

STATE OF CITIES:

Solid Waste Management in Dhaka City— Towards Decentralised Governance



BRAC Institute of Governance and Development
BRAC University



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Solid Waste Management of Dhaka City– Towards Decentralised Governance

BRAC Institute of Governance and Development

BRAC University
Dhaka, Bangladesh

BIGD State of Cities Series 2015

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ISBN: 978-984-33-9914-4

Recommended Citation:

BIGD, 2015. The State of Cities: Solid Waste Management of Dhaka City– Towards Decentralised Governance. BRAC Institute of Governance and Development, BRAC University, Dhaka.

Cover: State of Cities Report Team

Layout and Production: Dana Printers Limited, Ga-16 Mohakhali, Dhaka-1212, Cell: 01819280575

Price BDT 750.00
 USD 15.00

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The State of Cities 2015 is the product of an interdisciplinary team of researchers of the BRAC Institute of Governance and Development, BRAC University. The research team comprised S. M. Gubair Bin Arafat (lead), Mohammad Sirajul Islam, Gazi Arafat Uz Zaman Markony, Sumaiya Kabir Talukder, Raihan Ahamed and Nadir Shah.

The SoC team is thankful to the survey team comprised Md. Ashiqur Rahman, Chinmoy Paul Chayon, Afrin Farhad Drishty, Mahtab Ahmed Zihan, Priyo Paul, Aadeeba Kaareen, Tasmia Afroze, Abdul Jabbar, Miton Gaine, Md. Rafiqul Islam, Sanjay Kumar Sarker, A.S.M. Hadiuzzaman Monju, Abdullah-Al-Mahim, Md. Mohiuddin Helal, Mehedi Hasan, Abdullah-Al Mamun, Abdur Rahman, Tazrin Jahan Satu. Dr. Sultan Hafeez Rahman, Executive Director, provided valuable advice and guidance throughout the preparation of the report.

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List of Acronyms

ACI	Advanced Chemical Industries
ADB	Asian Development Bank
BDT	Bangladeshi Taka
BBS	Bangladesh Bureau of Statistics
BIGD	BRAC Institute of Governance and Development
CC	City Corporation
CI	Conservancy Inspector
DCC	Dhaka City Corporation
DSCC	Dhaka South City Corporation
DNCC	Dhaka North City Corporation
DWASA	Dhaka Water Supply and Sewerage Authority
DoE	Department of Environment
EPA	Environment Protection Authority
FGD	Focus Group Discussion
GO	Government Organisation
GI	Government Institution
GoB	Government of Bangladesh
GPS	Global Positioning System
HH	Household
HD	High Density
INGO	International Non-governmental Organisation
JICA	Japan International Cooperation Agency
KII	Key Informant Interview
LD	Low Density
MD	Medium Density
NGO	Non-governmental Organisation
PCSP	Primary Collection Service Provider
PWCSP	Primary Waste Collection Service Provider
RDF	Refuse-derived Fuel
STS	Secondary Transfer Station
SW	Solid Waste
SWM	Solid Waste Management
SWMG	Solid Waste Management and Governance
UN	United Nations
UNEP	United Nations Environment Programme
VIP	Very Important Person
WASA	Water Supply and Sewerage Authority
WHO	World Health Organization
WMD	Waste Management Department

Glossary

Amin Bazaar Landfill	Landfill site of DNCC
<i>Bhangari</i>	Dealer of recyclable products
Bulta Plant	Composting plant of Waste Concern
Kachpur Plant	Composting plant of Waste Concern
Matuail Landfill	Landfill site of DSCC
<i>Mohajan/Paikar</i>	A person who buys recyclable goods from Bhangaris
3R	Reduce, Recycle and Reuse
<i>Panchayet</i>	A village/community council
<i>Sardar</i>	Leader of the cleaners
<i>Tokai</i>	Street urchin

Preface

Bangladesh's imprecise economic growth "story" is underpinned by the large measure in urbanisation of Dhaka at a "break weak" pace. The mega city has lately been in the news headlines for all the wrong reasons. To cite an example, Dhaka has been ranked by the Economist Intelligence Unit (2015) as the second 'least liveable city in the world', for the three consecutive years. One internationally recognised and accepted indicator of a city's 'liveability' concerns the way it manages its wastes – especially solid wastes – with a view to maximising the welfare of the city residents. Solid Waste Management (SWM) in the current of context of rapid urbanisation is also considered a crucial manifestation of the overall state of governance of a given city. Accordingly, there have been growing worries over the formidable challenges that face Dhaka's process and nature of urbanisation characterised by, inter alia, unplanned 'development' interventions, a boom in population resulting especially from the unregulated influx of marginalised and peripheral people, and the consequent complication in provisioning such basic services as waste management, water, energy, and associated utilities. In particular, the challenges of devising and delivering an effective and economic SWM system have received greater media attention in the recent years. In the last Mayoral election (2015), for example, SWM, among other issues, assumed a prominent place in the stated electoral agenda and manifesto of the candidates. Notwithstanding the growing concerns and political rhetoric, however, major research and systematic study on the subject have been strikingly limited. Except for a few relatively detailed studies – most commissioned work such as the JICA 'master plan' (2005) and '3R strategy' (2012), serious research mainly by way of informing and illuminating the policy planners and central actors has been few and far between.

This study – 'State of Cities (SOC): Solid waste management of Dhaka City– Towards Decentralised Governance' by BRAC Institute of Governance and Development is conceived and conducted with the above context and rationale. It attempts to contribute to the relative gap in the concerned literature, as explained above. The report attempts to explore and understand the challenges of the existing solid waste management system, and unfold the disjoints among stakeholders that hinder effective governance. Unlike previous studies, the study has delved into the key micro issues from the 'governance' perspective with a particular focus on functioning of the various stages of the solid waste management process. It has adopted both qualitative and quantitative approaches, and conducted an extensive survey across 93 wards supplemented by secondary data. The survey covered the major stakeholders and institutions (including rules and regulations) relevant to solid waste management.

This report is the result of an outstanding team effort by BIGD researchers led by S.M Gubair Bin Arafat. We acknowledge the support received from the City Corporations' officials. Special thanks to Dr. Sandip Mitra, research adviser of the study and Associate Professor, Indian Statistical Institute (ISI), Kolkata for his extensive research supervision, and guidance at all stages of preparation of the report. We extend our sincere appreciations to ISI for permitting Dr. Mitra to work on the study under its collaborative research programme with BIGD. Other researchers and the operations team of BIGD also deserve thanks for their help and facilitation. We would also like to express our deep appreciation to the Think Tank Initiative administrated by International Development Research Centre for their generous support to BIGD which made the study possible. Thanks are also due to Zeenat Ahmed for editing the report. Last but not least, we wish to express our gratitude to the Mayors and officials of city corporations for their kind support and cooperation.

Executive Summary

The state of cities, 2015 (report) is a very timely research undertaken to highlight the problems of growing cities and the hurdles faced by the citizens living in these cities. In the context of Bangladesh, the study is more relevant as limited research has been undertaken in this direction. In particular, no comprehensive study has been undertaken in recent times to understand one of the most dreaded problems of urban living, the solid waste management (SWM). The problem is of complex nature as it involves several stakeholders and the impacts are far reaching. From experience in Dhaka city, one can argue that urban life has been seriously affected from traffic congestion, pollution, water logging and filthy dumping all caused through inadequate solid waste management. Effective SWM might be possible through effective Governance. Recent reform dividing the Dhaka City Corporation into North and South has raised expectations for a better Governance and thereby a better SWM. In recent times the issue has gained such importance that SWM was held as a top priority agenda in the recent Mayoral Elections of Dhaka held in April 2015. Some initiatives were undertaken in the past on SWM by JICA (2005) and through 3R strategy (2012). However, no major research was carried out since then.

Under this backdrop, BRAC Institute of Governance and Development (BIGD), has taken up this demand driven policy research to identify the challenges faced and opportunities available for effective SWM. This study within a limited timeframe and resources has tried to explore the role of various stakeholders and institutions through an indepth analysis at various stages of SWM. While doing so, the study looked at the micro level management at various stages: 1) Primary stage: looking at primary waste generators (households and public places); 2) Secondary stage: including disposal to land filling sites from container sites and other designated sites; 3) Tertiary stage: focusing on recycling and composting.

In line with the objectives, the study adopted a mixed methodology involving both qualitative and quantitative tools to achieve the goal. A large scale survey with 600 randomly selected sample households has been conducted in 12 randomly selected wards out of 93 wards. The fundamental basis of such selection was the density of population (high, middle and low) as it is directly related with SWM. In addition, considering the difficulty of conducting survey and to secure in depth information seven Focus Group Discussions (FGD) and 42 Key informant Interviews (KII) with relevant stakeholders were carried out. In this study, data was collected from various secondary sources (like DNCC, DSCC). Moreover, round-the-clock information tracking at selected primary waste disposal sites (container stations) were conducted. GIS data was collected and analysed for preparation of relevant maps.

The report is organised in the following manner. The first chapter presents in a nutshell the scope of the report. A brief review of the existing literature and relevant documents is presented. The objectives of the study and research methodology adopted have been stated in brief. This chapter is a prelude to the subsequent chapters of the report.

Chapter two of the report gives an overview of the existing scenario of SWM. Essentially a description of existing resources including infrastructure (trucks, compactors, containers), human resource (cleaners) and financial resources (revenue earned, budget allocated) for SWM has been given. In addition, it attempts to explore whether any relationship exists between tax collection and human resource involved in waste collection, infrastructure capacity and distribution of population density across wards. It is encouraging to see that the budget allocation for SWM (since 2011) has been increasing over time.

Chapter three aims at understanding the primary waste management in terms of in-house and off-house management with particular emphasis on households, since they generate about 61 percent of the total waste. Studies have been undertaken on the composition and volume of household waste, waste separation mechanism in the household, seasonal variation in waste generation, players involved and mechanism adopted in waste disposal etc. It has been observed that the households have a well-defined waste separation mechanism since long. Females play a dominant role in waste disposal as observed in the current study. The perception of the stakeholders are captured to make the study comprehensive. In addition the chapter tries to understand the perception of the stakeholders and their grievances especially relating to the existing practices of SWM.

Chapter four focuses on the secondary stage (container site to final disposal) and tertiary stage (recycling of organic and inorganic waste) of SWM. In this connection, the coordination between waste disposal and waste clearance has been studied. It has been observed that coordination failures have occurred frequently in specific wards in Dhaka city. An explanation in terms of Governance failure has been given in this connection. In addition to this, the chapter studies in details the management system of the final dumping grounds. Lack of coordination among key departments and absence of any viable planning for the future is widely observed. Subsequent to the secondary stage, the study on tertiary stage captures the recycling mechanism existing and opportunities available in the near future. The potentiality of a large informal market expanding at rapid pace has been highlighted. The need to encourage composting in order to save land and environment has been hailed in the study.

The last chapter presents the key results and concluding remarks. It has been observed that the rate of waste collection has been at an encouraging rate of 76 percent per day on an average. Per capita waste generation is estimated to be 0.38kg compared to 0.34kg in 2005. The study concludes recommending a decentralised form of governance to address inter ward disparities in SWM.



Introduction

1.1 Background

With the onset of urbanisation and the increasing economic growth, both developed and developing countries have been facing the challenges to manage urban solid waste, which has become one of the most serious environmental issues. Waste is generally defined as disposed or unwanted materials or by-products. According to Environment Protection Authority (2009), waste is “any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended for sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter”. Solid waste, on the other hand, is thought of as the group of waste produced in urban areas (UNEP, 2005) which are solid components, mainly generating from domestic premises created by public (EPA, 2009), streets, small offices, hotels and restaurants (JICA, 2009). Particularly, municipal solid waste is defined as waste from domestic, commercial, industrial and other process involving municipal services (World Bank 1999). Solid waste management (SWM) refers to the supervised handling of waste material from generation at the source through the recovery processes to disposal (UNEP, 2005).

In developing countries, particularly in Bangladesh the volume of waste generated has been quite significant. It has been estimated that 14 thousand tonnes of solid waste are being generated in 522 urban centres per day (Enayetullah 2005). Bhuiyan (2010) argues that the projected rise in solid waste per capita in 2025 will be around 0.60kg. With such an enormous volume of solid waste only 56 percent are collected and dumped as per the report (Enayetullah 2005). There is thus a need to address these issues urgently.

The current scenario of solid waste management (SWM) is not clearly known in absence of comprehensive studies. JICA (2005) studied SWM in Dhaka in some details and a master plan of the city was suggested in the study. Waste Concern, an award-winning Bangladeshi Social Business Enterprise for waste recycling also studied the state of SWM in Dhaka City in 2006. From 2005, till

date, very few comprehensive studies have been undertaken on SWM in Dhaka City. In this backdrop, BRAC Institute of Governance and Development (BIGD), has taken up this research in order to throw some light on existing scenario of SWM. This study within a given timeframe and resource has tried to explore the role of various stakeholders and institutions through the micro lens at various stages of SWM and thereby understand the overall SWM system in Dhaka. The issue of governance and subsequently development of SWM has been addressed in this context.

1.2 Literature Review

World Health Organization (2014) termed Dhaka as one of the mostly polluted cities. Bangladesh Bureau of Statistics (BBS) (2001) found that Dhaka has been urbanised at the rate of 28.4%. This implies the astronomical growth of solid waste. Linzner and Lange (2013) and Alam and Sohel (2008) in the context of SWM, have highlighted the importance of informal market as a significant components of SWM. Ahsan and Zaman (2014), while arguing on waste generation has opined that high-rise buildings manage waste better compared to the slums. Chowdhury (2007) studied the difference in SWM between slum and non-slum areas in the Dhaka City. Media reports like Ahmed (2015) and Khan (2014) has revealed the system failure in SWM and suggests some corrective steps in this direction. Baharuddin et al., (2012), and Gozun et al (2000), have stressed the need for community level engagement in SWM. Hassan (2009) has studied the demand for landfill sites. Chowdhury et al., (2006) emphasised cost effectiveness of waste through commercialisation. In the same tone Bhuiyan (2010) proposed effective governance through public private ownership. Effective governance in SWM and public policy theories in this regard has been outlined in brief by Luton (1996).

In recent year two important initiatives have been undertaken for SWM in Dhaka.

- A. In 2005, initiatives were undertaken by Japan International Cooperation Agency (JICA) with the objectives of formulating a master plan of Dhaka City and to develop capabilities and management skills of the Dhaka City Corporation. Highlights of the programme are listed below:
 1. Jurisdiction of the programme: Dhaka City
 2. Preparation of Master plan for domestic waste (medical and industrial waste were not considered).
 3. Attempts to estimate, generation, collection and disposal of SW in the city and thereby giving an overview of SWM.
 4. Financial analysis of budget and cost of management of SW.
 5. A household survey conducted to understand the practice and perception of SWM.
 6. Review of the administrative mechanism in practice.

- B. 3R Strategy: This initiative was undertaken in 2010 by Department of Environment (DoE), Ministry of Environment and Forestry of the Government. The principle of reducing, reusing and recycling of resources and products is often called the 3Rs. Major focus of the programme are as follows:
 1. The study stressed the need for intervention on both production and consumption.

2. National policy not adequately harmonised with local government.
3. Lack of landfill sites.
4. Lack of hazardous waste disposal facility.
5. Lack of guideline for an efficient use of agricultural waste.
6. Lack of incentives for environmental management system.

Some of the recommendations of 3R strategy are as follows:

1. Encouraging public private partnerships to improve public services with regard to environmental management system,
2. Collaboration with scientific research bodies to promote recycling and recovery of waste.
3. To develop a mechanism to correspond between services received and payments made by citizens.
4. Supporting informal sector for recycling.

In April 2012, under the DoE, a 3R pilot project was implemented in selected wards of Dhaka and Chittagong cities. With Government of Bangladesh and Climate Change Trust Fund, it aimed at building two 20-tonne compost plants and distributed more than 60,000 bins among 20,000 households. However, the project was abandoned as the attempt to segregate of waste at household level did not yield desired impacts (Khan, 2012).

In a nutshell, since 2005, there has been an absence of any comprehensive study at household level on SWM. In this connection the current study of BIGD aims at bridging the gaps in the existing literature to some extent. This comprehensive study involving all the stakeholders has been stressed in order to depict a wider picture of SWM in Dhaka City.

1.3 Scope and Justification

With the aim of bridging the gaps in past research, this study attempts to explore the state of entire SW management in Dhaka City. Given the limited timeframe of the research, this study has focused only on solid waste in terms of the waste that city corporation deals with excluding medical and hazardous waste. In doing so, the study looked at the micro level management in details at selected wards in both city corporations (Dhaka North and South). Considering the diversity of waste management at various stages, the analysis is focused in three prominent stages: I. Primary stage looks at primary waste generators (slum and non-slum households, markets and commercial establishments and public places), II. Secondary stage includes disposal to land filling from container sites and other designated sites. III. Tertiary stage studies the issues related to recycling and composting.

1.4 Objectives of the study

The broad objective of the study is to understand the existing solid waste management in Dhaka City. In this connection, the following objectives have been outlined:

1. To estimate the volume of solid waste generation in Dhaka.
2. To study the management issues in practice and identify the difficulties at various stages of SWM.

3. To understand the role of various stakeholders involved in SWM.
4. To recommend some measures for sustainable SWM in Dhaka City

1.5 Methodology

To understand the scenario of Solid Waste in Dhaka City, a study of stakeholders was essential. The following methods were adopted for the study:

- A. Large Scale Sample Survey of Households
- B. Focus Group Discussion(FGD) with relevant stakeholders
- C. Key Informant Interview (KII) with relevant stakeholders
- D. Secondary Information collection from various sources (like DNCC, DSCC)
- E. Round the Clock information tracking at the primary waste disposal sites (containers station)
- F. Geographical data Collection for preparation of relevant maps

A. Large Scale Sample Survey of Households

Since households are the major waste generators, an in-depth analysis through large-scale sample survey was planned. It was also observed (see overview in chapter two for details) from the data that the features of the municipal wards differ considerably on various aspects (Annex 1-1). To capture inter-ward and intra-ward characteristics, the ward level parameters appeared to be important. A proper representation of wards could be possible if proportional representation of all types of wards was considered. Density of population (Total Population/Total Area) being a well-known parameter in solid waste generation, was selected as the basis of sampling. In a nutshell, multistage stratified random sampling proportional to size without replacement has been used as a suitable sampling technique. The details of the steps undertaken are mentioned in the Annex (Annex 1-1). The household distribution is given below.

Table 1.1: Administrative and demographical distribution of both City Corporations

Corporation	Total No. of wards	Area (2015)	Population (BBS, 2011)	High population density (total no. of wards)	Medium population density (total no. of wards)	Low density (no.)	No. of sample wards	No. of HD wards in sample	No. of medium density in sample	No. of low density in the sample
Dhaka North	36	82.68	3956302	12	12	12	6	2	2	2
Dhaka South	57	43.64	3014803	17	19	19	6	2	2	2
Total	93	126.3	6971105	29	31	31	12	4	4	4

B. Focus Group Discussion (FGD)

It was difficult to conduct a sample survey with various groups of population (other than households) directly involved in the waste management of Dhaka City due to nature of duties and related reasons. It was felt that a focus group discussion with available stakeholders would throw some light on the problems and prospects of current waste management policy. Consequently a total of seven FGDs were conducted (one with cleaners, one with vanmen/van women, two with conservancy inspectors, three with scavengers in landfill sites).

C. Key Informant Interview (KII)

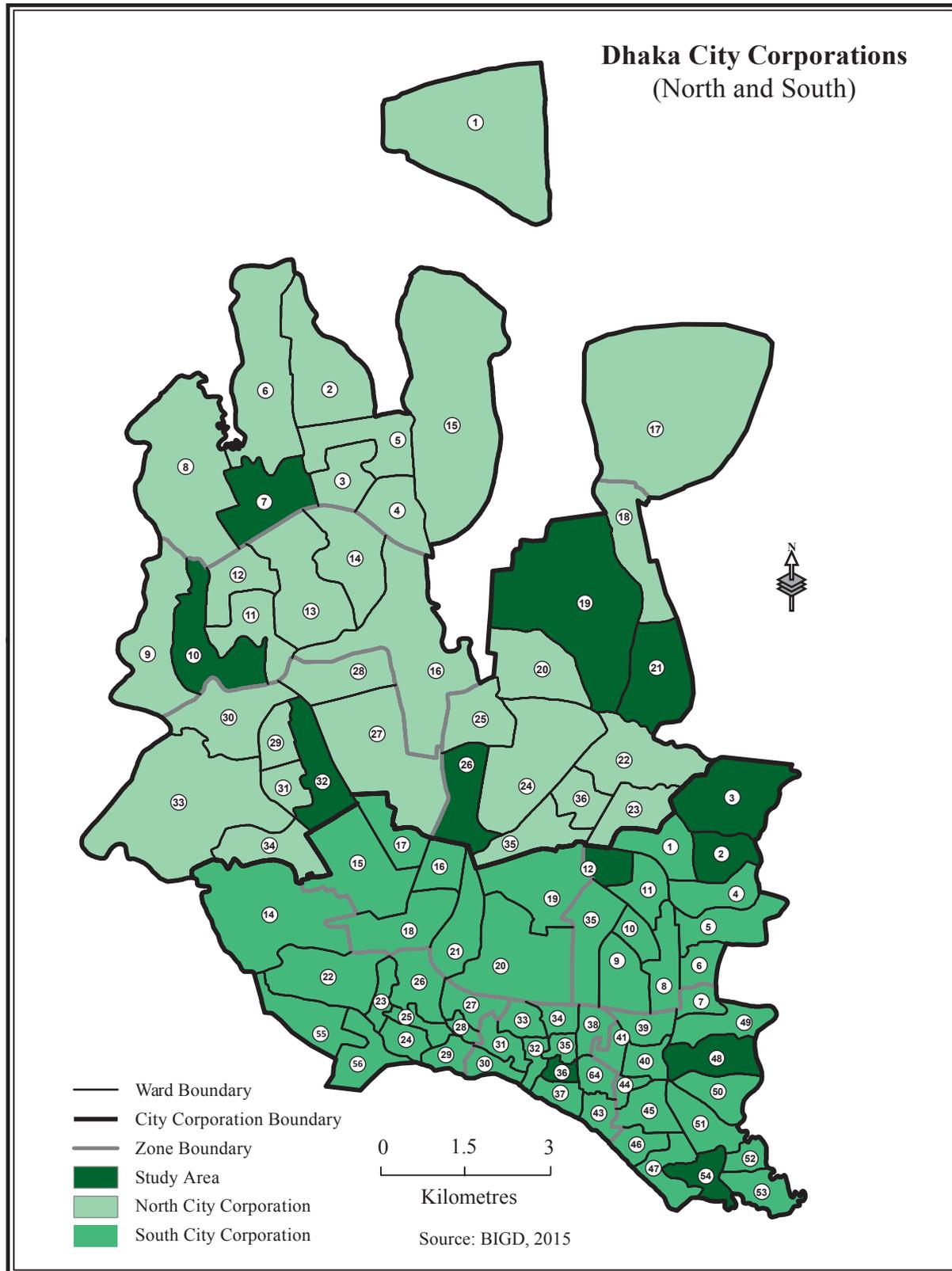
Limited information was available for some of the stakeholders KIIs were conducted with those stakeholders to have in-depth understanding of the nature of their activities. Thus 42 KIIs were carried out with three cleaners, eight vanmen/women, one ward councillor, five Conservancy Inspectors, eight leaseholders, four composting related officials and experts, 10 recycle related informants (recycle market, scavenger, whole seller), one on composting expert. It also included three Landfill officials and four conservancy inspectors among others.

D. Secondary Information on Solid Waste Management was collected from Dhaka City Corporations.

E. A round-the-clock tracking at limited number of primary disposal sites (containers in particular) was undertaken to observe the coordination between different stakeholders involved in waste management.

F. Geographical data (GPS based) were collected to analyse the spatial distribution of the wards. The maps were developed based on the printed maps of the city corporation printed maps. The following map indicates the study area of the current study.

Map 1.1: Study area



1.6 Organisation of the Report

The report consists of four chapters. The second chapter attempts to depict the existing state of solid waste management in Dhaka City. Chapter three aims at the exploring the SWM at the primary stage focused on household level. Chapter four demonstrates the secondary and tertiary stage of SWM that includes, storage (container), transportation, landfill, recycling and composting. The report concludes with chapter five presenting the key findings in concluding remarks and recommendations respectively.



Overview of Solid Waste Management of Dhaka City

2.1 Introduction

With an existing population of 6.97 million inhabiting in about 126.34 sqkm (BBS, 2011) - SWM scenario has not been effective to the expected level. According to WHO, among the 600 mostly polluted cities, Dhaka is ranked at 23rd (Prothom-Alo, 2014; Daily Star, 2014). In 1974, the urbanisation rate of Dhaka was 8.87 percent which become 28 percent in 2011 (BBS 2011). Having such high urbanisation rate and population density, the city authority is expected to collect limited volume of SW leaving the rest uncollected. Some of these recyclables waste are picked up by scavengers informally to sell in the informal market. It has been difficult to handle waste management by Dhaka City Corporations overtime. The new changes are expected with the formation of two city corporations in November 2011 - Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC) covering 57 wards with an area of 43.96 sq km (DSCC) and 36 wards with an area of 82.38 sqkm (DSCC, 2015) respectively. This formation is expected to bring visible change in SWM.

2.2 Solid Waste: Brief History

Solid Waste Management (SWM) is neither a recent phenomenon nor a new practice in DCC. Dhaka City had a traditional waste management system since 1864. With time, there has been a major shift in the management system. The following table gives a brief account of the development of SWM in the city.

Table 2.1: Development of SWM in Dhaka City

Year	Development activities
1864	Night soil collection by Bullock cart Liquid waste collection by Dhaka WASA
1963	Night soil collection by the Municipality
1982	Bullock cart system suspended, Septic tank system replaced, Waste collection by open truck introduced
1987	House to house collection in Kalabagan
1989	Night time Waste collection
1993	Demountable container system
2002	System of permission for primary collection
2003	Development study by JICA initiated
2005	Clean Dhaka Master Plan formulated
2007	Technical Cooperation Project by JICA began
2008	Waste Management Department officially approved
2010	Low Emission Compactor and 7 tonnes capacity containers introduced
2010	National 3R Strategy

Source: DSCC and DNCC 2015

All these initiatives to some extent added new value to waste management system of Dhaka City. The waste management problem, however remains locked in the traditional approach in which management is targeted to deal with generated waste. In this backdrop, recently in 2010 Bangladesh government introduced a 3R strategy (Reduce, Reuse and Recycle). This approach follows the waste hierarchy model in which waste is primarily reduced, reused and recycled respectively.

2.3 Solid Waste Governance: Policy and Practices

SWM is intrinsically related with Governance. Effective SWM is only possible through effective governance. The legal framework is considered essential for implementation of SWM. Following section gives some idea of the steps followed over time in this regard.

2.3.1 Legal framework

The evolution of the legal framework for SWM for Dhaka City is given in the following table:

Table 2.2: Legal framework related to SWM

Time and legislation	Framework for SWM
1864, Municipal Act	Night soil collection by Bullock cart Liquid waste collection by Dhaka WASA (DWASA)
1983, Dhaka City Corporation Ordinance	Dhaka City Corporation held responsible for secondary waste collection to remove waste from its dustbins/containers, and transport the waste to final disposal sites. Residents are responsible for bringing their waste to DCC's waste collection points where dustbins/containers are located.
1995, National Environmental Management Action Plan (NEMAP)	Waste recycling has been promoted, less land filling encouraged, EMS promoted among industries.
1997, Environmental rules and regulation	This policy outlined mainly the hazardous industrial waste. No other SW related guideline provided.
1998, National Policy for Water Supply and sanitation	This policy suggested government to take measures for recycling waste as much as possible and use organic waste materials for compost and bio-gas production.
2004, Dhaka Declaration on Waste Management by SAARC countries	This strategy is based on 4R principle i.e. reduce, reuse, recycle and recover of the waste, stressing the need for composting, segregation of waste at source, separating collection and resource recovery from wastes.
2006, Lead Acid Battery Recycling and Management Rules	Under the rules collection and recycling were expected to improve as it had stressed the need for Dhaka Environment Management Plant.
2006, Draft National Urban Policy	CDM and recycling emphasised in the policy.
2009, City Corporation Act	City Corporation held responsible for removal of waste from all public streets, public latrines, urinals, drains and buildings and land of the corporation and for proper disposal of waste.
2010, National 3R Strategy	3R Principal for Solid Waste reflected in the national and local government policies and plan.
2011, City Corporation Act 2009 (amendment)	Amendment about the re-formation of Dhaka City Corporation and distribution of resources and power between them.

Thus, DCC is assigned the sole responsibility of SWM in the city. Dhaka City Corporation by virtue of the ordinance 1983 performs the task of removal, collection and disposal of waste (biz) (Part 4, Article 78). Waste Management Department (WMD) of DCC is responsible for Solid Waste Management of the city. WMD aims at integrated solid waste management with a unified chain of commands.

2.3.2 Major initiatives

There have been several projects and programmes on SWM in the city. Among them, public-private partnerships have been a path breaking initiative. Both the city corporations have leased out the primary collection of waste to the NGOs. Dhaka North City Corporation has privatised extensively its conservancy works in Uttara, Gulshan, Banani, Baridhara, Mohakhali and Tejgaon areas. Some of the initiatives taken over time are as follows:

Table 2.3: Major initiatives taken for SWM in Dhaka City

Duration and Funding Agency	Project Title	Objectives/expected outputs of the projects
2013 (January to December) European Union	Towards Zero Waste (CONSORTIUM)	<ul style="list-style-type: none"> • Project consortium establishment and analysis of the situation in the pilot cities • Municipal cluster coordination and strategies • Capacity building on 3R towards zero waste
2013-2016 (First phase) Waste Concern, Swisscontact	Value for Waste (Household Solid Waste Management Project)	<ul style="list-style-type: none"> • Keeping the value of recyclables intact by encouraging segregation at source at household level. • Allocate space for waste management and operate waste transfer stations and • Awareness campaign in schools and universities • Promotes green businesses producing goods from recycled domestic waste
2007 to 2011 JICA partnership with DCC and LGRD&C	Strengthening of Solid Waste Management in Dhaka City	<ul style="list-style-type: none"> • Strengthened project management and coordination capacity of DCC • Improved capacity for solid waste collection and transportation, Efficient operation and management of Final Disposal Site, Improved accounts system for solid waste management and participation of citizen

Duration and Funding Agency	Project Title	Objectives/expected outputs of the projects
2009 to 2010 JICA partnership with DCC and LGRD&C	Improvement of Solid Waste Management in Dhaka toward the low carbon society	<ul style="list-style-type: none"> To strengthen the waste collection and transportation capacity of DCC To reduce emissions of greenhouse gases in waste collection and transportation in Dhaka City.
2010-2014 Govt. of Bangladesh and Asian Development Bank	Urban Public and Environmental Health Development Project	<p>Among other components of the project, solid waste related objectives are as follows:</p> <ul style="list-style-type: none"> Solid waste management in six city corporations. Building secondary transformation station (STS) Composting in slum areas
November 2009 to June 2011 UNICEF and GoB and Waste concern	Preparation of Solid Waste Management Plan for 19 towns of Bangladesh	Preparation of Action Plan for solid waste management in 19 towns of Bangladesh based on 3R principle and carbon financing.
2006- Continuing GoB and UNDP	Recycling training centre	<ul style="list-style-type: none"> To promote the concept of the 3R principle (Reduce, Reuse and Recycle) To demonstrate efficient technology and provide hands-on training To introduce a small-scale CDM model for urban waste recycling projects

2.4 Existing Practices

In general both DSCC and DNCC follow a heterogeneous solid waste management system in respect of operation and management. In both city corporations, different practices are followed for various types of waste across various wards. In case of household sector, wastes are typically collected in a non-segregated manner and placed into the slender containers at the households. Organisations outsourced by City Corporation (CC) collect the waste in vans through vanmen on payment basis and carry to the secondary collection points (containers or designated sites). Subsequently, the waste is carried by various size of trucks (of City Corporation or private organisation authorised by the city Corporation) to the landfill sites situated at Matuail and Amin Bazaar. In this connection, an informal market operates to recycle a significant portion of the solid waste. The roles of the Tokai or scavengers and door step, Hawkers are worth mentioning. Scavengers collect the recyclable items from both the landfills and open waste bins and finally sell it to a recycle waste dealer (Bhangari). The items are then washed, dried and sorted by the recycling dealers and traded in the market. Besides

the scavengers, the Hawkers buy recyclables from door to door and trade with the Bhangari (receivables buyers). The pattern of waste collection in slum households is different to some extent. City Corporation in general, does not provide any waste management services in these areas. The households individually dump the waste in nearby points by themselves. CC trucks or other authorised trucks carry this waste (infrequently) from those points to the dumping sites.

In case of city streets, the process of waste management is quite different. The city corporation through its cleaners (permanents and temporary) undertakes the cleaning of public places (roads, drains and parks etc) on a daily basis. The cleaning work are supervised by Sardars (cleaner leaders) and finally by the supervisors of the wards. The Conservancy Inspector is the final authority regarding the management of the ward-wise waste. It should be mentioned that all the personnel engaged in solid waste management at ward level are never accountable to the ward level government. There is thus, a degree of centralisation in the management and control of solid waste management system in DCC areas.

Unlike household and public place waste management, commercial waste management is far complicated. Petty traders and roadside vendors dispose their waste in the streets or nearby city corporation containers. On the other hand, in large markets (fish, vegetable or fruit market in particular) the arrangements for waste management are diverse. Often the traders engage labours informally to carry the waste from their premises to the city corporation container site or designated places. City corporation lifts these waste through their own transports or authorised transport (open trucks, compactors or container carriers) and finally dump at the land filling sites.

The waste collected from the city is disposed to the final destination at land filling sites. Over the Years, the sites for dumping are filling up fast as appropriate mechanisms to reduce waste generation at the source and diversion of secondary disposal from going to the land-filling site could not be evolved. The acute need for recycling has been felt over and over again in the city. However, in absence of any organised move to develop this sector, recycling process has not taken off at the expected rate. Various authorities sporadically ventured into the issue of recycling the organic waste. Composting of organic waste to produce organic fertiliser was initiated in the past for some years. However, in absence of appropriate financial support, the process of composting has been disrupted. Due to absence of alternative landfill sites and in view of scarcity of land, the problem has been compounded over time.

It is thus observed that CC adopts different strategies for different sectors and for different types of waste. The existence of a private sector involvement is traced at all levels of SWM. It should be mentioned that the involvement of informal sector especially in the area of recycling is clearly visible in SWM.

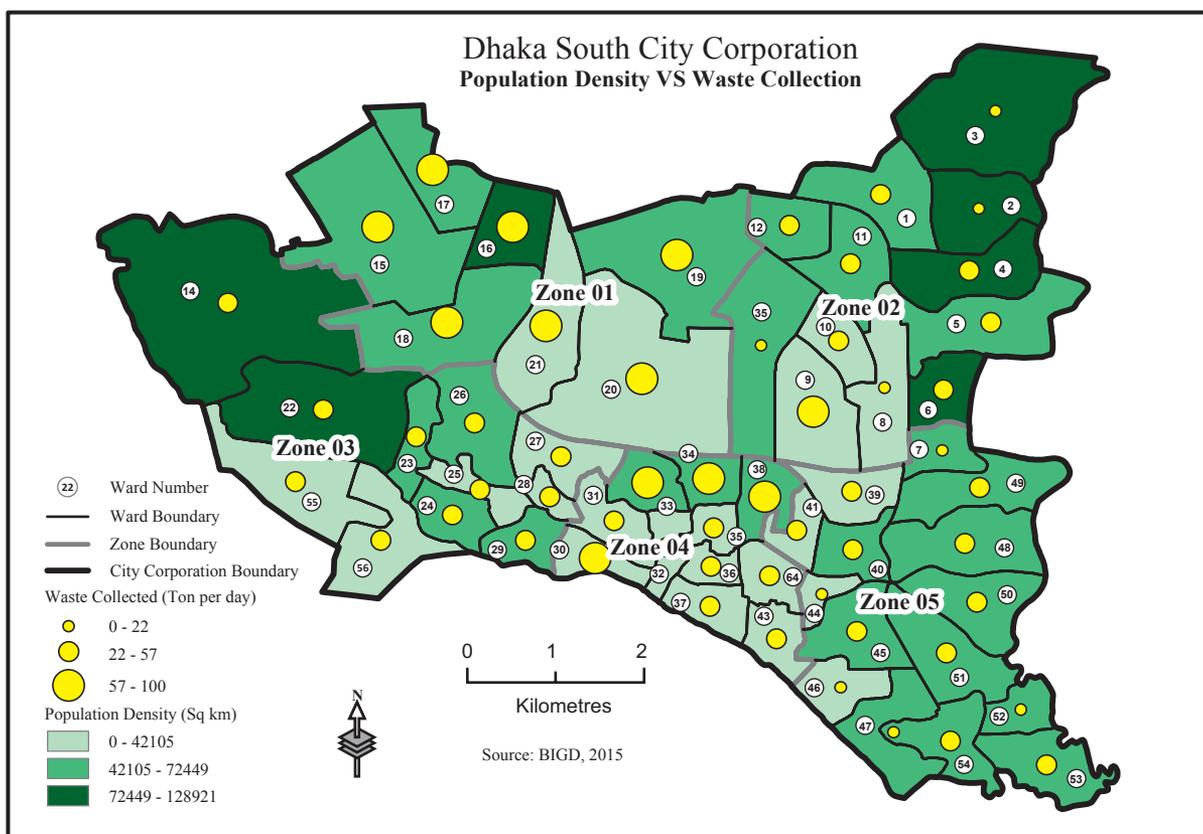
2.5 Ward-wise Characteristic

Information on 93 wards of City Corporation regarding infrastructure have been collected from City Corporations. In particular, data on the available manpower devoted to each ward and the infrastructural facilities like (vans, containers, and trucks) have been aggregated. Similarly the

demographic profile of each and every ward has been shown based on the census data. The primary objectives are to give a snapshot view of the wards and point out disparities (if any) among the respective blocks. In this way, attempts have been made to understand the solid waste management of various wards of the city corporations. The maps are the overview of demographic and waste collection areas of various administrative wards.

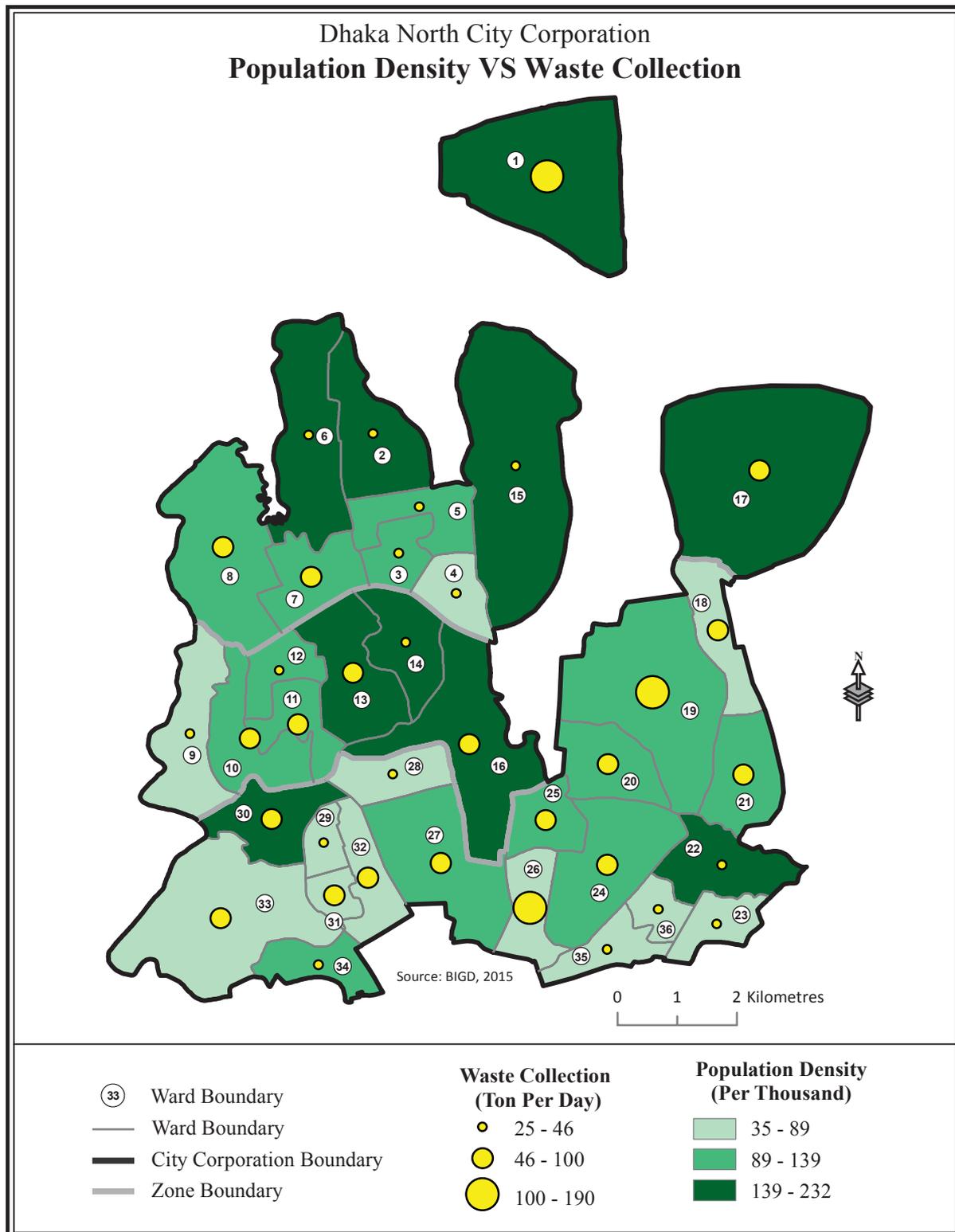
Demographic profile and incidence of waste collection across various wards are shown in the maps below. Data on waste collection and population density for various wards has been plotted to understand the variations.

Map 2.1: Dhaka South City Corporation



Source: DSCC, 2015

Map 2.2: Dhaka North City Corporation

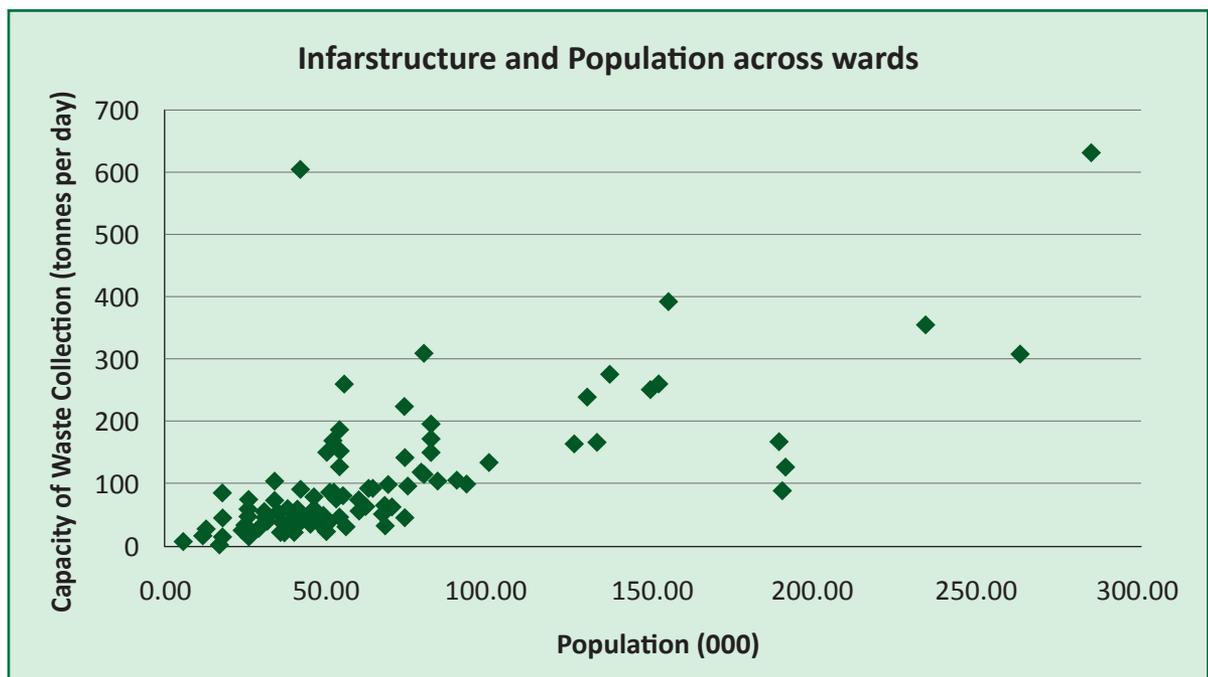


Source: DNCC, 2015

2.5.1 Infrastructure facilities across wards

To understand the solid waste management of the Dhaka City, it is essential to analyse the distribution of population and the support services available from the city corporations. The graph tries to explore the relation between population and infrastructure across various wards in Dhaka City Corporation. Here the population has been calculated from BBS 2011 and projected over to 2015. Infrastructure includes the facilities provided by City Corporation (like number of vans, containers, trucks including open and compactors). It is interesting to find that there is a high degree of correlation between the sets of variables. Further the concentration of infrastructure has an interesting pattern for different ranges of population. Wards with population below one lakh seem to have and infrastructural cap to clear about 200 tonnes of waste. Beyond a population of one lakh, the cap is observed to be nonexistent.

Figure 2.1: Infrastructure and population in Dhaka City Corporations



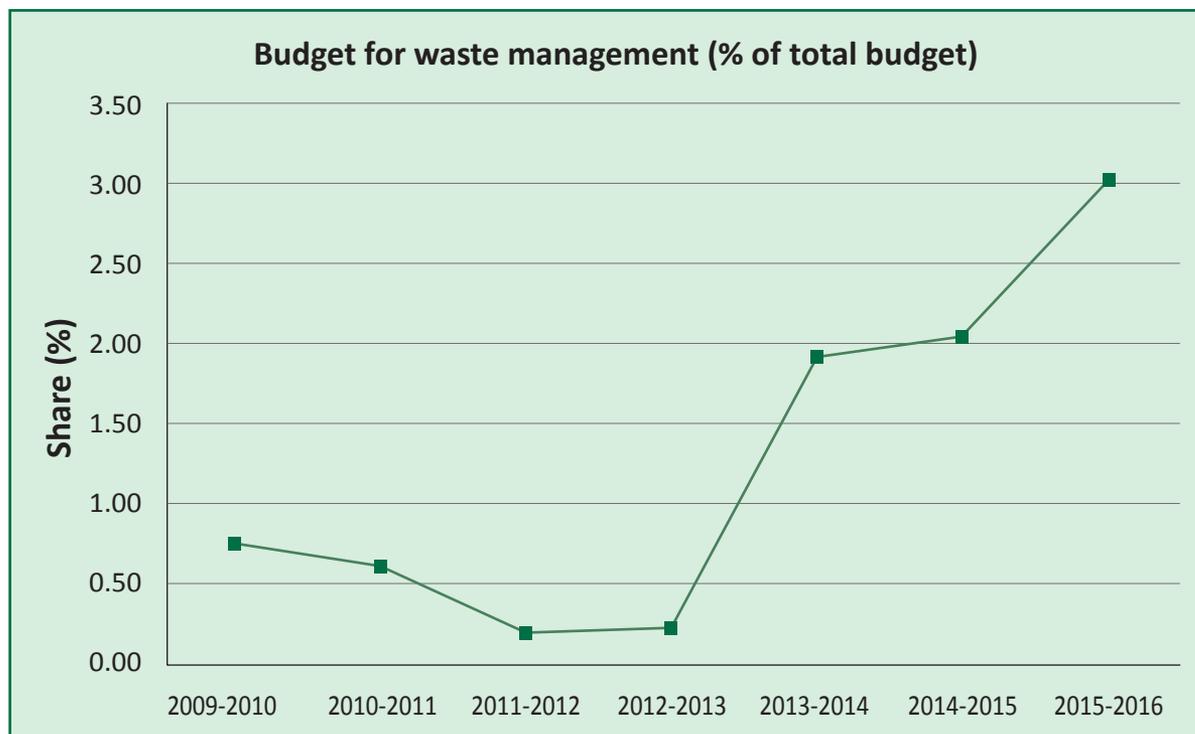
Source: BIGD Survey, 2015

It has been observed from the database available for CCs that human resource engagement across various wards vary considerably (detail in Annex Table 2-2).

2.5.2 Budget and Finance

Increasing interest among policy makers have been centred around financing of waste management programmes. Combining both the city corporation and constructing a time series of budget share for each respective year (from 2009 to 2015) the picture becomes clear. It is seen that the aggregate budget share on SWM of city corporations has increased over time from 2011-12 onwards.

Figure 2.2: Budget share of waste management (aggregate and annually)

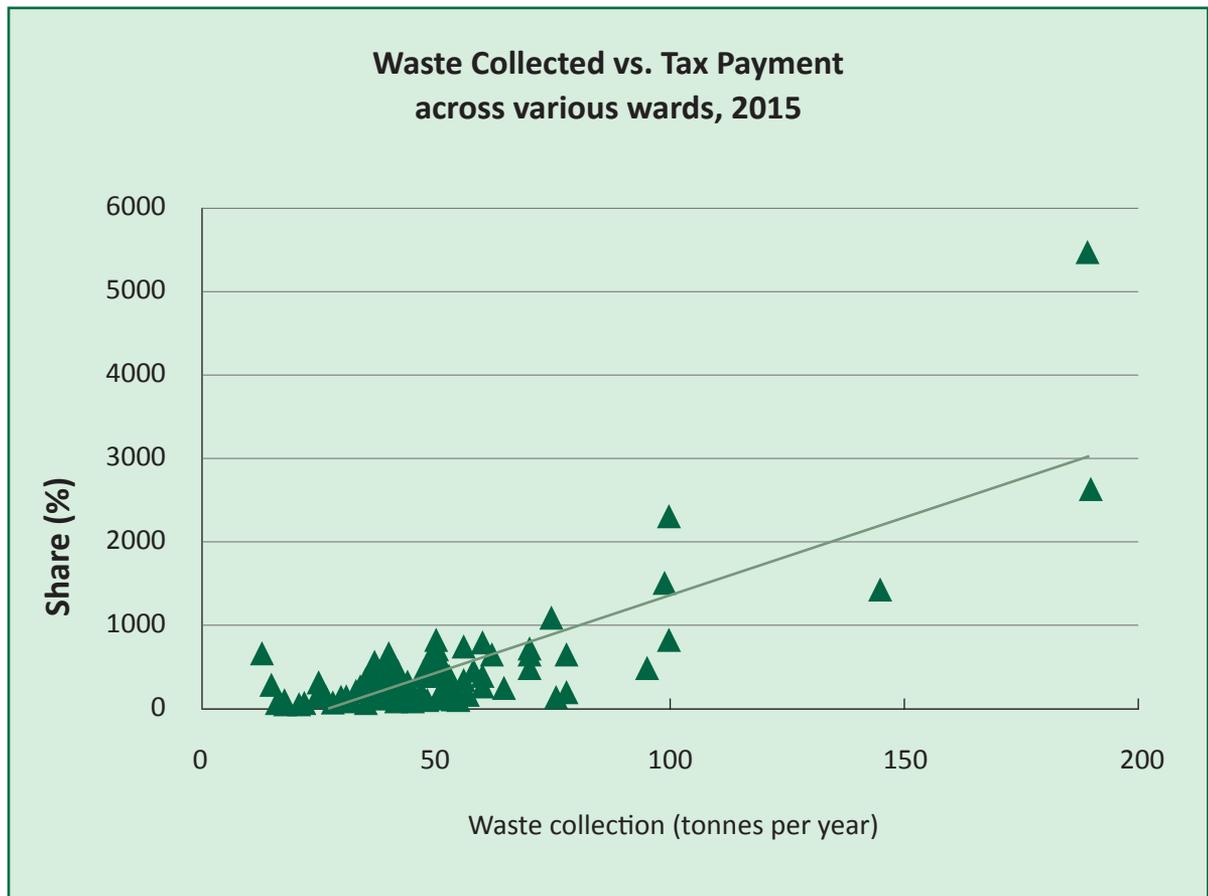


Source: (DSCC and DNCC 2015)

2.5.3 Revenue and waste collection across wards

Attempts have been made to examine whether tax collection in the wards have any relation with waste collection of the ward. Stating otherwise, the essential question is do rich wards (in terms of tax contribution) demand more attention in terms of waste collection? This is apparently confirmed from the graph below. The patterns of waste collection across various slabs of tax collection are quite diverse. Wards with tax collection up to the range of one crore enjoys significant waste collection compared to others.

Figure 2.3: Tax collection and waste collection across various wards, 2015



Source: (DSCC and DNCC 2015)

Thus, it is observed that ward-wise heterogeneity exists and is a matter of concern for SWM. Due to lack of recent studies on primary waste generators, it becomes difficult to throw some light on the aggregate domestic waste and its collection and disposal procedures convening in every ward under the two City Corporations.



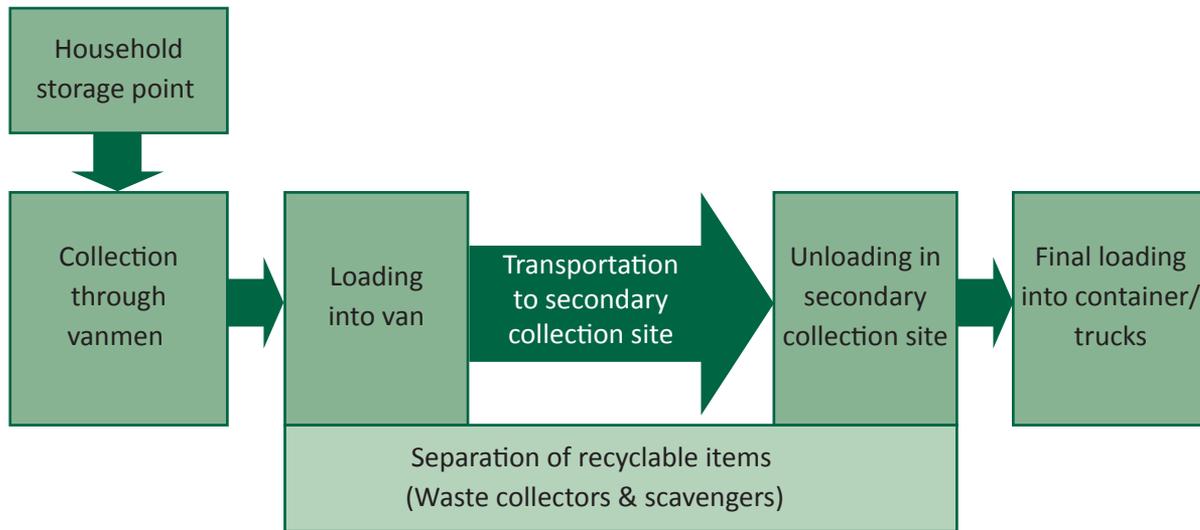
Waste Management: Primary Stage

3.1 Introduction

Primary waste management in Dhaka has been mostly studied from macro perspectives. Very few studies have considered the details of primary waste management. In the current study we have looked at the interfaces of waste generators and waste management service providers with particular emphasis on households since they generate about 60.94 percent of total waste volume (JICA 2005).

To understand primary waste management system the study examines household practices especially households' waste production, in-house and off-house waste disposals, perceptions regarding roads and open space cleaning, awareness about waste management chain and perceptions about grievance redressal mechanisms. With an aim to identify operational synergies, this chapter describes important aspects of primary waste management in detail.

Primary waste management is defined in this study as the act of removing solid waste from the central storage point of a primary generating source (i.e. households and roads and open space) to a disposal site earmarked or non-earmarked by City Corporations. Household waste storage includes the retention of waste within the households after waste being generated until off-house waste disposal. Waste collectors collect accumulated in-house waste either from each household or from a single point in each holding and load collected waste into a van. Waste collectors carry the waste vans to a secondary storage point for disposal. The waste collectors segregate saleable items during the period of collecting waste from households and disposing of collected waste into a container or a truck. The households' primary waste collection process is depicted in Figure 3.1.

Figure 3.1: Household waste collection process

While Waste collectors collect and dispose household waste into containers, such activities in case of street waste are carried out by City Corporations' cleaners. Ward-wise designated Conservancy Inspector allocates specific geographical area of a ward among available cleaners, in consultation with Ward Councilor and *Sardar* (informal team leader of cleaners) to ensure sweeping of all roads and open space of the ward on daily basis. Accordingly, cleaners sweep assigned streets and fill swept waste into trolley, which is manually transported to secondary collection point for disposal into a container or a truck. Before disposal of street waste into container, the cleaners too separate resaleable items from waste. Cleaners' activities are monitored by ward-specific Conservancy Inspector.

As mentioned earlier, the study on the Primary Waste Management has been based on both sample survey and anthropological approaches to examine governance in management of household and street waste and to describe perspectives of waste management service providing stakeholders. Survey findings are described here at first, followed by findings of interviews and discussions with stakeholders. At the end, the chapter provides some anecdotal evidences derived from the study.

3.2 Primary Waste Management: Household Scenario

To understand the primary waste management system in detail the study looks at the households' details including household characteristics, volume of waste generated, dominant items in composition of waste, seasonal variations in waste generation, storage mechanisms, waste segregation, and in-house and off-house waste disposal including interfaces between households and waste collectors.

3.2.1 In-house waste management

This section describes waste types and volume generated by households including per capita waste production, seasonal variation in waste generation, and households' practices in waste separation.

Waste types and volume generated by households

Household waste can broadly be categorised into organic and inorganic. It is clearly revealed that greater part of household waste (97.15 percent) is organic. Furthermore, vegetables contribute most (52.28 percent) in generating organic waste while polythene is the most dominant item in inorganic waste basket, followed by plastics and paper. Each individual in Dhaka generates 377 gm waste per day on an average. Per capita organic waste produced by each individual daily is 366 gm and inorganic waste is 11 gram respectively. Table 3.1 illustrates details of waste volume, types and per capita waste generation.

Table 3.1: Households' waste generation (daily): Volume and composition

Volume of waste	Total waste generated (kg): 1058.794 Average per capita waste (kg): 0.377									
Types of waste	Organic					Inorganic				
Total waste (kg)	1028.2					30.1				
Percentage of total waste	97.15%					2.85%				
Average per capita waste generated (kg)	0.366					0.011				
Broad categories of waste	Vegetables	Fish & Meat	Fruits	Others	Paper	Plastic	Polythene	Electric Waste	Glass	Others
Percentage	52.28	19.99	15.51	12.22	22.95	28.93	30.43	4.88	4.61	8.2

It is assumed that education level, expenditure, income source, and employment type of households influence waste generation. There is no evidence to say that level of education has reduced waste through appropriate planning at the source. Per capita waste generation by highly educated households is found to be 0.409 kg per day compared to 0.262 kg produced by less educated or illiterate people.

Similarly, it is observed that highest spending households generate maximum quantity of waste. Expenditure group of BDT 60,000 and above generates per capita waste of about 0.46 kg on an

average daily, which is about 40% higher than per capita waste generated by the lower expenditure group of city dwellers who spend less than BDT 20,000.

Self-employed (including petty retail business) households generate maximum waste. Average per capita waste generated by the group is reported to be 0.4 kg per day compared to less volume of waste generated by informal sector (which stands to be 0.26 kg daily). If the contribution of self-employed in solid waste generated is decomposed, it is observed that households hosting large scale businesses or are on house rents generate most waste. Details regarding relationship of waste generation with education level, expenditure, income source, and employment type of households are presented in Annex Tables 3-1 – 3-4.

Seasonal variation in waste generation

Waste generation is not uniform round the year. Approximately, two-third households (62.1 percent) did report that the highest volume of waste was generated in summer (March-June). Festival was cited by 22.8 percent households as the major waste generating time of waste. Fruits waste contributes largely in generating maximum waste in summer while remains of animal slaughtering during Eid-ul-adha have been main reasons for highest waste generation during festivals. Table 3.2 shows the details.

Table 3.2: Households' reporting maximum waste generation in respective seasons

Duration	Household (no.)	Households (%)
Summer	329	62.1
Rain	39	7.3
Winter	41	7.7
Festival	121	22.8
No change	70	11.6 (percentage out of 600 sample)

Waste separation by households

So far there are no available studies on the waste separation in households of the city. An important question remains: Is waste separated in the house at all? To understand in-house waste separation (if any), households were asked about methods of storing waste, number and size of waste bins used, spatial distribution of waste bins within the houses, and households' handling recyclable materials.

All of the households were found to use bins for storage of waste. However, all of them did not use multiple bins for different categories of waste. Plastic bin has been mostly used by 537 households

out of 600 households for accumulating waste. Reasons behind pre-dominant usage of plastic bins include its availability, durability, low cost, and convenience of handling. The incidences of different types of bins used by households are shown in Table 3.3.

Table 3.3: Incidence of bin usage by households (including multiple bin usage)

Types of bins	Plastic bin	Polythene	Plastic bag	Drum	Metal bin	Others
No. of households	537	44	18	22	11	35

It has been observed that 45 percent of households use multiple bins to separate waste. Placement of bin in kitchen has been very common in case of multiple bin users followed by bedroom. Spatial distribution of bins has been thus important. While asking about the reasons for using multiple bins, majority (63.24%) mentioned ease of handling as the reason (see Annex Table 3-5 for details). Table 3.4 demonstrates households using single and multiple bins and the spatial distribution of bins within the house.

Table 3.4: Spatial distribution of bins inside houses

No. of bins used	Location of the bins						Total households	Percentage
	Kitchen	Bedroom	Drawing	Dinning	Bath	Balcony		
1	258	3	3	0	2	54	330	55
2	149	50	18	26	13	45	157	26.17
3	40	30	8	9	13	11	41	6.83
More than 3	72	63	28	34	42	23	72	12
Total							600	100

However, 55 percent of households use single bin to reserve waste meaning that there is no source separation of waste at all in those households. They accumulate all types of waste in a bin by placing the bin mostly in the kitchen. Nonetheless, 20.61 percent of the single bin users acknowledge necessity of using multiple bins. Most of them think that it will be easier to reserve waste if they use multiple bins. Details are given in Annex Table 3-6.

There is variation in sizes of bins to keep organic and inorganic waste. Medium or large sized bins are typically used to store organic wastes. 46.43 percent of households use medium bins and almost same percentage of households (44.28 percent) opt for large bins for storing organic wastes (see

Figure 3.2). In case of storing inorganic waste, medium sized bins are used by majority of households (63.06%), followed by small bins (see Figure 3.3).

Figure 3.2: Households using bins of different sizes to store organic waste (percentage)

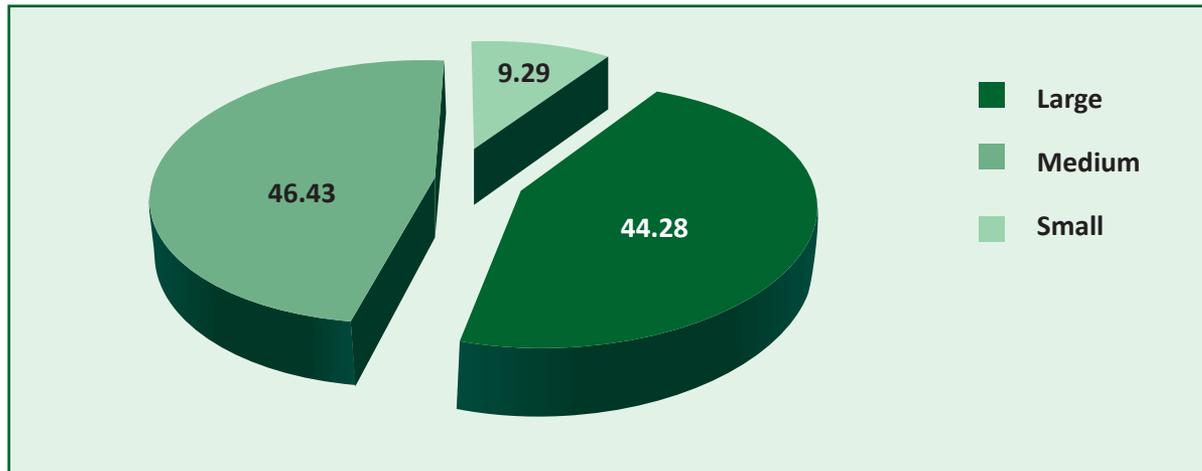
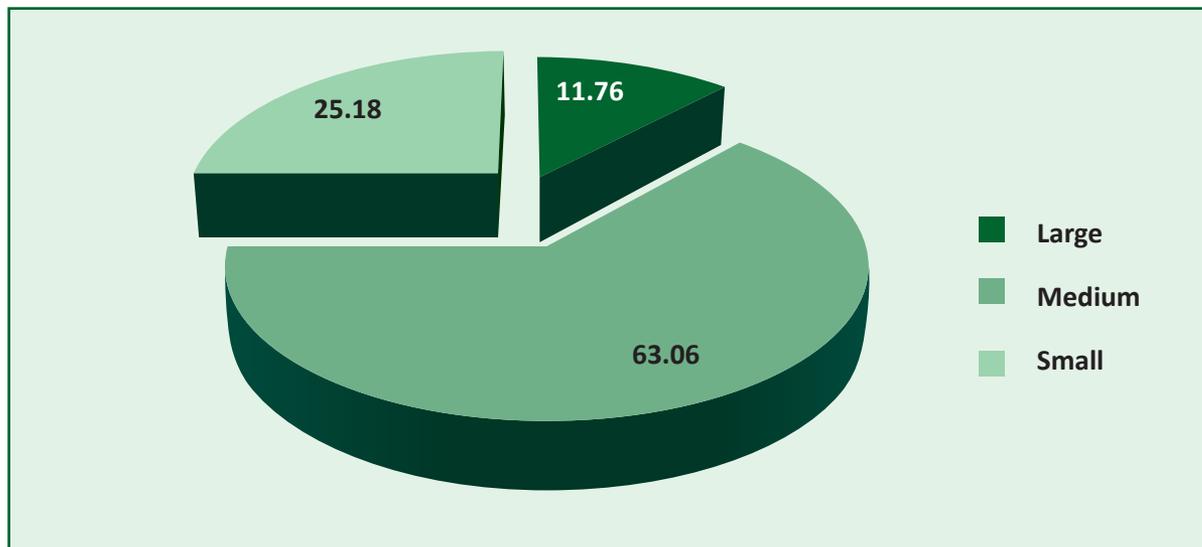


Figure 3.3: Households using bins of different sizes to store inorganic waste (percentage)



In addition, current study has also examined how the households get involved in the process of recycling. In this connection, sorting out saleable items from non-saleable before off-house waste disposal is considered as an important practice. Currently, 70 percent households separate waste into saleable and non-saleables in Dhaka. Out of 600 households, 180 households don't separate waste. Among them, 164 households do not separate waste for various reasons. 56 households consider it time consuming. Details are given in Table 3.5.

Table 3.5: Practice of in-house waste separation and reasons behind non-separation of waste

Practice of in-house waste separation	No. of Households
	(Total sample = 600)
Waste separated	420
Waste not separated	180
Reasons for non-separation	No. of Households
	(Applicable sample = 180)
Lack of space in house	23
Lack of appropriate bin	18
Time consuming	56
Absence of market to sell	11
Others	164

Recyclable materials of the household waste include paper, plastic, electronic equipments, clothes, and polythene. Plastic has been the dominant resaleable item as stated by majority of the households (84.05 percent). About 88 percent households sell these resaleable items to vendors from their houses.

Despite 'plastic' being categorised as the most dominant resaleable item, it remains unsold in 39.76 percent households. Second dominant unsold item is glass as mentioned by 36.19 percent households. Necessity of selling these items is not realised by 43.33 percent households. 31.19 percent households refer to unavailability of buyers as a major constraint for not selling these materials. In this context, 60.48 percent households dispose these unsold materials to waste collectors and 27.14 percent households give the same to the respective domestic helps. It is thus clear that a mechanism of sorting of waste is undertaken in most of the households. Along these lines, the involvement of an informal network for recycle is clearly visible.

3.2.2 Waste management outside holdings

Once households finally decide to discharge waste, they either carry the waste outside by themselves or discharge waste to door to door waste collection service providers. In the latter case, interfaces based on timing of waste collection, payment of fees, satisfaction and grievances take place between households and waste collectors. Household waste collection dynamics and other relevant issues are described in detail in this section.

Agents of waste disposal outside holding

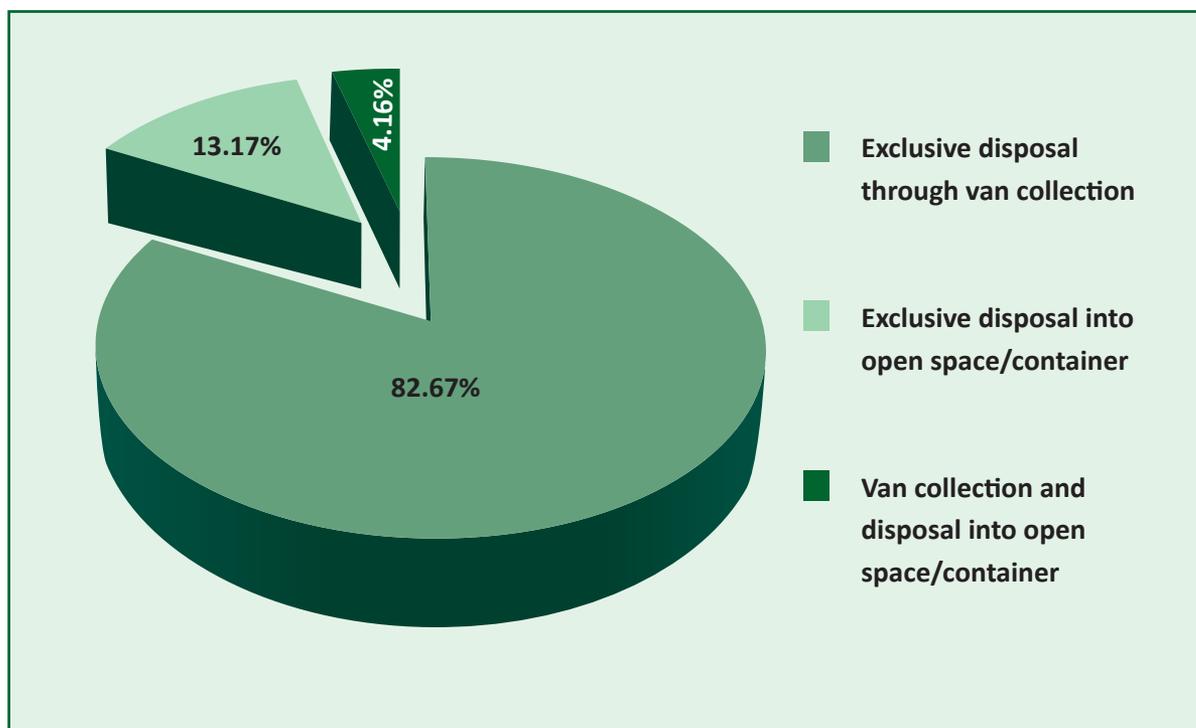
To study the mechanism of waste disposal by the households, there is a need for an in-depth study of the agents responsible for waste disposal. The relevant question is who disposes waste outside the

holdings? It is observed that women play a significant role in waste disposal. About 44 percent respondents mentioned that female members of the household have been major players in performing the job while 43.3 percent households rank domestic help as the first actor in discharging waste to the waste collectors. This scenario hints at imparting appropriate training (if needed) to the real performers, the women of the society for making them aware to improve waste disposal methods for solid waste management (including waste separation and recycling).

Means of waste disposal outside holding

Over the last twenty years, door to door waste collection service has transformed into a successful business endeavor which contributed significantly to systematic household waste disposal. Although more than four-fifth households opted for door to door van collection service for waste disposal, number of households deprived of this service is not insignificant (see Figure 3.4).

Figure 3.4: Prevalence of door to door waste collection service across households (percentage)



Out of 79 households not availing van service, 50.63 percent households did not avail due to non-availability of the service in their area. Irregular collection and lack of knowledge about the service were also reported by the respondents. Reasons are shown in Annex Table 3-7 in detail.

Among the households who dispose waste into open space or containers, 75.5 percent discharge waste every day in the same manner. For such disposal 21.4 percent households have to walk more than 10 minutes while the remaining were able to dispose within less than 10 minutes of walking distance. Regardless of the distance of waste disposal site, 79.6 percent households consider this

distance convenient for them whereas this distance is not convenient to the remaining 20.4 percent households.

Intervals and timing of waste disposal through door to door waste collection service

Among 521 households out of 600 households in the sample who currently avail door to door waste collection service, 86.8 percent enjoy daily collection. However, 11.2 percent households have to wait one or two days for waste disposal (see Annex Table 3-8 for details).

It is often thought that the timing of waste collection is a crucial issue to understand solid waste management. 26.1 percent households reported that there was no fixed time to collect waste by waste collectors. However, it has been revealed that waste collection from households begins at 6 am which continues until 6 pm. This timing is quite in contrast with City Corporation's stipulated time span from 6 to 10 pm for waste collection by waste collectors. Whether the actual practice matches the households' preferences, is an issue to be concerned about. About 86.8 percent households availing door to door waste collection services prefer waste to be disposed between 8 am and 4 pm. Among them, 50.3 percent like to dispose within 10 am – 2pm. Table 3.6 gives the details on this.

Table 3.6: Timing of actual waste collection and household preferences on day to day basis

Time of door to door waste collection									
Actual time		Household preferential time						Households without van service	
	Households with van service	Up to 8 am	8 am to 10 am	10 am to 12 pm	12pm to 2pm	2 pm to 4 pm	4 pm onwards	Non response	79
Up to 8 am	17	13	-	1	1	1	1	-	
8 am to 10 am	70	6	55	2	2	5	-	-	
10 am to 12 pm	147	6	9	111	6	12	3	-	
12 pm to 2 pm	83	1	7	5	64	6	-	-	
2 pm to 4 pm	59	-	-	4	10	45	-	-	
4 pm onwards	9	2	-	-	1	-	6	-	
No fixed time	136	6	21	30	25	29	2	-	
Households having fixed time	521	34	92	153	109	98	12	23	

Monthly payment for waste collection service and households' opinion regarding payment

There is a significant difference in households' payment for availing waste collection services (within and across wards). Actual individual household's payment varies from BDT 20 to BDT 700 per month. It has been reported that the rates vary often within the same holding too. Basis of such payment is not known to most of the households.

Only 15.55 percent households pay within the City Corporations' stipulated amount (BDT 30). However, 96.5 percent households don't know the Corporation's rate. 52.59 percent households pay maximum BDT 50 per month, followed by BDT 50-100 being paid by 30.7 percent households. About 10 percent households pay more than BDT 150 for waste disposal through van service. Highest rate is observed mostly in case of households of posh areas and least tariffs are paid by the households of peripheral areas of the City. The basis for such differences is not clearly known. Ward-wise monthly payment rates are shown in Annex table 3-9.

It is interesting to see the perception of the households regarding the payment. 63.2 percent of respondents consider the respective rates imposed for waste collection service as reasonable. However, 21.3 percent households judge this amount as excessive. Moreover, households who are paying minimum at present are highly satisfied about their respective amounts but households who pay the highest amount of money are somewhat dissatisfied (see Table 3.7).

Table 3.7: Monthly payment for waste collection services: Incidence and opinion

	Actual payment (BDT)					Total
	Up to 30	30 to 50	50-100	100-150	150 & above	
Total households	81	193	160	36	51	521
Percentage	15.55%	37.04%	30.71%	6.91%	9.79%	100%
Opinion about payment	No. of households and percentage within the group					
Excessive	13 (16.1%)	32 (16.6%)	55 (34.4%)	8 (22.2%)	20 (39.2%)	128 (24.6%)
Right	65 (80.2%)	157 (81.3%)	102 (63.7%)	25 (69.5%)	30 (58.8%)	379 (72.7%)
less	3 (3.7%)	4 (2.1%)	3 (1.9%)	3 (8.3%)	1 (2.0%)	14 (2.7%)
Total	81 (100%)	193 (100%)	160 (100%)	36 (100%)	51 (100%)	521 (100%)

About fifty percent households pay their respective amount to supervisor of van collection service and 40 percent give the fee to waste collectors. However, 39.7 percent households are not given any document as proof of payment or receipt.

Growth of door to door waste collection service in Dhaka

It is observed that door to door waste collection service through waste collectors has increased at non-uniform rates in various wards of Dhaka. However, the growth has been quite visible in the years 2000 and 2005 (see Figure 3.5). Growth rates of these two years are 15.6 percent and 14.3 percent respectively. The growth of 2000 might be related to City Corporation's plan to formalise the service and that of 2005 might be because of the initiatives undertaken by JICA. Ward-wise expansion of door to door waste collection services is demonstrated in Annex table 3-10.

Figure 3.5: Cumulative growth of door to door waste collection service in Dhaka over time



Quality of waste collection service

30.7 percent households report that the worst services are received in the rainy season. Service is said to be same type throughout the year by 61 percent of the households. The existence of seasonality is apparently evident. Details are given in Table 3.8.

Table 3.8: Quality of service reported by the households

Seasons	Percentage of households reporting best service
Summer	11.6
Winter	16.7
Festival	10.7
Seasons	Percentage of households reporting worst service
Rainy	30.7
No change of quality	61

Grievance redressal, satisfaction levels and expectation of the households

It has been reported that 39.2 percent of the households faced problems regarding waste disposal through waste collectors. Of them, about 33 percent could solve the problems whereas 67 percent of the problems remained unsolved. Most problems were regarding irregular waste collection and solved through negotiation with waste collectors.

It is noted that 61.8 percent households were more or less satisfied with the collection service. About 19 percent households were found dissatisfied with the service. Irregularity in waste collection has been the major reason behind their dissatisfaction.

59.7 percent households want changes in the existing services and most of them emphasised on regularity of service. In order to have better services 80 percent households have agreed to increase their monthly payment. Among them 30.75 percent respondents are willing to pay 60 percent more than their existing amount. Details are given in Annex table 3-11.

Households' perception regarding waste collection charge fixing criteria

26.8 percent households opined that the rate of waste collection charge should be different based on waste volume rather than current fixed rate. However, a majority of the households (71.1 percent) think that collection charges should be uniform for all households. Table 3.9 shows the details.

Table 3.9: Households' perception regarding waste collection charges

Criteria	Uniform rate for all	Rate based on waste volume	Others
No. of households	374	141	11
Percentage	71.1	26.8	2.1

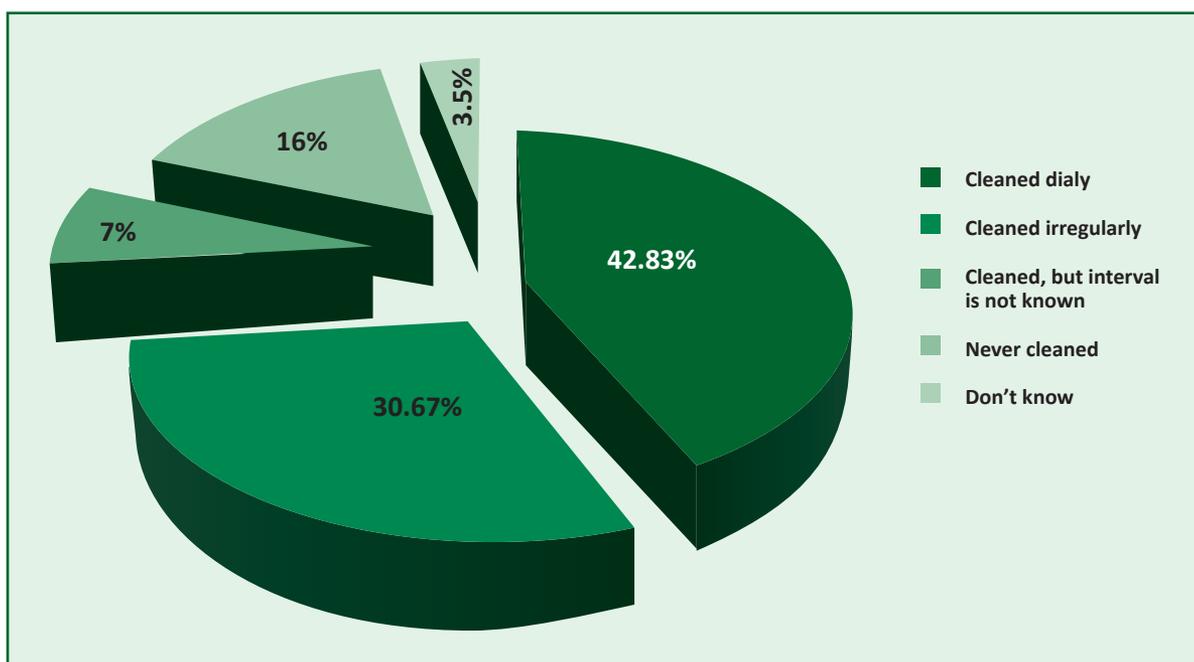
3.2.3 Roads and open spaces cleanliness: Households' perceptions

The current study has also made attempts to look at households' perceptions regarding cleanliness of roads and open spaces around their holdings. Issues of street sweeping, problems caused by waste disposal into non-earmarked places, and container-induced difficulties have been explored in this section. Individual and community level initiatives to improve cleanliness are also reported here.

Frequency of roads and open space cleaning and types of cleaners

On the question of frequency of cleaning roads and open spaces, 42.8 percent respondents out of 600 households mentioned that the task was done on daily basis while 16 percent respondents reported not sweeping at all. Figure 3.6 describes the details.

Figure 3.6: Households' perception regarding roads and open space cleaning (percentage)



Typically, references of two types of cleaners were found, City Corporation's cleaners and community cleaners. The former have been reported by 76.9 percent respondents for cleaning roads and open spaces and the latter were reported by 9.2 percent respondents for the same. Thus, it is known to most of the city dwellers that city cleaning services except for primary collection of household waste are mainly provided by City Corporation. Details are given in Annex table 3-12.

Timing of cleaning roads and open space

As the cleaning of roads and open spaces is mainly carried out by City Corporation's cleaners, time schedule appears to be important. There is little difference between the times when cleaners actually work and the time preferred by the households (see Annex table 3-13). 74.67 percent respondents

reported that cleaning was completed by 8 O'clock in the morning and this schedule is preferred by most of the respondents.

Grievance redressal regarding cleanliness of roads and open space

Respondents, who had grievances regarding cleaning of roads and open spaces, didn't get any resolution most of the times. Only 39 respondents have made complaints regarding cleanliness. Of them, two respondents could redress their grievances immediately and 35 respondents' complaints remained unresolved. It is revealed that most of the households refrained from lodging complaints about cleanliness of roads and open space. This issue was not considered as important to 33 households and 40 respondents didn't have information about procedures to lodge complaints.

In addition to individual initiatives, it was examined whether the community has taken any steps to improve cleanliness of respective area. Only 12 respondents reported that their community has taken some steps and 42 respondents did not see any activity of the community in this regard. However, majority of the households (61 households) do not know whether their community has taken any initiative to address cleanliness. It was also revealed that rate of complaint redressal at community level (75 percent) has been higher than that of complaint redressal at individual level (10.26 percent).

Problems caused by random disposal of waste into non-earmarked places

A major issue in Dhaka is random disposal of waste into open space which is not earmarked by City Corporation. About half of the sample respondents (52.33 percent) reported such disposal around their holdings. Because of this practice of disposal, 93.9 percent respondents have faced major problems. In order to stop this practice 33 percent respondents have taken steps individually. 18.6 percent respondents have reported immediate solution of problems. Some steps were taken by the community regarding open space waste disposal. On the question of grievance redressal based on complaints, 35.9 percent respondents mentioned that the issue was not redressed. Details are demonstrated in Annex tables 3-14 – 3-16.

Container-induced difficulties faced by city dwellers

City Corporation's containers being located on the roads are observed by the respondents to create problems for the city dwellers. In response to the question regarding incidences and severity of problems faced due to Corporation's containers, 86.3 percent respondents (out of sample 600 households) answered that they had faced problems. Among them, all respondents (100 percent) reported foul smell as a problem which is mentioned as severe by 94.5 percent respondents. 57.34 percent households think that containers' location on roads often lead to blockage of footpaths and also create traffic congestions as mentioned by 48.84 percent respondents. These problems have been reported as severe by majority of the respondents. Table 3.10 demonstrates the details.

Table 3.10: Problems faced by city dwellers (if any) due to City Corporation's containers

	Problems faced						Problems not faced
No. of households	518						82
Percentage of households	86.3						13.7
Types of problems	No. of households	Percentage of households	Frequency (percentage of households)		Severity (percentage of households)		
			Regular	Irregular	Severe	Not severe	
Traffic jam	253	48.84	49.8	50.2	94.5	5.5	
Foul smell	518	100	80.7	19.3	99.4	0.6	
Encroachment of footpath	297	57.34	50.2	49.8	91.9	8.1	

3.2.4 Stakeholders' awareness about waste management

The study has attempted to understand households' awareness about the chain of waste disposal process and waste management in neighbouring wards. An effort was also made to identify major waste management problems and prospective solutions from households' perspectives in this section.

Awareness about secondary and tertiary level waste disposal

52.2 percent respondents out of 600 households mentioned that they know the place for secondary disposal and 47.8 percent respondents didn't know about secondary disposal. In case of tertiary level disposal, majority of the households (86.3 percent) do not know about the place (see Table 3.11).

Table 3.11: Information of the households about secondary and tertiary disposal

Information about secondary disposal		
	Know	Don't know
No. of households	313	287
Percentage	52.2	47.8
Information about tertiary disposal		
	Know	Don't know
No. of households	82	518
Percentage	13.7	86.3

Awareness about waste management in neighbouring wards

In response to the question concerning the cleaning services in neighbouring wards, 34.8 percent (209 respondents out of 600 households) mentioned that services were similar in both wards. 15.8 percent (95 respondents) argued that the service in neighbouring ward is worse than their own ward and 11.2 percent (67 respondents) mentioned that cleaning services provided for neighbouring ward is better than their own ward. This gives some evidence to show the level of information households have.

Major problems of waste management identified by households

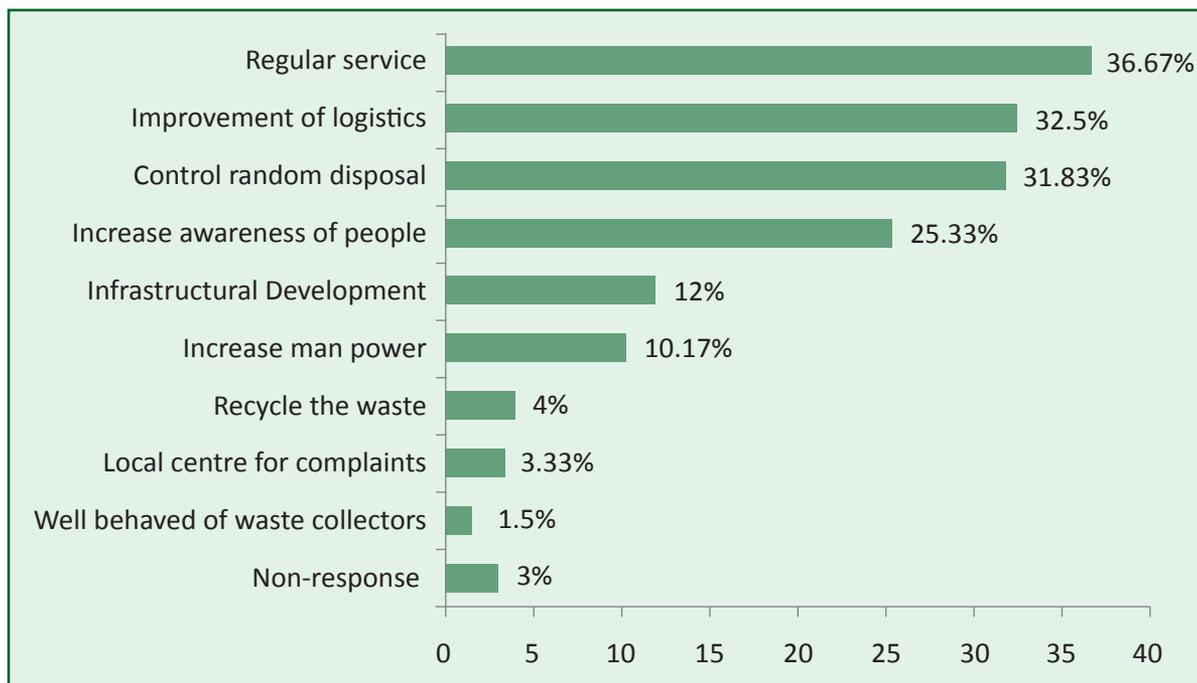
Respondents from both DSCC and DNCC state the following (see Table 3.12), as obstacles for a better and sustainable waste management. Among these, Environmental issues are the source of major problems. It is seen that 44.5 percent respondents point to foul odour causing environmental problems. 40.33 percent respondents acknowledge that throwing waste randomly is another major problem of waste management.

Table 3.12: Major problems of waste management: Perception of households

Problems	No. of households	Percentage of households
Environmental pollution	267	44.5
Waste thrown randomly	242	40.3
Water logging	169	28.1
Irregular collection and disposal of waste	132	22.0
Lack of logistics	103	17.1
Disease	38	6.3
Higher payment for monthly services	23	3.9
Worse Behaviour of waste collector	13	2.1
Bad service during occasions/festivals	3	0.5
No comment	28	4.7

Households' suggestions to improve waste management

Figure 3.7 indicates the recommendations on better solid waste management. 36.67 percent respondents recommended for better and regular service regarding waste management (collection and others). 31.8 percent respondents suggested controlling the practice of throwing waste randomly and 25.33 percent respondents recommended for raising awareness among city dwellers. There were recommendations by respondents including infrastructural development, increasing human resources and infrastructure, recycling waste, grievance reporting centres and improvement of behaviour of waste collectors.

Figure 3.7: Suggestions for improved waste management

3.3 Primary Waste Management: Service providers' perspectives

Ward level waste management services are provided by four stakeholders namely, Conservancy Inspector (CI), cleaners, primary waste collection service provider (PWCSP), and waste collectors; the former two are employees of City Corporation and the latter two are private entrepreneurs. Involvement of private service providers started with the Dhaka Municipal Corporation Ordinance of 1983 in order to bridge the gap between waste generation and disposal. It thereby ensured the disposal of urban households waste into the containers for a cleaner city. The major findings from key informant interviews and focused group discussions involving relevant stakeholders in this regard are stated below:

3.3.1 Stakeholders' identities and responsibilities

The Conservancy Inspectors are the topmost officials responsible for waste management in the City Corporation at ward level. Oversight of daily waste transportation from secondary container sites of a ward to landfill sites and cleanliness of roads and drains are principal responsibilities of the Conservancy Inspectors. However, their involvement is occasional as regards to domestic waste collection. They intervene only when a complaint is lodged by city dwellers or primary waste collectors. It was stated by the inspectors interviewed that they have to work for extended hours without any holiday in the weekends.

Cleaners are appointed by City Corporation except for five privatised wards of Dhaka North City Corporation. They are either regular employees or temporary employees on daily basis. All of them

have to work under the direct supervision of Conservancy Inspector of City Corporation. Their assigned duties include sweeping of main roads, adjacent narrow roads, road islands and parks and cleaning of saucers (shallow) drains and dumping the collected waste into open trucks/nearby container. The roads and adjacent drains of any ward are assigned by the Conservancy Inspector in consultation with the concerned Ward Councilor to different groups comprising of male and female cleaners. The number of cleaners in any ward has no relation with the population and geographical area of the respective wards. The cleaners usually work every day to prevent any wage-cut. It is often observed that the cleaners sweep the designated area of an absentee to prevent wage-cut.

Primary Waste Collection Service Providers (PWCSs) are private entrepreneurs, mainly responsible to collect waste from households through providing van services and subsequently dumping in the nearby containers. Number of households or holdings to be covered for waste collection by any PWCS is not uniform within or across the wards. It was found that the coverage of any service providers varied from 100 to 300 households on an average. Based on the intent of PWCS, the City Corporation after appropriate scrutiny finalises the geographical area for waste collection by the respective PWCS. City Corporation's authorisation is initially given for one year on yearly renewal basis. Twenty conditionalities are laid down in the City Corporation's permission letter. However, some of the conditions like service charge, collection time, monthly performance report submission and covering the van with a tarpaulin were not adhered to in practice by many PWCSs. Such deviations are corroborated by household survey carried out for this study. For instance, it was revealed from the household survey that about 72 percent households' waste was collected by 4pm whereas the stipulated timing for waste collection was from 6 pm to 10 pm. Moreover, only 15.55 percent of the households were found to pay for van service within the limit set by City Corporations (maximum BDT 30 per month per household).

Besides private entrepreneurs, community-based Panchayet committees also provide waste collection services. Some of these committees take permission from City Corporation and some are providing the service without any permission from the Corporation.

Waste collectors are generally employees of the PWCSs except for some waste collectors who receive permission from City Corporation for waste collection. The waste collectors are directly responsible to collect waste from households' storage point (either from each municipal household or single point of every holding) at pre-determined intervals and dispose the collected waste into containers earmarked by City Corporations. In addition to their assigned responsibilities they play a significant role in separating resaleable items from households' disposed waste. Consequently this becomes a major source of income for waste collectors. The expected earnings from saleable waste are often considered as a factor for fixing waste collectors' monthly wage. It was revealed from a PWCS that they allow waste collectors to take the entire earnings since it works as an incentive for waste collectors to collect waste from all households assigned to them. The more households the waste collectors cover, the probability of getting resaleable items increases.

3.3.2 Waste: Types, seasonal variation and collection across the wards

Heterogeneous composition of waste was observed in various wards. For example, leaves or tree branches contribute to a significant amount per day in one of the wards under DNCC. Remnants of clothes and papers spread are found everywhere in the wards of old Dhaka due to the country's largest wholesale markets in that area. Apart from conventional waste, a significant portion of street waste is contributed by sand and other construction materials. There have been no clear guidelines to take care of this non-conventional waste. Cleaners find sand most problematic in sweeping, piling up and transporting sands and construction materials to containers. It also causes blockade of drains. According to Conservancy Inspectors, construction work-induced problems cannot be checked without bringing any change in transportation of construction materials. Further, introducing proper cleanliness guidelines in construction sites and making estate owners responsible to clean up the residuals of construction work might improve waste collection in Dhaka.

Composition of waste varies from season to season. For example, in summer organic waste such as fruits are found in excessive proportion and dust increases in winter. Of all the seasons, summer is the peak time for waste generation. During this time waste collection from roads and households goes up to a maximum of 100 percent or even more than any other season. The waste from various fruits (e.g. litchi, palm, jackfruit, mango, etc.) is generated during the period April to July and are even scattered around the selling centres/markets in the City. The festival of Eid-ul-adha generates huge volume of waste within the shortest time. The problem can be partially addressed through operating more trips of vehicles (i.e. van, trolley, and trucks), increasing number of containers and extending working hours of cleaners and waste collectors. These are some ways to deal with the seasonal and festival induced waste generation. It is often observed that the waste lying between two holdings and those spread over water bodies are not cleared regularly. It was also revealed from interviews with Conservancy Inspectors that about 20 percent waste remained uncollected in various wards.

Both Conservancy Inspectors and PWCSPs have asserted that involvement of private sector in domestic waste collection has contributed significantly in reducing scattered disposal of domestic waste in Dhaka. Nonetheless, acceptance of private waste collection service has not been equal in all wards. It has been found that about two-third of a ward in old Dhaka remains outside the ambit of van services. Limited van service coverage in the older part of Dhaka is also revealed through BIGD's household survey. Similarly in one of the wards, only 30 percent households have availed door to door collection service.

In case of street sweeping, there is a mismatch in the timing of disposal of commercial waste and the time of sweeping by the cleaners. It was evident that, waste from shops along roadside is disposed after the roads are swept by cleaners in the morning. Such practice has generated a negative perception about the cleanliness of the city mainly undertaken by the cleaners of City Corporation.

3.3.3 Stakeholders' views about source separation of domestic waste

It was revealed from the Household Survey that a convenience-driven source separation of waste exists in 45 percent of households in Dhaka. However, waste collection does not follow the same

source separation. Some PWCSs think that waste collection in segregated manner will cost them more for arranging new logistics and which in turn will cause a hike in existing collection fees from the households. This might drive some households to opt out from waste collection service. More importantly, waste collectors do not prefer to collect waste in segregated manner even though such waste collection might save time for separation of resaleable items. It is argued that source separation will inspire the households not to dispose recyclable items to the waste collectors. It has also been reported that disposal of resaleable items has already been reduced to a great extent than the earlier times because of the awareness of housemaids and housekeepers regarding earnings out of the sale of recyclable items.

3.3.4 Waste separation and earnings

Separation of recyclable items is mainly carried out by cleaners and waste collectors during collection and dumping of domestic and street waste. Recyclable materials include bottle, plastic, paper, glass and metals. Recyclable materials separated from a van amount to 10-15 kg per day.

Such waste separation has two effects. Firstly, it reduces waste dumping into container and thus lessens pressure on secondary waste disposal and land filling. Secondly, waste separation provides some income to cleaners and waste collectors who belong to lower income group people in the society. Amount of income from the sale of recyclable items varies from BDT 30 to 300 daily. Within the group, waste collectors' income is much higher than that of cleaners. While a waste collector earns BDT 150-300 per day, a cleaner's daily income from recyclable items is around BDT 30.

However, waste separation around the container makes the sites dirty. Although City Corporation doesn't permit separating recyclable wastes around the container, it is not adhered to because of poor monitoring and oversight of City Corporation.

3.3.5 Stakeholders' views about existing resources, infrastructure and legal framework

It was found that number of cleaners did not increase proportionately with the growth of population and infrastructure (e.g. buildings, roads, etc.) in the City. Cleanliness of roads and drainage has been carried out by the cleaners recruited about 20 years ago. In addition, distribution of cleaners among the wards has not been consistent with the population. According to a cleaners' sardar of DSCC, they have to serve more people with fewer cleaners than the DNCC. Furthermore, lack of cleaners' quarters and ward office in all wards has created major problems for cleaners in accomplishing their duties properly and timely.

It must be borne in mind that, waste collection and waste storage should go hand in hand. However, waste storage capacity in Dhaka is quite limited. Lack of suitable places is the greatest challenge for City Corporations in placing the containers in appropriate sites. Such sites have not been earmarked in urban land use planning and in the absence of a plan, City Corporations place containers besides markets or parks most of the time. For instance, in the survey areas, containers for waste dumping in

two of the wards were located besides a famous park and near a Kitchen Market. Due to such unplanned container sites, waste collectors and cleaners have to travel a long distance for dumping waste. In addition to distance, container's height is also a big problem for female workers to dump waste. Coordination between arrival of van and that of compactor to clear the domestic waste timely and properly is a challenge, especially in summer. It was further observed that cleaners have had difficulties to sweep damaged roads. The situation aggravates in rainy season because of water logging. Dhaka's total drainage system is maintained by City Corporation and Water Supply and Sewerage Authority (WASA). In absence of an effective coordination between the two agencies the drains are not cleaned regularly.

All Conservancy Inspectors interviewed have highlighted the legal step needed to stop haphazard throwing of waste. Currently, they can issue a notice or file a case for illegal dumping of waste. Due to lengthy process involved in settling of cases including physical appearance before the court, the Conservancy Inspectors are less willing to file cases. For instance, a Conservancy Inspector did not file a single case in his 28 years of service. They aspire for legal empowerment to impose fines on the spot for breaching waste management related directives of City Corporations. Such empowerment of Inspectors is critical to control waste disposal made by mobile population and road-side vendors since it is difficult to track these people while filing cases or issuing notices. At present, indiscriminate dumping by road side shops and vendors has been one of the prime concerns of City Corporations.

3.3.6 Grievances redressed by stakeholders

A Conservancy Inspector is designated for each ward to oversee the waste management. He/she is the ward specific authority to readdress the problems of cleaners, PWCSs and city dwellers. Multi-faceted interactions among these stakeholders have been observed. Cleaners report their problems (mainly regarding non-cooperation from city dwellers in accomplishing their duties) to the Conservancy Inspector when their attendance is recorded. The Inspector solves cleaners' problems by himself or with the support of Ward Councilor.

City dwellers can make complaints against domestic waste collectors to the Conservancy Inspector over phone and the latter provide necessary instructions to the PWCSs over phone. If such instructions are not taken care of by the PWCSs the Inspector can take several steps including suspension of waste collection permission. Inspectors' directives are generally adhered by the PWCSs. City dwellers can also file complaints about domestic waste collection with PWCSs. Contact details are provided in the monthly payment receipt of PWCSs. Complaints related to waste collection have been solved by summoning the waste collectors, said a PWCSs of DNCC.

3.3.7 Role of stakeholders in building awareness about waste management

City Corporations have undertaken awareness building activities like distributing leaflets, organising rallies and ward meetings, street dramas, and verbal announcements to make the community

conscious about solid waste storage and dumping. The Corporation has tried to develop a ward-based approach for awareness building for the community. In this approach a monthly ward meeting of Corporation's officials with local stakeholders is held in general. The Conservancy Inspectors of respective wards have played key roles in organising such meetings. PWCSPs have distributed waste management leaflets door to door. According to the Conservancy Inspectors, ward meeting and other campaigns have had impacts on changing citizens' behaviour regarding solid waste management. A Conservancy Inspector of DSCC revealed that because of their campaign the road side shop owners in an area of old Dhaka have stopped dumping of commercial waste on the road. Instead they stored waste in polythene, to be collected by Corporation cleaners. However, in absence of ward office and lack of funding, ward meetings cannot be organised regularly, said a Conservancy Inspector of DNCC. Moreover, they have given emphasis on continuity of awareness building activities in collaboration with national and international non-government organisations. The contract given out for mid-islands of roads to various private companies or agencies for beautification in exchange of allowing them a free advertisement has been a successful collaboration of the City Corporation.

3.3.8 Political influence in waste management

The political economy in waste management in Dhaka has been rather complicated. There have been reports indicating stress and strain between PWCSPs and local councilors for the control of waste management in a particular ward. Collusions with PWCSPs are also often heard of.

“PWCSPs are City Corporation authorised organisations and have been experienced in providing services successfully. But if the responsibility is handed over to Councilors, their agents would not care about formal process for permission; they will charge more and provide worse service”

-PWCSP Association Leader

However, Conservancy Inspectors and other officials in general feel comfortable in accomplishing their tasks smoothly in a locality if the elected representatives – ward councilors are active in any ward.

“Councilors are directly accountable to community people and they can maintain the waste management service in a better way through direct supervision. So a better scenario of waste management will be tangible very soon”

– A Ward Councilor, DSCC

3.3.9 Stakeholders' suggestion to improve efficiency in waste management services

The Conservancy Inspectors wish to have more legal powers in order to control indiscriminate disposal of waste. In addition, they have emphasised on setting up at least one secondary transfer station (STS) at each ward to hide waste from public sight, removing illegal parking to facilitate road

sweeping, recruiting new staff and cleaners proportionate toward population and geographical area, and undertaking continued and multi-faceted campaigns to ingrain values on waste management among public. Cleaners demand supply of uniform on regular basis since it provides them a clear identity. They also demand rest rooms nearby work station. Waste collectors put emphasis on safety measures such as mask, boot or any hand gloves.

It is thus clear that interventions at the primary waste generating units are crucial for an effective solid waste management at the primary stage. It also observed that the heterogeneity across various wards created impediment against application of any uniformed policy across the wards under the City Corporations. It is further seen that the local government at the ward level has a very limited role to play in solid waste management especially at the primary stage. Even though some improvement has been reported through the deputation of the cleaners to the ward level and through organising citizens' awareness programmes at the ward level, hardly any step has been undertaken so far to adapt a decentralised form of governance for solid waste management in Dhaka.

4

Secondary and Tertiary Waste Management

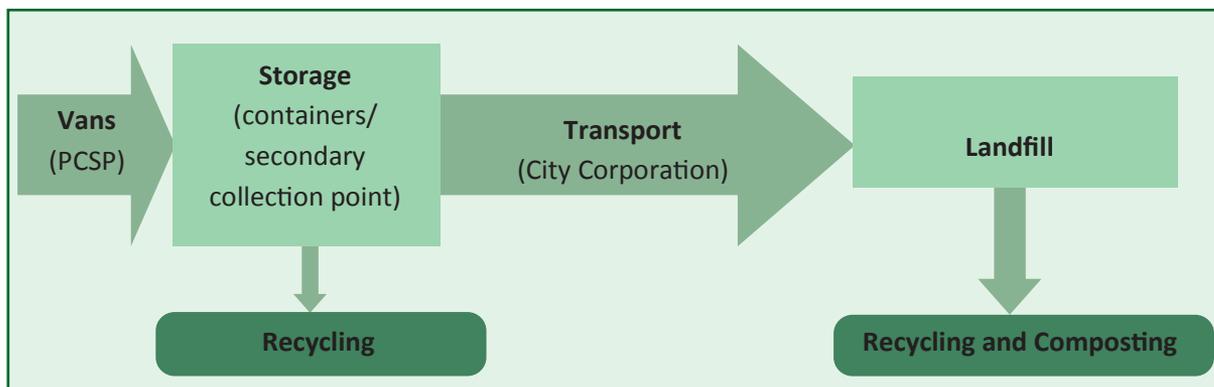
4.1 Introduction

Secondary waste management is the second stage of solid waste management. Secondary waste management involves the collection from secondary collection points and other secondary waste storage premises and onward transport to disposal site (World Bank, 2012). The synchronisation between the generation and disposal of waste is the deciding factor for clearing of waste. The secondary waste management is the subsequent stage of disposing waste after primary collection. This chain originates from the storage containers and terminates at the landfill (see figure 4.1). The final stage of solid waste management is the tertiary waste management. This stage is usually ignored by different stakeholders and it is mainly active through the support from private and informal sectors. The tertiary waste management involves recycling of waste (both organic and inorganic). As there is no formal recycling activity by the government, it is entirely done by the informal sector and the informal sector is solely responsible for any recycling of waste done in the city. However, the informal recycling sector is yet to be properly recognised by the formal sector for its immense contribution. There is thus a need for appropriate incentive to improve the efficiency level of both secondary and tertiary stages.

The focus of this chapter is to study in detail the mechanism of SWM at the secondary stage. Various approaches were used for the purpose. They are key informant interviews (KII), focus group discussions (FGD), 24 hour information tracking and official data collection from City Corporations. Data on infrastructure (container, truck and others) and landfill have been collected from both DSCC and DNCC. For in-depth study of the stages, interviews with players and group interviews with the associated stakeholders were organised. In total twenty-five KII and FGDs were conducted for this purpose. The numbers of KIIs conducted are the following: DSCC officials - 2, DNCC officials - 2, Local Governance Division - 1, Department of Environment - 1, Waste Concern (NGO) - 3, *Bhangari* - 5 and recycling markets - 7. The FGDs were conducted at landfill with scavengers and *Bhangari*.

The existing solid waste management chain in Dhaka City is as follows:

Figure 4.1: Secondary and tertiary waste management



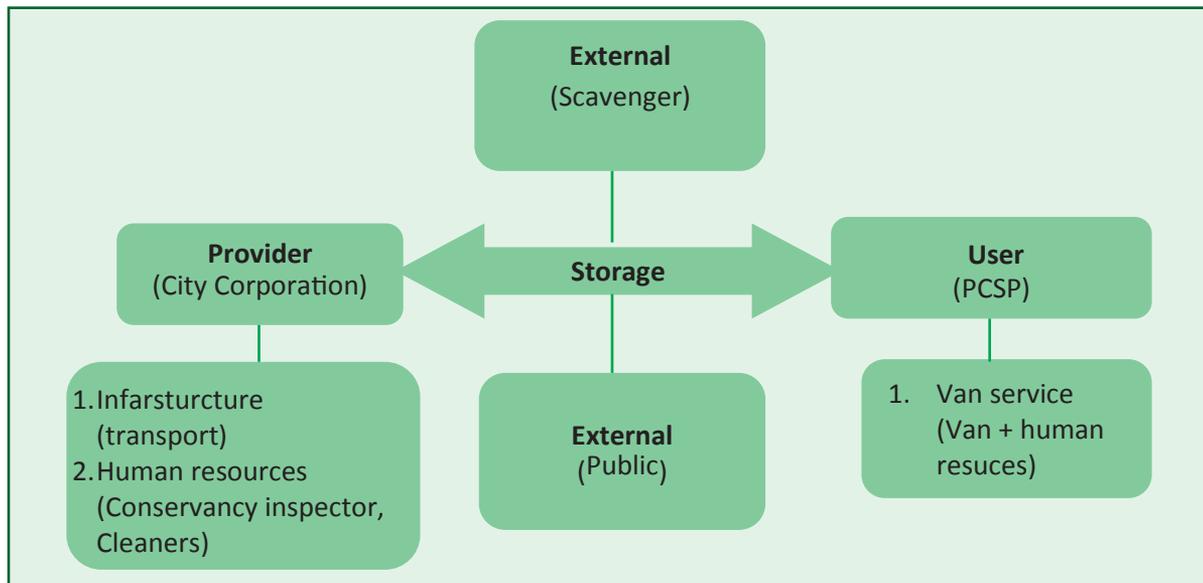
4.2 Storage of Solid Waste

In Dhaka City, wastes are disposed in containers by van services and by households in absence of van services and cleaners. City Corporations, subsequently carry these wastes with their trucks (covered or open). The wastes are then transported to the dumpsites. All wastes are supposed to be placed at the containers by the van services between 6pm and 10pm (as per contract between City Corporation and PCSP). It is expected that the waste would be collected and transported to the landfill site without much delay. From our KIIs and FGDs it was found that van services are operational throughout the day. So the waste remains in the container for a longer period and waste spilling over and around the container site is widely noticed. The reasons in addition to the earlier ones, might be the unsuitable location of containers, over-dumping, inappropriate ways of dumping etc. Many containers are not located in suitable places. For example, in Victoria Park of the city (in DSCC) only one container is there - due to lack of space in Ward-36, this ward's wastes are dumped in neighbouring wards' containers. Not only the waste bins are placed haphazardly, quite often these are situated at the most unsightly places, with garbage scattered all around. The roles of waste pickers (*Tokai*) and vanmen are immense at these particular sites. The problem is aggravated by the height of the containers creating inconvenience in disposing waste. In particular, the female workers have real difficulty in dumping waste at these containers. The open trucks often carry waste without appropriate coverings resulting in indiscriminate dropping of waste.

In Dhaka City, the wastes are dumped in three styles – concrete container site, steel containers site and open space. Even though open space dumping and concrete containers were the major sites for storing waste, they are less common now-a-days. Dhaka City Corporations have been demolishing such containers out of environmental concerns.

4.2.1 The stakeholders involved in storage of waste

The stakeholders in the storage phase are the providers and users of waste storage facility including aggregator of waste for storage (PCSP, cleaners), and the recyclers and the general public are directly or indirectly affected by the process. The process diagram is shown below.

Figure 4.2: Stakeholders at storage sites

The providers of the storage are the two city corporations, Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC). City Corporation provides truck services and conservancy inspectors (CI). The CI monitors the operation of containers including loading and unloading.

Primary Collectory Service Provider (PCSP) van services collect waste from households and dump to containers/dustbins. Even though the official operation time of these van services are between 6pm and 10pm, it has been informed that the service continues from 10 am to 5 pm in most of the wards. Absence of timely clearance causes difficulty for the public in general.

4.2.2 The problems of storage

According to the DSCC officials and PWCSPP president, vanmen, the dominant players in waste collection face the following major problems while dumping waste:

- Most households do not allow operating after 6pm due to security reasons.
- One van has to collect from a large number of households. The stipulated timeframe is not sufficient.
- The container sites do not have proper lighting system which makes it difficult to dump waste at night.
- The height of containers is quite high as mentioned earlier. So often the vanmen cannot dispose the waste directly and resort to unloading the waste on the roadside before manually uploading them into the high containers.

4.2.3 Secondary transfer station

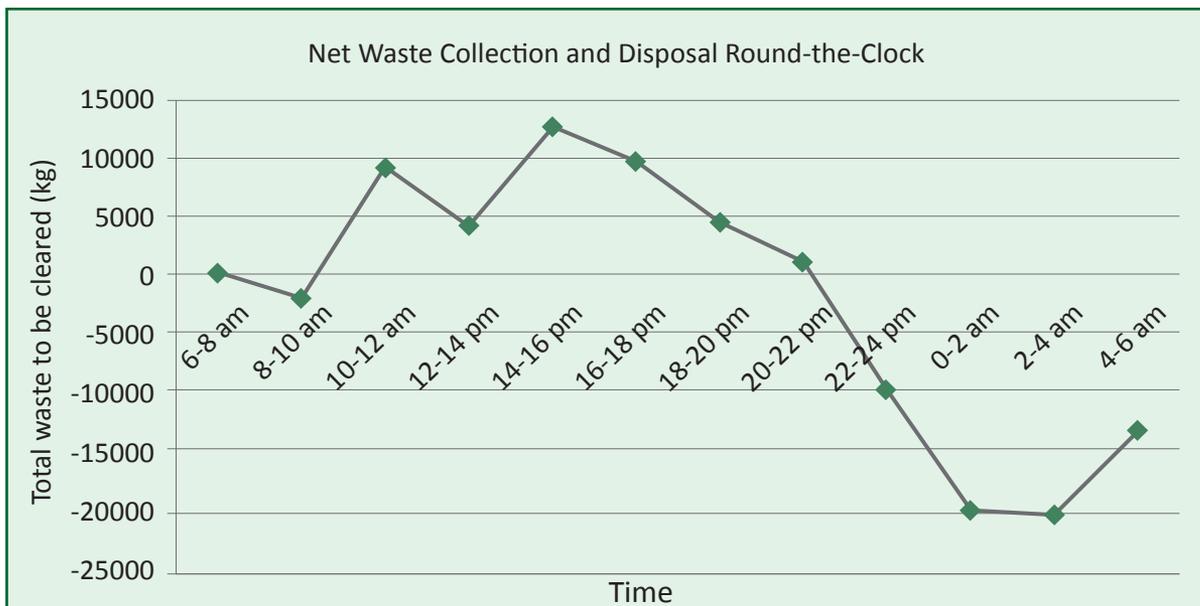
In 2010, to assist City Corporations in improving the standard of public health and environment, Local Government department had initiated a project with financial and technical support from Asian

Development Bank (ADB). The project aimed at building secondary transfer stations (STS) in both City Corporations with the expectation to reduce congestion and environmental pollution. Initially it was decided that seven STSs in DSCC and five in DNCC would be built. However, there were obstacles to establish the transfer stations. Constructions of STSs were resisted in many areas by local residents and environmental activists in fear of possible health hazards. The local councillors have been helping City Corporation in primarily locating station sites. DSCC managed to allocate seven locations and DNCC failed to allocate any place for STS till date. From the discussion with additional secretary of Department of Environment (DOE), it has been revealed that two of the running stations were stopped in the middle due to a court order in 2014. Even though constructing STSs are crucial in SWM of Dhaka, it has been undergoing an unexpected slow pace.

4.3 Transport of Solid Waste

City Corporations provide truck services to collect container wastes. There are three types of trucks operating in the container sites – open trucks, container carriers and compactors. Container carriers transport the containers to landfill sites and operate at night time whereas open trucks operate throughout the day. Container carriers are expected to collect the containers from 10pm to 8am in order to avoid traffic problems. The overloaded containers create difficulty in transportation. The movements of trucks are controlled centrally from the zonal offices. There is no evidence to show that the movements of trucks have any relation with the demand of the container sites. In absence of computerised data, it was not possible to understand the dynamics of truck movement and its implications.

Figure 4.3: Coordination failure: disposal vs collection of SW



Note: Total waste to be cleared = Total waste arriving at the container station (kg) -Truck Capacity (in kg)

It is often observed that the waste remains un-cleared at the container sites (Annex Table 4-4) for a longer period of time. From the information table, it is spotted that the trucks in general operate for the whole day, except from 6 pm to 10 pm. The vans dump the waste throughout the day from various sites, except from 4-6 am. From the household survey it has been found that the wastes are collected from households during 8 am to 2 am. Thus there is a huge time gap between collection and disposal over a day (see Annex Table 4-4). The figure above observes the failure of private public coordination and absence of demand driven clearance system. When additional trucks are required only few arrive and at times trucks arrive when adequate wastes are not collected. This coordination failure takes place on 5 occasions in a day.

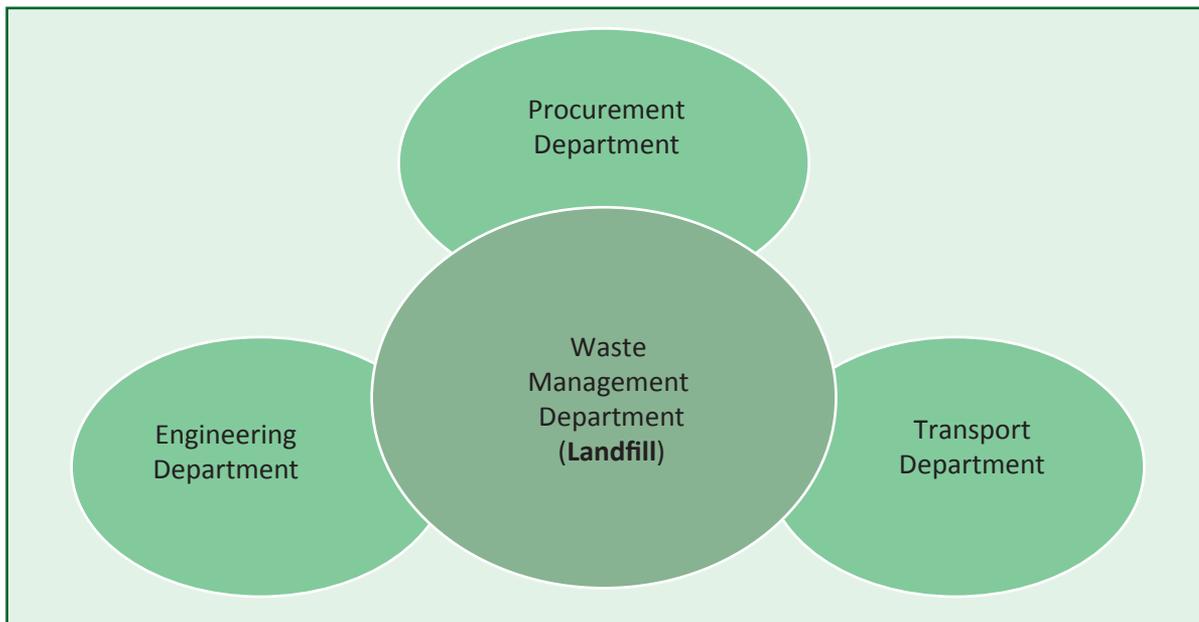
4.4 Landfill

The final disposal of solid waste is done in landfill sites. From the containers the wastes are transferred to landfill sites. Landfill sites are depository of the final residuals of solid waste after recycling, re-use or reduction. Landfills of Dhaka are usually situated outside the city boundary. Hai and Ali (2005) mentioned that the landfills of Dhaka are also situated far away from the centre because of the scarcity of land. This also increases the transport cost of disposing wastes. In Dhaka, Matuail is the sanitary landfill of South Dhaka and Amin Bazaar is the landfill of North Dhaka. Currently, the construction of a sanitary landfill is going on in Amin Bazaar landfill. The sanitary landfill is a result of the initiative by JICA. In the Sanitary landfill, the wastes carried by the truck are measured first and then they are dumped at the dumping platform. Subsequently, the trucks are unloaded using excavator and manually. Finally the bulldozers compact the waste at the dumping platform.

In Dhaka City, out of the two main landfills, Matuail Landfill is a semi-aerobic landfill, where methane-dioxide, oxygen and odorous gases release through pipes, so the smell of the landfill is less toxic. Matuail Landfill is under Dhaka South City Corporation, which consists of an area of about 40 hectares. JICA had stated in the master plan that out of 40 hectares, only 20 hectares area were still unused in 2005. The DSCC official confirmed that at present all the lands are covered in waste and by 2017 the capacity of dumping will be exhausted. Currently they are dumping the waste adopting pyramid method (having a slope of 1/3). The records of the trips by trucks are documented in a computer system at Nagar Bhaban (Central office of DSCC) to understand the truck movements. They have garbage bracket to prevent the trucks from slipping into the water in the rainy season. Amin Bazaar is an open dumping landfill at the moment. Even though the work of sanitary dumping site is going on, Amin Bazaar is expected to be fully exhausted and sealed by 2017. The total area of Amin Bazaar is 20 hectares and a mere 50 acre area is left for use.

4.4.1 Stakeholders of landfill

The stakeholders of landfill sites are shown in the following figure.

Figure 4.4: Stakeholders of landfill

Landfill section under the waste management department frequently deals with three departments:

- Waste Management Department – The landfill officials undertake management and the maintenance of the landfill sites. The salaries of the landfill employees are disbursed by human resource department.
- Transport Department – All modes of transport, bulldozer and other equipments and their support staff like drivers, helpers, operators are controlled by the transport department. The landfill section sends the requisition for vehicles and others to the transport department.
- Engineering Department – This department deals with renovation, repairing or related mechanical help (e.g. related vehicles, landfill platform) on the basis of requisitions.
- Procurement Department – If the landfill section needs to buy any assets for the management of landfill, they send the requisition to procurement department.

4.4.2 Problem of landfill

It is observed that the landfill section faces some difficulties in coordinating with these three departments. However, since 2009 things have improved as the Chief Conservation Officer was introduced in the new Waste Management department, who is empowered to coordinate the work.

Plan for future landfillsites

In place of existing Matuail Landfill site, the authorities plan to explore a new landfill site besides the current one as the capacity of existing one is going to be exhausted in near future. The process of land acquisition has started and it is expected to be complete by December, 2015. It might take 2-3 years

to start full scale operation of waste disposal site. The prices of acquisition of lands range from 103,000 taka to 1250,000 taka per decimal land.

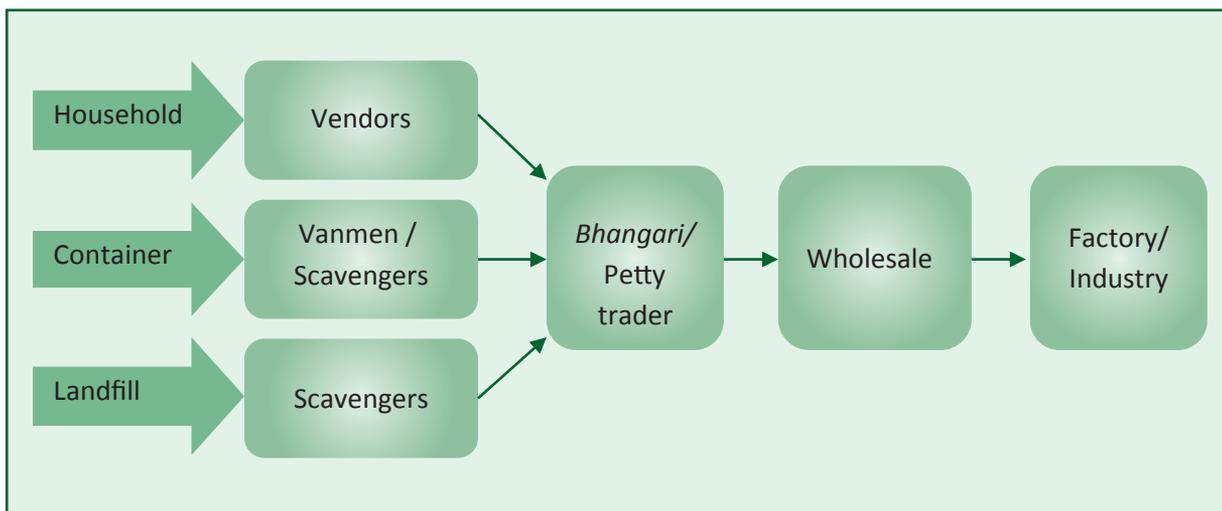
Exhausting the resource of the existing landfill site for sustainable environment

There is a plan to generate Refuse-derived Fuel (RDF) from the wastes of Matuail after the closure of the landfill. Independent companies like B&F Company had given proposal to generate RDF from the landfill waste. It was reported that due to financing problem the project failed. It has been estimated that approximately 1000 tonnes RDF can be produced from the current landfill. After the generation of RDF it is possible to reclaim the land. After reclaiming the land, the authorities plan to transform the land by leveling the waste using sufficient compacting. The land will subsequently be covered with soil and gas ventilation pipes to purify the polluted gas present. The final plan is to convert the landfill site into a park. On the other hand, there is no plan for Amin Bazaar at the moment.

Recycling

Recycling is termed to be the tertiary stage in which inorganic waste is recycled. The tertiary waste management of Dhaka City is mostly done by private organisations, waste pickers and vanmen. The waste pickers search for the recyclable items from the containers and landfills. These waste pickers collect the recyclables and sell them to *Bhangari* (the petty traders), *Bhangaris* inspect the materials which have scrap values. Subsequently, they sell it to *Mohajans/ Paikar* (wholesalers), who clean up the materials and sell them to different factories. These factories use the recyclable substances as raw materials and after some processing. The final products are sold in enlisted local markets. The scheme of recycling process is shown below:

Figure 4.5: Stakeholders of recycling



Vanmen directly collect recyclable items from waste bin of households or containers and sell them to the *Bhangaris* (petty traders). They do the initial sorting of waste collected from the households. The

items collected are almost at free of cost and the volume is around 5 to 15 kg of recyclable materials per day. The recyclable materials they collect are paper, glass, metals and plastic bottles. On an average, they can earn around 150-300 Tk. per day. Similar to vanmen, waste pickers or scavengers also collect similar recyclable items from containers.

The waste pickers operating in landfills risk their lives to search for new products from freshly dumped waste to get the best value after recycle. They usually work for 5-6 hours during the time the trucks arrive. They sell the recycled items to the *Bhangaris* near the landfill. They do not have any formal contract with *Bhangaris* and landfill authority or other waste pickers. The system is run informally. Usually they collect plastic, medicine bottles, plastic bottles, glass bottles, broken glass, rubber, iron (tin/steel) and milk packets. They sell the products to vendors. Vendors are the people who buy recyclable materials from the households and do not have a fixed shop. They buy the better quality recyclable products. The items they buy are iron, papers, plastic, newspapers, silver, copper and broken glass. They sell the products to *Bhangaris*. *Bhangaris* are the people who have localised shops. They buy the goods from vanmen, scavengers and vendors. They inspect the materials to identify goods with scrap values. They buy plastic bottle, silver, plastic, Mulom (raw material), glass bottle, broken glass, sandal, milk packet and iron (steel/tin). *Paikar* or *Mohajans* (Wholesalers) are the agents or middleman who buys the recyclable goods from *Bhangaris*. They clean up the materials and sell them to the businessmen outside. Factories buy the materials from these agents and process the materials for selling in the final market. The table below indicates the value addition for recyclable products at various stages. Thus a huge market for recycle (in both size and employment potential) exists in Dhaka City.

Table 4.1: Value chain of recyclable products

Items	Vendors	<i>Bhangari</i>	<i>Paikar/Mohajan</i> (Wholesale)	Factory/Industry
Paper (Clean)	15	15-20	22	23-25
Newspaper	15-17	18-20	21-25	24-30
Paper (Dirty)		5	7-8	9-10
Plastic	20	20-25	26-50	30-100

Composting

Waste Concern is one of the NGOs that have been composting organic waste of Dhaka. In 1995, Waste Concern started with a 5 tonnes per day capacity composting plant. Later in 2008, they scaled up the composting operation and opened a composting plant following the Clean Development

Mechanism (CDM) act. Waste Concern has two Dhaka based composting plants: Bulta plant with capacity of 130 tonnes of solid waste per day, and Kachpur plant with seven tonnes solid waste per day.

Around 70-80 percent of the total wastes of Dhaka are organic in nature on an average (JICA, 2015). However, 20 percent of the organic wastes are non-compostable and the rest (mainly vegetable wastes) are compostable. Chicken or other meat wastes have a slow decomposition rate. The later is thus suitable for production of bio-gas and refuse-derived fuel (RDF).

It has been mentioned on several occasions that small scale and large scale composting is feasible in Dhaka. According to Waste Concern, large scale compost plant should be decentralised and small scale compost plant should be internalised as far as possible. Medium scale community based composting has not been feasible in Dhaka City so far as there is a scarcity of land. The figure below shows the involvement of different stakeholders in the process of composting.

Figure 4.6: Stakeholders involved in composting



In Dhaka City, NGOs (like Waste Concern) produce compost in medium and large scales. Small scale composting is done in the slum areas. In slums, usually barrel composting techniques are applied. Department of Environment, under the 3R piloting project and through the efforts of NGOs like Swisscontact, imparted training on the techniques of composting. Waste Concern alone does not have the capacity to store and to distribute the compost across various regions of the country. So they use marketing agents such as ACI. ACI help them to build the market for compost by creating awareness among the farmers. They have already managed to create awareness in north Bengal for compost and there is a vast growing market for compost. In Dhaka, only some nurseries buy fertilisers in general. However, farmers outside Dhaka City are the main consumers of compost.

4.4.3 Challenges of composting

The compost production and marketing faces different types of problems. The challenges faced by the production side are:

- Less awareness among citizens about the advantages of composting. Demand driven production has not been observed.
- Government gives subsidy to chemical fertilisers capping the price level at 15 TK. per kg. On the other hand, the organic fertiliser (which in fact is environmentally better suitable) has not received any subsidy and price is levelled at 20 TK per kg. This unequal emphasis needs to be addressed.
- The carbon credit price has fallen from \$17 USD to \$0.50 USD recently. The incomes of the concerned companies have decreased by 30 percent creating impediments for production of organic fertiliser.
- The transport cost for carrying waste and distributing organic fertilisers cover about 50 percent of the total cost.

From the marketing point of view, the following challenges are faced:

- Inorganic fertilisers do help in bumper growth of the crops in a very short run. Organic waste could not compete so far to change the mindset and thereby promoting environmental friendly production system.
- Inorganic fertiliser in general is provided on credit. On the other hand, market for compost does not allow supply on credit. This imperfection in the credit market is noteworthy.
- Promotional activity has not been taken up in a large scale for creating market for organic fertilisers.

4.4.4 Opportunities for composting

It is an appropriate time to make use of opportunities to take up composting in a significant manner. The following are the details:

- Household organic waste is an excellent raw material for composting.
- There is an increasing demand in north Bengal and India for compost.
- Barrel composting in slums is very convenient as very little space is required for the purpose.
- Many nurseries have been increasingly using organic compost for their own farms.
- City Corporation has a plan to start a composting plant at Matuail landfill. The capacity of the composting plant at Matuail landfill is proposed to be 20 tonnes per day. This initiative has been undertaken in line with the 3R policy project.
- The expected outcome and advantages in the future, out of this composting plant:
 - o Create new jobs for urban poor (including waste pickers)
 - o Produce 0.20 – 0.25 tonnes of good quality compost for agriculture

- o Reduce 0.5 tonnes of GHG emissions
- o Produce 40 – 80 cubic metres of bio gas (clean energy which can be used for cooking purpose or electricity generation)
- o Save 1.1 cubic metre of landfill area
- o 2000 – 3000 citizens would be benefited from improved waste collection
- o Saving the production of between 0.2 – 0.3 cubic metres of water from pollution

From the above discussion it is clear that there is a complicated waste management chain in practice. The efficiency of the system depends on citizens-government initiatives in order to develop a sustainable environmental friendly waste management system of Dhaka city. The need to integrate the informal sector and adapt a localised form of monitoring and operation is felt over and again.

5

Concluding Remarks and Recommendations

5.1 Concluding Remarks

The present study describes in brief the scenario of SWM in Dhaka City. The work undertaken by several national and international organisations so far have been reviewed in this context. It is observed that literature available on this particular area especially in the context of Dhaka is very limited. Also, research studies involving a holistic approach towards SWM are yet to be seen. A comparative statement with the current estimates from the present study is given below.

Table 5.1: Comparative scenario: BIGD and other studies

Waste (tonnes per day)	Composition of waste	Results from different studies				
		JICA (2005)	Waste Concern (2005)	BIGD (2015)	City Corporation (2015)	JICA Projection 2015
Source-wise Generation	Domestic	1950		3070.71		
	Business/commercial	1050		1983.92		
	Street	200		1055.83		
	Others					
Total Generated		3200	4866.50	6110.47		4624
Collected by City Corporation		1400			4643	
Per Capita Waste generated		0.34	0.41	0.38		
Collected waste as percentage of generated		43%		75.98%		

- BIGD (2015) estimates are based on population projection using BBS 2011 population.
- JICA (2005) estimates for waste generation (commercial and street) used to determine the volume of waste of the respective category.
- The estimates of Waste Concern (2005) were based on separate definition of waste and covered different geographical area.
- In estimating the volume of waste, seasonal variation is not considered.
- Data Sources: JICA (2005), Waste Concern (2005).

The current study, in a limited scale, has tried to focus on the comprehensive SWM of Dhaka City taking note of most of the stakeholders involved in the process. While it was understood that the domestic sector is a major contributor of SW, the study has given additional focus on households as the primary generator of SW. The results are based on a representative sample. The studies with other stakeholders were based on FGD and KII due to limited time allotted for the study.

Some key findings are as follows:

- Per capita waste generated by HH under Dhaka City Corporation amounts to 0.38kg.
- Major sources of waste generated are from fruits and vegetables (52.2 percent of total domestic waste).
- The seasonality of SW generation is a matter of concern. About 62 percent HHs reported an increase of waste during the period March-June.
- In-house SWM has been an ignored area of study so far. It is observed that 63 percent adopts the segregation process through multiple bins inside the house. About 70 percent of households segregate waste before disposal. This gives some idea about the size recyclable goods.
- The segregation process of SW in-house as practiced by the HH requires special attention for policy intervention.
- Female HH members play a lead role in waste disposal. About 43 percent HHs have confirmed this in this study.
- More than 80 percent of HHs enjoys door-to-door van collection services. Unfortunately about 13 percent of the HHs in the sample disposes waste directly in open space.
- There is a wide variation of payments (from BDT 50 -150 per month per HH) made by HHs within and across the wards. The door-to-door services have gained popularity over time. A significant jump has been observed between 2000 and 2005. This might be due to the interventions undertaken by City Corporation and others. The time of collection varies widely within across the wards. It starts from morning at 6am and continues up to 12 at night. Individual preference maps for all wards reflected that the convenient time for door-to-door collection in general is, during 10 am-2 pm.

- The grievance readdressed mechanism not know to a significant portion of population (about 19 percent of total population)
- From the perception of the HHs, it is observed that about 43 percent of the HHs feel that the roads and the open spaces are cleaned on daily basis.
- About 37 percent HHs recommend that improved timing for door-to-door services and coverage would change the system of SWM.
- From the KII and FGD, it is evident that the contract and incentives of waste collectors vary widely across wards. The role of waste collectors in recycling needs more attention.
- The involvement of local government in SWM has been very limited. However, anecdotal evidence suggests that the involvement of wards in activities like cleaning and awareness building have resulted in great successes. It is rather impossible for the city corporation to implement any tailor-made policy for each and every ward which otherwise found to be heterogeneous in many respects.
- The duties of city corporation cleaners also vary from ward to ward. The mechanism of control by the Conservancy Inspector is not clearly understood. The difficulty of constructing container station and allied problem of waste collection by containers and truck has been pointed out in details in this study. A coordination failure between the waste disposal and the collection at container stations has been highlighted. This has been possible through round-the-clock information tracking undertaken during the study. It has been observed that waste remain unattended at the container site for a significant time.
- Detailed data on transportation of SW could not be retrieved from any source, thus study could not capture the movement of trucks in details. However, the study indicates movement of trucks in a routine manner without considering dynamic demands of the container stations.
- Detailed data on land filling were not available as the database is systematically not made available in the public domain. The limited interaction with the stakeholders made it clear that new land filling sites should be explored without any delay.
- The activities of the stakeholders in recycle market (vendors, bhangari, paiker/mohajan and factory) have been studied in some details. Attempts have been made to construct a value chain for selective recycled products. The profitability and the size of the potential market draw attention to revisit the informal sector and address the market failure. 27.83 percent and 25.33 percent respondents mentioned that they do not sell the plastic and glass respectively due to market shortage.
- In this study, it has been pointed out that a small investment (in terms of transporting organic waste to the composting centre and providing subsidy to promote organic fertiliser) would divert a significant portion of SW for composting saving thereby the disposal at the land filling site to some extent.

- The macro picture indicates the existence of inter-ward disparity in terms of area, population density, infrastructure, tax collection, waste generation and collection and timing of operation (Annex Table 2-2 mentions the details). This raises an important question on the model of governance to be adopted for solid waste management.

The results from the study indicate the need for a reform of the existing systems of SWM in Dhaka City. At the micro level, from the household survey the waste collection and delivery procedures along with perceptions have been narrated in some details. The KIIs and FGDs (though conducted in a very limited scale) indicate the need to address some of the pertinent problems of various stakeholders. At the macro level, the estimates from the study along with data provided by city corporation reveals the wide variation across wards under both the city corporations. A change in the existing structure and function of governance relating to SWM is upheld as a timely demand.

While the city corporation is a major decision maker of whole Dhaka City, it might be difficult to monitor and enforce efficient management systems in the wards with so much diversity. The ward committee with limited function has not been able to achieve much head way in this direction because the problems have been at the micro level and localised in nature. Thus there is a felt need for decentralised governance for SWM at ward level. Questions might arise about the possible role of City Corporation under this decentralised structure of governance. City Corporation might be empowered as a regulator to frame appropriate policies for the wards with regards to SWM and develop an effective competition across various wards.

It was also felt the database (if already computerised) should be released in the public domain to increase transparency for efficient functioning at the land filling site. Application of technology and information released in public domain might be considered.

5.2 Recommendations

- Decentralisation of SWM at the ward level (especially for enforcement and monitoring of day to day activities of SWM): looking at some success story related to engagement of staffs and infrastructure at the ward level, it might be prudent to recommend devaluation of power for effective SWM and to address the heterogeneity existing at grass root level. Appropriate capacity to be developed at ward level in phases for this purpose.
- In this connection, rationalisation of rates for door-to-door collection is expected to improve the existing system.
- The rationalisation of timing of waste collection and disposal is essential for effective SWM at ward level. In this connection, appropriate technology to be adopted to address coordination failure at the container stations (if any) considering the dynamic nature of demand at the container sites. GPS, mobile and other available technology might be adopted for monitoring and enforcement.

- To encourage recycling, the informal market might be institutionalised as far as possible. Identification of the stakeholders and enlisting them subsequently might help to generate employment and effective network.
- The traditional segregation method existing at the household level must be encouraged.
- To encourage composting, Government intervention is expected to play a significant role. Unless and until a self supporting revenue model is evolved, contribution from the government in the form of subsidy might be essential.
- Periodic reviews on SWM in short and long terms should be undertaken at regular intervals.
- NGOs can be partners in citizen awareness campaign.

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Annex

Annex 1

Annex 1-1: Stages

Step 1: Different municipal wards in two City Corporations of Dhaka, North and South, were segregated based on density of population (high, middle and low).

Step 2: Out of 93 wards, 12 wards to be selected for the study considering the time and budget constraint. 12 wards cover 12.9% of sample.

Step 3: Sample Size for each group (High, Medium and Low) = Number in each group divided by total number of wards

Let n_1 , n_2 and n_3 be the no. of high, medium and low wards respectively.

Let, no. of sample wards to be selected in High density ward group (N_h) = $n_1/n_1+n_2+n_3 * 12$

Similarly N_m and N_l were selected for medium and high density. In all, 6 wards from each City Corporation were selected. Some minor adjustments required while rounding off the ratios. From the selected wards individual's houses were selected from the list available from City Corporations. Further, the oldest living households in the houses were chosen for the sample.

Annex 1-2: Questionnaire

Questionnaire is available in BIGD website: www.bigd.bracu.ac.bd/

Annex 2

Table 2-1: Yearly budget of DSCC and DNCC

Sectors	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Salary	150	185	40	95	192.81	283.72	315
Power	60	61	20.8	49	84.82	114.99	115.5
Maintenance and Operation	16	13	4.1	7	18.21	23.6	52
Mosquito control	16	14	4	7.5	9.98	18.1	26.5
Supply	36	41	13.75	26.45	26.83	45.72	57.98
Rent, tax	2.65	2.65	0.8	1.7	6.58	6.32	13.3
Welfare exp.	5	5.8	1.9	2.75	4.92	9.9	21.9
Visit	0.1	0.1	0.15	0.03	0.1	0.1	0.15
Postal	0.5	0.5	0.2	0.15	0.4	0.31	0.4
Hostility & festival	2.3	2.3	0.7	1.95	1.34	1.75	2.4
Benefit	0	0	0	0	0	0.05	3.1
Addvertisement	1.8	2	0.5	1.25	2.12	3	9.5
Fees	2.9	6.5	4.8	4.5	4.79	7.65	13
Training & contribution	2	1.35	0.5	0.5	0.77	2.51	3.85
Insuarrance_Insuarrance	0.9	1	0.4	0.31	0.24	1.4	1.8
Waste management	7.3	8.8	2	2.8	18.3	16.7	24.6
Uprooted activities	0	0	0	0.07	0	0.15	0.55
Miscellaneous	3	2	0.5	2	2.55	3.25	3
Other exp.	21.25	19	7.1	8.6	36.44	42.58	85.2
Development exp.	587.86	1009	892.34	1012.34	1167.66	1638.59	2779.58
Closing status	55	60	15	15	103.55	148.55	158

Table 2-2: Wardwise variation of population, waste generation, waste collection and tax collection in both City Corporations

Ward No.	Population in thousand	Total Capacity (Tonnes Per Day)	Total Collected Waste (Tonnes Per Day)	Total Tax Collection (Lakh Per Year)
1	73.72	60	44	320.69
2	13.46	18	15	291.12
3	23.38	24	21	58.72
4	46.08	45	42	251.27
5	43.19	31	25	159.04
6	38.44	36	30	152.90
7	50.83	35	18	73.10
8	43.72	18	18	104.27
9	275.55	137	99	1508.09
10	308.40	80	44	102.86
11	97.39	69	57	168.77
12	84.58	51	51	208.40
13	113.60	80	13	669.76
14	125.47	191	48	397.64
15	307.43	263	100	2323.03
16	98.47	93	70	667.73
17	58.99	41	70	726.14
18	259.93	152	78	657.61
19	354.38	234	75	1087.49
20	631.82	285	95	497.61
21	391.69	155	60	398.75
22	62.12	62	54	122.77
23	53.71	31	35	163.45

Ward No.	Population in thousand	Total Capacity (Tonnes Per Day)	Total Collected Waste (Tonnes Per Day)	Total Tax Collection (Lakh Per Year)
24	58.61	46	42	98.11
25	73.81	26	30	86.57
26	140.70	74	52	142.04
27	148.44	50	35	158.30
28	185.48	54	35	165.91
29	91.62	63	54	127.36
30	605.12	42	60	264.46
31	194.76	82	31	147.86
32	126.52	54	33	198.85
33	163.44	126	76	140.14
34	250.10	149.5	65	232.98
35	223.23	74	47	134.22
36	168.09	52	34	253.95
37	258.68	55.5	47	217.25
38	238.61	130	78	209.62
39	57.46	26	35	188.81
40	149.55	82	38	117.78
41	171.10	82	43	186.79
42	103.27	34	31	130.76
43	88.83	42	52	128.07
44	83.59	18	18	60.39
45	77.27	46	34	115.44
46	71.51	34	22	72.29
47	45.85	26	21	97.57

Ward No.	Population in thousand	Total Capacity (Tonnes Per Day)	Total Collected Waste (Tonnes Per Day)	Total Tax Collection (Lakh Per Year)
48	79.29	55	43	127.29
49	73.62	53	35	77.18
50	117.86	79	42	163.81
51	102.51	84	48	125.84
52	25.05	13	16	63.16
53	91.94	64	28	83.21
54	95.32	75	45	96.39
1	87.78	190	190	2636.96
2	20.08	36	36	416.87
3	25.94	29	36	232.13
4	34.89	31	31	128.03
5	28.68	40	40	133.52
6	25.34	49	37	555.29
7	49.88	67	52	475.43
8	38.82	51	51	216.95
9	14.26	12	42	111.16
10	47.22	49	56	187.65
11	5.24	6	56	315.52
12	32.70	45	40	426.84
13	30.17	56	48	500.46
14	20.68	40	40	651.90
15	12.67	26	26	172.41
16	44.01	74	58	431.01
17	21.55	50	50	716.84

Ward No.	Population in thousand	Total Capacity (Tonnes Per Day)	Total Collected Waste (Tonnes Per Day)	Total Tax Collection (Lakh Per Year)
18	133.12	100	100	840.16
19	166.23	189	189	5474.10
20	54.55	60	60	794.55
21	61.68	70	70	482.81
22	19.55	37	37	487.86
23	33.20	25	25	316.79
24	41.00	50	50	812.49
25	45.86	54	54	227.01
26	165.94	133	145	1425.24
27	63.83	68	56	737.37
28	44.92	35	35	198.30
29	58.79	38	38	263.38
30	30.86	68	62	657.29
31	85.70	52	52	385.61
32	104.45	90	50	554.68
33	152.32	54	49	563.90
34	36.56	46	46	248.36
35	48.02	42	42	447.36
36	44.14	37	37	232.04

Note: we ignore 55, 56, 57 no. wards in DSCC because of information gap.

Annex 3: Waste Management: Primary Stage

Table 3-1: Daily waste generation by households with different levels of education

Highest education level of households	Illiterate to class VIII	Class IX to XII	Above higher secondary	Total
No. of households	60	170	370	600
Percentage of households	6.22	25.87	67.91	100
Total waste generation (kg)	65.7901	273.790	718.763	
Average per capita waste generated by the group (kg)	0.262	0.351	0.409	

Table 3-2: Daily waste generation by households across different expenditure groups

Amount of household expenditure (in BDT)	Low (up to 20000)	Medium (20000-40000)	High (40000-60000)	More than high (above 60000)	Total
No. of households	180	236	113	71	600
Percentage of households	22.25	37.15	22.27	18.33	100
Total waste generation (kg)	235.535	393.148	235.677	193.983	
Average per capita waste generated by the group (kg)	0.33	0.371	0.414	0.464	

Table 3-3: Daily waste generation by households with different sources of income

Source of income	Formal (Govt., pvt., pensioner)	Informal (Unemp., agri., day labour)	Self-employment and others	Total
No. of households	270	17	313	600
Percentage of households	41.34	1.94	56.72	100
Total waste generation (kg)	437.487	20.523	6000.334	
Average per capita waste generated by the group (kg)	0.354	0.258	0.405	

Table 3-4: Details of waste generation by self-employed

	Large Scale Business	Medium scale business	Small scale business	House rent
No. of households	50	142	47	74
Percentage of households	20.59	45.54	10.71	23.16
Total waste generation (kg)	123628.57	273395.71	64257.14	139052.86
Average per capita waste generated by the group (kg)	0.477	0.388	0.322	0.441

Table 3-5: Reasons for using multiple bins

Reasons	No. of household	Percentage of households
Easy to use	234	63.24
Less time	44	11.89
Easy to Clean	72	19.46
Non response	20	5.41
	370	100

Table 3-6: Acknowledgement of necessity for using and not using multiple bins and reasons

No. and percentage of households	Reasons	No. of households	Percentage of households
Yes: 68 (20.61%)	Easy to Use	59	17.88
	Less time	17	5.15
	For Sale	2	0.61
No: 62 (79.39%)	Less family member	54	16.36
	No need	183	55.45
	Have large bin (enough)	9	2.73
	Lack of enough space in the house	54	16.36

Table 3-7: Reasons for not taking door to door waste collection service

Multiple answers	No collection service	Irregular collection service	Costly collection service	Others	Don't know about service
No. of households	40	18	13	27	9
Percentage of households	50.63	22.78	16.46	34.18	11.39

Table 3-8: Intervals of door to door waste collection service

	Daily	One day interval	Two days interval	No fixed day	Others	Total	Not applicable
No. of HH	452	30	28	9	2	521	79
Percentage	86.8	5.8	5.4	1.7	.4	100	

Table 3-9: Variation of payment for waste collection services across different wards

	Payment per month				Total	Not applicable
	Up to 50 BDT	BDT 51-100	101-150	151 and above		
Lalmatia	8	23	13	4	48	79
Mirpur	20	27	1		48	
Gabtole	22	17	1	1	41	
Kawran Bazaar	15	22	5	8	50	
Gulshan	1	4	13	31	49	
Badda	23	25			48	
Meradia	31	16	2		49	
Goran	41	7		1	49	
Malibagh	34	7	1	5	47	
Karimullarbag	31	3			34	
Jatrabari	38	5			43	
Tanti Bazaar	10	4		1	15	
	274	160	36	51	521	

Table 3-10: Ward-wise implementation and growth of door to door services over time in Dhaka

Ward no.	Total House-holds	Sample households availing services over the years															N/A
		Before 2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Lalmatia	17	4	2	2	1	6	1	5	4	1	3	-	1	1	-	-	2
Mirpur	11	2	2	8	1	8	-	5	3	2	3	-	-	3	-	-	2
Gabtolli	9	1	2	2	2	6	1	4	6	2	1	1	-	3	-	1	9
Kawran Bazaar	16	1	1	3	1	8	1	5	3	1	4	1	2	3	-	-	-
Gulshan	25	1	2	2	4	6	2	1	3	-	2	-	-	1	-	-	1
Badda	15		1	2	3	5	3	2	3	3	3	1	3	3	1	-	2
Meradia	11		2		1	5	2	4	1	2	6	3	4	4	4	-	1
Goran	13	2	3	3	2	10	-	2	3	1	1	1	2	3	3	-	1
Malibagh	14	-	1	1	1	7	2	1	1	3	4	4	5	3	-	-	3
Karimullarbag	9	-	-	2	1	4	-	2	1	1	3	2	-	3	6	-	16
Jatrabari	9	-	-	3	-	8	1	3	4	2	5	-	4	2	2	-	7
Tanti Bazaar	1	1		2		2	1	3	1	2				1	1		35
Total	150	12	16	30	17	75	14	37	33	20	35	13	21	30	17	1	79

Table 3-11: Expectation for change in the service and willingness to pay for better service

Want change?	Yes: 311 households (59.7%)						No: 210 households (40.3%)
	Existing or reduced	1-20% increase	20-40% increase	40-60% increase	More than 60% increase	Non-response	
No. of households	65	62	56	55	107	3	
Percentage of households	18.67	17.81	16.09	15.80	30.75	0.86	

Table 3-12: Types of cleaners

	CC cleaner	Community cleaner	Others	Don't know
No. of households	392	47	24	47
Percentage of households	76.9	9.2	4.7	9.2

Table 3-13: Schedules of performing duties by cleaners

	Time	No. of households	Percentage of households
Time of road swept	Up to 8 am	448	74.67
	8 am to 10 am	11	1.83
	10 am to 12	4	0.67
	12 pm onwards	3	0.5
	Non response	134	22.33
Preferred time	Up to 8 am	93	15.5
	8 am to 10 am	1	0.17
	10 am to 12	3	0.5
	Not applicable	503	83.83

Table 3-14: Households' perception about open disposals in the area (other than containers): Problems faced and solutions

Practice of open disposals	Yes = 314 (52.33%)				No= 268 (44.67%)	Don't know= 18 (3.0%)
If it creates problem	Yes= 295 (93.9%)			No= 19 (6.1%)		
If any step taken by individual households	Yes = 102 (33.1%)			No= 204 (66.2%)	Don't know= 2 (0.6%)	
If the problem solved	Immediately solved	Solved within a week	Solved after long time	Not solved		
No. of households	19	17	8	58		
Percentage of households	18.6	16.7	7.8	56.9		

Table 3-15: Community interventions (if any) in case of open disposals

If any step taken by community	Yes = 59 (9.83%)				No= 120 (20.0%)	Don't know = 130 (21.67%)	Not response= 5 (0.83%)	N/A= 286 (47.67%)
	Immediately solved	Solved within a week	Solved after long time	Nothing happened				
If the Problem solved	Immediately solved	Solved within a week	Solved after long time	Nothing happened				
No. of HH	8	14	5	32				
%	13.6	23.7	8.5	54.2				

Table 3-16: Grievance redressed by community

			Frequency
Grievance redressed	12 (10.26%)	Nothing	3
		Immediately solved	4
		Within a week	2
		After a long time	3
Grievance not redressed	42 (35.89%)		
Don't know whether grievance redressed	61 (52.14%)		
No response	2 (1.71%)		
Total	117		

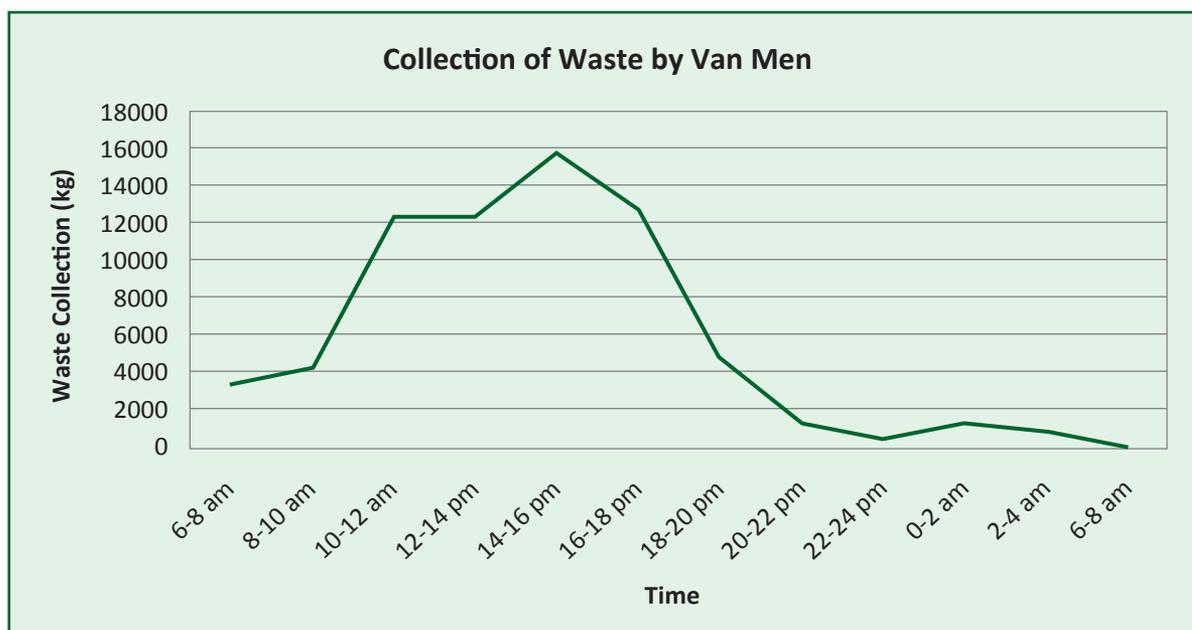
Annex 4

Annex 4-1: Storage/Container

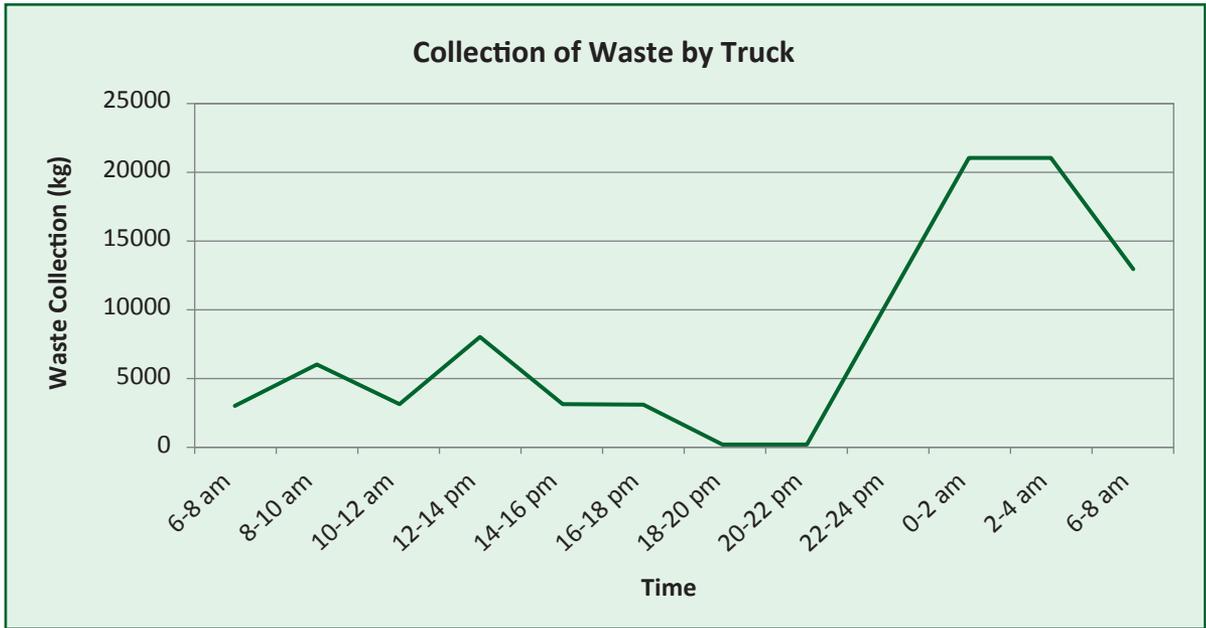
	Van Services	Trucks	Conservancy Inspectors
Introduction & Role	PCSP provides the van services to households and these vans collect their wastes and dump those into containers.	City Corporations provide truck services to collect container wastes. These trucks take the waste to dumpsite or clean the scattered waste.	Conservancy inspectors monitor containers loading and unloading, if the container location needs to be changed, indirectly monitor if PCSP vans are collecting waste properly.
Time	Official time of dumping 6pm-10pm, but dumps in the morning-mid day (10am-5pm)	Container carriers- 10pm-8am Open truck – throughout the day	
Challenges	<ul style="list-style-type: none"> Households do not allow vans to collect waste in the afternoon for security purpose, so they cannot maintain the official timing. They have to manually dump the waste to containers. As the containers are designed in such a way that they have to unload in the road before uploading the waste to containers. As the container sites do not have proper lighting, it is difficult for the van men to dump from evening to night time. Vans have to collect to wastes from a huge number of household Container location is perfect though container sitting is quite problematic. [NW7] Lack of containers and containers at distance [SW3 and 48] 	<ul style="list-style-type: none"> The containers are mostly overloaded, so it's difficult to upload the overloaded containers. For open trucks, in time of unplanned waste accumulation, it becomes difficult for them to collect the waste because of traffic problem, shortage of trucks. 	<ul style="list-style-type: none"> While placing the containers, they have resistance from the public. If transport department cannot provide trucks for unplanned wastes, conservancy inspectors face problem.

	Van Services	Trucks	Conservancy Inspectors
Suggestion	<ul style="list-style-type: none"> • D/V van service where capacity of 1 van. We know V=428.5 from above. If the time of van operation is strictly imposed (5 hours from 10am-3pm, verify from survey data), the trips of the vans will be automatically established. Ideally contracts should be given to private players to address capacity creation under the stipulated time. The inspector, citizen forum and the ward's authority should strictly enforce the timing of vans to introduce a hassle free collection system. • More containers are needed [SW3] • Containers should be nearby [NW19 and SW48] 	<ul style="list-style-type: none"> • If truck services are decentralised to ward level, then they can allocate the trucks according to need. • If there aren't enough trucks then wards can hire more private companies or privatises the whole service where wards will play a monitoring role. 	
Others			

Annex 4.2: Waste collection by van men from container site



Annex 4-3: Waste lifting by truck in container site



Annex Table 4-4: Coordination failure

Time	Total number of disposal agent (Van man) arriving at the container station in a day	Number of disposal agent (van man) as percentage of the total arriving at the container site in a day	Total waste arriving at the container station (kg)	Percentage of waste arriving at the container station in a day	Total number of truck arriving a container site in a day	Truck Capacity (in kg)	Percentage of truck arriving a container site in a day (total no. truck/)	Total waste to be cleared (c-f)	Total waste to be cleared as % waste generated (c-f/c*100)
	a	b	c	d	e	f	g	h	i
6-8am	8	4.91	3424	4.91	2	3000	4.35	424	12.38
8-10am	10	6.13	4280	6.13	1	6000	8.70	-1720	-40.19
10-12am	29	17.79	12412	17.79	2	3000	4.35	9412	75.83
12-14pm	29	17.79	12412	17.79	5	8000	8.70	4412	35.55
14-16pm	37	22.70	15836	22.70	1	3000	4.35	12836	81.06
16-18pm	30	18.40	12840	18.40		3000	4.35	9840	76.64
18-20pm	11	6.75	4708	6.75			0.00	4708	100.00
20-22pm	3	1.84	1284	1.84	1		0.00	1284	100.00
22-24pm	1	0.61	428	0.61	3	10000	8.70	-9572	-2236.45
0-2am	3	1.84	1284	1.84	5	21000	21.74	-19716	-1535.51
2-4am	2	1.23	856	1.23	4	21000	21.74	-20144	-2353.27
4-6am				0	3	13000	13.04	-13000	

* Trolley man not included

* Amount of waste cleared

Annex Table 4-5: Recycle

Stakeholders	Vendors	Bhangari (Petty traders)	Paikar/Mohajan (Wholesale)	Factory/Industry
Introduction	Vendors are the ones who buy recyclable materials from the households/door to door and do not have a specific stop.	Bhangaris are the one who have localised shops. They buy materials from van men, scavengers and vendors.	The Paikar or Mohajans are the agents or mediators that buy recyclable goods from Bhangaris.	Factories or industries buy the materials from the agents.
Respective roles	They buy the good quality recyclables from the household, so they have a direct cost of recycling.	They scrutinise the materials which have scrap values.	They clean up the materials and sell it to the factory.	They process the materials and sell the final product in both local & international markets.
Paper (Clean)	15	15-20	22	23-25
Newspaper	15-17	18-20	21-25	24-30
Paper (Dirty)		5	7-8	9-10
Plastic	20	20-25	26-50	30-100
Iron	18	18-20	21-25	
Silver	120	130	140	
Copper	480	500	512-520	
Cork-sheet				
Glass		2-5		
Broken Glass	50-70 (Per Sack)		75-85 (Per Sack)	90-95 (Per Sack)
Rubber		2		

Stakeholders	Vendors	Bhangari (Petty traders)	Paikar/Mohajan (Wholesale)	Factory/Industry
Plastic bottle		8-10	10-15	14-28
Plastic raw-material (mulom)		22	25	
Sandal (Chocolate)		18	20	
Sandal		8	10	
Challenges	<ul style="list-style-type: none"> Their access to households has decreased due to security purpose. Housemaids segregate and sell the recyclable to <i>Bhangaris</i> 	<ul style="list-style-type: none"> Companies, like Prism Bangladesh, have taken their market. 		<ul style="list-style-type: none"> Different markets face different kind of problems, for example, Metal industries like Mecca Metal Industries (PVT) faces high tax rate and Plastic Industries face loans with high interest rates.
Opportunities				

- A large informal market of recyclable goods operates in a most inefficient manner.

	Van Man	Container Scavengers	Landfill Scavengers
Introduction	Vanmen directly collect these items from dustbins/ containers and sell to the Vendor.	Container scavengers collect waste from containers	Landfill scavengers collect waste from the dumping platform of the landfill.

	Vanman	Container Scavengers	Landfill Scavengers
Roles	<ul style="list-style-type: none"> • They do the initial sorting of the wastes. As they collect from the waste they do not have any direct cost related to it. • They recycle around 5-12 kg of recyclable materials and sell them with a price of 150-300 taka. • Vanman sells 10-15 kg of recyclable materials. Main recyclable materials are paper, glass and bottles. • Vanman tries to collect two types of recyclables, paper and metal/plastic and earns around 200-300 TK. from those. • They sell plastic bottles which they separate from their four trips per day and earn Tk 200-250. • They get to collect a small amount of plastics bottles, plastic, broken glass. 		<ul style="list-style-type: none"> • They usually work 5-6 hours, around the time trucks arrive. They sell the recycled items to the <i>bhangaris</i> near the landfill.
Challenges	<ul style="list-style-type: none"> • They used to segregate bottles, plastic, broken glass but the amount they get is very low as house maids separate saleable waste to sell on their own. • They don't find any costly item like metal pieces to sell as maid-servants keep those things to sell on their own. • Now a days people are more aware and they sell material goods separately on their own. 		<ul style="list-style-type: none"> • City Corporation authorities are the only ones who can create problems for the waste pickers if they restrict them
Solution			
Advantages			<ul style="list-style-type: none"> • There is no start-up cost for recycling

Annex Table 4-6: Compost

	Private Organisations	City Corporation	Slum	Marketing Agents	Market /Farmers
Introduction	In Dhaka the main private organisation that produces compost is Waste Concern.		They do the barrel composting with the help of DOE and NGOs like Swiss Contact	ACI is the marketing agent of Waste Concern. They have created awareness in north Bengal for composting.	Farmers are the users of composts. Some nurseries in Dhaka also use compost.
Challenges	<ul style="list-style-type: none"> Fertiliser works on a credit market basis, e.g. farmers take the fertiliser before they start farming and pay after they sell their ready crop. People are less aware about the advantages of composting Government gives subsidy to chemical fertiliser at around 15 TK., where the organic fertiliser which is good for the soil is around 20 TK. The carbon credit price has fallen from \$17 USD to \$0.50 USD, so the income has reduced by 30% from producing organic compost. The transport cost of composting bears 50% of the expenses. 			<ul style="list-style-type: none"> Government gives subsidy to chemical fertiliser at around 15 TK., where the organic fertiliser which is good for the soil is around 20 TK. 	<ul style="list-style-type: none"> Organic fertilisers/composts do help in bumper growth of the crops and farmers care about the present income than the future income. Composts are expensive and do not have a credit market. If farmers have already used chemical fertiliser in their land, directly using compost will not increase the productivity of the land quickly.

	Private Organisations	City Corporation	Slum	Marketing Agents	Market /Farmers
Opportunities	<ul style="list-style-type: none"> Household organic waste is good for compost There is demand in north Bengal and India for compost. 	<ul style="list-style-type: none"> City Corporation has a plan to start a composting plant at Matuail Landfill. The capacity of the composting plant at Matuail Landfill is 20 tonnes. They will produce fertiliser from the plant. This is a project under 3R policy project. 	<ul style="list-style-type: none"> It is done in a barrel so less needs space. 		<ul style="list-style-type: none"> If they use the organic compost the land becomes more fertile, and better for future growth of the crops
Solutions	<ul style="list-style-type: none"> If Government gives subsidy on organic fertiliser, then farmers will be able to buy the fertilisers If the credit market for organic fertiliser starts it will be helpful. If government gives tipping fee or transfer the organic waste to the composting plant that will reduce the expense of producing compost. 			<ul style="list-style-type: none"> Government gives subsidy on the organic fertiliser, then farmer will be able to buy the fertilisers 	<ul style="list-style-type: none"> For better result from composting farmers should use a combination of organic and chemical fertiliser initially, and gradually reduce using chemical fertiliser.

Annex 5

Step-1 : Estimating per capita waste generation

Table 5-1 : House hold Survey Table

Ward No.	Ward Name	Population (BBS, 2011)	Population (Projected 2015)	Survey Unit	Organic Waste (kg per day)	Other Waste (kg per day)	BIGD Survey Waste (kg per day)
21	Badda	96111	110204	50	71.1	2.61	73.71
26	Kawran Bazar	67876	77829	50	104.5	2.9	107.4
7	Mirpur	58082	66599	50	98.2	3.02	101.22
19	Gulshan	96291	110411	50	140.85	2.25	143.1
10	Gabtolli	87879	100765	50	77.25	3.04	80.29
32	Lalmatia	72973	83673	50	99	3.70	102.70
3	Meradia	86931	99678	50	80.4	2.16	82.56
54	Karimullarbagh	66637	76408	50	75.8	1.67	77.47
48	Jatrabari	58741	67355	50	67.9	2.41	70.39
2	Goran	113273	129883	50	69.35	2.32	71.67
12	Malibagh	51067	58555	50	80.1	2.32	82.42
36	Tatibazar	26199	30041	50	63.75	1.71	65.46
Total		882060	1011402	600	1028.2	30.11	1058.31

Equation of Projected Population $Po + (1 + \gamma)^t$

Where,

Po = Population of BBS, 2011,

r = Population growth rate (3.48%) in Dhaka District (BBS, 2011) and

t = year (4.9)

Per Capita waste = 0.38 (plus, minus 5%) [Per capita waste=Total waste of 12 wards / total sample population 2988 in 12 wards]

Step-2: Total Domestic waste ward-wise in Dhaka City has been estimated using per capita waste

Waste per ward = Projected population, 2015 of a ward * Domestic waste generation per capita (BIGD, HH survey, 2015).

This has been estimated for all the wards.

Step-3: Estimation for Business and Street Waste

Due to time and resource limitation BIGD survey could not cover commercial and street waste. Therefore JICA's estimation was taken into consideration.

Waste Volume estimation

Assuming that the ratios of domestic waste, business waste and street waste are constant –

JICA=j, BIGD=B, Domestic=d, Business=b, Street=s

$$W_j^d = 1950$$

$$W_j^b = 1050$$

$$W_j^s = 200$$

$$W_B^d = 3070.71$$

$$W_B^b = ?$$

$$W_B^s = ?$$

$$\frac{W_j^d}{W_j^b} = \beta = \frac{1950}{1050} = 1.86 \text{ (Domestic: Business)}$$

$$\frac{W_j^d}{W_j^s} = \gamma = \frac{1950}{200} = 9.75 \text{ (Domestic: Street)}$$

$$\frac{W_s^d}{W_j^d} = \alpha = \frac{3070.71}{1950} = 1.57$$

$$W_B^b = \frac{W_B^d}{\beta} = \frac{3070.71}{1.86} = 1650.92$$

$$W_B^s = \frac{W_B^d}{\gamma} = \frac{3070.71}{9.75} = 314.94$$

BIGD values using JICA ration (domestic: commercial) =1650.92

Step-4:

However, JICA estimation was for 2005, but the economic growth and urbanisation rate have continued. Therefore we adjust our estimation to these changes.

Growth rate - according to BBS economic units report (2001 to 2011), per year growth rate is estimated as 1.17%, adding this rate for ten years with commercial waste calculated from JICA ratio.

But, the time difference between BIGD and JICA = (2015 September – 2005) = 10.9 years

So, we have to consider the commercial growth rate (1.17% per year) (BBS 2001-11) for calculating the commercial waste in Dhaka City, 2015

Commercial Waste = $1650.92 * (1+0.017)^{10.9} = 1983.92$

Again, Street Waste:

Urbanisation Rate in Bangladesh is 28.40% (CUS, 2011)

So, Street Waste = $314.94 * (1+0.28)^{4.9} = 1055.83$

$TN^B = W_B^d = W_B^b = W_B^s = 6110.47$

We have to estimate if the difference between collection by CC and waste generated by HH (BIGD survey) is equal to waste generated (JICA -Street + business)

- Total waste generated in Dhaka City based on apportionment of JICA estimated for 2015 (**BIGD FINDING**): 6110.47 tonnes per day
- Total waste collected in Dhaka City by City Corporation : 4643 tonnes Per day
- Total uncollected waste = Total waste generated – Total waste collected
= $6110.47 - 4643 = 1467.47$ tonnes per day
- Percentage of uncollected waste = Total waste collected/ Total uncollected waste = 75.98%

Step-5: Summary of estimation (Dhaka City Corporations)

Description	Details	BIGD Study (2015)
Waste Generated (tonnes)	A. Domestic (Organic + Inorganic)	3070.71
	A.1 Domestic (Organic)	2779.80
	A.2 Domestic (Inorganic): A-A1	290.92
	B. Business/commercial	1983.92
	C. Street	1055.83
	D. Others (Industrial, Medical etc.)	Not Collected
E. Total waste generated in tonnes	A+B+C+D	6110.47
F. Total waste collected	Source: Dhaka City Corporations, 2015	4643
G. Uncollected waste	E-F	1467.47
H. Per Capita waste generated (kg)	E/ Projected Population of Dhaka, 2015 (8080815)	0.38
I. Collected waste (Domestic + Street + Commercial) as percentage of waste generated per day (%)	F/E*100	75.98
J. Percentage of uncollected waste as percentage of total waste generated (%)	G/F*100	31.61
K. Inorganic waste generated by HH as percentage of total domestic waste (Recyclable and non recyclable) released to City corporation and Informal sectors (%)	(A.2/A)*100 Total Size of the recycle market i.e. A.2 (290.92 tonnes per day)	9.48