No.

Dhaka City Corporation
The People's Republic of Bangladesh

Japan International Cooperation Agency

THE STUDY ON THE SOLID WASTE MANAGEMENT IN DHAKA CITY

Final Report

Volume 2

Main Report

CLEAN DHAKA MASTER PLAN

March 2005

Pacific Consultants International
Yachiyo Engineering Co., Ltd.

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The following foreign exchange rate is applied in the study:

US$ 1 = Tk. 58 (Bangladeshi Taka) as of end of September, 2004

PREFACE

In response to a request from the Government of Bangladesh, the Government of Japan decided to conduct “The Study on Solid Waste Management in Dhaka City ” and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched the study team headed by Dr. Katsuhide NAGAYAMA of Pacific Consultants International Co., Ltd. and consisted of experts from YACHIYO ENGINEERING Co. to Bangladesh, from November 2003 to March 2005. In addition, JICA set up the advisory committee headed by Mitsuo YOSHIDA, Senior Advisor of JICA.

The team had a series of discussions with the officials from Dhaka City Corporation in Bangladesh, and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the practice of effective solid waste management in Dhaka City and to the enhancement of friendly relationship between Bangladesh and JAPAN.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for their close cooperation extended to the team.

March 2005

Etsuo KITAHARA
Vice-President
Japan International Cooperation Agency

March 2005

Mr. Etsuo KITAHARA
Vice-President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

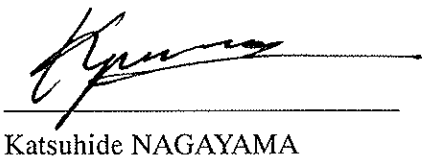
We are pleased to formally submit herewith the Final Report of "The Study on the Solid Waste Management in Dhaka City in the Republic of Bangladesh."

This report compiles the result of the Study, which was undertaken in the Republic of Bangladesh from November 2003 through March 2005 by the Study Team, represented by Pacific Consultants International.

We had been assisted by many people for the accomplishment of the Study, and we would like to express our sincere gratitude and appreciation to all those who extended their kind assistance and cooperation to the Study Team, in particular, Dhaka City Corporation, as the counterpart agency headed by Honorable Mayor who kindly deployed all the relevant sections to implement the study.

Also we acknowledge the effective assistance by all the officials of your Agency and the Embassy of Japan in the Republic of Bangladesh.

We hope that the report will be able to contribute greatly to improvement of solid waste management in Dhaka City.



Katsuhide NAGAYAMA
Team Leader
The Study on the Solid Waste Management in Dhaka City in the Republic of Bangladesh

List of Abbreviation and Acronyms

ABD	Apparent Bulk Density
ACCO	Assistant Chief Conservancy Officer
ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
BIEDF	Bangladesh Integrated Environmental Development Forum
BRAC	Bangladesh Rural Advancement Committee *(former name)*
BSCIC	Bangladesh Small and Cottage Industry Corporation
BSIC	Bangladesh Standard Industrial Classification
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CBM	Community Based Management
CBO	Community Based Organization
CC	Container Carrier
CCO	Chief Conservancy Officer
CEGIS	Center for Environment and Geographic Information Services
CEO	Chief Executive Officer
CI	Conservancy Inspector
CIDA	Canadian International Development Agency
CLAC	Central Land Allocation Committee
CMI	Census of Manufacturing Industries
CNG	Compacted Natural Gas
CO	Conservancy Officer
CPU	Counterpart Personnel Unit
CSI	Conservancy Supervising Inspector
DCC	Dhaka City Cooperation
DCCO	Deputy Chief Conservancy Officer
DG	Director General
Dhaka WASA	Dhaka Water Supply and Sewerage Authority
DMCH	Dhaka Medical College Hospital
DMDP	Dhaka Metropolitan Development Planning
DOE	Department of Environment, Ministry of Environment and Forests
DS	Deputy Secretary
DTCB	Dhaka Transport Coordination Board
DUTP	Dhaka Urban Transport Project
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERD	Economic Relations Division, Ministry of Finance
ETP	Effluent Treatment Plan
GDP	Gross Domestic Product
GIS	Geographic Information System
GNP	Gross National Product

GOB	Government of Bangladesh
GPS	Global Positioning System
HH	Household
ICDDR	International Centre for Diarrhea Diseases Research
IDA	International Development Association
IEB	Institution of Engineers Bangladesh
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IGES	Institute for Global Environmental Strategies
IT	Information Technology
JICA	Japan International Cooperation Agency
LGD	Local Government Division, Ministry of Local Government, Rural Development and Co-operatives
LGRD&C	Ministry of Local Government, Rural Development and Co-operatives
MCHTI	Maternity and Child Health Training Institute
MIS	Management Information System
MOEF	Ministry of Environment and Forests
NGO	Non-Governmental Organization
NOC	Non-Objection Certificate
OT	Open Truck
PCP	Project Concept Paper
PO	Personal Officer
PVC	Polyvinyl Chloride
RAJUK	Rajdhani Unnayan Katripakkha: Capital City Development Authority
RCV	Refuse Collection Vehicle
RHD	Roads and Highways Department
SE	Superintending Engineer
SEMP	Sustainable Environment Management Program
SOB	Survey of Bangladesh
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
SPM	Suspended Particulate Matter
SWM	Solid Waste Management
SWMC	Solid Waste Management Cell
TOR	Terms of Reference
TT	Trailer Truck
TWG	Technical Working Group
UNDP	United Nations Development Program
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Children's Fund
UPD	Urban Planning Department, Dhaka City Cooperation
WB	The World Bank
WHO	World Health Organization
WMC	Waste Management Committee
WMD	Waste Management Division
ZCO	Zonal Conservancy Officer
ZEO	Zonal Executive Officer

Executive Summary

1. Study Framework

1.1 Objectives

The objectives of this Study are:

(1) To formulate master plan concerning solid waste management in Dhaka City with the target year of 2015

(2) To develop capabilities and management skills of the DCC personnel through the technology transfer during the course of the Study.

1.2 Study Area

The Study area covers the jurisdiction of the Dhaka City Cooperation (DCC), which totals about 131 km^2. Sites of the new landfill facility will also be included in the study even if they are located in new urban area outside the jurisdiction of DCC.

1.3 Target Waste

The Study covers three types of solid wastes generated in the jurisdiction of the Dhaka City Cooperation: namely, Domestic waste, Industrial waste, and Medical waste. Liquid and gaseous wastes are not included in the scope of this study.

The master plan shall be prepared for only Domestic waste in this study. With regard to Industrial waste and Medical wastes, surveys will be conducted to identify the problems, and possible solutions will be proposed separately from Domestic waste.

1.4 Target Year

The master plan has one decade time-horizon with the target year 2015.

2. Present Situation of Solid Waste Management in Dhaka City

2.1 Waste Generation

Waste generation and disposal in Dhaka City is summarized below.

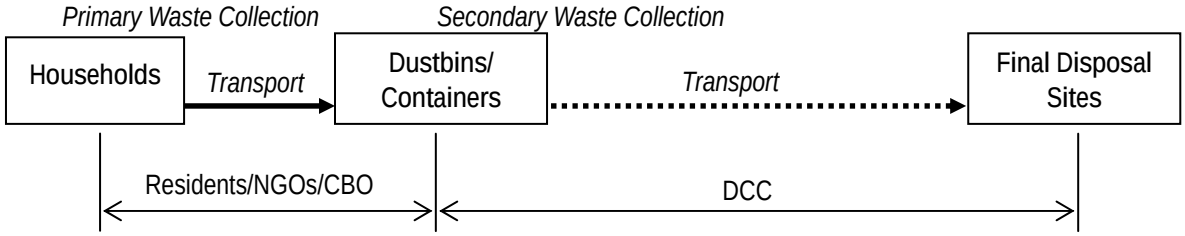
item	parameter
estimated generation	domestic waste: 1,950 t/d business waste: 1,050 t/d street waste: 200 t/d
generation rate	domestic waste: 0.34 kg/d/person (domestic+business+street) waste: 0.56 kg/d/person
calorific value	all waste average: 550 to 850 kcal/kg *requirement of self combustion: 1,200 kcal/kg
share of disposal volume by dump site	Matuail: 65 % Berri Band: 30 % Uttara: 5 %
total disposal volume at 3 dump sites	wet season average: 1,400 t/d

source: waste amount and quality survey by the study team

2.2 Primary Waste Collection

(1) Legal Basis of Waste Collection

Dhaka City Corporation Ordinance[1] is the basic law regarding street/drain cleaning, waste collection and transportation. According to Section 78 of the Ordinance, DCC is 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 as shown below.



(2) DCC Initiative in Primary Waste Collection

In 2002, DCC introduced an approval system of NGOs/CBOs/private organization for providing door-to-door waste collection services in all wards. DCC has given approvals to 47 NGOs/CBOs, however, not all of them have started their activities yet.

2.3 Secondary Waste Collection and Road/Drain Cleaning

(1) Allocation of Resources

DCC deploys the following facilities and manpower for secondary waste collection. DCC seems to have sufficient capacity of vehicle, but the number of drivers is apparently insufficient.

[1] Dhaka City Corporation Ordinance was promulgated by the Chief Martial Law Administrator on 24 August 1983.

Owner	Receptacle	Trucks	Truck Driver
DCC	dust bin: 647 units	OT+TT: 216 units	
	6 m^3 container: 260 units	CC 3 t: 93 units	
	12 m^3 container: 123 units	CC 5 t: 34 units	
subtotal:	1,030 units	343 units	266 persons
Private	dust bin: 41 units	OT 5 t: 19 to 27 units	27 persons

Source: DCC

For cleaning of roads/drains and public spaces, DCC deploys about 7,000 cleaners in eight zones while private firms deploy about 600 cleaners in two zones. A remarkable feature of DCC cleaners is the working hours; they work on average 4 hours with minimum 2 hours while private cleaners work on average 6 hours with minimum 4 hours

(2) Comparison of Efficiency between Open Truck & Container Carrier

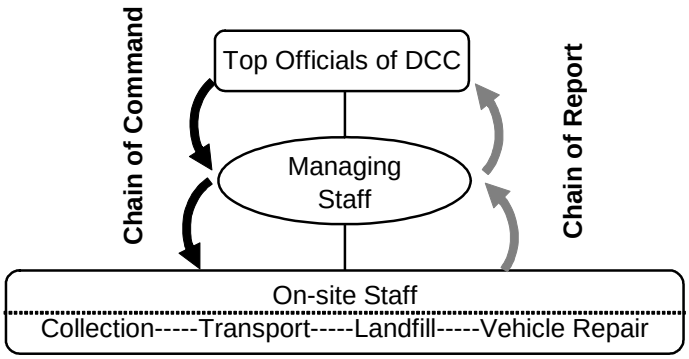
As for overall collection/transport efficiency (ton/hour), container carriers achieved on average 2 t/h, that is four times as much as open trucks, which carried only 0.5 t/h on average. As for the cost-performance, a container carrier spends 20% less cost than an open truck with the same capacity.

(3) Slow Motion in Vehicle Repair

Repair usually takes a long time. Half of vehicles that finished repair in 2004 had taken two years since the request for repair. Major repair is contracted with private workshops outside DCC. The tender document needs final decision by the Mayor and the process takes long time to complete. Because of the limited frequency of Mayor's approval, there is inevitable waiting for the next time of application to the Mayor. A fundamental improvement in this process is urgently needed.

(4) Lack of Management

The chain of management consists of two actions in opposite directions: namely, the chain of command and the chain of report as shown below. With the complete pair of chains, the Solid Waste Management (SWM) is executed effectively and efficiently.



DCC has a well connected chain of command; however, it does not have the opposite direction, the chain of report. To cope with this defect, a pilot project B for Management Information Acquisition (MIA) was initiated under the financial assistance of JICA.

2.4 Final Disposal

(1) Remaining Capacity of Landfill Site

DCC uses three landfill sites: namely, Matuail, Berri Band and Uttara; Matuail is the only official site owned by DCC. The rest (Berri Band and Uttara dumpsites) are private land. It is explained that owners of the land have requested DCC to fill the low lying land with solid waste. In response to their request, DCC started disposing of solid waste there. The remaining capacity of Matuail site is estimated at 1.1 million ton as of the end of 2004.

(2) Legitimacy of Landfill Site

As for Berri Band and Uttara sites, the final disposal of solid waste was started after the enforcement of the Environmental Conservation Act of 1995 and the Environmental Conservation Rules of 1997. These regulations require the Environmental Clearance Certificate (ECC) for earth filling by industrial, domestic and commercial waste, but this has not yet been acquired. Furthermore, neither of the sites got approvals from RAJUK, which is required for structural change of open space and/or reservoirs according to the Preservation Act of 2000.

(3) Operation and Management of Landfill Site

Conservancy Department dispatches 4 staff to Matuail landfill site; however, there is no job description for them or work record at all. Mechanical Division 2 also provides heavy equipment and operators to three landfill sites; however, there is no task description or work record or operation plan of landfill site either.

Operation method of solid waste at three landfill sites are open dumping (crude dumping) without control of incoming waste and no covering soil. The solid waste is dumped without surrounding bank at either Berri Band or Uttara.

(4) Heavy Equipment for Landfill

Three types of heavy equipment are used for final disposal; however, the provision is unstable because more than half of the equipment stock is broken.

2.5 Recycling

Recycling industry raises a total of 436 t/d of material recovery as shown in the table below. The amount recovered is the reduction of waste to be managed by DCC. Composting contributes very little to the waste reduction although the compostable waste has the largest portion among generated wastes.

Estimated Volume of Recycled Wastes in Dhaka City

Material	a) Estimated generation of recyclable waste (t/d)	b) Estimated recycled waste (t/d)	c) Recycle rate	d) Contribution to waste reduction (b / 3,200)
Plastic	124	103	83 %	3.2 %
Paper	260	168	65 %	5.3 %
Glass	46	24	52 %	0.8 %
Metal	27	41	*	1.3 %
Compostable	2,211	6	0 %	0.2 %
Others	99	94	95 %	2.9 %
Total	2,767	436		13.6 %

Source: Survey on recycle market by the Study Team

2.6 Legal Aspect

In connection with the existing landfill site, DCC should comply with Environment Conservation Act and Rules and Preservation Act.

2.7 Organization

(1) Job Allocation

Job descriptions of the departments, divisions and posts are not yet defined for those engaged in SWM.

(2) Missing Function

DCC does not have the function for planning, public involvement and management of final disposal at present.

2.8 Financial management

(1) Revenue and Expenditure of DCC

DCC budgeted Tk 2,670 million of their own account for financial year 02/03. The problem of finance is that revenues collected were only 70% of budgeted amounts, on average, from 2000-01 to 2002-03. This income gap compels DCC to squeeze its expenditures except for salary/wages. The major source of revenue is holding tax that accounts for 63% of revenue. The latest balance sheet of SWM indicates a growing deficit trend as shown below.

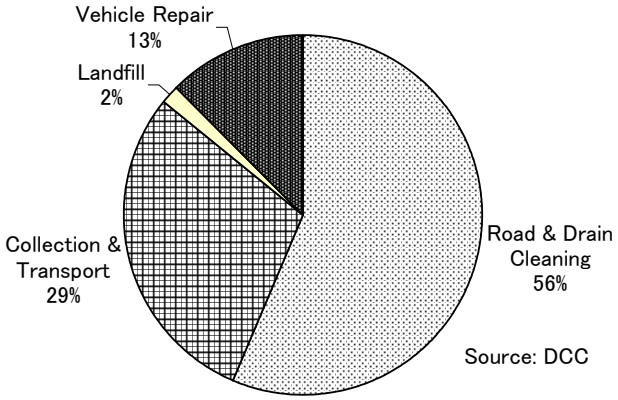
Financial Balance of SWM (million Taka)

Items	1999-00	2000-01	2001-02	2002-03	Ratio in own DCC Account
1. Overall SWM Income	126	141	150	176	6%
2. Overall SWM Expenditure	367	383	402	476	18%
3. Balance	-241	-242	-252	-300	-

Note: 1) Estimated by the Study Team based on various information and data of DCC.
2) Recurrent DCC own expenditures were used for estimates. Depreciation was not considered.
3) There were no capital expenditures during the period.

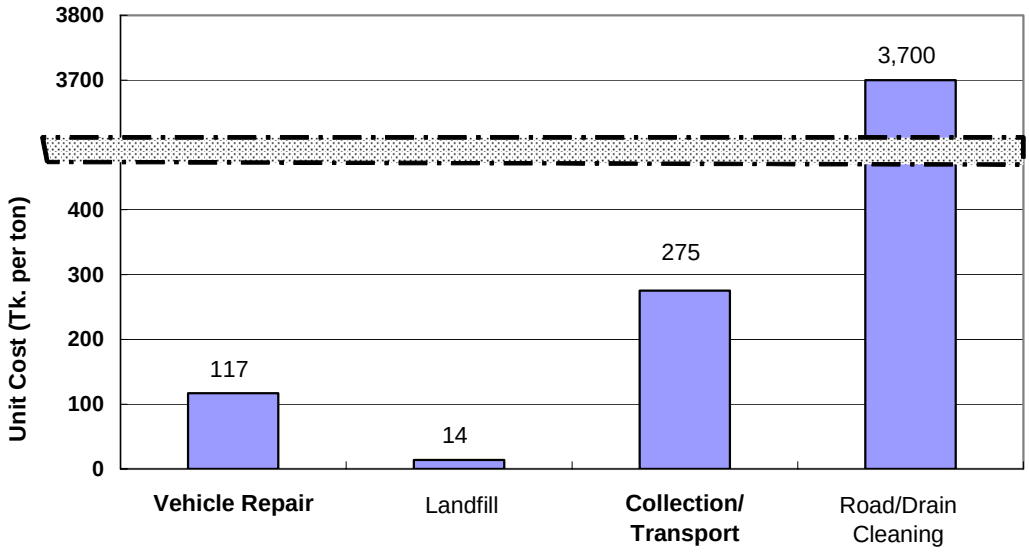
(2) SWM Expenditure by Type of Operation

DCC spends only 1.5% of budget for landfill while more than half is for road/drain cleaning.



(3) SWM Cost by Type of Operation

Total SWM cost of DCC in the financial year of 2002-03 is estimated at Tk. 930/ton (= US$ 16 /ton) as a whole. Operation-wise unit cost for road/drain cleaning is by far bigger than the other operation as summarized in the chart below.



2.9 Privatization

(1) Initiation of the Privatization Project

SWM privatization project for 8 wards of Dhaka City has been going on since May 15, 2003 as "Ward-Wise Waste Management Project of DCC (Private Initiative)". Through competitive bids, four organizations were selected and awarded contracts. The contractors shall undertake the same tasks as is done by DCC in the other wards.

(2) Prospect of the Privatization Project

As a result of grading for the first year, 3 contractors were given another contract for the second year with the same amount as the first year. On the other hand, the contractor of Ward 37 failed in the renewal of contract, so that competitive bidding was made with the revised contract term of 3 years.

3. Framework of Master Plan

3.1 Numerical Framework of Master Plan

(1) Population

The future population is projected at 7.7 million for 2015 and 6.7 million for 2010 respectively. The area of DCC is assumed fixed at 131 km^2.

(2) Solid Waste Generation Amount

Quantity of solid waste to be generated is estimated based on the population growth and waste generation rate. The future waste generation is projected at 3,909 t/d and 4,624 t/d for the years 2010 and 2015, respectively

3.2 Scenario for Improvement

(1) Alternative Scenarios

Three scenarios for the improvement are conceived, based on different collection service levels:

Scenario 1: with the same amount as 2004
Scenario 2: at the same collection rate as 2004
Scenario 3: at an expanded collection rate (with best effort)

(2) Adopted Scenarios

The target level of waste disposal is set up on the Scenario-3 as shown below. As a result, 3,054 t/d should be collected in 2015 with. Cumulative disposal volume is estimated at about 9 million tons by the end of 2015.

Targets of Waste Disposal

	Present 2004 (t/d)	Target for 2015 (t/d)	Year 2015/2004
Collection/ transport	1,400	3,054*	218%(almost twice)
Final disposal	1.385	3,032*	219%(almost twice)
Recycling	435	672	154%
Unidentified disposal	1,380	920	one-third reduction

Note: * indicates the assumption without counting effect of source reduction by waste generator

4. Master Plan for Improvement of SWM in Dhaka City

4.1 Schedule for Implementation of Priority Projects and Programs

Some of the priority projects and programs need immediate commencement in accordance with the desirable time schedule as shown in the chart below.

Priority Projects/Programs and Implementation Schedule

	Priority Projects and Programs	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Primary Collection/Public Involvement												
1	Institutionalization of Ward Solid Waste Management System											
2	Establishing a System of Approval and Monitoring of Primary Collection Service Providers											
3	Supporting Primary Collection Service Providers											
4	Initial Implementation of Ward Solid Waste Management System (20 Wards)											
5	Organization of Bangladesh Solid Waste Management Conference											
Secondary Collection/Transport and Road/Drain Cleaning												
1	Inctrease of New Containers and Trucks											
2	Increase of driver and truck cleaner											
3	Formation of Chain of Management in SWM											
4	Setting up Operation and Management Plan											
5	Capacity Development of Workers											
Final Disposal												
1	Improvement of Existing Matuail Dump Site											
2	Securing Future Landfill Site											
3	Closure of Berri Band Dump Site											
4	Establishment of Management Organization for Final Disposal											
5	Capacity Development of Disposal Section											
Legal Aspects												
1	Compliance with Environmental Conservation Act/ Rules and Preservation Act											
2	Legal Training to DCC Staff											
3	Enforcement of Section 150 against Illegal Garbage Throwing and Dumping											
Organization Aspects												
1	Preparation of Annual Operation Plan according to Master Plan											
2	Improvement of Operational Organization											
3	Reforming Organization for SWM											
4	Training of DCC Staff for SWM											
Financial Aspect												
1	Modification of Accounting system to Exhibit Actual SWM Cost explicitly											
2	Financing for Master Plan Implementation											
Privatization												
1	Continuation of Pilot Project on Privatization with In-depth Evaluation											

4.2 Financial Requirement

(1) Development & Procurement Cost

The sum of Development and Procurement Cost until 2015/16 is estimated at Tk. 3,595 million. The table below shows the estimate of sources of funds for Development and Procurement Cost. Some of the funds are already budgeted and the rest is a proposal of the study team.

Proposed Sources of Funds for Development and Procurement Cost

Project	Source of Funds (Taka in million)		
	SWM Own Income	Grant from Central or Foreign Government	Total
① New Landfill Development	-	670	1,575
	136	769	
② Existing Landfill Improvement	-	471	471
③ Closure of Berri band	11	-	11
④ Container Carrier and Truck Procurement	435	882	1,317
⑤ Heavy Equipment Procurement	55	107	162
⑥ Community Activities	-	59	59
Total	637	2,958	3,595

Source: Estimates by the JICA Study Team

(2) O&M Cost

On the other hand, the sum of O&M Cost until 2015/16 is estimated at Tk. 6,058 million. The unit cost is assumed to decrease continuously in spite of growing amount of waste collection as summarized in the table below.

SWM O&M Cost per Ton

Items	Unit	Actual	Master Plan			
		04/05	05/06	10/11	15/16	Average
SWM O&M Cost	Taka. In million	487	509	532	594	-
Collected Solid Waste Amount	1000Ton/Year	511	548	749	1,030	-
Taka/Ton		953	929	710	577	703

Source: Estimates by JICA Study Team

(3) Financial Balance

The financial balance of SWM finally reaches surplus from 2014/15 by putting the three income enhancement measures into effect (reassessment of estates, increase of tax rate and collection rate).

Final Report

Volume 2: Main Report

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Chapter 8 Evaluation and Conclusions

Appendix

COMPOSITION OF THE REPORTS

This Report consists of 4 volumes as follows:

volume 1: Summary
volume 2: Main Report
volume 3: Supporting Report
volume 4: Data Book

Chapter 1
Introduction

1.1 Background of the Study

The metropolitan city of Dhaka has an area of 131 km^2 and population of 5.7 million. Because of the scarcity of flood free land, the population density exceeds 40,000 per km^2 on one hand, and the rest of flood prone area is commonly used as voluntary dump site. The conspicuous intensity of building causes difficulty in waste collection from the city particularly from the old Dhaka area. The collection rate is estimated in this study at 44% of generated volume. This means almost half of waste is not properly collected and disposed at official dump sites. Uncollected waste has been recognized as the root of inferior environment such as scattered garbage, offensive odor, drain clogging, water pollution and mosquitoes.

Dhaka City Corporation is mandated the task of solid waste disposal and carryies out the task by mobilizing 7,000 workers and 300 plus trucks. The achievement of cleaning has not yet been appreciated by either of citizens or the government. The prime minister also expressed her concern about “Clean Dhaka” as an important mission of administration. Various studies have been conducted with the assistance of Asian Development Bank and United Nations Development Program in Dhaka City; however, an entire solution is yet to be found. The waste volume is still increasing as the city grows although Dhaka City Corporation does not have a confident view to solve the problems of uncollected waste.

Japan International Cooperation Agency (JICA) dispatched short-term specialist for the technology transfer of the waste disposal from March to August 2000. Further in response to the request, JICA sent a preliminary study team and concluded the Scope of Work for the study for formulation of a Master Plan on the waste management in the Dhaka City. Accordingly, JICA dispatched a study team to commence the study in December 2003 and study has continued for 14 months since then.

1.2 Objectives of the Study

1.2.1 Objectives

The objectives of the Study are:

(1) To formulate master plan concerning solid waste management in Dhaka City with the target year of 2015, and with following components:

- Planning of solid waste collection, transportation, disposal, and final disposal
- Planning of administration organization, institutional building, and public participation
- Planning of facility and material maintenance, maintenance management, and financial management

(2) To improve and strengthen the capabilities and management skills of the Bangladeshi counterpart organization and personnel in terms of solid waste management through the technology transfer during the course of the Study.

It is expected that the following will be accomplished throughout the Study period while jointly working with the Study Team and DCC personnel:

- To develop the capacity of implementing agency regarding solid waste management;
- To develop the consciousness of stakeholders by involving them in the process; and
- To develop partnership among DCC, private sector/community, and NGOs in Dhaka.

1.2.2 Study Area

The Study area covers the jurisdiction of the Dhaka City Cooperation (DCC), which totals about 131 km^2. Sites of the new landfill facility will also be included in the study even if they are located in new urban area outside the jurisdiction of DCC.

1.2.3 Target Waste

The Study covers three types of solid wastes generated in the jurisdiction of the Dhaka City Cooperation: namely, Domestic waste, Industrial waste, and Medical waste. Liquid and gaseous wastes are not included in the scope of this study.

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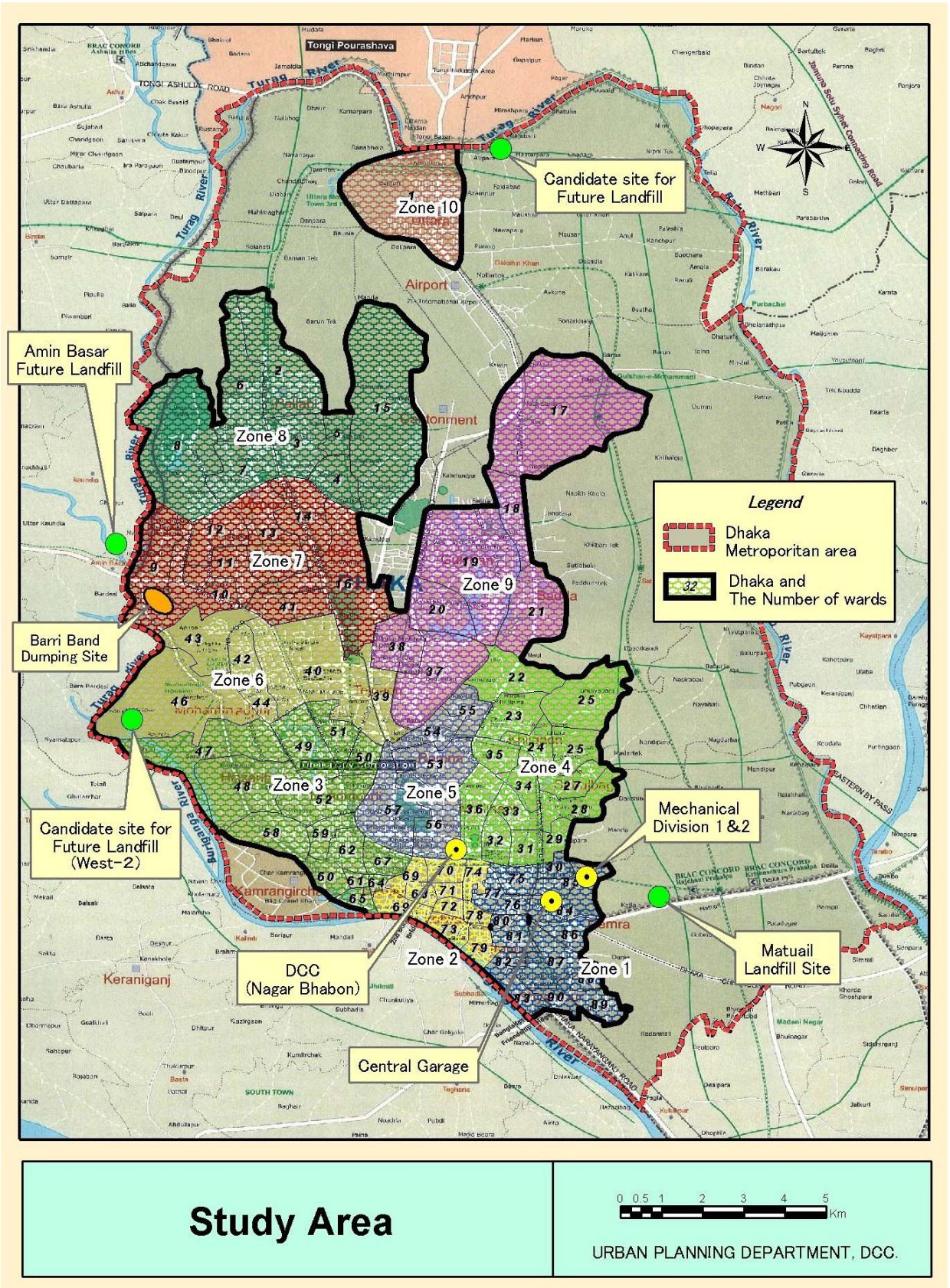


Figure 1.2-1 Study Area

1.3 Organization for Study Implementation

Figure 1.3-1 shows the overall Study organization and the relationship between the Study Team and the Counterpart organizations.

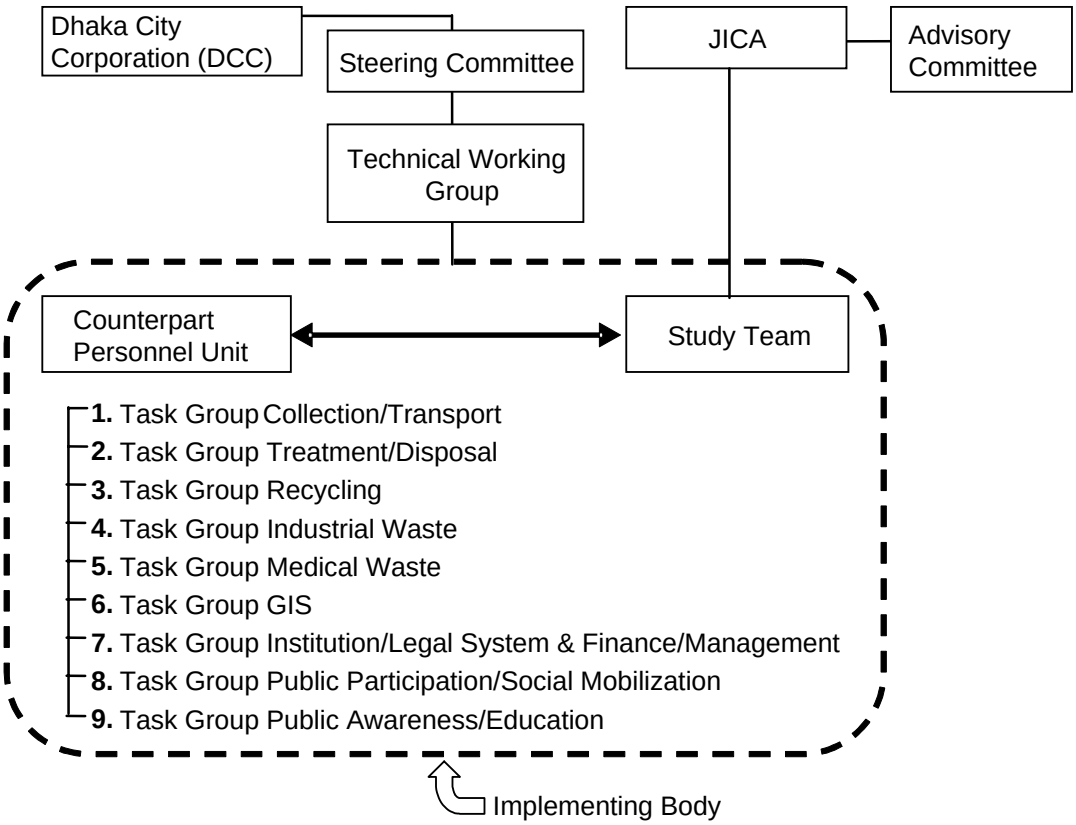


Figure 1.3-1 Overall Study Organization

In order to enhance the ownership and capacity of the DCC in addition to smooth implementation of the Study, the following committee and groups were organized:

- Steering Committee
- Technical Working Group under the Steering Committee
- Task Groups under the Counterpart Personnel Unit (CPU)

(1) Steering Committee

The committee was chaired by the Mayor or Chief Executive Officer of the DCC and consisted of representatives of organizations concerned, as mentioned below:

- Ministry of Finance, Economic Relations Division (ERD), Deputy Secretary
- Planning Commission, Physical Development, Joint Chief
- Ministry of LGRD & C, Local Government Division, Joint Secretary (Development)

- Ministry of Law & Parliament Affairs, PO
- Ministry of Environment & Forest, Director
- Ministry of Health and Family Welfare, Deputy Secretary
- Ministry of Industry, Joint Secretary
- Dhaka Transport Coordination Board (DTCB), Executive Director
- RAJUK, Chief Town Planner
- Ministry of Environment & Forest, Department of Environment (DOE), DG
- Dhaka WASA, PR & D
- Chief of Department of Dhaka City Corporation (DCC)
  - Conservancy Department
  - Planning Department
  - Engineering Department
  - Solid Waste Management Cell and Counterpart Personnel Unit (CPU)

The role of the committee was to take a comprehensive look at the Study, to indicate the direction of the Study to the Study team, and to coordinate among related departments and ministries. Each member examined the results of the Study, and put it into action what was decided in the committee.

(2) Technical Working Group

Technical Working Group was chaired by the Chief Executive Officer of DCC, and consisted of representatives from the same organizations which dispatch the member of Steering Committee and two representatives of Waste Concern (NGO). The role of the Group was to advise technical directions from each administration to the Study Team and to report the results of discussions to the Steering Committee.

(3) Task Groups

The Task Groups have been placed under the CPU and worked together with the Study Team. The Task Groups are divided into 9 categories as shown in Figure 1.3-1. As the members of the Task Groups, at last 28 DCC officers are appointed. The members of Task Groups undertook the following activities:

- Collection of necessary data
- Formulation of Master Plan
- Feedback of discussed issues to their own sections
- Organizing workshops/seminars and giving presentations in the said events

Table 1.3-1 Counterpart Personnel Assigned

Task Group		Name	Place of Position
0. Supervisor		Commander Sohel Faruquee	Chief Conservancy Officer, Conservancy Department
0. Coordinator		Mr. Anwar Hossain Patwary	SWMC, Coordinator
1. Collection/Transport		Mr. Dewan Md. Shah Alam	Conservancy Department, Deputy Chief Conservancy Officer
		Mr. Khandker Millatul Islam	Transport Department, Manager (transport)
		Mr. Md. Mofizur Rahman Bhuyan	Zone-4, Conservancy Department, Conservancy Officer
2. Treatment/Disposal		Mr. Abul Hasnat Md. Ashraful Alam	Mech. Eng. Division-2, Assistant Engineer (mech.)
		Mr. Ekramul Haque Khandker	Mech. Eng. Division-1, Assistant Engineer (mech.)
		Mr. Md. Rakib Ahmed	Store & Purchase Department, Sub-Assistant Engineer
		Mr. Md. Nazrul Islam Chowdhury	Mech. Eng. Division-2, Sub- Assistant Engineer (civil)
3. Recycling		Mr. Aminur Rahman Biswas	Zone-6, Conservancy Department, Conservancy Inspector
4. Industrial Waste		Mr. Jahir Uddim Patwary	Mech. Eng. Div.-2
5. Medical Waste		Dr. Mustafuzur Rahman	Zone-2, Health Department, Assistant Health Officer
6. GIS		Mr. Md. Sirajul Islam	Urban Planning Department, Architect
		Mr. Dilbahar Ahmed	Urban Planning Department
7. Institution/ Legal System & Finance/ Management	**Institution/ Capacity Building**	Mr. M. A. Bari	Establishment Department, Assistant Secretary
		Mr. Md. Nesar Uddin	Establishment Department, Assistant Secretary
	Legal System	Mr. Qazi Saifuddin Ahmad	Conservancy Department, Assistant Chief Conservancy Officer
		Mr. Arefin Chowdhury	Legal Officer (being transferred from LGRD &C)
		Mr. Afzarul Azam Reza	Children's Park
	Finance & Management	Mr. Belal Hossain	Account Department Account Officer (budget)
		Mr. Yousuf Ali Sardar	Zone-10, Taxation Department, Taxation Officer
8. Public Participation		Mr. Md. A. N. M. Iftekarul Haque	Zone-8, Eng. Department, Sub- Assistant. Engineer (elec.)
		Mr. Md. Abdul Motaleb	Zone-4, Conservancy Department, Conservancy Inspector
		Mr. Siddiquir Rahman	Mech. Eng. Division-1, Inspector
		Mr. Shafiqul Islam	Ward-33, Conservancy Inspector
		Mr. Shahidul Islam	Ward-65, Conservancy Inspector
		Mr. Md. Asaduzzaman	Zone-9, Conservancy Supervising Inspector
		Mr. Md. Anwar Hossain	Urban Planning Department
9. Public Awareness	**Public Awareness**	Mr. Md. Kuddus Ali	Public Relations Department
	Education	Mr. Qazi Saifuddin Ahmad	Conservancy Department, Assistant Chief Conservancy Officer

1.4 Study Approach

The entire study consisted of three phases as shown in Figure 1.4-1. In Phase 1, the evaluation of existing conditions of SWM in Dhaka City was carried out based on the following steps of study approach:

- hearing and examination of collected data and literatures;
- conducting field survey with the help of subcontractor; and
- organizing workshops and seminars by stakeholders.

The major items evaluated were:

- Existing practice of solid wastes in Dhaka City from source of generation to landfill disposal including technical measures adopted;
- Organizational, managerial and legal structure of DCC for SWM; and
- Community participation, NGO and private sector involvement in SWM in Dhaka City.

This report is prepared summarizing activities of Phase 1 & 2 for a review of TWG and Steering Committee.

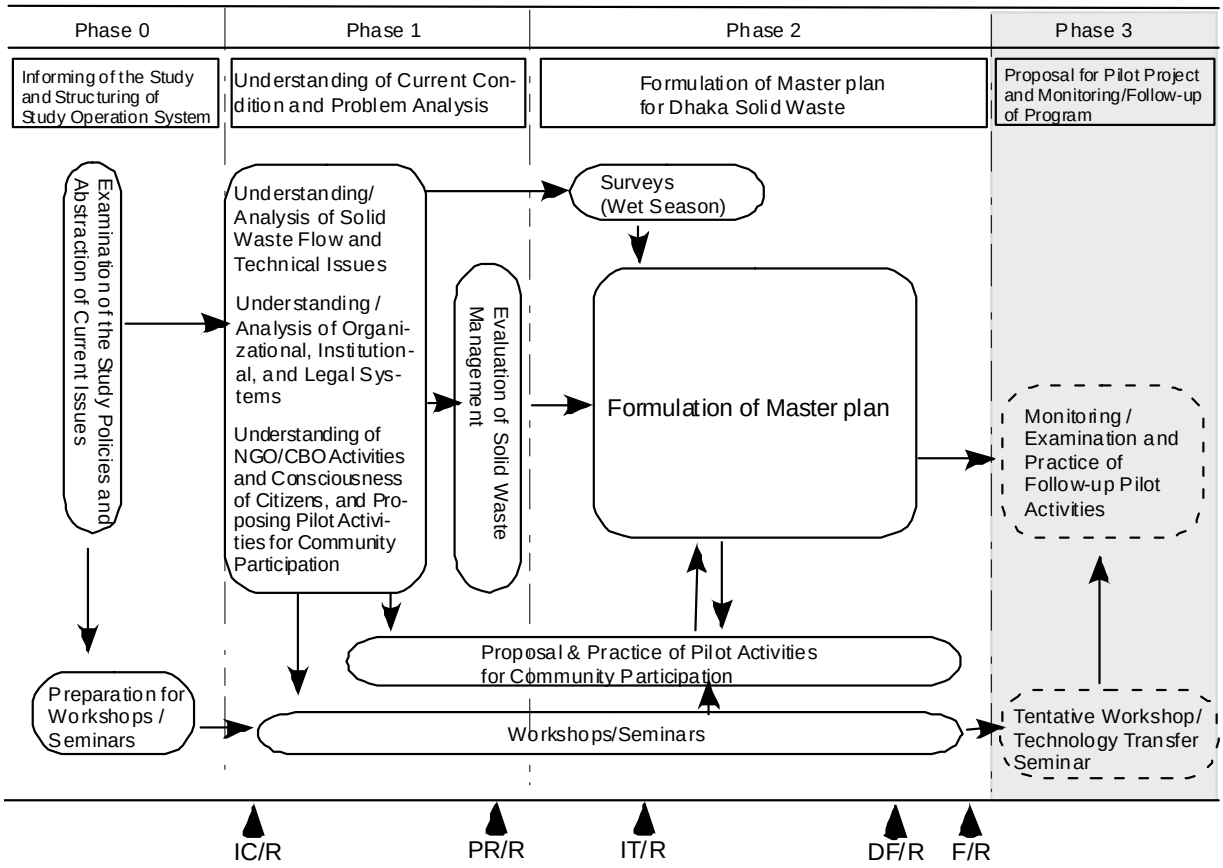


Figure 1.4.1 Entire Work Composition

1.5 Work Schedule

The work schedule of the Study is presented in Figure 1.5-1 up to the end of Phase 2.

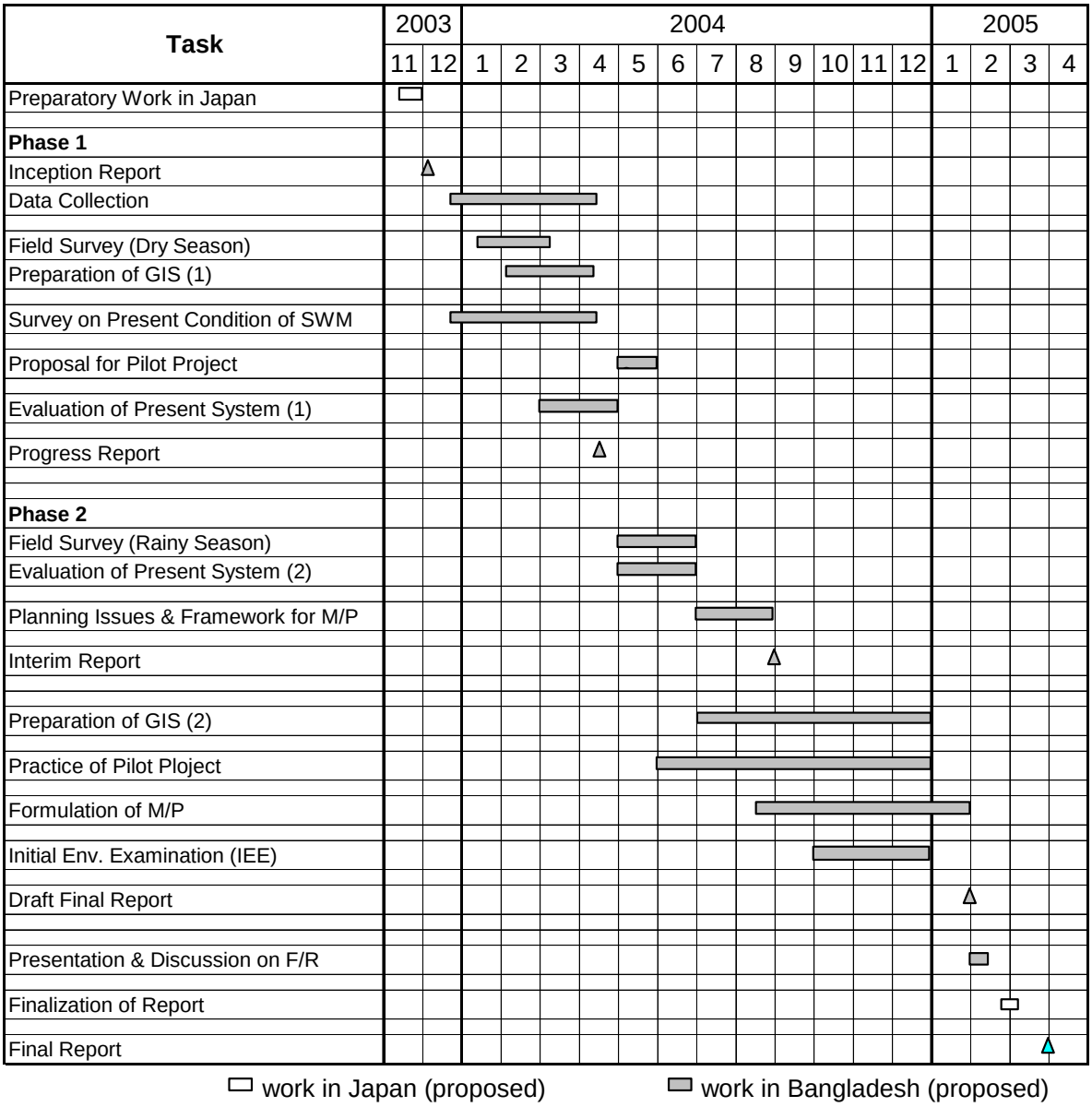


Figure 1.5-1 Work Schedule

1.6 Major Activities

1.6.1 Phase 1

In addition to hearing and observation of the present situations, the following field surveys were conducted to acquire original data on the present status of SWM in Dhaka City.

(1) Committee Meeting

- Technical Working Group (TWG) Meeting on Inception Report, held in December 2003
- Steering Committee (SC) Meeting on Inception Report, held in January 2004
- TWG/SC Meeting on revision of study schedule, held in March 2004

(2) Surveys on Solid Wastes (dry season)

- Waste Generation Amount (dry season): sampled from 250 houses + 50 others for 8 consecutive days
- Waste Composition (dry season): 300 samples from 10 areas and 30 samples from vehicles and synthesized 60 test samples
- Time & Motion of Secondary Collection (dry season): 18 modes of transport were surveyed
- Recycle Market: 20 business units related to recycling were interviewed
- Water Quality in and around 2 Dumping Sites: 3 samples from groundwater and 4 samples from surface water were tested

(3) Surveys on Awareness of Stakeholders related to SWM

- Awareness of Residents: 340 residents were interviewed
- Awareness of Business Units: 60 units were interviewed
- Working Conditions of Waste Pickers: 45 at dump site and 25 at container were surveyed
- Working Condition of Workers engaged in SWM: 370 workers were interviewed
- Activities of NGO/NBO engaged in SWM: 20 NGO/CBOs were interviewed

(4) Workshops and Seminars

- Workshop on identification of stakeholders of SWM, held in December 2003
- Workshop on analysis of problems in SWM, held in February 2004
- Logo/Mascot Contest for School Children, held in January 2004
- Seminar on role of community participation in SWM, held in March 2004.
- Exhibition of Logo & Mascot at Children Park, held from April to May 2004

1.6.2 Phase 2

(1) Committee Meeting

- TWG/SC Meeting on Progress Report, held in April 2004
- Presentation to LGRD Minister of urgent proposal on institutional reform and pilot projects, held in June 2004
- SC Meeting on Interim report, held in September 2004

(2) Surveys on Solid Wastes (wet season)

- Waste Generation Amount (dry season): sampled from 250 houses + 50 others for 8 consecutive days
- Waste Composition (dry season): 300 samples from 10 areas and 30 samples from vehicles and synthesized 60 test samples
- Time & Motion of Secondary Collection (dry season): 18 mode of transport were surveyed
- Water Quality in and around 2 Dumping Sites: 3 samples from groundwater and 4 samples from surface water were tested

(3) Pilot Projects

- Ward level waste management activity as Pilot A
- Management information Acquisition as Pilot B

(4) Workshops and Seminars

- Stakeholder Seminar on Institutional Reform for SWM in Dhaka, held in June 2004
- Training Seminar on Role of Citizens and Community in SWM, held in August 2004
- Workshop on Technical Evaluation of SWM, held in September 2004
- Workshop on Medical Waste and Zone-wise Waste Collection, held in September 2004
- Stakeholder Seminar on Proposed Structure of Master Plan, held in December 2004
- Community Seminar on Dissemination of Pilot Project A, held in February 2005
- Stakeholder Seminar on Draft Master Plan, held in February 2005
- Training Seminar on Data Coding and Database Handling, held from February 13 to 17, 2005

Chapter 2

Present Situation of Solid Waste Management in Dhaka City

2.1 Waste Generation

(1) Unit Waste Generation Rate

The Study Team conducted waste generation source survey in dry and wet seasons to obtain the unit waste generation rate of domestic waste and business waste. The results of surveys are shown in Table 2.1-1. The average waste generation rate from domestic source proved to be 0.34 kg/c/day.

Table 2.1-1 Survey Results of Unit Waste Generation Rate

Domestic Waste				
sources	income level (Tk/month/family)	Rate (kg/person/day)		
		dry	wet	average
High Income Group	>=20,000	0.588	0.438	0.513
Middle Income Group	20,000>, >=10,000	0.371	0.428	0.400
Middle-Low Income Group	10,000>, >=5,000	0.279	0.346	0.313
Low Income Group	5,000>, >=3,000	0.326	0.345	0.336
Lowest income group	3,000>	0.314	0.205	0.260
weighted average	kg/person/day			0.340
Business Waste				
sources	unit	dry	wet	average
Restaurant	kg/place/day	24.0	23.6	23.8
Shops	kg/place/day	0.9	0.8	0.9
Hotel	kg/place/day	11.0	19.6	15.3
Office	kg/place/day	2.4	5.6	4.0
Market	kg/m^2/day	0.91	1.31	1.11
Street waste	kg/km	344.5	384.5	364.5

Source: Waste Generation Survey, JICA Study Team

(2) Waste Generation Volume

a) Domestic Waste

As of 2004, the total solid waste amount from domestic source is estimated at 1,945 t/d generated by the population of 5.728 million with average generation rate of 0.34 kg/person/d.

b) Business Waste

As of 2004, the total solid waste amount from business sources is estimated at 1,035 t/d based on the survey conducted in this study as shown in Table 2.1-2. The waste generated by non-resident people coming to Dhaka is considered as being contained in this categories of waste and street waste stated hereunder.

Table 2.1-2 Estimate of Business Waste Generation

Business Category	Number	Area (m^2)	(kg/place/d)			Waste Volume (t/d)
			Dry	Wet	Average	
Restaurant	2,283		24.0	23.6	23.8	54
Shop	56,967		0.9	0.8	0.9	51
Hotel	642		11.0	19.6	15.3	10
Office	52,831		2.4	5.6	4.0	211
Market	26,550	457,367	0.907*	1.313*	1.110*	508
Factory	4,336					200
Total	143,609					1,035

*: ($kg/m^2/d$)

Source: Number of sources is referred to the licensing list of Revenue Department of DCC and the rest are from the JICA Study Team.

c) Street Waste

In Dhaka City, DCC is cleaning the street by deploying approximately 5,000 cleaners. During the survey of unit waste generation of street waste, it was estimated that on average, one sweeper sweeps 110 m of road length. Average volume of street waste is assumed at 365 kg/km of road length as shown in Table 2.1-1. Hence, the road length, which is swept by 5,000 cleaners in a day, is estimated to be 550 km and the amount of waste is estimated at 200 t/d (0.365 t/km x 550 km = 201 t/d).

d) Total Waste Generation

As the total of above mentioned two wastes, namely domestic waste and business waste, approximately 2,980 t/d of waste on average is generated in a day. By rounding up the figure to 3,000 t/d from fixed sources, the total generation amount in Dhaka City is estimated at **3,200 t/d** with the amount from fixed sources is shared by domestic source and business source at 65% and 35%, respectively, as follows.

- domestic waste: 1,950 t/d
- business waste: 1,050 t/d
- street waste: 200 t/d

(3) Present Waste Generation Amount by Zone

The waste generation amount by Zone is shown in Figure 2.1-1. The zonal average of waste generation is estimated at 320 t/d with the maximum at approximately 460 t/d in Zone 8 and the minimum at 43 t/d in Zone 10. The zonal waste generation reflects the population size and business activities in each zone.

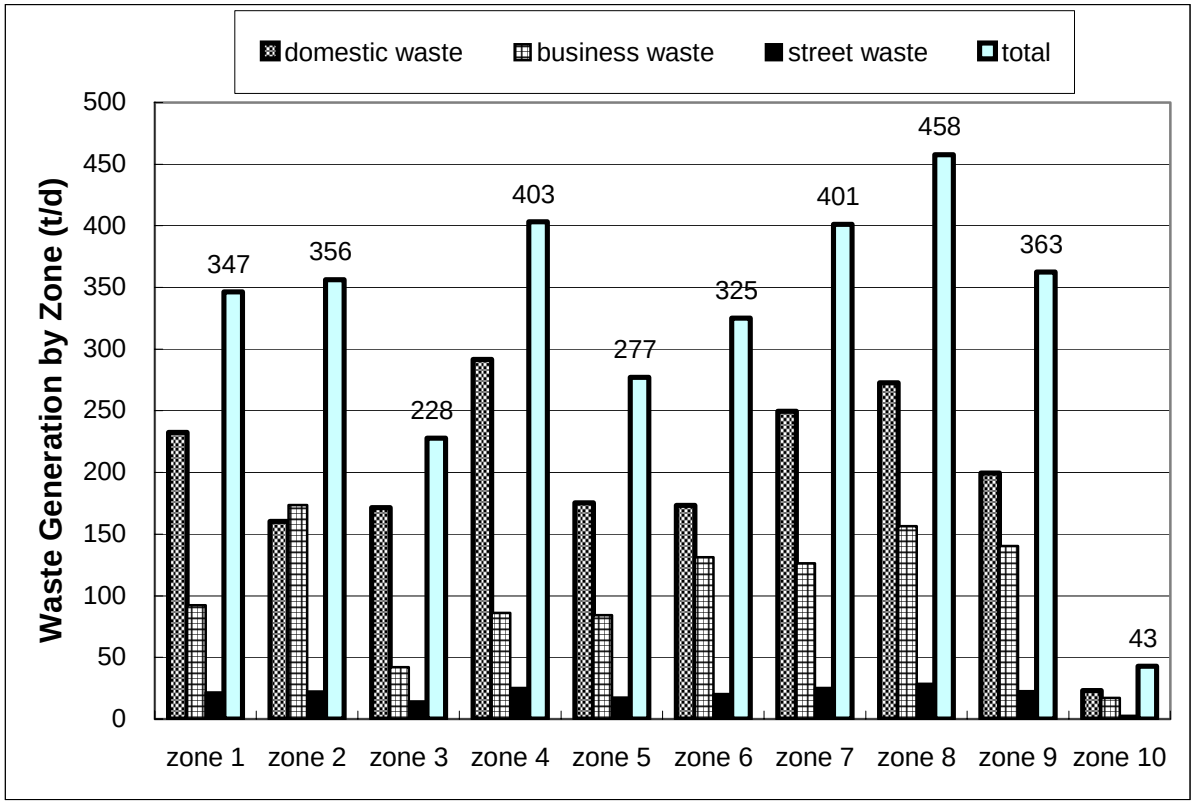


Figure 2.1-1 Assumed Waste Generation Amount by Zone

(4) Incoming Waste Amount: Waste Amount Transported to the Disposal Sites

Table 2.1-3 shows the result of the survey. The total incoming waste to the disposal sites varies from 970 t/d in dry season to 1,420 t/d in wet seasons. The capacity of secondary collection is assumed at **1,400 t/d** as the maximum level of performance during the waste amount survey the Study Team conducted. The capacity reflects the amount and quality of human and material resources as well as traffic condition to the dumpsites across the city. The capacity can be varied by changing input volume and quality of resources in accordance with the demand in the future.

Simultaneously, the incoming numbers of collection and transport vehicles increases from 350 trips in dry season to 525 trips in wet season. The increase ratio of numbers of trips in wet season is exactly 150%. On average, Matuail accounts for 65%, Berri Band accounts for 30% and Uttara accounts for the remaining 5% in weight of the collected waste.

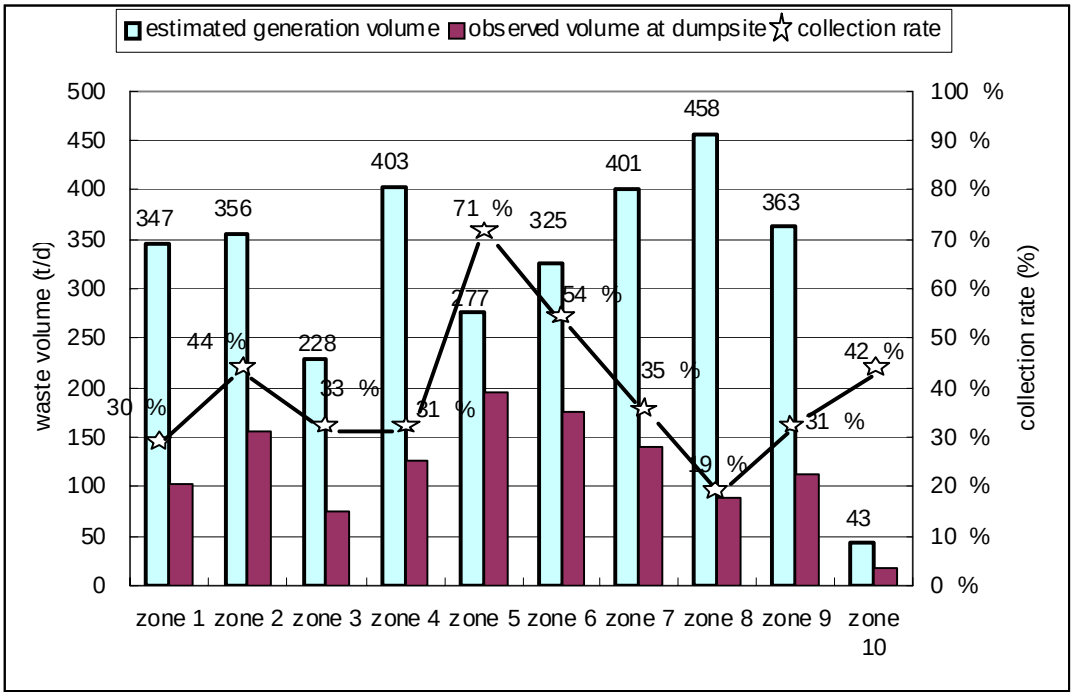
Table 2.1-3 Incoming Waste Amount to Disposal Site (t/d)

Survey time	Matuail		Berri Band		Uttara		total	
	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)
Dry season	649	226	313	122	6	2	969	350
Wet season	913	338	399	153	104	33	1,416	525
Average	781	282	356	138	55	18	1,193	437
	65 %	65 %	30 %	32 %	5 %	4 %	100 %	100 %

Source: JICA Study Team

Figure 2.1-2 indicates the daily average of incoming waste amount to the three disposal sites. Regarding the collection ratio between the estimated generation amount and the observed incoming amount, Zone 5 shows the highest collection ratio at 76%, while Zone 8 shows the lowest at 9%. The average collection ratio in the survey period is estimated at 40% approximately.

The gap of collection ratio between Zone 5 and Zone 8 is caused by the following reasons, according to higher officials of Conservancy Department. Zone 5 is located in Old Dhaka and Zone 8 in newly developed area in the north. Zone 5 is separated from the river and has no water surface in the area. They understand that the severe spatial restriction lies in Zone 5, which does not leave much space for storing waste for long periods by the time of secondary collection. There is much less space for voluntary dumping in the area. The situation in Zone 8 is in quite a contrast to Zone 5: the area faces the Briganga River and has abundant wetland and ponds just beside the urbanized area. There is still more space that can be used for temporary or voluntary storage of waste in Zone 8 that leads to low collection ratio in the area.



Source: Waste Amount Survey, JICA Study Team

Figure 2.1-2 Incoming Waste Amount and Estimated Waste Generation Amount

(5) Physical Composition of Waste

a) Domestic Waste

Domestic waste abounds in organic waste including food waste and its content becomes higher in rainy season than dry season. The food waste portion varies on average from 66% in dry season to 68% in wet season. The organic waste (paper, food waste, wood and grass) appears to be more than 80% in the domestic waste throughout the year. The survey result is shown in Table 2.1-4

b) Other Waste

The composition survey of commercial waste (others) indicates that the rainy season's food waste weight percentage and dry season's are almost the same. The survey result also indicates that the food waste weight percentage of restaurant is the highest of the other four categories. Paper content of public facilities is also the highest. Weight percentage of sand and dust of street waste is quite higher than the others.

Table 2.1-4 Physical Composition of Waste

source category	Income Level	Composition (%)					
		Paper	Food Waste	Wood & Grass	Plastics	Sand & Dust	Others
Dry Season							
Domestic waste by income group	Upper g.	12	49	21	2	1	15
	Middle g.	6	80	0	1	1	13
	Lower g.	4	71	1	2	17	5
	average	**7**	**66**	**7**	**2**	**6**	**11**
Business waste	Restaurant	2	97	0	0	0	1
	Shop, Hotel	4	89	1	1	0	5
	Market	5	53	23	3	6	9
	Public Faclity	35	19	25	0	14	7
Street waste		2	4	10	0	73	11
Wet Season							
Domestic waste by income group	Upper g.	13	64	8	6	0	9
	Middle g.	10	72	4	8	0	7
	Lower g.	8	69	10	4	4	5
	average	**10**	**68**	**7**	**6**	**1**	**7**
Business waste	Restaurant	3	96	0	1	0	0
	Shop, Hotel	8	89	0	2	0	2
	Market	3	67	16	1	4	8
	Public Faclity	31	19	14	11	20	4
Street waste		1	11	16	1	60	10

Source: JICA Study Team

(6) Apparent Bulk Density

The survey results indicate that apparent bulk density ranges from 0.1 to 0.2 t/m^3 for domestic waste and 0.1 to 0.6 t/m^3 for business waste throughout the year. The average of apparent bulk density is 0.24 t/m^3. The survey results are shown in Table 2.1-5.

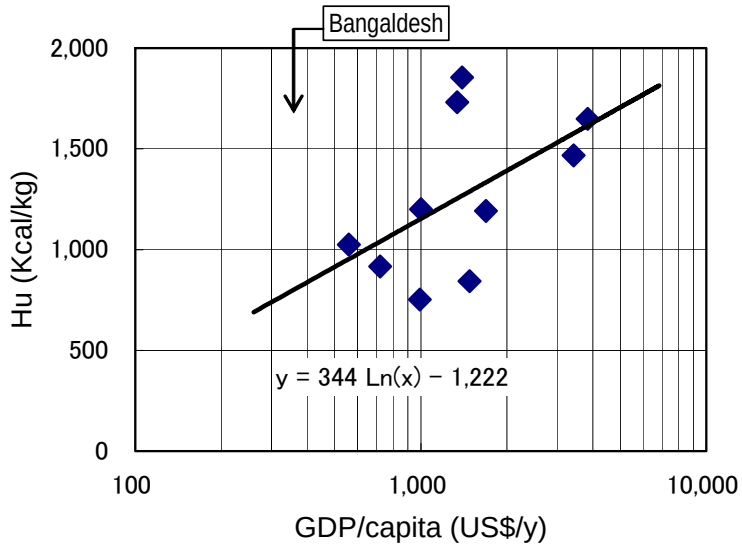
Table 2.1-5 Apparent Bulk Density of Waste

survey time	source category	Income Level	Bulk Density (t/m^3)	average (t/m^3)
Dry Season	Domestic waste by income group	Upper g.	0.14	
		Middle g.	0.12	
		Lower g.	0.10	
	Business waste	Restaurant	0.62	0.24
		Shop, Hotel	0.19	
		Market	0.42	
		Public Faclity	0.09	
	Street waste		0.24	
Wet Season	Domestic waste by income group	Upper g.	0.13	
		Middle g.	0.20	
		Lower g.	0.11	
	Business waste	Restaurant	0.41	0.23
		Shop, Hotel	0.22	
		Market	0.11	
		Public Faclity	0.36	
	Street waste		0.35	

Source: JICA Study Team

(7) Moisture Content

The moisture content analyzed ranges from 65% to 80% for the mixture of waste on average. Based on the value of the moisture contents, the lower calorific value (Hu) is calculated at 550 to 850 kcal/kg. This value indicates that the average waste in Dhaka does not sustain combustion without support of auxiliary fuel. The self-combustion requires 1,200 kcal/kg of Hu. Much less applicable technology is power generation. That requires at least 1,500 kcal/kg of Hu. The relationship between GDP/capita and Hu (28 countries) is shown in Figure 2.1-3. In general Hu value increases as GDP/capita grows.



sources: JICA Studies in cities, Budapest, Sofia, Poznan, Bucharest, Almaty, Guatemala, Asuncion, Tegcigalpa, Ujun Pandang, Jakarta

Figure 2.1-3 Relationship Between GDP/capita and Lower Calorific Value (Hu)

2.2 Primary Collection

(1) Primary Collection in Waste Collection System

In Dhaka City, waste collection consists of two parts, namely primary collection and secondary collection (see Figure 2.2-1). DCC is 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. NGOs/CBOs/private sector provide primary collection services to collect waste door-to-door and transport the waste to dustbins/containers, or sometimes to vacant lands, by rickshaw vans. At present, NGOs/CBOs/private initiative primary collection services are prevalent in wide areas of Dhaka City.

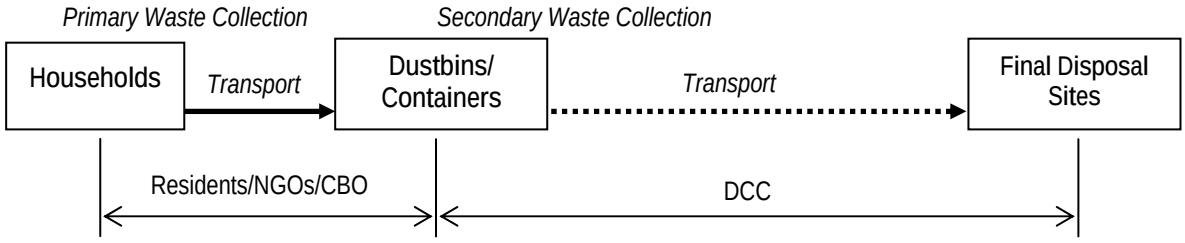


Figure 2.2-1 Waste Collection System in Dhaka City

(2) Responsibility of Primary Collection according to Dhaka City Corporation Ordinance

Dhaka City Corporation Ordinance[1] is the basic law regarding street/drain cleaning, waste collection and transportation. According to Section 78 of the Ordinance, DCC is allowed to provide dustbins or other receptacles at suitable places, and to require residents to bring their waste to the dustbins or receptacles. However, it is not clearly mentioned who takes responsibility of primary waste collection where such dustbins or receptacles are not provided.

(3) NGOs, CBOs and private initiatives in Primary Waste Collection

Recently door-to-door waste collection activities are prevailing in Dhaka City, due to high pressure of population growth. Various local civil societies or CBOs duplicated the system of door-to-door collection introduced in Kalabagan in 1987. It is said that more than 130 organizations were providing the door-to-door waste collection services in 1999.[2] However, it is difficult to grasp the accurate overall number of the organizations/persons engaged in door-to-door waste collection or the coverage of their services in Dhaka City. A variety of organizations and individual persons are working in this field in large to small scale, in many cases using only one or two rickshaw vans, and the number is still increasing (see Photo 2.2-1).

Primary collection is a labor-intensive work that uses rickshaw vans usually manned with one van driver and one to two helpers. They go to each house, collect waste from residents and

[1] Dhaka City Corporation Ordinance was promulgated by the Chief Martial Law Administrator on 24 August 1983.
[2] Decentralized Composting, Waste Concern

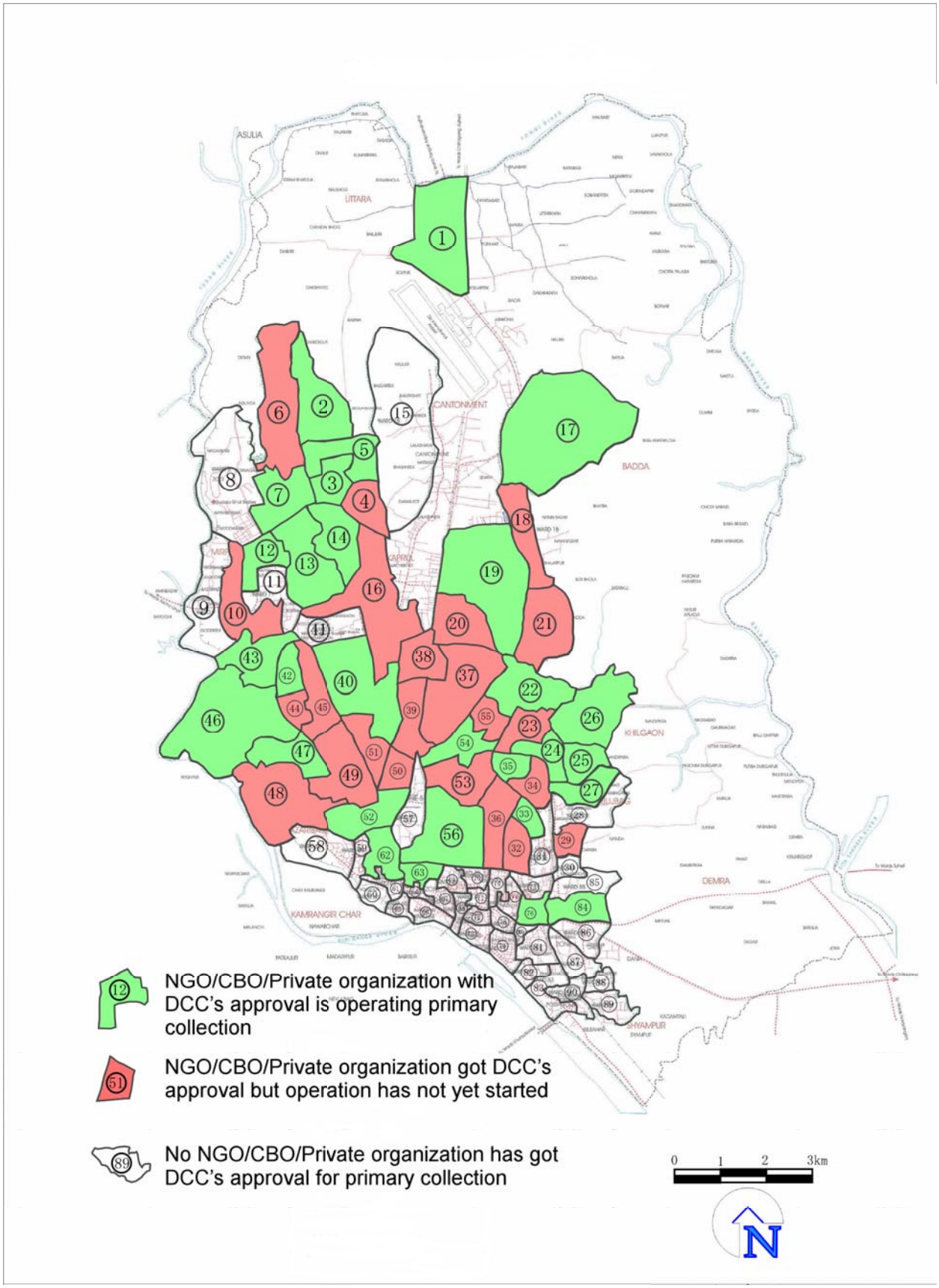
put the waste into the rickshaw van. In some areas, residents bring their waste to rickshaw vans using buckets/bags by themselves. After collecting waste from house-to-house, the rickshaw drivers and helpers dispose of the waste in DCC dustbins/containers, or at vacant lands. Some rickshaw van drivers complain that they cannot dispose of the waste in containers because they are already full of waste and the residents nearby complain to them if they dump the waste beside the container. Dumping the waste to the vacant lands, however, means dealing with slum dwellers who then complain to them, so they change the places to offload waste from time to time.

Photo 2.2-1 Various Designs of Rickshaw Vans Used for Primary Collection

(4) Approval of NGOs/CBOs for Primary Collection by DCC

In 2002, DCC introduced an approval system of NGOs/CBOs/private organization for providing door-to-door waste collection services ward-wide. At present, Chief Conservancy Officer has authority to sign the approvals. DCC was aiming at systemizing the primary collection through re-organizing various types and size of organizations/individual engaged in this job. Therefore, DCC gives the approvals to only those who have capacity to provide services basically in a whole ward, in some exceptional cases half or part of a ward. Organizations submit proposals and DCC evaluates those proposals and approves them.

At present, DCC has given approvals to 47 NGOs/CBOs to work in 57 areas, covering 52 Wards. Not all NGOs who got approvals have started their activities. At least 19 NGOs, members of Bangladesh Integrated Environment Development Forum (BIEDF), have not yet started the activities according to BIEDF (see the next section in this chapter). Figure 2.2-2 shows the distribution of NGOs/CBOs with DCC approval for Primary Collection.



Source: DCC Conservancy Department and BIEDF

Figure 2.2-2 Distribution of NGOs/CBOs with DCC Approval for Primary Collection

(5) Coordination among NGOs/CBOs engaged in Primary Collection Services

BIEDF is an NGO that functions to coordinate between member NGOs working in the field of solid waste management, DCC, and other related organizations. With the support of BIEDF, 35 member NGOs got approvals of providing door-to-door waste collection services from DCC, covering 40 areas in 38 wards. This means 74% of NGOs that received approvals are members of BIEDF.

(6) Role of Ward Commissioners in Primary Collection

Ward commissioners/female commissioners are a key in the local level activities. Ward commissioners play important roles in mediation and coordination among different organizations. Ward commissioners support the organizations to implement the activities, and in some wards, they themselves are taking initiatives to provide door-to-door waste collection services in their wards.

However, in some wards, ward commissioners disturb the activities of door-to-door waste collection carried out by NGOs or local CBOs in order to exercise their power over solid waste management and to be involved in the business of waste collection. Without ward commissioner cooperation and support, the service providers will face difficulties in getting cooperation from local people or continuing the service.

(7) Services Coverage of Primary Collection at the Ward Level

Figure 2.2-3 shows the types of coverage of primary collection service at the Ward level.

a) Type A: Full Coverage by one to two NGOs.

This type is desirable condition of DCC's initial idea that NGO/CBO approved by DCC would provide primary collection service in whole ward.

b) Type B: Partial Coverage by various local organizations

This type has been typical situation of wards in Dhaka City except Old Dhaka. Some areas are left with no primary collection services provided.

c) Type C: Full Coverage by various local organizations

This type is the progressed situation of Type B, becoming a typical situation in Dhaka City, except in Old Dhaka. The number of service providers has been increasing to the extent of covering whole areas in some wards.

d) Type D: Informal door-to-door collection by DCC cleaners

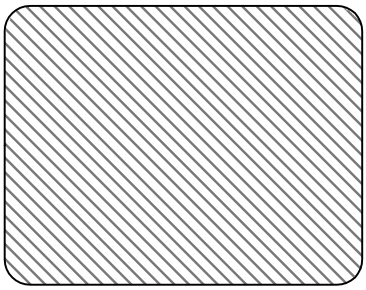
This type is typical in the wards in Old Dhaka. Two types of primary collection are seen in Old Dhaka. One is managed by *Ponchayt*, a traditional neighborhood association. The *Ponchayts* collect fees from residents to pay DCC cleaners for their services. Another is based on the individual agreement among DCC cleaners and the residents.

e) Type E: No primary collection services

This type is not seen in any ward in Dhaka City. Primary collection services provided by NGOs/CBOs are now prevailing in every part of Dhaka City.

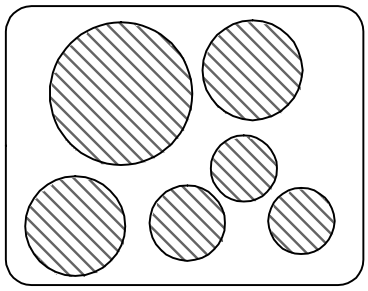
Type A:

Full coverage by one to two NGOs



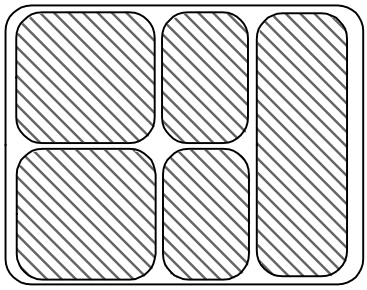
Type B:

Partial Coverage by various local organizations



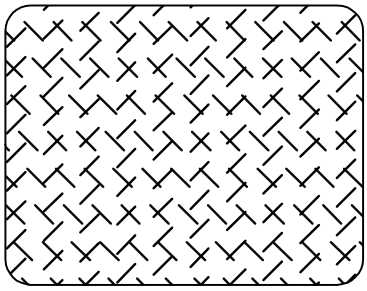
Type C:

Full coverage by various local organizations



Type D:

Informal door to door collection by DCC cleaners



Type E:

No primary collection services

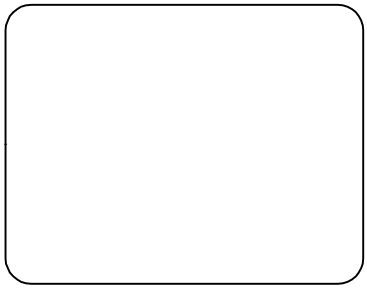


Figure 2.2-3 Types of Service Coverage of Primary Collection at the Ward Level

(8) Service Charge for Door-to-Door Waste Collection by NGOs/CBOs

Service charge is different depending upon the area for different income group. The following table shows three different service charge systems in different income areas. In case of high income group, such as Gulshan and Banani, Door-to-Door service provider even carries garden waste also.

Table 2.2-1 Service Charge for Door-to-Door Collection Service

Income	Area	Service Charge (per month) (Tk)
High	Gulshan Banani (Ward 19)	Hotel 500-1,000 Resident -Rich 100-300
Middle & Low	Khilgaon (Ward23)	Resident -Middle 10 -Low 10 or free
Middle & Low	Mirpur (Ward 6)	Resident -Middle 20 -Low 10 or free Industry 100-500

Source: Interview Survey by JICA Study Team

2.3 Secondary Collection/Transport and Road/Drain Cleaning

(1) Organization and Activity for Secondary Collection and Transport

a) Task of DCC

According to DCC Ordinance of 1983, DCC has the responsibility for secondary collection as well as proper disposal of waste. From Zone 1 to Zone 4, all of garbage is transported to Matuail landfill site while Zone 5 to Zone 9 use both Matuail and Berri Band landfill site (Gabtoli). Waste from Zone 10 is dumped at Uttara landfill site.

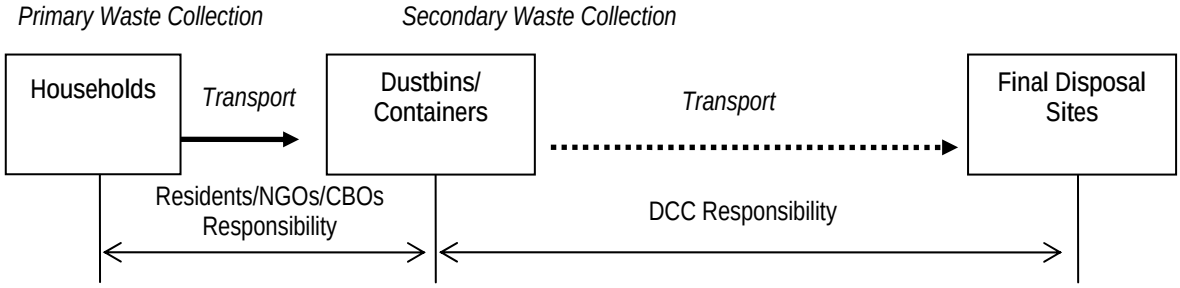


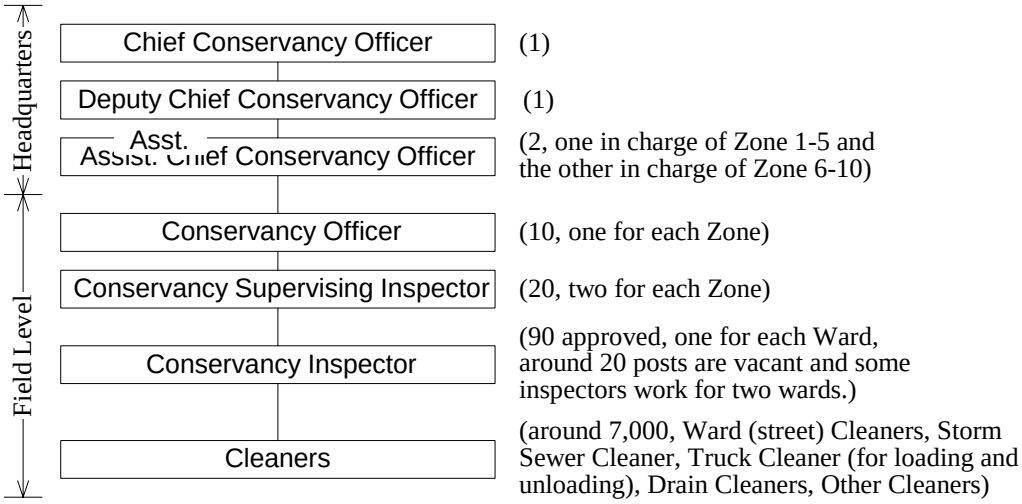
Figure 2.3-1 Waste Collection System in Dhaka City

b) Relevant Organizations

Conservancy Department

Conservancy Dept. is the core organization for solid waste management and is in charge of street and drain cleaning, carrying street and drain waste to dustbins/containers, and loading and unloading of waste to and from truck at places of dustbins/containers and

disposal sites. Conservancy Dept. comprises a predominant portion of field workers and very few officers for planning and administration at headquarters.



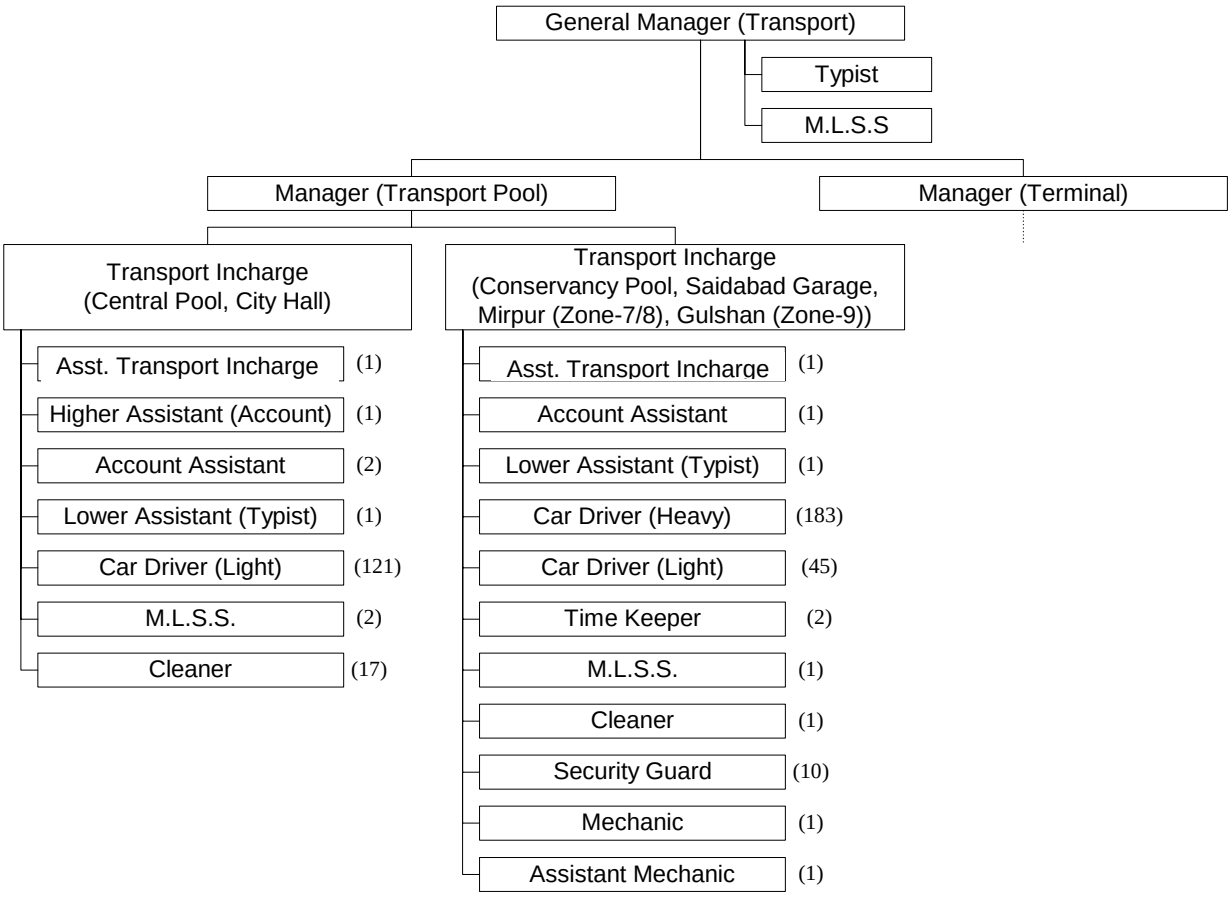
Source: DCC

Figure 2.3-2 Organization of Conservancy Department

Transport Department

Transport Dept. comprises two parts: one for operation of vehicles of DCC and the other for management of bus and truck terminals. The part for vehicle operation is composed of central pool and conservancy pool. The conservancy pool is in charge of transportation of waste from dustbins/containers to disposal sites. Transport Dept. also consists of a large portion of field staff and a small number of officers at the headquarters. Recently, the manager of conservancy pool has been temporarily placed under the Chief Conservancy Officer (CCO), the head of Conservancy Dept.

The number of drivers in the Conservancy Pool is less than the number of open trucks and container carrier. Some drivers are working two shifts to cover the insufficiency.



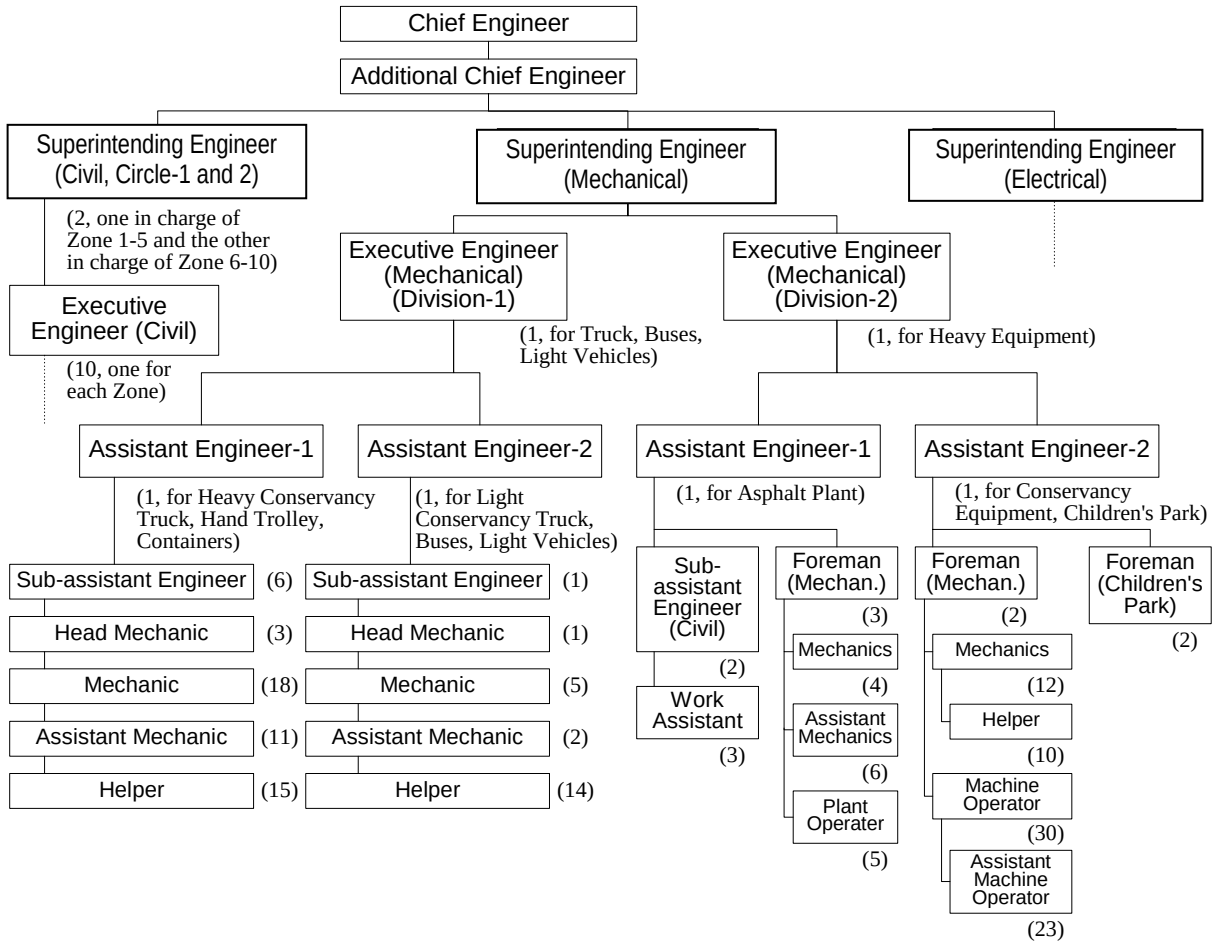
Source: DCC

Figure 2.3-3 Organization of Transport Department

Engineering Department

Engineering Dept. is involved in solid waste management for repair of transport vehicles and heavy equipment used in disposal sites through respective workshops. Mechanical engineering division is divided into two: Mechanical Division 1 is in charge of repair of transportation vehicles, while Mechanical Division 2 is undertaking repair of heavy equipment operating at disposal sites. Major repair works of transport vehicles are outsourced to private workshops with contracts. Foreman of Mechanical Division 2 gives a kind of instruction to heavy equipment operators, who also belong to the Division. Mechanical Division 1 also is in charge of manufacturing steel containers at demands of the Conservancy Dept.

Civil Engineering Circle in Engineering Dept. is also involved in the field of facility construction and site development for waste disposal. The organization of the Circle takes Zone system, where respective Executive Engineers (Civil) deployed to a Zone takes care of civil works of the Zone.



Source: DCC

Figure 2.3-4 Organization of Engineering Department

Store and Purchase Department

Store and Purchase Dept. procures conservancy appliances, such as brooms and baskets, at the demands of the Conservancy Dept. Store and Purchase Department also purchases spare parts for vehicles and equipment.

NGOs, CBOs and the Private Sector

Privatization is applied through outsourcing some services of DCC. In some wards of Zone 9 and 10, services of streets/drain cleaning and transportation of waste from dustbins to disposal sites are outsourced to two NGOs (Bangladesh Integrated Environmental Development Forum (BIEDF), and Mission of Rural Urban Development (MIRUD)) and two private companies (LN Corporation and Messer's Rhythm). A substantial portion of major repair works of conservancy vehicles and heavy equipment is also outsourced to private workshops.

c) Deployment of Manpower and Vehicles for Collection/Transport

<1. Regulatory Basis of Deployment >

There are neither regulations, by-laws/guidelines for installation of dustbins and container nor public notice. According to DCC officers, Ward Commissioners make a request to the Mayor for the installation of such receptacles. When the Mayor approves the request, the order is given to the Conservancy Dept. to install them. The Conservancy Dept. then asks Engineering Dept. to construct the dustbins or to install containers. Currently, DCC has a policy not to construct new dustbins but to replace them with containers. After the installation of the receptacles, respective Ward Commissioners give "public notice" verbally to the residents.

Deployment of additional conservancy vehicles/drivers as well as additional cleaners also starts with requests by Ward Commissioners, followed by the approval of the Mayor.

<2. Manpower Allocation to Collection and Transport Sector>

Manpower allocation is summarized by assignment in Table 2.3-1. Drivers belong to Transport Dept. and Cleaners are under Conservancy Dept.

Table 2.3-1 Assignment and Number of Cleaners and Drivers

Workers category	Assignment	Number	Total	Age
DCC worker				
Road Cleaner	Ward	5,003	6,992 (6.880 cleaners are deployed to Zones and Wards)	15～24＝15%, 24～44＝61%, 45～54＝20%, >55＝4%. Over 64 years = 1.43% (about 100 cleaners). There is no retirement system for Cleaners, so they could spend all their life doing this kind of work. There are many old cleaners in the Road Cleaner group. Comparatively Truck Cleaner and Container Cleaner are younger than Road Cleaner.
Deep Drain Cleaner	Zone	284		
Storm Sewage Cleaner	Zone	119		
VIP Road Cleaner	Zone	178		
Market Cleaner	Zone	425		
Other Cleaner	Zone	19		
Truck Cleaner	Ward	663		
Special Truck Cleaner	Zone	189		
Container Cleaner	Central	112		
Truck Driver	Ward	266	266	Most of them (76%) are between 25-44 years old.
Container Driver	Central			
Private worker	Zone 9 & 10		578	
Road Cleaner		359		
Deep Drain Cleaner		86		
Truck Cleaner		106		
Truck Driver		27		

Source: Conservancy Officers of Zone Office, Inspector Questionnaire Survey conducted by JICA Study Team

Private companies have only Road Cleaners, Deep Drain Cleaners and Truck Cleaners. Zone-wise deployment of cleaners is shown in Table 2.3-2.

Table 2.3-2 Deployment of Cleaners by Zone

Symbol→	A	B	C	D	E	F	G	H	I
Zone No	Road Cleaner	Truck Cleaner	Drain Cleaner	Storm Sewer Cleaner	VIP Road Cleaner	Market Cleaner	Special Truck Cleaner	Other Cleaner	Total
10	65	27	24	0	0	0	0	0	116
9	294	79	62	0	0	0	0	0	445
8	465	33	40	0	20	15	20	0	593
7	460	33	40	0	20	7	19	9	588
6	586	141	25	39	36	132	18	0	977
5	633	121	48	13	50	97	40	10	1,012
4	832	129	44	17	40	49	18	0	1,129
3	565	71	32	12	4	15	8	0	707
2	681	65	25	25	0	78	8	0	882
1	781	70	30	13	8	32	58	0	992
DCC Cleaner (Zone 1-8)	**5,003**	**663**	**284**	**119**	**178**	**425**	**189**	**19**	**6,880**
Grand Total	**5,362**	**769**	**370**	**119**	**178**	**425**	**189**	**19**	**7,441**

Source: Conservancy Dept., DCC

<3. Collection and Transport Vehicles>

There are 343 units of vehicles of DCC allocated for collection and transportation services. The breakdown of the vehicles in operation is shown in Table 2.3-3. These vehicles are placed at three garages: Saidabad, Zone 7 and Zone 8 offices. In addition to DCC vehicles, the four service providers operate 19 to 27 units of 5-ton open trucks in eight wards. Out of 343 units, 60 units are under repair as of September, 2004.

Table 2.3-3 Allocated Number of Collection/Transport Vehicles

Type	Manufacturer/Model	Rated Capacity (ton)	Nos of Vehicle (unit)
Open Truck	Isuzu N.H.R. Japan	1.5	12
Open Truck	Tata 407 India	1.5	71
Open Truck	Isuzu N.K.R. Japan	3	14
Open Truck	Tata 608, India	3	27
Open Truck	Tata 609, India	3	10
Open Truck	Tata 709 India	3	53
Open Truck	Tata 1613, India	5	18
Open Truck	Volvo Belgium	5	8
	Subtotal OT		213
Container Carrier	Ashok Leyland, India	3	81
Container Carrier	Tata 909 India	3	12
Container Carrier	Ashok Leyland, India	5	10
Container Carrier	Volvo Belgium	5	24
	Subtotal CC		127
Trailer Truck	NA	20	3
	Total		343

Source: DCC

The capacity of vehicles was estimated at 2,061 t/d as shown in Table 2.3-4.

Table 2.3-4 Estimated Collection and Transport Capacity of DCC Vehicles

Type and Capacity of Vehicle	Rated Capacity (ton)	Loading Ratio (%)	Nos. of Vehicle (unit)	One Trip (t/d)	Two Trips (t/d)	Four Trips (t/d)	Total (t/d)
Registered Vehicles							
1.5 ton Open/Cover Truck	1.5	100	83	-	249	-	249
3 ton Open Truck	3	80	104	-	499	-	499
5 ton Open Truck	5	80	26	-	208	-	208
3 ton Container Carrier	3	80	93	-	-	893	893
5 ton Container Carrier	5	80	34	-	-	544	544
Subtotal			340	-	-	-	2,393
20 ton Trailer Truck	20	100	3	60	-	-	60
Total			343	60	956	1,437	2,453
Vehicles under Repair							
1.5 ton Open/Cover Truck	1.5	100	16	-	48	-	48
3 ton Open Truck	3	80	21	-	101	-	101
5 ton Open Truck	5	80	2	-	16	-	16
3 ton Container Carrier	3	80	17	-	-	163	163
5 ton Container Carrier	5	80	4	-	-	64	64
Total			60	-	165	227	392
Estiamted Transport Capacity as of September 2004			283	60	791	1,210	2,061

Source: DCC

Note: Assumed frequencies to dumpsite are 2 trips for open trucks, 4 trips for container carriers and 1 for trailer.

<4. Dustbins and Waste Containers>

Total number of waste storage facilities is 1,071 units, which include 688 units of dustbins, 260 units of 6 m^3 containers and 123 units of 12 m^3 containers as summarized in Table 2.3-5. The total capacity of storage is estimated at approximately 1,720 tons. The storage capacity of DCC's dustbins in Zone 9 and Zone 10 is small since the private service providers are engaged in collection and transportation services in the two Zones and the storage capacity of service providers is not included in the list.

Table 2.3-5 Zone-wise Existing Dustbins and Waste Containers of DCC

Zone	No. of Dustbins in Field (units)	Total Capacity of Dustbins	No. of Containers in Field (units)		Capacity of Dustbins & Containers	Conversion to Weight of Waste
	unit	m^3	3 ton: 6 m^3	5 ton: 12m^3	m^3	ton
Zone 1	106	242	17	10	464	116
Zone 2	159	377	60	14	905	226
Zone 3	124	383	17	3	521	130
Zone 4	61	165	49	26	771	193
Zone 5	56	532	52	26	1,156	289
Zone 6	77	606	7	22	912	228
Zone 7	28	204	17	14	474	119
Zone 8	36	160	41	8	502	126
Zone 9	29	1,060	0	0	1,060	265
Zone 10	12	108	0	0	108	27
Total	688	3,837	260	123	6,873	1,718

Source: DCC

Note: These are assumed: size of dustbins at 2 m^3 per unit, bulk density of waste at 0.25 t/m^3.

d) Task of Cleaners and Actual Condition of Work

<1. Overview of Cleaners>

There are six groups of cleaners besides truck/container cleaner as shown in Table 2.3-6. These cleaners also do other tasks than their own subject to the order of the Conservancy Inspector (CI). There are road cleaners and deep drain cleaners in Private Company as well, but they are engaged in wider tasks than DCC cleaners.

Table 2.3-6 Responsibility of Cleaner

Cleaner	Responsibility
Road Cleaner	Road Sweeping Carry waste to bin/container
Deep Drain Cleaner	Cleaning drains/manholes Carry waste to bin/container
Storm Sewage Cleaner	Cleaning drainage pipeline Carry waste to bin/container
VIP Road Cleaner	Road Sweeping for VIP road Carry waste to bin/container
Market Cleaner	Road Sweeping around market Cleaning market place
Other Cleaner	Cleaning parks or lakes and surrounding areas

Source: DCC, Conservancy Dept.

<2. Road Cleaner>

Working Area of Road Cleaning

Responsibility of DCC is cleaning of all of roads in the city except roads located in private land. According to Conservancy Inspector (CI), even very narrow road less than 2 meters wide is also cleaned by DCC, though this kind of narrow road is not cleaned every day. Roads located inside the slum areas are not included in DCC's road cleaning.

Contents of Road Cleaning, Share and Frequency of Works

Road cleaning work consists of sweeping the roads and carrying the waste to bin/container using handcart. CI usually instructs the work location, size and area according to the ability of cleaners. There is no standard amount of work for cleaning work in terms of size and length of road. Therefore, it was found that there are differences and gaps among wards. Examples of frequency of road cleaning are shown below.

Table 2.3-7 Frequency of Road Cleaning

Ward area	VIP	5-10m wide	2.5-5m wide	Narrow >2.5m
Ward 6- New Developed Area	Everyday	Once in 1-2 days	Once in 2-5 days	Once a week
Ward 65 （Old Dhaka）	Everyday	Everyday	Everyday	Once in 1-2 days

Source: Interview of CI by JICA Study Team

Working Hours of DCC Cleaner and Private Cleaner

- DCC cleaners start work earlier than private cleaners as shown in Table 2.3-8.
- Average working time for DCC cleaner is shorter (approximately 4 hours a day), whereas for private cleaners, it is approximately 6 hours a day.

Table 2.3-8 Working Hours of Cleaner

		DCC Cleaner	Private Cleaner
Working hours	7 – 8 hours	0.7 %	25.0 %
	6 – 6.5 hours	15.0 %	46.9 %
	5 – 5.5 hours	9.3 %	21.9 %
	4 – 4.5 hours	45.6 %	6.2 %
	3 – 3.5 hours	22.9 %	null
	2 – 2.5 hours	6.5 %	null
Starting time of work	at 4:00 a.m.	32.8 %	9.4 %
	At 5:00 a.m.	50.7 %	34.3 %
	After 6:00 a.m.	16.5 %	56.3 %
Average working hour		4.12 hours	6.14 hours
Duration of work	- Max	8 hours (6:00-14:00)	8 hrs.（6:00-11:00 & 14:00-17:00）
	- Min	2 hours （7:00-9:00）	4 hrs. （6:00-10:00）

Source: Interview of CI by JICA Study Team

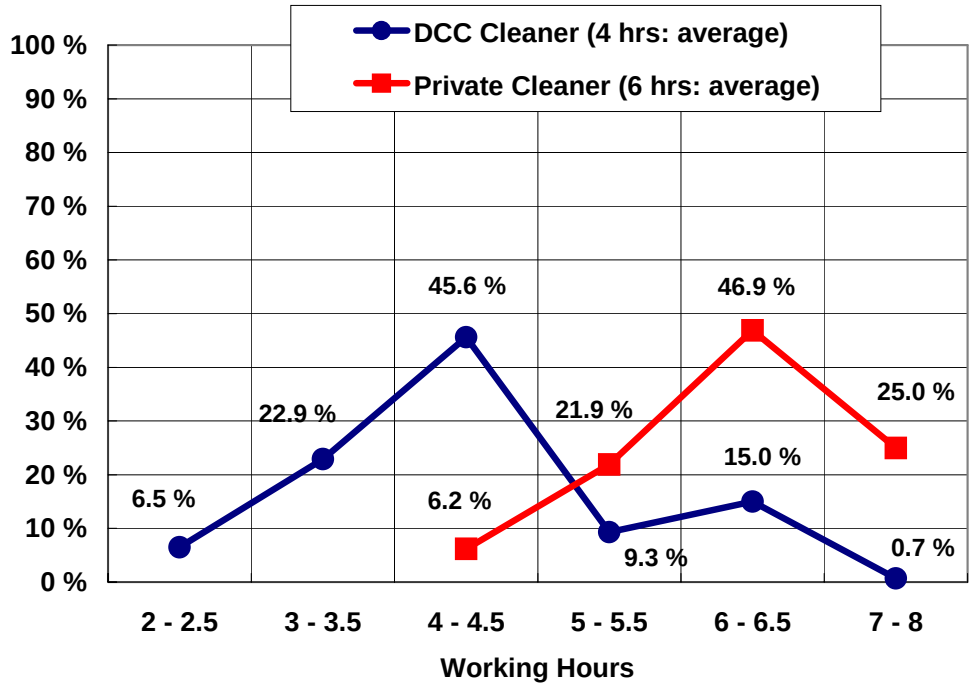


Figure 2.3-5 Comparison between DCC/private in Working Hours of Cleaners

Supervision and Management of Road Cleaning

CI controls assignment of work, checks the attendance and pays the salary. Zone CO and CSI regularly check the work of CI 2-3 times in a month. Attendance checking is done manually in record books. CI submits the record books to zone CO; however, the books are not effectively utilized for monitoring of cleaner attendance.

<3. Drain Cleaner>

Demarcation and Collaboration Work of Drain Cleaning with WASA

DCC is cleaning all of the channels beside the roads and drainage under the footpath and some roads but not the big pipelines. Cleaning of main drainage line is undertaken by Dhaka WASA. Due to lack of communication/information, city people do not know this demarcation of responsibility. So many people claim that DCC, instead of WASA, is the one cleaning the big drainage.

Drainage System in Dhaka

i) Old Dhaka

Shallow channels with about 30 cm wide are commonly installed beside the roads. Because of the limited gradient of the channels, wastewater sometimes floods the town during heavy rain. People are always worried about the channel getting clogged by waste. There are many small (movable) shops over the channels. Stationary shopkeepers also install concrete covers over the channel in front of them, which disturb cleaning of channel below.

ii) Northern Developing Area

Drainage extends behind the houses and they disappear from roadside. There is poor maintenance and cleaning of these drains and many of them are filled with waste.

iii) Slum Areas

There is no infrastructure for drains and sewerage. All of waste including night soil is dropped into the ponds below floors of shanties. These slums are not covered by DCC for cleaning.

Cleaning Mechanism

There are different drains cleaning systems in the city. For example, in Zone 2 of old Dhaka, about ten cleaners form a group to clean the channels/drains. One group takes the waste out of channel/drain while another group takes the waste to the bin/container. The frequency of cleaning is three times in a month for each channel/drain. In another case, CO or CSI instructs the deep drain cleaners and storm sewer cleaners individually to clean the drainage.

Problem of Deep Drain Cleaner's Job

- Many injuries occur from broken glass and metal parts in the drain;
- Obstacles against cleaning over the drainage installed by shopkeeper; and
- Pipelines in the open drain installed by private water supplier.

<4. Truck Cleaner>

There are two kinds of truck cleaners: a truck cleaner who is assigned at ward level and a special truck cleaner assigned at zone level. The task of both cleaners is to load waste from bin to truck and unload waste at dumpsite and cleaning around the bin. One truck is allocated to 3 to 4 truck cleaners. Special truck cleaners do not move to dumpsite but clean around the bin.

Truck cleaners are constantly exposed to hazardous waste such as medical waste, and broken glass, explosive waste, etc. According to the questionnaire survey, 10% of truck cleaners have experienced being injured by broken glass and 20% of them have had jaundice in the past two years. This figure is higher than the other kinds of cleaners. They are not provided with gloves, shoes or mask for protection.

<5. Container Cleaner>

A Container Cleaner's job is to set the container on the container vehicle, and unload the waste at dumpsite. To clean around the container and to assist the driver of container carrier are also the responsibilities of them. Container cleaners were assigned at central level in the past, but now Conservancy Officer of Zone 10 is supervising the work of container cleaners.

The actual working hours of the container cleaner is longer than that of other cleaners so they do not have a chance to work a second job. While about 68% of road cleaners can save some money, only 13% of truck and container cleaners save some money. Container cleaners are also exposed to hazardous waste.

d) Operational Aspects of Secondary Collection and Transport

<1. Synoptic Waste Flow in Dhaka City

The spatial flow of solid waste transport (dry season) is as follows:

- Zone 1 to Zone 4, all of waste is transported to Matuail landfill site
- Zone 5 to Zone 9 use both Matuail and Berri Band dumpsite
- Zone 10 entirely uses Uttara dumpsite

<2. Achievement of Secondary Collection and Transport>

The total incoming waste to disposal sites varies from 970 t/day in dry season to 1,420 t/day in wet season as shown in Table 2.3-9. Thus, present capacity of secondary collection is assumed at **1,400 t/d** as was achieved in wet season. The waste was destined to either of three dumpsites, Matuail, Berri Band (Gabtoli) and Uttara, at the average rate in weight of 65%, 30% and 5%, respectively.

Table 2.3-9 Average Incoming Waste Amount to Disposal Site

survey time	Matuail		Berri Band		Uttara		total	
	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)	waste amount carried (t/d)	No. of incoming vehicle (unit/d)
dry season	649	226	313	122	6	2	969	350
wet season	913	338	399	153	104	33	1,416	525
average	781	282	356	138	55	18	1,193	437
	65 %	65 %	30 %	32 %	5 %	4 %	100 %	100 %

Source: JICA Study Team

(2) Social Conditions of Cleaning Workers

<1. History of Cleaners in Dhaka City>

Initiation of Cleaning Service, Origin of Cleaners

During the British colonial era, the colonial government had brought cleaners from India to Dhaka City. The colonial government commenced cleaning of Dhaka with migration of Cleaner caste from Kanpur and farmer caste from Madras. Both of the groups are people of Hindu religion. Many of their descendants are still working as DCC cleaners.

Expansion of Dhaka and Increase of Cleaners

According to the information of an officer who has been working for DCC since 1971, about 1,000 cleaners were employed at the beginning. Cleaners were increased every five years in time for the appointment of a new mayor. Each time a mayor was appointed, about 500 to 1,000 cleaners were employed additionally. In August 2004, the number reached approximately 7,000. Among them, approximate 18% are Hindu. The positions of cleaners are hereditarily taken over by descendants.

<2. Consciousness of Cleaner>

Consciousness for Education

At present 71% of road cleaners are not educated and many cleaners who are over 30 years old have not had any formal education, but now the children of these people are studying at school. Many parents expect their children, especially the boys, to enter secondary school.

Outlook of Society towards People of the Cleaner Group

The Society looks down upon the cleaners as downtrodden people or people of lower class. This view is even more prominent for those of Hindu religion.

Attraction towards the cleaning job

More than 90% of cleaners want to continue working as cleaner according to the questionnaire survey. The main reasons: they all get to live on colony facilities and they get enough time for an additional job.

<3. Cleaner's Colony>

Location and Usage

Location and list of colonies are show in Figure 2.3-6. Most of the colonies were constructed from year 1960 to 1990. Some 6,300 cleaners are dwelling in colonies including DCC peons and drivers. Approximately 30,000 people are living in the colony, which includes the cleaners and their families.

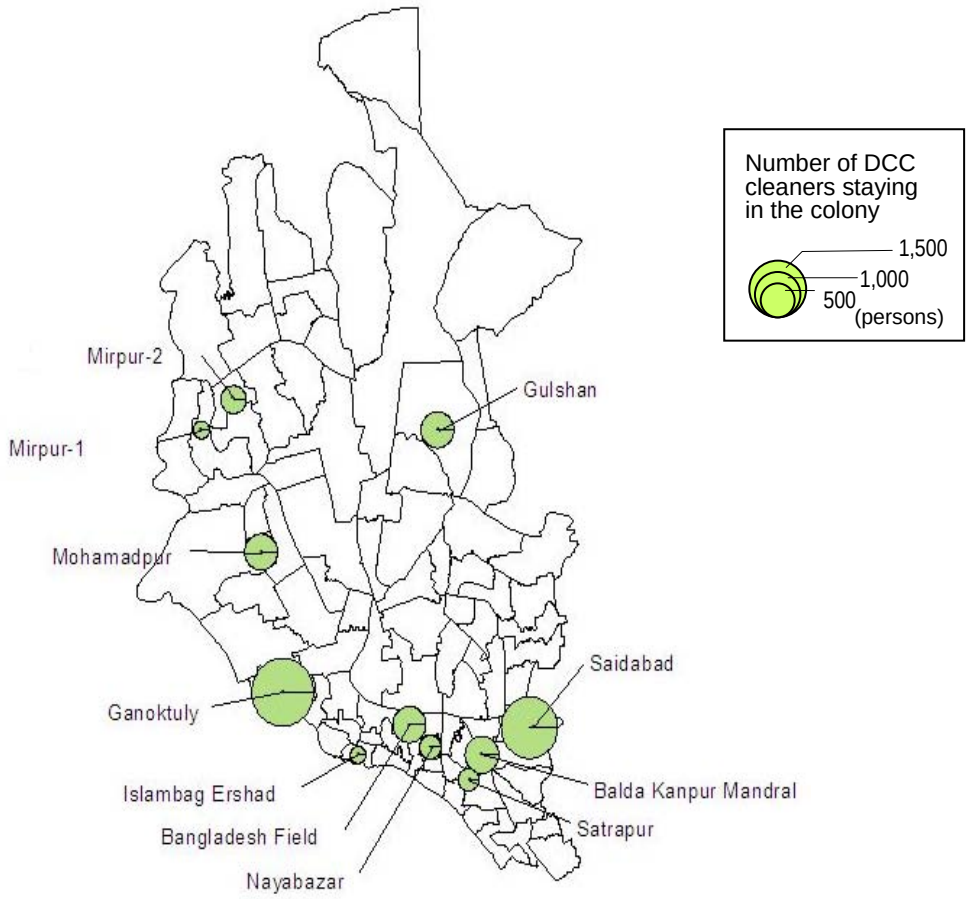


Figure 2.3-6 Location of Cleaner Colony

Uneven distribution of Cleaner Colony

Large numbers of cleaner colonies are located in south zone, which is shown in the above map. There are some problems in the disposition of cleaners and the location of colony. Dhaka City is rapidly expanding and developing from the south, where old Dhaka is situated, to the northern area, where new urban development is taking place. It seems that this growth is very rapid, while the growth of the cleaner colony is slow.

<4. Consciousnesses of Cleaners on Shift to Other Wards>

According to questionnaire survey (350 samples) of the cleaners, 50% of cleaners are willing to shift to nearer wards from where they now live. They mentioned the following problems arising from the shift of place of work to distant areas.

- Have to leave for work very early in the morning: 4:00 to 4:30 a.m.
- Have to spend longer time to go to work, which restricts the possibility of finding a second job
- Commuter cost consumes a significant portion of income and DCC does not give travel allowance

<5. Income Level>

DCC Cleaner

The salary of a cleaner hired on temporary basis ranges from Tk. 2,500 - 3,000 per month. Most of DCC cleaners have second jobs. After finishing jobs as DCC cleaners, they work as rickshaw pullers or street hawkers to sell cigarettes, candy, etc. Income of DCC cleaners is around Tk. 5,000 - 7,000 if they have second jobs. Additionally, house allowance is also allocated to DCC cleaners, thus DCC cleaners are financially better off than other workers, particularly private cleaners.

Table 2.3-10 Comparative Data of Road Cleaner and Other Workers

	Road Cleaner		Garment factory worker		Rickshaw Driver
	DCC	Private	Machine Operator	Assistant	
Salary	Permanent worker Tk. 4,000 (Work 10 years) Tk. 5,200 (Work <20 years) Temporary worker Tk. 2500 (Tk. 85/day)	All temporary-based, Tk. 1,500-2,000	Tk. 2,500	Tk. 1,500	Tk. 3,000-4,000 /month Tk. 100-150/day
Restraint time	4-5 hours	5-7 hours	8 hours	8 hours	8 hours
Housing	Allocates house allowance for Permanent worker; house rent is Tk. 275 for Temporary worker	No subsidy, house rent is Tk. 500-1,000/month			
Remark	Tk. 5,000-7,000 including earnings from second job		Tk. 4,000 including 3 hours overtime	Tk. 2,500 including 3 hours overtime	

Source: Interview by JICA Study Team

DCC Drivers

Drivers have to work overtime every day due to insufficient number of drivers. Monthly salary is Tk. 7,000, including overtime allowance, for a driver of middle age and with 10 years experience, Tk. 9,400, including overtime allowance, for a driver of 20 years experience. Drivers are not able to work two jobs because they are very busy at primary work.

<6. Living Conditions>

DCC Cleaner

About 75% of DCC cleaners live in DCC Cleaner Colonies. There are some 4-5 stories apartments in the colonies which accommodate mostly Hindu people. And about 37% of the colony dwellers live in self-made small houses in the colonies.

About 6% of DCC cleaners live in slum areas, where the living condition is inferior to the colonies.

DCC Driver

About 88% of DCC drivers are living in private apartments. About half of DCC drivers are paid Tk 1,000/month for house rent. Housing conditions of DCC drivers are better than those of DCC Cleaners living in the Colony.

(3) Laws and Regulations on Cleaning, Secondary Collection and Transport

Dhaka City Corporation Ordinance of 1983 makes DCC responsible for cleaning or "the removal of waste (refuse[3]) from all public streets,[4] public latrines, urinals, drains and all buildings and land vested in the Corporation" and for the collection and proper disposal of such refuse, while the occupiers of other lands and buildings other than those of DCC in DCC jurisdiction are responsible for removing the waste from their premises (Section 78 of the Ordinance).

(4) Expenditure for SWM

DCC SWM operation is categorized into 4 types:

i) Cleaning of road & drain,
ii) Collection & transport,
iii) Dumping & landfill, and
iv) Repair works.

DCC prepares only 'total actual expenditures' after closing of financial year. Neither 'department-wise expenditures' nor 'operation-wise expenditures' are available. Consequently, the Study Team estimated the operation-wise expenditures of the last 4 years as shown in Table 2.3-11. The table clearly indicates that the largest amount (58%) was spent for cleaning of roads and drains. On the other hand, very little (1.4%) was spent for landfill.

Table 2.3-11 SWM Expenditures by Operation (million Taka)

SWM Operations	1999-00	2000-01	2001-02	2002-03	Average % (99-03)
1) Cleaning of road & drain	201	227	249	273	58%
2) Collection & transport	87	98	116	139	27%
3) Dumping & landfill	5	5	6	7	1.4%
4) Repair works	74	53	31	57	13%
5) Total	367	383	402	476	100%
A: DCC total own expenditures	2,162	2,328	1,881	2,670	
rate of SWM total expense to A	17%	16%	21%	18%	
B: DCC revenue expenditures	-	-	-	1,138	
rate of SWM total expense to B	-	-	-	42%	

Source: DCC Account Dept.

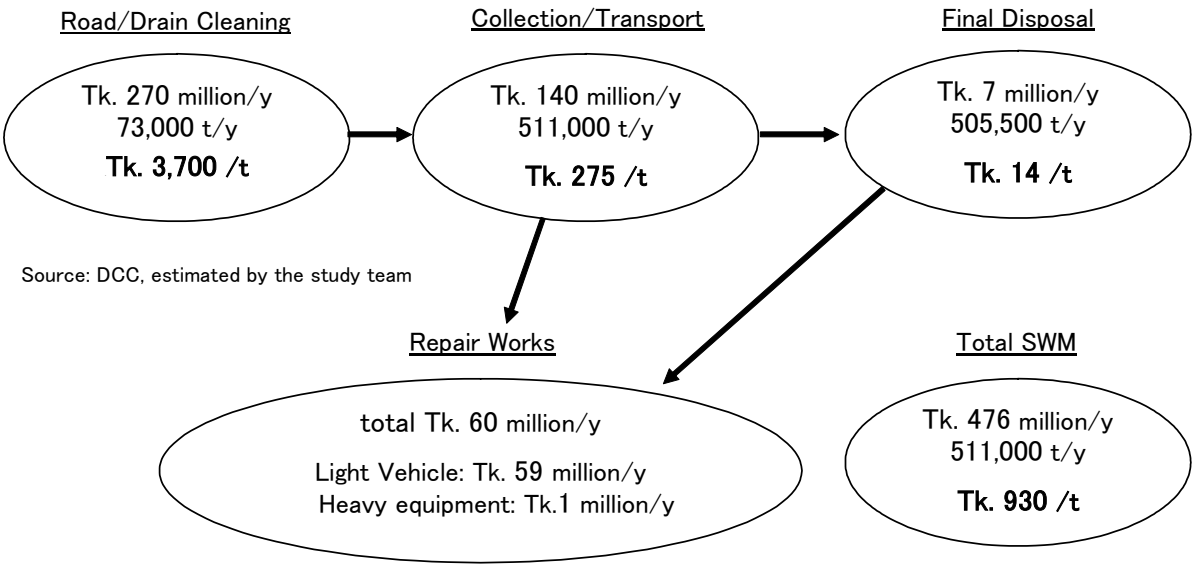
Note: There were no capital expenditures during the period.

[3] "Refuse" includes rubbish, offal night soil, and carcass of animals, deposits of sewerage, waste and any other offensive matter, according to the definition of the Ordinance.

[4] "Public street" is defined as a street maintained by the Government.

Total SWM expenditures have increased every year while the total DCC expenditure has an upward trend except fot the year 2001-02. In the financial year 2002-03, the total SWM expenditures reached approximately Tk 480 million, which accounted for 18% of DCC's total own expenditures, and 42% of revenue expenditures of the year.

SWM cost (Tk/ton) flow chart is presented in Figure 2.3-7. Total SWM cost of DCC in the financial year of 2002-03 is estimated at Tk. 930/ton (= US$ 16 /ton).



Source: DCC, estimate by the study team

Figure 2.3-7 Solid Waste Management Cost Flow

2.4 Final Disposal

(1) Existing Landfill Sites in Dhaka

a) Remaining Capacity of Landfill Site

DCC uses three landfill sites (namely Matuail, Berri Band and Uttara, which are described in Table 2.4-1). It is said that Matuail is the only official landfill site owned by DCC. The site has surrounding embankment and solid waste is filled inside the embankment. On the other hand, Berri Band and Uttara dumpsites are private land. It is explained that owners of the land requested that DCC fill the land with solid waste, and so DCC has been disposing solid waste there. The remaining capacity of Matuail site is estimated at 1.1 million ton as of the end of 2004.

b) Legitimacy of Landfill Site

It is noted that DCC has not obtained the ECC for Matuail landfill site, although use of the site for final disposal was started before the enforcement of the Environmental Conservation Act of 1995. Use of Berri Band and Uttara sites for final disposal of solid waste was started after the enforcement of the Environmental Conservation Act of 1995 and the Environmental Conservation Rules of 1997. These regulations require the Environmental Clearance

Certificate (ECC) for earth filling by industrial, domestic and commercial waste. Furthermore, neither of the sites got approvals from RAJUK, which is required for structural change of open space and/or reservoirs according to the Preservation Act of 2000.

Table 2.4-1 Existing Landfill Sites in Dhaka

Name of the site	Area	Start operation	Incoming trucks*	Remarks
Matuail	20 ha	1993	282	Only one official landfill site South east side of Dhaka Open dumping without soil cover
Berri Band	4 ha	Not clear	138	Said to be an unofficial landfill site West side of Dhaka Private land and open dumping
Uttara	1 ha	2003	18	Said to be a temporary landfill site North side of Dhaka Private land and open dumping

Source: JICA Study Team

Note: * Average of survey results in two seasons (refer to Table 2.3-9)

(2) Closed Landfill Site

There are several closed landfill sites in Dhaka City. These sites are used for development of urban infrastructure like stadium, market, filling station and housing in a few years after finishing landfill operation. The immediate use of these sites might have some problems such as ground subsidence and methane gas emission. This shows that the demand of such a risky land is still strong. Soil cover is carried out at the beginning of any development even though the site is left uncovered after closure. If the covering soil is spread during landfill operation, environmental pollution and hazards by vector could be reduced dramatically.

(3) Operation and Management of Landfill Site

a) Management of Landfill Site

It is explained that Conservancy Department dispatches 4 staff to Matuail landfill site; however, there is no task description for them or work record at all. Mechanical Division 2 also provides heavy equipment and operators to landfill site; however, there is no task description or work record or operation plan of landfill site either. Construction works in Matuail landfill site are executed under the supervision of Civil Engineer of Zone 1, however, it is not clear who is responsible for making a plan for such construction. It can be said that landfill operation is left to heavy equipment operators without instruction or control.

b) Operation of Landfill Sites

Operation method of solid waste at all three landfill sites are open dumping (crude dumping) without control of incoming waste and no covering soil. Surrounding embankment, access road and dumping platform are provided at Matuail landfill site, but no leachate collection and gas removal facilities are installed. The solid waste is dumped without surrounding bank at either Berri Band or Uttara. There have been many discussions and proposals on sanitary landfill, composting and gas recovery but nobody raised the matter of soil cover in landfill operation.

c) Heavy Equipment for Landfill

Heavy equipment used for final disposal is shown in Table 2.4-2. DCC has a considerable number of heavy equipment but only a few are working. Not only the number of equipment, but the combination of heavy equipment is also not appropriate from the following points of view:

- Spreading and Compaction of Waste and Covering Soil

Bulldozer is most common equipment for this purpose.

- Acquiring Covering Soil

If old waste is used as covering soil, excavation and onsite transport of it will be necessary. Excavator and dump trucks will be the suitable combination of equipment for this purpose.

- Maintenance of Drainage, Working Road

Excavator is very useful for this purpose.

- Maintenance of Dumping Platform

Tire dozer is effective to remove solid waste at dumping platform although it is not commonly used at landfill site. At present, excavators are working for unloading solid waste. Excavators also support bulldozers by removing waste from dumping platform to spread on the ground.

Table 2.4-2 Heavy Equipment for Landfill

Equipment	Total	Not Working	Working
1. Bulldozer	15	11	4
2. Tire dozer	8	4	4
3. Pay loader	9	3	6
4. Excavator	6	4	2
5. Wheel excavator	2	1	1
6 Hydraulic crane	2	1	1
Total	42	24	18

Source: Engineering Dept., DCC

d) Maintenance of Heavy Equipment

Maintenance of heavy equipment is carried out by Mechanical Division 2. Since the percentage of working equipment, especially bulldozers and excavators, is low, maintenance system of heavy equipment shall be reviewed so that an efficient system can be established.

e) Cost of Disposal

Expenditure of solid waste management in DCC including cleaning of road and drain was Tk. 477 million in 2002/2003 of which only Tk. 7 million (1.4%) was used for dumping and landfill. This means that DCC only spends Tk. 14/ton for final disposal. These facts indicate that improvement of landfill operation requires much more cost than is spent now.

(4) Planning and Construction of Landfill Site

Rehabilitation of surrounding embankment was planned by Urban Planning Department and was constructed under the supervision of Zone 1 Civil Engineer from Engineering Department. Plans for future landfill site and land acquisition are being carried out by Environmental and Infrastructure Development Project. Coordination among the Environmental and Infrastructure Development Project, Conservancy Department, Transport Department and Engineering Department is indispensable for effective planning and acquisition of landfill site. But it is not clear who decided to use Berri Band and Uttara sites for solid waste disposal without approval of related authorities. Also, it is not clear who will prepare an operation plan for the present landfill sites and until when these sites will be used.

(5) Illegal Dumping

There are many small dumpsites in Dhaka. Most of these sites are used by communities because communal bin and transportation services of solid waste are not sufficient. It is stressed that activities to fill lowland is required to comply with Environmental Conservation Act of 1995, Environmental Conservation Rules of 1997 and Preservation Act of 2000.

2.5 Recycling/Compost

(1) Outline of Recycling Activities in Dhaka City

a) Status of Recycling Industry in Dhaka City

According to "Bangladesh Statistical Yearbook 2001"and "Profile of Dhaka City", the labor force excluding unemployed persons is estimated at approximately 1.2 million. On the other hand, approximately 74,000 people are engaged in recovering material out of the stream of municipal solid waste, according to the interview survey by the Study Team with those people engaged in the said business. This means that approximately 6% of the total labor force in Dhaka City is in the recycling sector. In practice, recycling forms one of the important industries in Dhaka City.

b) Stakeholders of Recycling Activities

Recycling stakeholders of municipal solid waste are composed of three principal groups: namely, collectors, buyers and factory/shops for recycled products; their dealing relationships are shown in Figure 2.5-1.

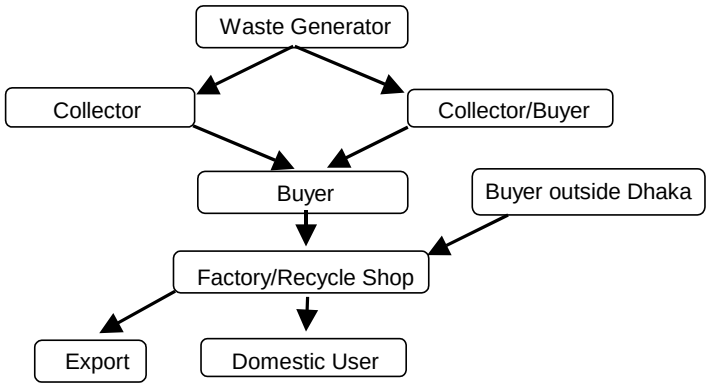


Figure 2.5-1 Basic Structure of Recycling Stakeholders of Municipal Solid Waste

There are many stakeholders and special groups not only in Dhaka City, but also in urban areas of Bangladesh. For example, there are special groups that function as collector and buyer. They are called *feriwalla* and they collect waste from waste generator (households) by paying cash in exchange of recyclable wastes. *Feriwalla* also buys recyclable wastes from other collectors at the places collectors are working. Collected materials are segregated by quality and nature before these are brought to recycling factories in order to meet the requirement of production.

c) Major Recyclable Wastes out of Municipal Solid Waste

Main recyclable wastes and recycled products from the municipal solid wastes in Dhaka City are shown in Table 2.5-1.

Table 2.5-1 Main Recyclable Wastes and Recycled Products in Dhaka City

Types of Wastes	Recyclable Wastes	Recycled Products
Plastic	Mug, pipe, old sandal, doll, plastic bucket, etc.	Shoes, sandal, boots, bucket, mug, bottle, lunch box, etc., more than 150 items
Paper	Newspaper, cardboard, duplex board, etc.	Media paper, simplex board, cement packing bag, etc.
Glass	Any kind of broken glass,	Glass sheet, bottle, lamp shade, etc.
Metal (Steel)	Iron tin, iron pieces	Steel rods, nuts, bolts, pumps, etc.

Source: Survey on recycle market by the JICA Study Team

The Study Team conducted interview surveys at first with collectors and then with manufacturers to get a more realistic volume of main recycled materials in Dhaka City. Estimated recycled waste volumes are described in the sections below.

d) Other Recycled Wastes

The Study Team conducted a survey of recyclable waste collectors to estimate the volume of their output by type of recyclable material. It was learned from 22 respondents that they collect materials other than the 4 major recyclables mentioned above at the rate of 22% of total output in weight. The contents of other wastes are shown in Table 2.5-2.

Table 2.5-2 Other Recycled Wastes

Category	Contents	Share
Major recyclables	plastics, paper, glass, metal	78%
Others	leather, rubber, bone, others	22%

Source: Survey on recycle market by the JICA Study Team

Assuming the total recovery of the 4 major recyclables at 336 t/d, the volume of other recyclables is estimated at 94 t/d.

e) Compostable Wastes

At present, there are five small-scale compost plants which use compostable municipal wastes from Dhaka City. The total capacity of 5 plants comes to 19 t/d; however, they are operating at lower level than capacity because of weak demand of compost products derived from kitchen waste. They are at present producing compost products less than approximately 1.5 ton per day in Dhaka City as a whole, according to Waste Concern. They estimate that four times as much input is needed to produce compost out of kitchen waste. This implies that 6 t/d of kitchen waste is consumed or recycled for composting. The selling price of compost depends on type of raw material, and the products of kitchen waste is valued by far lower than those of other materials, according to the interview survey results with manufacturers and dealer shown in Table 2.5-3.

Table 2.5-3 Compost Price at Manufacturer's Sales

Raw material	Selling price (Tk./kg)	Contents
Kitchen waste	2.5	
Mixed with kitchen waste	>10>	kitchen waste, cow dung, leaves, vegetable, bone
Other than kitchen waste	>20	poultry droppings

Source: Survey on recycle market by the JICA Study Team

(2) Estimated Volume of Recovered Waste

Each recycling activity raises a total of 436 t/d of material recovery as shown in Table 2.5-4. The amount recovered stands for the reduction of waste to be managed by DCC. According to the estimate, paper and plastic contribute much to the municipal solid waste reduction in Dhaka City, while composting contributes very little to the waste reduction although the compostable waste shares the largest portion among generated wastes.

Table 2.5-4 Estimated Volume of Recycled Wastes in Dhaka City

Material	a) Estimated generation of recyclable waste (t/d)	b) Estimated recycled waste (t/d)	c) Recycle rate	d) Contribution to waste reduction (b / 3,200)
Plastic	124	103	83 %	3.2 %
Paper	260	168	65 %	5.3 %
Glass	46	24	52 %	0.8 %
Metal	27	41	*	1.3 %
Compostable	2,211	6	0 %	0.2 %
Others	99	94	95 %	2.9 %
total	2,767	436		13.6 %

d) Assumed total municipal solid waste generation : 3,200 (t/d)

* Generation amount of metal is estimated by averaging 60 samples of waste composition survey, which did not contain metal factory at all. While recycled volume of metal contains imported metal from other cities in the country that did not appear in the composition survey. With this mechanism it is understood the recycled volume exceeds the estimated generation amount.

Source: Survey on recycle market by the JICA Study Team

(3) Places of Material Recovery and Collectors

Out of the same interview survey with recyclable waste collectors, their output volume is classified by places of collection activity. The major part of material recovery is raised at generation sources by employees of company/organization or individual buyers. Most of employees engaged in door-to-door collection of household waste are conducting material recovery together with their main job. The recovery downstream such as at container sites and dumpsites is undertaken by individual persons and the amounts are comparably small as shown in Table 2.5-5.

Table 2.5-5 Material Recovery by Place & Collector

Place of recovery	Share	Number of workers	Status
generation sources	84%	approx. 1,800	private sector employee for primary collection
		approx. 1,500	CBO employee for primary collection
		approx. 4,000	*Feriwalla*, individual buyer from generation sources
container/dust bin	11%	approx. 1,000	individual or organized
dumpsite	5%	approx. 400	individual
total	100%	approx. 8,700	

Source: Survey on recycle market by the JICA Study Team

Regarding collectors working downstream, the Study Team conducted an interview survey of them and found that they belong to low or middle-low income group in Bangladesh. Collectors upstream of the waste flow are considered to have higher income than those downstream because they collect much more volume of material per person in a day and the price of material tends to go higher as the collection points move upstream.

(4) Outline of Recycle Industry

In addition to material collectors, a huge number of dealers, manufacturers and merchants are operating on recovered material as shown in Table 2.5-6.

Table 2.5-6 Number of Firms and Employees of Recycle Industry

Type of business	Number of firms	Nos. of employees
Dealers		
small sized	approx. 5,000	approx. 20,000
medium sized	approx. 4,200	approx. 17,000
large sized	approx. 5,500	approx. 29,000
subtotal	approx. 14,700	approx. 66,000
Manufacturers		
plastic products	approx. 500	
paper product	11	
glass product	8	
metal products	306	
Recycle product store (plastics)	approx. 1,500	

Source: Survey on recycle market by the JICA Study Team

2.6 Industrial Waste

(1) Industrial Waste Flow

Assumed current flow of industrial wastes is illustrated in Figure 2.6-1. In the case of industrial wastes, reuse and recycling are aggressively done by industries themselves or by industry-related businesses. As a result, the amount of waste finally disposed of may not be as large as that of municipal wastes. The amounts of recovered wastes by waste pickers and scavengers seem to be relatively small compared to those removed at sources.

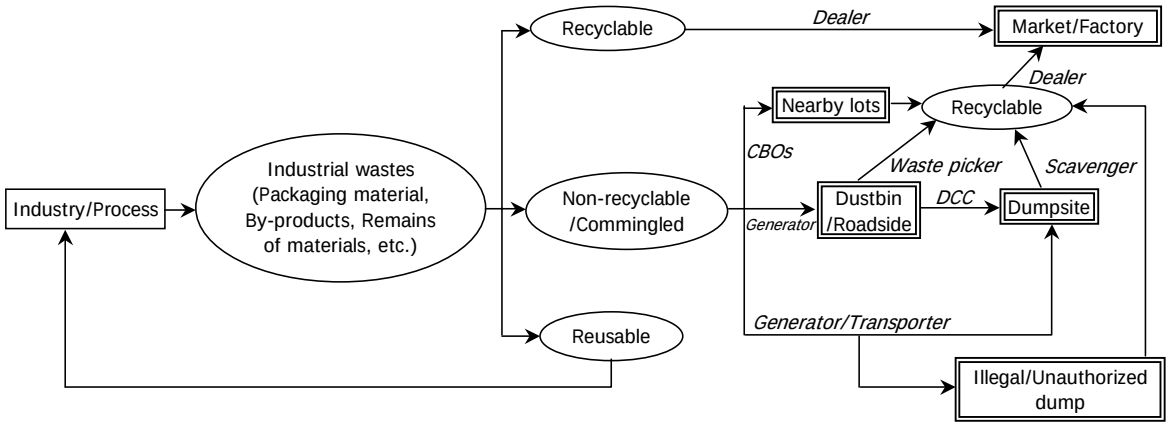


Figure 2.6-1 Assumed Industrial Waste Flow in the Study Area

Photo 2.6-1 Dump in factory premise

Photo 2.6-2 Roadside dump in industrial area

Photo 2.6-3 Dump in water channel

Photo 2.6-4 Dumping by CBO beside pond

(2) Amounts of Industrial Waste Generation in Dhaka

Information on industrial waste generation in Dhaka is nil and a survey such as the one on industrial waste management has never been conducted except for some hazardous and toxic substances control. Typical waste of such case is tannery waste that is mainly generated at Hazaribag area. The amount of tannery waste generated in this area is estimated to be 150 t/day, while other industrial wastes is approximately 25 t/day.[5]

In this study, as mentioned in section 2.1, the amount of business waste is estimated to be about 1,050 t/d in the Study area. About 850 t/d out of 1,050 t/d is calculated to be from markets, offices, hotels, commercial establishments and public units. Hence, the remaining 200 t/d is roughly considered to be from industries. If tannery wastes amount to 150 t/d as reported elsewhere, the amount of other industrial wastes accounts for 50 t/d in the Study area.

(3) Hazardous Industrial Waste Management

Cases of the environmental pollution resulted from improper industrial waste management are reported as soil contamination by heavy metals at some industrial zones. These are summarized in Table 2.6-1.[6] Tongi and Naraynganj are outside of Dhaka, and Hazaribag is a famous tannery industrial area where soil is highly contaminated by Cr and Cu; in Tejgaon are located various industries such as fabricated metal product, machinery and equipment, textile wearing apparel, leather industry, chemicals, petroleum, coal, rubber and plastics and thus soil in Tejgaon is contaminated by mainly Ni and Cd.

Table 2.6-1 Soil Contamination by Heavy Metals in Selected Industrial Area

District	Major industry	Heavy metals (mg/kg soil)
Hazaribag	Tannery	Cr : 25,014, Zn: 330 Cu: 1,156
Tejgaon	Food, Chemicals, Textile	Ni: 84~146, Cd: 163
Tongi	Battery	Zn: 2,026
Naraynganj	Power, Metal, Steel	Pb: 171~158, Ni: 84~146

Source: S. M. Ullah, Heavy Metals and Industrial Pollution in Bangladesh, in 1st national Conference on Environmental Health, 19-20 February 2002.

Table 2.6-2 is a list of industries that are predicted as sources of soil contamination by toxic chemicals and heavy metals in Dhaka.[7] Scenario of soil contamination from these industries is not necessarily clear, but it is plausible to think that both direct contamination from spillage of input material or product and waste pile, and indirect contamination by a deposit of air pollutants or effluents are major paths of soil contamination.

[5] Approximate amount for industrial waste is from UNDP, HABITAT, Dhaka Metropolitan Development Planning: Waste Management Report, October 1992.

[6] S. M. Ullah, Heavy Metals and Industrial Pollution In Bangladesh, in 1st national Conference on Environmental Health, 19-20 February 2002.

[7] http//www.sdnpbd.org/wb/industry.php .

Table 2.6-2 Industries Causing Soil Contamination by Toxic Chemicals and Heavy Metals in Dhaka (Top 20)

	Industry Name	Toxic chemical to land (% of Total National Load)	Industry Name	Toxic metal to land (% of Total National Load)
1	Tanning and Finishing	57.39	Tanning and Finishing	32.495
2	Allopathic and Medicines	12.954	Iron and Steel Re-Rolling	22.557
3	Iron and Steel Re-Rolling	4.063	Basic Copper, Copper Alloy	14.938
4	Matches Manufacturing	2.69	Iron and Steel Industries	3.006
5	Soap and Detergents	2.244	Iron and Steel Foundries	2.578
6	Basic Copper, Copper Alloy	2.054	Batteries Manufacturing	2.26
7	Industrial Chemicals Nec	1.877	Manufacturing of Rubber Products	2.144
8	Dyes, Colours and Pigments	1.645	CottonTextiles	1.971
9	CottonTextiles	1.307	Jute Textiles	1.466
10	Ayure-Vedic Medicines	1.277	Allopathic and Medicines	1.412
11	Edible Oils	1.254	Fabricated Metal Products	1.287
12	Jute Textiles	0.972	Bolts, Nuts and Rivets	1.239
13	Manufacturing of Rubber Products	0.551	Plumbing Equipment	1.148
14	Iron and Steel Industries	0.541	Electric Bulbs and Tubes	1
15	Fabricated Metal Products	0.512	China, Ceramic Products	0.96
16	Bolts, Nuts and Rivets	0.493	Soap and Detergents	0.791
17	Batteries Manufacturing	0.492	Utensils Manufacturing - Aluminium	0.764
18	Iron and Steel Foundries	0.464	Industrial Chemicals Nec	0.713
19	Pulp and Paper Manufacturing	0.459	Dyes, Colours and Pigments	0.625
20	Plumbing Equipment	0.457	Dyeing, Bleaching Textiles	0.576

Source: http//www.sdnpbd.org/wb/industry.php

Note: The "Load" used in this Table means pollution load expressed as targeted pollutants discharge to the environment in kilograms per 1,000 employees per year.

Tannery industry is ranked as the highest polluter of soil for both hazardous chemicals and heavy metals. The main chemicals used in this industry are sulfuric acid, chromium, ammonium sulfate, ammonium chloride, and calcium oxide. The wastes may contain chromium salts and/or tannic acid.

Although allopathic and pharmaceutical industries are ranked as higher polluters of soil by hazardous chemicals, if pesticide industries are included, those industries are potential producers of hazardous wastes. The manufacture of pesticides and fungicide should be aware of a need of appropriate waste management and their by-products, and wastes need proper disposal.

Metallic and non-metallic industries may produce solid waste containing some sort of heavy metals. Dust discharged from smelter or furnace of those factories may often contain heavy metals to some extent, so that, if dust is not disposed of appropriately, dust will be a pollution source of soil as well.

(4) Related Laws and Regulations of Industrial Waste Management

At present there is no legal requirement to manage industrial waste including hazardous waste. However, some laws and rules influence industrial waste management more or less. These are:

- Environmental Conservation Rules of 1997,
- Environmental Management Plan,
- Pollution Effect Abatement Plan,

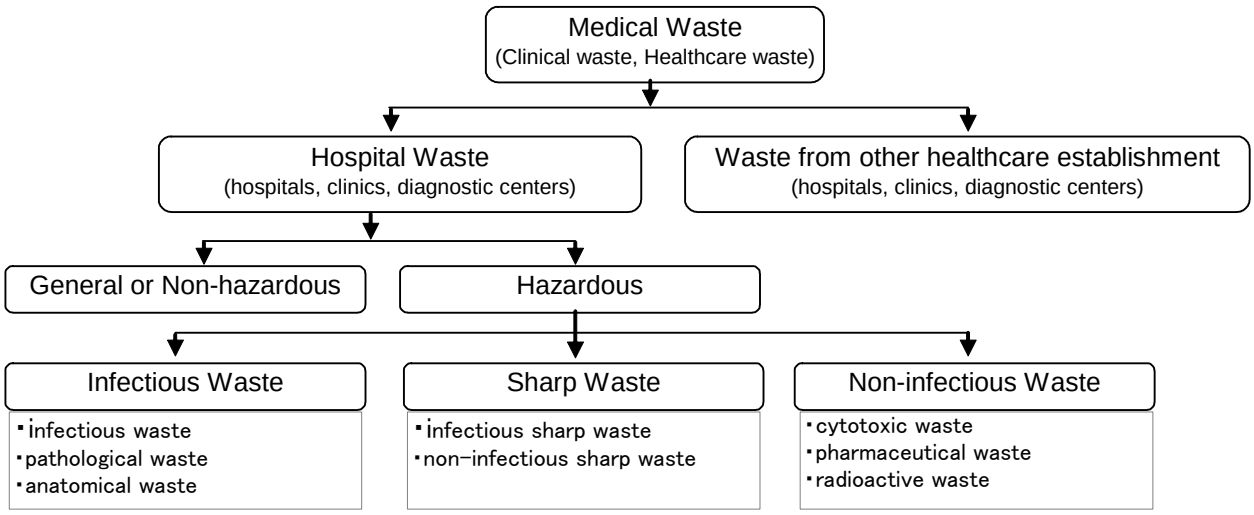
- Emergency Plan for Adverse Environmental Impact, and
- Environmental Impact Assessment Plan.

2.7 Medical Waste

(1) Definition and Sources of Medical Waste

Considering the distribution of healthcare establishments in Dhaka, medical wastes from hospitals, clinics and diagnostic centers are targeted waste in this study. Figure 2.7-1 shows classification of hospital wastes sourced from the Manual for Hospital Waste Management.[8] In this classification, hospital wastes consist of general or non-hazardous wastes and hazardous wastes. Hazardous wastes include sharp wastes, infectious wastes and non-infectious hazardous wastes. Hazardous hospital wastes need special handling for disposal. The Manual further classifies hospital wastes by type as follows.

Type-1: General waste (Recyclable waste and Non-recyclable waste)
Type-2: Infectious/Pathological/Anatomical wastes
Type-3: Cytotoxic/Pharmaceutical wastes
Type-4: Radioactive waste
Type-5: Sharp waste
Type-6: Liquid waste



Source: Slightly modified from Manual for Hospital Waste Management, Ed. by A.K.M. Saiedur Rahman, General of Hospital Services, Ministry of Health and Family Welfare, 2001

Figure 2.7-1 Classification of Medical Waste in Bangladesh.

In this study solid hospital wastes (Type 1, 2, 3 and 5) are targeted, and a description and major generation sources of these wastes are summarized in Table 2.7-1. Radioactive waste

[8] Manual for Hospital Waste Management, Ed. by A.K.M. Saiedur Rahman, General of Hospital Services, Ministry of Health and Family Welfare, 2001.

(Type 4) is not included in the scope of this study since radioactive waste is generally managed by sectors other than waste management sector. Liquid waste should be separated from solid waste at sources, and treated at a wastewater treatment system of the hospitals or discharged to a public sewer system after pre-treatment. Liquid waste should also be managed by generators.

Table 2.7-1 Description of Type 1, 2, 3 and 5 Hospital Wastes and their Sources

Type	Waste	Description	Generation source
Type 1	General waste	Recyclable wastes: papers, clothes, boxes, medicine containers, administrative waste, metals, polyethenes, plastic containers, etc. Non-recyclable wastes: kitchen waste, etc.	Administration, Support service, Patient service, Laboratories
Type 2	Pathological waste	Tissues, Organs, Body parts, Blood and blood products, Body fluids, Placenta, Human excreta, etc.	Patient service, Laboratories, Operation theater
Type 2	Infectious waste	Waste from surgery, Waste from patients with infectious diseases, Swabs, Wound dressing, Linen, Soaked bandage, Surgical accessories, Soiled plaster casts, etc. Culture materials from laboratories, Waste contaminated with infectious materials.	Patient service, Laboratories, Operation theater
Type 2	Anatomical waste	Waste from surgery of GYN, General surgery, Orthopedic, EYE, ENT, OBs, etc.	Operation theater, Laboratories
Type 3	Cytotoxic waste	Expired cytotoxic drugs, Waste contaminated with cytotoxic drugs and leftover Cytotoxic drugs, etc.	Patient service, Laboratories
Type 3	Pharmaceutical waste	Date-expired or contaminated medicine, no longer required medicine, leftover medicine, spilled medicine, vaccines, etc.	Patient service, Support service
Type 5	Sharp waste	Needles, Syringes, Intravenous set, Scalpel, Saw, Blades, Broken glass, Nails and Sharps generated from support service, etc.	Patient service, Laboratories

Source: Manual for Hospital Waste Management, Ed. by A.K.M. Saiedur Rahman, General of Hospital Services, Ministry of Health and Family Welfare, 2001

(2) Medical Waste Generator

The Specialized Hospitals, Medical College Hospital and registered Private Clinics with Diagnostic Laboratory are well documented by Directorate General of Health Service of the Ministry of Health and Family Welfare. According to the information[9] obtained at Directorate General of Health Service, there are 13 Specialized Hospitals and 5 Medical College Hospitals in the Study area. Beds of these two groups of Hospitals total 4,620 as of April 2004. The number of private registered bedded clinic and clinic with a diagnostic laboratory is 244 with beds totaling 6,196 as of September 2003. Besides these healthcare establishments, 8 hospitals are operated by 5 Government entities in the study area. In addition, there exist more than 450 diagnostic centers without beds. In total, the number of beds in the health care establishments in the study area is 12,000 at minimum even if information on some private hospitals is unavailable (see Table 2.7-2).

[9] Memo. No. DGHS/Dir. Hosp/HWM/2004/572 by Director (Hospital and Clinics) & Line Director, Hospital Services, DGHS, 11 May 2004.

Table 2.7-2 Number of Hospitals/Clinics and Beds in the Study Area

Entity	Type	Ministry	No	Beds	Remarks
Gov.	Hospital	Health & Family Welfare			
		DG Health Service	13	2,400	
		DG Family Welfare	1	100	Azimpur Maternity Hospital
		Defense	2	?	Out of Study Area
		Home Affair	2	?	Police Hospital, Jail Hospital (175)
		Communication	1	?	Railway Hospital
		LGRD&C	2	100	DCC Hospital
	Medical College Hospital	Health & Family Welfare/Education	5	2,220	
Private bedded	Medical College Hospital		244	6,196	
	Clinics				
	Clinics with Diagnostic lab.				
Private	Diagnostic C.		>450	0	No beds.
Others	BSMMU		1	600	Bangabandhu Shekh Mujib Medical University
	ICDDR,B		1	250	International Centre for Diarrhea Diseases Research, Bangladesh
Total			>722	12,041	

Source: (1) Memo No. DGHS/Dir. Hosp/HWM/2004/572 by Director (Hospital and Clinics) & Line Director, Hospital Services, DGHS, May 11, 2004. (2) Health and Population Statistical Report 1999-2000, DGHS, Dec. 2001. (3) Bangladesh Health Bulletin 1996, DGHS, Nov. 1998.

Figure 2.7-2 shows bed distribution for governmental and private hospitals listed in Table 2.7-2. There are 268 hospitals/clinics, where bed number is available totaling more than 12,000 beds in the Study area. Of 268 hospitals/clinics, 254 have less than 100 beds. Private hospitals/clinics are of rather small scale, and 97% of them have less than 50 beds. Besides hospitals/clinics there are about 450 diagnostic centers in Dhaka that also produce syringes, needles, blood soaked materials, toxic chemicals which are classified as Type 2, Type 4, and Type 5; their quantities are, however, considered difficult to determine.

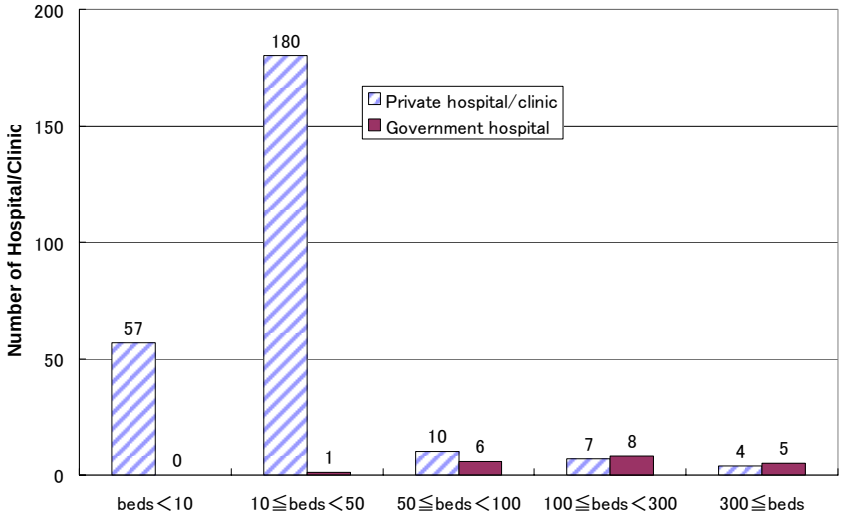


Figure 2.7-2 Beds Number Distribution of Hospital/Clinic in the Study Area

(3) Medical Waste Generation Rate

According to past surveys in other countries, generation of medical wastes differs not only from country to country but also within a country. Waste generation depends on numerous factors such as waste management methods, type of healthcare establishment, hospital specializations, proportion of reusable items employed in health care, and proportion of patients treated on a day-care basis. In middle- and low-income countries, medical waste generation is usually lower than in high-income countries. Also, the hospital waste generation rate increases with the size of hospital, i.e. number of beds.[10]

In the survey conducted during March and May 1998, it was found that waste generation rate at hospitals in Dhaka was 1.2 kg/bed/day on average.[11] 15% of it was hazardous waste that included infectious waste (10.5%), pathological waste (1.5%), sharp waste (3.5%), and a very small amount of pharmaceutical and chemical wastes.

Using data cited in a report and other sources,[12] waste generation rates at hospitals/clinics in Dhaka are plotted in Figure 2.7-3 for total hospital waste and in Figure 2.7-4 for hazardous hospital waste. It should be kept in mind that sources of some data on bed number and waste generation rate are different. In these Figures, empirical equations obtained by a Japanese survey[13] are drawn to estimate hospital waste generation rate as a reference.

As mentioned earlier, hospital waste generation is likely to increase as the scale of hospital increases, i.e. number of beds and economic development levels of the countries.[14,15] Both Figures 2.7-3 and 2.7-4 seem to reflect this fact. Empirically obtained equations in Japan definitely show the increase of waste generation per bed while data obtained in Dhaka do not necessarily show such a prominent tendency. Generation rates in Japan are higher than those in Dhaka in general. From these Figures, hospital waste and hazardous hospital waste generation rates in Dhaka (when bed number is below 600) range between 0.6 to 1.9 kg/bed/day, and 0.05 and 0.2 kg/bed/day, respectively, , or about 10% of hospital wastes are hazardous hospital waste. This estimation is similar to the recent survey results that concluded hospital waste generation and hazardous hospital waste generation as 0.78 kg/bed/day and 0.14 kg/bed/day, respectively.[16]

[10] Non-Incineration Medical Waste Treatment Technologies, Health Care Without Harm, August 2001.
[11] M.Habibur Rahman, S.N. Ahmed and M. Shehab Ullah, A Study on Hospital Waste Management in Dhaka City, 25th WEDC Conference, Addis Ababa, Ethiopia, 1999.
[12] Roteb-Solid Waste Consultancy B/V, Waste Landfilling and Hospital Waste Incineration in Dhaka, Bangladesh (Draft Report), February 1998.
[13] M. Tanaka, T. Ikeguchi and I. Aoyama, Research on Evaluation of Hospital Incinerator and Upgrading Operational Technologies (in Japanese), Scientific Research Program on Waste Management, Japanese Ministry of Health and Welfare, March 2001.
[14] Safe Management of Wastes from Health-care Activities, Edited by A. Pruss, E. Giroult, P. Rushbrook, WHO, 1999.
[15] W.A.Rutala, JAMA, Vol.262 (12), 22 September 1989, also cited in Non-Incineration Medical Waste Treatment Technologies, Health Care Without Harm, August 2001.
[16] A.K.M. Saiedur Rahman, Private Communication, 28 July 2004.

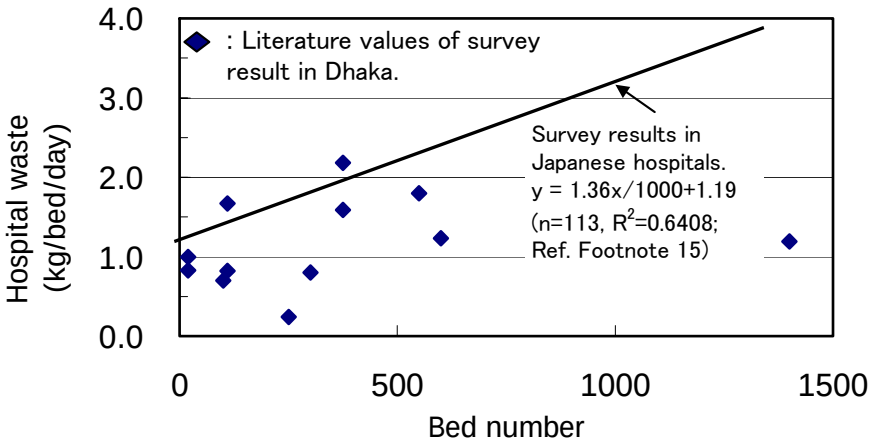


Figure 2.7-3 Total Hospital Waste Generation vs. Bed Number

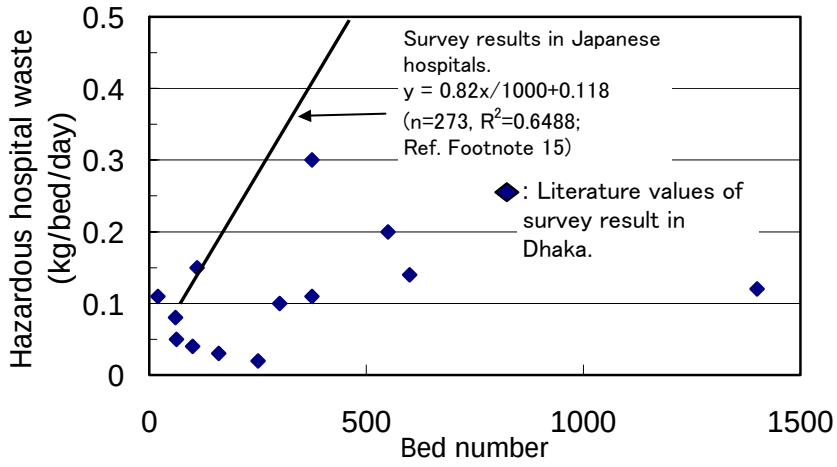


Figure 2.7-4 Hazardous Hospital Waste Generation vs. Bed Number

(4) Amount of Medical Waste Generation in the Study Area

Based on generation rate of hospital wastes mentioned in the previous section, total amounts of hospital waste and hazardous hospital waste in the Study area are projected at 7.2~22.8 t/day and 0.6~2.4 t/day, respectively, by multiplying total bed number (ca. 12,000) with waste generation rates.

Figure 2.7-5 shows Thana-wise hospitals and beds distribution in the Study area. The number of hospitals/clinics and beds in Dhanmondi is the largest in the Study area. This means the amount of hospital wastes is also largest in Dhanmondi. The second and third highest generators of hospital wastes are Ramna and Tejgaon although the number of hospitals/clinics is smaller.

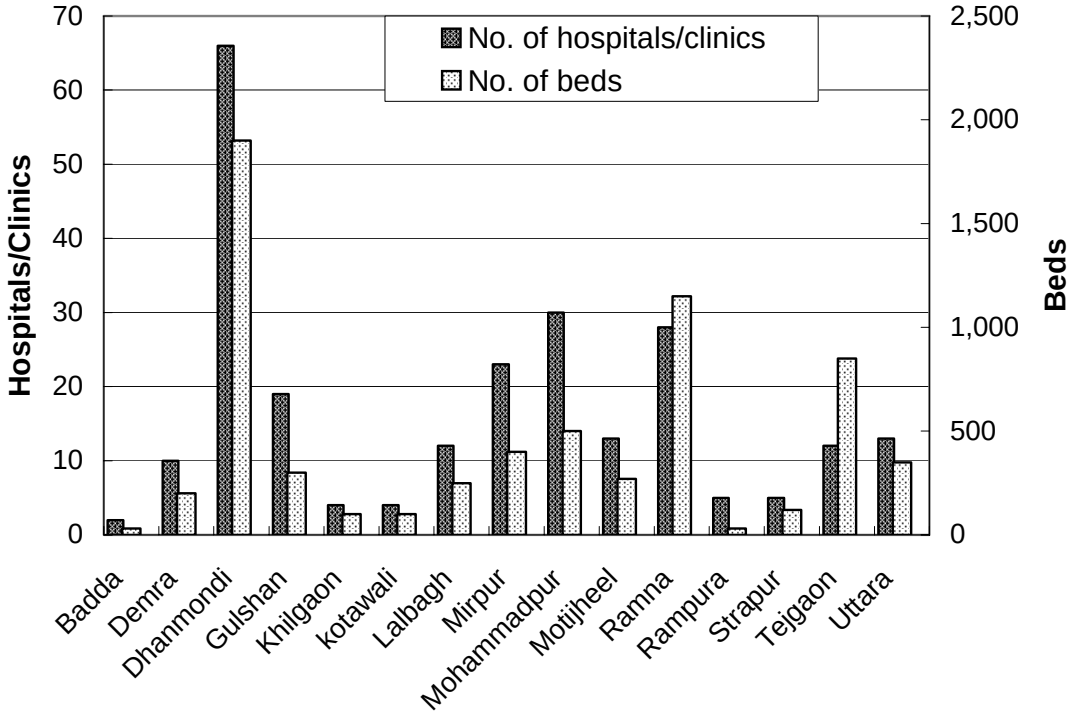


Figure 2.7-5 Hospitals/Clinics and their Beds Number Distribution by Thana

(5) Discharge, Collection and Transport of Medical Waste

Hospital wastes that are segregated at sources, more or less, are normally discharged to a public dustbin in which wastes are mixed with general municipal waste. The wastes discharged and stored in the dustbin are eventually scavenged by a waste pickers to recover recyclables. Remaining wastes are collected by DCC waste collection fleet for a final disposal, mostly land disposal, at official or unofficial dumpsites.

(6) Treatment Technology of Medical Waste

Quite a few hospitals have on-site treatment facilities for their hospital wastes. Incinerator is the most common technology among them. Only one out of three units of Dhaka Medical College Hospital (DMCH) was in operation at the time of survey. The other two units were not operating because of technical trouble. It is also reported that Shahid Sohrawardi Hospital with 375 beds has a plan for installation of incinerator. As for other technology for hazardous hospital wastes, DMCH has a small electric furnace for destruction of syringes and presumably needles, but they do not use it. Holy Family Hospital with 375 beds has a crusher for infectious waste and hazardous waste to be buried in a pit at the hospital compound.

(7) Reuse and Recycling of Medical Waste

Some sort of hospital wastes such as syringe, plastic tube, and plastic packaging materials are recycled in a similar way as other municipal waste. However, serious public health threat associated with hospital waste reuse and recycling is pointed out.[17] This is the case when the

[17] WHO, Managing Medical Wastes in Developing Countries, Report of a Consultation on Medical Wastes Management in Developing Countries, WHO, Geneva, September 1992, WHO/PEP/RUD/94.1.

scavengers collect syringes including needles and plastic materials. These are sold to scrap buyers who sell them to specific traders, who wash and clean the syringes and needles for resale. The syringes and needles are thus returned to the hospitals or clinics for re-use.

(8) Disposal of Medical Waste

Majority of hospital wastes discharged at public dustbin, either hazardous or non-hazardous, are hauled and dumped at Matuail dumpsite together with ordinary municipal waste. Current medical waste flow in the Study area is illustrated in Figure 2.7-6. Quantitative information of the flow is unavailable. But wastes segregated at hospitals and clinics are likely to be quite a few.

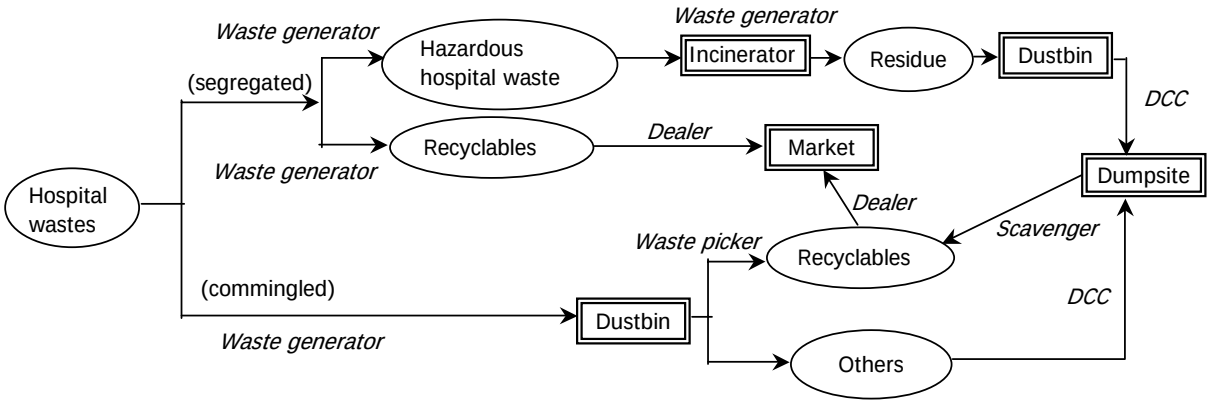


Figure 2.7-6 Possible Current Hospital Waste Flow in the Study Area.

(9) Related Laws and Regulations of Medical Waste Management

At present, there is no law that specifically regulates medical waste generation and its management. Government has no written legislation for the healthcare (waste) workers or on hospital waste management, but only a manual compiled by the Directorate General of Health Services, Ministry of Health and Family Welfare in 2001. Some laws that may influence hospital waste management system, more or less, are:[18]

1) Environmental Conservation Rules of 1997;
   This law partly regulates waste management and disposal facilities. It classified polluting industries into four categories, such as Green, Orange A, Orange B, and Red. Orange B includes pathological clinics and Red indicates hospitals,
2) Import and Export Control Act of 1950 controlled by shipping ordinance of 1979,
3) Custom Act of 1965,
4) Environmental Management Plan,
5) Pollution Effect Abatement Plan,
6) Emergency Plan for Adverse Environmental Impact, and
7) Environmental Impact Assessment Plans (EIA).

[18] A.K.M. Saiedur Rahman (Chief editor), Situation Assessment and Analysis of Hospital Waste Management (A Pilot Study), Line Director, Hospital Services, Directorate General of Health Services, Ministry of Health and Family Welfare, June 2000.

According to Environmental Conservation Rules, Effluent Treatment Plan (ETP) and Pollution Effect Abatement Plan along with Emergency Plan for Adverse Environmental Impact must be submitted to establish a clinic or hospital. However, there is no definite description of hospital solid waste. The City Corporation Acts do not cover hospital waste treatment and disposal.

2.8 Public Involvement

(1) Findings from Household Survey

Household Awareness Survey was conducted by the Study Team in February 2004. The survey was composed of Household Questionnaire Survey (340 samples; Old Dhaka, Older Urban Area, New Urban Area, Slum Area) and Focus Group Discussion (Ward 19: Gulshan, Ward 23: Malibagh/Khilgaon, Ward 61: Lalbag, Ward 84: Saidabad/Jatrabari, Ward 60: Shaheed Nagar). The following are the findings from the household questionnaire survey of upper to lower class households in Dhaka City, excluding slum areas.

a) Waste Discharge and Primary Collection

- Servants/maids are in charge of waste discharge in 96% of upper class households and in 79% of middle class households, while in 95% of lower class households, members of the households, mostly wives and daughters, are in charge.
- 88% of upper class households and 75% of middle class households receive door-to-door collection services, while only 30% of lower class households receive such services.
- In contrast, 51% of lower class households dump their waste in vacant lands/river/marsh, while only 5% of upper class and 4% of middle class do that.
- Of the households who receive door-to-door collection services, 80% in New Urban Area receive the services from local organizations/organized communities, and 14% from private companies. In Older Urban Area, 64% of households receive the services from local organizations/organized communities and 19% from DCC cleaners. In Old Dhaka, 78% mentioned DCC cleaners are providing the services.
- Of the households who receive door-to-door collection services, 85% are satisfied with the services.

b) Waste Collection Charge

- Of the households who receive door-to-door collection services, 88% are paying waste collection charges.
- The collection charges paid by upper class households range from 11 taka to more than 100 taka per month. Of the households paying collection charges, 77% of middle class households pay 11 to 20 taka monthly and 82% of lower class households pay 1 to 10 taka.

c) DCC Services

- Of the respondents (household heads), 21% do not know the locations of nearest dustbins/containers.
- Of those who know the locations of dustbins/containers, 58% in new urban areas and 52% in older urban areas mentioned that the locations are in more than 300 ft distance from the houses. On the other hand, 32% in Old Dhaka mentioned that dustbins/containers are located in less than 70 ft distance and 28% in less than 150 ft.
- 64% of households are not satisfied with the waste collection services provided by DCC (or private companies in privatized zones); 72% of middle class and 75% of lower class households are not satisfied with the services, while more than half of upper class households are satisfied with the services.
- Of those who are not satisfied with the waste collection services, 69% mentioned that wastes are scattered around bins/containers and 34% mentioned that bins/containers are too far or there are no bins in their areas; 21% mentioned that time schedule of collection is not suitable.
- 60% of households are not satisfied with the street sweeping services provided by DCC (or private companies in privatized zones) in their areas; 34% of respondents in New Urban Area mentioned that street sweeping is not provided in their areas.

d) Waste Segregation, Recycling and Composting

- 91% of upper class households and 88% of middle class households give or sell recyclable waste, while only 29% of lower class households do that.
- 70% of upper class, 68% of middle class and 75% of lower class households are not willing to participate in Waste Segregation activities.
- 88% of upper class, 95% of middle class and 100% of lower class households are not willing to participate in Recycling activities.
- 85% of upper class, 96% of middle class and 98% of lower class households are not willing to participate in Composting activities.

e) Participation in Community Activities

- 80% of upper class households, 83% of middle class households and 96% of lower class households are not participating in any community activities.
- 77% of all respondents mentioned that they are willing to participate in activities on solid waste management in their communities.

(2) Unique Sense of “Community” and “Participation”

a) General Feature of “Community” in Dhaka

In Dhaka City, there is almost no area-based community to which member has strong sense of belonging. Boundaries of “community” are vague and usually difficult to

identify. One of the reasons might be that more than half of the households in Dhaka City do not own lands and they pay rent to landowners. Most of them are immigrants from rural areas and still holding strong links with their home villages and relatives. They still identify the village/township of origin to be their real home[19].

b) Informal Community

Some kinds of informal communities called "Shomity" and "Ponchayt" exist in Dhaka City. Shomity is an association of neighborhoods. Their main activities include community security, waste collection, road widening, sports and culture. Ponchayt was a system originally introduced by the Chaukidari Act of 1880. It was established by one village or group of villages, mainly for the maintenance of police. Now local associations of ponchayt are seen only in Old Dhaka. Their activities and functions are similar to Shomity at present. The past several decades saw the decline of these kinds of small-scale informal communities except for some working in particular fields as waste collection.

c) Formal Community

On the other hand, there are various civil organizations working in local areas for specific purposes (CBOs). CBOs have emerged in response to the various requirements/needs of the concerned locality or community. There are now approximately 1,830 CBOs in Dhaka City[20]. The organizations are mainly funded by individual members/sympathizers/ patrons, who pay yearly or monthly contributions/subscriptions/donations. They are registered with the GOB Directorate of Social Services, under the Voluntary Social Welfare Agencies (Registration and Control) Ordinance 1961.3. CBOs' activities include social welfare, micro-credit, health, education, securities, and waste collection.

d) Sense of "Participation"

In Dhaka City, "Participation" or "Community-Based" does not always mean local people are included. In terms of solid waste management sector, many related organizations/government institutions use the word "participation" as meaning that people understand and support their activities. For example, "participation" could mean that people stop to throw their waste in vacant lands or on roads and properly give the waste to CBOs who provide door-to-door collection services, and pay a certain amount of collection charge.

e) Attitude of People as Individuals

On the other hand, from the viewpoint of an individual, most of the respondents from upper to lower class are not participating in any community activities at present, according to the Household Questionnaire Survey. It was found that people's attitude strongly depends on the initiatives of government, NGOs and CBOs, especially in middle and lower class households. Most of the households indicated negative

[19] Overcoming the Governance Crisis in Dhaka City, Kamal Siddiqui, Jamshed Ahmed, Abdul Awa, Mustaque Ahmed.

[20] The Role of Civil Society Organizations in Urban Development in Dhaka City, Nazrul Islam, Zeenat Mahjabeen, Oriental Geographer Vol.47: No.2: July 2003.

answers to the questions regarding willingness to participate in specific activities in solid waste management (i.e. segregation, recycling and compositing), although many are willing to participate in community activities on solid waste management in general.

(3) Formal Environmental Education

a) Education System of Bangladesh

The education system in Bangladesh is divided into three major stages: primary education, secondary education, and higher education as shown in Figure 2.8-1.

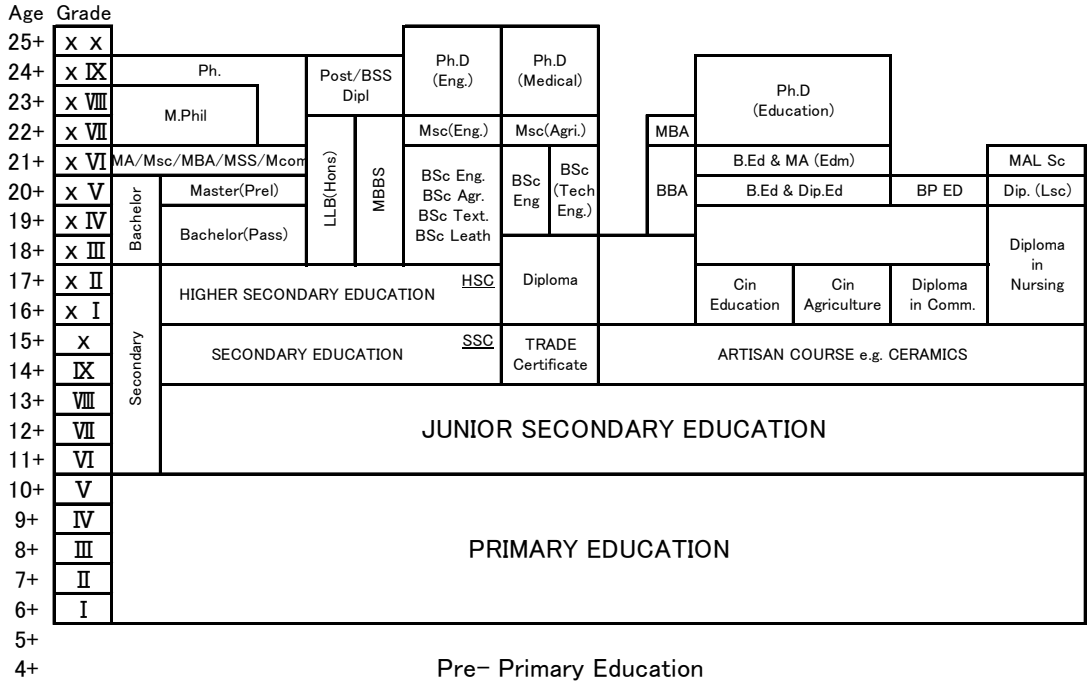


Figure 2.8-1 Education Structure in Bangladesh

Primary education consists of 5 years of formal schooling from grades 1-5. It normally begins at the age of 6 and goes up to 11. Secondary education consists of 7 (3+2+2) years of formal schooling. The first 3 years from grades 6-8 is referred to as junior secondary, the next 2 years (Grades 9-10) is secondary while the last 2 years (Grades 11-12) is called higher secondary education.

b) Educational Statistics of Primary and Secondary Education (Grades 1-10)

The educational institutes are categorized into governmental, registered non-governmental, non-registered non-governmental, madrasa and NGO's school in primary and secondary education of Bangladesh. Enrollment rate is 83% for Primary Education (Grades 1-5), and 55.7% for Grades 6-8 and 40.6% for Grades 9-10 for Secondary Education.

c) Literacy Indicator

Literacy indicators in 1997 for Bangladesh are shown in Table 2.8-1. Average adult illiteracy for over 15 years old is 61%. Among female population, the illiteracy rate is about 1.44 times higher than the male. Among all the age groups, more than half are

illiterate. So it is necessary to consider the illiterate persons when posters or textbooks are made.

Table 2.8-1 Illiteracy Indicator in Bangladesh

Illiteracy rate	%
Illiteracy rate of age: >15 years old	**61**
male	50
female	72
Illiteracy rate of age: 15-24 years old	**51**
male	41
female	62

Source: World Bank Regional Education Database for South Asia Countries

d) Policy of Environment Education

Environment education is not mentioned in the National Education Policy "NEP2000" of Bangladesh and in the action plan. Related government institutions and NGOs are carrying out Environment Education based on projects, which are supported by donors. It seems that Environment Education in Bangladesh depends mostly on donors' support because of the financial constraints.

e) Curriculum of Environmental Education for Grades 1-10

Environmental Education is included in Science and Social Science. Most primary schools operate in two shifts and there are seven classes in a shift. The duration of unit is 30 minutes. The teacher teaches many subjects. They teach other subjects until grade 8. After grade 9, there are specific teachers per subject, such as Physics and Chemistry. Teacher training centers are located in each region and training is conducted for pre-service and in-service training.

f) Education on Solid Waste

The textbooks for Science and Social Science describe solid waste above third grade. The connection between environment pollution, infectious diseases and unmanaged solid waste is taught to pupils. Description regarding solid waste is shown as below:

Grade Three (Society) Introduction to Environment:

Chapter 1-Our Environment

Environment Pollution:

- If the areas surrounding our living quarters are dirty, many diseases will infect us.
- If the classroom is not clean, the environment in the classroom will be unhealthy.
- If we pile up waste in and around our house, the environment will be polluted.
- If our toilets and latrines are not clean, this will also pollute the environment.

- Spitting on the roads or throwing waste in the street after eating any food makes the road dirty. Also, sometimes people use roadsides for their construction materials.

Environmental pollution is one of the most important problems of our society.

Therefore, we have to do the following things to protect the environment:

- Do not dump materials and waste in any place. Dump the waste into dustbin or container at a proper time
- Home, school, classroom, road should always be clean
- Do not throw the waste into river or pond

Chapter 9-Respect for the Work

- Cleanliness of the house: Two times in a day, the house has to be cleaned
- Dump the waste in the proper place
- Not only the house should be clean, but areas surrounding the house should also



be clean

<u>Grade Three (Science) Introduction to Environment:</u>

Chapter 1-Our Environment

- Taking a bath in the ponds or dumping waste in the ponds and rivers can pollute the waters of ponds and rivers
- We sometimes dump the waste beside the dustbin, which can produce bad odor. Also, some people burn the dumped waste which can produce even more pollution

Chapter 5- Health

- Influence of a dirty home
- How to clean the home: Put waste in dustbins or bury it
- Cleaning of classroom: Everyday we should clean the room after the lessons. There should be a wastepaper basket in the corner for waste materials
- Maintain proper sanitation

(4) Informal Environmental Education

Informal environmental education for people is carried out in many sectors. In the health sector, environment education is introduced for hygiene education and infectious disease control. Informal education in environmental and solid waste management is implemented

by government institutions and NGOs. However, DCC does not have a division and/or section for informal environmental education, and consequently has never carried out informal education regarding environment and solid waste.

(5) Awareness Campaign

a) Awareness Campaign by Related Organizations

Dhaka City Corporation

In DCC, communication with the citizens is maintained by the Department of Public Relations. The duty of the department is mainly to publish announcements of daily activity and opinions of the mayor and administrative matters. Therefore, there are few awareness campaign regarding solid waste and environment conservation within DCC. DCC does not maintain any communication or coordination between NGOs and other relevant agencies for environmental awareness programs. On the other hand, the Conservancy Department announces and publishes notices to citizens for clean-up campaigns regarding solid waste management. In 2004, the Conservancy Department distributed 100,000 stickers to ward commissioner offices, mosques and many other public places.

NGOs

Examples of awareness program implemented by NGOs are found in SEMP and the slum environmental improvement funded by UNICEF.

b) Media for Awareness Campaign

Newspaper

In Bangladesh, at present, there are 17 newspaper companies including 6 English newspapers that publish and distribute newspapers. Total number of publications in Bangladesh is about 3,000,000. About 1,500,000, half of national total, are published in Dhaka. Among many newspapers, three companies, Daily Prothom Alo, Daily Jugantor and Observer, publish articles regarding environment and solid waste. They have given good coverage on several occasions to events on solid waste and environment and government-related matters for environment protection in their Newspapers.

Television

There are 5 television channels in Bangladesh: BTV and BTV World channels are government-owned, while Channel-I, ATN Bangla, NTV are privately owned. It seems that the middle class and poor people watch BTV and NTV channels mostly since they do not require satellite antenna.

Radio

There is only one government-owned broadcasting company in Bangladesh. Radio programs cut across nine sectors including agriculture, health and nutrition, commerce, education, etc. Each sector has some promotional and awareness programs. Radio programs do not cover environment and solid waste much, unlike TV. The TV programs have a wider coverage of solid waste management and environmental issues.

c) Activities for Awareness Programs

Major Actor

The NGOs are the most active groups in implementation of environmental awareness programs. They provide consultations as well as implement the programs including activities such as workshop/seminar, environment camp, environment fair, eco-tour for student, photograph exhibition, publication ceremonies, culture show, and competition among students. These kinds of activities are not common and not always widespread in mass communication media. They perform these activities more for getting prompt action among the people and communities.

Mass Media

At present, the print media such as newspaper is not effective to communicate to the poor people because of high illiteracy rate. High-income group watches private broadcasting channels such as Channel-I and other international TV networks, so it seems that many people are not watching the environmental awareness programs broadcast on local/governmental TV channels.

2.9 Legal Aspect

(1) DCC Ordinance of 1983

a) Relevant Section of the Ordinance

Basic law regarding solid waste management in Dhaka City is Dhaka City Corporation Ordinance made and promulgated by the Chief Martial Law Administrator on 24 August 1983. Section 78 of the Ordinance stipulates as follows:

> Section 78. Removal, collection and disposal of refuse. - (1) The Corporation shall make adequate arrangements for the *removal of refuse*[21] *from all public streets,*[22] *public latrines, urinals, drains and all buildings and land vested in the Corporation, and for the collection and proper disposal of such refuse.*
>
> (2) The **occupiers of all other buildings and lands** within the Corporation shall be responsible for the removal of refuse from such buildings and lands *subject to the general control and supervision of the Corporation.*
>
> (3) The Corporation *may cause public dustbins or other suitable receptacles to be provided at suitable places* and where such dustbins or receptacles are provided, the Corporation *may, by public notice, require that all refuse accumulating* in any premises or land shall be deposited by **the owner or occupier of such premises or land** in such dustbins or receptacles.
>
> (4) All refuse removed and collected by the staff of the Corporation or under their control and supervision and all refuse deposited in the dustbins and other receptacles provided by the Corporation shall be property of the Corporation.

[21] "Refuse" includes rubbish, offal night soil, carcass of animals, deposits of sewerage, waste and any other offensive matter, according to the definition of the Ordinance.

[22] "Public street" is defined as a street maintained by the Government.

b) Responsibility of DCC

According to the above, DCC is responsible for removal of waste from all public streets, drains and buildings and land of the Corporation and for the collection and proper disposal of waste, provided that the private drains, which may be constructed with the previous permission of DCC, shall be subject to control, regulation and inspection by DCC, and that DCC may, by notice, require the owner of any building or land within the City to take such steps necessary for the effective drainage.

c) Responsibility of Occupiers

In turn, the occupiers of all other buildings and lands within jurisdiction of DCC are responsible for the removal of refuse from their buildings and lands. To discharge their responsibility, they have to carry and dispose of their waste in the receptacle (containers or dustbins), which DCC may install, by themselves or to contract an NGO, CBO or private company to carry their refuse to the public dustbins or containers.

d) Offense and Penalty

When the occupiers do not follow the Ordinance, i.e., "throwing or placing any refuse on any public street or in any place not provided or appointed for the purpose by the Corporation (item 19 of the Third Schedule of the Ordinance)", it shall constitute an offense and punishment shall be meted out after conviction according to Sections 150 – 153 of the Ordinance.

e) Interpretation of Boundary between DCC and Occupiers

DCC Ordinance of 1983 gives DCC responsibility for adequate disposal of refuse removed from public streets, public latrines, urinals, drains and all buildings and lands of DCC (Section 78). Although this ordinance does not explicitly give DCC responsibility of disposal of refuse deposited in dustbins or containers by occupiers of buildings and lands other than those of DCC, the responsibility is widely regarded as that of DCC; then DCC transports and disposes of the refuse at dumpsites.

(2) Environment Conservation Act and Rules

a) Requirement related to SWM

Environmental Conservation Act of 1995 and Environmental Conservation Rules of 1997 require the person, who proposes or undertakes every industrial unit or project, to acquire Environmental Clearance Certificate (ECC, Section 12 of the Act). Landfilling by industrial, household and commercial wastes is classified as "Red Category", which includes most harmful or dangerous industrial units and projects (Rule 7. and Schedule 1 of the Rules).

b) Procedure to Acquire ECC

To obtain Environmental Clearance Certificate for industrial units or project of the Red Category, the following should be submitted to the Department of Environment (DOE) of Ministry of Environment and Forests.

(i) report on the feasibility of the industrial unit or project (applicable only for **proposed** industrial unit or project);

(ii) *report on the Initial Environmental Examination (IEE)* relating to the industrial unit or project, and also the terms of reference for the Environmental Impact Assessment of the unit or the project and its Process Flow Diagram;
or
Environmental Impact Assessment report prepared on the basis of terms of reference previously approved by the Department of Environment, along with the Layout Plan (showing location of Effluent Treatment Plant), Process Flow Diagram, design and time schedule of the Effluent Treatment Plant of the unit or project (these are applicable only for a **proposed** industrial unit or project);

(iii) *report on the Environmental Management Plan (EMP)* for the industrial unit or project, and also the Process Flow Diagram, Layout Plan (showing location of Effluent Treatment Plant), design and information about the effectiveness of the Effluent Treatment Plan of the unit or project (these are applicable only for an **existing** industrial unit or project);

(iv) *no objection certificate* of the local authority (City Corporation);

(v) emergency plan relating adverse environmental impact and plan for mitigation of the effect of pollution;

(vi) *outline of relocation, rehabilitation plan* (where **applicable**);

(vii) o*ther necessary information* (where **applicable**);

c) Little Sense of Compliance in DCC with the Act and Rules

DCC does not obey the Act and Rules. Most of the staff appear not to be aware of these provisions. Uncontrolled or unidentified dumping or disposal prevails. In some cases, this kind of dumping is done with request of the landowners and sometimes the owners even tip the person who dumps waste. In other cases, dumping is made in public open space or even some roadsides.

(3) Preservation Act

a) Requirement related to SWM

Preservation Act of 2000, requires consent of the Government before the owner of the land changes the structure, i.e., causes any change from the original Master Plan or Government Gazette, of open place, playing field or natural reservoir of water identified by the Master Plan or declared in the Government Gazette by *filling land*, building construction and any other construction that alter the original Master Plan.

b) Procedure to Acquire the Consent of the Government

The owner shall apply with reason of the change to the Government through authorities, such as RAJUK, other city development authorities, City Corporations, or Municipalities, and the related authority shall fully examine the situation, and send their precise comments and recommendations to the Government. The Government shall decide on the matter within 60 days after the receipt of the application and send a

written decision letter within 15 days after the decision. If the applicant does not agree with the decision of the Government, the person can apply, within 30 days after receipt of the decision, for reconsideration of the Government, whose decision shall then be final. The Act is also applicable for land owned by the Government or a local authority.

c) Compliance of the Act by DCC

DCC currently does not comply with the above Act. Almost all of its staff seem not to know these provisions. Uncontrolled or unidentified dumping or disposal might be done without the consent of the Government.

2.10 Organization

(1) Job Allocation within DCC

a) Current Job Assignment in DCC related to SWM

The administrative jobs related to SWM are assigned to various departments and divisions as shown in the table below. Owing to this setup, some sequences of jobs require long procedures and long periods of time to complete.

Table 2.10-1 *Required Administrative Jobs and Current Implementing Organization for Solid Waste Management*

Jobs	Implementing Department: Conservancy Dept.	Transport Dept.	Engineering Dept.	Store and Purchase Dept.	Urban Planning Dept.	Others
A. Generation						
1. Estimation of Current and Future Generation	---	---	---	---	---	---
2. Promotion of Waste Reduction	---	---	---	---	---	---
B. Waste Handling at the Source						
1. Control of Waste Carriage to Dustbins/Containers	---	---	---	---	---	---
2. Control of Transport/Disposal by Generators	---	---	---	---	---	---
C. Primary Collection (Door-to-door)						
1. Awareness Campaign	**(1)**					
2. Promotion of Activities by NGO/CBO/Private Companies	**(1)**	←	.....	.....	**(1)**	
D. Storage at Dustbins/Containers						
1. Installation of Dustbins/Containers	**1, 3**	**5**	**4**			$1^{*1}, 2^{*2}$
2. Repair of Containers	**1**	**2, 4**	**3**			
E. Cleaning						
1. Campaign and Legal Actions not to Scatter Wastes	**(1)**					
2. Employment and Deployment of Cleaners	**1, 4**					$1^{*1}, 2^{*2}, 3^{*3}$
3. Procurement of Conservancy Tools	**1, 3**			**2**		
4. Cleaning Works	**1**					
5. Carriage of Road and Drain Waste to Dustbins/ Containers	**1**					
6. Conservancy Inspection	**1**					2^{*1}
7. Outsourcing of Cleaning Services	**7**				**1, 3, 6**	$2^{*2}, 4^{*4}, 5^{*2}$

Jobs	Implementing Department: Conservancy Dept.	Transport Dept.	Engineering Dept.	Store and Purchase Dept.	Urban Planning Dept.	Others
F. Secondary Collection and Transport						
1. Deployment of Conservancy Drivers	**1**	**4**				$1^{*1}, 2^{*2}, 3^{*3}$
2. Procurement of Conservancy Vehicles	**1**	**7**	**3, 6**			$1^{*1}, 2^{*2}, 4^{*4}, 5^{*2}$
3. Driving Conservancy Vehicle		**1**				
4. Supervising and Monitoring of Drivers	**(1)**	**(1)**				
5. Procurement of Fuel/Lubricant of Conservancy Vehicles		**1**				
6. Deployment of Truck Cleaners	**1**					
7. Procurement of Conservancy Tools	**1, 3**			**2**		
8. Loading and Unloading of Waste to and from Truck	**1**					
9. Inspection/washing/pooling of Conservancy Vehicles		**1**				
10.Repair of Transportation Vehicles		**1, 5**	**2, 4**	**3**		
11.Outsourcing of Repair Works (Conservancy Vehicle)		**1, 6**	**2, 5**			$3^{*4}, 4^{*2}$
G. Disposal						
1. Construction of Disposal Site	**1**		**1, 3, 6**			$2^{*2}, 4^{*4}, 5^{*2}$
2. Procurement of Heavy Equipment			**1, 4**			$2^{*4}, 3^{*2}$
3. Repair of Heavy Equipment			**1**			
4. Outsourcing of Repair Works (Heavy Equipment)			**1, 4**			$2^{*4}, 3^{*2}$
5. Recording Incoming Waste (Conservancy Vehicle)	**(1)**					
6. Control of Dumping Place			**(1)**			
7. Dressing and Compaction			**1**			
8. Soil Cover	---	---	---	---	---	---
9. Leachate Control	---	---	---	---	---	---
10.Gas Removal Collection	---	---	---	---	---	---
(Transfer)						
(* Ward Transfer Stations)	(1)					
H. Recycling						
* Promotion of Recycling	---	---	---	---	---	---

Source: Interviews with DCC Staff

Note: 1) Responsibility allocation varies depending on sources of information.
2) Figures show the sequence to get the job done.
3) Parentheses ( ) shows the limited activities)
4) *1; Commissioners, *2; Mayor, *3; Establishment and Administration Dept., *4; Tender Evaluation Committee)

b) Current Status of Job Allocation

Job descriptions of the departments, divisions or posts should be generally documented or coordinated. About 10 years ago, Administration and Establishment Dept. started to coordinate and define job descriptions of departments and divisions. The task, however, was not completed. Now some of departments have internal job descriptions for high ranked posts while others do not have yet. Probably in the latter type of departments and divisions, it is believed to be common sense that "every one knows what he/she should do because of the post within the department/division" or "he/she should do whatever ordered by the head."

c) Organization Customs in DCC

Generally, in DCC or in Bangladesh, the authority of heads of departments and divisions is strong. Strong authority and loyalty is a good driving force on the one hand; however, it may deter junior staff to raise good proposals for better execution of their job on the other hand.

d) Need for Integrated Performance of Departments

Departments and divisions of DCC are made up of professionals, but the necessary functions on solid waste management are scattered over many departments and divisions. Conservancy Dept. plays the core role of solid waste management by shifting Manager of Transport (Conservancy Pool) to work under Chief Conservancy Officer (CCO), who headed Conservancy Dept. recently.

(2) Capacity of Operating Departments/Divisions

a) Cleaning of Road and Drains

Major human resources are deployed to this job covering all the public roads and drains. As for road cleaning, the capacity seems to exceed the demand. Consequently, the majority of them work for shorter than 6 hours a day. On the other hand, the capacity for drain cleaning seems insufficient since not all the drains are cleaned regularly. It is not yet clearly defined to what extent DCC shall perform drain cleaning as its task. The tools they use for drain cleaning need improvement for better efficiency and health protection of cleaners.

b) Vehicle Operation

The capacity of conservancy vehicles for secondary collection and transport is considered sufficient to maintain the present collection rate of about 45%. On the other hand, the number of drivers is less than that of vehicles. This leads to longer working hours for drivers compared to the other workers engaged in SWM. Vehicle operation is entirely recorded though. The record is referred to for determining the fuel consumption when the Transport Dept. issues a fuel ticket to the drivers.

Truck cleaners undertake quite tough and unhealthy loading works, which take them a longer time to finish than container cleaners. In view of work efficiency, container carrier shows better efficiency than open truck, which forms the majority of vehicle stock at present.

c) Maintenance and Repair

Works for repair of conservancy vehicles are separated into two Departments and major repair works are outsourced; repair works require lengthy procedures. Scores of vehicles are not working. The capacity of this sector is insufficient to utilize the vehicle fleet to maximum extent.

d) Disposal

Operation in disposal sites is controlled by foremen (Mechanical Division 2) who rarely supervise the work of operators at disposal sites. There are no staff members

exclusively assigned to landfill operation permanently. Due to lack of knowledge and skills of the foremen and the operators, the landfill is not effective and hygienic. Operation rate of heavy equipment is quite low because of old ages of vehicles and lengthy procedure for outsourcing of major repair works.

Personnel dispatched by Conservancy Dept. are not working properly. Their works are neither clearly defined nor supervised and consequently not recorded and analyzed at all.

e) Community Participation in National Policy

Although community participation is encouraged in National Policy on Water Supply and Sanitation, which includes solid waste management as a component in urban sanitation, no department or division gives sufficient care of public participation in solid waste management.

(3) Capability of Planning and Coordination among the Departments Concerned

Despite the efforts to coordinate SWM activities by temporarily shifting the Conservancy Pool to Conservancy Dept. and by establishing Solid Waste Management Cell under Conservancy Dept. initiated by the Mayor, the capability for planning and coordination was still limited when the Study started. The Study Team, comprising JICA Study Team and Counterpart Unit of DCC, has proposed establishment of Waste Management Committee and Waste Management Division.

a) Proposed Approach toward Master Plan

This JICA Study is the first study to formulate a comprehensive master plan specifically on solid waste management in a city of Bangladesh. A scientific approach toward the Master Plan is adopted in this study. Scientific approach is represented by the phrase of running management cycle of “plan – do – see” or of “plan – implement – monitor – feedback to implementation – evaluate – learn lessons.”

b) Establishment of New Organization

Waste Management Committee (WMC) and Waste Management Division (WMD) was established with the objective of enhancing coordination mechanism among the departments of DCC. Proposed organizations were regarded as evolving from Solid Waste Management Cell, which had been established for better coordination and management among the concerned departments and divisions.

c) Function of WMC

WMC is composed with chairmanship of Chief Executive Officer (CEO) and membership of relevant department heads of DCC and representatives from the relevant Government Ministries. Functions of the WMC are to finalize the recommendations to the Mayor on the following:

* Implementation Plans /Action Plans including Formulation of Implementation Unit
* Annual Operation Plan and Budget Plan
* Formulation/Review of Master Plan (once in five years)

WMC is to make decisions within the frame of the above plans approved by the Mayor, on i) coordination for smooth implementation and on ii) necessary countermeasures after analysis of monitoring results.

d) Function and Composition of WMD

WMD is to carry out i) secretarial works to WMC and ii) day-to-day liaison with external organizations for one-stop service. WMD was placed in Conservancy Dept.

A proposal was submitted to CEO in April from the Study Team. CEO sent the proposal to the Local Government Division (LGD) of Ministry of Local Government, Rural Development and Cooperatives. After inquiries from LGD and response by DCC, the LGD issued instructions to establish WMC and WMD in August and July 2004, respectively.

Due to inconvenience in original qualifications of staff and because of identified issues and approaches of the Master Plan, the composition of WMD was reviewed and proposed to CEO from Study Team in December 2004.

2.11 Financial Management

(1) Budget Preparation

a) Ordinance and Rules relevant to Budget

"The Dhaka City Corporation Ordinance, 1983" and "The Dhaka Municipal Corporation (Preparation and Sanction of Budget) Rules, 1974" provide the budget preparation and sanction of DCC. In compliance with the Ordinance and Rules, the budget shall be prepared and sanctioned in a prescribed manner and shall be submitted to the Government by the first day of June each year.

The Revised Budget is, if necessary, also prepared and sanctioned in compliance with the Ordinance and Rules before the expiry of the Financial Year.[23] Financial year starts in July and ends in June in Bangladesh.

b) Budgeting Process of DCC

Programmed Procedures and Deadline

According to Accounts Department, the budget of DCC shall be prepared and sanctioned through the following procedures and deadline, as illustrated in Table 2.11-1.

[23] The term "Financial Year" is commonly used in official documents, such as budget statements of the Government of Bangladesh and DCC, instead of the words "fiscal year" used in other countries. For better understanding of the counterparts and other officials of DCC and the Government, "financial year" is used in this report.

Table 2.11-1 Budget Procedures and Schedule

Month	Feb	Mar				April				May			
Week	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1.	■	Budgeting request from Chief Account Officer to Departments/Zones											
2.		■	■	Preparation of draft by Departments /Zones									
3.				■	■	Review & consolidation by Departments							
4.		Review & consolidation of				■	■	draft budget by Accounts Dept.					
5.	Review, examination and recommendation to Mayor by							■	the Standing Committee*				
6.						Approval by Mayor			■				
7.			Preparation of final draft by Accounts Dept.							■	■		
8.					Special budget meeting of Municipal Committee							■	
9.								Submission to the Government					■

Source: Information from Accounts Department
Note*: Finance & Establishment Standing Committee

Actual Budgeting

The budget should be formulated by the concerned Department/Zones within 3 months in accordance with the above schedule. But actual work is not necessarily executed on schedule. It is said that adequate budgeting requires at least several months for each department to prepare draft budget through frequent consultation with accounts department. However, most of departments of DCC spend only one month, so accurate and achievable projection of incomes and expenditures can hardly be prepared.

(2) Budget and Actual Income/Expenditure

a) Original Budget

Summary of DCC budget is shown in Table 2.11-2. So-called general or recurrent budget is known as “Revenue Budget” in Bangladesh and the capital or investment budget as “Development Budget”.

Table 2.11-2 Summary of DCC Budget (Taka in million)

Items			Original Budget					Revised Budget
			Financial Year					
			00-01	01-02	02-03	03-04	04-05	03-04
Opening Balance			50	50	60	70	80	216
Incomes	Revenue		1,908	2,063	2,497	3,058	3,910	2,482
	Development	Government Grant	650	650	500	500	500	409
		Special Govt. Grant	0	0	2,000	1,000	1,000	250
		Govt./Foreign-aided Project	2,800	2,800	1,711	2,995	3,723	2,944
		Total	3,450	3,450	4,211	4,495	5,223	3,603
	Others		60	60	5	7	7	10
	Total		5,418	5,573	6,713	7,560	9,140	6,095
Expendi-tures	Revenue	Salary/wages	510	580	740	800	1,000	700
		Others	619	629	777	948	1,075	911
		Total	1,129	1,209	1,517	1,748	2,075	1,611
	Development	Own source/Gov. Grant	1,154	1,244	1,160	2,262	2,992	1,523
		Gov/Foreign aided Project	2,800	2,800	1,711	2,995	3,723	2,944
		Total	3,954	4,044	4,871	5,257	6,715	4,467
	Others	Loan repayment, etc	335	320	332	555	350	225
	Total		5,418	5,573	6,723	7,560	9,140	6,303
Closing Balance			50	50	50	70	80	80

Source: DCC Budget Report and information from Accounts Department

Revenue income accounts for 35%-45% of all incomes; while development income, for 55%-65%.

Revenue expenditures account for 20%-23% of all expenditures; while development expenditures, for around 70%-75%, that is to say, some 10%-15% of development expenditures are made up by revenue incomes. Salary/wages is the largest expenditure accounting for 45%-48% of all revenue expenditures.

It is quite difficult to extract the SWM budget amount because the summary table that shows the breakdown of department-wise budget is not available.

b) Revised Budget

The Revised Budget of each financial year is also prepared in the third quarter. However, there is no basis of continuous monitoring for either of budgeted incomes and expenditures. Actions for balancing the budget are taken only in the fourth quarter by the following traditional manner: Revenue Department calculates 10 months actual income and then estimates the rest of 2 months income, and forwards it to Accounts Department.

Usually, revised revenue incomes are lower than the original ones. As a result, original budget revenue expenditures are cut down through immediate discussion with each department by suspending on-going works and material procurement, and postponing payment to suppliers. Simultaneously, tax officers are instructed to drive tax collection more than usual, especially from taxes in arrears.

c) Actual Income and Expenditure

A summary of actual income and expenditure of DCC own account is shown in Table 2.11-3. The problem is that revenue incomes collected were only 70% of budgeted amounts, on average, over the three financial years from 2000-01 to 2002-03. This income gap compels DCC to squeeze its own source development expenditures and recurrent expenditures aside from salary/wages.

Table 2.11-3 Actual Income and Expenditure of DCC Own Account (Taka in million)

Items			Financial year	99-00	00-01	01-02	02-03	% (02-03)
Opening Balance				39	42	41	286	10
Incomes	Revenue			1,615	1,717	1,625	1,828	64
	Development	Government Grant		550	550	500	463	
		Special Govt. Grant		0	0	0	285	
		Total		550	550	550	748	26
	Total			2,165	2,267	2,125	2,575	
Opening Balance + Incomes				2,204	2,309	2,166	2,861	100
Expendi-	Revenue	Salary/wages		464	504	607	634	24
tures		Others		476	487	364	504	19
		Total		940	991	971	1,138	
	Development	Own source/Govt. Grant		1,158	1,134	711	1,241	46
	Others	Loan repayment, etc		64	143	199	291	11
	Total			2,162	2,268	1,881	2,670	100
Closing Balance				42	41	286	216	

Source: Information from Accounts Department

Note: DCC own account does not include income and expenditures of Government/Foreign-Aided projects.

Another problem is that it usually takes more than one year to add up actual income & expenditure figures after closing financial year; it is also quite difficult to extract from it SWM's own expenditure by Department as well as by operation.

(3) Breakdown of DCC Incomes

DCC incomes are classified into three categories: 1) Revenue Income, 2) Government Grant, and 3) Government and Foreign Agencies/Donors Support.

a) Revenue Income

DCC has as many as 19 regular revenue income items of its own as shown in Table 2.11-4. Among these items, only 5 items contribute around 83% to total revenue incomes and they are: 1) Holding Tax, 2) Market Rent, 3) Market Salami, 4) Trade License, and 5) Property Transfer Fee. The substantial amount of arrears has remained in the account of Holding Tax. Arrears chronically constrict the financial condition of DCC.

Table 2.11-4 Classification of Revenue Incomes (Taka in million)

Classification		Remarks	Financial Year 2002-2003		proportion (%)
			Budget	Actual	
1.	Holding Tax	12%: Property tax 7%, Conservancy rate 2%, Lightning rate 3%	1,600	1,054	63 %
2.	Market rent	Rent from 105 markets owned by DCC	59	89	5 %
3.	Market salami	Security deposit for market use determined based on the construction cost plus slight margins	100	42	3 %
4.	Trade license fee	License fee on every profit aiming business payable every year	135	96	6 %
5.	Property transfer fee	1% on transfer value, of which 97% is distributed to DCC	47	105	6 %
6.	Wheel license fee	*Rickshaw license payable every 3 years*	20	0	17 %
7.	Cattle market fee	Market fee mostly from Berri Band Market	70	67	
8.	Equipment lease		30	24	
9.	Bus terminal fee		100	28	
10.	Children park		15	16	
11.	Octroi	Compensation from Government	25	25	
12.	Others		146	131	
Sub-total			2,347	1,677	100.0 %
13.	Road cutting fee*	Compensation of road digging expenses paid by WASA, Light, Gas, Telephone, etc	150	151	-
Total			2,497	1,828	-

Source: DCC Budget Report and Information

Note*: Road Cutting Fee is not considered in calculation because this is offset by relevant expenditures and not effectively regarded as revenue income.

Holding Tax

Holding Tax is the largest income resource to DCC. Holding Tax is composed of Property Tax 7%, Conservancy Rate 2% and Lighting Rate 3% and imposed on annual value of property that a taxpayer owns. Holding Tax system is administered by practicing three procedures as follows:

* Valuation of Properties:

Annual valuation of holdings is fixed by physical verification of the holdings based on a reasonable rental value in the surrounding area or on the basis of construction cost. Tax payers can appeal against the valuation assessed by DCC. The valuation of respective holdings is recorded in the valuation list. There are two kinds of valuation lists that are prepared manually.

- General Valuation List

A valuation list of properties shall be prepared and reassessed once every 5 years in compliance with "The Municipal Corporation Taxation Rules, 1986". This valuation list is called a General Valuation List. The latest reassessment of the General Valuation List was made in 1988-89 and no more reassessment has been made at all since then for some 15 years in DCC.

- Field List

Valuation of new holdings and of existing holdings for addition or alteration is prepared by routine field examination works and added to the list. This is an interim

registration list that is called interim assessment. The interim assessment is obviously reflected to the tax bills; however, the effect to raise the valuation may not be as large as reassessment of General Valuation.

* Billing and Collection:

The tax bill is prepared based on the General Valuation List and/or interim valuation, and delivered directly to the house of taxpayers from July to August 15. The bill is payable in 4 installments. There are several tax incentives (rebates) for advanced payment and a penalty on delinquent payers. Tax history of each taxpayer is recorded in Demand and Collection Register. All recording and items in the tax bill are filled manually.

Market Rent

Market rent is also a substantial financial resource to DCC revenue income. DCC has been providing market places and is increasing the number. DCC currently owns and rents out some 105 markets. The rental agreement has been made with around 25,000 tenants. The area per tenant is roughly 70 ft^2 on average. Market fee collected from the tenants is practically a land rental fee that is determined based on the market rent of the surrounding area. Accordingly, the rent varies from place to place, that is, from Tk. 2.5/ft^2 of the lowest at present to Tk. 12/ft^2 of the highest at present, and it is collected every first week of the month. It is noted that the agreement requires the tenants to clear drains, front balcony and roads. The arrears in the account of market rent as of June 1999 reached Tk. 20 million, which corresponds to 30% of original budget amount.

Trade License Fee

Trade license fee is levied on every profit-making organization or profession. For example, the company with paid-in capital of more than Tk. 50 million has to pay currently Tk. 10,000 a year; a small cloth retailer has to pay Tk. 250 yearly. The fee varies by the size of capital and/or type of business activities. However, it should be noted that the arrears in the account of trade license fee as of June 1999 amounted to Tk. 120 million, which exceeded the original budget amount of the year.

b) Development Revenue

Government Grant

This is the basic intra-governmental grant to DCC from the Government. DCC retains considerable discretion over the use of funds if they are spent on development program. Annual amount of the Government Grant is informed to DCC in July, payable in 4 installments—September, December March and June. The problem is that this timing of Government information is not synchronized with DCC budgeting schedule that shall be concluded before June.

Government/Foreign-Aided Project Funds

DCC also receives substantial financial support from the Government and foreign agencies and donors to implement specific projects approved by the Government. All expenditures on Government/Foreign-Aided Projects are usually disbursed to the

contractors by DCC simultaneously on receiving the aid funds. Therefore, budgeted revenue income and expenditures of Government/ Foreign-Aided Project are usually equal.

> Japanese Government Grant from Debt Cancellation Program
>
> In 2004-05 financial year, Tk. 1,900 million of the Program is appropriated for DCC development budget through the Ministry of LGRD for the first time. The Program started in 2004 and can be appropriated through the Ministry both for development and non-development budget including personnel expenditures.

(4) Balance Sheet

The balance sheet (B/S) is essential to obtain the management information about the financial activities and conditions in the year, and cash movement comparing the previous year B/S; nevertheless, the B/S the last three years from June 2001 are not available because they are still being prepared.

Table 2.11-5 shows B/S of 1996, 1999 and 2000 that are the only ones obtainable at present. June 2000 B/S shows that the sum of three items such as land, building/structure and Holding Tax receivables (mostly arrears) accounted for 92% of total assets amount, respectively 45%, 41% and 6%. It also reveals that DCC concentrated on infrastructure investment in the past. Meanwhile, total assets increased Tk. 5.2 billion during 4 years over the period of 1996/2000, mostly caused by increase of building/structures (Tk. 4.0 billion), transport equipment (Tk. 0.5 billion), and receivables account (Tk. 0.7 billion). This Tk. 5.2 billion of assets increase was funded by its own source (Tk. 4.6 billion) and loan and/or the like (Tk. 0.6 billion). According to the preliminary information, receivables (mostly Holding Tax arrears) of June 2003 soared to Tk. 1.47 billion, that equals to an annual increase of 8% from June 2000.

This sort of information is expected to be open to the public anytime and immediately by disclosing the B/S accompanied with explanatory notes.

Table 2.11-5 Balance Sheet as of Financial Year End of 1996, 1999 and 2000 (Taka in million)

Balance Sheet Items			1996	1999	2000	Balance (2000-1996)
Current Assets	Cash in Bank		147	39	42	-145
	Security Deposit		87	120	7	-80
	Receivables	Holding Tax	n/a	1,131	1,082	-
		Market Rent	n/a	21	n/a	-
		Trade License Fee	n/a	121	140	-
		Others	n/a	7	2	-
		Total	561	1,280	1,224	663
	Advance & Stores		77	148	121	44
	Total		872	1,587	1,394	522
Fixed Assets	Land	Development	n/a	4,614	4,626	-
		Roads	n/a	3,545	3,545	-
		Total	8,125	8,159	8,171	46
	Building/Structure		3,516	6,473	7,502	3,986
	Machinery /Equipment	Heavy Equipment	n/a	285	287	-
		Others	n/a	74	81	-
		Total	185	359	368	183
	Transport Equipment	Vehicles	n/a	539	624	-
		Motorcycle	n/a	5	5	-
		Total	172	544	629	457
	Others		13	35	43	30
	Total		12,011	15,570	16,713	4,702
Total of Assets			12,883	17,157	18,107	5,224
Current Liabilities	Accounts Payable (Overdraft)		91	340	328	237
	Security Deposit		87	230	157	70
	Others		203	100	96	-7
	Total		381	670	581	300
Fixed Liabilities	Long-term Loan(Nagar Bhaban Bldg.)		560	788	926	366
	Debentures		100	124	131	31
	Total		660	912	1,057	397
Total Liabilities			1,041	1,582	1,638	597
Fund (equivalent to equity of private company)			11,842	15,575	16,469	4,627
Total of Liabilities and Fund			12,883	17,157	18,107	5,224

Source: June 1996; Dhaka City Management Reform Pilot Project, ADB, June 1998
June 1999 and 2000; Information from Accounts Department of DCC

2.12 Privatization

(1) Initiation of the Privatization Project

SWM privatization project for cleaning roads, drains and other public places, secondary collection, and transport in 8 wards of Dhaka City was planned and implemented in 2003 by the initiatives of Urban Planning Department of DCC under "Ward-Wise Waste Management Project of DCC (Private Initiative)". Through competitive bidding, four organizations were selected and awarded to operate the project. The project started on 15 May 2003 and was administered entirely by Conservancy Department.

(2) TOR for Contractor

Terms of Reference (TOR) for the project are summarized in Table 2.12-1. The four organizations awarded shall report the performance of works to DCC periodically and shall be graded from rank A to rank D by DCC. If graded rank A, the organization will be given the right to continue the project in the following year. On the other hand, if ranked D, no right will be given for the next year.

Table 2.12-1 Summary of TOR for Ward-Wise Waste Management Project

Items	Contents
1.Name of the Project	Project for Ward-Wise Waste Management of Dhaka City Corporation (Private Initiative)
2. Objectives	To provide superior quality of service to the residents
3. Project Area	8 Wards Zone 9: Ward 17, 18, 19, 20, 21, 37, and 38 Zone 10: Ward 1
4. Project Duration	1 (one) Year
5. Working Area	1. All roads, market, park, footpaths, etc 2. All open and closed drains 3. The surrounding area of dustbin and container 4. Dumping the waste at landfill site (Matuail) 5. Road signs and traffic signs
6. Other descriptions	Requirements for methodology and quality of service, cleaning frequency, working time, grading the service, etc

Source: Urban Planning Dept., DCC

(3) Progress of Project in the First Term

Contracts were awarded to 4 organizations, namely BIEDF (Bangladesh Integrated Environment Development Forum), MIRUD (Mission for Rural Urban Development), Messer's Rhythm, and LN Corporation. To start the project, the contractors employed generally slum dwellers especially as cleaners. Total number of field staff employed by the contractors was smaller than the number deployed by DCC before privatization. At the beginning, conservancy supervising inspectors and conservancy inspectors of Zone 9 and Zone 10 of DCC gave practical training to the cleaners employed by the contractors.

Containers were removed due to unavailability of the container carriers to the contractors. The contractors also reduced the number of locations of dustbins/containers in response to the demand of residents after consultation with DCC and local communities. In fact, the number of locations in the area of 3 contractors interviewed except Rythm was cut from 111 before privatization to 73 at present. It is noted that Uttara and Berri Band are actually used as dumping sites, despite Matuail being directed in the TOR, by getting permission or receiving compulsory order from DCC. The deployment of resources is summarized in Table 2.12-2.

Table 2.12-2 Summary of Program Management by the Awarded Organizations

Zone	9							10
Ward	18	19	20	21	38	17	37	1
Organization Name	BIEDF					Messer's Rhythm	LN Corporation	MIRUD
Legal Status	NGO					Private Company	Proprietorship	NGO
Contract Amount	37,000,000 in Total							
No. of field staffs	46	154	55	51	52	55	46	130
-Manager	1	1	1	1	1	1	1	1
-Supervisor	2	2	2	2	1	6	2	6
-Cleaner	26	110	30	30	37	36	25	65
-Drain cleaner	7	16	12	8	3	6	10	24
-Truck loaders	10	25	10	10	10	6	8	27
-Others	-	-	-	-	-	-	(7-10)	7
Trucks (Rental)	14 (22 in rainy season)					2	2	3
No. of dustbins	3	10	4	2	5	4	8	41
Dump site	Uttara B. Band	Uttara Matuail	Matuail B. Band	Uttara B. Band	Uttara B. Band	Tongi	B. Band	Uttara (Ashulia)
Trips a day/truck	2					2	2	3
Financial results	Probably around the break-even point					In loss	Break-even	Not clear
References								
-Population (.000)	36	72	81	73	82	85	117	66
- Area (km^2)	8.85	4.62	1.60	2.07	1.13	6.77	2.99	3.92

Source: JICA Study Team, Interviews with Contractors

Note: 1) Population – preliminary data of 2001 from Bangladesh Bureau of Statistics
2) Area – Information from Urban Planning Department of DCC

(4) Opinions on the Privatization Project

Based on interviews with the residents and contractors, the project is appreciated by both sides; details are as follows:

The contractors often received a variety of demands and complaints from community, either directly or through DCC, at the beginning stage. Nowadays this kind of problem has been minimized due to the action taken against the demands and complaints. The contractors think the contract period is too short (it should at least be 3 to 5 years) to make adequate and necessary capital investment essential for better performance of SWM. The income tax and value added tax that totals 7.5% of the contract amount are charged and withheld monthly from the bill. This was neither described nor appeared in the TOR. This financial burden also makes it difficult to achieve good performance.

(5) Prospect of the Project over the Next Term

The first year's performance grading was made according to the TOR. As a result of grading for the first year, 3 contractors were given another contract for the second year with the same amount as the first year. However, the contractor of Ward 37 failed in the renewal of contract, so that the competitive tender for Ward 37 was made again this year with the revised contract term extended to 3 years. The tender had not been finalized yet at the end of 2004.

DCC reviewed the TOR and added the following items to it:

- DCC collects wastes and bills the organizations for it if the collection is made in insufficient manner.
- DCC gives warning if the cleaning is done in insufficient manner.

Chapter 3

Evaluation of Solid Waste Management in Dhaka City

3.1 Primary Collection

(1) Coordination and Collaboration among DCC, Primary Collection Service Providers and Community People at the Local Level

In recent years, various types of CBOs have been emerging and rapidly growing in the solid waste management sector. They are making efforts in primary waste collection in response to people's needs.

However, there are no guidelines or rules of primary waste collection and other related activities in solid waste management at the ward level and the community level. Structure and roles of the various actors are not clearly identified and informed to the public. Therefore different actors are making efforts following their own concerns or interests.

There is usually no common ground open to related actors to discuss and coordinate the activities toward improvement of the situations at the ward level and the community level. The process of establishing door-to-door waste collection system is not always transparent to the public. Conflicts among different primary collection service providers are seen in some wards and that obstructs the service improvement. Residents are just giving their waste to waste collectors and paying collection charge. Some of them do not know who is organizing the activities and to whom they are paying collection charge. People usually receive services of primary collection service providers and DCC, and are not fully involved in the activities/decision making process.

Coordination and linkage between primary collection service providers and DCC are also insufficient. DCC Conservancy Inspectors and Ward Commissioners do not grasp all primary collection service providers working in the wards and their service areas. Primary collection and secondary collection are not synchronized and this causes waste scattering around dustbins and containers.

(2) DCC's Approval System of Primary Collection

In the present system, DCC gives approvals on primary collection to only those who are to provide services in a whole ward, in some exceptional cases half or part of a ward. However, in the present situation at the ward level, the authorized primary collection service provider is only one of the organizations providing primary collection services. There are many local

organizations/ individual persons working without any authorization or with approvals of ward commissioners. In addition, many of primary collection service providers with DCC approvals are facing problems in starting the activities. The present approval system is not properly working and so DCC cannot properly monitor the primary collection activities of service providers and coordinate with them.

(3) Capacity of Primary Collection Service Providers

Most of the primary collection service providers, especially the local organizations working in small areas, do not have any opportunity to have technical knowledge and information how to manage the waste collection, how to improve the services, and how to raise people's awareness. In addition, many primary collection service providers are facing difficulties to develop their capacities to expand their activities and cover more households in their service areas because of the lack of funds.

(4) Method of Primary Collection and Design of Rickshaw Vans

Design of rickshaw van is primitive and inappropriate. The height of vans is generally too high and sacks for segregating recyclable waste are hung at the edges of rickshaw vans. Such rickshaw vans are not easily manageable by primary waste collectors. Furthermore, the design of rickshaw vans is not suitable to transfer waste to DCC containers. Primary waste collector cannot transfer waste from rickshaw vans to DCC containers directly. Some experienced NGOs have ideas of specific design of rickshaw vans in order to transfer the waste to containers efficiently. However, those ideas have not been realized in Dhaka City.

Even in the areas with narrow roads, primary collection service providers are using rickshaw vans. The method of primary collection initiated in Kalabagan was duplicated and spread all over Dhaka City. However, suitable and adoptable design of collection equipment based on the characteristics of town structure is not developed.

(5) Remaining Areas without Primary Collection Services

There are still many areas where primary collection services are not available; mostly those are not easily manageable areas such as congested areas with narrow roads and poorer areas including slums. In such areas, DCC street sweeping services are not available, dustbins are located far away, and people throw waste to vacant lands, on roads, and into drains.

Recently door-to-door waste collection activities are prevailing in Dhaka City, due to high pressure of population increase. Various local civil societies or CBOs duplicated the system of door-to-door collection introduced in Kalabagan in 1987. It is said that more than 130 organizations were providing the door-to-door waste collection services in 1999.[1] However, it is difficult to grasp the accurate overall number of the organizations/persons engaged in door-to-door waste collection or the coverage of their services in Dhaka City. A variety of organizations and individual persons are working in this field in large to small scale, in many cases using only one or two rickshaw vans, and the number of such organizations and individuals is still increasing.

[1] Decentralized Composting, Waste Concern

Primary collection is a labor-intensive work that uses rickshaw vans usually manned with one van driver and one/two helpers. They go to each house, receive waste from residents and put the waste into the rickshaw van. In some areas, residents bring their waste to rickshaw vans using buckets/bags by themselves. After collecting waste house-to-house, the rickshaw drivers and helpers dispose of the waste at DCC dustbins/containers, or vacant lands. Some rickshaw van drivers complain that they cannot dispose of the waste into a container because the container is already full of waste and the neighbors complain to them if they dump the waste beside the container. They have to dump the waste onto vacant lands; however, the slum dwellers then complain to them, so they change places to dump waste from time to time.

3.2 Secondary Collection and Transport

(1) Capacity of Collection and Transport Vehicle

a) Gap between Estimated Capacity and DCC's Recognition

Assuming normal shift of vehicles, DCC seems to have sufficient vehicle capacity; however, they are making a request to increase the number of vehicles by 150 together with 200 more drivers to the Mayor. The number of drivers is apparently insufficient. 266 drivers were assigned to operate 283 trucks. During the Pilot Project B from Sep. to Nov., 2004, totally 307 drivers were found operating waste transport trucks. Other drivers regularly working for bus, ambulance, dump truck etc. were also involved in waste transport to mitigate the shortage of regular member of driver as their overtime work. The number of trucks is still considered as providing enough capacity to transport 1.5 times as much waste as achieved in 2004 as seen in Figure 3.2-1.

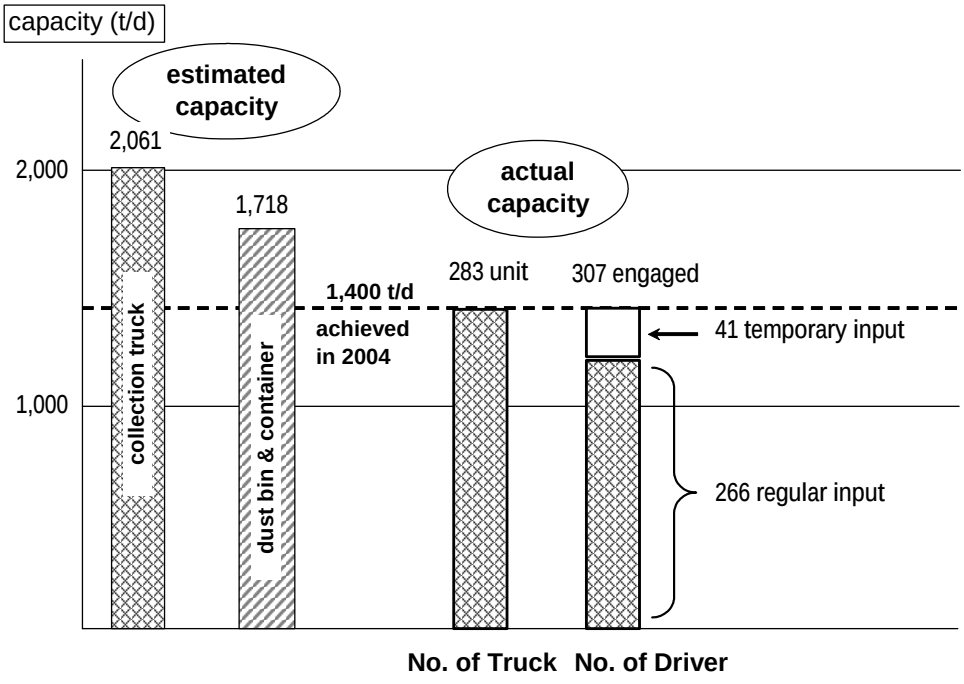


Figure 3.2-1 Evaluation of Present Capacity

Provided that 307 drivers achieve 1,400 t/d of transport, 452 drivers are proportionally required to use the current stock of trucks at their estimate full capacity as shown in Figure 3.2-2. The solution is achieved by the use of trucks with more frequent trips to dump site in a day. Additional drivers are required of 186 persons at a time.

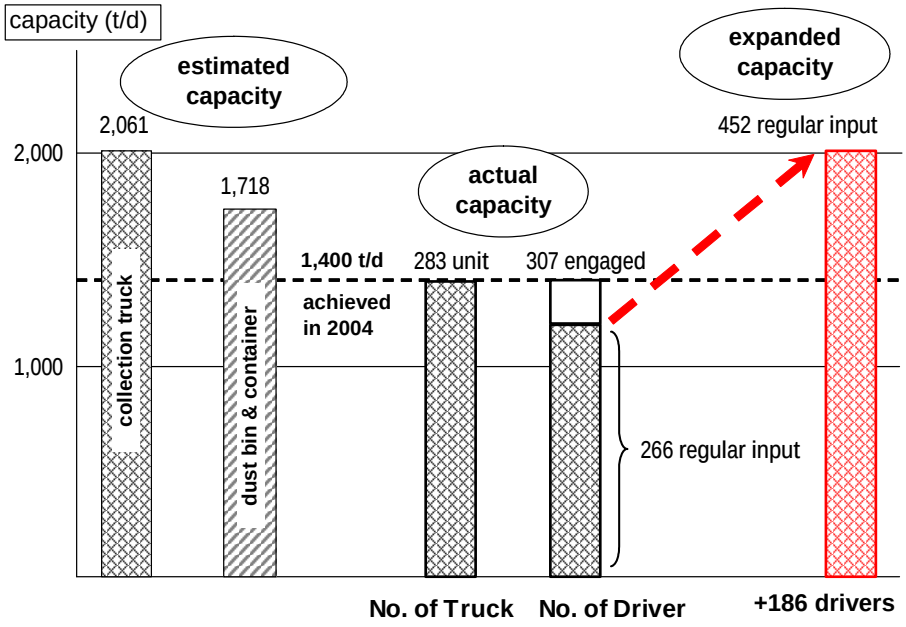


Figure 3.2-2 Capacity Expansion by Increase of Driver

The study team pointed out the urgent need is more drivers for expansion of transport capacity; however, the gap of recognition between the team and DCC should be further analyzed and clarified for realistic solution to gain necessary capacity in the near future.

b) Composition of Trucks

DCC regularly uses three types of trucks while private firms use only Open Truck (OT) with capacity of 5 tons.

- Open Truck (OT) 3 ton, 5 ton for dustbins on wider road, 1.5 ton for narrow road
- Container Carrier (CC) 3 ton, 5 ton for containers on wider road
- Trailer Truck (TT) 20 ton for big market

Loaded amount of each type of trucks was observed at the entrance of Matuail dump site for three months as part of Pilot Project B as shown in Figure 3.2-3. As the result of observation in September, OT 1.5 ton and trailer exhibits larger load than rated capacity. Private OT and CC 3 ton proved almost fully loaded to their rated capacity, whereas OT 3 ton and CC 5 ton were just loaded about 70 % of rated capacity.

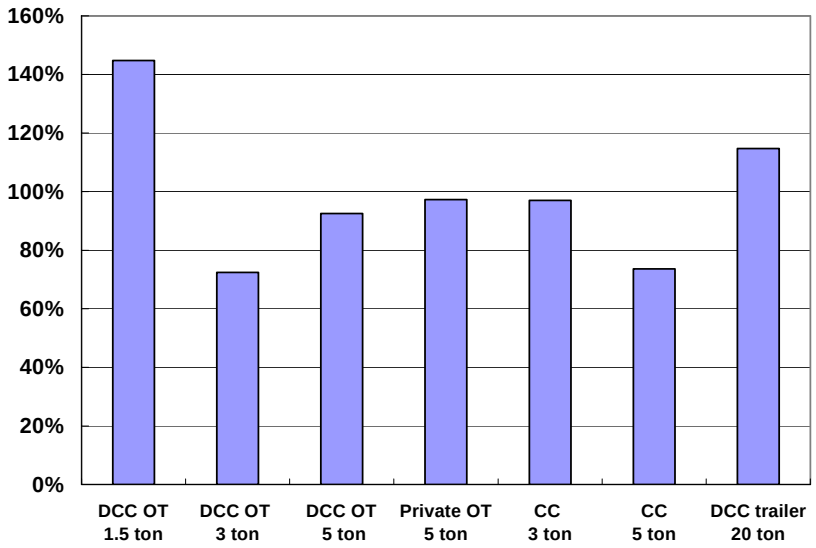


Figure 3.2-3 Loaded Rate of Trucks (Sep. 2004 average at Matuail)

Regarding the frequency of trips for dumping in a day, observation was made also as part of the Pilot Project B at Matuail dump site. OT proved to make 1 to 2 trips a day while CC makes 2 to 10 trips a day and about 3 trips on average. The combination of three types works well in spite of minor problem of partial inefficiency.

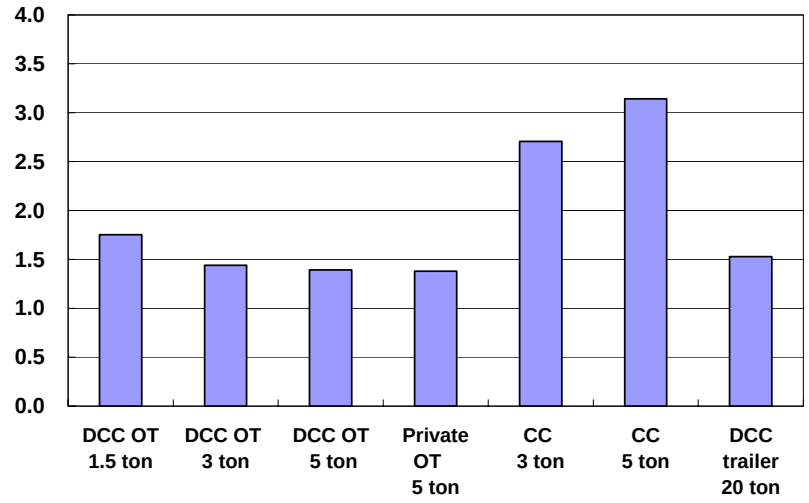


Figure 3.2-4 Frequency of Trips to Dump Site (Sep. 2004 average at Matuail)

Owing to short distance to dump site, the traveling distance is usually less than 20 km for one trip and less than 100 km a day. This keeps trucks working for long years of duty particularly for vehicle parts: chassis, tyre, and engine look better than the age of vehicle. On the other hand the body for loading is comparably worse than because of corrosion. The same deterioration is found for containers which are mostly eroded inside by leachate generated from raw waste. According to DCC officer in charge of transport, the service life of containers is 2 to 3 years.

c) Comparison of Efficiency between Open Truck & Container Carrier

Figure 3.2-5 shows the efficiency of vehicle in secondary collection and transport by type of vehicle based on the results of time & motion survey. As for overall collection/transport efficiency (ton/hour), container carriers achieved on average 2 t/h, or four times as much as open trucks which carried only 0.5 t/h on average.

As for the cost-performance, a container carrier spends less cost per collection volume of waste as the result of comparison between the two types of trucks. The comparison indicates that the collection volume can be doubled by container carrier, but the cost does not rise to twice as much as open truck. Container carriers cost 20 % less than open truck for 3-ton class trucks.

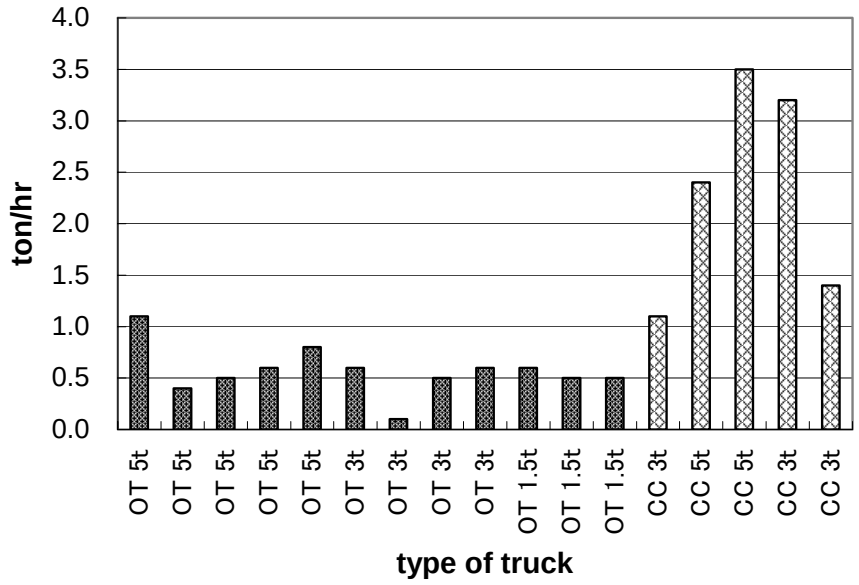


Figure 3.2-5 Efficiency of Waste Transport by Type of Truck

(March 2004, time & motion survey)

(2) Appropriate Location and Capacity of Bin/Container

The estimated capacity as a whole seems not enough to cover the total collection volume at present. Master plan framework is aiming at expansion of capacity for secondary collection so that the plan for bin and container also needs to be investigated. The items to be discussed are type of bin/container together with the container carrier, scattering of placement, and rehabilitation/scrapping of existing bin/containers as stated below.

a) Inadequate Classification of Dustbin>

DCC designates dustbins on the roadsides and/or vacant areas as waste dumping places. Although some of dustbins are made of concrete, others are not. Some of dustbins are designated and/or authorized dustbins by DCC as waste dumping areas without any facilities. This type of dustbins are unhygienic and an eyesore. It is recommended that waste containers that are without any facilities should not be called dustbins and should be closed immediately.

Photo 3.2-1 Broken Dustbins and Containers

b) Broken Dustbin

The existing design of dustbin is not appropriate for waste storage because at least one side is open, allowing waste to scatter, odor to escape, flies to multiply, and rainwater to enter. Most of dustbins are broken in Dhaka caused by superannuated facilities and careless operation. Broken dustbins cannot hold waste well, resulting in scattered waste around dustbins, odor and flies. It is necessary to repair or close down broken dustbins.

c) Scattered Waste around Dustbins and Container

Scattered waste around dustbins and other waste containers is caused by the following:

- Inadequate design of containers and rickshaw van;
- Careless depositing of waste to container;
- Scavenging of recyclable waste by waste pickers.

d) Disturbance of Road Traffic by Placement of Containers and Scattered Waste>

Containers are set obliquely on roads to facilitate loading of containers to trucks. However, traveling cars are obstructed by this position of containers and the scattered waste around them.

(3) Deployment of Human Resources to SWM

There might be a necessity to review the allocation of human resources. The Conservancy Dept. and Transport Dept. do not have sufficient staff for planning, monitoring, and evaluation. Even though a few staff are assigned, they do not have any tools like computers for execution of their task of management. Moreover they are usually too busy to spend time for managing activity because of massive routine that could be diverted to the lower level of staff. Table 3.2-1 shows the handicapped situation of management found in the pilot project B.

Table 3.2-1 Responsible Staff for Recording Operation in Current Routine

Department	Person	Location	Recording item (duty)	Interval	Report to
Conservancy	4 inspectors	Matuail	not defined	not defined	Deputy CCO
Transport	drivers (230 persons)	Saidabad Mirpur	date, time, name, job area, fuel etc.	everyday	Manager Transport
	2 Accounts Assistants	Saidabad	(to approve above , but actually records in place of all drivers)	everyday in principle (actually once in a few weeks but everyday for only fuel)	Manager Transport
	1 Supervising Inspector	Mirpur	(to approve above)	everyday in principle (actually once in a few days but everyday for only fuel)	Manager Transport
Mech. Div. 1 & 2	2 Assistant Engineers	Workshop 1 & 2	date, car number, point of repair, contract etc.	not defined	not defined

Source: pilot project B by the study team

Adequate staffing in this field is urgently required with enough equipment and proper task reallocation.

(4) Slow Vehicle Repair

The repair usually takes a long time. Half of vehicles that finished repair in 2004 had taken two years since the request of repair.

There is a record of status: namely, under repair, under process of repair order, waiting for delivery after repair; however, there is no rule for periodical report of the progress to top management and vehicle users like Transport and Conservancy Department. As experienced in the pilot project B, it takes a long time to report the summary of the present status of vehicles in repair. Moreover it seems impossible to follow the progress of repair for each vehicle; accordingly. the vehicle users are left uninformed of when they can expect the completion of repair. Major repair is contracted with private workshops outside DCC. The tender document needs final decision by the Mayor and the process takes a long time to complete. Because of the limited frequency of Mayor's sanction, there is an inevitable waiting for the next time for application to the Mayor. A fundamental improvement in this regard is urgently needed.

(5) Lack of Management

In the Pilot Project B (Management Information Acquisition), waste transport operation was recorded by two different sources: namely, at garages based on logbook and at Matuail based on interviews with drivers. The two records from different sources should be in accord with each other; however, they showed an apparent difference particularly in number of trips as shown in Figure 3.2-6. The number of trips recorded in logbook is almost twice as many as those recorded at the entrance of Matuail dump site. The number of trips at Matuail was counted by the consultant staff in this project while the other is extracted from the logbook only for those which define the destination as Matuail. An unusual case happened on September 13 to 14 when heavy rain caused severe floods in many places of Dhaka. The

flood gave a serious damage to collection and transport of waste. The situation is reflected as a sudden fall in count at Matuail in the chart; however, the number of trips by logbook does not reflect the abnormal situation at all.

The number of trips is regarded as a basis of estimation of fuel consumption in the current routine. The clarification is required for justifying the expenses for the fuel that is a significant portion of SWM. On the other hand, most of conservancy trucks are not equipped with distance meter in the cabin. The distance record is an essential data for rational valuation of fuel consumption; hence, the function must be recovered. It is also necessary to maintain the function from the time of purchase. First of all DCC should regard the absence or disorder of distance meter as a kind of failure and target their repair by Mechanical Division-1. The drivers shall be given responsibility for the function of distance meter as well as the vehicle as a whole.

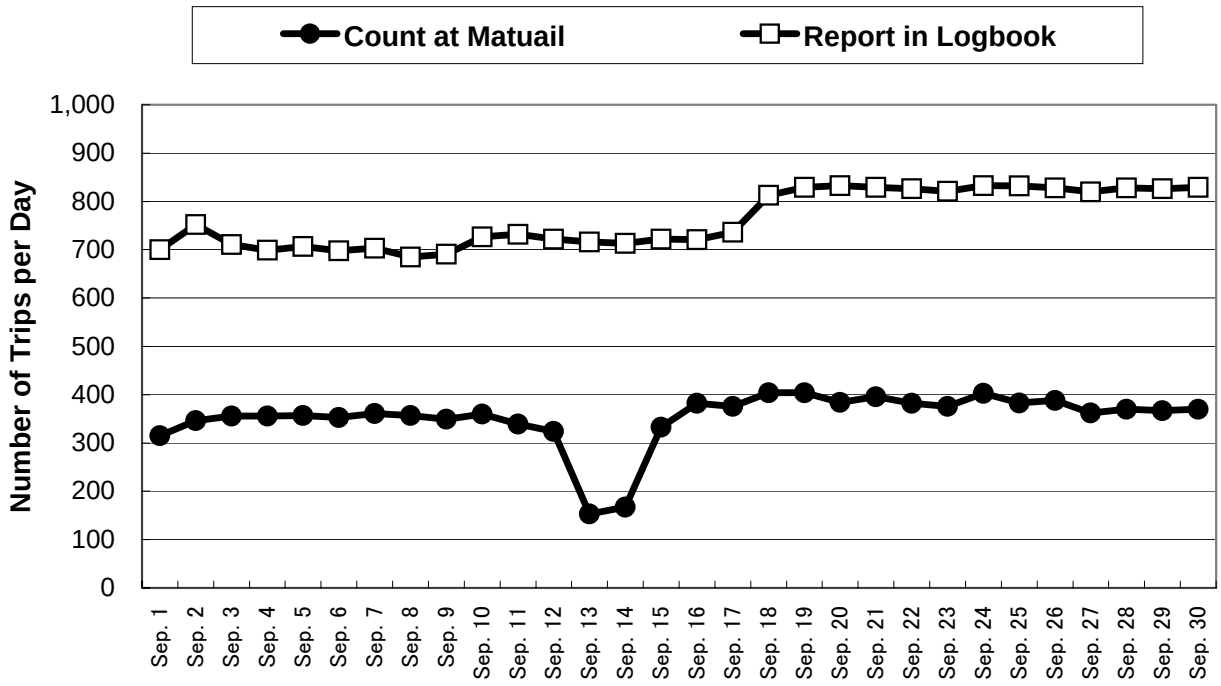


Figure 3.2-6 Different Number of Trips to Matuail by Record (Sep. 2004 in Pilot Project B)

3.3 Road and Drain Cleaning

(1) Work Efficiency of DCC Cleaning Workers

Work efficiency of DCC cleaning workers could be improved by mitigating the following causes of inefficiency.

- Low working ability of aged cleaners. There is no retirement age for DCC cleaners and so there are about 100 cleaners over 65 years old.
- Poor management and monitoring system for cleaners. This is due to lack of checking system and the manual recording system.
- No proper work standard for deep drain cleaner and road cleaner, etc

- Lack of training for cleaners and inspectors
- Lack of communication between DCC, CBOs/NGOs and community

(2) Distribution of Cleaners

Table 3.3-1 shows data for zones such as number of cleaners in each category, quantity of estimated waste generation and population. Study of verification of cleaners is described in next section with graphs.

Table 3.3-1 Comparative Zone Data for Cleaners, Waste Generation & Collection and Population (Data as of 2004)

Symbol→	I	J	K	L	M	N	O	P
Zone No.	Total Cleaner assigned (t/d)	Estimated Waste Generation (t/d)	Waste Collected by DCC (t/d)	Virtual No. of Cleaners relative to Present Collection Amount	Excess (+) /Shortage (-) of Cleaners (I - L)	Population in Zone	Population/ Cleaner (N/I)	Ratio of Population/ Cleaner 1.00=Average
10	116	43				65,537	565	0.80
9	445	363				546,476	1,228	1.73
8	593	457	89	577	16	739,749	1,247	1.76
7	588	401	141	913	-325	681,478	1,159	1.63
6	977	325	175	1,134	-157	469,329	480	0.68
5	1,012	278	197	1,276	-264	480,803	475	0.67
4	1,129	402	126	816	313	783,422	694	0.98
3	707	229	75	486	221	463,437	655	0.92
2	882	356	156	1,011	-129	428,868	486	0.68
1	992	346	103	667	325	622,986	628	0.88
DCC Cleaner (Zone 1-8)	6,880	2,793	1,062	6,880	0	4,670,072	679	0.96
G. Total	7,441	3,200				5,282,085	710	1.00

Note: Waste Generation = Estimated by JICA Study Team, Number of Cleaner = DCC, Conservancy Department
Population = 2001 Census
Symbol → K = Waste collected by DCC at present= Table 2.1-4 is referred to.
Symbol → L = No of Cleaners relocated according to present achievement of Collection (ton/day)

DCC cleaners as a whole collect 1,062 t/d generated by 6,880 persons: this means they collect on average 154 kg of waste per person per day. In the above table, column "I" shows the actual number of cleaners assigned to each zone and column "L" shows a simulation of cleaner's relocation that assumes the required number of cleaners is relative to the amount of collected waste at present. Excess or shortage of cleaners in each Zone appears as the balance "I - L". This figure provides a factor for evaluation of cleaner distribution.

a) Uneven Distribution of Cleaners against Zone-wise Waste Volume

Trend of distribution in south zone is higher than in north zone. In Zone 1 to 6 the cleaners should be decreased and in zone 7 there should be an increase of 400 cleaners. Similarly, in zone 8 the number has to be increased by 533 considering equal distribution. Of course, the land use and situation of infrastructure in each zone in Dhaka should also be considered. According to CIs information, all roads including narrow private roads are swept within 1 – 2 days in south zone (example ward 65, old

Dhaka), but in north zone (example Ward 6) road sweeping is carried out in 3 to 6 days interval due to lack of cleaners.

b) Uneven Distribution of Cleaners against Zone-wise Population

In Zone 5 one DCC cleaner covers 475 dwellers only, whereas in Zone 8 one cleaner covers 1,247 zone dwellers. The difference of coverage is 2.62 times between Zone 5 to 8. This figure also needs to be considered for evaluation of cleaner distribution in zone. For example, the ratio of population/cleaner in Ward 6 in north zone is 136,422/60=2,273, and Ward 65 in south zone is 62,244/71=876.

(3) Proper Monitoring of Cleaning and Collection/Transport Activity

Working records are prepared at collection, repair work, and cleaning with the conventional notebook or file. Those records are usually piled up at the on-site manager's office and are hardly accessible for higher officers who need to know the everyday fact for proper management and planning for sustainable operation. Pilot project B will contribute to improve present situation in this regard; however, the matter with the cleaning activity is also a subject of planning.

(4) Problems concerning Work Environment selected by DCC Cleaners

Major problems faced by DCC cleaners are shown in the following table. The data was selected through a survey of 5,146 cleaners. Results of survey analysis shows the major constraints: “Carrying out the waste not in proper timing” is first. Second is “Obstruction from construction materials in roadside” third is “People are not cooperative”. All of the constraints are concerning the attitude of the dwellers.

Table 3.3-2 Problems Concerning Work Environment as Selected from Survey

Constraint/Difficulty	Male	Female	Total
Danger in road side by bad or reckless driving	444	747	1,191
Difficult to work due to lack of /old handcarts	132	148	280
Obstruction from construction materials on roadside	536	830	1,366
Lack of cleaners for many cleaning works	299	351	650
Face risk when coming to work place in early morning	134	236	370
People are not cooperative	508	692	1,200
Carrying out the waste not in proper timing	579	820	1,399
No room/shed or space for checking attendance of worker	70	111	181
Lack of storage for working apparatus/tools	169	271	440
No holiday	259	441	700

Source: Inspector Questionnaire Survey conducted by JICA Study Team

3.4 Final Disposal

Most of solid waste is disposed of at landfill sites without any intermediate treatment in Dhaka. Manual composting is done in Dhaka but the capacity is negligibly small as an alternative measure of waste disposal. Present landfill operation is quite simple and costs very little among the entire expense for SWM as shown in Figure 3.4-1: The cost for landfill shares only 1.5% of total expenditure.

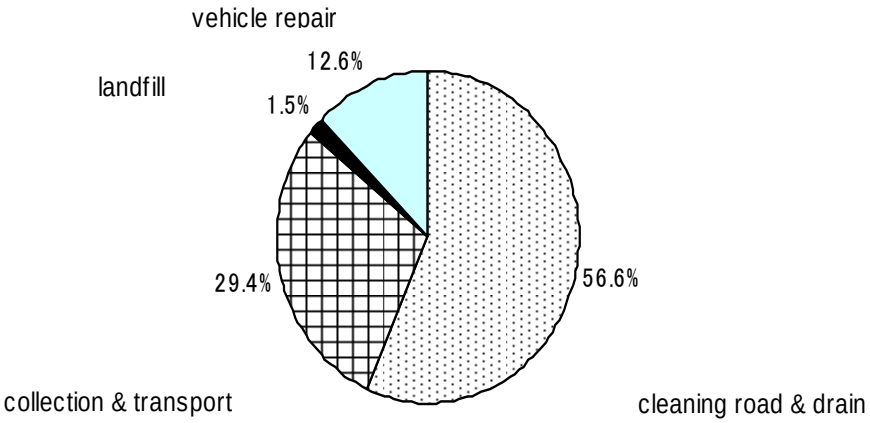


Figure 3.4-1 Budget Allocation to Waste Management Process

There is no responsible organization or personnel to manage and control landfill sites. The final disposal is paid very little attention by DCC administration, which is apparent from its very poor budget and manpower allocation. Landfill is almost neglected in DCC and this status of landfill induces the problems shown in Table 3.4-1.

Table 3.4-1 Evaluation of Present Situation of Solid Waste Treatment and Disposal

Evaluation items	Evaluation
(1) Existing landfill site	a. Dumping at Berri Band and Uttara sites are same as illegal dumping. b. It will be necessary to apply for ECC of Matuail landfill site, because it will be used continuously. c. Only 45% of generated solid waste was disposed of at Matuail and Berri Band landfill site in July 2004. d. Landfill operation shall be improved to reduce environmental pollution.
(2) Operation of landfill site	
a. Landfill Management	a. There is no responsible organization to manage and control landfill sites.
b. Operation of landfill site	a. Waste is simply dumped and filled without covering soil. b. No leachate collection and gas removal.
c. Heavy equipment	a. Available bulldozer is not enough. b. Tyre dozer is not suitable for landfill site. c. Role of heavy equipment shall be reconsidered.
d. Maintenance of heavy equipment	a. Working ratio of heavy equipment is low. b. Maintenance system shall be reviewed.
(3) Planning and construction of landfill site	a. Planning of existing and future landfill sites require coordination of related department and division.
(4) Illegal dumping	a. There are many small illegal dumping in Dhaka. About 40% of generated waste is self-disposed and/or illegally dumped b. Provision of transportation service of solid waste will be essential to reduce illegal dumping. c. Berri Band and Uttara shall be closed as soon as possible.
(5) Cost of dumping	a. Only Tk. 7.4 million (1.6%) is used for dumping and landfill. It means the cost is only Tk. 14/ton of disposed waste. b. Proper landfill is one of the important issues on solid waste management.

Source: JICA Study Team

3.5 Recycling/Compost

(1) Contribution to SWM by Waste Volume Reduction

Paper and plastics contribute much to the municipal solid waste reduction in Dhaka City, while composting contributes very little to the waste reduction although compostable waste is a huge portion among generated recyclable wastes.

(2) Coexistence with SWM

Collection and segregation of recyclable wastes are mostly conducted along with the waste collection and dumping. Among the places of recyclable waste collection, those conducted around dustbins or containers cause negative impacts to keep the street clean and to remove waste efficiently because recyclable waste collectors spread waste around there as they choose. They do not return the remaining waste to dustbin or container after they finish picking material. This suggests some adjustment of activity between waste collection by DCC and material recovery by waste pickers is necessary to make both sides pursue their interests in peaceful coexistence. At the dumpsite, some adjustment of activity is also needed in waste dumping and spreading by DCC to keep a safe and efficient operation, allowing picking activity by waste pickers.

(3) Economic Aspects

Present recycling system generates huge job opportunities in Dhaka City under entirely private initiative. It is estimated that approximately 10% of the total labor forces in Dhaka City are engaged in recycling industries. According to the Study's interview surveys, more than 31,000 persons are directly hired by recycling factories in Dhaka City.

Most of the recycling industry in Dhaka City is low capital investment and low cost, except paper recycling factories. For example, glass recycling factories in Dhaka City are facing severe competition with the foreign as well as local glass manufacturing factories, which do not use recyclable materials.

Concerning the compost industry in Dhaka City, kitchen waste processing plants have negligibly small amount that meets limited demand of small-scale users. From economic points of view, kitchen waste derived compost is valued lower than the products made of the other material. The circumstances make the kitchen waste derived compost difficult for businesses that may distribute the product to wider users of agriculture.

(4) Social Aspects

Visible full-time workers engaged in recycling are material collectors at dumpsites and containers. They are working mostly on individual basis and earn Tk. 3,000 to 5,000 /month. Their revenue level is comparable to those of garment industry workers earning Tk. 3,000 to 3,500 /month. They are raising almost the same money as the workers of leading industry of Bangladesh. Material collectors upstream get, in general, higher revenue than those downstream. Therefore, material collectors as a whole are regarded as average workers in this country, not a distressed vocational group. From the point of working condition, they are exposed to unhealthy environment as the place of work descends along the waste stream.

3.6 Industrial Waste

(1) Problems of industrial waste management in Dhaka

a) Legal aspect

There is no law or act to control industrial wastes, neither on governmental level nor on city ordinance level. Although related laws or rules exist such as Environmental Impact Assessment, those are enacted recently in general; hence, those may be applied only to new establishments. Furthermore, the rules may be applied to a relatively large industry. Considering the size distribution of industry in Dhaka, there are a lot of industries exempted from those rules or regulations. Even if there exist laws and regulations to control industrial and hazardous waste, the capability of authority or agency to enforce the rules and regulation is questionable.

b) Technological aspect

There is no collective waste treatment or disposal facility for both industrial wastes and hazardous wastes in Dhaka. Some industrial wastes, either hazardous or non-hazardous, are disposed of at the Matuail dumpsite together with ordinary municipal waste. It is hard, however, to distinguish industrial waste from other waste. This may be because the volume of industrial waste hauled to the Matuail site is not so large, and waste pickers and scavengers pick up most recyclables at roadside containers or at the dumpsites for selling. Some industrial wastes may be stored inside factories or disposed of at unofficial waste dumpsites. There is neither data on such practices, or information regarding location and amount of waste pile illegally dumped, or information on the environmental condition around the sites.

c) Lack of awareness and knowledge

In the interview with a manager of a tannery factory in Hazaribag, bad performance of waste collection by DCC was pointed out. Once the factory discharges wastes into the public dustbin, then DCC has total responsibility for transporting and disposing of them. The factory does not care where and how the wastes are dumped. Attitude and awareness of factory on waste treatment may be low and nearly the same as other industries. Even if hazardous and toxic chemicals are used in their processes, it is questionable that factories are aware of the chemical's characteristics or take necessary measures for the sake of occupational safety as well as for prevention to environmental pollution associated with wastes disposal containing hazardous chemicals.

(2) Relocation of tannery factory to outside of Dhaka

Several plans for construction of the centralized wastewater treatment plant and relocation of the tannery industries were proposed in the past, but the effort was in vain because of political power shifts, financial constraints, or some other reasons. In 2004, the government decided to relocate the tannery industry from Hazaribag area to Savar area within a few years to restore the environmental condition in Hazaribag area. The Ministry of Industry ordered Bangladesh Small and Cottage Industry Corporation (BSCIC) to construct a tannery industrial zone in Savar together with infrastructure development. Savar area is out of the Study area and relocation is expected to be completed before the target year of the Study.

3.7 Medical Waste

Problems in Medical Waste Management in Dhaka are summarized below.

(1) Legal Aspect

There is no law or act to control medical waste neither on governmental level nor on city ordinance level. Although only "Manual for Hospital Waste Management" was released by Directorate General of Health Services, Ministry of Health and Family Welfare in 2001, this manual is not widely known nor used commonly by staff handling medical waste, both in medical institutions and DCC. This manual was supposed to give directions to hospitals on how to handle and manage medical waste to prevent nosocomial infection and to protect hospital staff from incidents caused by hazardous and toxic components contained in the hospital waste rather than to give directions to waste handling workers in DCC.

(2) Technological Aspect

Incineration is the most promising technology to treat medical waste, if operated properly, in terms of volume reduction of original waste, detoxification and microbiological inactivation. A few hospitals segregate infectious waste from other hospital wastes and store and dispose of separately. Most hospitals, however, dispose of their waste into public dustbins without any segregation. Even segregated infectious waste is often thrown into the same dustbins with ordinary municipal solid waste because of absence of infectious waste treatment technologies. The only technology applied for hospital waste management in Dhaka is use of incinerator; mostly hospitals own and operate incinerators to treat their own wastes. At waste dumpsite where hospital wastes are disposed of together with other municipal waste, there is neither technology nor engineering practice applied to dispose of them appropriately.

(3) Public Health Issue

Inappropriate management of hospital waste poses a threat on not only the environment but also the public health. The hospital waste affects the people at every stage of its life cycle either physically or biologically. Waste handling workers in hospitals and in DCC crews may be most vulnerable group that can be affected by hospital waste. Also, a significant number of urban poor rely on the collection of valuables from waste to earn livelihoods. A waste picker sorts through the waste at public dustbins along street and at waste dumpsites for recyclable or reusable things they can sell, including hospital waste. They have no special protection for sorting through wastes and are at risk of serious injury or disease.

(4) Ethical Aspect

It is said that a lot of body parts and human remains are disposed of at dumpsite once or twice a year. Those could come from autopsy department of hospitals and forensic laboratories. Body parts and human remains are handled in the same way as ordinary hospital waste, i.e., disposed of at land together with general municipal waste without any care to protect the environment and the health of workers and scavengers flocking at dumpsite. Apart from ordinary hospital waste, those waste can be easily recognized and thus should be separately disposed of at dumpsites or treated by other technologies to the level that people can no longer recognize them as body parts.

(5) Lack of Awareness and Knowledge

Since there are few medical institutions that segregate hazardous wastes and manage them appropriately in Dhaka, awareness of waste generators is not enough for satisfactory management of hazardous hospital waste. DCC is also lacking awareness and a sense of importance for good managing of hazardous hospital waste to reduce the risk of infections among DCC workers who engage in waste handling, even though workers at dumpsites claim that there are medical waste in the wastes that are disposed of at DCC's landfill site. Waste pickers in the street and scavengers at dumpsites also lack awareness and knowledge of hazardousness of hospital wastes so that there is always risk of epidemics of infectious diseases caused by infectious waste.

3.8 Public Involvement

(1) Problem Structure from Social Aspect

Solid waste management problems were identified through secondary data analysis, field survey and interview survey. In this section, solid waste management problems from the social aspect is discussed. The problem structure is shown in Figure 3.8-1.

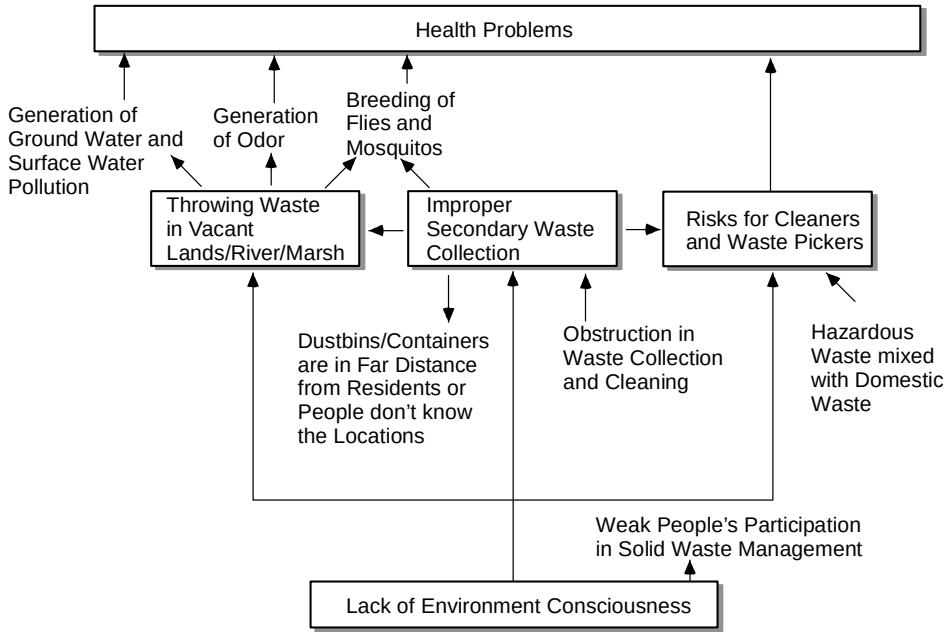


Figure 3.8-1 Problem Structure of Solid Waste Management from the Social Aspect

a) Lack of Environmental Awareness

Lack of Environmental Awareness branches out to two other problems for solid waste management: namely, 1) the deterioration of environmental conditions through the indiscriminate throwing of waste to just about anywhere, and 2) the lack of awareness of participation in solid waste management. Details of problem 1) are described in the next section. Regarding the second problem, according to the Household Awareness Survey, most of respondents do not like to participate in solid waste management activities such as segregation, recycling, and composting activities. On the other hand, 76% of respondents will likely join community solid waste management implemented

by someone else. It seems that people recognize the necessity of solid waste management, but are not likely to take the initiative. In other words, people leave necessary activities and implementation for solid waste management to other people.

b) Throwing Waste

According to the Household Awareness Survey, 51% of low-revenue respondents have thrown waste on vacant land and roadsides, and in swamps, rivers and others. There are two reasons for throwing away waste as follows:

- Lack of environmental awareness; and
- Insufficient collection system.

Scattering waste gives rise to bad odor, flies and mosquitoes, and surface water and groundwater pollution. As a result, people's health suffers.

c) Insufficient Secondary Collection

Although the present primary collection is acceptable to the people, secondary collection leaves much to be desired for the following reasons:

- Scattering of waste around waste containers/dustbins;
- No information on locations of containers/dustbins;
- Far location of containers/dustbins from some households; and
- No regular collection schedule (discharged waste brought to containers/dustbins are not collected sometimes)

On the other hand, people disturb collection and cleaning services. For example, parked cars are obstructive to collection and cleaning services. People do not cooperate with collection and cleaning services, going as far as harassing the cleaners sometimes.

d) Increasing Risk for Solid Waste Management Staff

Discharged waste at containers/dustbins, and disposal sites could contain hazardous materials and harmful objects. It could pose danger for solid waste management staff including road cleaners, container cleaners, truck cleaners, and disposal site staff, and also waste pickers. These kinds of waste should be separated from domestic waste.

(2) Community and People with No Sense of Solidarity

Concept of "community" which is unit for people's involvement is scarce in Dhaka City. Community participation in solid waste management is also poor in Dhaka City. Especially women's participation in community activities is very weak, though women usually take responsibility of discharging waste. It can be said that people do not understand and recognize the importance of community participation. According to some NGOs, community participation of Dhaka is just people paying collection fee, and people providing recyclable waste. At the present, community participation is just at a beginning stage compared with that in other countries such as the Philippines, Indonesia and others.

(3) Education and IEC (Information, Education and Communication) Activities for Public Involvement

Education and IEC activities are very effective tools for motivating, improving awareness and empowering people. But environmental education is not fully taught and is merely one of several topics discussed under such subjects as Science and Social Science at school. A teacher who handles classes below Grade VIII also teaches other subjects. So in reality, there is no environmental education subject and there are no teachers specialized in environmental education and solid waste.

It can be said that DCC did not make the effort to raise public awareness in order to improve people's behavior and increase cooperation for DCC's work regarding solid waste management. To be able to provide good public services require good manners and cooperation from the people as well. It is necessary that DCC make administrative effort to raise public awareness.

3.9 Legal Aspect

(1) Responsibilities of DCC and Waste Generators

Although it is clear that the occupiers of the buildings and lands other than those of DCC are responsible for removal of their refuse from their buildings and lands (Section 78 (1) of the DCC Ordinance), the responsibility for carrying their waste to public receptacles remains unclear when and where DCC does not install public receptacles and require the occupiers to deposit the waste into such receptacles.

When problems on SWM are discussed at ward level, participants raise problems for insufficient number or size of containers or dustbins. Under the current conditions, some people cannot carry out their responsibility.

In some cases, commercial establishments or their contractors dispose of large volumes of refuse into public receptacles, easily making the receptacles full so that other people cannot discharge their refuse into the receptacles.

It is also not explicitly provided in the DCC Ordinance what is the responsibility of DCC for the collection and proper disposal of refuse deposited in public dustbins or other receptacles by the occupiers. DCC taking responsibility for collection, transport and disposal of large volumes of refuse deposited by commercial establishments, with their limited resources, should also be carefully examined.

Clear and equitable responsibility assignment between DCC and the waste generators as well as partnership between the two after clear responsibility allocation and its notification is required.

(2) Enforcement of Laws and Rules

a) Environmental Conservation Act (1995) and Rules (1997)

For Matuail Disposal Site, as the validity of the Environmental Clearance Certificate (ECC) is extended, DCC has to submit the Environmental Management Plan of Matuail for every year of its operation since it started in 1995.

For Berri Band Disposal Site, DCC is dumping waste on private land. The question is *who should* conduct the *land filling* in legal terms. In case the landowner asked DCC for the land filling, the landowner should acquire ECC from DOE. In case the landowner just allowed DCC for land filling, the act of the land filling is done by DCC and DCC has to acquire the ECC. The latter might be the case because, according to CPU for the Study, DCC makes disposal with permission of the landowner. Even in the former case, DCC should help the owner to prepare the documents required to acquire the ECC. Or, for both cases, DCC asks DOE for temporary indemnification and stops disposal as soon as possible.

For uncontrolled land filling requested by the landowner, the landowners have to get an ECC from DOE since the promulgation of the Act and the Rules. Cases of dumping occurs in public street or open spaces should be controlled by enforcing Sections 150 – 153 (Offense and Punishment).

b) Prevention Act (2000)

It is not clear whether the existing Matuail Disposal Site is located in the area subject to the Act. When DCC asked for a no objection certificate for Matuail Extension project to relevant authorities, it was RAJUK that issued the letter.

For Berri Band (Gabtori) Disposal Site, it seems to be located in a natural reservoir of water, which includes areas declared as floodwater flow. The landowner, with DCC's cooperation, might have to get the Government's consent by submitting an application through RAJUK.

For uncontrolled dumping, the landowner should get the Government's consent if the owner asks or allows land filling to take place.

c) Punishment against the Offenses

Few cases have been filed to Magistrates by DCC against offenders of No. 19 in the Third Schedule of the Ordinance. The reason might be that staff members of the Conservancy Dept. do not know the provisions.

Although the punishment would be the last resort to prevent the offenses, the enforcement of the provisions may contribute to enhancement of public awareness and subsequent change of the behaviour of the people.

3.10 Organization

(1) Responsibility Allocation within DCC

Since coordinated job descriptions do not exist, it is necessary to list up the required jobs for solid waste management and to assign the jobs to departments and divisions.

Important missing jobs were found to be:

- Social Mobilization (Assistance to Community Solid Waste Management, implementation of Public Awareness Programs and establishment of partnership with waste generators and taxpayers)

- Proper Management of Disposal Sites (Site Development, and Operation to mitigate environmental impact and to better working conditions of operators)

When conservancy vehicles breakdown, Conservancy Pool of the Transport Dept. hands over the vehicle to Mechanical Division 1 of the Engineering Dept. with a form detailing the conditions of disorder. After Mechanical Division 1 accepts the vehicles, the Division starts assessment of the condition. If the Division does not have the required spare parts in stock, an Assistant Engineer starts a procedure for outsourcing or for purchase of the parts. Documents required for outsourcing of a vehicle make a thick file. Each document has to be approved by several persons. After approval of Chief Engineer, the documents are sent to the Mayor. After the approval of the Mayor, Engineering Dept. prepares a tender. Evaluation of tender documents and contract awarding, after approval of the Mayor, are done by Tender Evaluation Committee. There are some cases when actual repair works take only a week but the whole procedure takes more than half a year.

(2) Capability to Formulate Integrated SWM Plan and Coordination among the Departments

Waste Management Committee (WMC) and WMD were established with assigned staff of around ten to the Division. Additional staff assignment is to be done after examination of newly proposed composition of the Division. For the start of effective activities of WMC and WMD, procedures for annual planning and monitoring/evaluation are to be discussed.

3.11 Financial Management

(1) Problem Findings

The study revealed the following problems in the current budget/cost management and taxation.

a) Budget/Cost Management

Eight problems were identified from the current budget/cost management of DCC as shown in Table 3.11-1

Table 3.11-1 Identified Problems from Current Budget System

Problems Identified	Major Constraint arisen from the problems
1) The budget preparation schedule is not followed by the departments concerned.	There are no sufficient times to prepare accurate and achievable estimates of revenues and expenditures.
2) There is no basis for continuous monitoring both of budgeted revenues and expenditures.	Quick and adequate actions to balance budget is too difficult to be taken.
3) Accounting and budgeting are made manually.	Timely and proper information to the top management is impossible.
4) Annual account report has not been prepared.	No existing checking and appraisal measures for the public. Actual activities, operations, works, financial position, financial performance, changes in net assets and cash-flow generated in the Financial Year are very much unclear and nontransparent to the public.
5) Department-wise budget exists; however, no operation-wise budget is prepared.	Overall SWM cost is unclear at all. So cost recovery measures are difficult to be taken quickly and properly. Unified SWM budget system composed by operation-wise cost should be introduced.
6) Actual SWM cost is not grasped at all.	
7) Shortage of number of accounts staff	Constraints in managing and operation
8) Double entry accounting system is not adopted, and depreciation of fixed assets is not made.	Real cost incurred in the year is uncertain. Financial position is unclear. Current property value is not correct.

b) Taxation

Seven problems were also identified on taxation of Holding Tax as shown in Table 3.11-2.

Table 3.11-2 Identified Problems from Taxation

Problems	Major Constraint caused by the problems
1) General Valuation List has not been reassessed for 15 years.	Low revenue revenue of DCC
2) Arrears have been increased year by year.	
3) Assessment system is not transparent to taxpayers.	Many appeals from taxpayers
4) All works are done manually.	Impedes a quick, accurate and proper management and action
5) Lack of computerized system	
6) Shortage of number of taxation staffs	
7) Few experience of enforcement by seizure, remand and sale of movable properties of defaulters.	Impedes taking an aggressive recovery action

(2) Issue on Cost Recovery of SWM

Among constraints arising from problems identified, SWM cost recovery is one of the major issues. Hence, financial balance and cost structure of SWM, and cost recovery measures are studied.

a) Financial Balance of SWM

Actual financial balance of the past four years is estimated as shown in Table 3.11-3. Conservancy Rate, which is collected as a part of taxes collected by DCC and is equivalent to 2% of annual (rent) value of the building and land at present, is considered a sole revenue for SWM, while overall SWM cost is estimated based on assumptions and extraction from relevant department expenditures.

As a result, the financial situation of SWM was characterized by the negative balance to the considerable amount every year and its growing imbalance. The major cause might be derived from the low level of taxation.

Table 3.11-3 Financial Balance of SWM (Taka in million)

Items	1999-00	2000-01	2001-02	2002-03	Ratio in own DCC Account
1. Overall SWM Revenue	126	141	150	176	6%
2. Overall SWM Expenditure	367	383	402	476	18%
3. Balance	-241	-242	-252	-300	-

Note: 1) Estimated by the Study Team based on various information and data of DCC.
2) Recurrent DCC own expenditures were used for estimates. Depreciation was not considered.
3) There were no capital expenditures during the period.

b) Department-wise and Operation-wise SWM Cost

There are three big cost centers of SWM: 1) Conservancy Department, 2) Transport Department, and 3) Engineering Department. Other departments are also involved directly or indirectly in SWM, but the expenditures of these departments are insignificant due to their size.

Although Conservancy Department is considered entirely involved in SWM, the other two departments should be separated because;

- Transport Department has 2 pools: conservancy pool and central pool. Conservancy pool is considered fully involved in SWM. However, the Department expenditures are not separated into the two pools.
- Engineering Department has 2 divisions involved in SWM. One is Mechanical Division 1, which deals with vehicles and the other is Mechanical Division 2, which deals with heavy equipment. These two divisions also take care of other tasks besides SWM. Hence, SWM cost is neither separated nor actually obtained.

In order to grasp SWM cost more accurately, estimates are made by applying the assumptions and extracting necessary figures from existing data of respective departments (The methodology of the estimates is presented in Appendix 1 to Section 3.10 of Supporting Report).

Thus, SWM cost is separated by Department and by operation, and summarized as shown in Table 3.11-4. (The cost of respective departments and operations by cost item can be referred to in Appendices 2 and 3 to Section 3.10 of Supporting Report).

Conservancy Department is the largest portion (64%) of department-wise SWM cost, and “cleaning of roads & drains” is the largest (57%) in operation-wise SWM cost.

Around 90% of the cost for "cleaning of roads & drains" comes out of staff salaries & allowances.

Table 3.11-4 Department and Operation-wise Actual SWM Cost
(Taka in million)

Items	1999-00	2000-01	2001-02	2002-03	Ratio
1. Department-wise Actual SWM Cost					
1) Conservancy Department	212	243	279	305	64%
2) Transport Department	66	73	84	106	22%
3) Engineering Department	89	67	39	65	14%
Total	367	383	402	476	100%
2. Operation-wise Actual SWM Cost					
1) Cleaning of roads & drains	201	227	249	273	57%
2) Collection & transport	87	98	116	139	29%
3) Final disposal	5	5	6	7	1.4%
4) Repair works	74	53	31	57	12%
Total	367	383	402	476	100%

Source: Estimated by the Study Team based on various information and data of DCC

c) SWM Revenue Enhancement and Cost Recovery

The law requires financial balance of the year, so that every kind of expenditures is limited within the revenue actually collected in the year. If the actual revenue becomes smaller than expected, simultaneously the expenditure shall be squeezed. With regard to this, the current SWM expenditure might not be sufficient enough to attain the most efficient SWM services, and might be considered a minimum amount that cannot be cut down anymore despite the SWM expenditure exceeding SWM revenue.

Consequently, pursuing a more efficient SWM as well as its cost recovery, the following measures should be studied and discussed from long-term SWM strategy viewpoints:

SWM Revenue Enhancement Measures

1) To reassess property value periodically: DCC has already started such action in 2003, which must be taken periodically according to the law.

2) To revise the tax rate for Conservancy: The law says that the ceiling is 7% on property value. Currently, DCC imposes only 2% on it in spite of other cities imposing 5% or 7%. The taxation ground of 2% supposedly comes from a notification made in 1962, according to Revenue Department. It is easy to understand that the main SWM at that time was to clean exclusively roads, which could allow only 2% as compensation toward services rendered. Now that the public recognizes SWM has changed and diversified dramatically, this taxation rate should be revised upward realistically.

3) To improve tax collection efficiency: At first, a more intensive city-wide campaign on why taxation revenue is needed for DCC should be planned to raise the awareness of taxpayers and alleviate tax defaults. Furthermore, in order to attain tax collection effectiveness, the current collection system could be

reconsidered by adopting such alternative systems such as: 1) collaboration with business associations such as Chamber of Commerce & Industry especially for collection from business entity, and/or 2) contract-out to private organizations on commission basis for collection from individual taxpayers.

SWM Cost Cutting Measures

To extend the privatized wards, substantial cost could be reduced as discussed in Section 3.12 if it would be possible to reduce manpower by privatization. However, further qualitative evaluation should be made on privatization service before encouraging the wards toward privatization.

Results of the Enhancement Measures

The following results could be estimated from the above measures on current value basis.

1) Reassessment works are currently suspended, as previously mentioned, so that property value is not certain at the moment. Provided it is reassessed to 2 times or 5 times as large as current value, the taxation revenue may increase respectively by Tk. 180 million or Tk. 720 million.
2) Persevering and continuing awareness campaign is necessary for concurrence of the public. However, it would be desirable to revise tax rate gradually because of its large impact on taxpayers. If taxation rate is raised to 3%, tax revenue may increase by Tk. 90 million.
3) If tax collection rate goes up to 80% (currently 70%), tax revenue may increase by Tk. 25 million.
4) As previously studied, Tk. 16 million could be cut down in 8 wards, so that Tk. 80 million could be cut down if extended to 40 wards.

3.12 Privatization

The Study Team tentatively made an evaluation of on-going SWM privatization project from technical, financial and social points of view in order to judge the capability of contractors and possibility to expand privatization area. However, the Study Team would suggest that the overall evaluation be made after gaining more experience for the following reasons.

- Experience of only 1.5 years is too short for DCC to judge.
- DCC has not established a proper system to assess the services in a qualitative and quantitative manner, though DCC has some performance evaluation system by DCC inspectors.
- Many inhabitants of the privatized ward have favorable opinion of services; on the other hand also many have adverse opinion. This should be analyzed with more efforts to hear from them and reflect comments to the next program.
- Contractors' opinion should also be reflected to attain better service, especially on the term of contract.
- Relocation problem of DCC cleaners should be taken into consideration.

This section presents the technical, financial and social evaluation tentatively made by the Study Team.

(1) Technical Evaluation

From the data of the time and motion survey, the Study Team compared some collection work of open trucks from departures to return to the garage between private and DCC.

a) Number of Trips

The number of trips indicates the frequency of dumping at the same dump site during one collection cycle. The average number of trips of private contractors and DCC are shown in Table 3.12-1. It is obvious that private contractors operate more trips than DCC, namely 1) 3-ton open trucks 1.5 times and 2) 5-ton open truck 1.1 times.

Table 3.12-1 Comparison of Number of Trips

Size of Open Truck	Average nos. of trips on one collection work		Comparison
	(A) DCC	(B) Private Contractors	B/A
3 ton	1.3	2.0	1.5
5 ton	1.8	2.0	1.1

Source: JICA Study Team

b) Hours Spent for One Collection Work

Hours spent for one collection cycle are summarized in Table 3.12-2. The table indicates that private contractors spend many more hours in collecting waste than DCC: namely, 1) 3-ton open trucks 2.4 times and 2) 5-ton open truck 1.8 times.

Table 3.12-2 Comparison of Hours Spent

Size of Open Truck	Average hours spent for one collection work		Comparison
	(A) DCC	(B) Private Contractors	B/A
3 ton	5.01	11.78	2.4
5 ton	6.32	11.10	1.8

Source: JICA Study Team

c) Waste Volume Loaded at One Trip

Waste volume loaded for one trip is summarized in Table 3.12-3. In general, private contractors load more waste into one open truck than DCC: namely, 1) into 3-ton open tuck 2.7 times and 2) 5-ton open truck.9 times as much as DCC. According to the record of Pilot Project B, it was observed that 5-ton private vehicles usually brought waste to Matuail of more than 10 tons per trip.

Table 3.12-3 Comparison of Truck Load

Size of Open Truck	Average truck load/trip (ton)		Comparison
	(A) DCC)	(B)Private Contractors	B/A
3 ton	1.5	4.0	2.7
5 ton	2.8	5.4	1.9

Source: JICA Study Team

In fact, private contractors operate more trips, spend more hours, and load more waste per trip than DCC by operating a limited number of open trucks for collection work.

(2) Financial Evaluation

SWM costs of privatized area are analyzed by comparing those of DCC and private organizations. The analysis revealed that the cost of Tk. 16 million could be cut by privatization as shown in Table 3.12-4. Consequently, the conclusion from the financial point of view is that the privatization project should be expanded to a wider area.

Table 3.12-4 Nominal Cost Cut by Privatization (million Taka)

SWM in 8 Wards	Cost	Cost Estimates
a. DCC Own Cost	53.1	DCC cost (Conservancy+Transport+Mechanical-1= 467.0) ×Population ratio (8 wards/DCC total = 11.4%)
b. Private Organizations	37.0	Annual payment from DCC to private organizations
c. Nominal cost cut	16.1	= a – b

Source: JICA Study Team

Note: * Annual payment is deemed to include capital costs since DCC does not prove any facility or equipment to the contractors for carrying the services.

** Cost cut is nominal and indicative only because of difficulty in precise comparison.

The cost cut of Tk. 16.1 million is broken down into 3 cost items as shown in Table 3.12-5, which indicates that the major cost cut item was personnel cost that amounted to Tk. 10.8 million.

Table 3.12-5 Breakdown of Cost Cut (Taka in million)

Cost Items	a. DCC	b. Private Organizations	Cost Cut = a - b
Personnel	27.5	16.7	10.8
Fuel	9.0	6.4	2.6
Others	16.6	13.9	2.7

Source: JICA Study Team

More precise analysis of Personnel Cost and Fuel Cost is discussed shown below.

a) Personnel Cost

An in-depth analysis revealed that majority of the personnel cost that was cut was derived from cleaners' salary of Tk. 10.0 million as shown in Table 3.12-6. This is further brokendown into 2 factors: Tk. 3.3 million by downsizing the number of cleaners and Tk. 6.8 million by downsizing the cleaners' salary. Thus, it is quite obvious that the lower level of cleaners' salary of private organizations is a major contributor of cost cut by privatization.

Table 3.12-6 Comparison of Personnel Cost

Staff	Number of staffs		Salary/staff/month (Taka)		Cost/year (Taka in million)	
	DCC	Private	DCC	Private	DCC	Private
Cleaner	646	558	3,087	2,047	23.9	13.9
Driver	29	29	5,982	3,000	2.1	1.0
Supervisor	14	31	8,731	4,806	1.5	1.8
Total	689	618	-	-	27.5	16.7

Source: JICA Study Team

b) Fuel Cost

The fuel cost of DCC is difficult to ascertain either department-wise or operation-wise, and much harder ward-wise. So fuel cost of DCC in 8 wards was roughly estimated and compared with fuel cost of private organizations as shown in Table 3.12-7.

Fuel cost of Tk. 2.6 million was supposedly cut by privatization. Besides, it was revealed by analyzing the respective cost items that the major factor of fuel cost cut might be derived from the fuel efficiency (liter/vehicle/day). The fuel efficiency of DCC was analyzed to be far worse than that of private organizations as shown in Table 3.12-7. Distance/trip or mileage or petrol price or others might cause this. The real causes must be examined by DCC in order to pursue more cost-efficient operation.

Table 3.12-7 Fuel Efficiency of Vehicle

SWM	Cost Estimates	Tk. million
DCC	Fuel consumption = a × b a. DCC SWM fuel cost = Tk. 86.3 million b. Vehicles in operation of 8 wards/ of DCC = 29/280	9.0
	Fuel efficiency of vehicle: 28.3 liter/vehicle/day	
Private Organizations	Fuel consumption = distance/trip ÷ mileage (km/liter) × trips/day × number of vehicles × 365 × petrol price = 30 ÷ 3 × 2.1 × 29 × 365 × 30	6.4
	Fuel efficiency of vehicle: 20.1 liter/vehicle/day	

Source: JICA Study Team

(3) Social Evaluation

When DCC privatized the DCC cleaning works of Zone 9 and Zone 10, the Cleaners Union went on strike against the privatization. As a result, the problem was settled and none of cleaners was fired. Most of them kept their jobs as DCC cleaners and their working areas were shifted to other wards. However, if privatization of DCC works expands to other zones in the future, the superfluous cleaners losing their jobs will be a problem. It would be possible that DCC keeps the existing number of cleaners by expanding the service areas and improving the quality of services. However, if privatization of DCC cleaning works is promoted to the extent of covering whole city, measures to support the unemployed cleaners should be considered.

Chapter 4
Framework of Master Plan

4.1 Master Plan Goal

This master plan has the aim:

> *To improve solid waste management system of Dhaka City based on social acceptability and technical capability in order to achieve* ***"Clean Dhaka"****.*

4.2 Scope of Master Plan

(1) Targets of Master Plan

a) Target Area

The planning area of the master plan covers the entire jurisdiction of DCC as of 2004, which is composed of 90 wards. The total land area is approximately 131 km^2 (estimated by the Study Team, based on a GIS analysis).

In addition, the master plan also covers the existing waste disposal sites and future disposal site(s) in the adjacent area outside DCC's jurisdiction

b) Target Waste

Target waste in the master plan is so-called municipal solid waste. In principle, the following types of solid waste are tackled in the Master Plan:

- Domestic waste from households;
- Business waste from business establishments, commercial entities; public institutions such as schools, government offices and market waste from public markets; and
- Street waste from pubic roads.

Whilst the following two types of waste are not dealt with in the Master Plan, their framework of will be presented in this report.

- Medical waste; and
- Hazardous industrial solid waste.

c) Target Year

The master plan has one decade time-horizon with the target year 2015, the framework of which is divided into three phases as follows:

➔ Short-term	:	2005 - 2007
➔ Mid-term	:	2008 - 2010
➔ Long-term	:	2011 - 2015

(2) Structure of the Master Plan

The structure of the Master Plan is shown in Figure 4.2-1. Planning issues are based on the recent conditions and demands/requirements for an organized solid waste management toward the target year 2015. Planning approaches show how these issues shall be addressed.

The Master Plan is composed of seven (7) components, including three (3) technical components and four (4) institutional and social components. The technical components include “Primary Collection”, “Secondary Collection and Transport” and “Disposal”, while the institutional/social components covers “Legal Aspect”, "Organization Aspect", "Financial Aspect” and “Privatization”, which shall be integrated with the three technical components. These components show the supporting mechanism of technical components from viewpoints of institutional and financial aspects and social acceptability and involvement aspects.

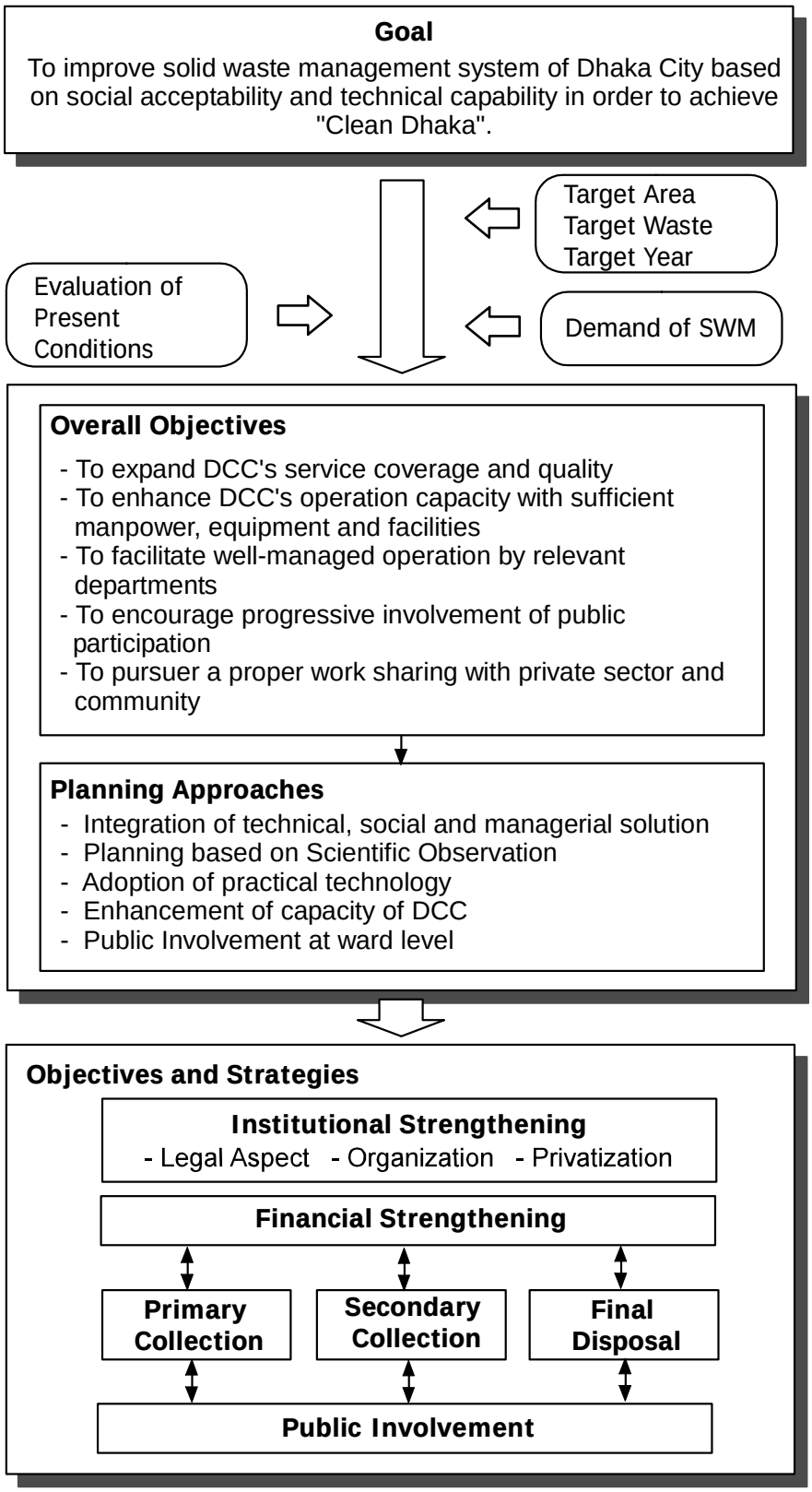
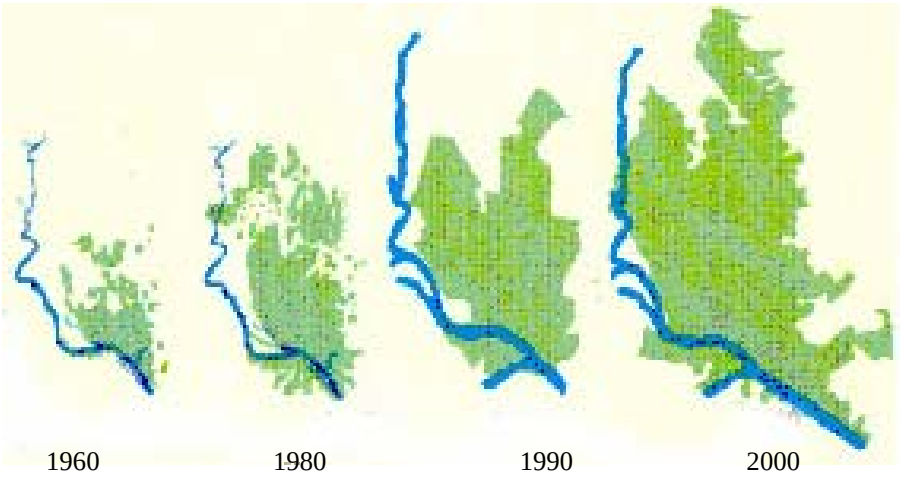


Figure 4.2-1 Structure of Master Plan

4.3 Growth of Dhaka City

(1) Urbanization of Dhaka City

Development of Dhaka City has been rapid since the independence of Bangladesh in 1971. Figure 4.3-1 shows the historical change of expansion of Dhaka city and neighboring area.



Data Source : DCC Pamphlet "Profile of Dhaka City Corporation"

Figure 4.3-1 Expansion of Dhaka City and Neighboring Area

The map shows that the development of Dhaka city area started from Old Dhaka area, and the urban area has expanded toward North to Northeast. The GIS map of Figure 4.3-2 shows more detailed information of the expansion of build-up area and Ward boundaries of DCC and encroaching urbanization especially in the East and Southeast side fringe area.

The number of Wards increased as the build-up area developed. Table 4.3-1 shows the increase of Ward numbers in DCC reaching 90 in 1993. DCC administers all the Wards as of 2004.

Table 4.3-1 Increase of Ward Numbers

Year	No. of Wards
1971	50
1982	56
1983	75
1993	90

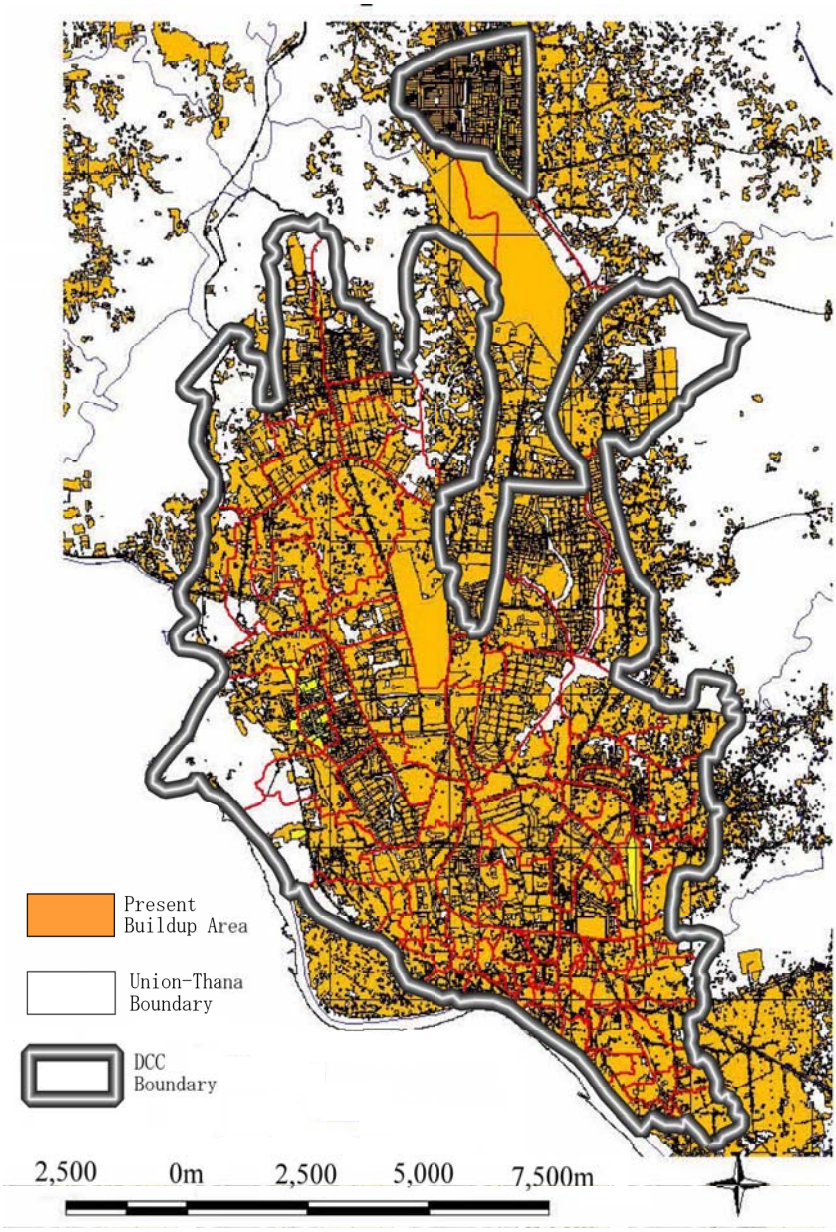


Figure 4.3-2 Build-up Area of DCC and Adjacent Area (2002)

The jurisdictional area of DCC expanded to 131.2 km^2 for 90 Wards with the smallest Ward area of 0.17 km^2 (Ward 80) to the largest Ward area of 8.1 km^2 (Ward 17). Of the total area of 131.2 km^2, 103.8 km^2 or 79.1% is classified as built-up area.

The following Table 4.3-2 shows the zone-wise sum of land use area. Total housing area of DCC is about 72.5 km^2, which is about 55.3% to the total DCC area. Housing areas of Zone 4, Zone 7, Zone 8 and Zone 10 are largest, extending in the range of 9.2 km^2 and 11.8 km^2. Housing areas of Zone 2 and Zone 10 are smallest, about 2.3 and 3.6 km^2, respectively.

Table 4.3-2 Zone-wise Area by Land Use in DCC

(unit: km^2)

Zone No.	Total Area	Built-up Area					Potential Built-up Area	Water Body
		Housing	Commer-cial, Mixed & Public Facilities	Industrial	Road & Railways	Parks, Urban greens, Brickfields & Restricted Area	Cultivated Land, Forest, Bush, Grass Land & Open Space	Swamp & Water Body
1	9.3	6.8	1.1	0.2	0.4	0.1	0.3	0.5
2	3.9	2.4	1.2	0.1	0.2	0.0	0.0	0.1
3	8.3	4.7	0.8	0.2	0.3	0.2	1.0	1.1
4	14.9	9.3	1.8	0.0	1.2	0.4	0.5	1.8
5	12.7	7.2	2.0	0.0	1.4	1.6	0.0	0.6
6	15.6	6.7	1.6	0.0	1.0	1.4	2.9	2.0
7	16.3	9.2	1.4	0.0	0.6	2.2	1.7	1.2
8	22.7	10.9	1.5	0.2	1.0	0.7	3.6	4.9
9	22.1	11.8	1.9	0.9	1.6	0.7	2.3	2.8
10	5.5	3.6	0.2	0.0	1.1	0.2	0.1	0.2
Total	131.2	72.5	13.4	1.6	8.9	7.4	12.3	15.1

(2) Population Growth

Population of DCC increased along with the expansion of the city area as tabulated in Table 4.3-3. Data obtained from the National Census in 2001 showed about 5.3 million population in 90 Wards in DCC.

Table 4.3-3 Past Population of Dhaka City

Year	Population (person)
1961	362,006
1974	1,310,976
1981	2,816,805
1991	3,612,850
2001	5,282,085

Data Source: Bangladesh Bureau of Statistics

The population growth rate was analyzed to find the trends of annual growth of population by the numerical analysis represented by Arithmetic Series, Geometric Series and Exponential Model. The trends of population growth are analyzed based on the population statistics in Table 4.3-4.

Population growth in the period of 1974-1981 is large with the annual increase of population more than 210,000 or annual growth rate about 11%-14%. In the following decade, the population growth rate dropped conspicuously. Evaluation of the population increase by the last 20 years in the period of 1981-2001 shows the annual increase of 120,000, or an annual growth rate of 3.1% to 3.4%.

Table 4.3-4 Trends of Population Growth

Evaluation Period	Arithmetic Series	Geometric Series	Exponential Model
	Annual Population Increase (persons)	Annual Population Growth Rate (%)	Annual Population Growth Rate (%)
1961 - 1974	72,998	11.32	9.90
1974 - 1981	215,118	13.60	10.93
1981 - 1991	79,605	2.80	2.49
1991 - 2001	166,924	4.32	3.80
1974 - 2001	147,078	5.52	5.16
1981 - 2001	123,264	3.36	3.14

The average population density of 90 Wards in Dhaka City reached 40,300 person/km^2 in 2001. The density of built-up area became 50,900 persons/km^2 for the area of 103.8 km^2. This population density is so high that the growth of population is coming near the saturation point. In Old Dhaka, there is little room for the horizontal expansion of built-up area. The growth of the city is only possible by expanding the city vertically. The rest of Dhaka City that is new has a bit more possibility to absorb the population growth because of comparably larger portion of open space left to develop.

On account of these reasons, assumptions were made for the forecast of future population in DCC as follows:

- Base year for the population projection is determined as the year 2001;
- Population will increase within the present built-up area and the potentially available land for housing. The area is estimated at 116.1 km^2 in total and the average population density in the said area is estimated at approximately 45,500 in 2001;
- The population of the Wards having lower population density than the average in 2001 will increase at the rate of 3.14%/yr derived from the annual growth rate in the period of 1981-2001; and
- The population of the Wards having higher population density than the average in 2001 will increase at the rate of 1.54%/yr derived from the national population growth rate in the period of 1991-2001. The national growth rate is reported in Population Census 2001 by Bangladesh Bureau of Statistics, which is deemed applicable to the natural increase of population in the densely populated Wards in DCC.

Based on the assumptions determined above, the future population was forecast Ward by Ward for the period of 2002-2015. Figure 4.3-3 indicates the total population forecast for 90 Wards together with the past population record. Table 4.3-5 indicates population and population density by ward for the years 2010 and 2015.

In 2015, the target year of the Master Plan, the total population will increase up to 7.7 million and the population density will be about 66,000 persons/km^2 in 90 Wards of DCC.

"Dhaka Metropolitan Area Development Plan", Vol-II: Urban Area Plan (1995-2005), prepared by RAJUK, forecast population at 6.08 million in 2006 for the area corresponding to DCC's 90 Wards. The estimate in this study forecasts the population at 6.04 million in 2006. There is no significant difference between the two projections prepared separately.

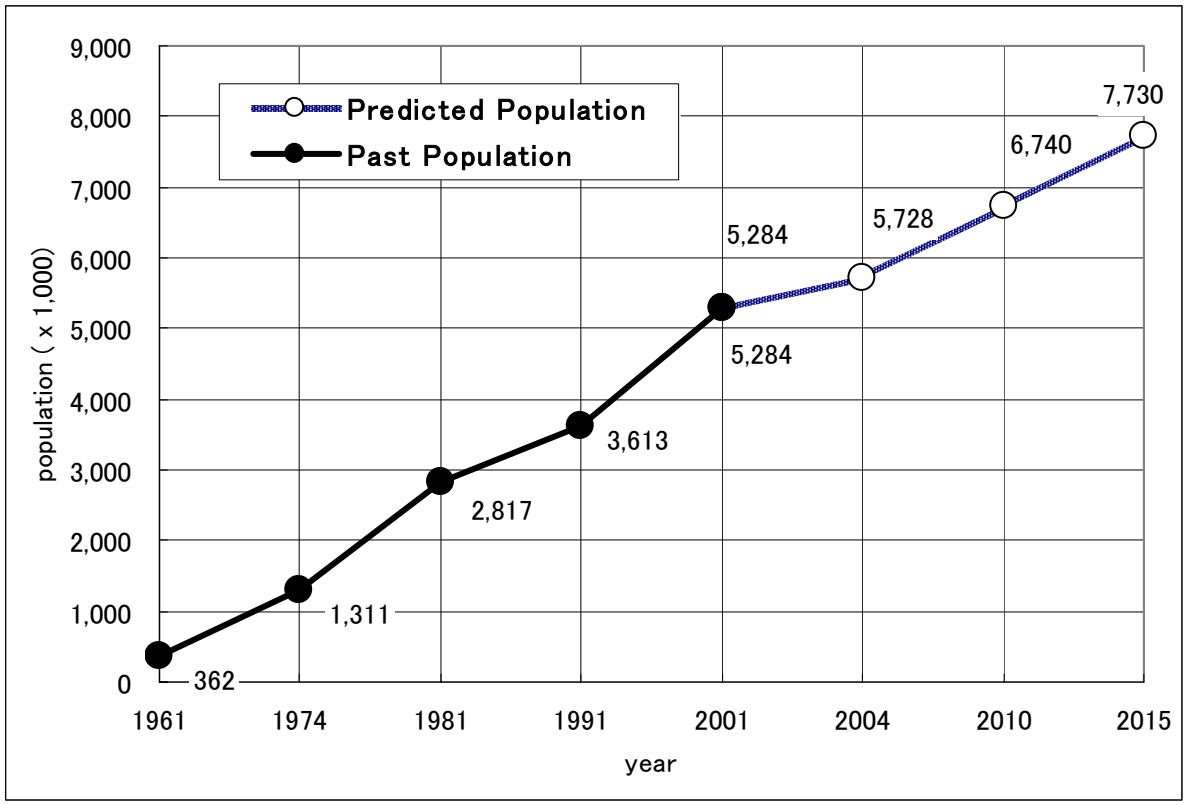


Figure 4.3-3 Population Forecast for 90 Wards in DCC (2002-2020)

Table 4.3-5 Projection of Ward-wise Population and Population Density (2010 & 2015)

Ward No.	Build-up Area km^2	Population (person)				Population Density (person/km^2)			
		2001	2004	2010	2015	2001	2004	2010	2015
1	5.203	65,537	68,636	75,280	81,306	12,595	13,191	14,468	15,626
2	1.955	128,814	141,538	170,881	199,930	65,884	72,392	87,400	102,258
3	1.043	71,117	78,142	94,342	110,380	68,205	74,942	90,479	105,860
4	0.945	53,702	59,007	71,240	83,350	56,805	62,416	75,356	88,166
5	1.088	88,444	97,180	117,328	137,273	81,308	89,340	107,862	126,198
6	2.953	136,422	149,898	180,974	211,739	46,204	50,768	61,293	71,713
7	1.606	52,213	54,682	59,975	64,776	32,519	34,057	37,353	40,343
8	3.379	96,390	100,948	110,720	119,582	28,524	29,873	32,765	35,388
9	1.936	58,569	61,338	67,276	72,661	30,257	31,688	34,755	37,537
10	1.668	66,813	69,972	76,746	82,889	40,044	41,937	45,997	49,679
11	1.280	76,059	83,572	100,898	118,050	59,428	65,299	78,836	92,238
12	0.879	87,975	96,665	116,705	136,545	100,124	110,014	132,822	155,401
13	2.284	89,925	94,177	103,294	111,561	39,374	41,236	45,228	48,848
14	1.929	111,137	122,115	147,432	172,494	57,605	63,295	76,417	89,407
15	4.842	112,647	117,973	129,394	139,751	23,266	24,366	26,725	28,864
16	4.118	103,760	108,666	119,185	128,725	25,197	26,389	28,943	31,260
17	7.033	85,275	89,307	97,952	105,793	12,126	12,699	13,928	15,043
18	0.961	35,898	37,595	41,235	44,535	37,367	39,133	42,922	46,357
19	4.302	71,801	75,196	82,475	89,077	16,689	17,479	19,171	20,705
20	1.752	81,209	89,231	107,730	126,043	46,346	50,924	61,481	71,932
21	1.718	73,156	76,615	84,032	90,758	42,587	44,601	48,918	52,834
22	1.721	90,127	99,030	119,560	139,885	52,380	57,554	69,486	81,298
23	0.713	50,896	55,923	67,517	78,995	71,346	78,393	94,646	110,735
24	0.774	58,685	64,482	77,850	91,084	75,789	83,276	100,540	117,632
25	1.039	80,564	88,522	106,874	125,042	77,541	85,201	102,864	120,351
26	1.758	51,723	54,169	59,412	64,168	29,419	30,810	33,793	36,498
27	0.824	72,587	79,757	96,280	112,661	88,089	96,790	116,857	136,726
28	0.907	46,142	50,700	61,211	71,616	50,894	55,921	67,515	78,992
29	0.544	56,637	62,232	75,133	87,906	104,129	114,415	138,135	161,617
30	0.328	34,628	38,049	45,937	53,746	105,422	115,836	139,851	163,625
31	0.983	32,687	34,233	37,546	40,552	33,258	34,831	38,203	41,261
32	1.149	41,826	43,804	48,044	51,890	36,416	38,138	41,830	45,178
33	0.421	30,352	33,350	40,264	47,109	72,092	79,213	95,636	111,893
34	0.736	66,517	73,088	88,240	103,240	90,431	99,363	119,963	140,356
35	0.498	53,661	58,962	71,185	83,287	107,839	118,491	143,056	167,375
36	1.081	51,018	56,058	67,679	79,184	47,201	51,863	62,615	73,259
37	2.487	116,531	128,042	154,587	180,866	46,865	51,494	62,170	72,739
38	1.053	82,606	90,766	109,583	128,212	78,420	86,166	104,030	121,714
39	0.945	51,313	56,382	68,071	79,642	54,304	59,669	72,039	84,285
40	3.615	69,663	72,957	80,019	86,424	19,268	20,179	22,132	23,904
41	1.006	87,240	95,858	115,730	135,404	86,756	95,326	115,088	134,653
42	0.628	56,459	62,036	74,897	87,629	89,909	98,790	119,271	139,547
43	1.162	73,814	81,105	97,920	114,566	63,511	69,785	84,252	98,575
44	0.531	44,507	48,903	59,042	69,079	83,760	92,034	111,114	130,003
45	1.363	48,581	53,380	64,446	75,402	35,639	39,160	47,278	55,315
46	4.249	60,922	63,803	69,979	75,580	14,339	15,017	16,471	17,789
47	1.083	64,070	70,399	84,994	99,442	59,136	64,978	78,449	91,785
48	2.505	83,775	87,736	96,229	103,932	33,440	35,022	38,412	41,486
49	2.049	41,263	43,214	47,397	51,191	20,142	21,095	23,137	24,989
50	0.689	64,141	70,477	85,088	99,552	93,157	102,359	123,579	144,587
51	0.825	55,650	61,147	73,824	86,374	67,418	74,078	89,435	104,639
52	1.361	61,608	64,521	70,767	76,431	45,273	47,413	52,003	56,166
53	1.825	43,857	45,931	50,377	54,409	24,037	25,173	27,610	29,820
54	1.055	74,325	81,667	98,598	115,359	70,466	77,427	93,479	109,370
55	0.505	61,532	67,610	81,627	95,503	121,851	133,887	161,644	189,123
56	1.967	42,535	44,546	48,858	52,769	21,625	22,647	24,840	26,828
57	1.882	35,892	37,589	41,228	44,528	19,075	19,977	21,911	23,664
58	1.221	72,361	79,509	95,992	112,311	59,241	65,093	78,588	91,947
59	0.503	48,859	53,685	64,815	75,833	97,166	106,764	128,898	150,810
60	0.453	62,595	68,778	83,037	97,153	138,045	151,681	183,127	214,258
61	0.367	29,018	31,884	38,495	45,038	79,072	86,883	104,895	122,727
62	0.915	49,240	54,104	65,321	76,425	53,813	59,129	71,387	83,523
63	0.585	27,411	30,119	36,363	42,544	46,894	51,526	62,208	72,783
64	0.182	27,934	30,693	37,057	43,356	153,633	168,809	203,806	238,452
65	0.394	62,244	68,392	82,571	96,608	157,832	173,422	209,376	244,969
66	0.415	34,307	37,696	45,511	53,247	82,659	90,824	109,653	128,294
67	0.436	35,550	39,062	47,160	55,177	81,461	89,508	108,064	126,435
68	0.313	41,920	46,061	55,610	65,063	133,977	147,211	177,730	207,943
69	0.434	63,946	70,263	84,829	99,250	147,477	162,044	195,639	228,896
70	0.353	49,639	54,542	65,850	77,044	140,588	154,476	186,501	218,205
71	0.263	31,564	34,682	41,872	48,990	119,957	131,806	159,132	186,184
72	0.189	29,938	32,895	39,715	46,466	158,316	173,954	210,018	245,720
73	0.353	29,369	32,270	38,960	45,583	83,251	91,475	110,439	129,213
74	0.409	46,246	50,814	61,349	71,778	113,201	124,383	150,170	175,698
75	0.482	31,418	34,521	41,678	48,763	65,247	71,692	86,555	101,269
76	0.467	40,151	44,117	53,263	62,318	85,988	94,482	114,070	133,461
77	0.420	36,324	39,912	48,186	56,378	86,574	95,126	114,847	134,370
78	0.297	26,519	29,139	35,179	41,160	89,435	98,270	118,642	138,814
79	0.381	39,870	43,808	52,891	61,882	104,696	115,038	138,887	162,497
80	0.160	27,718	30,456	36,770	43,021	173,102	190,201	229,633	268,669
81	0.693	49,246	54,110	65,328	76,434	71,043	78,060	94,243	110,264
82	0.412	38,825	42,660	51,504	60,260	94,307	103,623	125,105	146,373
83	0.802	45,831	50,358	60,798	71,134	57,140	62,785	75,801	88,687
84	1.129	32,507	34,044	37,340	40,328	28,783	30,144	33,062	35,708
85	0.551	45,754	50,274	60,696	71,014	83,070	91,276	110,199	128,932
86	0.767	50,244	55,207	66,652	77,983	65,502	71,973	86,894	101,665
87	0.757	52,016	57,154	69,003	80,733	68,734	75,524	91,181	106,682
88	0.360	34,152	37,526	45,305	53,007	94,977	104,359	125,995	147,413
89	0.976	51,215	56,274	67,941	79,490	52,474	57,658	69,611	81,445
90	0.556	52,957	58,188	70,251	82,194	95,325	104,742	126,456	147,953
total	116.124	5,282,085	5,726,076	6,738,392	7,727,841	45,486	49,310	58,027	66,548

Source: Estimated by JICA Study Team

Table 4.3-6 Projection of Zone-wise Population Density

Zone No.	Population (x 1,000 person)				Population Density (person/km^2)			
	2001	2004	2010	2015	2001	2004	2010	2015
1	623	683	821	957	70,325	77,082	92,638	108,007
2	429	471	569	666	111,630	122,656	148,085	173,259
3	463	505	600	693	65,038	70,857	84,186	97,282
4	783	854	1,017	1,177	59,592	64,984	77,345	89,501
5	481	517	598	676	39,552	42,505	49,173	55,619
6	469	509	599	688	34,568	37,487	44,146	50,656
7	681	732	847	958	45,133	48,503	56,113	63,468
8	740	799	935	1,067	41,535	44,883	52,490	59,897
9	546	587	678	765	28,307	30,393	35,099	39,641
10	66	69	75	81	12,595	13,191	14,468	15,626
DCC total	5,284	5,726	6,738	7,728	45,504	49,327	58,045	66,565

Source: Estimated by JICA Study Team

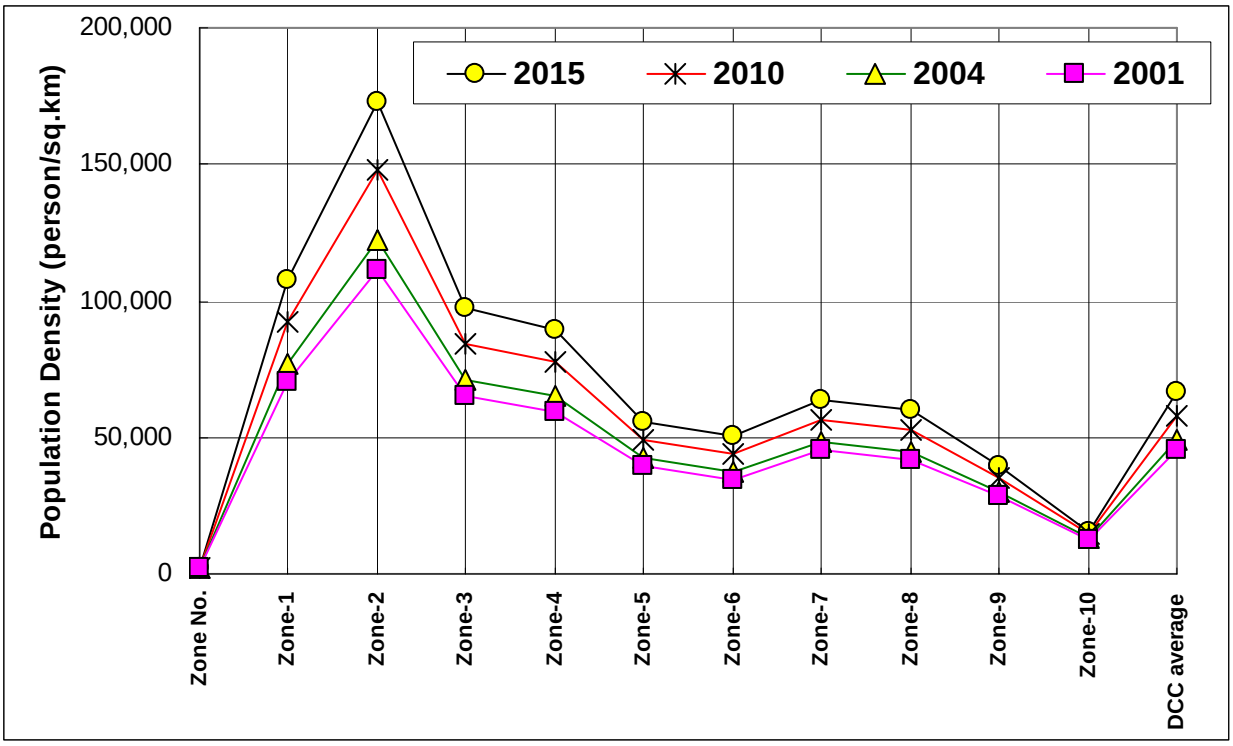


Figure 4.3-4 Population Density by Zone in Future (up to 2015)

(3) Solid Waste Generation Amount

Quantity of solid waste generated in DCC administration area will be estimated for 1) domestic waste, and 2) commercial, business and public facilities, based on the waste generation rate obtained through the waste generation source survey conducted in dry season and wet season.

The waste generation source survey conducted for the residential houses grouped in five income groups resulted in the per capita domestic waste generation rate at 0.340 kg per day as indicated in Table 4.3-7.

Table 4.3-7 Result of per Capita Domestic Waste Generation Rate in Dhaka

Income Groups	Ratio of Pop. in each Income Group (%)	Dry Season per Capita Waste Generation Rate (kg/c/day)	Dry Season Weighted Average per Capita Waste Generation Rate (kg/c/day)	Wet Season per Capita Waste Generation Rate (kg/c/day)	Wet Season Weighted Average per Capita Waste Generation Rate (kg/c/day)
High	8.3	0.588		0.438	
Middle	16.3	0.371		0.428	
Middle-Low	34.3	0.279	0.337	0.346	0.342
Low	23.6	0.326		0.345	
Lowest/Slum	17.4	0.314		0.205	

Source: Waste Generation Source Survey 2004

Note: Annual Average per Capita Waste Generation Rate of Domestic Waste : 0.340 kg/c/day

Waste generation rate tends to increase as income/economic condition improves. The study conducted by the United Nations in 1995[1] shows the per capita GNP and the municipal waste generation rate of Bangladesh at US$ 240 and 0.49 kg/c/day. The latest per capita GDP of Bangladesh estimated for the year 2002 indicated the amount of US$ 389.[2]

Meanwhile, the domestic waste generation rate was estimated at 0.340 kg/c/day from the result of waste generation source survey in 2004. The business waste generation rate was estimated at 0.183 kg/c/day as the rate between daily generation of 1,050 t/d and population of 5.726 million in 2004. The street waste generation rate is similarly estimated at 0.035 kg/c/day. Thus, the total municipal waste is estimated at 0.558 kg/c/day. Using these parameters, the conditions for forecast of future waste generation volume are determined as shown in Table 4.3-8.

[1] "What a Waste", Solid Waste Management in Asia, Urban Development Sector Unit, East Asia and Pacific Region, October 1998.

[2] Country Report, Website of Ministry of Foreign Affairs of Japan.

Table 4.3-8 Conditions for Forecast of Future Solid Waste Quantity

Per Capita GNP/GDP	US$ 240:1995 * footnote 1	US$ 389:2002 * footnote 2	Growth Rate: 6.90% per year
Per Capita Municipal Solid Waste Generation Rate (kg/c/day)	0.49 : 1995	0.558 : 2004	Growth Rate : 0.71% per year
Increase Ratio of per Capita Waste Generation Rate to GDP (Elasticity Coefficient) in 1995-2004			10.3% per 1% GDP
Assumption of GDP during 2004-2015			6% per year
Assumed Elasticity Coefficient during 2004-2015			0.62% to 6% GDP
Estimated per Capita Domestic Waste Generation Rate in Future (kg/c/day)	0.340 : 2004	0.352 : 2010	0.364 : 2015
Assumption of Ratio (Domestic Waste : Business Wastes)			65% : 35%

source: assumed by the study team

The ratio of domestic waste and commercial waste, which is assumed at 65:35, was determined with reference to the result of waste source generation survey.

Solid waste forecast was conducted based on the prescribed conditions and yearly base for the quantity of domestic waste, commercial/business wastes including market waste. The total solid waste to be generated in 90 Wards was forecast at 3,200 t/d, 3,909 t/d and 4,624 t/d for the years 2004, 2010 and 2015, respectively, as shown in Table 4.3-9 and Figure 4.3-5.

The estimated waste amount shall be interpreted as a daily average waste generation amount year round. There is a seasonal fluctuation in waste generation: the higher waste generation rate occurs in wet season and lower waste generation occurs in dry season. The waste generation source survey conducted both in dry/wet seasons showed the higher waste generation rate per capita per day at only 5 grams in wet season, but this difference can not be a significant value for the average per capita waste generation rate at 340 grams per day. Meantime, the survey conducted at three disposal sites at Matuail, Berri Band, and Uttara to measure the loaded weight of all the incoming vehicles to the sites shows a significant difference in the average daily waste amount at 970 tons/day in dry season and 1,420 tons/day in wet season. The difference implies that the planning for collection and transportation shall consider the seasonal fluctuation in waste generation amount but it will not be required to consider the fluctuation to determine the scale of waste disposal site but for control area of collection and transportation vehicles and the heavy equipment used at the landfill site.

Ward-wise solid waste amount forecast is presented in Table 4.3-10. The largest waste amount of stationary sources is generated at 96 t/d in Ward 15, which is followed by 95 t/d and 89 t/d in Ward 39 and Ward 37, respectively. The generation amount of domestic waste is forecast in proportion to the population size in the wards. The larger amount of domestic waste generation is forecaast in Ward 6, Ward 2 and Ward 37 at 51 t/d, 48 t/d and 44 t/d, respectively. Business wastes including market wastes are forecast by distributing the total quantity to wards in proportion to size of the area. Accordingly, the largest business waste generation is forecast for Ward 39 and Ward 79 at 63 t/d followed by Ward 15 at 47 t/d.

Table 4.3-9 Forecast of Zone-wise Solid Waste Quantity (2004-2010-2015)

	2004				2010				2015			
	domestic	business	street	total	domestic	business	street	total	domestic	business	street	total
zone 1	233	92	22	347	284	113	26	423	336	133	31	501
zone 2	160	173	22	356	196	212	27	435	232	251	32	515
zone 3	171	42	14	228	209	51	17	278	248	61	21	329
zone 4	292	86	25	403	356	105	31	493	422	125	36	583
zone 5	175	84	17	277	214	103	21	338	254	122	25	400
zone 6	173	131	20	325	212	160	25	397	251	190	29	470
zone 7	250	126	25	401	305	154	31	490	361	183	36	580
zone 8	273	156	29	458	333	191	35	559	394	226	41	661
zone 9	200	140	23	363	244	172	28	443	288	203	33	524
zone10	23	17	3	43	28	21	3	52	33	25	4	62
total	1,950	1,050	200	3,200	2,382	1,283	244	3,909	2,817	1,518	289	4,624

Source: Estimated by the JICA Study Team

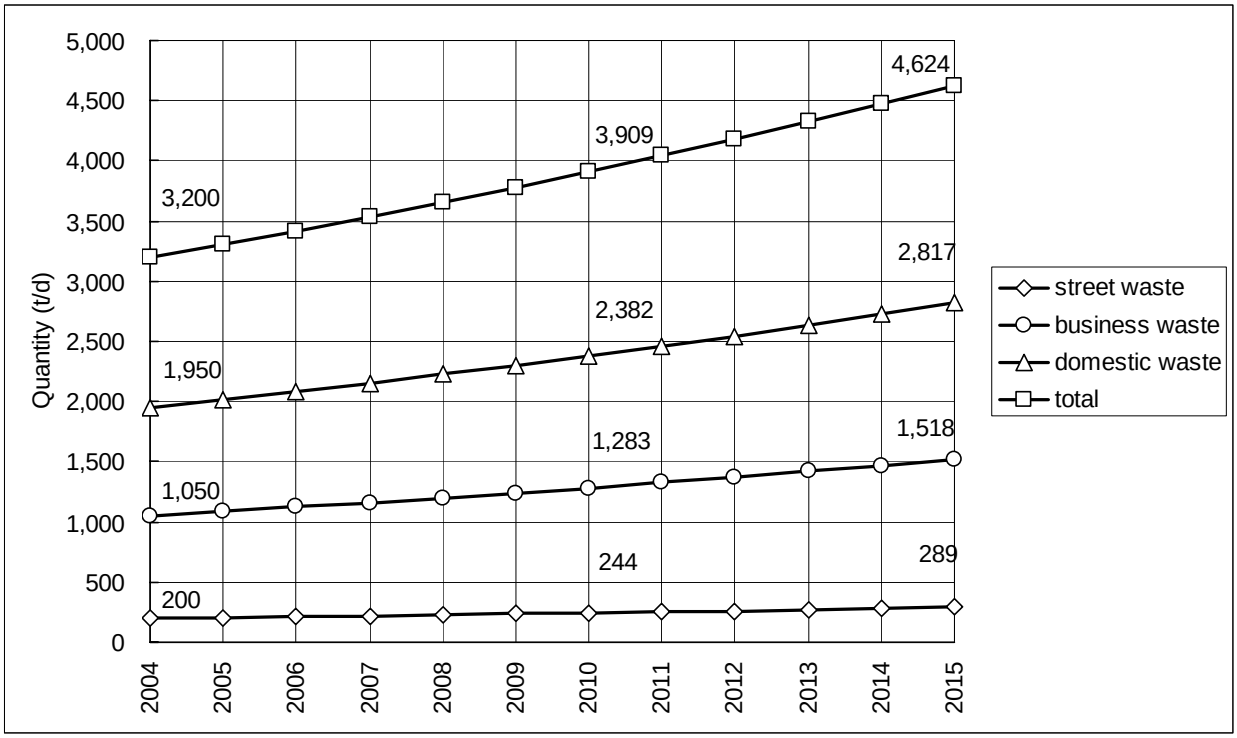


Figure 4.3-5 Forecast of Solid Waste Generation Amount (t/d)

Table 4.3-10 Forecast of Solid Waste Quantity in DCC (2004-2015)

ward	2004			(t/d)	2010			(t/d)	2015			(t/d)
No.	domestic	business	street	total	domestic	business	street	total	domestic	business	street	total
1	23	17	3.3	44	27	21	4.0	52	30	25	4.7	59
2	48	8	1.6	58	60	10	1.9	72	73	11	2.2	86
3	27	22	4.3	53	33	25	4.7	63	40	27	5.1	72
4	20	5	1.0	26	25	7	1.4	34	30	9	1.8	42
5	33	8	1.6	43	41	10	1.8	53	50	11	2.1	63
6	51	29	5.4	85	64	35	6.7	106	77	42	7.9	127
7	19	11	2.2	32	21	16	3.0	40	24	21	3.9	48
8	34	25	4.8	64	39	29	5.5	73	44	33	6.2	83
9	21	50	9.5	80	24	54	10.3	88	26	58	11.0	95
10	24	16	3.0	43	27	20	3.7	50	30	23	4.4	58
11	28	7	1.4	37	36	10	2.0	48	43	13	2.5	59
12	33	4	0.7	38	41	5	1.0	48	50	7	1.3	58
13	32	11	2.1	45	37	13	2.5	52	41	15	2.9	59
14	42	5	1.0	48	52	7	1.4	61	63	9	1.8	74
15	40	47	8.9	96	46	52	9.8	107	51	57	10.8	118
16	37	14	2.7	54	42	17	3.2	62	47	20	3.8	71
17	30	15	2.9	49	35	22	4.1	60	39	28	5.3	72
18	13	15	2.8	30	15	18	3.5	36	16	22	4.1	42
19	26	17	3.3	46	29	24	4.6	58	32	31	5.9	69
20	30	14	2.6	47	38	19	3.6	61	46	24	4.7	75
21	26	18	3.4	47	30	21	3.9	54	33	24	4.5	61
22	34	4	0.7	38	42	5	1.0	48	51	7	1.3	59
23	19	3	0.5	22	24	4	0.7	29	29	5	1.0	35
24	22	4	0.8	27	28	6	1.1	34	33	7	1.4	42
25	30	2	0.4	33	38	3	0.6	42	46	4	0.8	50
26	18	1	0.3	20	21	2	0.4	23	23	2	0.5	26
27	27	4	0.8	32	34	6	1.1	41	41	7	1.4	50
28	17	2	0.4	20	22	3	0.6	25	26	4	0.8	31
29	21	10	1.8	33	27	10	2.0	39	32	11	2.1	45
30	13	1	0.2	14	16	1	0.2	18	20	2	0.3	22
31	12	23	4.3	39	13	28	5.4	47	15	34	6.4	55
32	15	13	2.5	31	17	18	3.5	39	19	24	4.5	47
33	11	1	0.2	13	14	2	0.3	16	17	2	0.4	20
34	25	3	0.5	28	31	4	0.7	35	38	5	0.9	43
35	20	2	0.3	22	25	3	0.5	28	30	3	0.6	34
36	19	15	2.8	37	24	19	3.6	47	29	24	4.5	57
37	44	38	7.2	89	55	53	10.1	118	66	68	13.0	147
38	31	24	4.6	59	39	26	5.0	70	47	29	5.5	81
39	19	63	12.1	95	24	70	13.4	108	29	77	14.6	120
40	25	25	4.7	54	28	34	6.5	69	32	44	8.4	84
41	33	19	3.7	55	41	23	4.3	68	49	26	5.0	81
42	21	21	3.9	46	26	22	4.3	53	32	24	4.6	61
43	28	2	0.4	30	35	3	0.5	38	42	3	0.6	46
44	17	4	0.7	21	21	5	1.0	27	25	7	1.3	34
45	18	8	1.5	28	23	11	2.1	36	27	14	2.8	45
46	22	6	1.1	28	25	7	1.3	33	28	8	1.5	37
47	24	3	0.7	28	30	5	0.9	36	36	6	1.2	44
48	30	18	3.4	51	34	22	4.3	61	38	27	5.1	70
49	15	6	1.2	22	17	9	1.7	27	19	11	2.1	32
50	24	1	0.3	26	30	2	0.4	33	36	3	0.5	39
51	21	3	0.5	24	26	4	0.7	31	31	5	1.0	37
52	22	22	4.1	48	25	26	5.0	56	28	31	5.9	65
53	16	9	1.7	26	18	13	2.4	33	20	16	3.1	39
54	28	2	0.4	30	35	3	0.5	38	42	4	0.7	46
55	23	1	0.1	24	29	1	0.2	30	35	1	0.2	36
56	15	28	5.3	48	17	38	7.2	62	19	49	9.2	77
57	13	13	2.5	28	15	18	3.4	36	16	23	4.4	44
58	27	4	0.8	32	34	6	1.1	41	41	7	1.4	50
59	18	2	0.3	20	23	2	0.4	26	28	3	0.5	31
60	23	2	0.3	25	29	2	0.5	32	35	3	0.6	39
61	11	4	0.7	15	14	5	1.0	20	16	7	1.3	24
62	18	7	1.4	27	23	10	1.9	35	28	13	2.4	43
63	10	3	0.5	14	13	4	0.7	17	16	5	0.9	21
64	10	1	0.2	11	13	1	0.2	15	16	2	0.3	18
65	23	3	0.5	27	29	4	0.7	34	35	5	0.9	41
66	13	6	1.2	20	16	9	1.7	27	19	11	2.2	33
67	13	10	1.9	25	17	13	2.5	32	20	16	3.1	39
68	16	2	0.5	19	20	3	0.6	24	24	4	0.8	29
69	24	8	1.6	34	30	10	1.8	41	36	11	2.1	49
70	19	4	0.8	23	23	6	1.1	30	28	7	1.4	37
71	12	9	1.7	22	15	10	1.9	27	18	11	2.1	31
72	11	2	0.4	13	14	3	0.5	17	17	3	0.6	21
73	11	40	7.6	58	14	44	8.4	66	17	48	9.1	74
74	17	25	4.9	48	22	27	5.2	54	26	29	5.6	61
75	12	3	0.6	16	15	5	0.9	20	18	6	1.2	25
76	15	3	0.6	19	19	4	0.8	24	23	6	1.1	29
77	14	1	0.2	15	17	1	0.2	19	21	2	0.3	22
78	10	3	0.5	13	12	4	0.7	17	15	5	1.0	21
79	15	63	12.0	90	19	67	12.7	98	23	70	13.4	106
80	10	1	0.2	11	13	1	0.2	15	16	2	0.3	18
81	18	3	0.6	22	23	4	0.8	28	28	6	1.1	35
82	15	2	0.3	17	18	2	0.5	21	22	3	0.6	26
83	17	11	2.2	31	21	14	2.7	38	26	17	3.3	46
84	12	6	1.1	19	13	8	1.5	23	15	10	2.0	27
85	17	5	0.9	23	21	7	1.2	29	26	8	1.6	36
86	19	27	5.1	51	24	30	5.6	59	28	32	6.1	67
87	19	10	1.9	31	24	11	2.1	38	29	12	2.3	44
88	13	2	0.3	15	16	2	0.5	19	19	3	0.6	23
89	19	2	0.4	22	24	3	0.6	28	29	4	0.8	34
90	20	15	3.0	38	25	18	3.4	46	30	20	3.8	54
total	1,950	1,050	200	3,200	2,382	1,283	244	3,909	2,817	1,518	289	4,624

4.4 Demand for Solid Waste Management

(1) Estimate of Waste Reduction, Recyclable

The target quantity of waste reduction[3] and recycling volume is assumed as a ratio to waste generation amount and is set in Table 4.4-1.

Table 4.4-1 Proposed Target Level of Waste Reduction and Recycling

Item \ Year	2004	2010	2015
Waste Generation	3,200 t/d	3.909 t/d	4,624 t/d
Waste Reduction at Source*	-	98 t/d	231 t/d
	-	2.5 %	5.0 %
Material Recovery at Source and Collection	420 t/d	531 t/d	650 t/d
Process**	13.1 %	13.5 %	14.0 %
Recovery of Resources at Disposal Sites	15 t/d	18 t/d	22 t/d
	0.5 %	0.5 %	0.5 %

Note: * effects expected by changing consumable goods into less waste and changing lifestyle into generating less waste by reducing consumption and promoting self-disposal

** effects expected by promoting recycling at source or discharging manner favorable to recycle business

The total waste reduction at source was estimated at 98 t/d and 231 t/d for the years 2010 and 2015, respectively. Meanwhile, the total amount of resource recovery was estimated at 549 t/d and 672 t/d in 2010 and 2015, respectively. The total amount of waste reduction and resource recovery at source is deemed as the waste diversion amount that will not be transported to the disposal site, that is, the waste amount of 647 t/d and 903 t/d will be potentially divertible.

The increase of resource recovery mainly depends on the change of waste composition which generally happens as the economy develops. The recyclable portion of waste is expected to grow particularly by the wider use of paper and plastics, which are considered major contents of increase in the future. The rate of growth for recycling is assumed at about 0.1%/y for the period of Master Plan.

The increase of waste reduction solely depends on the awareness of people of waste generation in everyday life. Waste reduction is pursued by changing commodities consumed into those generating less waste. Consumable goods, which result in waste at the place of consumption in Dhaka City, are required to have less unusable portion and simpler packaging. There is no definite numerical basis for a target; however, ultimately 5% (150g/day for an average family with five members, equivalent to one and half cup of steamed rice, three eggs or five small paper bags) is assumed as the target of this effort by the society in the year 2015. For the intermediate year of the Master Plan in 2010, 2.5% is assumed (half of population will join in waste reduction activities) as the target, which is half of the final achievement.

[3] Waste reduction, in this report, is defined as activities to reduce amount of waste before the generation by users, producers/manufactures, or dealers, while recycling is defined as activities to use generated waste as resources. Amount of reduced waste can be calculated with the difference between generated waste and estimated amount without waste reduction.

(2) Collection/Transport Demand

Quantity of collection and transport of waste is determined in consideration of the reduction of waste quantity to be made (through the target level waszte quantity of waste reduction and resource recovery at sources as prescribed). Thus, the amount of municipal solid waste requiring collection and transportation is estimated for each Ward as shown in Table 4.4-2.

Table 4.4-2 Potential Collection Demand

Year	Waste Generation "A"	Reduction at source "B"	Material recovery at source and collection process "C"	Collection demand (minimum) = A – B – C	Collection demand (maximum) = A – C
2004	3,200 t/d	0 t/d	420 t/d	2,780 t/d	2,780 t/d
2010	3.909 t/d	98 t/d	531 t/d	3,280 t/d	3.378 t/d
2015	4,624 t/d	231 t/d	650 t/d	3,743 t/d	3,974 t/d

The minimum potential waste collection and transport demand is estimated at 2,780 t/d, 3,280 t/d and 3,743 t/d in 2004, 2010 and 2015 respectively. Excluding reduction of waste at source, the estimated demand goes higher to the maximum of 3,378 t/d and 3,974 t/d in 2010 and 2015, respectively.

The amount indicated herein is a daily average waste amount. Due to seasonal fluctuation in waste generation rate, the planning of waste collection and transportation shall consider an increase of waste collection and transportation amount in the range of 20%-40 % to the annual average daily waste collection and transportation amount.

(3) Final Disposal Demand

a) Future Disposal Site

DCC has plans to construct Matuail extension and Amin Bazar landfill site. Both sites will be available to use at year 2007 if all procedures required for land acquisition and Environmental Clearance will be smoothly conducted. Berri Band will be used for disposal until Amin Bazar new site will be available because of shortage of resources including transportation capacity, budget, etc, although it is better to stop using it as soon as possible to avoid environment pollution.

b) Peripheral Area to be considered

DCC has a plan to construct future landfill site at Matuail (Matuail Extension) and Amin Bazar. Matuail landfill site is located at Matuail village (outside of DCC Area), Thana Derma, Dhaka District. Population of Thana Demra including a part of Zone 1 of DCC in 2001 was 421,540 persons and population density was 13,553 persons/sq km.

Amin Bazar landfill site is located mainly at Baliapur and Konda village (outside of DCC Area), Thana Savar, Dhaka District. Population of Thana Savar including

municipality of Savar was 602,860 persons in 2001 and population density was 2,152 persons/km^2. Since Thana Savar has huge area, population of the surrounding area will be less than one-third of above population.

Since small landfill site is not effective to reduce environmental pollution, it is desirable to receive solid waste collected at the areas surrounding the planned landfill sites.

c) Final Disposal Demand

Final disposal demand is the difference between the collection demand and the material recovery at dumpsite. Thus, the amount of municipal solid waste requiring collection and transportation is estimated for each Ward as shown in Table 4.4-3.

Table 4.4-3 Potential Final Disposal Demand

year	Collection demand (minimum) "A"	Collection demand (maximum) "B"	Material recovery at dumpsite "C"	Final disposal demand (minimum) =A –C	Final disposal demand (maximum) =B – C
2004	2,780 t/d	2,780 t/d	15 t/d	2,765 t/d	2,765 t/d
2010	3,280 t/d	3.378 t/d	18 t/d	3,262 t/d	3.360 t/d
2015	3,743 t/d	3,974 t/d	22 t/d	3,721 t/d	3,952 t/d

Source: Estimated by the JICA Study Team

The minimum potential waste collection and transport demand is estimated at 2,765 t/d, 3,262 t/d and 3,721 t/d in 2004, 2010 and 2015, respectively. Excluding reduction of waste at source, the estimated demand goes higher to the maximum of 3,360 t/d, and 3,952 t/d in 2010 and 2015, respectively.

In the Study, maximum cases for collection and final disposal are applied for the following reasons:

* Because of insufficient information for estimation of future waste amount, the waste amount estimated above might be low. Hence, planning for collection and final disposal are conservatively done to cope with "maximum" amount of waste.

* Due to seasonal fluctuation of waste amount, which might be larger than the amount of reduced waste, the reduced amount can be neglected.

* Since the attainment of waste reduction cannot numerically predicted, planning for collection and final disposal are to be done conservatively.

4.5 Scenario for Improvement

(1) Alternatives of Improvement Scenario

Section 4.3 "Solid Waste Management Demand" discussed waste generation and forecast amounts. Here, three scenarios are set based on collection service level in order to achieve the stated goal. They are as follows:

Scenario 1: with the same amount as 2004

Scenario 2: at the same collection rate as 2004

Scenario 3: at an expanded collection rate (with best effort)

The following conditions are used in the formulation of scenarios for improvement of collection service level:

Table 4.5-1 Conditions for Improvement Scenario

Year	Waste Generation (t/d)
2004	3,200
2010	3,909
2015	4,624

Note: Collection rate: 43.8% of generated waste or 1,400 t/d in 2004
Disposal volume: 43.3% of discharged waste or 1,385 t/d

Parameters of the above three scenarios are as follows:

[Scenario 1]: amount of collection at 1,400 t/d

The waste collection amount and disposal volume, which are at present 1,400 t/d and 1,385 t/d respectively, remain the same throughout the planning period from 2004 to 2015, so that waste collection rate will decrease to 30% of waste generation in 2015 from 44% in 2004.

[Scenario 2]: collection rate at 44%

Waste collection rate will be kept at 44% of waste generation, which is the rate of 2004. However, waste generation in 2015 will be 1.44 times as much as that of 2004, so that collection volume will be 2,023 t/d in 2015 from 1,400 t/d in 2004.

[Scenario 3-A]: collection rate at 61% or 2,823 t/d in 2015

Collection rate will increases to 61% of waste generation in 2015 on condition the waste reduction at sources is achieved at 2.5% in 2010 and 5% in 2015. Collection volume will also increase to 2,823 t/d in 2015.

[Scenario 3-B]: collection rate at 66% or 3,054 t/d in 2015

Collection rate will increase to 66% of waste generation in 2015 from 44% in 2004 on condition the waste reduction at sources is not achieved. Collection volume will also increase to 3,054 t/d in 2015.

(2) Comparison among Three Scenarios

Comparison among the above three scenarios is shown in Table 4.5-2 and Figures 4.5-1 and 4.5-2 assuming the effect of waste reduction at source and recycling is in place.

a) Disposal Volume

At the present, disposal volume is 1,385 t/d or 43% of waste generation. In case of Scenario 1, 30% of waste generation will be disposed of in 2015. In contrast, if Scenario 3-B will be adopted, 3,032 t/d or 66% of waste generation should be disposed in 2015. This amount of disposal volume will be approximately two times as much as Scenario 1.

b) Unidentified disposal

Haphazardly thrown waste may be considered as constituting unidentified disposal volume. It is estimated that unidentified disposal will increase 2.3 times of the present volume in year 2015, if Scenario 1 is adopted. This means 2.3 times increase of scattered waste in vacant spaces, rivers and other places. In Scenario 3, disposal waste will decrease to 920 t/d in 2015, or a 30% reduction of present unidentified disposal volume.

c) Adopted Scenario

The goal of Master Plan is to improve the environment of Dhaka City through appropriate solid waste management. Therefore, the amount of unidentified disposal waste should be reduced. Only Scenario 3 can provide a lower volume of unidentified disposal waste than present. Therefore, Scenario 3 should be adopted in the Master Plan. Out of two variations of Scenario 3, case B which gives the larger figure of collection volume will be referred to in the master plan, particularly for the plan of physical expansion of management capacity.

Table 4.5-2 Comparison Among Three Scenarios

Year	Assumed disposal volume	Waste generation (t/d)	Waste collection volume (t/d)	Waste discharge volume (t/d)	Waste collection rate to generation (%)	Waste collection rate to discharge (%)	Waste disposal volume (t/d)	Unidentified disposal (t/d)
2004	present	3,200	1,400	2,780	44	50	1,385	1,380
2010	1. same volume	3,909	1,400	3,280	36	43	1,382	1,880
	2. same rate		1,710	3,280	44	52	1,692	1,570
	3. expanded rate -A		1,955	3,280	50	60	1,937	1,325
	-B*		2,053	3,378	53	61	2,035	1,325
2015	1. same volume	4,624	1,400	3,743	30	37	1,378	2,343
	2. same rate		2,023	3,743	44	54	2,001	1,720
	3. expanded rate -A		2,823	3,743	61	75	2,801	920
	-B*		3,054	3,974	66	77	3,032	920

Note: *Waste reduction is assumed by recycling only.
Source: Waste Amount Survey by JICA Study Team

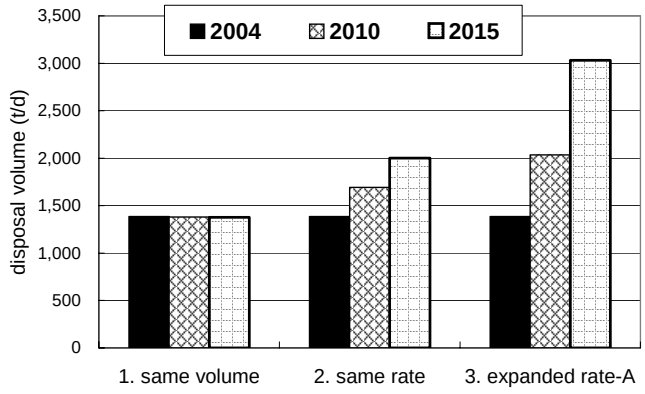


Figure 4.5-1 Change of Disposal Volume by Improvement Scenarios

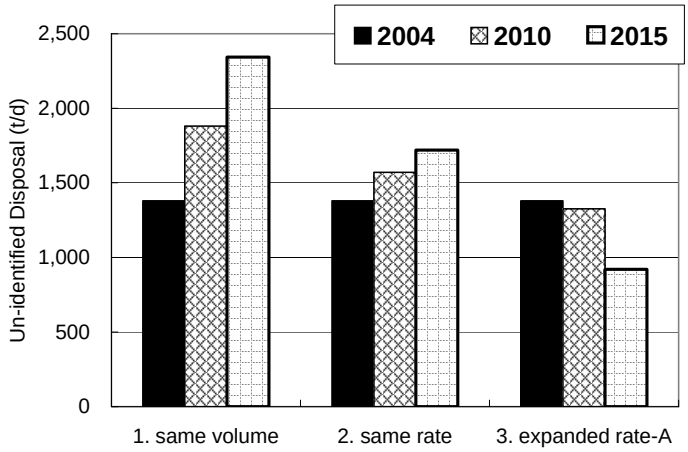


Figure 4.5-2 Change of Unidentified Disposal Volume by Improvement Scenarios

(3) Target Framework

The discussion in the previous section concluded that the Scenario-3 is recommendable for the Master Plan. The scenario requires drastic expansion of the capacity for collection and final disposal simultaneously. The extent of expansion is affected by the achievement of waste reduction by waste generator and recycle industry. The effect of waste reduction by generator at source depends on the progress of public awareness, which is also a target of the master plan. The attempt has just been started in two wards as pilot project; consequently, it is much too early to consider the dissemination of the achievement in those pioneer wards. On the other hand, the reduction effect by recycling industry seems surer than that by waste generator.

In this connection, the target level of waste disposal is summarized based on the Scenario-3 in Table 4.5-3. As a result, 2,823 t/d or 3,054 t/d should be collected in 2015 with or without counting the reduction effect by waste generator respectively. With this scenario, the performance of waste disposal system is illustrated in Figures 4.5-3. Figures 4.5-4 to 4.5-5 show the schematic of waste stream for the milestone years of the master plan.

Table 4.5-3 Targets of Waste Disposal

	Present Condition 2004 (t/d)	Target for 2015 (t/d)	Year 2015/2004	Possible Actions by DCC
Collection and transport	1,400	2,823	202 % (almost twice)	☐ improvement of efficiency on waste collection ☐ increase of vehicle, heavy equipment and manpower ☐ capacity development of workers ☐ development of disposal sites
		3,054*	218 %	
Final disposal	1.385	2,801	202% (almost twice)	
		3,032*	219 %	
Source reduction by waste generator	0	231	genuine reduction: equivalent to 0.2 kg/ house/day	☐ waste reduction campaign ☐ collaboration with supplier of consumer goods ☐ providing economic incentive ☐ ward level activity
Recycling	435	672	154%	☐ coordination with private sector ☐ ward level activities
Unidentified disposal	1,380	920	one-third reduction	☐ awareness campaign ☐ ward level activities ☐ enforcement of anti illegal-dumping

Note: * indicates the assumption without counting effect of source reduction by waste generator

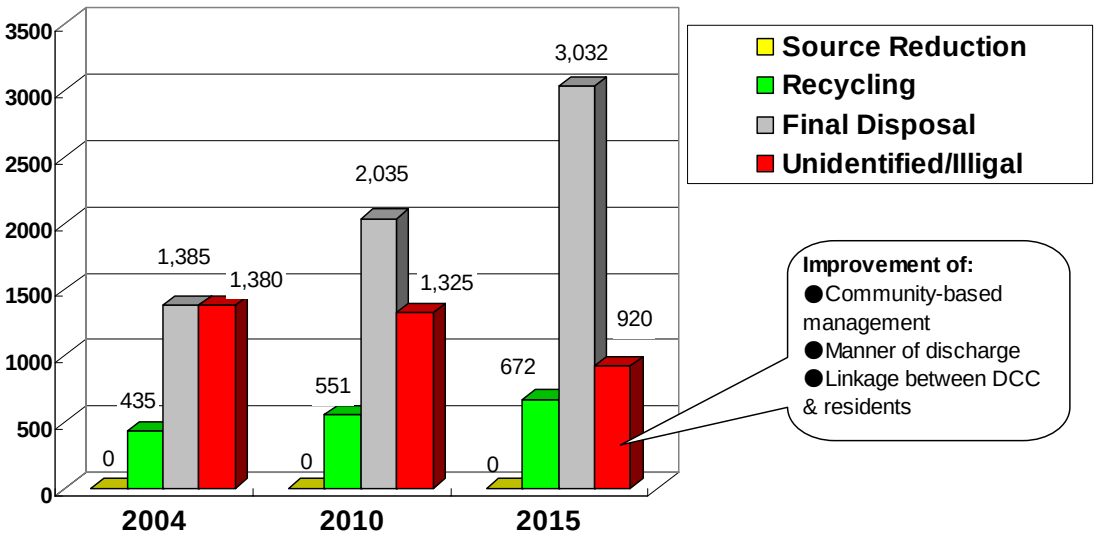


Figure 4.5-3 Targets of Waste Disposal System (maximum case of disposal volume)

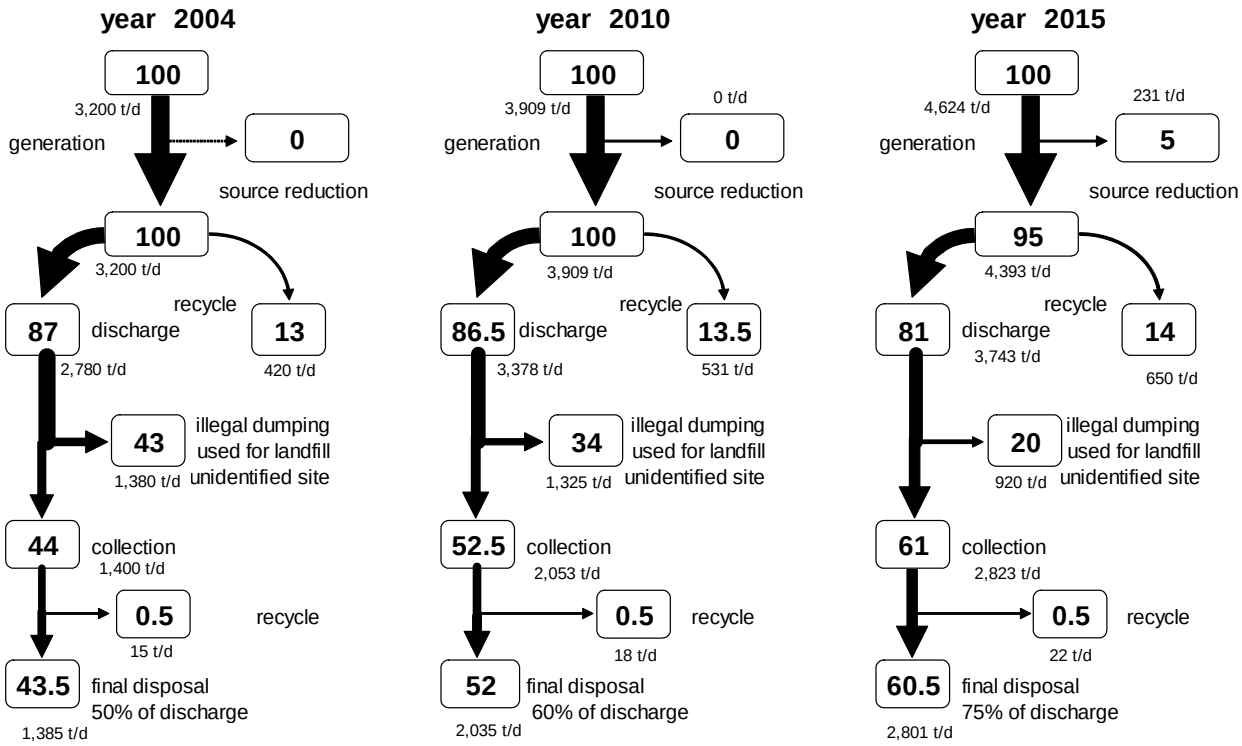


Figure 4.5-4 Comparison of Waste Stream by Target Year (with Source Reduction)

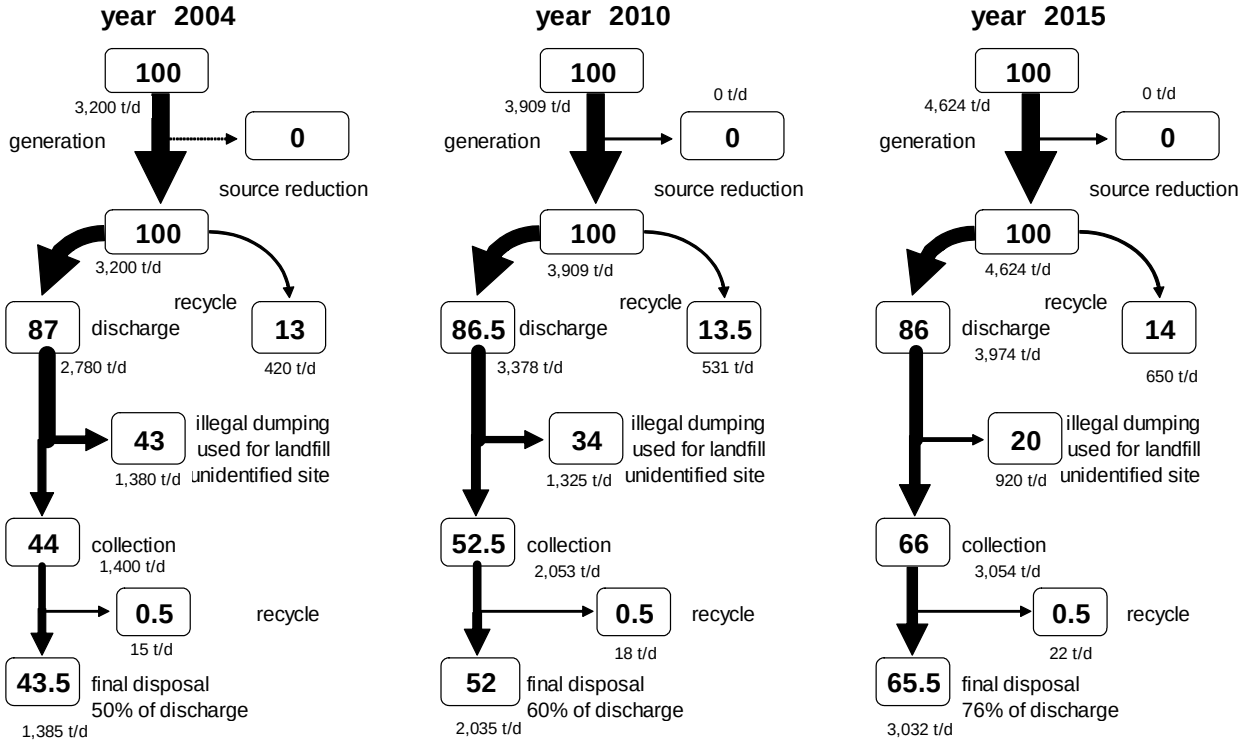


Figure 4.5-5 Comparison of Waste Stream by Target Year (without Source Reduction)

(4) Target Amount of Collection/Transport

According to Scenario 3, DCC needs to collect 1,955 t/d in year 2010 and 2,823 t/d in 2015, on condition source reduction is achieved by waste generators, and 2,053 t/d in year 2010 and 3,054 t/d in 2015 without source reduction. Since the achievement of source reduction is difficult to forecast quantitatively, the target level of waste collection is assumed as the case without source reduction as the safer assumption to specify the required capacity of collection and transport. The yearly target collection rate and the waste amount are proposed as shown in Table 4.5-4.

Table 4.5-4 Target Amount of Waste Collection

Year	Waste Generation Amount (t/d)	Waste Collection Amount (t/d)	Waste Collection Rate (%)
2004	3,200	1,400	44%
2005	3,308	1,492	45%
2006	3,420	1,591	46%
2007	3,536	1,695	48%
2008	3,656	1,807	49%
2009	3,780	1,926	51%
2010	3,909	2,053	52.5%
2011	4,042	2,223	55%
2012	4,180	2,406	58%
2013	4,323	2,605	60%
2014	4,471	2,821	63%
2015	4,624	3,054	66%

Source: Estimated by the JICA Study Team

(5) Reduction of Unidentified/Illegal Dumping

There are many reasons why people engage in unidentified or illegal dumping regardless of whether they are conscious or unconscious that they are performing an illegal act. Because of the huge number of potential actors in this kind of activity, widely spread actions are needed to address the situation. Table 4.5-5 gives a guide to what sort of actions are assumed in the master plan to reduce unidentified and illegal dumping.

Table 4.5-5 Control Measures against Unidentified/Illegal Dumping

Concerning Party	Control Measure	Assumed Action
• residents • business entities	• awareness promotion • expansion of service area of primary collection • increase of licensed service provider for primary collection	• ward level SWM • school education • IEC program
• primary collectors	• proper distribution of DCC containers • expansion of DCC capacity for secondary collection	• increase number of trucks, drivers and containers • setting up operation and management plan of waste collection
• road/drain cleaners	• removal of voluntary collection points	• standardization of collection and transport work
• DCC drivers	• reduction of dumping on-demand of landowners • reduction of voluntary dumping	• capacity development of DCC workers

(6) Target Amount of Final Disposal

Disposal amount is estimated based on Scenario 3 with following assumptions:

- Present disposal amount at Matuail and Berri Band landfill site is in total 1,385 t/d (43% of generated waste in DCC).
- Disposal amount of DCC will increase to 2,053 t/d (52% of generated waste) in the year 2010 and 3,032 t/d (65.5% of generated waste) in 2015 without waste reduction by generators at source.
- DCC stops operation at Berri Band by the end of 2006.
- Distribution of waste from DCC is assumed as follows:

  a. until end of 2006: Matuail: Berri = 70%: 30%

  b. from beginning of 2007: Matuail (new): Amin Bazar = 70%: 30%

- It will be necessary to consider receiving solid waste from areas surrounding the landfill site. However, estimating demand for disposal presents some challenges because the disposal amount depends on solid waste collection rate and system in the area. It is assumed that 30% of generated waste in the surrounding area will be received in 2015. The amount will be 110 t/d from the surrounding area of Matuail and 30 t/d from the surrounding area of Amin Bazar.

Annual disposal amount is estimated for each year in the planning period as shown in Tables 4.5-6 and 4.5-7. Accumulated disposal amount until 2015 will reach 9.3 million tons, of which 6.5 million tons will be disposed of at Matuail landfill site and 2.3 million tons at Amin Bazar landfill site. The balance of 0.5 million tons will be accepted at Berri Band until 2006.

Table 4.5-6 Daily Disposal Amount (t/d)

Disposal Sites	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Disposal Amount from												
DCC	1,385	1,477	1,575	1,679	1,790	1,909	2,035	2,204	2,387	2,585	2,800	3,032
Matuail neighboring area				22	30	40	53	61	70	81	93	107
A. Bazar neighboring area				8	10	13	17	19	21	23	25	28
Total	1,385	1,477	1,575	1,709	1,830	1,962	2,105	2,284	2,478	2,689	2,918	3,167
Disposal Sites												
Matuail	970	1,034	1,102	1,196	1,281	1,373	1,474	1,599	1,735	1,882	2,042	2,217
Berri Band	416	443	472	0	0	0	0	0	0	0	0	0
Amin Bazar	0	0	0	513	549	588	632	685	743	807	875	950
Total	1,385	1,477	1,575	1,709	1,830	1,962	2,105	2,284	2,478	2,689	2,918	3,167

Table 4.5-7 Annual Disposal Amount (1,000 ton)

Disposal Sites	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Matuail												
Annual amount	354	377	402	437	468	501	538	584	633	687	745	809
Accumulation	354	731	1,133	1,570	2,038	2,539	3,077	3,660	4,293	4,980	5,726	6,535
Berri Band												
Annual amount	152	162	172									
Accumulation	152	313	486	486	486	486	486	486	486	486	486	486
Amin Bazar												
Annual amount	0	0	0	187	200	215	230	250	271	294	319	347
Accumulation	0	0	0	187	388	602	833	1,083	1,354	1,649	1,968	2,315
Total												
Annual amount	506	539	575	624	668	716	768	834	904	981	1,065	1,156
Accumulation	506	1,045	1,619	2,243	2,911	3,627	4,395	5,229	6,133	7,115	8,180	9,336

4.6 Overall Objectives

The Study found various and serious solid waste management (SWM) problems in Dhaka City. The following overall objectives are identified to achieve the goal of the Master Plan that redounds to achievement of the goals of "Clean Dhaka":

- to expand DCC service coverage and quality;
- to enhance DCC operation capacity with sufficient manpower, equipment and facilities;
- to facilitate well-managed operation by relevant departments;
- to encourage progressive involvement of public participation; and
- to pursue a proper work sharing with private sector and community.

There are various types of solid waste management problems in Dhaka City such as technical problems, management problems and social problems. This is not surprising considering there are lots of stakeholders in solid waste management. Furthermore, each problem is complicated with the various sectors and fields intricately intertwined. Therefore, solid waste management is not mono-sectoral management and **only an integrated approach** can solve solid waste management problems and sustain improvement.

This brings us to solutions for solid waste management problems and improvement, which are categorized into three areas: 1) technical solution, 2) social solution and 3) managerial solution (see Figure 4.7-1). "Clean Dhaka" cannot be achieved without the combined efforts of the three areas of solutions (technical, social and managerial solutions).

4.7 Planning Approaches

The following approaches shall be adopted for the formulation of the Master Plan:

- Integration of technical, social and managerial solution
- Planning based on Scientific Observation
- Adoption of practical technology
- Enhancement of capacity of DCC
- Public Involvement at ward level

(1) Integration of Technical, Managerial and Social Solution

Since the problems of SWM are in three areas, the solutions cover the three areas as well: 1) technical solution, 2) social solution and 3) managerial solution (see Figure 4.7-1). And only by integrating these three solutions can "Clean Dhaka" be achieved.

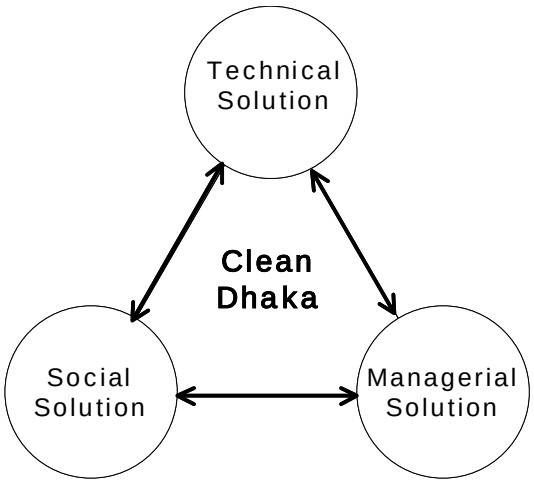


Figure 4.7-1 Integration of Technical, Social and Managerial Solutions for Master Plan Formulation

Integration in solid waste management is explained here. For primary collection, for example, method of door-to-door collection and design of rickshaw van should be studied from the technical aspect. At the same time, people should accept the primary collection system. It is also important how residents and community will be involved in primary collection. On the other hand, appropriate permission system for primary collection service providers is necessary.

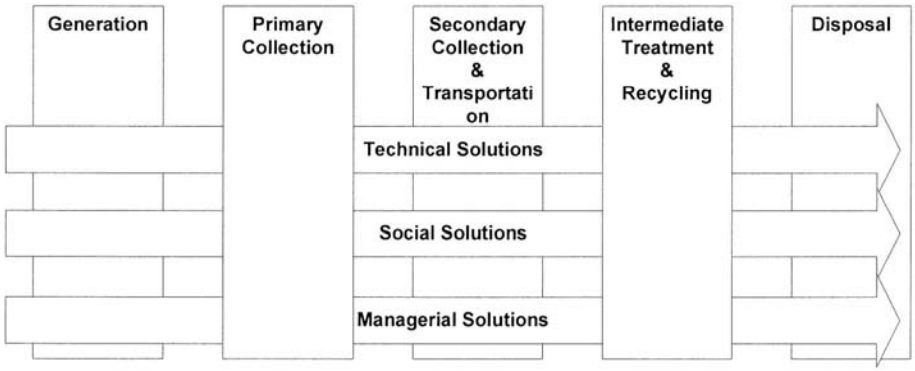


Figure 4.7-2 Approach for Integration among Technical, Social and Managerial Solutions by Each Planning Component

(2) Planning based on Scientific Data

The problems, ideas to solve the problems, and other matters pertaining to Dhaka's solid waste are often discussed by just about everybody. However, it is difficult to formulate a solid waste management plan objectively without scientific data and information. Imagination alone cannot be the basis for planning. To realize a solid waste management plan, it is indispensable to formulate a management plan based on scientific data and information. This will ensure the correct formulation of the plan.

Data Utilization

Factual analysis forms the basis of planning. In this respect, the Study made various kinds of surveys to fully understand the actual state of SWM. The Study gave greater weight to the results of these surveys conducted by means of measuring and interviews directly with concerned people than on information reported so far (the exception is the GIS output by the JICA Study Team). The outline of the planning process is shown in Figure 4.7-3 in connection with utilization of source data acquired in this study.

Analysis of Present State

Present state of SWM in Dhaka City is analyzed with the data and information that cover waste generation, internal/external resources, and operational aspects. A considerable number of waste samples were taken for estimating waste generation amount and waste composition for the first time in Dhaka City. Findings give quantitative figures of operation and its circumstances. Clarification was made of the restrictive factors and advantages that DCC has for the planning issues. In response to the planning issues, suggestions in terms of management were made on the required action wherever necessary.

Incorporation of Evaluation Result of Pilot Projects

Pilot projects were conducted as simulations to verify practicability and effectiveness of the two subjects that may form the essential parts of the Master Plan. It is expected that the result of evaluation will become available toward the middle of January 2005.

Planning

Targets of Master Plan and priority projects were selected out of required actions in consideration of urgency, required time duration for execution, leading effect, and so on. The Study has prepared recommendations to guide DCC to the targets more effectively. Legal, institutional, and financial arrangements are also suggested when those items do not constitute the target of the Master Plan.

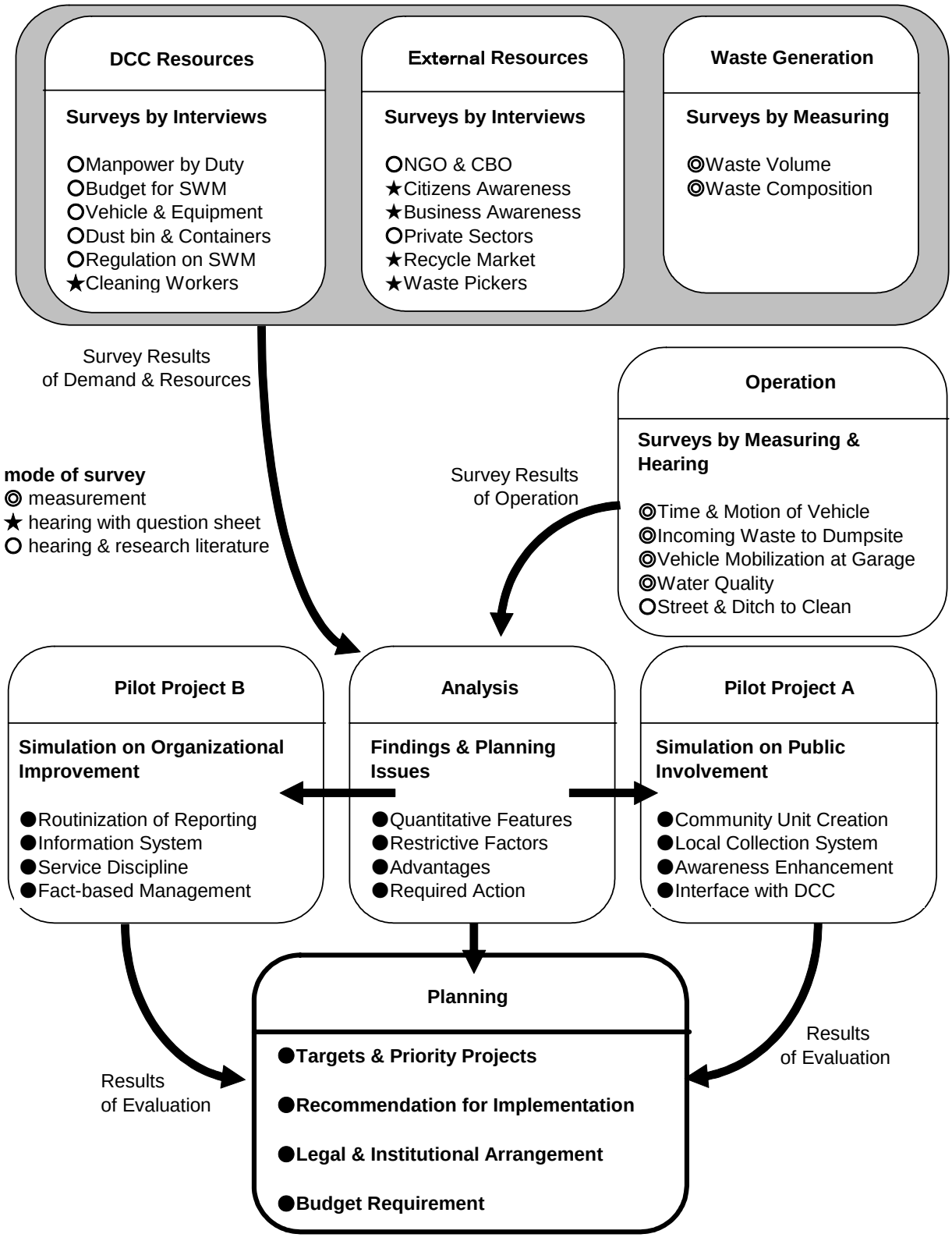


Figure 4.7-3 Planning Process Based on Scientific Observation

(3) Adoption of Practical Technology

a) Alternatives of treatment and disposal

Appropriate solid waste management system in Dhaka will be a combination of several technologies because disposal amount will exceed 3,000 t/d in year 2015. Only landfill could receive and treat this whole amount. However, other options such as composting or incineration can treat part of this waste. Therefore, it will be a practical approach to establish a base system at first consisting of landfill. Once the base system is established, other systems can be introduced with less difficulty.

Also, it is important to understand why the present system has continued despite the fact that many citizens consider current treatment and disposal system to be inadequate. Change of priority is required to improve treatment and disposal.

Four alternatives will be considered on treatment and disposal. Baseline scenario is continuation of present system. This base scenario will include temporary dumping, the same as Uttara and Berri Band, although it will create many problems and nuisance to surrounding residents.

- Baseline scenario (Continuation of present system)
- Landfill with improved operation
- Sanitary landfill with leachate treatment
- Introduction of pre-treatment and sanitary landfill

b) Work flow to prepare the Master Plan

Figure 4.7-4 shows work flow to prepare the Master Plan. It is important to have consensus on possible improvement at present because capacity building is one of the important preconditions to realize the Master Plan. Also, it will be effectively developed with actual trial to improve the present situation.

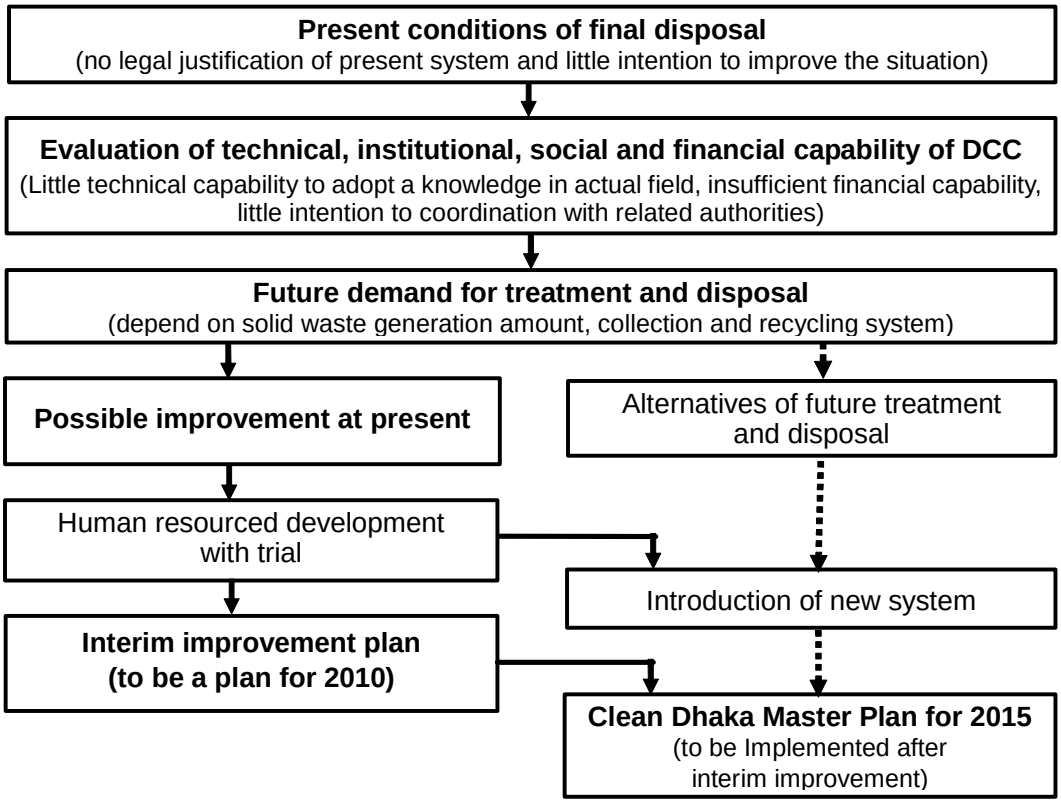


Figure 4.7-4 Work Flow to Prepare the Master Plan

(4) Management Approaches

Targets, objectives, and required management approaches as well as their major relations are shown below. Required approaches are set mainly from the results of the evaluation of the current status of SWM.

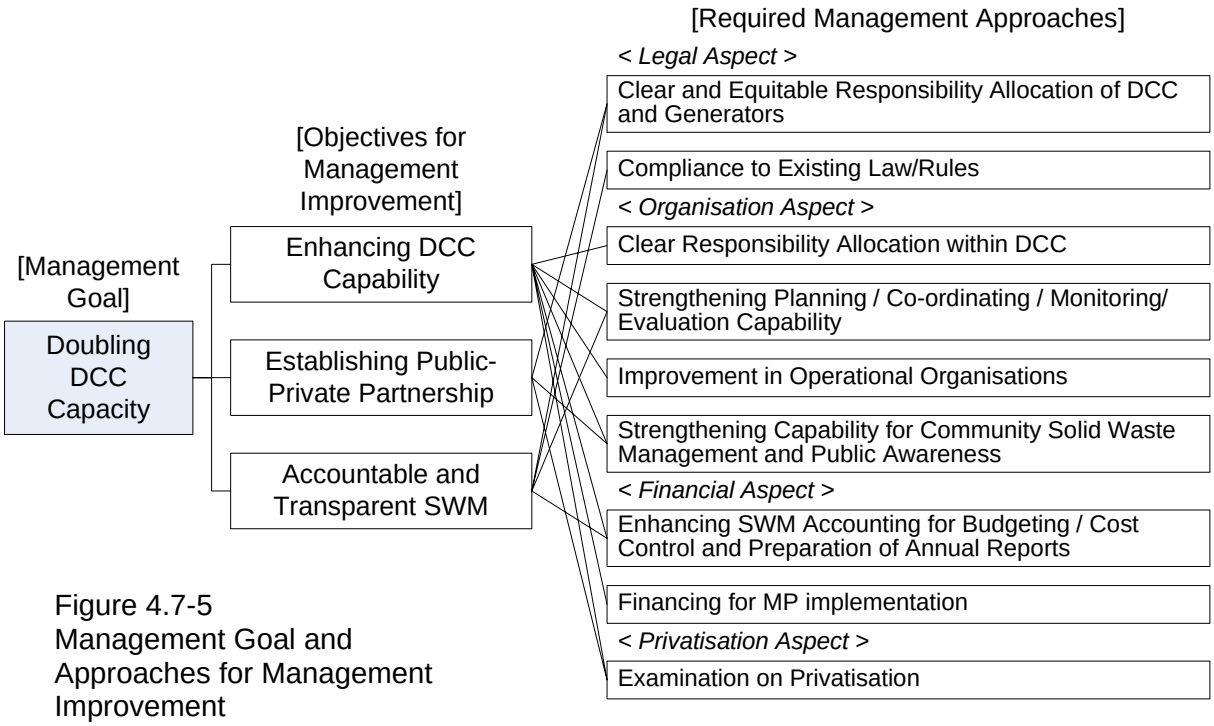


Figure 4.7-5
Management Goal and Approaches for Management Improvement

(5) Public Involvement at Ward Level

Waste generators are responsible for their generated waste under the Polluter-Pay-Principle. DCC cannot make its waste management system work without people's cooperation. Furthermore, DCC has limited resources, technical capability, and financial capability. It is not expected that DCC will fully provide the waste collection system. Responsibility of solid waste management should be shared with not only government agencies but also waste generators including residents. Therefore, roles of community are indispensable for effective solid waste management.

It is expected that people and community contribute time and effort for the following activities:

- to reduce generation of waste from household;
- to cooperate for promotion of recycling;
- to bring waste to waste collection stations such as containers/dustbins or waste collection vehicle appropriately;
- to manage waste collection stations; and
- to watch for persons throwing/dumping waste.

The following approaches shall be adopted for the formulation of the Master Plan in order to achieve social acceptability, sustainability and effectiveness:

- Solid waste management as a shared responsibility between people and community; and
- Solid waste management suitable to the local situations for increasing social acceptability and sustainability through establishment of institutional system for solid waste management at ward level.

Chapter 5
Objectives and Strategies

5.1 General

The goal of the master plan is to improve solid waste system in Dhaka City. The process of solid waste management is as follows:

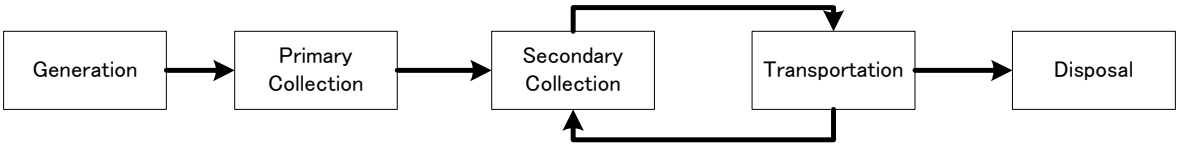


Figure 5.1-1 Solid Waste Management Process

Solid waste management system is composed of Generation/Primary Collection, Secondary Collection/Transportation and Disposal components. They are named technical components group. It was mentioned that technical, social and managerial solutions should be integrated in the master plan in order to solve technical aspect. Issues of technical component group should be tackled by technical, social and managerial solutions (see Table 5.1-1).

Public Involvement, Institutional Strengthening and Financial Strengthening are common components in the master plan. They support the above technical component group by facilitating people, education and enlightenment, institutional and social aspects. Each planning component including technical component and other common components should well perform its roles, and link with each other in order to improve "the system" for solid waste of Dhaka City. Identified issues, objectives and strategies by each planning component are summarized in Table 5.1-2.

Table 5.1-1 Planning Issues Matrix by Planning Component

	Generation	Primary Collection	Secondary Collection & Transportation	Road Cleaning & Drain Cleaning	Final Disposal
Technical Issues	• categories of sources segregation • method of waste storage	• development of primary collection vehicle	• matching design between primary collection vehicle and secondary collection facilities	• appropriate distribution of cleaners	• capacity expansion • improvement of sanitary conditions
Social Issues	• promotion of sources reduction • promotion of waste segregation	• people's cooperation for primary collection • providing right information	• minimize environmental impact caused by the existence of secondary collection facilities • minimize scattering waste around secondary collection facilities	• increasing of people's cooperation	• coexistence with neighbors
Managerial Issues	• people's involvement • Raising awareness of people	• strengthening of capacity of primary service providers • development of DCC's human resources for community involvement	• coordination between primary collection and secondary collection • effective operation and maintenance of vehicle and equipment • development of DCC's human resources for community involvement	• increasing of capability and awareness of cleaners • ensuring of cleaner's safety	• human resource development

Note: Compost and recycle are excluded from component as these are executed by private initiative. Other intermediate treatments are also excluded because of financial restriction of DCC: the conventional 100 % final disposal requires least investment and O&M cost.

Table 5.1-2 Objectives and Strategies (1/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Generation/ Primary Collection	• Lack of coordination and collaboration among DCC, primary collection service providers and community people at the local level • Improper DCC's approval system of primary collection • Low capacity of primary collection service providers • Poor development of primary collection method • Uneven distribution and quality of primary collection services	1. To encourage community people to participate in primary collection for ensuring effective, socially acceptable and sustainable primary collection at the local level 2. To expand service coverage of primary collection especially at congested areas with narrow roads and slum areas 3. To improve quality and efficiency of primary collection to contribute more to the cleanliness of living environment	1. To promote partnership among DCC, primary collection service providers and community people at the Ward level through Ward Solid Waste Management System 2. To supervise and monitor primary collection activities by DCC 3. To encourage primary collection service providers 4. To develop suitable and efficient methods of primary collection 5. To promote equitable primary collection services in Dhaka City	a) WMD b) CD, SDD

WMD (Waste Management Division/Department in future); CD (Conservancy Department); SDD (Slum Development Department) ; Each of them belongs to DCC.

Table 5.1-2 Objectives and Strategies (2/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Secondary Collection/ Transport & Road/Drain Cleaning	• Improper structure, inappropriate location, and shortage of bins/containers • Inefficient use of collection vehicle • lengthy procedure for repair works • Shortage of drivers • Watered records on collection/ transport • Poor management and monitoring system • Lack of sanitary care in cleaning works • Uneven geographical distribution of cleaners • Poor development of work standard • Lack of training for cleaners and inspectors • Lack of communication between DCC, primary collection service providers and community people	1. To expand the capacity of collection/transport 2. To develop the capacity of road/drain cleaning 3. To improve work environment and health condition in collection/transport and cleaning 4. To develop capacity of cleaning workers	<u>Expansion of Capacity of Collection/Transport</u> 1. To expand collection/transport capacity by existing vehicles 2. To replace aged vehicles and procure new vehicles 3. To expand storage capacity of waste containers 4. To expand collection and transport capacity through service providers 5. To identify an alternative way of vehicle repair 6. To standardize collection/transport work <u>Development of Capacity of Road/Drain Cleaning</u> 1. To make effective use of cleaning workers by reviewing existing work method and area-wise deployment 2. To standardize road/drain cleaning work 3. To coordinate with recycle industry <u>Improvement of Work Environment</u> 1. To clear scattered waste around dustbins and waste containers 2. To protect cleaning workers from health risks <u>Capacity Development of Cleaning Workers</u> 1. To give street cleaners wider tasks for cleaning 2. To raise awareness of DCC and cleaning work staff for sanitation and environment	a) WMD, ED b) CD, TD, UPD

WMD (Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department); UPD (Urban Planning Department) ; Each of them belongs to DCC.

Table 5.1-2 Objectives and Strategies (3/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Final Disposal	• Lack of responsible organization to manage and control landfill sites • Illegal dumping at Berri Band and Uttara • Lack of ECC of Matuail landfill site • Improper operation of landfill • Insufficient heavy equipment • Inefficient maintenance system • Low ratio of disposal at landfill sites out of generated waste • Poor allocation of budget and manpower to final disposal • Lack of coordination in planning of existing/future landfill sites	1. To establish future landfill site 2. To improve operation and landfill site at Matuail 3. To challenge for managed final disposal	<u>Establishment of Future Land fill Site</u> 1. To cooperate with “Infrastructure and Environmental Improvement Project”. 2. To acquire land by facilitating the necessary legal procedures 3. To obtain Environmental Clearance Certificate (ECC) 4. To make efforts in timely land acquisition, ECC and construction to meet the schedule for starting operation of Matuail extension and new Amin Bazar site in 2007 5. To identify a few candidate locations for construction of new landfill sites, other than Matuail extension and Amin Bazar, on a longer term perspectives after 2015. <u>Improvement of Existing Landfill Site at Matuail</u> 1. To introduce covering soil 2. To compact waste layer and to shape the surface in gentle slope 3. To continue preparing dumping platform and working road 4. To prepare drainage 5. To introduce leachate collection and gas removal <u>Challenge for Managed Final Disposal</u> 1. To establish a task force to improve operation in Matual landfill site 2. To extend the task force to manage and control all landfill sites	a) WMD b) CD, ED, TD

WMD (Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department) ; Each of them belongs to DCC.

Table 5.1-2 Objectives and Strategies (4/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Public Involvement	• Lack of "community" sense • Weak interest of community people in participation in SWM • Weak environmental education • Lack of IEC activities of DCC for raising public awareness	1. To establish socially acceptable and sustainable community initiative in SWM 2. To raise awareness of stakeholders	<u>Establishment of Community Initiative in SWM</u> 1. To establish partnership among people, community, ward commissioners and DCC 2. To establish a SWM at ward level <u>Raising Awareness of Stakeholders</u> 1. To develop suitable methods considering local situations 2. To educate young generation in order to change their behavior at childhood 3. To raise awareness of decision makers and DCC staff members	a) WMD b) CD, MOPME
Legal Aspect	• Unclear boundary of responsibility between DCC and waste generators • Weak enforcement of laws and rules (i.e. Environmental Conservation Act and Rules, Prevention Act, and punishment against the offenses of DCC Ordinance.)	1. To allocate responsibility clearly and equitably between DCC and waste generators 2. To comply with existing laws/rules	<u>Clear and Equitable Responsibility Allocation between DCC and Waste Generators</u> 1. To define responsibility of DCC and primary collection service providers/residents by clarifying the conditions of container installation 2. To start discussion to define responsibly of business waste management <u>Compliance to the Existing Laws/Rules</u> 1. To provide training on legal matters to DCC staff 2. To prepare and implement Environmental Management Plan (EMP) 3. To prepare and enforce the procedure for punishment of offenses against the Ordinance	a) WMC, WMD, CD b) ED, TD, UPD, LGD, MOEF, Magistrates

WMC (Waste Management Committee); WMD (Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department); UPD (Urban Planning Department); AD (Accounts Department); MOPME (Ministry of Primary and Mass Education); LGD (Local Government Division in the Ministry of Local Government, Rural Development and Co-operatives, MOEF (Ministry of Environment and Forests) ; Each of them belongs to DCC.

Table 5.1-2 Objectives and Strategies (5/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Organization	• Nobody is assigned to planning, coordination, monitoring and evaluation of SWM • Nobody is assigned to community-based SWM. • Nobody is assigned to manage final disposal. • Poor capability of vehicle repair	1 To strengthen planning/ coordinating/ monitoring/ evaluation capability 2. To restructure organizations for SWM 3. To strengthen capability for community-based SWM and promotion of public awareness	<u>Strengthening Planning/Coordinating/Monitoring/ Evaluation Capability</u> 1. To consolidate the function of planning/coordinating, monitoring/evaluation and to introduce a certain form and procedure for cooperation 2. To establish Waste Management Department <u>Improvement in Operational Organizations</u> 1. To enhance the function of Zone Offices for secondary collection and transport 2. To establish a task force for disposal 3. To study on procedure for repair of the conservancy vehicles and the heavy equipment <u>Strengthening Capability for Community Solid Waste Management and Public Awareness</u> 1. To establish Community SWMSection in WMD 2. To enhance the function of Zone Offices for community SWM and public awareness enhancement	a) WMC, WMD b) CD, TD, ED, UPD, AD, ESD

WMC (Waste Management Committee); WMD (Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department); UPD (Urban Planning Department); AD (Accounts Department); ESD (Establishment Department) ; Each of them belongs to DCC.

Table 5.1-2 Objectives and Strategies (6/6)

Planning Components	Identified Issues	Objectives	Strategy	a) Responsible/ b) Concerning Body
Financial Management	• Inadequate budget preparation and cost management • Lack of operation-wise budget control and unclear actual SWM cost • Shortage of SWM finance caused by inconsistent tax collection system	1. To reform SWM accounting for budgeting/cost control 2. To enhance financial capacity for master plan implementation	<u>Reform of SWM Accounting for Budgeting/Cost Control</u> 1. To introduce a modified accounting system for actual SWM cost 2. To prepare annual report <u>Enhancement of Financial Capacity for Master Plan Implementation</u> 1. To increase revenue by reassessment of estate, raising conservancy rate of holding tax and improving tax collection rate 2. To prepare a financial plan enough to cover the cost for implementation of Master Plan	a) WMC, WMD b) AD
Privatization	• Still on the way of a pilot project for privatization	1. To continue an in-depth evaluation of the privatization projects	<u>To continue an in-depth evaluation by examining terms and conditions of the privatization projects</u> 1. To pursue possible work for outsourcing in addition to the pilot project in operation 2. To review the terms of contract for better work 3. To study appropriate system for evaluation	a) WMD b) CD, TD, UPD

WMC (Waste Management Committee); WMD (Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department); UPD (Urban Planning Department); AD (Accounts Department) ; Each of them belongs to DCC.

5.2 Generation/Primary Collection

(1) Objectives

The following objectives are set based on the understanding of present problems and issues:

1. To encourage community people to participate in primary collection for ensuring effective, socially acceptable and sustainable operation of primary collection at the local level;
2. To expand service coverage of primary collection especially at congested areas with narrow roads and slum areas;
3. To improve quality and efficiency of primary collection to contribute more to the cleanliness of living environment.

(2) Strategies

The following strategies are formulated to achieve the objectives:

a) To promote partnership among DCC, primary collection service providers (NGOs/CBOs) and community people at the Ward level through Ward Solid Waste Management System

In these years, various stakeholders including local organizations and DCC have been making efforts individually to improve the local solid waste management by promoting primary collection activities. The efforts are successful to some extent and the primary collection system using rickshaw vans is dramatically spread in Dhaka City. However, problems such as scattered waste around containers/dustbins and illegal dumping are still remaining. More systematic and collaborative approach is needed to promote local people's participation and to strengthen the partnership among the stakeholders.

In view of this, development of the Ward level solid waste management system is set as a key strategy. A ward is identified as a potential unit of local level solid waste management in Dhaka City. Through the Ward Solid Waste Management System, community people, primary collection service providers (NGOs/CBOs) and DCC should coordinate and integrate for proper operation of primary collection. In addition, the system should be the base to facilitate the initiatives of community people in decision-making process and supervision of primary collection activities, as well as to develop the mechanism of raising people's awareness.

b) To supervise and monitor primary collection activities effectively by DCC

Present approval system of primary collection is not ruling the entire situation of primary collection activities. Authorized service provider is usually one of various organizations providing primary collection services in a ward. DCC does not always have control over all service providers engaged in primary collection; accordingly DCC is not supervising the activities of service providers as a whole.

As primary collection is an important part of the entire solid waste management system, DCC should take more responsibility to supervise and monitor primary collection activities, in consideration of actual situations at the local level. The approval procedure for primary collection service providers should be transparent to the public, and opinions of local people, who pay collection fees, should be taken into account in the evaluation process.

It is difficult for DCC alone to oversee all primary collection service providers, particularly those of small scale. Therefore, DCC should collaborate with local organizations through Ward Solid Waste Management System to strengthen the system of approval, supervision and monitoring of primary collection.

c) To encourage primary collection service providers

Primary collection is an important part of solid waste management in Dhaka City and primary collection service providers, mostly local CBOs, are playing an important role. However, the service providers have almost no opportunities to have technical knowledge and information related to solid waste management. DCC should make efforts to encourage primary collection service providers in order for them to provide proper and efficient primary collection services in Dhaka City, and to expand their capacity in terms of coverage and quality of services. Technical support should be provided including providing information about improvement of rickshaw van design and proper management of waste (hazardous waste, illegal dumping, etc.).

d) To develop suitable and efficient methods of primary collection

The proper methods of primary collection should be developed in order to improve the efficiency of primary collection at the local level. The followings are considered to be the points of development:

- Methods of waste discharge by residents
- Design of equipment to collect the waste at narrow roads
- Design of rickshaw vans with which the waste is easily transferred to DCC containers
- Structure and distribution of dustbins/containers that suit local conditions

e) To promote equitable primary collection services in Dhaka City

The service of solid waste management should be equitably provided in Dhaka City. Private sector is taking initiatives in primary collection and the mechanism is functioning in Dhaka City in general. However, the quality of services of primary collection is usually inferior, or the services are not available in congested areas with narrow roads and slum areas, where lower income people are living. In such areas, primary collection provided by CBOs on business basis would not be workable without active participation of residents. As the mid-term strategy, special efforts should be made to encourage the community people in such areas to take initiatives in solid waste management. The followings are to be considered:

- Appropriate intervention by DCC
- Generation of funds for solid waste management by community-based recycling/composting
- Collaboration with Slum Development Department
- Awareness program integrated with health education through primary healthcare networks

5.3 Secondary Collection/Transport and Road/Drain Cleaning

(1) Objectives

One of the major problems taking place in SWM of DCC is the waste collection system. The following objectives are set based on the understanding of present problems and issues:

1. To expand the capacity of collection/transport;
2. To develop the capacity of road/drain cleaning;
3. To improve work environment and health condition in collection/transport and cleaning;
4. To develop capacity of cleaning workers

(2) Strategies

a) Expansion of Capacity of Collection/Transport

i) Expansion of Collection/Transport Capacity by the Existing Vehicles

Physical expansion of numerable resources is inevitable as stated above, however, other efforts are also necessary for the entire use of the resources DCC has now and in future. Figure 5.3-1 shows the contribution of other efforts to expand the capacity to meet the demand.

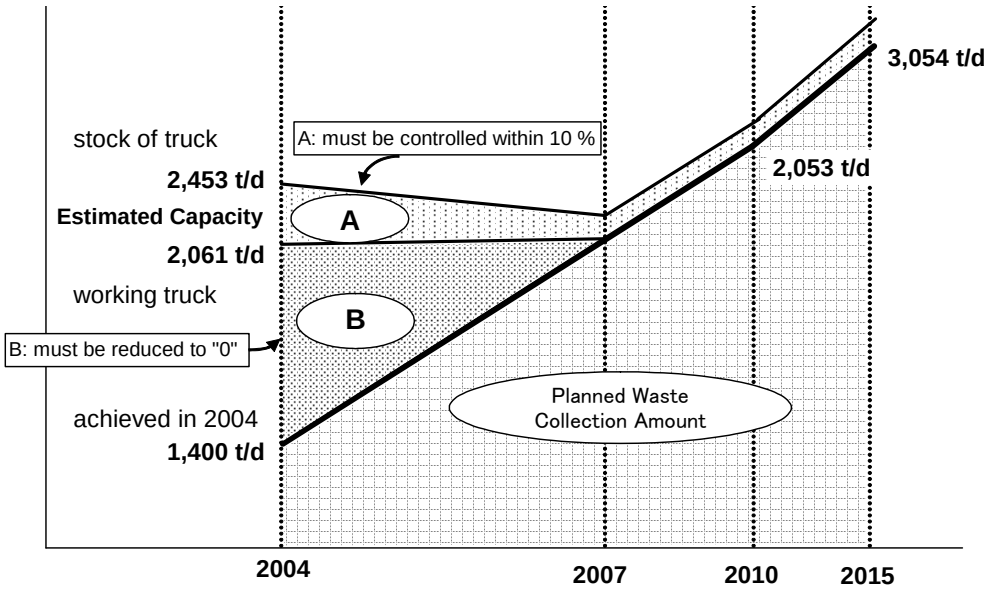


Figure 5.3-1 Managerial Tasks Other than Increase of Input Resources

The basic scope of expanding capacity is to use the existing resource to the utmost extent It must be initiated before purchase of new trucks and equipment. To reduce the idle rate of trucks (part A in the chart), well maintenance like car washing and quicker repair work is the task of management. Though this rate can not be zero, it is recommended to manage within 10 % considering present level of 14 %. It is assumed to improve the rate 1 % per year from 2005 and reach the target in 2010 in the master plan.

ii) Replacement of Aged Trucks and Procurement of New Trucks

The life span of collection and transport truck is more or less 7 years. DCC has not procured new trucks since 1999. The oldest trucks were procured in 1989. Using the aged vehicles will cause increase of frequent breakdown and repair. Replacement of the aged trucks and/or the procurement of new ones in consideration of alternative type(s) will become an important issue in planning.

iii) Expansion of Storage Capacity of Waste Containers

There are 688 units of dustbins and 383 units of waste containers placed over 90 wards. The total storage capacity is estimated at 6,900 m^3, which is equivalent to the waste amount of approximately 1,700 tons. Assuming that all waste generated in a day is stored, the storage capacity of existing receptacles is insufficient and the storage capacity meets only a half of the required capacity for a day. In fact, there are many temporary roadside waste depots presenting ugly scenes in the town. Dustbins shall be phased out following scrapping of the aged vehicles and replaced with the waste containers.

iv) Expansion of Collection and Transport Capacity through Service Providers

Secondary collection and transport services of 8 Wards in Zone 9 and Zone 10 is carried out by five groups of private service providers on contract with DCC. Utilization of the resources of the private service providers will be an alternative for securing or expanding the collection and transportation capacity for DCC. However, the viability of the private sector should be utilized on the condition that the service providers perform the services better than or at least the same level with that of DCC's performance with less cost. In other words, securing the collection and transport capacity by the service providers could be an alternative as their work performance is proved credible through the DCC's control and monitoring.

v) Alternative Way of Vehicle Repair

Repair of vehicles are undertaken under the initiative of Mech. Division 1 and 2 at present, however, the time for repair requires years of duration. This time consuming system diminishes the capacity of collection/transport so that an alternative way is to be identified in the master plan.

b) Development of Capacity of Road/Drain Cleaning

Road wastes including sludge from open ditches are collected together with general municipal waste at present. Settled sludge in open ditches is also collected by drain

cleaners and taken away under the present secondary collection and transport system. The effective use of cleaning workers is a key issue to expand the capacity of road/drain cleaning through the review of existing work method and manpower deployment.

c) Improvement of Environmental Sanitation in Cleaning Work

i) Clearing Scattered Waste around Dustbins and Waste Containers

Scattered waste in the surrounding area of dustbins and containers is commonly observed in town and this problem is a good evidence for the citizen to complain about the cleaning service of DCC. The causes of scattered waste are insufficient storage capacity, infrequency of collection, inappropriate way of the waste generators to discharge waste into container or dustbin, the waste collectors of primary collection service discharge waste onto the road, the waste pickers scattering waste in scavenging for recyclables, etc. Planning issues to the enhancement of supervision and control by DCC through regulations, monitoring, inspection, and community participation shall be adequately discussed and studied in formulation of the plans and programs on this matter.

ii) Protection of Cleaning Workers from Health Risks

The cleaning workers including conservancy inspectors, truck drivers and cleaners are facing health risks through daily cleaning work. Awareness of DCC is a key issue to assist/compensate those people to furnish the appropriate tools, work clothes and outfit to increase efficiency of the daily work and protect themselves from health risks.

d) Capacity Development of Cleaning Workers

i) Giving Street Cleaners Wider Tasks for Cleaning

Street cleaners could be appreciated considerably for cleaning up Dhaka if their functions not only cover sweeping the street but also clearing scattered waste in the surrounding area of dustbins and waste containers. Furthermore, their manpower can be utilized to monitor and instruct the people who scatter waste on the public area and around site of waste receptacles. Most of the street cleaners start working early in the morning or in the night time for 2 to 3 hours in a day. They are idling rest of the time unless the conservancy inspector gives a special collection order. The issues to make effective use of street cleaners will be a sensitive matter but it shall be discussed carefully in the course of formulation of the master plan to improve environmental sanitation in the town.

ii) Raising Awareness of DCC and Cleaning Work Staff for Sanitation and Environment

Raising awareness of all the people involved in cleaning work will be the key issue for planning to provide the better services to improve cleanliness and environmental sanitation in the capital city of Bangladesh. The awareness of individual member for

the roles and assigned tasks as civil servant will be a motivation to maintain the public sanitation and better environment together with the citizens.

5.4 Final Disposal

(1) Objectives

It shall be clearly recognized that solid waste collected and transported to landfill site is simply dumped without covering soil. No leachate collection pipe and gas removal pipe are installed. In this situation, from among a number of planning issues, the most important ones are the following three:

1. To establish future landfill sites;
2. To improve existing landfill site at Matuail
3. To challenge for managed final disposal

(2) Strategies

a) Establishment of Future Land fill Site

i) Ongoing project

It is very important to have sufficient landfill site to establish proper solid waste management system. Future landfill sites of Dhaka City have been planned and will be constructed under "Infrastructure and Environmental Improvement Project of Different Areas of Dhaka City". Project concept and cost are shown in Table 5.4-1. Therefore, close cooperation with above project is necessary to formulate future plan.

Table 5.4-1 Land Acquisition for Dumping Depots and Development

No.	Proposed name of work	Quantity	Cost (million Tk.)
1	Land Acquisition		
	a. Amin Bazar	55 acres	285
	b. Baunia/Matuail	50 acres	235
2	Development Works of Dumping Depots		
	a. Amin Bazar/Badda	L.S.	75
	b. Buania/Matuail	L.S.	55
3.	Construction of mobile steel bridge/Weight Bridge on the waste for the movement of waste truck	L.S.	20
Total			670

Note: (Justification) Everyday Dhaka City Corporation is removing and dumping 1,200 tons of waste from Dhaka City. With the constant increase in the expansion of Dhaka City, the amount of household waste and other wastes is also increasing. Previously Dhaka City Corporation used to dump all the collected waste into the low lands and swamps of the city. At present all the wastes collected from old Dhaka, in west Mohammadpur, Mirpur, in north Gulshan, Banani, and Uttara are being dumped all the way to Matuail, situated east of Dhaka, as there is no dumping place in southwest or north of Dhaka. Due to this reason the waste carrying trucks are wasting a lot of fuel, as they have to travel from one corner of Dhaka City to the other. On the other hand, the trucks are polluting the environment and creating traffic jams in the city. Described on the aforesaid scenario is a proposal to acquire 55 acres of land in Amin Bazar and 50 acres of land in Baunia/Matuail.

ii) Land Acquisition and Environmental Clearance

1. DCC shall submit the following document to Central Land Allocation Committee (CLAC):
    - Approval of LGRD
    - No Objection Certificate from RAJUK, Ministry of Public Works and Housing, Local Authority (Dhaka District) and DOE
2. Central Land Allocation Committee (CLAC), which is chaired by Secretary of Land Ministry, will decide whether the Land will be expropriated or not.
3. CLAC will given an order to District Deputy Commissioner (Chief of Land Acquisition Branch) for expropriation of the land. District Deputy Commissioner will be the Magistrate and also Land collector.
4. Deputy Commissioner and DCC will make Joint Survey for land acquisition
5. Payment and Compensation for landowner will be made through Deputy Commissioner. DCC shall prepare necessary money for the payment
6. Finally, the land will be handed over to DCC

iii) Environmental Clearance Certificate (ECC)

Necessary document and procedure for Environmental Clearance is described in the Environmental Conservation Rules, 1997 for each category of the industrial unit and project. Land filling by solid waste is categorized in the red category. New landfill project is requested to prepare necessary document including No Objection Certificate (NOC) of local Authority, IEE and EIA to obtain Environmental Clearance Certificate (ECC). It is noted that a project to expand workshop for maintenance also required the ECC.

iv) Schedule for land acquisition and construction

Possible schedule for land acquisition and Environmental Clearance is as follows:

a. Completion of IEE	Middle of October 2004
b. Submission and land clearance of DOE	End of 2004
c. EIA and Land Acquisition	End of 2005 (Period of 1 year)
d. Submission of EIA and ECC	March 2006
e. Construction	April 2006 – March 2007
f. Start operation	From April 2007

Operation of Matuail extension and new Amin Bazar site is expected to be started in April 2007. However, it will be necessary to pay more attention and effort to meet the above schedule.

b) Improvement of Existing Landfill Site at Matuail

Proper operation of landfill site is important to reduce environmental pollution. However, no attention was paid to control and/or improve operation of landfill site until now. As present disposal method is simply dumping and spreading of solid waste, introduction of covering soil and compaction of solid waste should be put into the routine of landfill, which will require more number of heavy equipment.

c) Challenge for Managed Final Disposal

As there is no responsible organization to manage and control landfill site, WMD shall take an initiative to improve the landfill. A temporary management organization shall be set up and placed at dumpsite to achieve the objectives.

5.5 Public Involvement

(1) Objectives

It is necessary to establish people's initiative in solid waste management and raise awareness of stakeholders in solid waste management. Those are major components of public involvement. Figure 5.5-1 shows components of public involvement related to waste flow.

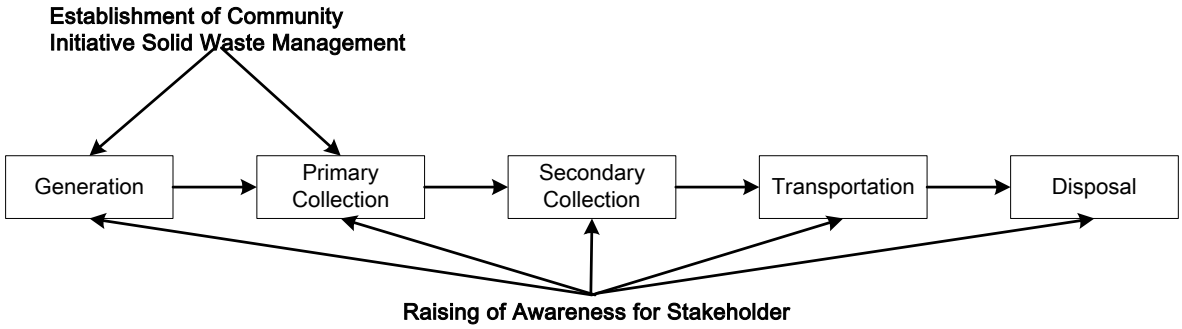


Figure 5.5-1 Sub-Component of Public Involvement

Establishment of community initiative solid waste management is aimed at providing opportunities and places for communities to be actively involved or contribute to solid waste management. Raising awareness for stakeholders aims to promote the understanding of stakeholders and taking actions. The following objectives are set based on the understanding of present problems and issues:

1. To establish socially acceptable and sustainable community initiative in solid waste management
2. To raise awareness of stakeholders

In order to achieve a socially acceptable and sustainable solid waste management, the following strategies should be taken in solid waste management.

(2) Strategies

a) Establishment of Community Initiative Solid Waste Management

In Dhaka City, people are highly depending on the initiative of DCC and primary collection service providers. It is one of the reasons that the mechanism of involving in solid waste management is lacking. Community involvement is another important approach to raise the public awareness. However, most of people and community do not know their roles in solid waste management. Responsibility for solid waste management should be shared among stakeholders, and then, good partnership should be established.

There are 90 wards in Dhaka City with varying characteristics such as high-density areas, named old Dhaka, new urban areas, fringe areas and slum areas. Different wards have different residents, socio-economic conditions, environment, requirement, and management issues. An institutional system to organize communities including men and women and empower the communities for community initiative solid waste management is to be developed. It is called ward solid waste management. The ward solid waste management is based on local situations so that the following are expected:

- more detailed and concrete solid waste management based on local situations can be carried; and
- necessary factors can be included in solid waste management for ensuring social acceptability, sustainability and effectiveness through involvement of people.

The following strategies should be taken in order to establish community initiative solid waste management:

- establishment of partnership among people, community, ward commissioners and DCC; and
- establishment of solid waste management system at ward level.

b) Raising Awareness of Stakeholders

There are social problems such as throwing waste anywhere, discharging waste improperly, not cooperating and disturbing cleaners that are working, inadequate primary collection, inappropriate waste disposal and others. Lack of understanding, knowledge and awareness of DCC's staff members also affects delivery of appropriate and effective solid waste management. It is necessary that each stakeholder understand, cooperate and take actions in order to establish good partnership. The following strategies should be taken to address these issues:

- raising public awareness by suitable methods considering local situations
- educating young generation in order to change their behavior at childhood
- making decision makers and DCC staff members better understand and recognize solid waste management

Targets of raising awareness are people, ward commissioners, DCC's cleaners, drivers and operators of collection vehicles and heavy equipment, administrators and decision makers. It is necessary to promote a sense of pride among DCC's staff members, especially cleaners and ward inspectors.

5.6 Legal Aspect

(1) Objectives

The following objectives are set based on the understanding of present problems and issues:

1. Clear and Equitable Responsibility Allocation between DCC and Waste Generators
2. Compliance to the Existing Laws/Rules

(2) Strategies

a) Clear and Equitable Responsibility Allocation between DCC and Waste Generators

For the discussion of responsibility allocation between DCC and waste generators following are to be focused. To require waste generators to carry out their obligation, it is necessary for DCC to discharge the responsibility of i) below. By-laws or some standards are necessary to define the suitable places.

i) responsibility to install receptacles and appoint places of primary deposit at suitable places

ii) responsibility for proper disposal

iii) responsibility of business and commercial establishments or large waste generators

b) Compliance to the Existing Laws/Rules

Training on Legal Matters to the Staff of DCC

As most staffs of DCC do not know the relevant laws and rules, instruction on the following are necessary:

- DCC Ordinance, generally, and specific parts such as Sections 76 – 78, 88 – 89, and 150 – 153.
- Environmental Conservation Act and Rules and EIA Guidelines
- Preservation Act and Contents of Dhaka Metropolitan Development Plan

Preparation and Implementation of Environmental Management Plan (EMP)

Preparation of EMP and its implementation are necessary and DOE to get Environmental Clearance Certificate for existing dumping sites.

Preparation and Enforcement of Procedure for Punishment of Offenses against the Ordinance

Procedure for the punishment should be drafted following discussions with magistrates and Law Officer as well as with Conservancy Officers and Inspectors.

The procedure should be enforced by Conservancy Dept. in cooperation with Social Mobilization Section.

5.7 Organization

(1) Objectives

The following objectives are set based on the understanding of present problems and issues:

1. Clear Responsibility Allocation within DCC
2. Strengthening Planning/Coordinating/Monitoring/Evaluation Capability
3. Improvement in Operational Organizations
4. Strengthening Capability for Community Solid Waste Management and Public Awareness

(2) Strategies

a) Clear Responsibility Allocation within DCC

DCC drafts the matrix of responsibility allocation to be checked by WMC and submitted to the Mayor for approval. Final responsibility allocation should be distributed to all relevant staff to be used as a basic tool for organizational strengthening.

b) Strengthening Planning/Coordinating/Monitoring/Evaluation Capability

A mechanism to consolidate the annual operation and budget plan of each relevant department/division is to be monitored and feed back given to the JICA Study Team. Establishment of Waste Management Department will also be an issue in future.

c) Improvement in Operational Organizations

Following items are planned:

* *Secondary Collection and Transport*: For meticulous services, Zone Offices are to be enhanced. Decentralization plans are formulated. For efficient use of conservancy vehicles, maintenance functions are to be strengthened. Review of procedure for vehicle repair is to be discussed.

* *Disposal*: To enhance the functions of disposal and compliance to the environmental act/rules, a taskforce is planned to be organized, having its core member in Waste Management Division. Procedure for repair of the heavy equipment is also to be discussed.

d) Strengthening Capability for Community Solid Waste Management and Public Awareness

After establishment of Community Solid Waste Management Section in the Waste Management Division, Zone organizations are to be strengthened.

5.8 Financial Management

(1) Objectives

The following objectives are set based on the understanding of present problems and issues:

1. Enhancing SWM Accounting for Budgeting / Cost Control and Preparation of Annual Reports
2. Financial Planning for Master Plan

(2) Strategies

a) Enhancing SWM Accounting for Budgeting / Cost Control and Preparation of Annual Reports

Actual SWM cost account is not kept properly in DCC as previously mentioned in Chapter 2, section 2.3 (4). In other words, the actual cost is not classified into "department-wise" or "operation-wise" at all.

It is quite in the nature of things that top management and staff customarily put into mind the department- and operation-wise actual cost. Normally the budget preparation as well as the long-term plan formulation is made on the basis of actual cost data. For that purpose, the actual SWM cost must be accounted for and disclosed in every financial year.

Thus, annual actual cost accounting is recognized as a crucial and urgent matter for SWM of DCC. However, as a matter of fact, few computers are currently installed in DCC and almost all data is managed manually, so that actual SWM cost of DCC is hardly computable in time. Accordingly, the simple accounting system for actual SWM cost should be studied and introduced. The results of the costs analysis and budget control should be made known to the public.

b) Financial Planning for Master Plan

It is necessary to raise the following costs for the smooth implementation of Master Plan:

i) Development and Procurement Cost for Master Plan

ii) Operation and Maintenance Cost reflecting the implementation of Master Plan

At present the projects of "New Landfill Site of Amin Bazar" and "Extension of Matuail" have been already budgeted and promoted under the 'Infrastructure and Environmental Improvement Project of Different Areas in Dhaka City' sponsored by Ministry of LGRD that committed Tk. 670 million for land acquisition, development and related investment cost. Accordingly, the rest of funds are studied and planned.

5.9 Privatization

(1) Objectives

The following objectives are set based on the understanding of present problems and issues:

- To pursue a more effective and efficient solid waste collection system with private sector's participation, establishing the best partnership with the public and private sectors

(2) Strategies

The following strategies are formulated to achieve the objectives:

1. To continue an in-depth evaluation by examining terms and conditions of the privatization projects
2. To accumulate know-how to establish better privatization schemes

Chapter 6

Master Plan for Improvement of Solid Waste Management in Dhaka City

6.1 Primary Collection

(1) Establishment of Ward Solid Waste Management System

a) Formation of Local Organization at Ward Level

From legal point of view, primary collection is the responsibility of residents or business entities. It is essential to formulate the orderly manner of waste discharge for every individual resident and business entity in this connection. This is self-evident but, in general, people do not know their responsibility and do not want to take any responsibility in solid waste management. The plan proposes to form a special organization and encourage residents through the movement envisaged by the organization to change their behavior of waste discharge to well-managed primary collection. The stakeholders of primary collection are expected to form a partnership with the others as shown in Figure 6.1-1.

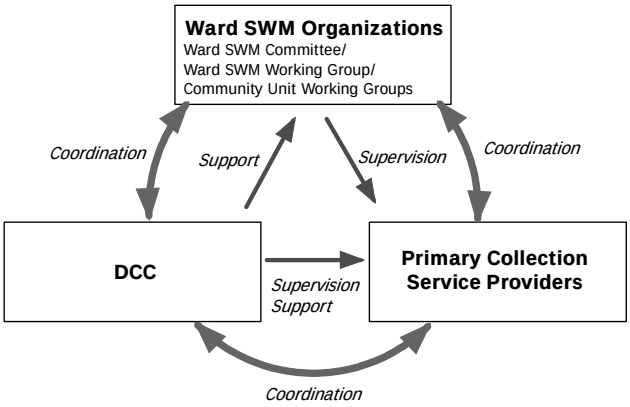


Figure 6.1-1 Partnership of Stakeholders in Primary Collection

It is necessary to involve people and communities in order to share the responsibility of solid waste management and ensure social acceptability and sustainability for solid waste management based on local situations. According to Pilot Project-A, it can be said that the smallest administrative unit in Dhaka is the ward so that a ward can be used as community unit for solid waste management. Based on Pilot Project-A, establishment of Ward Solid Waste Management System is recommended as follows:

b) Structure of Local Organization at Ward Level

The organizational structure of ward solid waste management is shown in Figure 6.1-2. It proposes that the following ward solid waste management organizations be established by DCC ordinance as legal basis:

- Ward Solid Waste Management Committee
- Ward Solid Waste Management Working Group
- Community Unit Working Group

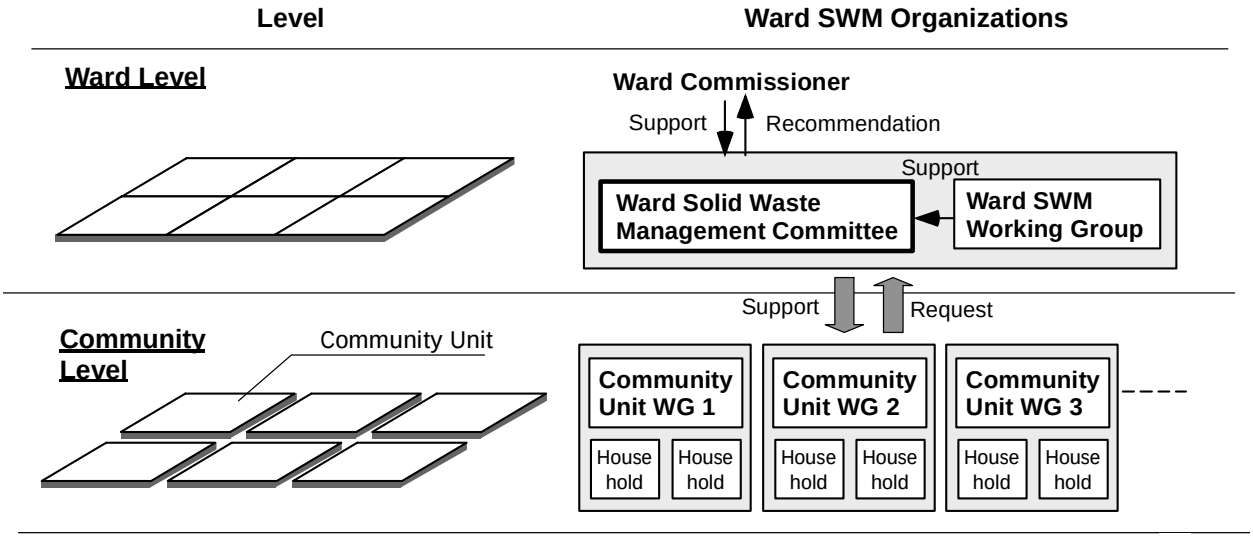


Figure 6.1-2 Structure of Ward Solid Waste Management Organizations

Ward Solid Waste Management Committee and Ward Solid Waste Management Working Group at one ward shall be established by DCC Ordinance. Members of the ward solid waste management organizations will be appointed by ward commissioner. Community Unit Working Groups should be established and authorized by ward commissioner, since the size of ward is too large to manage local solid waste management activities. Delineation of Community Units is based on the existing block system, *Ponchayt*, and other traditional boundaries.

c) Roles of Ward Solid Waste Management Organizations

Proposed roles of ward solid waste management organizations are shown in Table 6.1-1. Ward Solid Waste Management Committee and Ward Solid Waste Management Working Group cover solid waste management in the whole ward. On the other hand, Community Unit Working Groups covers solid waste management within a community unit.

During planning and implementation, Waste Management Division of DCC will coordinate between Zone Office and community side for smooth implementation. For example, if community side will collect waste, DCC will send a collection vehicle at an appropriate time. This kind of collaboration and coordination is required. Level of collaboration and coordination works depends on contents of plan and solid waste management issues.

Proposed roles of Ward Solid Waste Management Committee and Working Group is summarized in Table 6.1-1.

Table 6.1-1 Proposed Roles of Ward Solid Waste Management Organizations

Related Groups	Proposed Members	Roles
Ward Solid Waste Management Committee		
	• Ward key persons • Representative of peoples organization • Representative of private sector	➔ Coordinate ward administration ➔ Decide Ward Solid Waste Management Policy ➔ Establish ward Solid Waste Management plan
Ward Solid Waste Management Working Group		
	• Resident representatives at ward level • Volunteers	➔ Support Ward SWM Committee technically ➔ Prepare Ward Solid Waste Management Plan ➔ Support Community Unit Working Group ➔ Encourage residents for SWM at ward level ➔ Arrange and implement SWM activities with residents
Community Unit Working Group		
	• Resident representatives at community unit • Volunteers	➔ Prepare Community Unit Solid Waste Action Plan based on Ward Solid Waste Management Plan ➔ Implement and monitor Solid Waste Community Unit Action Plan

Source: JICA Study Team

d) Training of Ward Solid Waste Management Organizations

Most residents do not have enough actual knowledge of solid waste so that members of Committee and Working Group should be trained. The objective of training seminar is to build skills for community solid waste management regarding planning, implementation and monitoring.

Curriculum of training seminar includes:

- regulations and ordinance regarding solid waste management
- the existing conditions of Dhaka City
- the existing solid waste management system
- baseline survey methods
- solid waste management plan
- community involvement methods and workshop mechanism

e) Ward Solid Waste Management Planning

Ward Solid Waste Management Planning is one of the important tasks for ward solid waste management organizations. A bottom-up approach will be taken in the planning process of Ward Solid Waste Management, so that ward people will be invited and planning workshops are held by the Committee to be supported by Working Group.

Planning should be based on results of baseline survey and workshops. After planning workshops, Ward Solid Waste Management Plan will be formulated based on results of workshops. The example of Table of Contents on Ward Solid Waste Management is shown below.

Ward Solid Waste Management Plan

Table of Contents

f) Expanding Ward Solid Waste Management System

In 2004 and 2003, Pilot Project has been implemented in two wards. However, there is a total of 90 wards in Dhaka City. Schedule of expanding Ward Solid Waste Management is shown in Table 6.1-2.

Table 6.1-2 Number of Expanding Wards for Solid Waste Management

Year	Expanding Number of Wards
2004	2
2005 - 2007	18
2008 - 2010	30
2011 - 2012	40

Source: JICA Study Team

(2) Development of Primary Collection through Community Based Approach

a) Identification of Community Unit and Establishment of Community Organizations

In Dhaka City, a Ward is the smallest administrative unit and there are almost no area-based organized communities under the Ward with a strong sense of belonging to certain unit of residents in certain areas. However a ward is too large scale to develop/manage appropriate primary collection system as well as to promote people's participation. Community units should be identified as smallest management unit in the Ward Solid Waste Management System in consideration of population density, town structure, land uses, road networks, socio-cultural situation, local/traditional organizations and economic conditions. The existing primary collection coverage is also to be considered to identify community units, to make the effective linkage between service providers and community people. In many cases, covering areas of primary collection are related to the characteristics of local areas. At each community unit, Community Unit Working Group should be established by involving local organizations and key persons.

b) Development and Improvement of Primary Collection System at the Community Level

A suitable and acceptable method of primary collection based on the town structure should be developed at the community level. Coordination at the ward level with DCC Conservancy Department should be made including distribution of DCC containers and waste collection frequency and time.

In order to improve the efficiency of waste collection, not only daily door-to-door collection using rickshaw vans but also the following methods should be considered at the community level.

- closing dustbins
- Using trolleys in narrow roads
- Introduction of community containers in congested areas where rickshaw vans/trolley cannot enter
- Introduction of containers at high buildings/apartments
- Reduction of collection frequency (e.g. every two days)

- Separation of bulky waste
- Differentiation of collection methods/fees for shops/factories

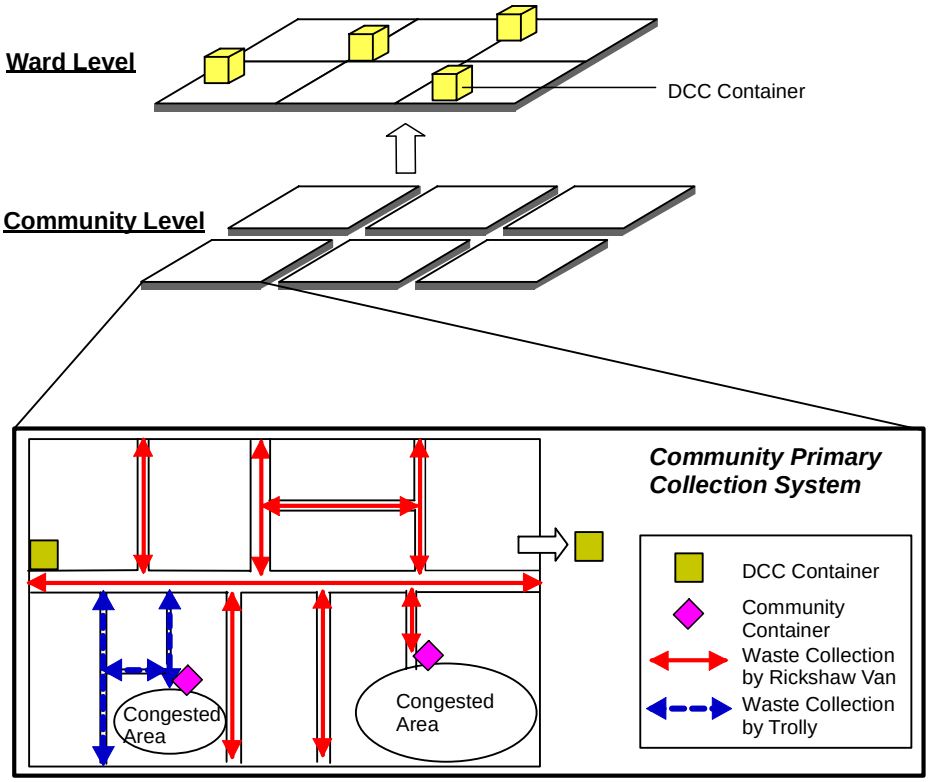


Figure 6.1-3 Community Primary Collection System

Figure 6.1-4 Community Container

c) Applying Participatory Approach on Development and Improvement of Primary Collection System

In order to develop and improve primary collection system at the community level, people's participation is essential. However, it is not easy to fully involve various community people in the activities of solid waste management. Although the approach through the network of Ward Commissioners and local key persons/leaders is effective

in Dhaka City, the top down approach is not always effective to reach out to the various community people such as women who usually manage waste discharge at the households, and poorer people that generally receive lower quality service of both primary collection and secondary collection. In order to develop socially acceptable primary collection system and to operate the activities with full cooperation of community people, bottom up approach with the initiatives of Community Unit Working Groups should be taken.

Community Unit Working Groups in collaboration with primary collection service providers should make the effort to approach to various community people and listen to the people's voices through different local networks.

- Public hearings
- Set up complaints box
- Focus group discussions (womens group, youth group, key persons/leaders group)
- Mapping for system design
    - Analysis of existing situations (Location of illegal dumping, dustbins/containers, service coverage of primary collection, land uses, narrow roads, etc.)
    - Design of primary collection system (types of collection vehicles, distribution of community containers/dustbins, distribution of secondary collection points)
- Monitoring and evaluation using PUA (Participatory Urban Appraisal) tools

Figure 6.1-5 Public Hearing and Mapping at Community Unit for Development and Improvement of Primary Collection System

(3) Establishment of Partnership among Stakeholders

a) Sharing Solid Waste Management with People and Community Organization

In general, people do not know their responsibility and do not want to take a responsibility in solid waste management. Ward Commissioners, who are elected by ward people, are key persons for public involvement in solid waste management in Dhaka City. It is necessary to clarify and recognize roles of people, community organizations and ward commissioners in solid waste management.

The roles of people, community groups and ward commissioner are shown in Table 6.1-3.

Table 6.1-3 Roles of Residents, Community Organization and Ward Commissioner

Residents	
	• to join ward solid waste management • to reduce amount of generated waste at household level • to segregate waste at household • to not throw waste anywhere but to bring it to appropriate places
Community Organization	
	• to organize people in solid waste management • to cooperate in solid waste management • to mobilize people
Ward Commissioners	
	• to organize community groups • to mobilize people • to collect people's opinions and influence DCC administration

Source: JICA Study Team

b) Organizing of Semiannual Solid Waste Management Conference

Rationales

There are various solid waste problems in Dhaka City such as scattered waste thrown by residents, primary collectors, and commercial establishments. In order for stakeholders to have a venue to share problems and come up with solutions, a regular conference for solid waste management should be held at ward level.

Issues to be discussed

Ward Semiannual Solid Waste Management Conference should be held at ward level chaired by Ward Commissioner. Ward Solid Waste Management Committee (see item (2)) is to support Ward Commissioner for organizing the conferences as ward administration office.

The ward solid waste management policy, plans, coordination, problems and solution of the following issues will be discussed:

- primary collection including service level, collection fee, cooperation from residents
- illegal activities regarding solid waste management
- containers management
- promotion of people's awareness
- other solid waste management issues

Participants

Participants to the conference are proposed as shown in Table 6.1-4.

Table 6.1-4 Participants of Ward Solid Waste Management Conference

Chairperson	:	Ward Commissioner
Administration	:	Ward Solid Waste Management Committee
Member of the Conference	:	CCO
		Zone Conservancy Officer, Concordance Inspector
		Primary Collection service providers
		Committee Chairperson
		Representatives of Community groups
		NGOs on Solid Waste Management

Source: JICA Study Team

(4) Strengthening of Function of DCC in Primary Collection and Community Involvement

a) Short Term Action

DCC does not have staff specially working for guiding primary collection activities as well as for promotion of community involvement. A special section (Community Solid Waste Management Section) with full-time staff should be set up in the Waste Management Division under DCC Conservancy Department in order to develop and expand the Ward Solid Waste Management System and support primary collection activities.

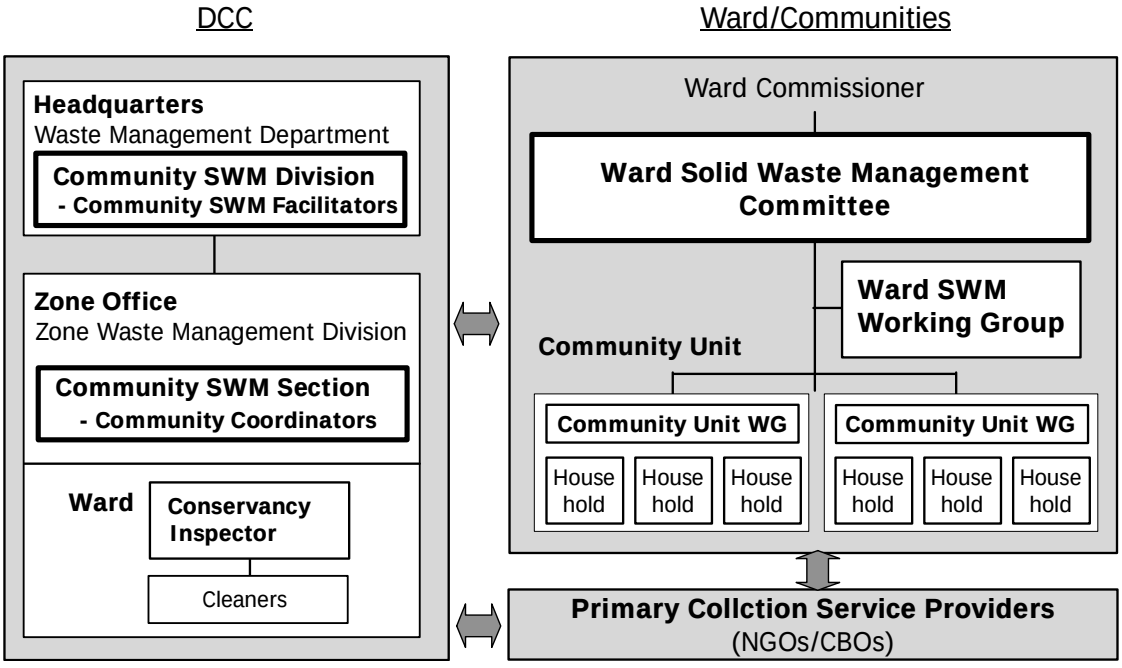


Figure 6.1-6 Structure of Ward Solid Waste Management System and Linkage with DCC

Community Solid Waste Management Section prepares guidelines of Ward Solid Waste Management System, prepares the legal framework for authorizing Ward Solid Waste Management Committees, and supports people to establish the Ward Solid Waste Management System. The section should also work for monitoring of primary

collection activities. The work includes the improvement of the approval and monitoring system and its enforcement, and support of primary collection service providers to enhance their capacity.

Community coordinators should be appointed at Zone offices to facilitate the activities of Ward and community-level solid waste management. The community coordinators closely communicate with people as well as DCC Conservancy Officer and Conservancy Inspectors, and endeavor to understand the local situation and support the activities of primary collection.

The staff of Community Solid Waste Management Section at DCC headquarters and Community Coordinators at the zone offices should exchange technical experiences and work on problem-solving in order to improve the technical knowledge and skills on primary collection and ward/community level solid waste management. In addition, the staff should develop knowledge and skills of participatory planning, monitoring and evaluation as well as communication and listening, understanding of local situations, training for primary collection service providers and members of ward solid waste management organizations, and coordination. Training opportunities should be given to the staff.

Tasks of Community Solid Waste Management Section

1. Expansion of Ward Solid Waste Management System
   - Formulation of guideline and regulation of Ward Solid Waste Management System
   - Support of people for the activities of Ward Solid Waste Management
   - Training for DCC staff regarding Ward Solid Waste Management
   - Monitoring and evaluation of Ward Solid Waste Management System
   - Coordination with DCC Conservancy works to improve solid waste management
2. Awareness Program
   - Implementation of city-wide awareness program
   - Support of awareness program of Ward Solid Waste Management Committee
   - Training for DCC decision makers and staff regarding social consideration and participatory approach
3. Supervision and support of primary collection activities
   - Formulation of guidelines and regulations for primary collection service
   - Approval of primary collection service providers in cooperation with Ward Solid Waste Management Committee
   - Development of suitable and efficient methods of primary collection and linkage with secondary collection
   - Support of primary collection service providers (providing information and training, etc.)

Functions of DCC in primary collection and community involvement mentioned above should be further strengthened according to the phased organisational reform related to SWM (See Section 6.5). Figure 6.1-7 shows the recommendations of short-term and mid-term organizational structure.

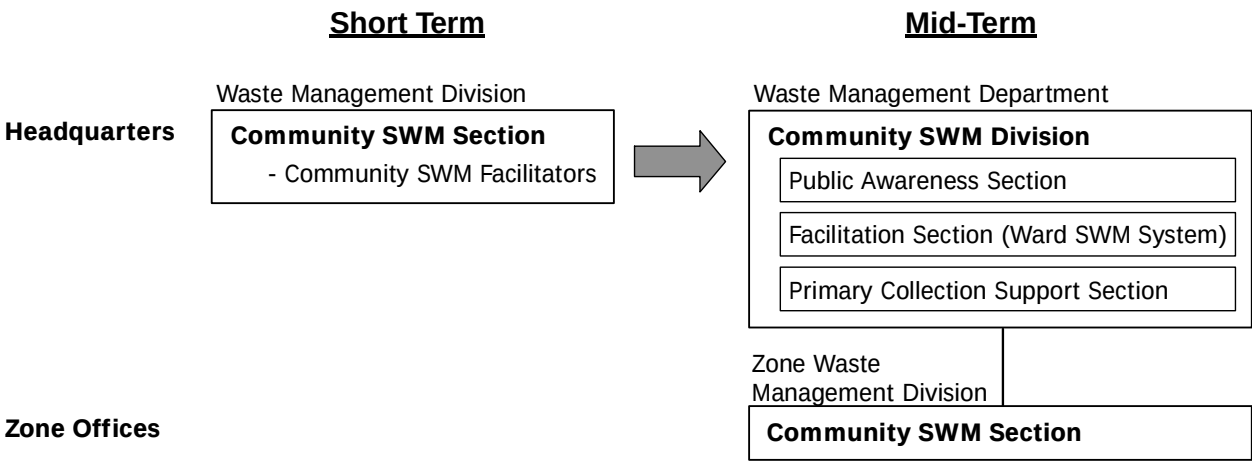


Figure 6.1-7 Proposed Evolution of Competent Section in Community Involvement

(5) Required Coordination by DCC

a) Establishment of Approval System of Primary Collection

Approval Procedure

Figure 6.1-8 shows the recommendation of the approval system of primary collection. It is difficult for DCC to evaluate all primary collection providers, including small scale ones, and give approvals, since DCC cannot appropriately understand local situations and conditions, and acceptability of the organizations at the community level. Therefore, Ward Solid Waste Management Committee evaluates the primary collection providers and gives recommendations to Ward Commissioner; the Ward Commissioner gives endorsement on the primary collection providers to DCC Conservancy Department; and CCO gives approval to the primary collection providers.

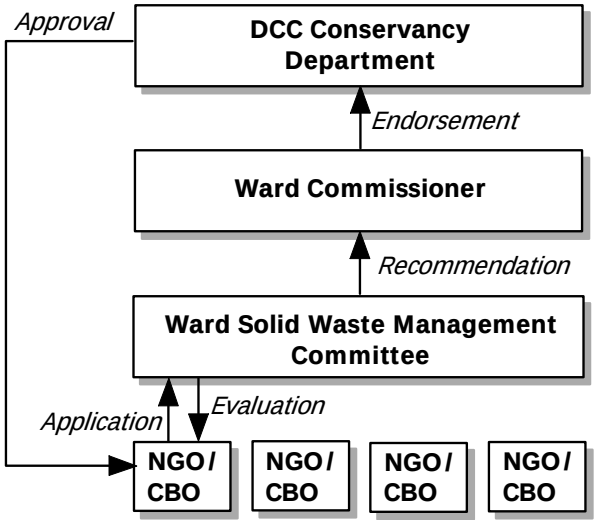


Figure 6.1-8 Approval System of Primary Collection

Identification of primary collection service providers

Inasmuch as many service providers have already been operating primary collection without DCC's approval in Dhaka City, the first step should be the identification of

existing primary collection service providers of each Ward. DCC Community Solid Waste Management Section of Waste Management Division, in collaboration with Ward Solid Waste Management Committee and DCC Conservancy Inspector, should conduct the survey. Figure 6.1-9 shows an example of survey results for identification of primary collection service providers.

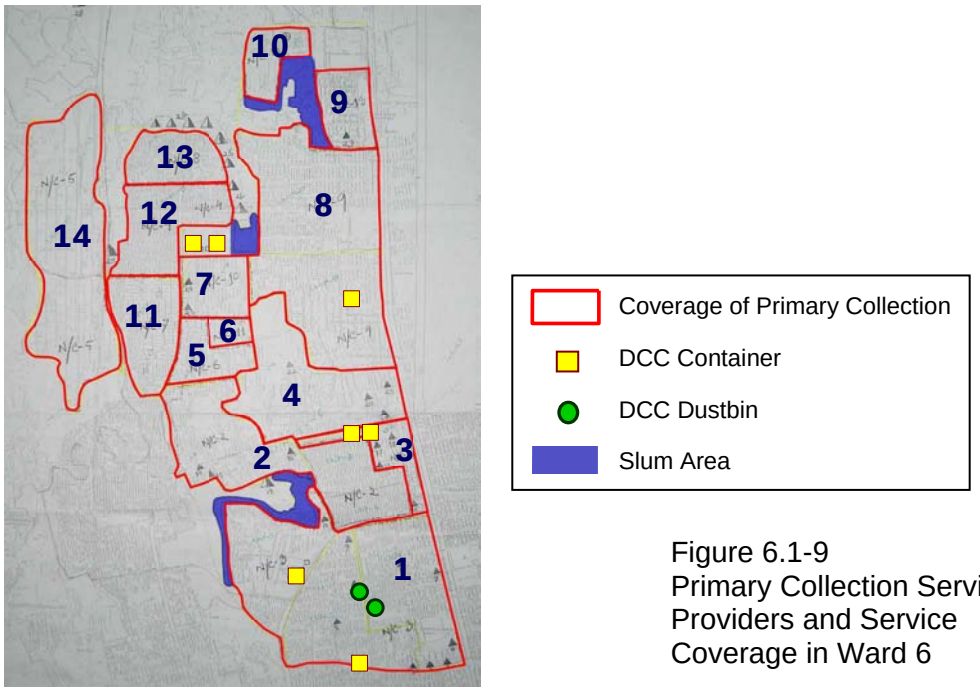


Figure 6.1-9
Primary Collection Service Providers and Service Coverage in Ward 6

Evaluation of primary collection service provider

Ward Solid Waste Management Committee should evaluate primary collection service providers by having an interview with each of them. The evaluation criteria will cover the following:

- Financial capacity
- Management capacity
- Acceptability by community people
- Attitude of cooperating with community people
- Understandings of local conditions

Coordination and agreements should be made among Ward Solid Waste Management Committee, primary collection service providers and DCC, in order to ensure the conditions of primary collection activities. The items to be covered by the agreements are as follows:

i) Among DCC, Primary Collection Service Providers and Ward Solid Waste Management Organization

- Time and frequency of primary waste collection
- Time and frequency of secondary waste collection
- Distribution of secondary collection points (containers)

- Structure of containers and design of rickshaw vans
- Appropriate way and manner of waste transfer from primary collection vehicles to DCC containers
- Roles and responsibility of DCC, primary collection service providers and community people

ii) Among Primary Collection Service Providers and Ward Solid Waste Management Organization

- Method of waste discharge by residents
- Method of waste collection
- Time and frequency of primary waste collection
- Service coverage
- Waste collection fees
- Management of community dustbins/containers

b) Supervision and Monitoring of Primary Collection Activities

Ward Waste Management Committee, Ward Waste Management Working Group and representatives of Community Unit Working Groups should organize regular meetings with primary collection service providers regarding the daily activities of primary collection. DCC Conservancy Inspector and staff of Community Solid Waste Management Section, and Community Coordinators of Zone offices should also participate in the meeting. The problems and solution should be discussed and necessary actions should be made. Community Unit Working Group should supervise the activities at the community level by observing and getting the opinions of community people.

(6) Support of Primary Collection Service Providers

a) Technical Training for Primary Collection Service Providers

DCC should make efforts toward supporting primary collection service providers technically in order for them to improve their capacity and to provide proper and efficient primary collection services in Dhaka City.

Training and manuals should be provided to all primary collection service providers. The contents of the training should cover:

- Ward Solid Waste Management System
- Management of waste collection activities
- Proper management of waste
  - Measures to protect collection workers from health risks and injury
  - Transfer of waste to containers
  - Regulations on illegal dumping

- Design of primary collection system
- Appropriate types of rickshaw van and other collection vehicles/facilities
- Communication with community people

b) Financial Support for Investment for Primary Collection Activities

Most of primary collection service providers are local small-scale organizations. They are usually facing difficulties to invest for further expansion of the activities and cover more households in their service areas because of the lack of funds. As the primary collection is a business-oriented activity, it is difficult for DCC to provide collection equipment/facility free of charge. The possibility of two-step loan through DCC and/or establishment of loan scheme by Bangladeshi NGOs for investment in primary collection should be examined and developed. The information of such loan schemes should be distributed to primary collection service providers.

(7) Technical Development of Primary Collection Methods

DCC should make continuous efforts to develop and improve the primary collection methods considering local conditions, in order to improve the efficiency of solid waste management.

a) Pilot projects to test and develop equipment/facilities for primary waste collection

DCC should examine and develop the methods of primary collection and linkage with secondary collection, in order to improve the efficiency of primary collection.

The highest priority is harmonization of design of rickshaw vans and DCC containers. At present, transfer of waste from rickshaw vans to containers takes time and the waste scatters around containers. DCC should conduct pilot projects to introduce new design of rickshaw vans and containers. Based on the pilot project, users including primary collection service providers and DCC should have discussions to improve the design.

Another priority is to develop primary collection system in congested areas with narrow roads. In such areas, rickshaw vans are not always suitable and even trolleys cannot enter in some areas. In addition, it is difficult to find places to set up sufficient DCC containers. The following should be considered to develop the method of primary collection system in such areas.

- Design of equipment to collect the waste at narrow roads
- Introduction of community containers in congested areas where rickshaw vans/trolleys cannot enter.

b) Technical Conference on Primary Collection and Experience Sharing

The primary collection service providers have actual experience and some of them have ideas to improve the method of waste collection. It is important for DCC to listen to them and understand the actual situations. DCC should organize annual conference inviting primary collection service providers to share their work experiences and problem-solving, and to discuss how to improve the primary collection technically. The experience of pilot projects should be also shared and improvement ideas should be

discussed. The opportunity of sharing experience is also useful for primary collection service providers to develop their technical capacity.

(8) Raising Public Awareness by Suitable Methods Considering Local Situations

It is important that various methods are taken. In order to increase public awareness in Dhaka City, the following should be implemented:

a) Establishment of a Community Solid Waste Management Section in Charge of IEC (Information Education and Communication) Activities

Waste Management Division (WMD) was established in DCC in 2004 in order to manage solid waste of Dhaka City effectively. This division deals with not only technical issues but also social issues. Public awareness is indispensable for social acceptability and sustainability of solid waste management so that IEC activities are a key task of Waste Management Division.

Community Solid Waste Management Section should be established under WMD immediately. Community Solid Waste Management Section should intensively and extensively implement IEC activities with effective production of IEC materials and distribute them to the public, and coordinate events for promotion of people's understanding and changing of awareness and behavior.

Roles of Community Solid Waste Management Section regarding IEC activities are as follows:

- to prepare annual action plan for IEC activities;
- to produce IEC materials such as posters, brochures, leaflets, DVD and others materials;
- to provide necessary information regarding solid waste management policy, plans, and activities through DCC Zonal Offices;
- to dispatch IEC mobile teams to communities, schools and events; and
- to evaluate IEC activities.

b) Various Levels of Communication by Different Media

There are various target groups for raising awareness of solid waste management such as aged and young persons, men and women, of different education and income levels. The message for solid waste management depends on target group. Usage of media also depends on message and target group. Proposed message by media for solid waste management is shown in Table 6.1-5.

Table 6.1-5 Media and Message

Media	Message
Poster	• disseminate slogan of appropriate activities using graphic illustration to everybody
Brochure and Leaflet	• show relations between people's activities and their influence in generation of solid waste and environmental impact by illustration and text to target groups • present manner regarding solid waste to target groups
Newsletter	• provide news, information, policy and activities regarding solid waste management to stakeholders
Newspaper	• disseminate slogan regarding solid waste to everybody • inform activities, news and event to everybody
Radio	• disseminate general message to a wide area

Source: JICA Study Team

c) "Clean Dhaka Ward Contest" to be Held

"Clean Dhaka Ward Contest" will present an award to the best ward(s)—a ward that would have made brilliant success in cleaning and beautifying its hometown. This contest aims to clean Dhaka City through competition among 90 wards.

Participation of wards

The 90 wards in Dhaka City can participate in the Contest.

Establishment of Clean Dhaka Ward Contest Committee

Clean Dhaka Ward Contest Committee will be established by mayor of Dhaka City. The Committee will select the best ward based on the criteria every year.

The Committee shall consist of the following members:

Chairperson	:	Mayor of Dhaka City
Members	:	CEO CCO Ministry of Local Government and Rural Development (LGRD) Ministry of Environment and Forest RAJUK Universities
Secretariat	:	Waste Management Division, DCC

Judging Criteria

The Committee shall score nominated wards according to the following criteria:

- ward that makes an effort and contribute to clean ward such as activities of primary collection, secondary collection points management, promotion of waste reduction, segregation and recycling;

- ward that establishes Ward Solid Waste Management Committee and Ward Solid Waste Management Group, and Ward Solid Waste Management Plan;
- ward that is beautiful and clean; and
- ward that is inhabited by people who are very active for community solid waste management such as cleaning parks, roads and drainage, recycling activities and others.

(9) Education of Young Generation in order to Change their Behavior at Childhood

It is expected that young generation can have raised awareness and adopt appropriate behavior more firmly than adults although it takes time to change the entire society. Therefore, education for young generation should be started immediately. However, education curricula and tools are not enough for teaching solid waste management at present. It is necessary to develop curricula regarding solid waste and educational tools and materials.

a) Development of Curricula Regarding Solid Waste

Solid waste matters cover Environmental subjects. Hours of teaching for solid waste is very short, only a half unit. Matters regarding solid waste should be taught by showing real situations and their relation with other daily activities.

Curricula should cover the following aspects:

- relationship between daily activities and solid waste;
- problems of solid waste management;
- system and process of solid waste management; and
- appropriate manner of people regarding solid waste management
- methods of contribution from people regarding solid waste management

b) Improvement of Ability of Schoolteachers

Most of school teachers are not competent to teach about solid waste, because they do not have proper knowledge of solid waste and have never visited solid waste management facilities. DCC should provide lessons on solid waste management and the opportunity to visit solid waste management facilities.

(10) Raising Awareness of Decision Makers and DCC Staff Members

It is necessary to increase the number of skilled government officers and to improve and develop DCC capability in solid waste management, because DCC staff lacks competence to provide good service and cannot perform to meet expectations. One of the reasons for this problem is that DCC staff is not provided enough on-the job training and off-the-job training. However, technical training of DCC staff is not tackled here. In this section, enlightenment for decision makers and DCC staff members is discussed.

a) Involvement of Decision Makers in Solid Waste Management

In Dhaka, decision makers such as mayor, DCC high ranking officers and ward commissioners have important roles in not only solid waste management but also other administrative tasks. It can be said that the success of solid waste management

depends on how much decision makers are involved. It is indispensable that decision makers understand and recognize issues of solid waste management as a priority for their policymaking.

Waste Management Division should coordinate and implement the following in order to involve decision makers:

Sharing actual information

Solid Waste Management Division of DCC should provide actual situations based on scientific data to decision makers in order to share solid waste management problems and solutions for people. It is good incentive for ward commissioners that their ward will be clean and beautiful, creating a healthier ward for the electorate.

Bangladesh Solid Waste Management Conference

Bangladesh Solid Waste Management Conference will be held every year. This conference aims to provide opportunity of discussion on solid waste management issues, and sharing of possible solutions among cities of Bangladesh. Cities will take turns at providing a meeting place.

The mayors of the following four metropolitan cities shall participate in the Conference:

- Dhaka City;
- Chittagong City;
- Rajshahi City; and
- Khulna City.

The following shall be discussed at the Conference:

- solid waste management problems
- solutions of solid waste management problems
- exchange of technical aspect
- introduction of community based solid waste management

b) Enlightenment of DCC Staff Members

It is essential for DCC staff members to build their technical capability. It is also important for DCC staff to show good attitude as public servant. Therefore, DCC staff should have both technical capability and good attitude as public servant, in order to show good performance. This issue may be addressed in the following manner:

Having self-confidence and pride

DCC should provide improvement opportunity for staff members who are in charge of solid waste management including ward inspector and cleaners. Especially the cleaners, they do not have confidence and pride in their job. Ward inspectors and cleaners contribute to cleaning Dhaka. DCC should undertake the following, and prepare dissemination materials:

- make people understand a cleaner's job
- boost cleaner confidence and pride in their work by letting them know that they are doing a good job and are contributing to clean Dhaka

6.2 Secondary Collection/Transport and Road/Drain Cleaning

(1) Procurement of New Trucks and Waste Containers

a) Recommendable Type of Vehicle

From viewpoints of efficiency and cost-performance, the following principle is recommended for the future composition of collection and transport trucks.

- CC 5 ton to keep the present quantity
- OT 5 ton not to renew
- OT 3 ton not to renew
- OT 1.5 ton to keep the present quantity
- TT 20 ton to keep the present quantity
- CC 3 ton to increase as many as necessary to meet the demand in any year in the planning period

b) Consideration of Aging of Trucks and Containers

Trucks are costly goods but have limited lifetime. In planning future line-up of collection and transport trucks, the following residual ratio is adopted for estimation of service life of every type of trucks.

Table 6.2-1 Adopted Residual Ratio of Trucks by Age

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Rate (%)	100	100	100	100	100	94	86	79	71	64	56	48	41	33	26	0

Containers also undergo deterioration by age. The following residual ratio is adopted.

Table 6.2-2 Residual Ratio of Waste Container by Age

Purchased by 2006	Residual Ratio	Purchased from 2007 on*	Residual Ratio
Initial 3 years	100 %	Initial 4 years	100 %
4th year	66.7 %	5th year	66.7 %
5th year	33.3 %	6th year	33.3 %
6th year and thereafter	0 %	7th year and thereafter	0 %

*Note: Car washing equipment will be installed in 2007 at dump sites so that the service life is expected longer than present by washing container every time unloaded

With this residual ratio, it is assumed that all the existing containers will be exhausted by year 2008.

c) Assumption of Truck Operation

Trucks are assumed to operate with the following frequency of dumping and load.

Table 6.2-3 Assumption of Truck Operation

Type of truck	frequency of dumping per day	load
CC 5 ton	4 trips	80 %
CC 3 ton	4 trips	80 %
OT 5 ton	2 trips	80 %
OT 3 ton	2 trips	80 %
OT 1.5 ton	2 trips	100 %
TT 20 ton	1 trips	100 %

d) Required Collection and Transport Capacity in Future

The following Figure 6.2-1 shows the capacity of the existing vehicles and the required capacity of collection and transport trucks. In the year 2010, the shortage of capacity will become 1,036 t/d even though the existing vehicles collect and transport 1,017 t/d. In the year 2015, all the existing vehicles will fall into disuse while the demand of collection and transport will rise to 3,054 t/d.

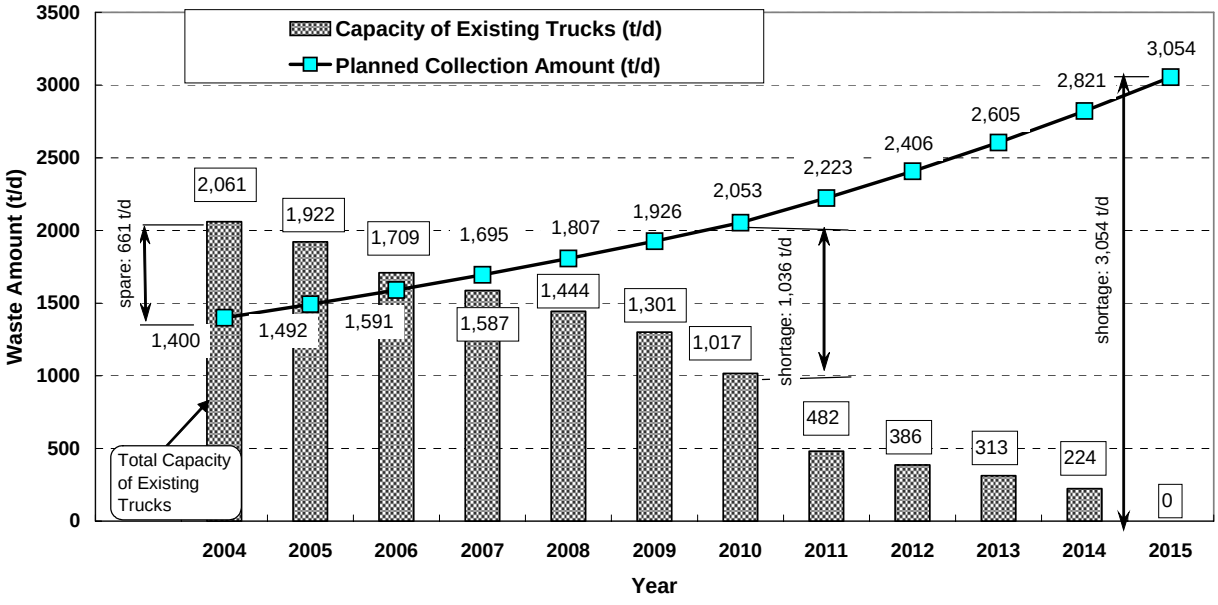


Figure 6.2-1 Required Total Capacity of Trucks in Future (estimated by the Study Team)

e) Procurement Plan of Trucks and Waste Containers

The required number of trucks and containers to be procured is estimated at 411 and 2,161 pieces during the planning period. The procurement plan is summarized in Table 6.2-4.

Table 6.2-4 Procurement Plan of Trucks and Containers

year	OT 1.5 ton	CC 5ton	CC 3 ton	TT 20 ton	12 m3 container	6 m3 container
'05	0	0	0	0	80	166
'06	0	0	0	0	32	0
'07	30	10	17	0	36	203
'08	0	0	0	0	15	0
'09	20	10	54	0	70	255
'10	0	0	0	0	0	30
'11	20	10	88	3	60	216
'12	0	0	0	0	0	63
'13	25	10	117	0	50	613
'14	0	0	0	0	50	75
'15	0	0	0	0	0	147
total	95	40	276	3	393	1,768

Source: JICA Study Team

f) Staffing Plan and Assumed Operation Manner

The required number of drivers and cleaners is estimated under the following conditions by type of trucks.

- CC 5 ton (1 crew consists of 1 driver + 2 cleaners) 2-shift a day
- CC 3 ton (1 crew consists of 1 driver + 2 cleaners) 2-shift a day
- OT 5 ton 1 crew consists of 1 driver + 5 cleaners (truck and special cleaners)
- OT 3 ton 1 crew consists of 1 driver + 4 cleaners (truck and special cleaners)
- OT 1.5 ton 1 crew consists of 1 driver + 3 cleaners (truck and special cleaners)
- TT 20 ton 1 driver for trailer

Two-shift aims at ensuring 4 trips a day to dump site because present achievement of container carrier is 3 trips at most and it needs a special measure to increase the frequency by one more trip. The number of cleaners is set minimum 2 persons in a crew and becomes larger number as the size of truck becomes bigger in order to save time for loading waste. The planned staff for each year is summarized in Table 6.2-5. Drivers need an urgent and drastic increase in number while cleaners as a whole do not need increase until 2008 if only some of truck cleaners or special cleaners are converted to container cleaners. From 2009, DCC needs increase of container cleaners every 4 years.

Table 6.2-5 Summary of Planned Staffing for Collection and Transport

year	driver	cleaner: truck, special & container	Dispatcher (8 zones)
'04	266	964	16
'05	365	964	16
'06	365	964	16
'07	373	964	16
'08	373	964	16
'09	451	1,126	16
'10	451	1,126	16
'11	492	1,126	16
'12	492	1,126	16
'13	694	1,534	16
'14	694	1,534	16
'15	694	1,534	16

As the result of retirement and new input of trucks and containers, the composition will undergo a significant change as shown in Figures 6.2-2 and 6.2-3.

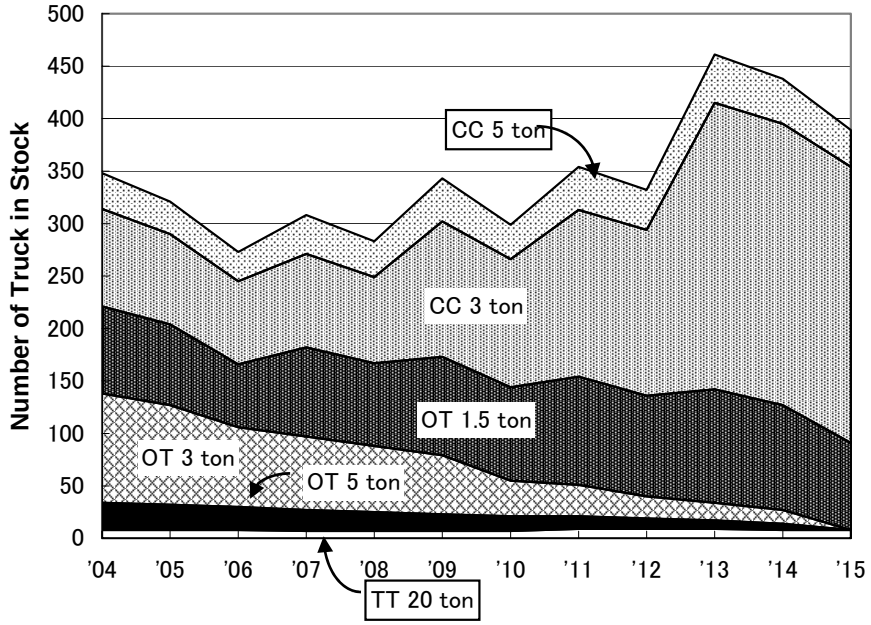


Figure 6.2-2 Change of Truck Type Composition

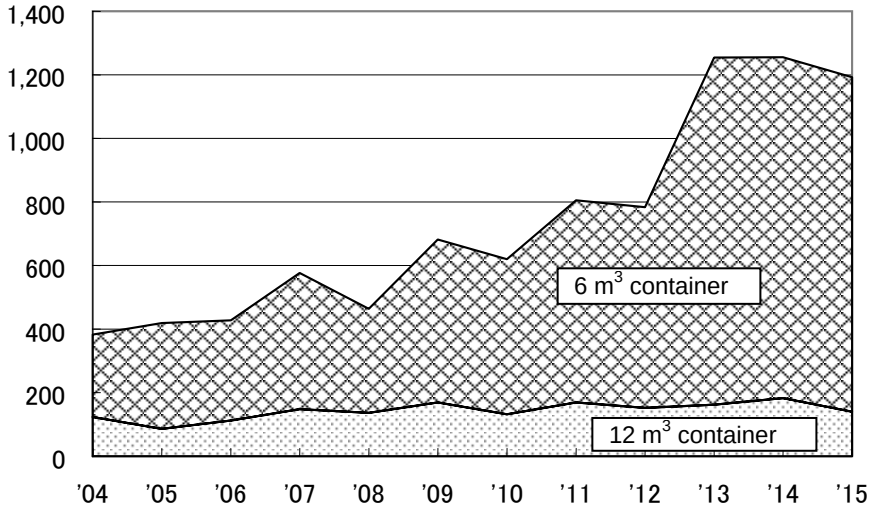


Figure 6.2-3 Change of Container Size Composition

g) Expansion of Collection/Transport Capacity

Considering procurement and staffing, the collection and transport capacity will increase to meet the target waste collection amount as indicated in Figure 6.2-4.

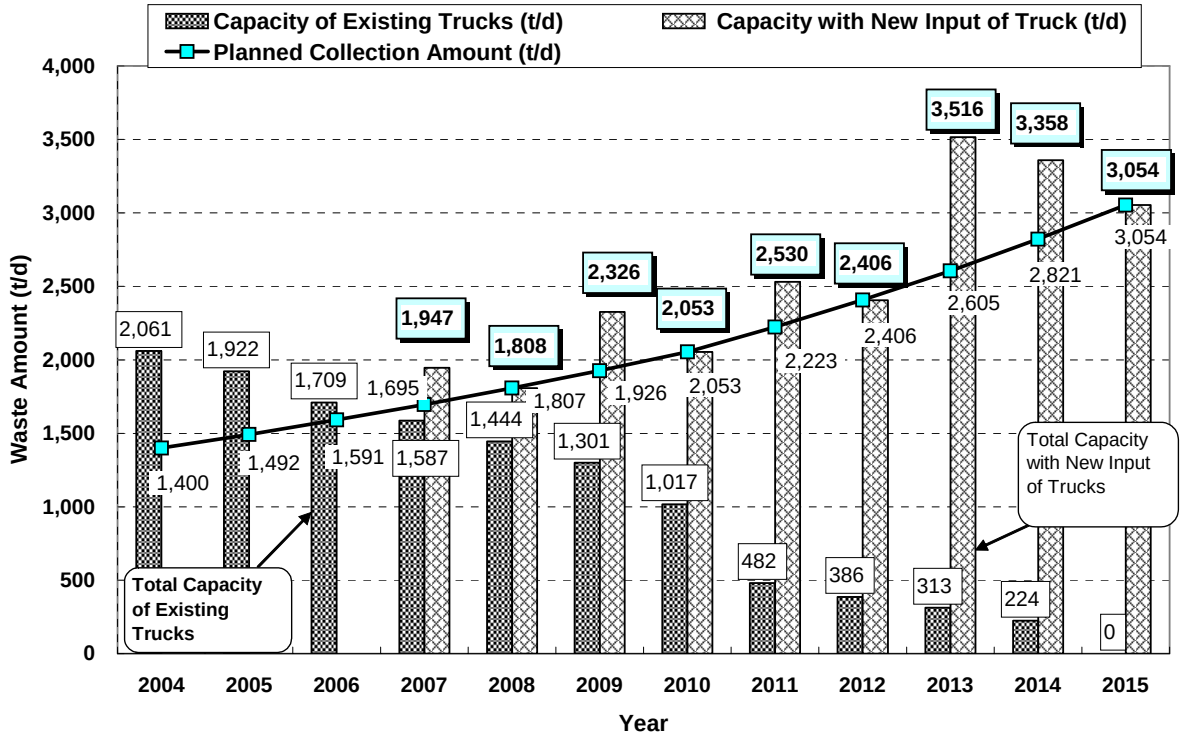


Figure 6.2-4 Total Capacity with New Trucks (estimated by the Study Team)

h) Other Alternatives

i) Procurement of Open Truck and Dump Truck

Collection and transport of waste by the combination of dustbins and open truck was regarded as inappropriate system because of inefficient loading/unloading operation of open truck. However, open trucks or the alternative low bed dump truck may be used to collect bulky waste.

ii) Procurement of Trailer Truck

Trailers are used to collect waste from markets where large amounts of waste are generated everyday. Using the trailer at some markets such as Shaha Ali Market is an effective system and the trailers and trailer truck may be procured and serviced for collection of waste from the large-scale waste generators. Placing plural numbers of 6 m^3 waste containers will be an alternative at the site of large waste generators.

(2) Formation of Management Chain in SWM

a) Structure of Chain of Management

The chain of management consists of two actions in opposite directions: the chain of command and the chain of report as show in Figure 6.2-5. The former is from top officials to those engaged in on-site jobs while the chain of report goes from on-site staff to top officials. Between the top and the on-site staff, managing staff are placed to convey and compile information. The managing staff performs key role of relaying

instructions and reports smoothly along the chain. With this chain of management, the SWM is executed effectively and efficiently.

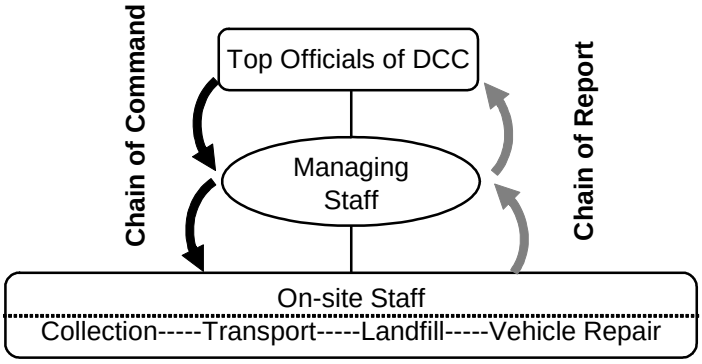


Figure 6.2-5 Structure of Management Chain in SWM

DCC has a well connected chain of command; however, it does not have the opposite direction, the chain of report. To cope with the defect, the pilot project B for Management Information Acquisition (MIA) was initiated under the financial assistance of JICA. Although the pilot project B finished in February 2005, there still remains something to do for formation of the chain of report.

b) What is Lacking for Formation of Chain of Report

As heritage of pilot project B, DCC keeps core equipment for recording management information in the middle of the chain of report. However some more efforts are still needed to get ready for formation of the chain of report. The vital factors yet to achieve are shown in Figure 6.2-6.

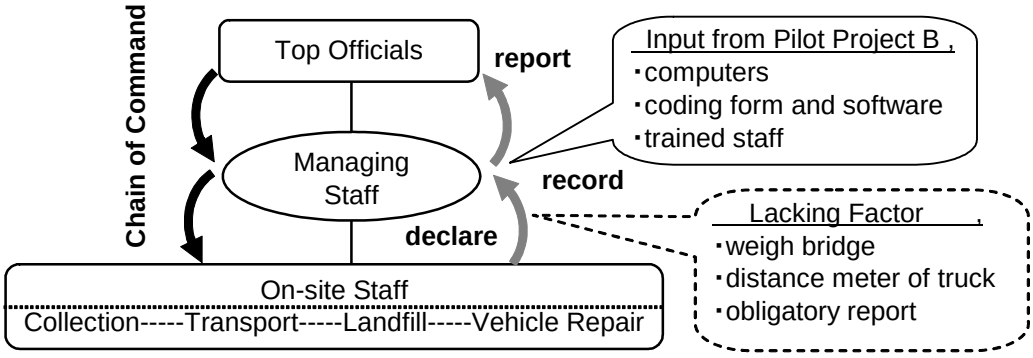


Figure 6.2-6 Lacking factor of Chain of Report

As for weigh bridge, the “portable load checker” used for the pilot project proved unsuitable for such intensive use to receive 300 to 400 trucks a day. It has frequent failure of electric circuit because of impact given by trucks when they run over the sensor of the ”portable load checker”. The master plan assumes use of a fixed type weigh bridge instead. The installation of the weigh bridge is planned to be executed in financial year 2005/2006 as part of the “Improvement of Final Disposal in Matuail”.

As for distance meter of trucks, most of conservancy trucks are not equipped with a distance meter in the cabin. The distance record is an essential data as the basis of rational valuation of fuel consumption so that this function must be recovered. It is

also necessary to maintain the function from the time of purchase. First of all DCC should regard the absence or disorder of distance meter as a kind of failure and make Mechanical Division-1 fix them as a priority. The drivers shall be required to take responsibility for the function of distance meter as well as the vehicle as a whole. This reform will take long time; it seems impossible to recover distance meter for existing trucks and it is easier to secure them from the time of purchase of new trucks in the future.

The remaining factor is the obligatory report from each staff of their performance. Truck drivers only are obliged to report daily using a well-designed form; however, the contents they cover seem questionable. Road and drain cleaners are checked everyday but only by the conservancy inspector. Mechanical Division has no obligation to report either of progress of repair or landfill operation. Moreover they do not have any job description at all.

c) Immediate Action to Form the Chain of Report

DCC is able to start forming the chain of report by determining the job descriptions of relevant sections at anytime from now, except two factors stated above need to wait for the right timing. The authorized job description contributes to giving the basis of better work discipline to all the staff on-site and also to managing staff. It is reasonable to define the obligation of reporting to superiors as part of the job description. The job description should be authorized as the standard for every DCC staff to follow. The standard needs to be established for DCC to acquire the following abilities:

- To adopted safe and effective manner of cleaning
- To evaluate the contribution of individual staff,
- To make maximum use of resources,
- To solve uneven burden of work among staff

d) Coverage of Job Description

In principle all the jobs of the sections which handle waste should have job descriptions. However, it is recommended to start determination of job description with the following two groups considering their larger size of budget allocation.

- Secondary collection/transport job (drivers, truck cleaners, special cleaners, special cleaners, container cleaners, time keepers, inspectors and other on-site management staff)
- Road/drain cleaning (road cleaners, drain cleaners, other cleaners, inspectors and other on-site management staff)

e) Contents of Job Description

Minimum contents of the job descriptions are suggested as follows:

- Name of job
- number of staff in a crew
- chain of command
- tools for the job

- work procedure
- maintenance of tools
- working hours
- report to the superior

f) Preparing Organization

For the determination of cleaning work description, a committee should be established to discuss all the aspects of works by reflecting the interests of concerning staff. WMD should assist secretariat by preparing the draft job description for the discussion by the committee. Figure 6.2-7 shows a tentative structure of the committee that may cover both collection/transport and road/drain cleaning.

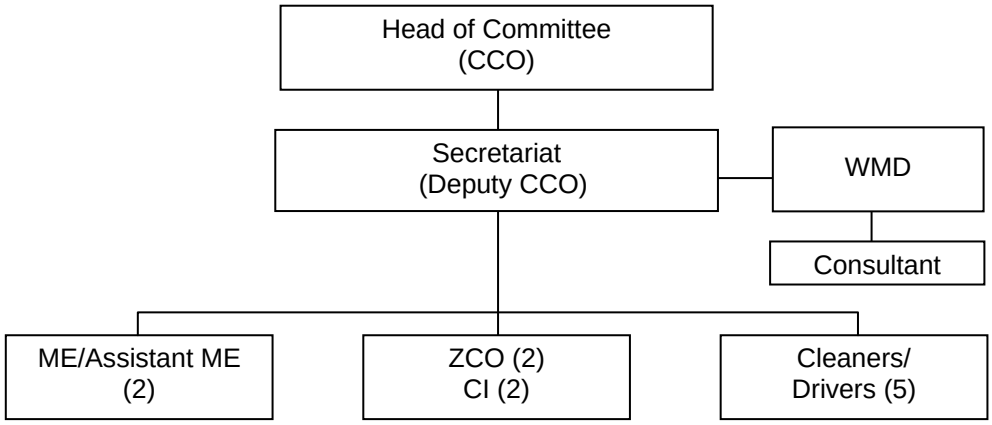


Figure 6.2-7 Organization of Committee for Determination of Job Description

g) Special Findings of Cleaning Work to be Reviewed

- Review of Working Hours of Secondary Collection and Transport

DCC executes 24-hour continuous and non-stop secondary collection throughout the year. This non-stop operation gives the cleaners, drivers and landfill operators a heavy burden and makes it difficult for DCC to manage the operation. It is recommended to limit the opening hours of dump site as the first step to limit the working hours as a whole.

- Adopt 2-shift work for container carrier

Container carriers can remove waste in shorter time than open trucks. To complement shortage of trucks, it is recommended to adopt 2-shift work to the crew of container carriers.

- Reduce Loading Time at Dust Bin or Waste Container

It is recommendable to increase the number of open truck cleaners to 4 to 5 men or more by converting some people from the road cleaners working nearby dustbins. It is also recommendable to allocate 2 cleaners to each container carrier to shorten the time for clean-up the place around the container

h) Process of Job Description Preparation

For the preparation of the draft job description, the following steps should be adopted to make the draft realistic and effective.

- Review of present work procedure
- Review of present manner of supervision and management
- Examination of alternative work procedure on trial
- Examination of alternative manner of supervision on trial

It is recommended to adopt external people as consultants for preparation of the draft to avoid halfway description that may spoil the staff. Finally the committee should conclude the following documents and submit them to the Mayor through Waste Management Committee for authorization.

- "the standard work of road and drain cleaning"
- "the standard work of collection and transport"
- "the standard work of inspection on road and drain cleaning"
- "the standard work of inspection on collection and transport"

(3) Setting up Operation and Management Plan

a) Improvement of Waste Container

Waste containers now in use are inconvenient for primary collectors with rickshaw-van to put waste into. The inlet is at the top of box, which is higher than 1 m from the ground surface and twice as high as the floor height of rickshaw-van. The container exercises remarkable efficienct once it is filled with waste; however, filling it requires tough work. Tough work for filling tends to cause the scattering of waste, which imposes additional work on container carrier in turn or makes the place dirty after container is taken away. DCC cannot change the basic structure of container to fit the large number of carriers; however, it may be possible to make some modification of the existing ready-made design. This action must be started as early as possible. If the results of the effort proves completely negative, it will be a sign of the need for fundamental change of the container and carrier system.

b) Phase-out of Dustbins and Appropriate Setup of Waste Containers

Collection and transport plan proposes the gradual shifting of main collection vehicles from open trucks to container carriers in consideration of the higher collection and transport efficiency of the container carrier as 4 times that of the open trucks. Dustbins collected by open truck shall be replaced by 6 m^3 containers accordingly. As to the increase of collection rate of waste, the storage capacity of receptacles of waste shall be increased by placing 6 m^3 waste containers accordingly.

c) Development of Geographic Information Systems (GIS) for SWM

Managerial staff of DCC engaged in solid waste management needs to refer to the GIS to have area-wise information that enables them to monitor performance for longer-term decisions to carry out their responsibilities.

WMD shall have the responsibility to maintain the GIS assisted by Urban Planning Department, where Ward GIS maps are being prepared. The team members for GIS

shall be recruited from the Department concerned and from the private sector to form effective database systems for SWM.

The basic data of existing facilities/equipment for SWM have been basically installed in the GIS prepared by the Study Team. Further development and updating are assumed to be handled by WMD for the indicators listed below.

- Service area map, service frequency, shift work by Ward
- Location map of dustbins and waste containers
- Waste generation amount and per capita generation rate by Ward/Zone
- Collection quantity by Ward/Zone, per truck type
- Rate of vehicle utilization by Zone
- Average number of trips made by vehicles by Ward/Zone
- Numbers of incoming vehicles at disposal site and quantity of waste per truck and per disposal site including the vehicles of private service providers and other incoming vehicles to the disposal sites
- Operation logbook of vehicles including time-in/time-out, check of vehicles at start/finish, washing of vehicles and waste containers at disposal sites
- Working hours of vehicles and landfill machines
- Repair records of vehicles and landfill machines
- Annual inventory of vehicles and landfill machines
- Results of environmental monitoring, e.g. leachate quality
- Number of complaints from citizens by Ward/Zone

d) Introduction of Mechanized Cleaning Equipment

The 3rd Waste Management Committee suggested that the following mechanized cleaning equipment should be provided during the master plan period. The total cost estimate was stated as Tk. 2,310 million in the meeting.

- Mechanical road sweeper 60 units
- De-sludging trucks/equipment 60 units
- Drain sweeper 60 units
- Water sprinkler 20 units

Necessity and rationality of this equipment had never been discussed in the study nor stated in the comment. Therefore it is recommended that DCC should further define this matter by conducting feasibility studies by itself.

e) Surface Drain Construction

The 3rd Waste Management Committee also suggested that the surface drain construction should be included in the projects/programs of the master plan. The total cost estimate was stated as Tk. 500 million; however, the necessity and rationality of this construction had never been discussed in the study nor referred to the relation with the solid waste management in the comment. Therefore it is recommended that DCC

should further discuss this matter in the course of setting up annual implementation plan for the annual budget acquisition.

f) Shortening Time for Vehicle Repair

It is required to review the current processes of repair order to accelerate the approval of each section. The following measures need to be examined by DCC for shortening the contract procedure.

- to skip some sections in the procedure, if possible,
- to call the bids for repair at least every month,

In case the above mentioned measures are unable to be considered, it is recommended that truck operation should be contracted out to private firms including repair and maintenance of trucks. It is reasonable to set a longer contract period because a long lasting contract alone allows contractors to invest in special trucks and equipment which are required to serve for SWM. This recommendation covers both trucks for transport and heavy vehicles for landfill.

(4) Capacity Development of Cleaners and Drivers

Capacity development of the staff, not only collection and transport staff but also all the staff engaged in SWM services, shall be carried out based on the authorized job description.

a) Training Programs

All staff members are required to have specific and periodic training for the purpose to perform better quality public services of SWM for maintaining cleanliness and sanitation and conserving the environment. The following are the training courses necessary to develop human resources to acquire the capable staff for collection and transport staff:

- Standards and criteria for the field work
- Public sanitation to avoid health risks
- Individual performance for accomplishing the tasks

The training programs, subjects of the training courses, text and the trainers shall be prepared by WMD.

b) Human Resource Management

Training plan and execution shall be recorded for all the workers. In addition the following action should be taken into consideration:

- annual appraisal of performance of each worker against the agreed objectives or targets;
- improving morale and motivation as the civil servants through encouragement and motivation to the staff; and
- rewarding good proposal for improving work procedure or tools, for example, bonus and/or linking promotion.

(5) Mitigation of Health Risks to Cleaners/Drivers

Measures shall be taken to address the following issues for the sake of protecting the cleaners from health risks and injury:

- preventing cleaners from getting injured during daily cleaning work,
- preventing cleaners from getting hit by vehicles during daily cleaning work,
- raising awareness for sanitation,
- supplying the appropriate tools and working clothes & outfits periodically, and
- assisting/compensating cleaners that contracted occupational disease.

Periodical and on-demand supply of the appropriate tools, working clothes and outfits of the following items will be helpful for the cleaners to lessen encountering the health risks.

- Tools for individual truck cleaner including rake, hoe and basket,
- Tools for each open truck including hoe, scoop and broom
- Consumables for individual truck cleaner including long boots, gloves, working clothes, mask, and soaps.

Assistance and/or compensation of the cleaners who have suffered injury during working hours and occupational injury shall be discussed for the conservancy workers.

(6) Pursuit of Privatization of Collection and Transport

A pilot project of private contract to cover entire cleaning work is still going on in two Zones. As the time duration so far executed is less than 2 years, it is still necessary to continue the project for accumulation of information on performance to be evaluated. DCC should wrap up the results of the projects at due time for the future decision on privatization.

(7) Coordination with Recycle Industry

a) Coexistence with Recycle Industry along Waste Stream

DCC should open a channel to recycle industry for having periodical dialogue with them. It is assumed that a charge will be imposed on WMD for the moment and Planning Division of Waste Management Department in the future. The topics of major concern with SWM are:

- time sharing between secondary collection and recycle activity
- work sharing in cleaning the place of DCC container/dustbin after recycling

b) Coordination with Compost Makers

DCC should disclose information to those entrepreneurs interested in compost business in view of material supply and coordination among compost maker and special waste generators like food markets and restaurants.

c) Provision of Information to Waste Pickers on Vocational Health

DCC should give information on vocational health and safety to waste pickers who are working in the same place as DCC cleaners and landfill operators. As part of the

preparation of this capacity building program, DCC should encourage them to form organization that may keep contact with DCC for cooperation.

6.3 Final Disposal

(1) Three-step improvement of disposal sites

DCC is using three dumping sites (Matuail, Berri Band and Uttara) in the manner of open dumping without covering soil. It is crucial that Berri Band and Uttara are used without Environmental Clearance Certificate (ECC) that is enforced by Environmental Conservation Rule of 1997. Even for Matuail, it will become necessary to obtain the ECC because it will be continuously used as dumpsite from now on.

Solid waste in the landfill site shall be covered by soil under an appropriate landfill operation and management plan. The Study Team recommends soil covering with the substitute material (aged solid waste in the dumpsite) and leachate control, with retaining pond and forced circulation system as the initial practice of sanitary landfill. To execute the sanitary landfill, a new organization for landfill management, heavy equipment and special training will be indispensable.

New landfill sites shall be secured to continue final disposal until year 2015. It is recommended that Berri Band and Uttara dumpsites be closed with proper post-closure work such as surrounding bank and covering soil when new landfill site comes into operation. Afterward, all final disposal shall be upgraded through the following three steps. The concept is described in Figure 6.3-1.

a. To make Matuail dumpsite into a model of sanitary landfill through improvement of landfill facilities and operation
b. To secure and construct new landfill sites to dispose of solid waste until 2015.
c. Berri Band and Uttara dumpsites shall be closed after new landfill sites are opened. Safety measures shall be done to reduce environmental pollution.

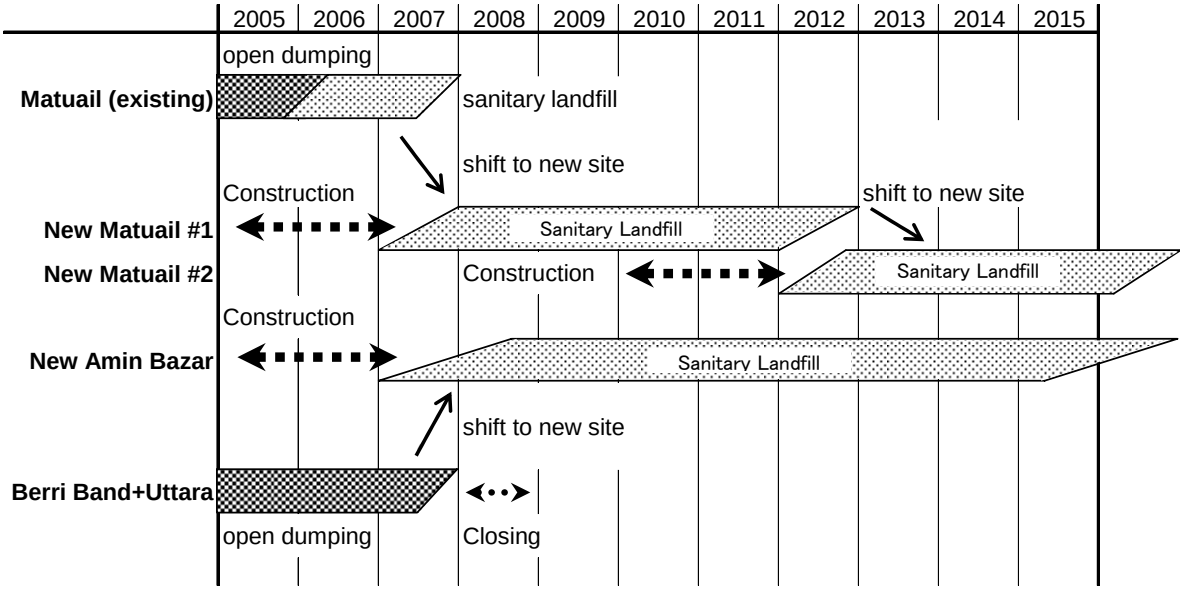


Figure 6.3-1 Concept of Step-wise Landfill Improvement

(2) Improvement of Matuail Dump Site

a) Basic idea

Matuail is only official landfill site of Dhaka and it is planned to use it continuously. Therefore, the first step of improvement shall be the establishment of a model of sanitary landfill at Matuail and every other place of final disposal in future. The model shall have the following facilities, function and improved operation, which reduces environmental pollution.

- Surrounding embankment to resist flood and to secure boundary
- Control of incoming waste at entrance with weighing and interviewing
- Periodical covering soil (material: debris and/or old waste in the site)
- Leachate retention with aeration & re-circulation
- Drainage system to reduce leachate amount
- Gas removal system
- Management organization & building

It is noted that the subsurface of the site is covered with 8-12 meter clay layer. This clay layer is expected to be a natural liner of landfill site to prevent groundwater pollution.

b) Disposal of waste

Matuail site is planned to be divided into two parts: the western part and the eastern part. Western part will be 4 ha and used as a multi-purpose facilities site with installed control facilities and leachate pond. Eastern part will be 16 ha and used for solid waste disposal. Eastern part will be filled up to 27 m high (20 m high from surrounding bank). Slope is formed on average at 1:4 on the enclosing surface. Capacity of site is 1.1 million m^3 that will be used more than 2 years.

c) Covering soil

Solid waste shall be covered every 3 meters in height of waste layer with thickness 0.3-0.5 meters of soil. As soil is costly material in Dhaka, construction debris and/or old waste could be used instead of soil. Since additional heavy equipment will be required to conduct covering soil, it is desirable to contract out the work of soil covering including rental of heavy equipment.

d) Leachate collection and drainage

Leachate collection system is to be installed based on the following principles:

- Leachate collection pipe is installed on the filled western layer of east part.
- Leachate pond is constructed in the west part and leachate is collected to the pond. Aeration and re-circulation are used for first step of treatment.
- Leachate collection well and drainage ditch are installed along the surrounding bank.

It is noted that leachate will not be discharged outside the site in dry season while it is discharged in rainy season after simple treatment. Reduction of leachate amount through provision of drainage system is important to reduce water pollution in rainy season.

d) Arrangement of Facilities Site

Western part is allocated to facilities site with leveling of filled waste and soil covering. Rainwater drainage shall be installed along the surrounding embankment and road.

Control facilities and leachate pond will be constructed using a part of this site. Remaining part will still have enough size to place some kinds of pilot plants or temporary storage of recovered material collected by waste pickers.

e) Arrangement of Landfill Area

Eastern part is used as long as 2005 or 2006 and for some more months. This part shall be the model area of sanitary landfill. As the waste layer goes higher, the surrounding bank will be formed outside covered with soil. Surrounding drainage and internal leachate collection pipe and gas removal pipe shall be installed. Working road shall be constructed in the operation. Construction debris and/or crushed stone will be a common material used for working road.

f) Control Facilities

Administration building, truck scale and car wash facility are to be installed at the entrance of landfill site. Solid waste transported to this site shall be checked and measured at the entrance. Administration building will be prepared to manage landfill operation.

(3) Securing Future Landfill Sites

a) Disposed Amount

From 2005 to 2015, a total of 9.3 million tons of solid waste will be disposed of. As the existing site of Matuail has a remaining capacity of 1.1 million tons, it will serve for almost two more years until the end of 2006. DCC has a plan to expand Matuail landfill site and construct Amin Bazar landfill site by year 2007. Another extension of Matuail landfill site will be necessary again to meet the demand of disposal until 2015. Capacity of each site and extension is planned as shown in Table 6.3-1

Table 6.3-1 Required Landfill Site until Year 2015

Landfill site	Location of disposal (year to be used)	Disposal amount (Capacity)
Matuail	Existing (2005,2006)	1.1 million tons
	Extension (2007-2012)	3.1 million tons
	Further extension (2013- - - - -)	(3.1 million tons)
Amin Bazar	New establishment (2007- - - - -)	(3.1 million tons)
Berri Band	Existing (2005,2006)	0.5 million tons

Source: estimated by the study team

b) Expansion of Matuail Landfill Site

i) Area of expansion : 20 ha

ii) Landfill method

Sanitary landfill shall adopt experience obtained in improvement of landfill operation at existing site and foreign practice. This part will be used from year 2007.

iii) Schedule of Landfill

Capacity of expanded area will be 3.1 million tons composed of lower part (0.9 million tons) and upper part (2.2 million tons). Lower part will be filled in 2 years and upper part will be filled in 4 years. Therefore, further extension will be necessary for the use since year 2013 as shown in Figure 6.3-2.

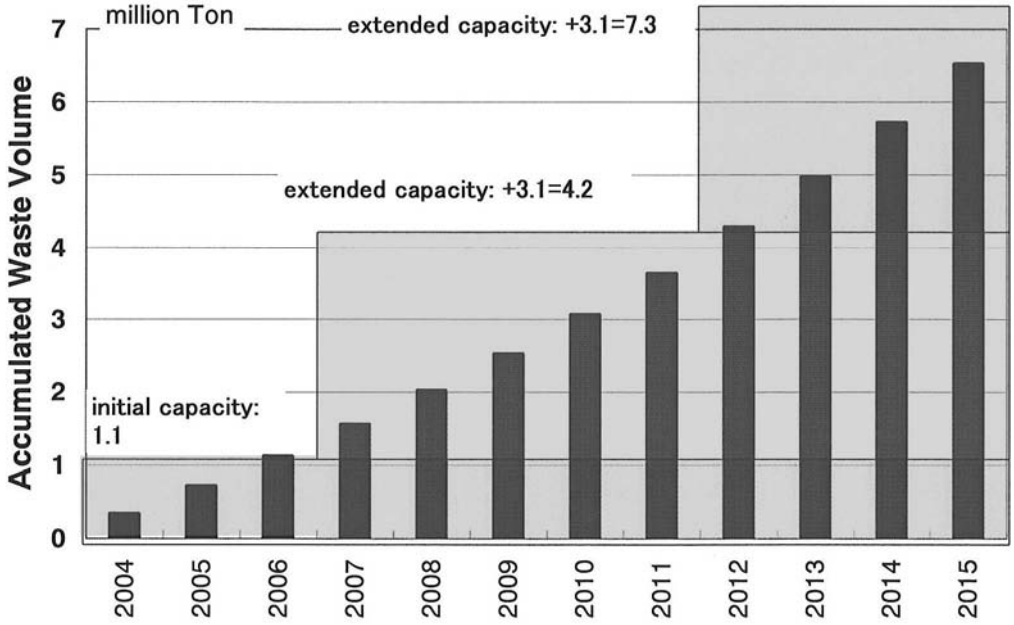


Figure 6.3-2 Time Schedule for Matuail Expansion

iv) Leachate Collection and Drainage

To reduce leachate amount during disposal of lower part, the area shall be divided into 4 blocks. Leachate collection pipe is installed at the foot of surrounding bank and section bank. Leachate pond is constructed and aeration and re-circulation is used as first step of treatment. Rainwater drainage is constructed along surrounding bank after lower part is filled up.

v) Facilities to be Constructed

Facilities to be installed at Matuail landfill site are shown in Table 6.3-2

Table 6.3-2 Facilities of Matuail Extension

Facilities	Quantity	Remark
Embankment	1,500 m	width of 10 m
Block embankment	800 m	width of 5 m
Leachate collection pipe	3,100 m	diameter of 400 mm
Leachate pond	1 lot	with aerator and re-circulation pump
Floodlight	76 unit	for night shift operation

Source: JICA Study Team

c) Further Extension of Matuail

Assuming that the further extension is 20 more ha, and that the additional capacity is 3.1 million tons, it can be used for 5 more years. As final disposal shall be continued even after 2015, DCC shall make the efforts to secure new landfill site also in the north of DCC considering the trend of rapid urbanization in this part of the city.

d) Amin Bazar landfill site

Amin Bazar site will be constructed with same idea used at Matuail landfill site. Sanitary landfill shall be applied to prevent environmental pollution.

i) Area : 20 ha

ii) Landfill method

Sanitary landfill shall adopt experience obtained in improvement of landfill operation at existing site and foreign practice.

iii) Schedule of landfill

This part will be used from year 2007 as shown in Figure 6.3-3. Capacity of expanded area will be 3.1 million tons composed of lower part (0.9 million tons) and upper part (2.2 million tons). Lower part will be filled in 4 years and use of upper part will be until year 2018.

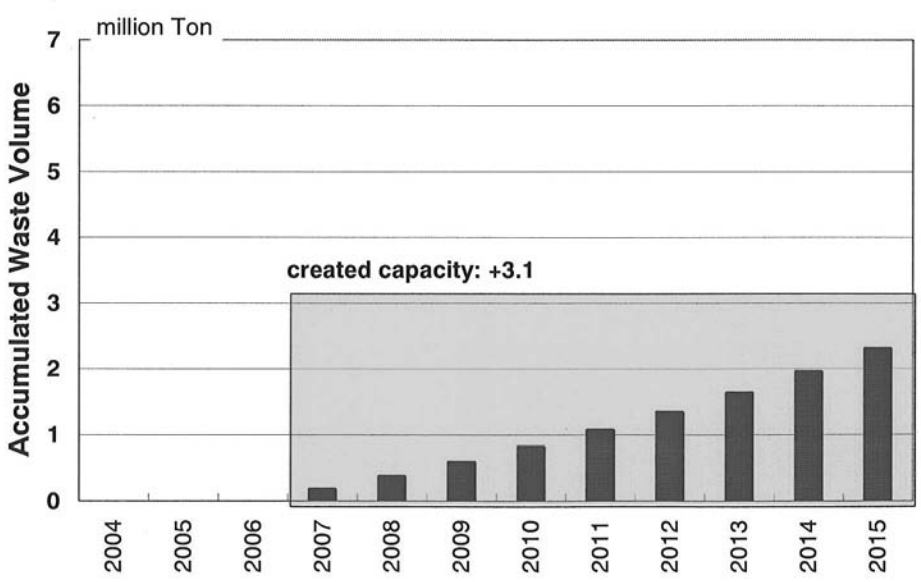


Figure 6.3-3 Time Schedule for Disposal at Amin Bazar

iv) Leachate collection and drainage

To reduce leachate amount during disposal of lower part, the area shall be divided into 4 blocks. Leachate collection pipe is installed at the foot of surrounding bank and section bank. Leachate pond is constructed and aeration and re-circulation is used as first step of treatment. Rainwater drainage is constructed along surrounding bank after lower part is filled up.

v) Facilities to be constructed

Facilities to be installed at Amin Bazar landfill site are shown in Table 6.3-3

Table 6.3-3 Facilities of Amin Bazar Landfill Site

Facilities	Quantity	Remark
Access road	355 m	width of 10 m
Embankment	2,000 m	width of 10 m
Block embankment	890 m	width of 5 m
Leachate collection pipe	3,510 m	diameter of 400 mm
Leachate pond	1 lot	with aerator and re-circulation pump
Floodlight	119 unit	for night shift operation
Control & administration building	1 unit	10 m x 20 m
Truck scale	2 unit	
Carwash	1 unit	with water supply

(4) Closure of Berri Band Dump Site

After construction of Amin Bazar landfill site, Berri Band and other temporary landfill sites shall be closed to quit illegal dumping. When Berri Band dumpsite is closed, embankment shall be constructed on the riverside and covering soil shall be placed to reduce environmental pollution.

(5) Establishment of Management Organization for Final Disposal

a) Temporary Organization

A temporary management organization shall be set up as a special task force of landfill operation. The staff should be basically assigned from those are now engaged in landfill operation, for example, staff of Conservancy Department and operators of Mechanical Division 2. The necessary staff is assumed as shown in Table 6.3-4.

Table 6.3-4 Necessary Manpower of Taskforce at Matuail Landfill Site

Name	Role	Required number
Chief (Site manager)	Site manager (Engineer)	1 person
Assistant staff to manager	Give assistance to site manager (technician)	2 shifts x 1 person
Maintenance staff	Mechanical technician (Temporary)	1 person
Reception and control staff	Measurement of weight and check of waste	2 shifts x 2 persons
Dumping platform instructor	Instruction to trucks	2 platforms x 2 shifts x 2 persons
Heavy equipment operator	Operator	2 shifts x 10 persons
Guard	entrance control	3 shifts x 2 persons

b) Permanent Organization

Management organization shall be established for daily operation and preparation of future landfill site. Task force to improve Matuail landfill site shall be developed to the permanent organization of two future landfill sites. To coordinate with external stakeholders on final disposal, a division in charge of final disposal shall be appointed in Waste Management Department. A certain part of landfill work such as covering soil can be contracted out for the convenience of acquiring heavy equipment such as bulldozer, excavator and dump truck for the work. The required staff are listed in Table 6.3-5 and the structure of the organizations is shown in Figure 6.3-4.

Table 6.3-5 Required Staffs for Management of Final Disposal

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Division chief				1	1	1	1	1	1	1	1	1
Matuail												
Site manager		1	1	1	1	1	1	1	1	1	1	1
Assistant manager		1	2	2	2	2	2	2	2	2	2	2
Maintenance		1	1	1	1	1	1	1	1	1	1	1
Reception		4	4	4	4	4	4	4	4	4	4	4
Dumping platform		4	9	9	10	11	11	12	13	14	15	17
Operator	13	10	19	20	21	23	24	26	28	30	32	34
Gurde		6	6	6	6	6	6	6	6	6	6	6
subtotal	13	27	42	44	45	47	49	52	55	58	61	65
Berri Band or Amin Bazar												
Site manager				1	1	1	1	1	1	1	1	1
Assistant manager				2	2	2	2	2	2	2	2	2
Maintenance				1	1	1	1	1	1	1	1	1
Reception				4	4	4	4	4	4	4	4	4
Dumping platform				4	4	5	5	5	6	6	7	7
Operator	4	4	4	10	10	11	11	12	13	14	15	16
Gurde				6	6	6	6	6	6	6	6	6
subtotal	4	4	4	28	29	29	30	31	33	34	35	37
Total	17	31	46	71	74	77	79	83	87	92	97	102

Note: Number of staffs for dumping platform and operator will increase as disposal amount increases.
source: JICA study team

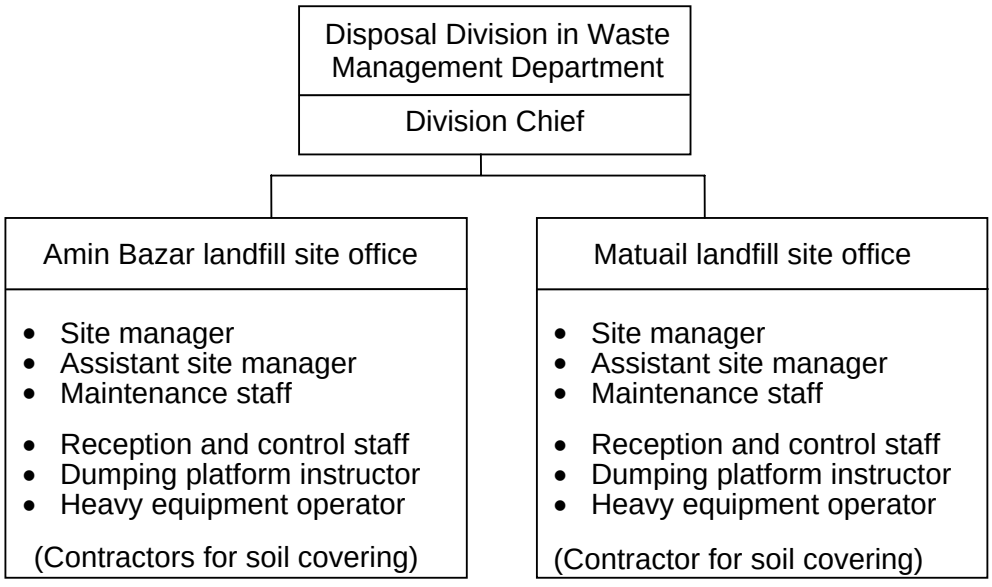


Figure 6.3-4 Management Organization of Final Disposal in Future

(6) Capacity Building for Final Disposal

Capacity building for final disposal shall be achieved through actual improvement of Matuail landfill site. Training programs on the following shall be prepared by DCC in collaboration with international agency that would assist DCC.

- Standard and criteria for the sanitary landfill
- Public sanitation to avoid health risks
- Environmental regulation derived from law
- Individual task

6.4 Legal Aspects

(1) Clear and Equitable Responsibility Allocation with DCC and Waste Generators

a) Responsibility of DCC to Install Containers at Proper Locations

Discussion with Commissioners/Ward SWM Committees

As is currently done, for the determination of proper locations of containers, discussion with Commissioners and/or Ward SWM Committees is inevitable. Since containers may cause some nuisance to the residents nearby, and demands for containers may be different depending on the conditions of primary collection services, close discussion with residents and primary collection service providers are required.

Standards for Allocation among Wards

Before discussion with Commissioners or Ward SWM Committees, DCC has to prepare standards for allocation of containers among wards. Number of containers *per Population* and *Longest Distance to Containers from a Building* will be the indicators for the standards. After examination of resources allocation in total (such as deployment of container carriers and manufacturing capacity of the containers or fund capacity for procurement of additional containers), total number as well as ward-wise distribution has to be determined. Ward distribution should be notified to the public.

b) Responsibility to Remove and Dispose of Business Waste

Needs to Transfer the Responsibility of Business Waste

Although the responsibility to remove and dispose of business waste[1] is implemented by business entities in many countries, especially in most of developed countries, the DCC Ordinance of 1983 does not make any difference in responsibility allocation by type of waste generators, and DCC has to transport and dispose of the waste when occupiers of lands or building discharge waste to public dustbins or containers unless the waste discharge is not covered by Environmental Conservation Act and Rules.

It would be recommendable that DCC should transfer responsibility to business entities in the long term future because they need special care to cope with the huge volume of waste. Furthermore some large waste generators often make dustbins/containers full

[1] Business waste is defined as non-domestic waste caused by business activities. It includes commercial, industrial and institutional waste generated from juridical persons other than from households.

and prevent the rest of users from using the dustbins/containers any more and because of prospective large burden on DCC in future.

Long-Term Discussion

To transfer the responsibility to business entities, however, it is necessity to modify the DCC Ordinance (Sec.78), whose legal level is same as Acts and whose modification has to be passed by the Parliament. Thus, long-term, nation-wide discussions between public administration (local governments and Local Government Division of the Ministry of Local Government, Rural Development and Cooperatives) and business communities are necessary.

It would be a good chance for DCC to raise the discussion during the course of the preparation of (Municipal) Solid Waste (Management) Handling Rules by the Ministry of Environment and Forests, since the basic Act (Environmental Conservation Act of 1995) contains waste management and its definition of "hazardous substance" may cover a wide range of types of waste.

Required Preparation

During the discussion, Ministry of Environment and Forests, Ministry of Local Government, Rural Development and Cooperatives and City Corporations should discuss how to control and monitor the waste management by business entities. The focus of the discussion might be the following:

- Methods to distinguish waste sources, especially those of small businesses
- Control of service providers such as primary collectors

The discussions should also include collection of conservancy rate from business entities. It would be natural to exempt some portion of conservancy rare from business entities when the responsibility is transferred to the business entities, while the rest can be chargeable to recover the cost for street and drain cleaning.

(2) Responsibility of DCC for Proper Disposal

a) Legalization of DCC's Responsibility for Proper Disposal

Responsibility of DCC for proper disposal of domestic waste should be clearly stipulated in the Ordinance and (Municipal) Solid Waste (Management) Handling Rules. The Rules should include proper standards and guidelines for the disposal. The Rules should also provide financial support to DCC and other City Corporations to practically implement the standards and guidelines.

b) Environmental Management Plan under Environmental Conservation Rules of 1997

All the staff engaged in SWM should learn and recognize the importance of the environmental laws and regulations.

DCC should immediately start preparation of Environmental Management Plan (EMP) according to the Rules and Guidelines for Environment Impact Assessment. As the Rules and Guidelines are mainly destined for industrial activities and effluent (liquid waste), consultation with the Department of Environment is necessary.

It is not realistic or practical to prepare Environmental Management Plan of Berri Band (Gaptori). The site should be immediately closed after the commissioning of Amin Bazar Disposal Site.

c) Compliance to Preservation Act

For new disposal sites of Matuail Extension and Amin Bazar, it can be regarded that DCC complies with the Act because RAJUK has issued no objection certificates. Some doubt remains that the request letters of DCC to RAJUK for issuance of "no objection" certificates that do not include the description of how the structure will be changed. It would be better for DCC to ask RAJUK for judgment/recommendation on the compliance after design of civil works.

(3) Enforcement of Section 150 against Illegal Garbage Throwing and Dumping

Throwing and dumping of garbage in streets or other public places are major problems of Dhaka City, and is deteriorating living conditions by degrading the landscape and producing awful odor, and is endangering public health by harboring vectors, such as flies, mosquitoes and rats, of infectious diseases. Prevention of throwing garbage may mainly consist of two measures: i) community activities, including door-to-door collection and environmental (awareness) education, and ii) enforcement of Sections 150-153 of DCC Ordinance (1983) and its Third Schedule. Further, the legal task group proposes establishment of a by-law regarding the following procedure and "administrative charge".

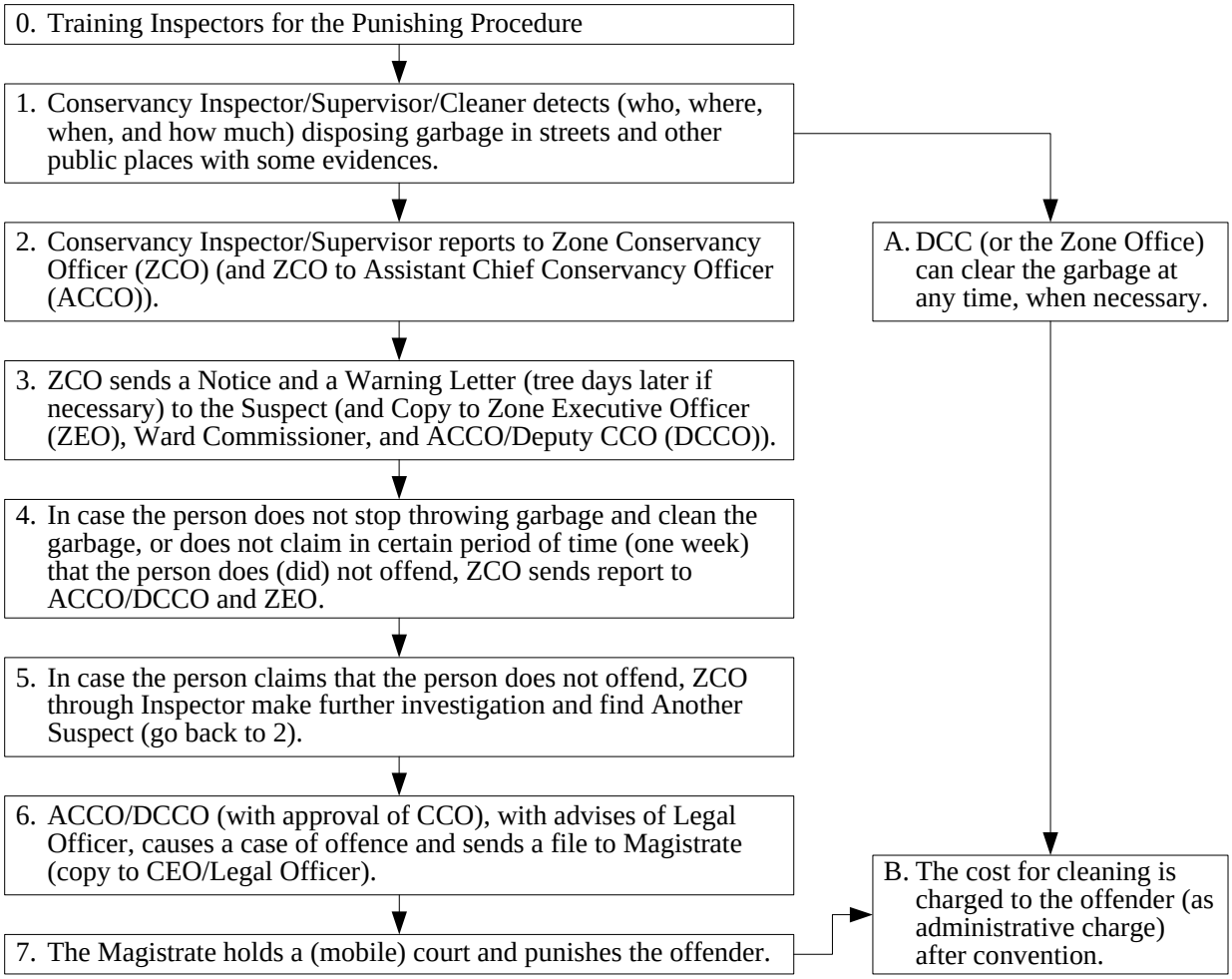


Figure 6.4-1 Procedure to Punish Illegal Garbage Throwing or Dumping and for Administrative Charging

(4) Legal Training to DCC Staff

The following program is recommendable.

Table 6.4-1 Legal Training Program

Target Trainee	Topic	Duration
Top Managers (Members of Waste Management Committee) (around ten persons)	* Basic Concept on Environmental Conservation Act (1995), Rules (1997) and Guidelines for Environmental Impact Assessment * Basic Concept on Preservation Act (2000) and Required Procedure for the Compliance * Basic Concept on Relevant Part of the Ordinance * Basic Concept on (Draft) (Municipal) Solid Waste (Management) Handling Rules * Discussion and Determination on What to do to Comply with the Laws/Regulations * Discussion on Responsibility Demarcation on Business Waste and DCC's Strategy for Responsibility Re-allocation	One Day Seminar
Conservancy Officers, Supervising Inspectors and	* Basic Concept on Relevant Part of the Ordinance, including the Part of Offense and Punishment	One Day Seminar

Target Trainee	Topic	Duration
Inspectors, etc. (Around 120 persons)	* Basic Concept on Environmental Conservation Act (1995), Rules (1997) and Preservation Act (2000) * Required Procedure for the Compliance of the Ordinance * Planning for Implementation of the Procedure for Relevant Areas and Presentation for the Results of the Planning	and One Day Workshop
Junior Engineers and Officers in charge of SWM (around 25 persons)	* Basic Concept on Environmental Conservation Act (1995), Rules (1997) and Guidelines for Environmental Impact Assessment * Basic Concept on Relevant Part of the Ordinance * Basic Concept on Preservation Act (2000) and Required Procedure for the Compliance * How to Prepare Environmental Management Plan * Required Procedure for the Compliance of the Ordinance	One Day Seminar and One Day Workshop

Although general courses on environmental legislation may be available at government training institutes, customized training courses are preferable, which combine workshops for formulation of action plans to be implemented by trainee themselves, to make the courses more effective. Consultations with Bangladesh Lawyers Association or other capable organizations are recommendable.

6.5 Organization

(1) Strengthening Planning/Coordinating/Monitoring/Evaluation Capability

a) Planning Hierarchy

Since the functions for implementation of SWM components are scattered in several departments in DCC, consolidation in planning and monitoring/evaluation (M/E) are inevitable to achieve integrated and coordinated management. To attain consolidated planning and M/E a certain form and procedure/process should be adopted. The procedure should accord with budget compilation procedure.

Master plans normally describe projects/programs during their target periods in rough ways; for priority or short-term programs/projects of large-scale and new concept, formulation of action plans, preliminary design, or feasibility studies are to be conducted.

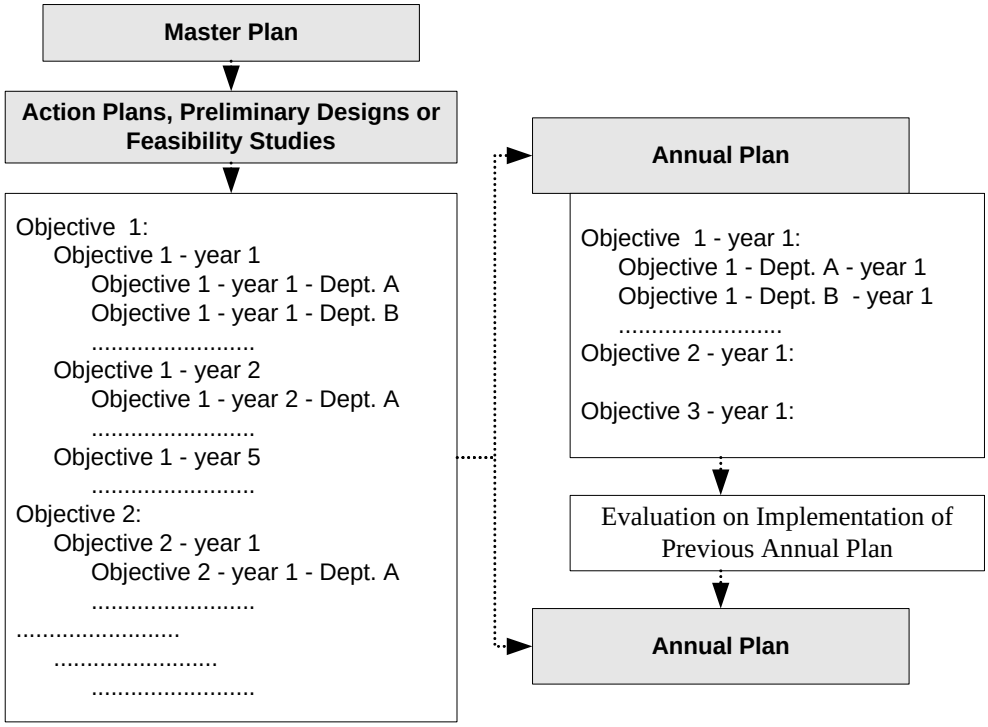


Figure 6.5-1 Breakdown of Master Plan to Annual Plans

b) Breakdown of Objectives

DCC objectives in the master plan have to be broken down into department-wise objectives, and then into objectives of divisions/zones. Division/zone-wise objectives should further be broken down into smaller units if necessary. Objectives of an upper level organ should be attained when all objectives of the lower organs are accomplished. When objectives of a lower level organ include those not necessary to achieve the upper ones, it can be deleted to achieve efficient implementation of the annual plan.

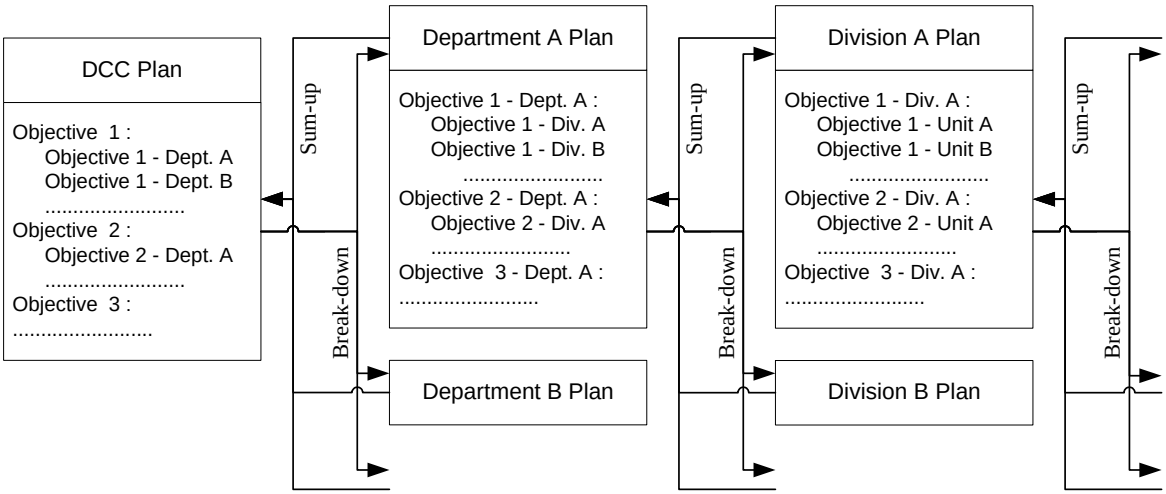


Figure 6.5-2 Breakdown of DCC Annual Plan

c) Procedure of Annual Planning

After the objective assignment, lower level organs have to prepare concrete operation plans according to Table 6.5-1. When the upper level organs received the operation plans of the lower organs, the upper ones have to check the consistency, mainly among different operation plans of the lower within the authority of the same upper organ.

There may be cases that a lower organ cannot achieve the objectives assigned to it without supports of other organs. Those supports should be clearly mentioned in the operation plans. During the check by the upper organs, the upper organs have to confirm for other organs to include the supporting activities in their operation plans.

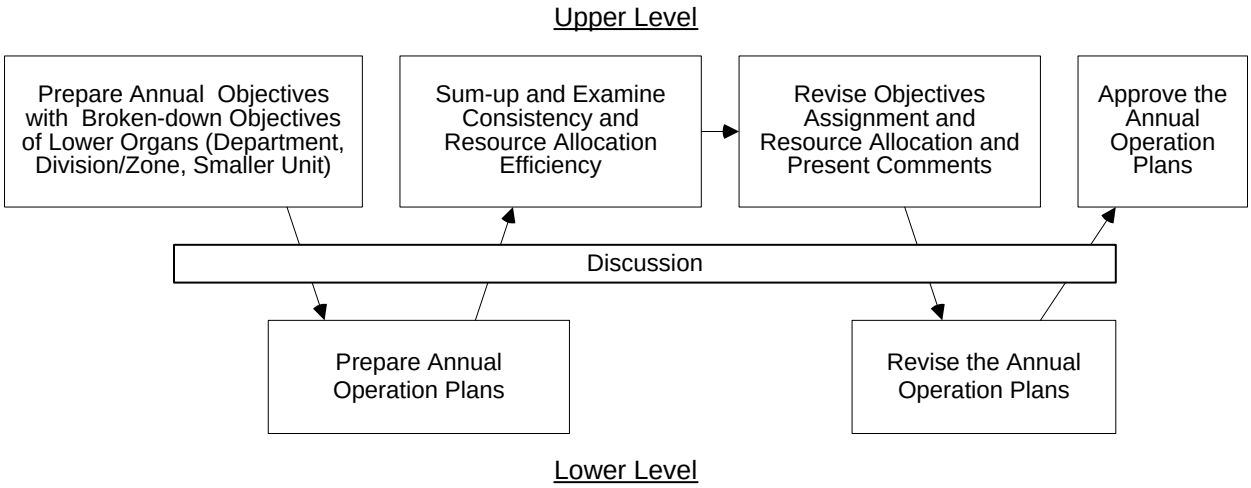


Figure 6.5-3 Procedure of Annual Planning

Table 6.5-1 Elements of Annual Operation Plan

(Initial. Revised in Mid-year)														
Objective 1 – Dept. A: (related objective of the upper organ)														
Division A														
Objective 1:														
Verifiable Indicator: (numerical indicator)			Responsible Person: (division manager normally)											
Actions to achieve the Objective	Verifiable Indicator	Responsible Leader	Required Input	Schedule										
				1	2	3	4	5	6	7	8	9	10	11	12
			Manpower: (profession)- M/M Money (Disburse): Tk. Equipment: (Type), (Quantity)												
Necessary Support of Other Divisions to Achieve the Objective														
Name of Division/Department			Type of Support					Delivery/Deadline							
Important Risks to Monitor: (price escalation, budget disbursement, etc.)															

d) Processes to be Taken

The processes for annual operation planning and monitoring/evaluation are listed in Table 6.5-2. The implementation should be monitored briefly every one or two months, and in the mid-year and countermeasures should be planned/taken. After the mid-year monitoring, implementation plans are to be revised in the same way as was done at the beginning, if necessary. The monitoring within a lower organ should be carried out first, and then managers of the lower organs should meet together under the presence of higher managers for their monitoring.

Table 6.5-2 Process of Annual Operation Plans

Works to be Done	Responsible Organization	Deadline
Planning		
1) Drafting DCC Annual Objectives and Objective Assignment to Relevant Department by referring Results of Preliminary Design, Action Plans or Feasibility Study and the Master Plan	WMD	End Dec.
2) Determine DCC Annual Objectives, Department Objective Assignment and Send to Each Dept.	WMC	Mid Jan.
3) Determine Division/Zone Objective Assignment with Assistance of WMD	Dept. Managers (WMD)	End Jan.
4) Held a Meeting to Assign Departmental Meeting to Assign Division/ Zone Objectives	Dept./Zone Managers, Div. Managers/CSI	End Jan.
5) (Held a Meeting to Assign Divisional/Zonal Meeting to Assign Objectives of Lower Units)	Div. Managers/ CSI, Leaders of Smaller Units (CI)	End Jan.
6) Prepare Draft of Annual Operation Plan of Lower Units/ Zones/Divisions	Div. Managers/ CSI, Leaders of Smaller Units (CI) (WMD)	Mid Feb.
7) Check the Consistency of Annual Operation Plans of Lower Units/ Zones/Divisions in a Dept. and Modification of Operation Plans if necessary	Dept. Manager, Div. Managers/ CSI, Leaders of Smaller Units (CI) (WMD)	End Feb.
8) Check the Consistency of Annual Operation Plans of Departments and Drafting Modification if necessary	Dept. Managers (WMD)	Early Mar.
9) Discussion and Determination of Operation Plans	WMC	Mid Mar.
10) Budget Compilation and Submission to Accounts Dept.	WMD	End Mar.
11) Drafting Adjustment of Objectives and Operation Plans	WMD	Early Jun.
12) Approval of Adjusted Objectives and Operation Plans	WMC	Early Jun.
Monitoring/Evaluation (M/E)		
1) Bimonthly Monitoring * Check the progress * Identification of Problems * Identify Countermeasures	Implementing Organs, WMD, (WMC, in case large problems are identified)	End Aug., Oct., Feb., Apr.
2) Mid-year and Year-end Evaluation * Check the Progress, incl. that of Countermeasures * Review Annual Operation Plans, if necessary * Identification of measures to be take in the next financial year	Implementing Organs, WMD, WMC	End. Dec., Jun.

e) Performance Evaluation in Objective Oriented Management

After a cycle of planning and implementation, performance evaluation of managers could be made based on the evaluation form; an example is given below.

Table 6.5-3 Example of Evaluation of a Division/Division Manager

Objective 1 – Dept. A:															
Division A															
Objective 1:															
Attained Level:		Responsible Person:												Evaluation: (Rank)	
Actions to achieve the Objective	Attained Level	Responsible Leader	Actual Input	Actual Schedule											
				1	2	3	4	5	6	7	8	9	10	11	12
			Manpower: (Member) - M/M Money: Material: (type), (Quantity) (Delivery)												
Actual Support given from Other Divisions															
Name of Division			Actual Support										Actual Delivery/Deadline		
Actions taken to avoid Risks:															

Note: Grey columns are to be defined at times of planning.

(2) Improvement of Field Organizations

a) Shift of Collection and Transport Functions to Zone Office

Enhancing Planning and Supervisory Capability of Zone Offices on Collection and Cleaning

Vacant posts of Conservancy Inspectors as well as Conservancy Supervising Inspectors should be fully assigned immediately (already started by the Conservancy Department), including those made newly vacant by shifting some staff to Waste Management Division.

Plans for container installation and re-deployment of cleaners should be formulated by the initiative of zone personnel assisted by staff of the headquarters.

Even after the full posting, it would be difficult for an Inspector to supervise 70 or more cleaners. It is recommendable to create posts of 'Supervising Cleaners' or 'Conservancy Sub-inspectors', one for a type of cleaning work and 20-30 street cleaners. Permanent Cleaners (or Cleaners of Pay Scale) will be candidates for the posts.

Shift of Waste Transport Functions to Zone Offices

After the transfer of the functions of transport to Waste Management Dept. or Conservancy Dept., function of control of drivers/conservancy trucks as well as

refueling should be transferred to Zone Offices where each driver has to report to before starting collection of waste in assigned area (route) and get fuel tickets.

b) Improvement in Vehicle and Equipment Maintenance

To reduce frequency of breakdown of conservancy vehicles, periodic inspection (daily inspection of drivers/operators and other periodic inspection, such as weekly or monthly ones, by mechanics and drivers/operators) are to be implemented. Standard kilometers for lubrication and replacement of spare parts are to be prepared and followed.

A mechanical engineer or an assistant mechanical engineer assigned to Waste Management Division should start to prepare manuals for the inspections as well as procurement plans for periodical change of spare parts with consultation with dealers. After the preparation a few mechanics as well as helpers have to move to conservancy pool from the workshop.

Rationalization of Procedure for Procurement of Repair Services

Some prompt procedure for the procurement to reduce the time for approval is to be discussed. The following procedure are recommendable.

1) Past records on repair works should be analyzed at first.
2) The mechanical workshops should carefully prepare conservative annual plans and budgets based on the results of the analysis.
3) Repair service can be outsourced with short-cut procedure within the limit of the approved plan and budget. Tendering has to be done at least once in a month to reduce the number of waiting vehicles and equipment for repair works.
4) After a few years, possibility for packaged contracts for maintenance and repair service of a group of same type vehicle should be discussed.
5) Frequency of bid for contracting should be increased up to once a month.

(3) Plan of Organization Reform

a) Options and Proposal of the Future Organization

Two options were selected as follows:

Option I: One Department with Planning/Monitoring and Implementing Functions related to Solid Waste Management

Option II: Conservancy, Transport, Engineering, Store and Purchase Departments to continue the current Implementing Functions and Planning/Monitoring/ Evaluation Functions by Waste Management Committee (WMC) and Waste Management Division (WMD)

Merits and demerits of the two options were discussed as follows.

Table 6.5-4 Merits and Demerits of Establishment of Waste Management Department

	merits	demerits
Option I	- Easier to attain Integrated Solid Waste Management. - Easier to attain graded-up management with specialized persons.	- Costly to assign persons/facilities/equipment exclusively used for SWM. - Necessary to re-organize Profession-Posting System
Option II	- Efficient use of DCC resources (persons or facilities/vehicle/equipment) - Easier to deploy resources for other operation or tasks other than SWM	- Difficult to achieve Coordination among the Departments even by WMC and WMD. - Not given proper priority to tasks requested by other departments.

Due to the merits and to double DCC's SWM capacity, the Study Team recommends Option I; The proposed future organizational structure of the Waste Management Department is shown in Figure 6.5-4.

Zone Waste Management Div. is to be established in each of Ten Zone Offices and to be responsible for community solid waste management, cleaning, secondary collection and transport in each Zone, while Community Solid Waste Management Div., and Zone Management Support Div. of the headquarters support Zone Waste Management Divisions for better solid waste management by preparation of standards/guidelines and forms and other management material and by developing techniques and educating staff and workers of Zone Waste Management Divisions.

b) Phased Development of the Future Organization

To overcome the difficulties and to reduce the demerits, following phased development is recommended. Employment of new staff is strongly recommendable to functionalise community solid waste management and final disposal.

Phase I: i) to change the name of the Department, ii) to organise Administrative, Planning and Community Solid Waste Management Divisions, and iii) to enhance zone office for cleaning and collection; [blue coloured part of Figure 6.5-4]

Phase II: vi) to merge Conservancy Pool and to organise Zone Management Support Div., v) to enhance maintenance functions, and vi) to organise Zone Divisions and Sections; [green coloured part of Figure 6.5-4]

Phase III: vii) to organise Disposal Div.; [yellow coloured part of Figure 6.5-4]

Phase IV: viii) to include functions of vehicle/heavy equipment purchase and repair (to organise Mechanical Sections in Zone Management Support and Disposal Divisions; [pink coloured part of Figure 6.5-4]

c) Change in Composition of Waste Management Committee

Even after the organization reform proposed above, the Waste Management Committee (WMC) should take its functions as a deliberative organization. Accordingly, composition of WMC is to be changed. Representative from academic institutes, such as BUET, Ward Commissioners/Ward SWM Committees, RAJUK, business communities, residents near disposal sites and NGOs, should be invited as members.

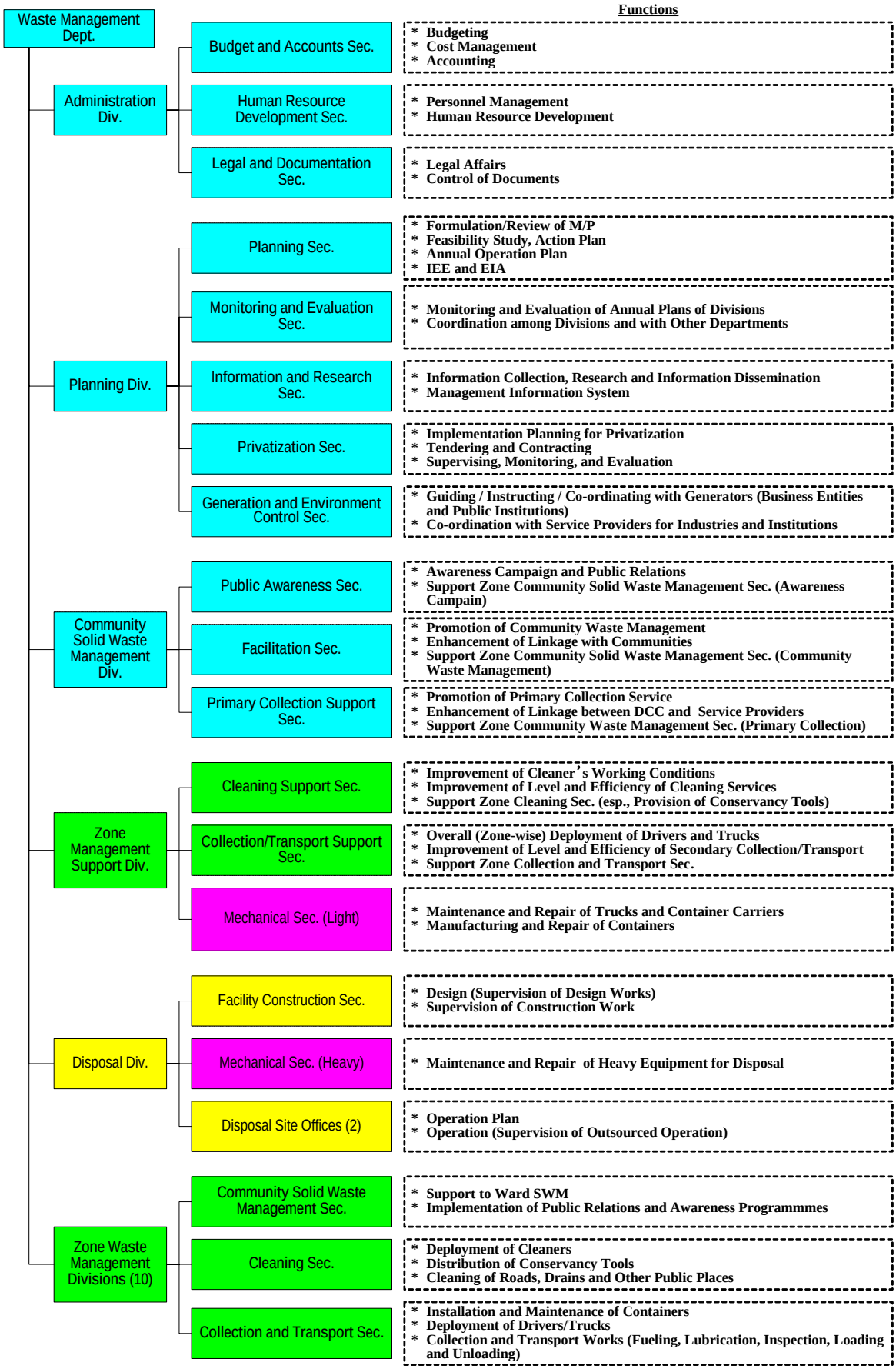


Figure 6.5-4 Proposed Future Organization Structure of Waste Management Department

d) Transformation to the New Department and Divisions

Relations of new divisions of the Waste Management Dept. with existing organisations including sections of Waste Management Div. during the phased development of Waste Management Dept. are described in the below table.

Operation Improvement Sec. of Waste Management Div. will work as is assigned at present in the Waste Management Dept, being subordinated directly to the head of the department until it is transformed to Zone Management Support Div. or Disposal Div.

Current headquarter staffs of the Conservancy Dept. will continue to work with the present posts until they are transformed to Zone Management Support Div., while Zone Conservancy Officers and their staffs will also continue to be the present posts until they are enhanced as Zone Waste Management Divisions.

Table 6.5-5 Transformation to New Divisions in Waste Management Department

New Divisions in WM Dept. (Phase to be Transformed)	Transformation and Remarks
Administrative Div. (Phase I)	* Division Manager's Office as well as a part of Planning and Management Improvement Sec. of Waste Management Division (WM Div.) will be the base for the establishment. * A few additional staff will be required.
Planning Div. (Phase I)	* Planning and Management Improvement Sec. of WM Div. will the base for the establishment. * A few additional staff will be required.
Community Solid Waste Management Div. (Phase I)	* Community Solid Waster Management Sec. of WM Div. will the base for the establishment. * A few to several additional staffs will be required. * Before the establishment of Zone Waste Management Divisions in Phase II, this section will be responsible for community solid waste management at zone level.
Zone Management Support Div. (Phase II and IV)	* Some of the current headquarter staff of Conservancy Dept., Conservancy Pool of Transport Dept., and Operation Improvement Sec. of WM Div. will be transformed to this division. * Some engineers from Mechanical Div.-1 are to be invited to Collection/ Transport Support Sec. to enhance maintenance/inspection capability of the vehicles.
Disposal Div. (Phase III and IV)	* A part of Operational Improvement Sec. and Taskforce for Matuail Landfill Site Improvement in WM Div. will a core for the establishment. * Substantial additional staffs will be required.
Zone Waste Management Div. (for each of 10 Zones) (Phase II)	* Current staff and workers, such as cleaners except truck cleaners, of Zone Conservancy Divisions will be organised to Cleaning Sections of these divisions. * Current drivers of Conservancy Pool of Transport Dept. and truck cleaners of Zone Conservancy Divisions with additional staff to control waste collection and transport will be organised to Collection and Transport Sections. * Establishment of Community Solid Waste management Sections should accord with expansion of Ward Solid Waste Management System with substantial staff employment.

(4) Training Plan to Enhance the Capability of DCC

a) Technical Training for Junior Engineering Staff

To enhance the engineering capability of SWM, DCC should send junior engineering staff members, a few for every year, to relevant university courses, such as BUET, regarding SWM, especially on final disposal and environmental engineering.. Similar scheme to that for Supervising Inspectors to diploma courses on public health has to be prepared.

b) Preparation of Reference Library for Research and Self-Study

A reference library for research and self-study has to be prepared with following books and documents. A system not to scatter the documents has to be established. Provision of Internet environment is also essential.

- Common engineering textbooks of university courses on SWM
- Common reference books for community development and empowerment
- Relevant journals and other periodicals on SWM
- Legal documents including those of other countries

6.6 Financial Management

(1) Simplified Accounting System for Actual SWM Cost (Standardized SWM Cost)

Firstly, the Study Team analyzed DCC financial data, secondly, extracted the component of actual cost related to SWM from the data, and lastly computed SWM cost applying a methodology as shown in Section 3.11. However, the process and methodology is supposedly too complicated and unrealistic to be followed properly by DCC staff.

Accordingly, more simplified accounting system for actual SWM cost should be established that could be easily understood and computed by all DCC staff.

For that purpose, so-called 'Standardized SWM cost' is designed as a model accounting that is digitized and provided to the WMD and the counterpart. The cost component of Standardized SWM Cost is as shown in Table 6.6-1.

The methodology and model format is presented in Tables 6.6-2 to 6.6-6. The basic data in the model format can be changed freely and easily according to the accounting objectives.

Table 6.6-1 Cost Component of Standardized SWM Cost

Cost	Department-wise				Operation-wise			
	Conservancy	Transport	Mech-1	Mech-2	Cleaning	Collection /Transport	Final Disposal	Repair Works
Personnel	*	*	*	*	*	*	*	*
Repair/Maintenance	-	-	*	*	-	*	*	-
Fuel	-	*	-	*	-	*	*	-
Utility	-	*	*	*	-	*	-	*
Supply	*	*	*	-	*	*	*	-
Development	*	-	-	-	*	-	-	-
Depreciation	-	-	-	-	-	*	*	-

Note: Marked * means respective cost component.

Table 6.6-2 Summary of Standardized SWM Cost (thousand Taka)

Cost Items		SMW Cost	Department-wise				Operation-wise			
			Conservancy	Transport	Mech-1	Mech-2	Cleaning of Road & Drain	Collection & Transport	Final Disposal	Repair Works
General Cost	**Personnel**	315,045	291,245	16,473	5,595	1,732	262,120	45,597	1,163	6,163
	Repair & Maintenance	12,450			12,075	375				12,450
	Fuel	67,769		61,554		6,215		61,554	6,215	
	Utility	3,819			2,291	306		1,222		2,597
	Supply	49,484	14,669	1,222	34,816		14,669			34,816
	Total	448,566	305,913	79,248	54,777	8,628	276,789	108,373	7,378	56,026
Development Cost		14,579	14,579				14,579			
Total Cost before Depreciation		463,146	320,493	79,248	54,777	8,628	291,368	108,373	7,378	56,026
Depreciation		100,714						86,429	14,286	
Total Cost after Depreciation		563,860					291,368	194,801	21,664	56,026

Table 6.6-3 Standardized Cost of Conservancy Department

Cost Items			Basic Data: Number	Basic Data: Basic Salary	Basic Data: Allowance	Basic Data: Festival	Basic Data: P.Fund	Calculation	Yearly Cost Taka .000	Distribution by Operation: Cleaning of Road & Drain	Distribution by Operation: Collection & Transportation
Personnel	Cleaner	Temporary	4800	2,550	0	0	0	=Number x Basic Salary x Allowance x Festival x P.F	146,880		
		Permanent	2300	2,310	80%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.F	131,762		
	C.O		10	5,000	70%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.F	1,180		
	C.S.I		20	4,400	70%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.F	2,077		
	C.I		90	4,400	70%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.F	9,346		
	Total of Personnel Cost								**291,245**	90%	10%
Supply	Hand Trolley		Supply Cost is determined by using Supply Cost Ratio.								
	Spread, Broom, Fork		Supply Cost Ratio is determined from average ratio of supply cost								
	Bammboo Stick		to personnel cost over the past 4 years.								
	Bammboo Basket										
	Supply Cost Ratio						5%	=Total of Personnel Cost x Supply Cost Ratio	**14,669**	100%	0%
Development	Dustbin		Development Cost is determined by using Development Cost Ratio.								
	Sweepers Colony Develop.		Development Cost Ratio is determined from average ratio								
			of development cost to personnel cost over the past 4 years.								
	Development Cost Ratio						5%	=Total of Personnel Cost x Development Cost Ratio	**14,579**	100%	0%
Total Cost of Conservancy Department									**320,493**	291,368	29,124

Parameter of salary	
Allowance	
House rent	50%
Medical,	10%
Tiffen &	20%
Dearness	10%
Festival Bonus	
2 months payable	17%
Provident Fund	
DCC Contribution	10%

Table 6.6-4 Standardized Cost of Transport Department

Cost Items		Basic Data: Number	Basic Salary	Allowance	Festival	P.Fund	Calculation	Yearly Cost Taka .000	Distribution: Collection & Transportation
Personnel	Drivers	230	2,800	70%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.Fund	15,198	
	Others	20	2,700	70%	17%	10%	=Number x Basic Salary x Allowance x Festival x P.Fund	1,274	
	Total							**16,473**	100%
Fuel	SWM vehicles	(Number)				340	=SWM Vehicles x Operation Rate x Trips x Trip Distance		
	Operation rate	(%)				80%	/ Mileage x Diesel Oil Price x Operation days		
	Trips	(number/day/vehicle)				3.1			
	Trip distance	(km/trip/vehicle)				30			
	Mileage	(km/liter)				3			
	Diesel oil price	(Taka/liter)				20			
	Operation days	(days/year)				365			
	Total							**61,554**	100%
Utility	Total Cost of DCC	(Taka .000)				61,100	=Total Cost of DCC x Proprotion (%) of SWM		
	Proportion (%) of Transport					2%	x Proportion (%) of SWM		
	Total							**1,222**	100%
Total Cost of Transport Department								**79,248**	79,248

Parameter of salary	
Allowance	
House rent	50%
Medical, Tiffen & Convence	10%
Dearness	10%
Festival Bonus	
2 months	17%
Provident Fund	
DCC Contribution	10%

Table 6.6-5 Standardized Cost of Mechanical Division 1

Cost Items		Basic Data: Number	Basic Salary	Allowance	Festival	P.Fund		Calculation	Yearly Cost Taka .000	Distribution: Repair Works	Distribution: Collection & Transportion
Personnel	Mechanics	20	3,900	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	1,841		
	Assistant Mechanics	10	3,300	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	779		
	Helpers	25	3,200	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	1,888		
	Welders	1	4,300	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	101		
	Painters	4	2,800	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	264		
	Others	15	2,600					=Number x Basic Salary x Allowance x Festival x P.Fund	468		
	Management Heads	14	5,000	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	1,652		
	Personnel Cost of Mech-1								6,993		
	Proportion (%) of SWM						80%				
	Personnel cost of SWM							=Personnel Cost of Mech-1 x Proportion (%) of SWM	**5,595**	100%	
Repair & Maintenance	Total Cost of Mech-1(Taka. 000)						16,100	=Total Cost of Mech-1x Proprotion (%) of SWM			
	Proportion (%) of SWM						75%				
	Total								**12,075**		100%
Utility	Total Cost of DCC (Taka .000)						61,100	=Total Cost of DCC x Proprotion (%) of SWM			
	Proportion (%) of Mech-1						5%	x Proportion (%) of SWM			
	Proportion (%) of SWM						75%				
	Total								**2,291**	100%	
Supply	Parts	Total Cost of DCC (Taka .000)					39,500	=Total Cost of DCC x SWM vehicles /DCC vehicles *Efficiency			
		DCC vehicles					490				
		SWM vehicles					350				
		Efficiency: SWM spends more parts than Central pool by 1.1 tir					1.1				
		Total							31,036		
	Body for truck & handcarts	Total Cost of DCC (Taka .000)					4,200.0	=Total Cost of DCC x Proprotion (%) of SWM			
		Proportion (%) of Mech-1for SWM					90%				
		Total							3,780		
	Total								**34,816**		100%
Total Cost of Mech-1 before Depreciation									**54,777**	7,886	46,891
Depreciation	Vehicles	Acquisition Co		600,000	Economuc Life (Years		7	= Acqusition Cost x (1/Economic Life)	**85,714**		
	Containers	Acquisition Co		5,000	Economuc Life (Years		7	= Acqusition Cost x (1/Economic Life)	**714**		
	Total								**86,429**		100%
Total Cost of Mech-1 after Depreciation									**141,205**	7,886	133,319

Parameter of salary	
Allowance	
House rent	50%
Medical, Tiffen &	10%
Dearness	10%
Festival Bonus	
2 months	17%
Provident Fund	
DCC Contribution	10%

Table 6.6-6 Standardized Cost of Mechanical Division 2

Cost Items		Basic Data: Number	Basic Salary	Allowance	Festival	P.Fund		Calculation	Yearly Cost Taka .000	Distribution by Operation: Repair Works	Final Disposal
Personnel	Mechanics	4	3,900	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	368	100%	
	Assistant Mechanics	5	3,300	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	389	100%	
	Helpers	25	3,200	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	1,888	100%	
	Operators	17	2,900	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	1,163		100%
	Management Heads	4	6,700	70%	17%	10%		=Number x Basic Salary x Allowance x Festival x P.Fund	632	100%	
	Personnel Cost of Mech-2								**4,442**		
	Proportion (%) of SWM						39%				
	Personnel cost of SWM							=Personnel Cost of Mech-2 x Proportion (%) of SWM	**1,732**		
Repair & Maintenance	Total Cost of Mech-2 (Taka .000)						2,500	=Total Cost of DCC x Proportion (%) of SWM			
	Proportion (%) of SWM						15%				
	Total								**375**		100%
Fuel	Total Cost of DCC (Taka .000)						124,300	=Total Cost of DCC x Proportion (%) of Mech-2			
	Proprotioin (%) of Mech-2						20%	x Heavy equip for SWM / Heavy equip of DCC in operation			
	Heavy equip of DCC in operation						80				
	Heavy equip forSWM						20				
	Total								**6,215**		100%
Utility	Total Cost of DCC (Taka .000)						61,100	=Total Cost of DCC x Proportion (%) of Mech-2			
	Proprotioin (%) of Mech-2						2%	x Proportion (%) of SWM			
	Proportion (%) of SWM						25%				
	Total								**306**	100%	
Total Cost of Mech-2 before Depreciation									**8,628**	874	7,753
Depreciation	Heavy Equipment	Acquisition Cost	100,000	Economic Life (Years			7	= Acqusition Cost x (1/Economic Life)	**14,286**		100%
Total Cost of Mech-1 after Depreciation									**22,913**	874	22,039

Parameter of salary	
Allowance	
House rent	50%
Medical, Tiffen & Convence	10%
Dearness	10%
Festival Bonus	
2 months	17%
Provident Fund	
DCC Contribution	10%

(2) Financial Planning for Master Plan

a) Financial Consequence of Overall SWM Cost

Primarily, overall SWM Cost must be covered entirely by DCC's own SWM revenues. However, the financial situation of SWM is characterized by negative balance to a considerable amount every year. Provided the current revenue level continues, DCC can not afford to bear the overall SWM cost of the Master Plan as shown in Table 6.6-7.

Table 6.6-7 Predictable DCC Financial Condition by Current Revenue Level

(Taka in million)

Items	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
Current Revenue level (Conservancy Rate)	180	180	180	180	180	180	180	180	180	180	180
Development & Procurement cost	839	701	305	0	263	0	686	322	478	0	0
O&M Cost	509	472	539	519	570	532	564	539	631	589	594
Overall SWM Cost	1,348	1,173	844	519	833	532	1,250	861	1,109	589	594
SWM Financial Balance	▲1,168	▲993	▲664	▲339	▲653	▲352	▲1,070	▲681	▲929	▲409	▲414

b) Necessity of Financial Enhancement

Consequently, the SWM enhancement measures discussed in Chapter 3.11 (namely, 1) periodic reassessment of property value, 2) taxation rate revision of Conservancy Rate, and 3) tax collection improvement), should be effected to attain the SWM O&M cost recovery as well as more efficient SWM service proposed in the Master Plan.

These enhancement measures are analyzed below and the respective incremental revenues are considered as the source of funds for SWM O&M Cost.

Reassessment of Property Value

DCC has already decided and started the reassessment this year. However, it is unclear at this moment, when the reassessment works will be completed because the court ordered DCC to suspend it. Taking into consideration the current information of DCC, the Study Team judged to the effect that the reassessment could be completed in financial year of 2005/06 and the new taxation table could be effective from financial year of 2006/07.

Taxation revenue is expected to increase by 2.5 times at minimum and 5 times at maximum. In this study, the minimum increase by 2.5 times is applied because the hike of consumer price index during the period over the 15 years is estimated at 2.5 times. Accordingly, the revenue of Conservancy Rate is estimated to increase to Tk. 450 million in financial year of 2006/07.

The periodic reassessment in financial year of 2011/12 is also estimated at 13% increase of property value on the basis of yearly increase by 2.5%.

Taxation Rate Revision of Conservancy Rate

The law says that the ceiling of Conservancy Rate is 7% on property value. Currently DCC imposes only 2% on it in spite of other cities imposing 5% or 7%. The taxation

ground of 2% supposedly comes from a notification of the year 1962 according to Revenue Department. Now that the public recognizes SWM service has changed and diversified dramatically, this taxation rate should be revised upward realistically.

However, it would be desirable to revise taxation rate gradually because of large impact on taxpayers. In this study, taxation rate of 2.5% is applied as Conservancy Rate from financial year of 2008/09 and 3% from 2013/14.

Tax Collection Improvement

Currently the Holding Tax may be collected only 70% of total tax amount that is imposed to taxpayers. This collection rate should be improved by applying the measures presented in Chapter 3.11. In this study, the collection rate of 75% from 2006/07 and 80% from 2011/12 is applied.

c) Financial Recovery of O&M Cost

By putting into effect the above 3 revenue enhancement measures, Conservancy Rate Revenue could finally cover SWM O&M Cost as shown in Table 6.6-8.

Table 6.6-8 Recovery Planning of SWM O&M Cost (million Taka)

Items	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
SWM Revenue Enhancement Measures											
Reassessment*	-	Increase by 2.5 times					Increase by 13 %				
Taxation Rate**	Currently: 2 %			Increase to 2.5 %					Increase to 3 %		
Tax Collection**	70 %	75 %					80%				
Revenue from Conservancy Rate	180	480	480	600	600	600	730	730	870	870	870
O&M Cost	509	472	539	519	570	532	564	539	631	589	594
Balance after O&M Cost	▲329	+8	▲59	+81	+30	+68	+166	+191	+239	+281	+276
Development & Procurement Cost	839	701	305	0	263	0	686	322	478	0	0
Final Balance	▲1,168	▲693	▲364	+81	▲233	+68	▲520	▲131	▲239	+281	+276

Note: * Reassessment scheme of annual value of the properties using self assessment system has stated last year and tax collection based on the reassessed value will start from the financial year of 2006/07. Increase of 13% tax collection from 2011/12 is estimated based on the recent tendency in increase of real estate value.

** Revision of Conservancy Tax Rate as well as tax collection ratio are proposed by the Study Team.

Source: Estimates by the JICA Study Team

SWM financial balance turns into surplus from 2006/07, which would be increased in 2008/09 and 2011/12 by taxation rate revision and periodic reassessment every 5 years.

However, cost recovery cannot be attained easily or immediately. Long-term strategy must carefully plan for it by grasping the public opinion and concurrence. Also, considering growing business waste, imposing additional SWM charges on Market Rent Fee could be studied as alternative measure to cover the increasing SWM cost in the future.

d) Sources of Funds for Development and Procurement Cost

Development and Procurement Cost should be also primarily covered by DCC own SWM revenues and then, if difficult, other sources will be taken into account as alternatives.

The size of Conservancy Rate Revenue is not enough to cover all Development and Procurement Cost as shown in Table 6.6-8; therefore the cost burden capability on respective plan is analyzed below, from which the predictable sources of funds are summarized in Table 6.6-9.

i) New Landfill Development Cost

The total costs of the project are estimated at Tk. 1,575 million in the Master Plan. The project has been already budgeted and promoted under the 'Infrastructure and Environmental Improvement Project of Different Areas in Dhaka City' sponsored by Ministry of LGRD that committed Tk. 670 million for land acquisition, development and related investment cost. Tk. 136 million in 2012/13 is estimated to be covered by SWM own revenue. However, the rest of Tk. 769 million should be requested to the Government because new landfill is an environmentally indispensable infrastructure due to the growing size of the Capital City.

ii) Improvement Cost of Existing Landfill >

The total costs of the project are estimated at Tk. 471 million in the Master Plan in the year of 2005/06 and 2006/07. The project should start as soon as possible to resolve the environmental problem arising at surrounding area of existing landfill. The total cost of Tk. 471 million should be covered primarily by SWM own revenues; however SWM own revenues could not cover the cost in that year as shown in Table 6.6-9., so that DCC should consider an allocation from another account of DCC budget, or request the grant of the Government and/or external official organizations.

iii) Closure of Berri Band

The total costs of the project are estimated at Tk. 11 million in the Master Plan in the year of 2007/08 that could be covered by SWM own revenues.

iv) Container Carrier Procurement Cost

The procurement is proposed in 4 phases: financial year of 2007/08, 2009/10, 2011/12, and 2013/14. SWM revenues could not cover it for 2007/08 and 2009/10, so that DCC should plan and request the grant of the Government and/or external official organizations. On the other hand, SWM revenues could cover a part of the cost in 2011/12 and 2013/14.

v) Heavy Equipment Procurement Cost

The procurement is proposed in 2 phases: financial year of 2007/08 and 2012/13. SWM revenues could not cover it 2007/08, so that grant from the Government and/or external official organizations should be planned and applied. On the other hand, SWM revenues could afford for 2012/03.

vi) Community Activities

The total costs of the project are estimated at Tk. 59 million in the Master Plan for the three years of 2005/06, 2006/07 and 2007/08. SWM revenues could not afford for it, so that grant from the Government and/or external official organizations should be planned and applied.

vii) Predictable Sources of Funds for Overall Development & Procurement Cost

Sources of funds for Development and Procurement Cost as discussed above are summarized in Table 6.6-9. Obviously, WMD should carefully study the Grant Scheme of Central Government and Foreign Government, and execute the procedures in proper manner to advance it in line with respective Governments budget schedule.

Table 6.6-9 Sources of Funds for Development and Procurement Cost

Project	Source of Funds (million Taka)		
	SWM Own Revenues	**Grant from Central or Foreign Government**	Total
① New Landfill Development	- - - 136 (2012/13)	630 (2005/06) 396 (2006/07) 282 (2011/12) 129 (2012/13)	1,575
② Existing Landfill Improvement	- -	181 (2005/06) 290 (2006/07)	471
③ Closure of Berri Band	11	-	11
④ Container Carrier & Truck Procurement	- 30 (2009/10) 166 (2011/12) 239 (2013/14)	172 (2007/08) 233 (2009/10) 238 (2011/12) 239 (2013/14)	1,317
⑤ Heavy Equipment Procurement	55 (2012/13)	107 (2007/08)	162
⑥ Community Activities	- - -	28 (2005/06) 16 (2006/07) 15 (2007/08)	59
Total	637	2,958	3,595

Source: Estimates by the JICA Study Team

6.7 Privatization

(1) Continuation of Pilot Project and In-depth Evaluation

Outsourcing may generally promote cost efficiency and better performance. Therefore, it is necessary for DCC to continue evaluation of the privatization project more profoundly. Based on the results of the evaluation of the pilot project, the privatization schemes have to be improved and expanded.

(2) Examination and Accumulation of Know-how for Outsourcing

During the continuation and expansion of the pilot project, the following are to be examined. The contracts have to be improved and know-how to control the contractor has to be accumulated.

a) Period of Contracts

To induce the investment by the private sector, current one-year or three-year contracts have to be reviewed. For the investment in the vehicles, the contract period should be longer than six years. Or, in case DCC continues one-year contract, DCC may lease the container carriers (maintenance and repair works by the contractors), or rent them (maintenance and repair works by DCC).

b) Scope of Contract

Currently many cleaners of the contractors work for primary collection (under the supervision of a different service provider company, so that they can survive with lower wages. Although the involved parties are different (primary collection with residents/ restaurants/hotels/shops and secondary collection and transport with DCC), combination of the two services, not by DCC cleaners but only by cleaners of contractors, may promote work efficiency of the service providers.

Expansion of outsourcing for cleaning works may cause dismissal of the cleaners or substantial shift of work places of cleaners. Although the attractiveness to the private sector might be reduced, excluding cleaning works from the contracts may reduce the problems of dismissal and shifts of cleaners. As discussed earlier, outsourcing maintenance and repair works of conservancy vehicles should be examined. Outsourcing of operation of disposal sites should also be considered.

c) Area of Outsourcing

Area for a contractor should also be examined. Wider area for a contractor may promote economies of scale, increase the attractiveness of the contract and result in better competition Despite the location of cleaner colony in Gulshan, secondary collection and transport in Ward 19 has been privatized, causing longer distance commuting and higher commuting costs.

d) Survey on Capability of the Private Sector

DCC should set up management indicators for objective monitoring and evaluation by establishing weighing system and by improving SWM accounting system. DCC should also establish a system for collection of opinions of residents and other establishment such as hotels, restaurants or shops.

DCC should also conduct survey on capability of workshops and other facilities used by the contractors. It could be recommended that DCC hold periodical meeting with contractors for hearing opinions of the contractors and reflect some reasonable opinions for the improvement in the outsourcing. DCC should also take some measures for technical support, such as training, to improve the service quality of the contractors.

e) Performance Monitoring/Evaluation

Currently, performance monitoring and evaluation are conducted by DCC staff. For unbiased monitoring/evaluation, community involvement, such as those by Ward Solid Waste Management Committees, will be necessary.

Chapter 7
Priority Projects and Programs

7.1 Priority Projects and Programs

The proposed master plan focuses on four major aspects of waste management that is mandated to DCC. Out of entire master plan the priority projects and programs are extracted as shown in Table 7.1-1. These projects and programs are considered of urgent need of implementation as the core of "Clean Dhaka Master Plan." The projects and programs will be the key to open the new era in which DCC would promote SWM to the highest level ever achieved by its own capacity.

Table 7.1-1 Priority Projects and Programs

	Title of Program	Executing Body	Concerning Body	Time of Execution
Primary Collection/Public Involvement				
1	Program for Institutionalization of Ward Solid Waste Management System	WMD	CD	2005-2007
2	Program for Establishing a System of Approval and Monitoring of Primary Collection Service Providers	WMD	CD	↑
3	Program for Supporting Primary Collection Service Providers	WMD	CD	↑
4	Program for Initial Implementation of Ward Solid Waste Management System (20 Wards)	WMD	CD	↑
5	Organization of Bangladesh Solid Waste Management Conference	WMD	CD of DCC, CCC, RCC, KCC	2005-2007
Secondary Collection/Transport and Road/Drain Cleaning				
1	Increase of New Containers and Trucks	ED	CD, TD	2005-20015
2	Increase of Drivers and Container Cleaners	CD, TD	-	↑
3	Formation of Chain of Management in SWM	WMD	CD, TD	2005-2007
4	Setting up Operation and management Plan	↑	CD, TD, ED, UPD	2005 2015
5	Capacity Development of Workers	↑	CD, TD	2005-2010
Final Disposal				
1	Improvement of Existing Matuail Dump Site	WMD	CD, ED	2005-2007
2	Securing Future Landfill Site	WMD	CD, ED	2005-2012

Title of Program		Executing Body	Concerning Body	Time of Execution
3	Closure of Berri Band Dump Site	WMD	CD, ED	2007-2010
4	Establishment of Management Organization for Final Disposal	WMD	CD, ED, TD	2005-2007
5	Capacity Development of Disposal Section	WMD	CD, ED	2005-2007
Legal Aspects				
1	Compliance with Environmental Conservation Act/ Rules and Preservation Act	WMD	CD, ED	2007-2015
2	Legal Training to DCC Staff	WMD	CD, ED, TD, UPD	2005-2015
3	Enforcement of Section 150 against Illegal Garbage Throwing and Dumping	CD	WMD, Magistrates	2007-2015
Organization Aspects				
1	Preparation of Annual Operation Plan According to Master Plan	WMD	CD, ED, TD, AD	2005-2007
2	Improvement of Operational Organization	WMD	CD, TD, ED	↑
3	Reforming Organization for SWM	WMD	CD, TD, ED, UPD, AD, ESD	2007-2015
4	Training of DCC Staff for SWM	WMD	CD, ED. TD, UPD	2007-2015
Financial Aspect				
1	Modification of Accounting system to Exhibit Actual SWM Cost explicitly	WMD	AD	2005-2012
2	Financing for Master Plan Implementation	WMC, WMD	AD	2005-2015
Privatization				
1	Continuation of Pilot Project on Privatization with In-depth Evaluation	WMD	CD, TD, UPD	2005-2007

Note: WMD（Waste Management Division/Department in future); CD (Conservancy Department); ED (Engineering Department); TD (Transport Department); UPD (Urban Planning Department); AD (Accounts Department); ESD (Establishment Department); SDD (Slum Development Department); MOPME (Ministry of Primary and Mass Education); DCC (Dhaka City Corporation); CCC (Chittagong City Corporation); RCC (Rajshahi City Corporation); KCC (Khulna City Corporation)

7.2 Schedule for Implementation

The priority project and programs have an urgent need of execution as the successive action to the joint efforts to establish the master plan by the counterpart personnel unit of Bengali side and the JICA study team. Bangladesh Government decided to establish the Waste Management Committee and Waste Management Division (WMD) in DCC in July, 2004. In response to the decision of LGRD&C, DCC selected the personnel for WMD in November, 2004 and proceeded it to the Government for the concurrence of the competent authorities. On the other hand, residents in Ward 6 and Ward 65 have started active participation in the pilot project for community level waste management program as demonstrated in the event "Mirpur Declaration" where thousands of citizens gathered and resolved "Clean Mirpur for Our Children." These surrounding circumstances indicate this is the time to get the "Clean Dhaka master Plan" started without delay. Some of the priority projects and programs need immediate commencement as shown in Table 7.2-1.

Table 7.2-1 Implementation Schedule of Priority Projects and Programs

	Priority Projects and Programs	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Primary Collection/Public Involvement												
1	Institutionalization of Ward Solid Waste Management System											
2	Establishing a System of Approval and Monitoring of Primary Collection Service Providers											
3	Supporting Primary Collection Service Providers											
4	Initial Implementation of Ward Solid Waste Management System (20 Wards)											
5	Organization of Bangladesh Solid Waste Management Conference											
Secondary Collection/Transport and Road/Drain Cleaning												
1	Inctrease of New Containers and Trucks											
2	Increase of driver and truck cleaner											
3	Formation of Chain of Management in SWM											
4	Setting up Operation and Management Plan											
5	Capacity Development of Workers											
Final Disposal												
1	Improvement of Existing Matuail Dump Site											
2	Securing Future Landfill Site											
3	Closure of Berri Band Dump Site											
4	Establishment of Management Organization for Final Disposal											
5	Capacity Development of Disposal Section											
Legal Aspects												
1	Compliance with Environmental Conservation Act/ Rules and Preservation Act											
2	Legal Training to DCC Staff											
3	Enforcement of Section 150 against Illegal Garbage Throwing and Dumping											
Organization Aspects												
1	Preparation of Annual Operation Plan according to Master Plan											
2	Improvement of Operational Organization											
3	Reforming Organization for SWM											
4	Training of DCC Staff for SWM											
Financial Aspect												
1	Modification of Accounting system to Exhibit Actual SWM Cost explicitly											
2	Financing for Master Plan Implementation											
Privatization												
1	Continuation of Pilot Project on Privatization with In-depth Evaluation											

7.3 Financial Requirement

The sum of Development and Procurement Cost until 2015/16 is estimated at Tk. 3,595 million that is:

1) new landfill development: Tk. 1,575 million
2) existing landfill improvement: Tk 471 million
3) Berri Band closure: Tk. 11 million
4) container carrier & truck procurement: Tk. 1,317 million
5) heavy equipment procurement: Tk. 162 million
6) primary collection/public involvement: Tk. 59 million

Sources of funds for Development and Procurement Cost are summarized in Table 7.3-1. Some of the funds are already budgeted and the rest is a proposal of the study team.

Table 7.3-1 Proposed Sources of Funds for Development and Procurement Cost

Project	Source of Funds (Taka in million)		
	SWM Own Incomes	Grant from Central or Foreign Government	Total
New Landfill Development	- 136	670 769	1,575
Existing Landfill Improvement	-	471	471
Closure of Berri band	11	-	11
Truck Procurement	467	850	1,144317
Heavy Equipment Procurement	55	107	162
Community Activities	-	59	59
Total	637	2,958	3,422

Source: Estimates by the JICA Study Team

On the other hand, the sum of O&M Cost until 2015/16 is estimated at Tk. 6,058 million that averages Tk. 551 million a year, composed of personnel cost 70%, fuel cost 8%, etc. O&M unit cost (Taka/Ton = O&M cost/collected solid waste amount) is summarized in Table 7.3-2. The unit cost is assumed to continuously decrease due to good cost efficiency in spite of growing waste collection.

Table 7.3-2 SWM O&M Cost per Ton

Items	Unit	Actual	Master Plan			
		04/05	05/06	10/11	15/16	Average
SWM O&M Cost	Taka. In million	487	509	532	594	551
Collected Solid Waste Amount	1000Ton/Year	511	548	749	1,030	-
Taka/Ton		953	929	710	577	703

Source: Estimates by JICA Study Team

Overall SWM cost of the Master Plan is summarized in Table 7.3-3 to 5.

Table 7.3-3 Summary of Overall SWM Cost

(Taka in million)

	estimate	Master Plan											
	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	Total
Development and Procurement Cost by Implementation of Master Plan													
1. Collection & Transport	0	0	0	172	0	263	0	404	0	478	0	0	1,317
2. Final Disposal	0	811	685	118	0	0	0	282	322	0	0	0	2,219
3. Primary Collection/Public Involvement	0	28	16	15	0	0	0	0	0	0	0	0	59
Total	0	839	701	305	0	263	0	686	322	478	0	0	3,595
SWM Operation & Maintenance Cost													
1. Cleaning of Road & Drain	282	290	279	290	279	288	277	288	277	283	272	283	3,105
2. Collection & Transport	188	193	165	179	158	196	166	182	162	248	212	198	2,059
3. Final Disposal	8	10	11	50	53	56	59	64	68	73	79	85	608
4. Repair Works	9	9	9	9	9	9	9	9	9	9	9	9	100
5. Community Activities	0	2	2	2	9	9	9	10	10	6	6	6	71
6. Management Improvement	0	5	6	9	10	12	12	12	12	12	12	12	115
Total	487	509	472	539	519	570	532	564	539	631	589	594	6,058
Overall SWM Cost	487	1,348	1,173	844	519	833	532	1,250	861	1,109	589	594	9,653

Note: 1) Price escalation is not applied.
2) Development and Procurement cost includes an additional cost of consulting service 10% and contingency 10%.

Table 7.3-4 Breakdown of Development and Procurement Cost (Taka in million)

Operation	Development Items	Estimate	Master Plan										
		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	Total
Development and Procurement Cost by Implementation of Master Plan														
Collection & Transport	1) 3 ton Container Carrier	0	0	0	54	0	173	0	282	0	374	0	0	883
	2) 5 ton Container Carrier	0	0	0	36	0	36	0	36	0	36	0	0	142
	3) 1.5 ton Open Truck	0	0	0	82	0	55	0	55	0	68	0	0	259
	4) 20 ton Trailer Truck	0	0	0	0	0	0	0	32	0	0	0	0	32
	Total	0	0	0	172	0	263	0	404	0	478	0	0	1,317
Final Disposal	1.New Landfill Development													
	1) Land Acquisition	0	624	0	0	0	0	0	282	0	0	0	0	906
	2) Construction	0	0	396	0	0	0	0	0	267	0	0	0	663
	3) EIA	0	6	0	0	0	0	0	0	0	0	0	0	6
	Subtotal	0	630	396	0	0	0	0	282	267	0	0	0	1,575
	2. Existing Landfill Improvement													
	1) Covering Soil	0	24	23	0	0	0	0	0	0	0	0	0	27
	2) Facility Site	0	68	0	0	0	0	0	0	0	0	0	0	68
	3) Slope Arrangement	0	70	0	0	0	0	0	0	0	0	0	0	70
	4) Truck Scale, etc	0	19	0	0	0	0	0	0	0	0	0	0	19
	5) construction for extension	0	0	267	0	0	0	0	0	0	0	0	0	267
	Subtotal	0	181	290	0	0	0	0	0	0	0	0	0	471
	3. Closure of Berri Band	0	0	0	11	0	0	0	0	0	0	0	0	11
	4. Heavy Equipment													
	1) Bulldozer	0	0	0	58	0	0	0	0	29	0	0	0	87
	2) Excavator	0	0	0	31	0	0	0	0	15	0	0	0	46
	3) Dump Truck	0	0	0	18	0	0	0	0	11	0	0	0	29
	Subtotal	0	0	0	107	0	0	0	0	55	0	0	0	162
	Total	0	811	686	118	0	0	0	282	322	0	0	0	2,219
Primary Collection /Public Involvement	Hiring Consultants	0	21	11	9	0	0	0	0	0	0	0	0	40
	Community SWM System Develop.	0	2	0	0	0	0	0	0	0	0	0	0	3
	Implementation of Ward SWM System	0	5	5	6	0	0	0	0	0	0	0	0	16
	Total	0	28	16	15	0	0	0	0	0	0	0	0	59
Grand Total		0	839	701	305	0	263	0	686	322	478	0	0	3,595

Note: 1) Price escalation is not applied.
2) Cost includes an additional cost of consulting service 10% and contingency 10%.

Table 7.3-5 Breakdown of Operation & Maintenance Cost

(Taka in million)

Operation	Cost Items	estimate	Master Plan											
		04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	Total
Cleaning of Road & Drain	Personnel	272	272	272	272	272	270	270	270	270	265	265	265	2,963
	Conservancy Materials	10	18	7	18	7	18	7	18	7	18	7	18	142
	Subtotal	282	290	279	290	279	288	277	288	277	283	272	283	3,105
Collection & Transport	Personnel	65	73	73	73	73	87	87	91	91	123	123	123	1,017
	Repair & maintenance	44	49	42	43	39	42	35	34	31	40	37	30	420
	Fuel	69	55	47	48	44	47	40	39	35	46	43	35	478
	Utility	1	1	1	1	1	1	1	1	1	1	1	1	13
	Container	9	15	2	14	1	20	3	17	4	39	8	9	131
	Subtotal	188	193	165	179	158	196	166	182	162	248	212	198	2,059
Final Disposal	Personnel	1	3	4	6	7	7	7	7	8	8	8	9	74
	Repair & maintenance	1	1	1	4	4	4	5	5	5	6	6	7	47
	Fuel	6	7	7	9	10	10	11	12	12	13	14	15	120
	Covering Soil	0	0	0	31	33	35	37	40	43	46	50	54	368
	Subtotal	8	10	11	50	54	56	59	63	69	73	78	85	608
Repair Works	Personnel	6	6	6	6	6	6	6	6	6	6	6	6	71
	Utility	3	3	3	3	3	3	3	3	3	3	3	3	29
	Subtotal	9	9	9	9	9	9	9	9	9	9	9	9	100
Primary Collection /Public Involvement	Personnel	0	1	1	1	4	4	4	4	4	4	4	4	35
	Awareness Program, Community Activities, etc.	0	1	1	1	5	5	5	6	6	2	2	2	36
	Subtotal	0	2	2	2	9	9	9	10	10	6	6	6	71
Management Improvement	Personnel	0	4	5	8	8	10	10	10	10	10	10	10	86
	Training, etc.	0	1	1	1	2	2	2	2	2	2	2	2	19
	Subtotal	0	5	6	9	10	12	12	12	12	12	12	12	115
Total		487	509	472	539	519	570	532	564	539	631	589	594	6,058

Note: Price escalation is not applied.

Chapter 8
Evaluation and Conclusions

8.1 Evaluation of Master Plan

(1) Technical Aspects

The technical system to be explored for the future SWM is summarized along with the process of waste stream as shown in Table 8.1-1. For the primary collection and road/drain cleaning, the conventional methods are assumed to be adopted continually. For the secondary collection and transport, the conventional combinations of dust bin & open truck, container & container carrier & trailer with tractor are proposed to be in use at the beginning. As the time elapses, existing vehicles become old and reduce in number. Since the replacement of retired open trucks is planned with container carriers accompanied by new containers, the two combinations namely container/carrier and trailer/tractor will survive to the end of the planning period. These systems do not require DCC cleaning staff, residents or private stakeholders additional special efforts, but require a more organized management system to adapt to them.

Table 8.1-1 Technical System Assumed in the Master Plan

Process	Primary collection	Road cleaning drain cleaning	Secondary collection	Transport	Final disposal
Measure	rickshaw	manual cleaning with wheel barrow	● dust bin & open truck ● container/carrier, ● tractor/trailer ↓ ● container/carrier, ● tractor/trailer	● open truck ● container/carrier, ● tractor/trailer ↓ ● container/carrier, ● tractor/trailer	● open dumping ↓ ● control dumping ↓ ● sanitary landfill

Regarding the final disposal, it is proposed that the conventional open dumping activities should be changed into a control dumping and sanitary landfill system as the priority projects and programs progress. This transition requires DCC staff in charge to learn technical features and practice of upgraded landfill method. In addition, DCC needs to spend much more money for improving the structure of the dump site and deploying much more heavy equipment for daily operation. These requirements are a sort of trial for DCC; however, the

extent is not as large as it can not be overcome by the efforts for expanding financial capacity. Some neighboring countries have already introduced sanitary landfill for years. Some of counterpart personnel were sent to one of such countries in 2004 to observe such technologies adopted there including sanitary landfill. Technical assistance from those countries which have advanced experience will be available under certain conditions. Thus the Master Plan is evaluated as technically viable.

(2) Economic Aspects

The total investment cost of the Master Plan is estimated at Tk. 3,595 million for activities during forthcoming 11 years. Although this amount is equivalent to almost half of the total budget for the financial year 2004/2005, the size of investment is not a remarkable impact on the economy of the whole society. DCC's special efforts and introduction of innovative polices to increase the government revenue is highly recommended. There is a possibility to double the current revenue to reassess the basis of property values. In this sense, the Master Plan is evaluated as economically viable.

(3) Social Aspects

One of the key issues of the Master Plan is social mobilization to improve SWM. The plan encourages local people to participate in primary collection of their waste and improvement of behavior to keep their place clean. The required activity is planned to disseminate to all residents under the initiative efforts of community leaders assumed to represent the smaller unit of town in the ward. The activities of local units will lead to better amenity of the area and more cooperative community than they recognized before execution of the Master Plan. The projects and program will not only contribute to cleaner environment in a certain area, but also contribute to formulating a community unit in which the residents have a sense of solidarity through achieving the common target of clean home town. In this sense the Master Plan is evaluated as socially viable

(4) Environmental Aspects

The Master Plan aims at cleaning city as a whole as the title "Clean Dhaka Master Plan" says. The implementation of the plan makes those areas surrounding a water body and voluntary or official dump sites more clean and hygienic by reducing illegal dumping and conducting sanitary landfill. Those people around such areas presently suffer from adverse environmental conditions caused by the current incomplete waste management. However, the situation will be definitely improved by the implementation of the Master Plan. In this sense, the Master Plan is evaluated as environmentally viable.

8.2 Conclusions

(1) Compliance with the National Policy

In October 2004, Ministry of Environment and Forest (MOEF), the Government of Bangladesh, organized a SAARC workshop on SWM. At the conclusion of the event, the

delegates from five countries (India, Pakistan, Nepal, Bhutan and Bangladesh) announced "the Dhaka Declaration on Waste Management 2004" with the unanimous consensus of all the participants. The declaration at first refers to the required nature of SWM as effective, efficient, affordable, safe and sustainable which the member countries are to promote. The declaration also pointed out several details to promote in member countries. It should be noted that most of them are in accord with the direction of the Master Plan concluded in this study as summarized below. MOEF is the authority to regulate the SWM at national level and it took the initiative in issuance of the declaration. The accord observed in the Master Plan and the declaration suggests that the plan substantially complies with the national policy.

- Open dumping should be stopped immediately and be replaced with new safe options like control dumping.
- Incineration as well as unproven technologies such as Plasma should not be considered as an option for the treatment of municipal solid waste for low calorific value and environmental pollution potential.
- Incineration may be considered for the treatment of infectious/hazardous bio-medical waste in absence of an appropriate non-burn technology.
- Informal waste picking practice should be improved by improving working conditions of the waste pickers and thereby reducing the occupational health hazards.
- Encourage NGOs and private companies to establish community based segregation at source, and to separate collection and resource recovery from waste with particular focus on composting.
- Hospital waste may be treated as a special waste and managed separately.
- The cost of SWM should be rationalized with the view to increase revenue in order to make the system financially viable.
- Waste collection, treatment and disposal may be privatized to allow greater mobilization of capital.

(2) Parallel Implementation of Projects and Programs

The Master Plan covers four major fields to achieve the goal of "Clean Dhaka." The corresponding projects and programs to the fields have the special targets of improvement as shown in Table 8.2-1. Since SWM is the mandated task of DCC, it is natural that the key program is to enhance its managing capacity. However, it is essential to execute the projects and programs in other three fields simultaneously for strengthening comprehensive governance of DCC.

Table 8.2-1 Focus of Improvement by Projects and Programs

field of program/project	Focus of Improvement			
	infrastructure (hardware)	organization/ institution (software)	social mobilization	capacity development
A: Community Based SWM		○	◎	○
B: Doubling Cleaning Capacity	◎	○		○
C: Improvement of Final Disposal	◎	◎		○
D: Enhancing Managing Capacity		◎	○	◎

◎: main focus of improvement ○: sub-focus of improvement

8.3 Recommendations

For the implementation of the Master Plan, it is recommended for DCC to take the following into consideration.

(1) To accelerate functioning of WMD with capable and practical personnel assigned exclusively to the required position.

(2) To acquire the government grant for the expense of specific project and program as soon as possible.

(3) To assign all the members of WMD to objective tasks stated in the Master Plan.

(4) To pursue foreign assistance for implementation of each project and program particularly for the training of DCC staff engaged in various assignments.

(5) To have regular contact with SOB over the use of GIS database for SWM.

(6) To keep regular contact with MOEF over the improvement of final disposal.

(7) To take consideration of the recommendations on industrial waste management and medical waste management presented in the appendix of this report.

APPENDIX

Appendix A

Special Recommendation for Industrial and Medical Waste

Concerted efforts are required to institute and improve environmental condition, and especially controls, to keep a large amount of waste generated from some specific industries and wastes containing hazardous substances including hazardous medical wastes out of the municipal waste management system. Most importantly, potential sources of hazardous materials in industrial wastes, whether they are served by public or private waste collectors including CBOs and NGOs, must be identified, registered, and targeted for appropriate management.

A.1 Industrial Waste

Currently there is no legislation to control industrial and hazardous waste management directly in Bangladesh. Although the laws controlling industrial and hazardous wastes are normally enacted at the governmental level, DCC has the key role in monitoring the generation of industrial and hazardous waste in its jurisdiction, identifying suitable sites for environmentally safe disposal and monitoring of the collection and disposal operations. In particular, incoming wastes are required to keep hazardous industrial wastes out of waste dumping site currently operated at Matuail since there is neither engineering consideration to protect surrounding environment nor appropriate operational standards for waste deposit. The most critical requirements arise in relation to hazardous wastes from small-scale industries, as so many are operated in DCC, which are practically impossible to prevent from entering the normal waste stream.

A large-volume-waste-generator, if identified, requires some measures to control its waste coming to the DCC dumpsite since those wastes may consume the capacity of dumpsite so quickly. Estimation of this study shows the amount of industrial waste generation is 200 tons/day, of which 150 tons/day are from tannery industry, and this is not so large compared to a total waste generation of 3,000 tons/day in the Study area. Although some of the tannery wastes are recycled to produce fish or animal feeds, most of them are considered to be directed to the dumpsite. The number of establishments in textile and garment industry is large in DCC and thus the amount of wastes produced is likely large because of inactive reuse and recycling of those wastes.

To improve industrial wastes management is currently proving to be an obstacle to DCC's waste management system; hence, intensive negotiations and coordination among stakeholders are required to formulate a better system. The Ministry of Industry, associations of specific industries and DCC may have major roles and responsibilities for this coordination and integration of policy. Planning issues for a formulation of appropriate industrial waste management system to improve current practice include the following:

- Demarcation of role and responsibility to control industrial waste between central government and DCC;
- Definition of industrial waste which DCC handles,
- Collection and tipping fee;
- Discharge/Storage/Collection method;
- Land disposal planning; and
- Countermeasures for hazardous waste.

A.2 Medical Waste

Special attention must also be given to the management of infectious waste originating from hospitals and clinics. There is an urgent need for planning and implementation of medical waste management systems, and for the integration of appropriate procedures and methods into both health care and waste management systems for appropriate medical waste management both in healthcare establishments and in waste handling sectors such as DCC. Coordination and integration of both entities are indispensable for medical waste management. And consistency or conformity in policy and technologies employed at both entities are also required.

Figure 1 shows some approaches for medical waste management in the Study area. In this these approaches, institutional and technical developments and human resources development need to be strengthened for both medical establishments and DCC. Also, introduction of new system for a safe disposal of segregated and collected hazardous hospital wastes is proposed. Intensive segregation of hazardous waste at sources is essential for better hospital waste management. The share of hazardous waste to total hospital wastes is 10%~20% in general hospitals, so that, if segregated thoroughly, the amount of waste requiring special attention for handling is less. To do this training to hospital worker including doctors, nurses, and supporting staff is required. This training also contributes to raise their awareness to hospital waste and thereby, infection caused by inappropriate handling of infectious waste may be prevented.

In-house treatment of hazardous waste should be encouraged especially for a large hospital. Hazardous hospital wastes from middle and small hospitals that are incapable of owning an on-site treatment system are to be stored appropriately in hospitals and collected by waste collection vehicle exclusively designed for medical waste hauling and transported for centralized treatment or disposal. Setup of such facilities, number of facilities, technologies,

ownership, procurement of initial cost, treatment fee, management system, etc. are issues among stakeholders.

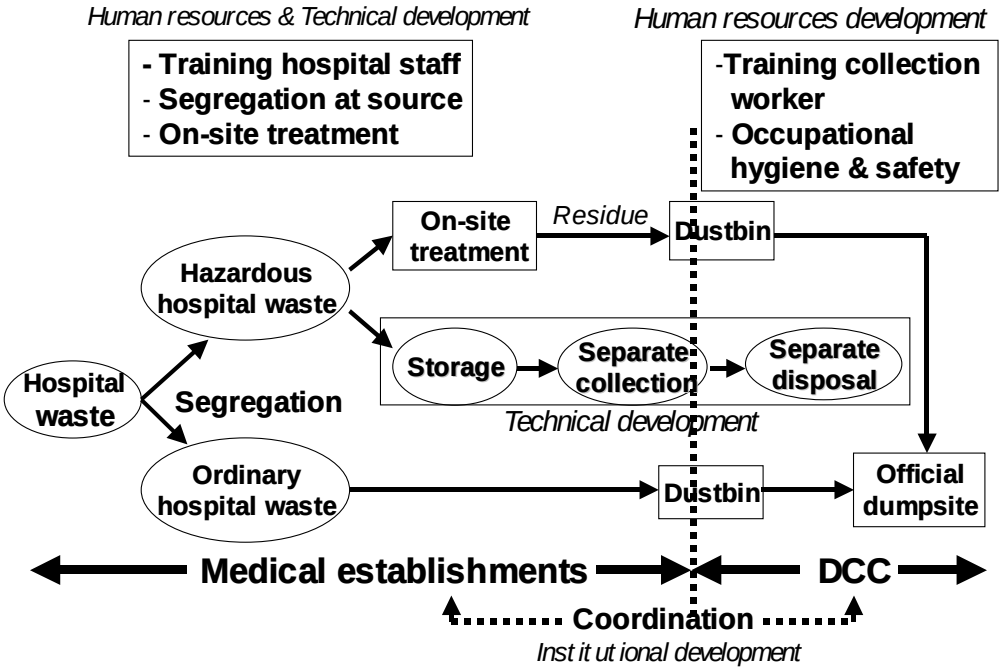


Figure A.2.1 Approaches for Appropriate Medical Waste Management in DCC.

Training for waste handlers in DCC is also necessary as a program of human resources development, irrespective of handling only medical wastes or ordinary domestic wastes. Targeted trainees include SWMD in DCC as well as wards officers in charge of inspection of waste management, waste collection workers, and workers at dumpsites. This training is required for ensuring occupational hygiene and safety. Especially in handling hazardous hospital wastes, awareness and correct knowledge are needed for waste handlers to prevent epidemics of infectious diseases originating from hospital wastes.

Appendix B
Summary of Master Plan

Based on the envisaged strategies for each technical and institutional component, projects and programs have been identified; these strategies can be materialized through concrete actions to be taken by key stakeholders as well as DCC. These recommended programs and projects are tabulated below under seven headings: Primary Collection, Secondary Collection, Final Disposal, Legal Aspect, Organization, Financial Management, and Privatization:

B.1 Primary Collection and Public Involvement

Table B.1 Projects/Programs of Primary Collection/Public Involvement

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Program for Institutionalization of Ward Solid Waste Management System**	**WMD**	**CD**	**2005-2007**
1)	Evaluation of Pilot Project A conducted in the Master Planning Study		CD	↑
2)	Formulation and adoption of legal framework and a guideline for implementing Ward Solid Waste Management System		CD	↑
3)	Development of a manual on implementing Ward Solid Waste Management System		CD	↑
4)	Implementation of training for staff of Community Solid Waste Management Section of WMD as trainers/facilitators		CD	↑
5)	Implementation of training for DCC Community Coordinators of Zone Offices as trainers/facilitators		CD	2005-2010
6)	Implementation of training for staff of Conservancy Department of Zone Offices (CO, CSI&CI)		CD	2005-2007
7)	Implementation of training for DCC decision makers (CCO, DCCO, ACCOs, Division Manager and Section Managers of WMD)		CD	↑
2	**Program for Establishing a System of Approval and Monitoring of Primary Collection Service Providers**	**WMD**	**CD**	↑
1)	Formulation and adoption of legal framework and a guideline for primary collection service system		CD	↑
2)	Development of a manual on primary collection service		CD	↑

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
3	**Program for Supporting Primary Collection Service Providers**	**WMD**	**CD**	↑
1)	Development of micro credit scheme for primary waste collection		CD	↑
2)	Development of facilities/equipment for suitable and efficient primary collection and for linkage with secondary collection		CD	↑
3)	Implementation of training for primary collection service providers		CD	↑
4)	Organizing technical conferences on primary collection			2005-2007
4	**Program for Initial Implementation of Ward Solid Waste Management System (20 Wards)**	**WMD**	**CD**	↑
1)	Training for Ward Solid Waste Management Organizations		CD	↑
2)	Training for primary collection service providers		CD	↑
3)	Baseline surveys		CD	↑
4)	Planning workshops at ward level		CD	↑
5)	Making agreements between Ward SWM Committee and primary collection service providers		CD	↑
6)	Coordination conferences among related stakeholders		CD	↑
7)	Community meetings to develop/improve primary collection activities		CD	↑
8)	Improvement of rickshaw vans, community containers and DCC containers		CD	↑
9)	Implementation of awareness program		CD	↑
5	**Program for Expansion of Ward Solid Waste Management System Citywide**	**WMD**	**CD**	**2007-2015**
6	**Slum Solid Waste Management Program**	**WMD**	**CD, SDD**	↑
1)	Implementation of awareness program integrated with health education		CD, SDD	↑
2)	Implementation of slum solid waste management project integrated with slum development project		CD, SDD	↑
7	**Program for Promoting IEC Activities for Raising People's Awareness**	**WMD**	**CD**	**2007-2010**
1)	Establishment of Public Awareness Section under Community Solid Waste Management Division		CD	↑
2)	Training for staff of Public Awareness Section of Community Solid Waste Management Division		CD	↑
3)	Development and Production of IEC Materials		CD	↑
8	**Strengthening of School Education on Solid Waste**	**MOPME**	**WMD**	**2007-2015**
1)	Development of curricula regarding solid waste		WMD	↑
2)	Training for school teachers		WMD	↑
9	**Organization of Clean Dhaka Ward Contest**	**WMD**	**CD**	**2007-2010**
10	**Organization of Bangladesh Solid Waste Management Conference**	**WMD**	**CD of DCC, CCC, RCC, KCC**	**2005-2007**

Note: WMD（Waste Management Division/Department in future); CD (Conservancy Department); SDD (Slum Development Department); MOPME (Ministry of Primary and Mass Education); DCC (Dhaka City Corporation); CCC (Chittagong City Corporation), RCC (Rajshahi City Corporation); KCC (Khulna City Corporation)

B.2 Secondary Collection/Transport and Road/Drain Cleaning

Table B.2 Projects/Programs of Secondary Collection/Transport and Road/Drain Cleaning

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Increase of Collection/Transport Capacity**			
1)	Procurement of New Trucks & Waste Containers	ED	CD, TD	2005-2015
2)	Increase of Drivers and Container Cleaners	CD, TD	-	↑
2	**Formation of Management Chain in SWM**	**WMD**	**CD, TD**	**2005-2007**
3	**Setting up Operation and management Plan**			
1)	Improvement of Waste Container	↑	CD, TD, ED	2005-2007
2)	phase-out of dustbins and appropriate setup of containers	↑	CD, TD, ED	2005-2015
3)	development of GIS for SWM	↑	CD, TD, UPD	↑
4)	Introduction of Mechanized Cleaning Equipment	ED	CD, TD	↑
5)	Surface Drain Construction	↑	CD, TD	↑
6)	shortening time for vehicle repair	↑	CD, TD	↑
4	**Capacity Development of DCC Staff**	WMD	**CD, TD**	**2005-2010**
5	**Mitigation of Health Risks to Cleaners and Drivers**	↑	**CD, TD**	**2005-2010**
6	**Pursuit of Privatization of Collection/Transport**	↑	**CD, TD**	**2005-2010**
7	**Coordination with Recycle Industry**	↑	**CD**	**2005-2010**

Note: ED (Engineering Department); WMD（Waste Management Division/Department in future); CD (Conservancy Department); TD (Transport Department), UPD (Urban Planning Department)

B.3 Final Disposal

Table B.3 Projects/Programs of Final Disposal

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Improvement of Existing Matuail Dump Site**	**WMD**	**CD, ED**	**2005-2007**
2	**Securing Future Landfill Site**	**WMD**	**CD, ED**	**2005-2015**
3	**Closure of Berri Band Dump Site**	**WMD**	**CD, ED**	**2007-2010**
4	**Establishment of Management Organization for Final Disposal**	**WMD**	**CD, ED, TD**	**2005-2007**
5	**Capacity Development of Disposal Section**	**WMD**	**CD, ED**	**2005-2007**

Note: ED (Engineering Department); WMD（Waste Management Division/Department in future); CD (Conservancy Department); TD (Transport Department)

B.4 Legal Aspect

Table B.4 Projects/Programs of Legal Aspect

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Clarifying Responsibility Allocation with DCC and Waste Generators**	**WMC, WMD**	**UPD, CD**	**2005-2010**
1)	standardization of procedure for container deployment		UPD, CD	2005-2007
2)	change of responsibility allocation for removal and disposal of business waste		LGD, MOEF	2007-2010
2	**Compliance with Environmental Conservation Act/ Rules and Preservation Act**	**WMC, WMD**	**CD, ED**	**2007-2015**
1)	fulfilling responsibility for proper disposal		CD, ED	↑
2)	formulation and implementation of Environmental Management Plan (EMP) for Matuail dump site in accordance with Environmental Conservation Rules		CD, ED	↑
3)	reconfirmation of compliance of new landfill sites with Preservation Act		CD, ED	2005
3	**Enforcement of Section 150 against Illegal Garbage Throwing and Dumping**	**CD**	**WMD, Magistrates**	**2007-2015**
4	**Legal Training to DCC Staff**	**WMD**	**CD, ED, TD, UPD**	**2007-2015**

Note: WMC (Waste Management Committee), WMD（Waste Management Division/Department in future); CD (Conservancy Department); TD (Transport Department), ED (Engineering Department); UPD (Urban Planning Department), AD (Accounts Department), LGD (Local Government Division in the Ministry of Local Government, Rural Development and Co-operatives, MOEF (Ministry of Environment and Forests)

B.5 Organization

Table B.5 Projects/Programs of Organization

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Preparation of Annual Operation Plan according to Master Plan**	**WMC, WMD**	**CD, ED, TD, AD**	**2007-2015**
2	**Improvement of Operational Organization**	**WMC, WMD**	**CD, TD, ED**	**2005-2010**
1)	transfer transport functions to Zone Office		CD, TD	2007-2008
2)	improvement of vehicle and equipment maintenance		CD, TD, ED	2005-2010
3	**Reforming Organization for SWM**	**WMC, WMD**	**CD, TD, ED, UPD, AD, ESD**	**2005-2012**
1)	one department with planning/monitoring and implementing functions related to SWM (phased development of future organization)		CD, TD, ED, UPD, AD, ESD	2005-2012
2)	change composition of WMC		CD	2007-2012
4	**Training of DCC Staff for SWM**	**WMD**	**CD, ED. TD, UPD**	**2007-2015**
1)	technical training for junior engineering staff		CD, ED. TD, UPD	↑
2)	preparation of reference library for research and self-study		CD, ED. TD, UPD	2007-2015

Note: WMC (Waste Management Committee), WMD（Waste Management Division/Department in future); CD (Conservancy Department); TD (Transport Department), ED (Engineering Department); UPD (Urban Planning Department), AD (Accounts Department), ESD (Establishment Department)

B.6 Financial Management

Table B.6 Projects/Programs of Financial Management

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Modification of Accounting system to Exhibit Actual SWM Cost explicitly**	**WMD**	**AD**	**2005-2012**
2	**Financing for Master Plan Implementation**	**WMC, WMD**	**AD**	**2005-2015**

Note: WMC (Waste Management Committee), WMD（Waste Management Division/Department in future); AD (Accounts Department)

B.7 Privatization

Table B.7 Projects/Programs of Privatization

	Title of Program/ Program Components	Executing Body	Concerning Body	Time of Execution
1	**Continuation of Pilot Project on Privatization with In-depth Evaluation for Expansion of Privatization**	**WMD**	**CD, TD, UPD**	**2005-2012**

Note: WMD（Waste Management Division/Department in future); CD (Conservancy Department); TD (Transport Department), UPD (Urban Planning Department)