern equipments and technologies are the driving force for managing standard SWM system in different countries, but in Savar *Pourashava*, traditional and out dated equipments are used. Although technology enhances any activity saving total cost, person hour and time, Savar *Pourashava* is far behind these modern interventions. This results in the inefficiency of the management to a great extent.

- Finally, citizens' awareness is very much important for the successful accomplishment of any plan and program, especially solid waste management in particular. As resource is limited, citizen can play a proactive role to manage wastes themselves efficiently. As regards to waste minimization, segregation and storage mechanism is important for managing solid wastes effectively. Peoples' awareness or participation is absent and *Pourashava* let alone NGO or CBO has not yet addressed the social awareness program in the study area. So people are not actually aware of

the obligations made by existing laws and rules on the environmental degradation and health hazard issue.

Summary

This chapter focused on data collection method by elaborating the methodology and its rationale. A brief summary on the study area is given. Collected data through questionnaire survey and personal interview are presented in graphical manner and related documents are studied and analyzed critically for better understanding of the existing system of SWM of Savar *Pourashava*. Afterwards, presented data are analyzed extensively to find out major challenges and constraints and scopes and opportunities as well. The analysis leads to detailed discussion and helps to gather major findings. Findings will help to generate some recommendations for further improvements in the total solid waste management system of Savar *Pourashava*.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter tries to accumulate the whole study points from literature review, conceptual framework, data presentation, data analysis, discussion and findings at the end. All the elements of the discussion will justify the objectives of the dissertation and answer the research questions. The analysis of data helps to identify gaps and challenges of the existing solid waste management system of Savar *Pourashava*. Based on the findings, recommendations are made further improvement. Suggestions are given in order to develop an integrated sustainable solid waste management system in Savar *Pourashava*. This is regarded as a potential option for sustainable and better solution of the present SWM system of Savar *Pourashava*.

5.1. Recommendations

According to the research findings it is evident that Savar *Pourashava* is facing huge challenges, that are- (i) lacking of a legal instrument that explicitly addresses municipal solid waste management, (ii) weakness of the financial resources mobilization and its proper utilization, (iii) lack of institutional capacity and organizational liberation/upgradation of the waste management sector, and (iv) absence of specified technological options for management of the predominant waste components. So, the following recommendations can be supportive to overcome the loopholes of the existing system-

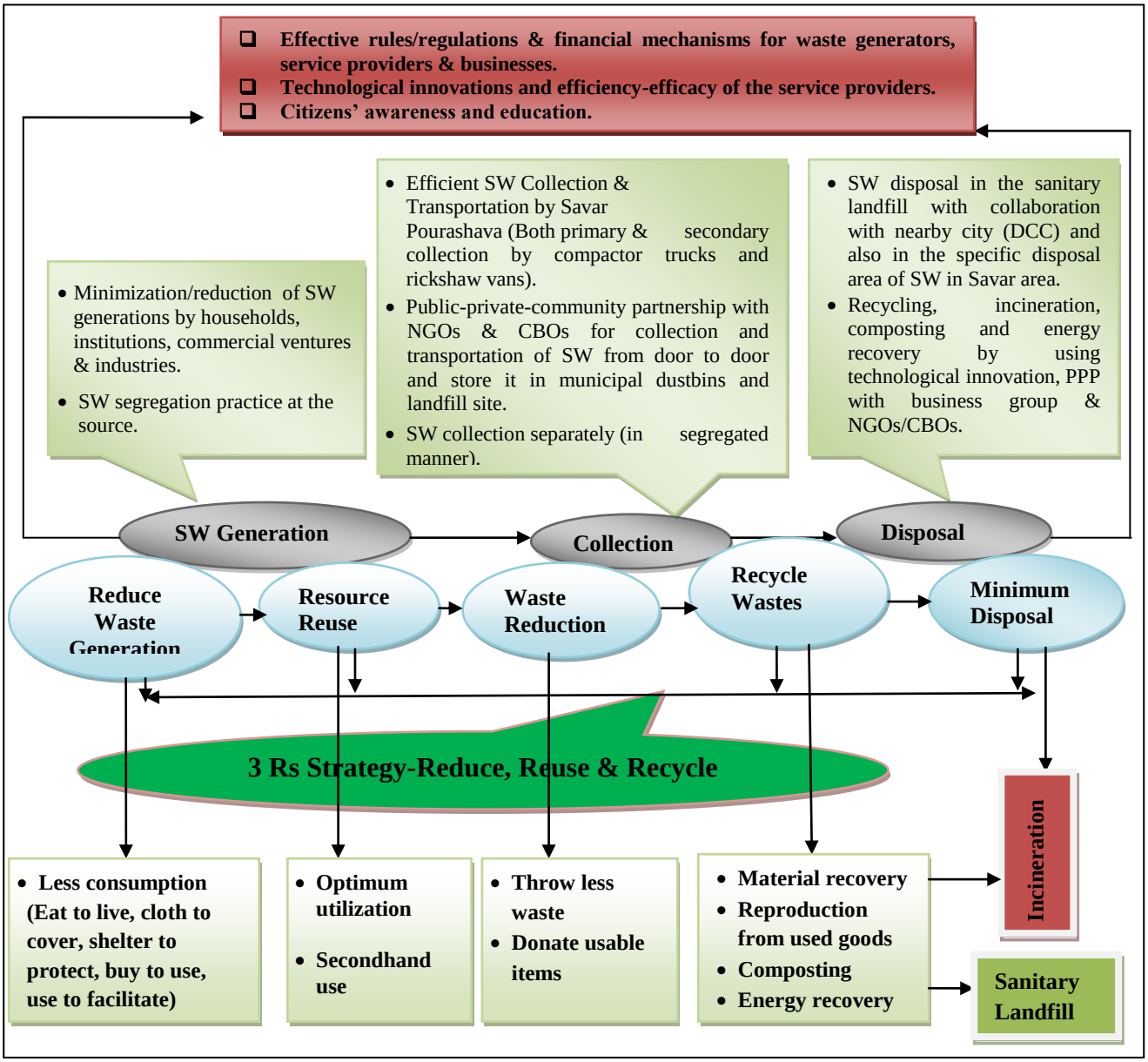
- Modify and upgrade SWM related self rules & regulations with accordance of the 'Local Government (*Pourashava*) Act, 2009'.
- New strategy like '3Rs-Reduce, Reuse and Recycle' strategy can be introduced for the sustainable waste management system.
- A fund or trust for promoting 3R needs to be developed instead of a micro credit program in the informal sector.
- Transformation of 3R into financial terms or economic value is needed.
- Increasing the financial resources as per the need of the SWM in the budget allocation especially for the collection and disposal of SW in a transparent and accountable manner.

- Local resource mobilization and utilization should be emphasized that will be ensured the organizational capacity and self sufficiency.
- Solid Waste department should be well equipped and more expert personnel are needed for proper planning and management.
- Adequate human resources should be recruited for ensuring the field level activities-collection, transportation and disposal. Necessary training should be provided to the officials and staffs.
- Operational management of solid waste should be more efficient. Solid waste storage facilities-curbside bins, dustbins should be increased in numbers as per the need of the citizens'; more collection fleets are needed and also ensure the safe disposal site. Sanitary landfill is essential and for this, collaboration can be made with nearby city of DCC, because sanitary landfill site of DCC is situated within the Savar Upazila.
- Encouraging the private sector involvement for waste collection, hauling and disposal as both short term and long term contractors.
- Necessary equipments and technological facilities should be available.
- Citizens' awareness can be increased regarding SWM through advertisement, billboard etc. is essential. In this regard collaboration/partnership arrangement with NGOs, CBOs should be made.
- Citizens' awareness regarding solid waste segregation at the source, waste minimization and its proper storage should be emphasized.
- Recycling of solid wastes by the Pourashava can play an important role to manage SW effectively. Incineration is also needed to handle the hazardous waste. Moreover, energy recovery and composting of solid waste by the private sector can be emphasized to make waste as resource.

According to the above recommendations and previous discussion a sustainable and cost effective solid waste management system is needed for any Pourashava, because this urban local government institution is responsible for many more public services for the citizens'. From that concern an 'Integrated Sustainable Solid Waste Management' model is recommended to improve the existing SWM system of Savar *Pourashava* by the researcher. The following model illustrates this ISSWM system-

Figure-43: Integrated Sustainable Solid Waste Management (ISSWM) Model

Proposed Potential Option for Savar *Pourashava*



Source: Prepared by author (modified from Hickman, 1999 & Penjor, Y., 2007)

The above model illustrates that solid waste generation can be minimized if rules/regulations are reinforced to the waste generators. In this regard, waste reduction is also possible by applying 'Reduce & Reuse' strategy under 3R strategy that is already followed by other Asian countries and Bangladesh as small scale. The main theme of the strategy is less consumption generates less wastes. On the other hand, waste segregation at the source also can enhance the safe collection and disposal of the SW. This above mentioned activity can be possible to ensure by effective rules/regulations and building mass awareness & education. For building awareness and education among the citizens' NGOs & CBOs can play an

important role. So, service providers, citizens' and the third sector, this all stakeholder's have the specific role in this proposed system. This is a holistic approach and it can be ensured the sustainability of SWM.

In addition, the above model depicts that, efficient collection and transportation of SW is crucial for SWM. In this regard, the integrated approach can ensure door to door maximum waste collection and transportation by the *Pourashava* with the support of the NGOs & CBOs and the informal sector of the community by introducing collaboration (PPP) and support approach. Here, 'waste reduction and recycle of waste' approach of 3R strategy can ensure the efficient SWM. Moreover, SW collection in segregated manner will also ensure the safe & efficient disposal and waste can be possible to use as resource.

Furthermore, from this proposed model it is very identical that, minimum waste generation will pave a space to minimum disposal of waste. If this happen, SW disposal in the sanitary landfill and incineration for the unusable waste is possible in scientific manner by the service providers with the collaboration or network governance approach and at the same time different waste treatment strategy is also very possible. On the one hand, segregated SW can give more opportunity to reuse & recycle and on the other hand, composting & energy recovery by treating this minimum wastes might be resource for the society. By following this model informal sector and businesses can make employment opportunity and business as well. All these things are environment friendly & safer for the human health and the city might be cleaner and more beautiful to live that will be ensured the sustainability.

So, in short it is summarized that the proposed 'Integrated Sustainable Solid Waste Management' model is very much applicable and sustainable for the Savar *Pourashava* because the resource constraint and incapacity of the organization. As different stakeholders have different roles in this model, they can also be part to add public value by creating public goods & services.

5.2. Conclusion

Solid Waste Management is a growing concern for all round the globe. In Bangladesh, this issue is frequently discussed and considered very important from organizational perspectives. The performance of a particular organization depends largely on the services it offers to the community. Both urban and local government organizations in Bangladesh are entirely responsible for managing public services and waste management is one of them. Management of solid waste largely depends on several intra and inter-organizational factors.

These factors play individual as well as collective roles in the management system. This study explored that Savar *Pourashava* has its own organizational pattern, management approach and functional groups to accomplish the huge task of waste management. Often these players fail to coordinate among themselves and fail to provide basic services. Government has provided strong legal basis for reinforcing the rules and regulation to the service providers as well as to the service recipients. The service Savar *Pourashava* renders does not reflect the expectation of community people due to inadequate human, financial and technical and technological resources and supports. As soon as the *Pourashava* gets supports as regards to the resources, some temporary changes take place. This study therefore focused on the sustenance of waste management services and chalked out for potential alternatives. These options refer to the community people who are key factors for managing solid wastes properly. They can ensure reduction of waste generation, separation and storage mechanism. Therefore these actions require strong coordination in the community. A potential mechanism to accelerate sustainable solid waste management is the integration of both the intra and inter-organizational factors and their balanced performances. Government should develop mechanism for regular monitoring and supervision whereas local government authority should implement government rules and regulation properly. Integration of all actors and players only can ensure a sustainable solid waste management in Savar *Pourashava*.

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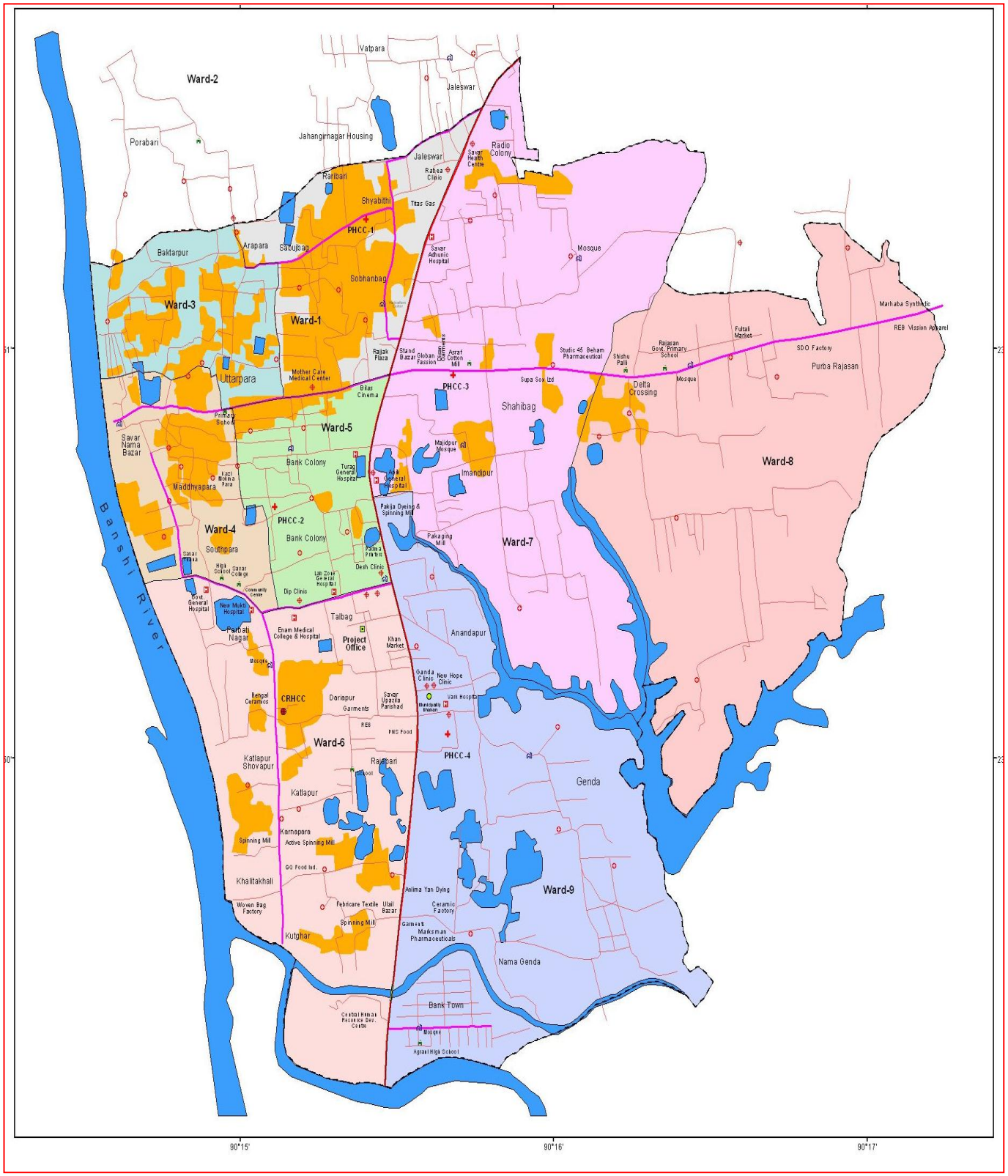
Appendix-A

Map of Savar Pourashava



Appendix-B

Questionnaire

Survey for the Master Thesis on 'Solid Waste Management System of Savar Pourashava -A Case Study'

Part-1

(For the Pourashava officials and staffs)

[N.B.-The following information will be used only for academic research purpose]

Basic Information:

Respondent's Name:

Date of interview: Gender: (M/F):

Qualification: Address/Location:

Designation:

1. Do you know about the solid waste management functions of Pourashava under 'Local Govt. (Pourashava) Act-2009'?

   Yes No

2. Do you think that the 'Local Govt. (Pourashava) Act-2009' has defined clearly about the solid waste management of the Pourashava?

   Yes No

3. Do you think that savar pourashava is managing solid waste according to the Act? Solid waste management system is-

   (i) Very good (ii) Good (iii) Average (iv) Not good

4. Do you have any idea about other solid waste management related laws/regulations, acts or policies?

   Yes No

   If yes; what extent? –

   (i) Very good (ii) Good (iii) Fair (iv) A little

5. Do you know about the 'National 3Rs strategy-2010' of waste management in Bangladesh?

   Yes No

If yes, what do you think about '3Rs strategy'?

(i) I think it is a very good strategy

(ii) It can be adapted

(iii) It has some limitations

(iv) It has a little scope to adapt

6. Is Savar Pourashava implementing the National 3Rs strategy 2010 for waste management?

Yes	No

7. Does solid waste management need huge financial resources?

Yes	No

8. What are the sources of fund for the solid waste management of Savar Pourashava?

(i) GOB Grant (ii) Grants from donors/dev. Partners

(iii) Own fund (iv) User charge

(v) Others

9. Do you think the allocated fund is enough for solid waste management of the Pourashava?

Yes	No

If No, how Savar Pourashava can mobilize more funds?

(i) Regular collection of tax from the citizens'

(ii) Imposing more tax on to the citizens'

(iii)Public-private partnership

(iv)More income generation activities

10. Is Savar Pourashava accountable to the citizens' to utilize the fund regarding solid waste management?

Yes	No

11. Has Savar Pourashava an independent solid waste management department?

Yes	No

If Yes, how many persons are working in this department?

12. Do you think the current employee (supervisor & cleaner) position is adequate to manage this function?

Yes	No

13. Do you have the expert personnel in the management system for appropriate planning of solid waste management?

Yes	No

14. What do you think about the present incentive/salary structure of the cleaners and supervisors?

(i) Satisfactory (ii) Fair (iii) Poor (iv) Very poor

15. How does savar pourashava collect waste?

(i) From door to door (ii) From municipal bins (iii) Open space (iv) Secondary collection

16. How frequently the waste is collected?

(i) Every day (ii) Twice in a week (iii) Three days a week (iv) Weekly (v) Never

17. How much waste generated everyday in Savar Pourashava?

(i) 100-105 tons (ii) 105-110 tons (iii) 110-115 tons (iv) 115-120 tons

18. How much waste collected by the Pourashava every day?

(i) 30% (ii) 40% (iii) 50% (iv) 60%

19. How is the waste transported?

(i) Compactor truck (ii) Tipping truck with sliding cover (iii) Open truck (iv) Rickshaw Van (v) Others

20. Where does Savar Pourashava dispose the waste?

(i) Landfill site (ii) Road side (iii) Open space (iv) Dumping in the water body (v) Others

21. How much you have necessary and adequate equipments for doing this business efficiently?

(i) Satisfactory (ii) Fair (iii) Not enough (iv) Very little

22. What is the condition/status of these equipments?

(i) Good in condition (ii) Fair in condition (iii) Old/aging equipments (iv) Bad in condition

23. Does Savar Pourashava have proper maintenance facilities of these useful equipments?

Yes	No

Thank you for your kind cooperation

Questionnaire

Survey for the Master Thesis on 'Solid Waste Management System of Savar Pourashava -A Case Study'

Part-2

(For the Citizens' of the Pourashava)

[N.B.-The following information will be used only for academic research purpose]

Basic Information:

Respondent's Name:

Date of interview: Gender: (M/F) :

Qualification : Address/Location:

Occupation : Age :

1. What do you know about the legal framework of solid waste management is followed by Savar Pourashava?
   (i) Well (ii) Fair (iii) Little (iv) None
2. Do you think Savar Pourashava is following the existing acts, laws, rules/regulations and policies that are related to waste management?

Yes	No

3. Do you have any knowledge about the 'National 3Rs strategy-2010' of waste management in Bangladesh?

Yes	No

   If Yes, what do you think?
   (i) It is a good strategy (ii) It has limited applicability (iii) It needs mass awareness (iv) It has many limitations
4. Do you think that solid waste management needs huge financial resources?

Yes	No

5. How Pourashava authority can arrange this financial resource?
   (i) Collecting taxes regularly (ii) Collecting more grants from GOB/Donors (iii) Arrange through PPP (iv) Penalty & user Charges
6. Is Pourashava authority transparent and accountable to the citizens' in utilizing resources to manage solid waste?

Yes	No

7. Do you think that the solid waste management department of pourashava is working efficiently?

   (i) It works properly (ii) It works moderately (iii) It works poorly (iv) It works very badly

8. Do you think that the present number of employees, who are responsible to manage solid waste of Savar Pourashava, is adequate?

Yes	No

9. Do you have municipal solid waste service accessibility?

Yes	No

   If Yes, what extent?

   (i) Satisfactory (ii) Fair enough (iii) Not enough (iv) Very little

10. What is the service frequency?

    (i) Every day (ii) Twice in a week (iii)Three days a week (iv) weekly (v) Never

11. What type of waste collection service do you receive?

    (i) Door-to-door (ii) Roadside bin (iii) Collection trucks (iv) No

12. Do you segregate waste?

Yes	No

13. Do you think waste transportation activities are smoother?

Yes	No

    If No, what is the reason?

    (i) Inadequate number of vehicles (ii) Old/aging vehicles (iii) Lack of monitoring and supervision (iv) All

14. Do you know where Savar Pourashava disposes the waste?

    (i) Landfill site (ii) Road side (iii) Open space (iv) Dumping in the water body

    (v) Other

15. What is your opinion about the open dumping, road side dumping or dumping in the water body?

    (i) Unhygienic (ii) Threat for the environmental (water & air pollution) (iii) Dangerous for human health (iv) Causes of various diseases (v) All

16. What is your opinion regarding betterment of solid waste management of Savar Pourashava?

    (i) Increase municipal tax (ii) Ensuring legal bindings (penalty/fine) (iii) Building awareness (iv) Introducing 3Rs strategy (reduce, reuse and recycling)

17. What is your overall comment about the solid waste management system of Savar Pourashava?

    (i) Lack of commitment (ii) Lack of resources (both human and financial) (iii) Lack of peoples' awareness (iv) Lack of proper planning.

18. What is your suggestion to improve this current situation?

    (i) Ensuring good governance (ii) Proper utilization of resources (iii) Introducing new sustainable strategy like 3 Rs strategy (iv) All the above mentioned

Thank you for your kind cooperation

Appendix-C

Some Photographs of the existing SWM scenario of Savar Pourashava

Garbage Truck of Savar Pourashava

Garbage Truck of Savar Pourashava

SW Disposal at the Roadside (Genda) by cleaner of the Pourashava

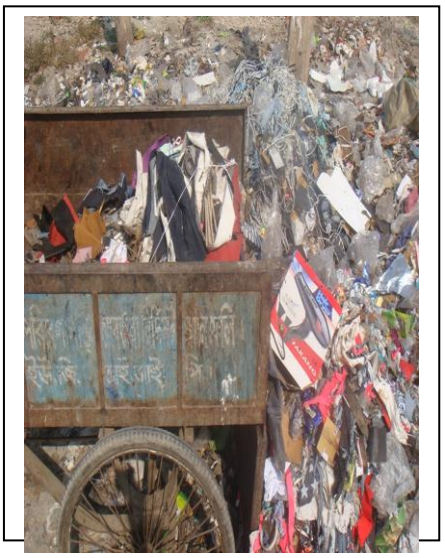
SW Disposal in the Roadside at Bank Town

SW Storage at Dustbin at Thana Stand (Ward No-6)

Solid Wastes are stored at the locality (Ward No-7) at Sobhanbug

SW are overflowed and collapsed the Drainage system (Ward No-7) Sobhanbug & Savar Bazar area

Waste Pickers are collecting reliable wastes (Ward No-3 & 6) at Radio colony& Genda area



Rickshaw Van to transport SW by Pourashava

Pic-1, 2 & 3; Recycle shop by informal sector