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 3

Supporting 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

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
DEM	Digital Elevation Model
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
FM	Facility Management
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
SPOT	the name of satellite operated by French government
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

Final Report

Volume 3: Supporting Report

Table of Contents

List of Abbreviation and Acronyms

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
Overview of Dhaka City

1.1 Geography

Dhaka City was established in the year 1608 along the bank of the river Buriganga and was made Provincial capital in the year 1905 with the total area of about 6 sq. km. In 1947 the city emerged as the provincial capital of the then East Pakistan. After independence in 1971, Dhaka became the capital of Bangladesh. Now the Metropolitan city of Dhaka has an area of 131 sq. km. Dhaka's dominant feature is the small proportion of land which is permanently flood free. Virtually all flood free land close to Dhaka has already been developed. Dhaka City is located at a latitude of 23o 43' N and longitude of 90o 24' E. The climate is tropical with heavy rain and bright sunshine in the monsoon and warm for the greater part of the year. Annual rainfall is about 2,540 mm and humidity is about 80 %.

1.2 Population

The total population in Dhaka City grew from only 0.10 million in 1906 to 5.3 million in 2001, according to the countrywide census carried out in the year 2001. Table 1.2-1 shows the census population of Dhaka City in 2001. The rapid rise of population has been caused mainly by a large number of people migrating from rural areas. The average population density is above 400 persons/ha on average. In old Dhaka, most of wards exceed the average population density, while the northern part of the city has smaller density but has still more potential of population growth. With limited availability of flood free land areas in Dhaka City, further densification and haphazard encroachment to northern wards and peripheral areas are in progress.

Table 1.2-1 Population of Dhaka City

year	total household (million)	total population (million)	total male (million)	total female (million)	total area (km^2)***	average pop. density (capita/ha)
2001*	1.107	5.282	2.986	2.296	131.2	403
2004**		5.726			131.2	436

* Source: Population Census 2001, BBS
** Estimate by the Study Team
*** Source: GIS Data 2004, BBS

1.3 Economic Situations

The GDP growth of the country between 1991 and 1996 was 4.1 % per year. The agriculture sector grew at only 1.8 % whereas the industry and commercial service sectors at 5.6 % and 5.9 % respectively. Considering the relatively low potential growth of the agricultural sector in rural areas due to little expansion of arable land and the slow increase in productivity, future economic growth will depend more on the secondary and tertiary sectors, which are mostly provided in urban centers.

Dhaka's economic contribution is significant, although there is no official data or system to estimate the economic products at local government level. Considering that the garment industry contributed largely to the economic growth and with more than 90 % the manufacturers located in Dhaka, the per capita GDP of Dhaka is much higher than the national average. As Dhaka is a large urban agglomeration, the contribution of commercial and service sectors are also significant. With well-provided economic and social infrastructures, Dhaka will be the engine of the economic growth in the country.

1.4 Land Use and Infrastructure

Urban Planning Department is in the process of preparing land use maps for 38 wards. Another study being funded by JICA is also preparing land use maps for Dhaka City. These maps will be utilized in the study at the later stage when these maps will be made available by DCC.

The available residential land area is very scarce in Dhaka City. With the area of 131 sq. km Dhaka City has to accommodate more than 5.3 million people. Being capital of the country, central government offices, large educational institutions, hospitals exist in the city.

Legally there was no designated place for disposal of solid wastes several years ago and public land was used for waste disposal. At present Dhaka City Corporation has acquired land at the outskirts of the city for disposal of solid wastes.

1.5 Environmental Conditions

According to an UNFPA report (Huda, Kitakyushu 2001), Dhaka is one of the most polluted cities in the world. Three major issues of concern are air pollution, water pollution and municipal waste. The research shows that Suspended particulate matter (SPM) and SO_2 levels in Dhaka exceed 12 and 10 times of the World Health Organization standard respectively. A recent World Bank report (Huda, Kitakyushu 2001) claims four major cities in Bangladesh lose about 15,000 lives each year due to air pollution.

In Dhaka City more than 3 million people do not have legal access to water supply. Only 41% of city population get continuous water supply. However quality of water is poor and the incidence of water-borne diseases such as diarrhea, cholera, dysentery, jaundice, typhoid etc. is very high. Analysis of drinking water (World Bank, 2000) from different sources

revealed that both the total and fecal coliform counts of the samples were unacceptably high. It has been reported that Buriganga contains soluble chromium, which causes cancer. The major source of chromium is the leather industries, most of which are situated along the river in Hazaribagh.

The water bodies within and around Dhaka City are polluted mainly due to indiscriminate discharge of wastewater. About 45 % of populations are connected to separate or combined sewerage system and 11% of populations are connected to septic tank. Rest of the population discharges wastewater directly or indirectly to water bodies. The lakes within the city are polluted. These water bodies often are loaded with human excreta, decomposable kitchen wastes, other non-decomposable wastes and industrial effluents.

Disposal of solid wastes is another area of concern in Dhaka City. More than 3,000 metric tons of solid wastes are produced each day in Dhaka City, of which about 20 metric tons are from hospitals and clinics and contains small portion of hazardous wastes. These wastes, when dumped with other municipal wastes in the open land, poses serious threat to health of the citizens. Dhaka City Corporation (DCC) is responsible for collection and disposal of solid waste generated in the DCC area. Only about 44 % of generated waste is collected and dumped at landfill sites. The rest of generated waste is supposed to be dumped at unauthorized places, which makes environmental scenarios of Dhaka City gloomy and dismal for the future. Such inadequate and uncontrolled management of wastes causes serious health hazards, environmental degradation in the city. Issues related to solid waste management in the city are elaborated in detail in the following chapters.

1.6 Social and Cultural Conditions

(1) History of Growing Area and Population of Dhaka City

Population was increased 19.5 times between 1951 and 2001. Main causes for increasing of population was migration from rural area to Dhaka and from India to Dhaka. Settlement of Dhaka town was started near the banks of Buriganga River during the 16th century and it was enlarged, growing wider to the direction of north and west-east year after year except lowlands in east of Dhaka City. The old part of Dhaka is populated by many small industries and houses in limited area and the roads are narrow.

Migration during independence

During the year of Bangladesh's independence, a large number of Hindus migrated from Dhaka to west Bengal and also a large number of Indian Muslims migrated from West Bengal, Bihar, Uttar Pradesh, etc., far outweighing the number of immigrating Hindus. Most of migrants from India settled in old part of Dhaka and industrial area. Then after the rapid growth of trade, commerce and industry, and the expansion and development of technology, other groups of people were also attracted to these areas.

Migration from rural to urban city

Large-scale movement of the population has been a feature for a very long time – people moving within rural areas, from urban area to rural area and its reverse in Bangladesh. But from the 1970s, this situation had changed clearly: the most consistent flow of migration has indeed been from rural area to urban area. According to the survey of Anwara Begun (book=Destination Dhaka, the dwellers who migrated gave the following reasons for moving to the city:

Pavement dwellers	:	1) family quarrel: 30%
		2) present income cannot maintain family: 15%
		3) incapacitated/begging is only alternative: 10%
Slum dwellers	:	1) present income cannot maintain family: 30.5%
		2) River erosion by flood: 16.2%
		3) lack of employment; 12.4%.

Ninety-nine percent of respondents to the survey had no skills and two-thirds were illiterate; therefore most of migrants could not get good income from their jobs in Dhaka City.

(2) Religion

Majority of the population in all parts of Dhaka district including the city is Muslim. A century ago Hindus constituted a third of the country but now only 10% of the population is Hindu. One of the big factors of decrease of Hindus is that many Hindus migrated to India in the decades since the partition in 1947. Population by religion based on census conducted in Dhaka district is shown in Table 1.6-1.

Table 1.6-1 Census of Population by Religion in Dhaka District

Religion/year	1951 (%)*1	1961 (%)*1	1991 (%)*2
Muslim	3,212,711 (78.5)	4,203,400 (82.5)	12,167 (92.0)
Caste Hindus	415,873 (10.2)	443,222 (8.7)	985 (7.4)
Scheduled Hindus	424,285 (10.4)	427,524 (8.40)	
Christians	19,114 (0.40)	21,230 (0.40)	60 (0.5)
Others	19,912 (0.50)	369 (0.00)	20 (0.2)
Total	4,091,895 (100)	5,095,745 (100)	13,232 (100)

Source: *1: Bangladesh District Gazetteers Dacca 1975

*2: Statistical Yearbook of Bangladesh, 2000

Muslim

Bangladesh's Muslim majority is almost Sunni sect. Shias are concentrated mainly in the city of Dhaka, and the Ismailia communities of the Shia sect are migrants in old part of and are actively engaged in the trades of the Dhaka district. During the month-long observance of Ramadan, Muslims are prohibited from eating between sunrise to sunset – this might affect

solid waste management. And during the days of Eid ceremony, street cleaning and garbage collection by DCC might also be affected.

Hinduism

Before the partition in 1947, Hindus were highly influential and, in terms of wealth and learning, were far more advanced than Muslims, both government services and private business. Many Caste Hindus migrated to India, but many Scheduled Caste Hindus (fishermen, sweepers, etc) remained in Bangladesh. Hindu population was decreased.

Christianity

There is a very small Christian population in Dhaka district, mostly comprising descendants of Portuguese traders and adventurers. There are Christian villages near Arikhola railway station and near Nawabganj Thana. Most of the Christians are Roman Catholics.

(3) Culture

The culture of Dhaka City is predominantly Islamic. The influence of Islam on the language, literature, folk song, dressing and social customs of the people is very strongly manifested.

They are very punctilious in the performance of their religious rites and ceremonies and follow the orthodox tradition even in respect of dressing and manners. They daily wash themselves clean, and the Muslims perform ablution or "wazi" five times daily before saying their prayers.

The culture of the people of the city was greatly molded and influenced by the various orders of the Sufis or mystics of Arabian or Persian origin who settled here during the Muslim rule and played a very significant part in the development of the community.

(4) Education

The Literacy rate of Dhaka City is about 64.1 %. Unemployment rate is 10 % and about 10 % are underemployed (Huda, Kitakyushu, 2001). Per capita income is about US $ 450. About 55 % people live below the poverty line in Dhaka and half of those poor people live in slums and squatter settlements. The slum population has increased to about 3 million in the last decade with almost no access to water supply, sanitation, solid waste management and other civic and social services.

1.7 Comparative Features of SWM in Adjacent Countries

Table 1.7-1 shows a comparison of features of SWM in adjacent countries. Principal indexes are featured as follows.

(1) Unit Waste Generation

Dhaka City generates approximately 0.56 kg of municipal waste per day per capita according to the survey in 2004: it is ranked at smallest among cities in comparison.

(2) Collection Rate

Dhaka City Corporation collects municipal waste at about 44 % of total generation as an estimate by the study team in 2004: it lies in comparably lower level among cities in comparison.

(3) Share of SWM Budget in Municipality Budget

Dhaka City Corporation allocates budget for SWM at about 18 % of total budget of the city: it is ranked at second highest among cities in comparison.

(4) SWM Budget per GNP per capita

The rate of budget for SWM to GNP per capita proves 2.5 % in Dhaka City: it lies in medium level among cities in comparison.

(5) Out-sourcing to Private Firms

Dhaka City Corporation partly adopts private firms for collection and transport of municipal waste: it is ranked at comparably advanced level among cities in comparison.

(6) Grade of Sanitary Condition of Final Disposal

Dhaka City Corporation still conducts open dumping, which is the most primitive level toward sanitary landfill as shown below: it lies in comparably lower level among cities in comparison.

grade	definition of sanitary condition
0	open dumping
1	controlled dumping (without soil cover but the place for daily dumping is controlled)
2	sanitary landfill (with soil cover and surrounding earth bund)
3	sanitary landfill (with soil cover and surrounding earth bund, in addition, leachate is collected and returned to the waste pile)
4	sanitary landfill (with soil cover and surrounding earth bund, in addition, leachate is collected and treated before discharge)

Table 1.7-1 Comparison of Features of SWM in Adjacent Countries

Country		**Bangladesh**	Philippines	Thailand	Indonesia	Viet Nam	Malaysia	Pakistan
City		**Dhaka**	Manila	Bangkok	Jakarta	Hanoi	Penan	Lawarpingi
Population (1,000)		**5,726**	9,454	5,716	7,300	1,313	559	780
Year of study completion		**2004**	1997	1990	1986	2000	1988	1995
GNP per capita	US$/capita/year	**323**	634	1,420	560	350	2,340	430
Unit Waste Generation								
city total	kg/capita/day	**0.56**	0.57	0.88	0.68	1.33	0.77	0.90
Solid Waste Amount								
waste generation amount	t/d	**3,200**	5,345	5,043	4,930	1,752	432	702
waste collection amount	t/d	**1,400**	3,496	4,085	2,310	1,317	372	283
final disposal amount	t/d	**1,385**	3,900	4,072	2,160	1,314	408	283
collection rate	%	**44 %**	80 %	81 %	70 %	76 %	97 %	41 %
Financial Status of Cleansing Authority *								
annual budget of municipality	million US$/y	**46**	404	546	267	130	28	18
annual budget for SWM	million US$/y	**8.2**	57.9	80.0	11.0	5.2	7.0	2.8
share of SWM budget	%	**18 %**	14 %	15 %	4 %	4 %	25 %	15 %
per-capita SWM budget	US$/capita/y	**1.4**	6.1	14.0	1.5	4.0	12.5	3.6
SWM budget per GDP	%	**0.4 %**	**1.0 %**	**1.0 %**	**0.3 %**	**1.1 %**	**0.5 %**	**0.8 %**
Out-sourcing to Private Firms								
yes or no	collection	**yes**	yes	yes	no	no	no	no
	transport	**yes**	yes	yes	no	no	no	no
	intermed. Treat.	**no**	no	no	no	no	no	no
	final disposal	**no**	yes	yes	no	no	no	no
Sanitary Condition of Final Disposal Site **		**O**	1	O	O	O	2	O

note *: Financial year 2002 to 2003 for Dhaka with the exchange rate Tk 58 per US dollar

note **: grade of sanitary condition of final disposal site

O: open dumping

1: controlled dumping (without soil cover but the place for daily dumping is controlled)

2: sanitary landfill (with soil cover and surrounding earth bund)

3: sanitary landfill (with soil cover and surrounding earth bund, in addition, leachate is collected and returned to the waste pile)

4: sanitary landfill (with soil cover and surrounding earth bund, in addition, leachate is collected and treated before discharge)

1.8 Profile of Dhaka City Corporation

(1) Functions of Dhaka City Corporation

Functions of Dhaka City Corporation (DCC) are stipulated in Part IV of Dhaka City Corporation Ordinance, 1983. There are compulsory and optional functions. For the compulsory functions DCC shall carry out the duties, while for the optional ones DCC may perform them. In case the Government requires, however, DCC shall carry out optional functions. DCC is required and performs additional functions other than those provided in the Ordinance. Some of the compulsory functions are not actually performed at present by DCC.

Table 1.8-1 Functions of DCC

Functions of DCC		compulsory/ optional/ additional
Public Health	i) measures required for sanitation	optional
	ii) control of insanitary buildings	optional
	iii) removal, collection and disposal of waste	**compulsory**
	iv) provision and maintenance of public latrines and urinals	optional
	v) registration of births, deaths and marriage	compulsory
	vi) control and prevention of infectious diseases (performing eradication of mosquitoes)	compulsory
	vii) establishment and maintenance of health and maternity centres, etc.	optional
	viii) promotion of public health and health education	optional
	ix) establishment and maintenance of hospitals and dispensaries	optional
	x) provision and maintenance of medical relief	optional
Water Supply and Drainage	i) water supply	optional
	ii) control and regulation of private sources of water supply	compulsory
	iii) provision and maintenance of adequate system of public drains	compulsory
	iv) preparation of drainage scheme	optional
	v) provisions and maintenance of public bathing and washing places	optional
	vi) declaration of public water courses	optional
	vi) management of public ferry and fisheries in public water courses	optional
Articles of Food and Drink	i) regulation of manufacturing, import and sale of food and drink	optional
	ii) licensing milk supply	compulsory
	iii) establishment and maintenance of public markets	optional
	iv) control and regulation of private markets	compulsory
	v) provisions and maintenance of slaughter houses	compulsory
Animals	i) establishment and maintenance of veterinary hospitals and dispensaries, and prevention of contagious animal diseases	optional
	ii) seizure, detention and impounding of stray animals	optional
	iii) establishment and maintenance of animal homes and farms	optional
	iv) registration of cattle and other specified animals	optional
	v) improvement of livestock	optional
	vi) detention, destruction and disposal of dangerous animals	optional
	vii) holding of cattle shows and maintenance zoological gardens	optional
	viii) disposal of carcasses	compulsory

Functions of DCC		compulsory/ optional/ additional
Town Planning	i) development of master plan for the city	optional
	ii) preparation of site development schemes	optional
	iii) execution of site development schemes	optional
Building Control	i) building control (with respect to dangerous buildings)	optional
Streets	i) provision and maintenance of public streets, and prepare and execute road maintenance and development scheme	compulsory
	ii) regulation of streets other than public streets	optional
	iii) naming streets	optional
	iv) prevention of street encroachment	compulsory
	v) street lighting	compulsory
	vi) street watering	compulsory
	vii) control and regulation of traffic	compulsory
	viii) licensing of public vehicles	compulsory
Public Safety	i) fire fighting	optional
	ii) civil defence	compulsory
	iii) flood fighting	optional
	iv) anti-famine measure	optional
	v) control of dangerous and offensive articles and trades	optional
	vi) provision and maintenance of graveyards and burning places	optional
Trees, Parks, Gardens and Forests	i) planting trees on public streets and other public places	compulsory
	ii) laying out and maintenance of public gardens under garden development plan	optional
	iii) provision and maintenance of open spaces	optional
	iv) provision, improvement development, and maintenance of forests and plants	optional
	v) pests control and control of dangerous forests and plants	optional
	vi) improvement of tanks and reclamation of low-lying areas	optional
Education	i) maintenance of educational institutions	optional
	ii) enforcement of compulsory education	compulsory
	iii) promotion of education	optional
Culture	i) promotion of cultural activities (through museums, exhibitions, art galleries, information centres, sports, games and physical culture, public halls and community centres, etc.)	optional
	ii) establishment of public libraries, reading rooms and circulating libraries	optional
Social Welfare	i) promotion of social welfare (through welfare homes, asylums, orphanage, widow homes and other institutions, and by prevention of beg, prostitution, gambling, taking of injurious drugs, consumption of alcohol, juvenile delinquency, etc.)	optional
Develop-ment	i) preparation and implementation of development plans	optional
	ii) Sponsoring and promoting of community development projects	optional
	iii) Promotion, administration, and implementation of commercial schemes	optional
	i) issuance of certificate relating to nationality, character and succession	additional
	ii) conciliation of certain disputes under the Conciliation of Disputes (Municipal Areas) Ordinance, 1979 (such as contracts, marriage, recovery of possessions of immobile property, compensation for damages against mobile property, etc.)	additional

Source: DCC Ordinance and " Overcoming the Governance Crisis in Dhaka City" , 2000

The Word Commissioners perform the following functions:

- formulate development plan of the ward and submit it for inclusion of DCC development programme
- inspect DCC development works in the ward and recommend payment of the bill
- sign the monthly salary bill of muster roll conservancy staff within the ward after checking their attendance and performance
- issue nationality, succession and character certificate to citizens within the ward

(2) Organisation

The organization structure of DCC is shown below. Executive power of DCC vests in the Mayor, assisted by the Chief Executive Officer, who is in turn assisted by the Secretary, Heads of the Department and Zone Executive Officers.

Figure 1.8-1 Organization of DCC

(3) Staff of DCC

DCC has around 12,200 approved posts and actual employees of 11,100 persons. Fourth Class employees are excluded from the Local Council Service. Among the staff, Chief Executive Officer (CEO) and Zone Executive Officer (ZEO) are deputed from the Government. Some Heads of Departments, from time to time, are also deputed.

Table 1.8-2 Manpower of DCC by Category

Category		Approved	Existing	Vacant
1st Class	Senior administrative and professional posts	346	271	75
2nd Class	Senior administrative and professional posts	178	127	51
3rd Class	Skilled and clerical employees with supervisory responsibility for non-skilled workers	2298	1735	563
4th Class	Non-skilled workers	2230	1836	394
Total		5052	3969	1083
Muster Roll	Conservancy Workers	7156	7156	0
Grand Total		12208	11125	1083

as of 2002, source: Dhaka City Corporation

(4) Evolution Local Government of Dhaka

Dhaka Municipality was established with introduction of Dhaka Municipal Improvement Act, 1864. Prior to the establishment, a Committee of Improvement was set up as early as 1823, and replaced by Dhaka Committee in 1840. Dhaka Municipal Committee was formed with members appointed by the Government, and the District Magistrate was ex-officio Chairman of the Committee. The main functions of the Committee were, i) maintenance of town police, and ii) maintenance of roads, iii) conservancy, iv) control of offensive trades and v) vaccinations. Main source of the revenue was the tax on value of holdings.

Bengal Municipal Act of 1884 introduced elected representatives. Two-thirds of the Commissioners were elected, and they elected the Chairman and Vice Chairman among themselves. The Act also extended tax base and functions of the municipality. Provisions of hospitals, dispensaries, playgrounds, libraries, fire brigades, etc., were included. Bengal Municipal Act of 1932 extended election franchise to women and reduced the portion of appointed Commissioners from one third to one fifth. The Act specified and clarified the inspection, control and supervision by the local offices of the Government.

Municipal Administration Ordinance of 1960, however, repealed all previous municipal laws and provided officially appointed Chairman whose tenure was determined at the pleasure of the Government. Dhaka was divided in to 25 Unions (later to 30 Unions in 1964).

Dhaka became the Capital of Bangladesh with the independence in 1971. Pourashava Ordinance of 1977 introduced direct election of Ward Commissioners and one Chairman elected among the Commissioners. In 1978, Dhaka was awarded the status of corporation and the Chairman at the time became Mayor. The Municipal Corporation, however, was

superseded by Martial Law of 1982. Mirpur and Gulshan were merged with Dhaka in the same year.

In 1983, Dhaka Municipal Corporation Ordinance was enacted, repealing the application of Pourashava Ordinance of 1977. In 1990, Dhaka Municipal Corporation was renamed as Dhaka City Corporation, and was divided into ten Zones with the objective of decentralisation.

In 1993, the Government made drastic amendment of the Ordinance for the democratisation of the Corporation and introduced direct election of the Mayor on the basis of adult franchise. The City was divided into 90 Wards and one directly elected Commissioner represented each Ward. Reserved seats of 18 were introduced exclusively for Women Commissioners, who were elected by the Mayor and the Commissioners. In 2002, direct election was also applied for Women Commissioners and the member of the reserved seats was increased to 30.

Table 1.8-3 Evolution of DCC

year	Evolution	Nos. of unions/wards
1823	Town Improvement Committee	-
1864	Dhaka Municipal Committee	7 commissioners
1884	First election system	-
1932	* Right for women to vote * Proportion of appointed Commissioners was reduced from 1/3 to 1/5 * Reserved seats for minorities were provided.	-
1947	Municipal Committee was dissolved.	-
1953	Elected Chairman took over his office again.	-
1960	Municipal laws were repealed and selected Commissioners were dissolved.	25 Unions
1964	Number of Unions was increased.	30 Unions
1971	Dhaka became the Capital of Bangladesh.	50 Wards
1977	* Pourashava (Municipal) Ordinance, 1977 was introduced. * Ward Commissioners elected one of their colleague as the Chairman.	50 Wards
1978	* Dhaka Municipality was awarded the status of corporation. * Mayor was appointed of the Government.	50 Wards
1982	* Municipal Corporation was superseded by the Martial Law. * Mirpur and Gulshan were merged to Dhaka Municipal Corporation. * Number of wards was increased to 56.	56 Wards
1983	* Dhaka Municipal Corporation was restored. * Dhaka Municipal Corporation Ordinance 1983 was enacted.	75 Wards
1990	* Renamed as Dhaka City Corporation. * The City area was divided into 10 Zones.	90 Wards
1993	* The Parliament approved election system for one Mayor and 90 Commissioners. * Eighteen (18) Reserved Women Commissioners were elected by the Mayor and Commissioners.	90 Wards

year	Evolution	Nos. of unions/wards
1994	* First elected Mayor by a direct vote.	90 Wards
1996	Introduction of Dhaka City Coordination Committee consisting of all relevant organisations chaired by the Minister of Local Government, Rural Development and Cooperatives and Co-chaired by the Mayor	90 Wards
1998	City area and number of wards were to be increased to 100, but could not be implemented due to some boundary conflicts.	90 Wards
2002	* Introduction of direct voting for Reserved Women Commissioners. * Number of Reserved Women Commissioners was increased from 18 to 30.	90 Wards

Source: Dhaka City Corporation

Chapter 2
Review of Previous Reports

2.1 Waste Management Report (UNDP, 1992)

The study of solid waste management practices in the RAJUK area was carried out as a part of the Dhaka Metropolitan Development Planning (DMDP) project during the period August – October 1992. The study findings were reviewed as a part of Master plan study and are mentioned below.

The present system of waste management in Dhaka city was reported to be environmentally ineffective, inefficient and a hazard to the health of the public and the operators. Within the DCC area Conservancy Department is being asked to dispose of all types of wastes without benefit of stringent waste management regulations or sufficiency of qualified managers to undertake the work of disposal. In the pourashavas waste management consists largely of dumping of wastes in convenient and often undesirable places, usually close to the areas where the waste was generated.

Implementation of an appropriate Solid Waste Management strategy is immediately required so that the management can be recruited and the necessary training undertaken to maximize efficiency in conservancy and to start a waste management engineering department. Landfill for hazardous industrial wastes and for normal domestic wastes must be planned and co-ordinated, container systems, refuse collection vehicles, maintenance schedules, collection schedules and the problems of very narrow streets must be addressed. Clinical waste and some hazardous wastes must be incinerated through co-ordination between the clinics and hospitals and waste management department.

The strategies presented in the study for dealing with solid waste in the project area to be covered in three phases are summarized below.

2.1.1 Staff Resources and Training

- Appoint a Specialist Waste Management Engineer.
- Appoint Deputy Waste Management Engineer (Mechanical).
- Appoint Waste Management Engineer in each Pourashava.

- Training Courses for all the above and expert consultant guidance, 3 months per year for 3 years.
- Specialist training for Mechanics in Maintenance and Minor repairs of DCC Refuse Collection Vehicles.
- Train Specialist Mechanics in DCC; Auto Electrical, Hydraulics, Major repairs.
- Train Mechanics in Maintenance of Refuse Collection Vehicles.
- Train Operators of DCC Refuse Collection Vehicles in Pourashavas.
- Train Operators of Refuse Collection Vehicles in Pourashavas.
- Continuous Training of Refuse Collection Personnel on new Vehicles as they are purchased for Pourashavas.

2.1.2 Landfill and Plant

- Survey and Design of Containment Landfill including access road, fill system, leachate collection and treatment method. Allow for co-disposal of industrial wastes.
- Verify volume of landfill required by each Pourashava and survey and design landfills. Include workshops facility for each Pourashava and refuse collection vehicles depots.
- Construct Earthworks etc and Access Road to Containment Landfill including leachate pond. Purchase landfill plant: Dozer, Front End Loader, Leachate pump and pipes.
- Construct Landfills for all Pourashvas.
- Review all landfill requirements and review all pollution tests in and near landfill sites.

2.1.3 Refuse Collection Vehicles (RCV) and Plant

- Introduce demountable containers to DCC and Pourashavas (77 Vehicles).
- Introduce 4 new RCV's for use with 1,100 litres containers on Trial Basis in DCC. Budget to include spare parts and supervision for 1 year.
- Purchase flatbed trucks for Pourashavas.
- Evaluate trials for demountable system and for wheeled bin system.
- Later introduce 4 more RCV's to cover all Model Towns in DCC area and review Pourashavas demountable container requirements in Phase II.
- Later introduce RCV's to the Pourashavas complete with spares and supervision.
- Finally complete introduction of RCV/s to cover all remaining areas in DCC and Pourashavas.

2.1.4 Containers

- Trials with demountable containers in Old Dhaka and markets and other high-density areas.
- Demountable system to be introduced to Pourashavas.
- 1,100 litres bin trial in selected Model Town. Probably 3,500 households. Purchase containers for trial.
- Evaluate trials.
- Later expand 1,100 litres system to cover all Model Towns in DCC area, purchase containers and introduce to Pourashavas.
- Finally complete container system throughout Dhaka Metropolitan Area.

2.1.5 Incinerators and Composting

- Temporary Central Incinerator for Hospitals and clinics. Find finance for permanent incinerator. Design and site.
- Composting trials and implementation for small scale composting as an employment opportunity.
- Finally Central Incinerator to be constructed.

2.1.6 Business Analysis, Tariffs and Fines

- Analyze the business potential of each sector of the waste management market and set charges for service provided within a legal framework.
- Calculate real cost of collection and disposal for all categories of wastes and prepare charge schedule for domestic, commercial, industrial and clinical/hospital/infectious wastes. Consider contracting out selected waste services, all to be approved by municipal authorities.
- The above mentioned steps to be taken for Pourashavas.
- Ensure income and expenditure are balanced for waste collection and disposal.
- Prepare tender documents for part or all of collection and disposal contracts by private enterprise.
- Institute legal framework for fining illegal/incorrect disposal of solid wastes and pollution clean up.

2.1.7 Legislation and Enforcement

- Publication of New Environmental Protection Act.
- Interpretation of Act for solid wastes management in conjunction with existing Bangladesh Government Ordinances.
- Enforcement Program for waste disposal authorities, waste collection authorities, hospitals, industries, markets and livestock and for domestic/commercial users.

2.2 Dhaka City Management Reform Pilot Project (ADB, 1998)

The Dhaka City Management Reform Pilot Project was undertaken jointly by the Bangladesh Center for Advanced Studies and BRAC in collaboration with the Asian Development Bank (ADB). The objectives of the project was to promote commitment among stakeholders, including key decision makers and city employees for undertaking a process of management reforms aimed at establishing a professional citizen oriented and effective city government in Dhaka. Project findings and conclusions related to solid waste management are reproduced here.

2.2.1 Current situations

Dhaka City Corporation (DCC) is responsible for collection, transportation and treatment of solid wastes in Dhaka City. Because of resource constraints and many other reasons, the DCC in general has not been able to provide a satisfactory waste management system in Dhaka. The major sources of municipal solid wastes in Dhaka are domestic, streets, market places, commercial establishments, clinics and hospitals. At present, Dhaka City generates about

3500 - 4000 tons of solid waste per day, the per capita generation being 0.5 kg/day. The density of solid waste is reported to be 600 kg/m^3.

There are over 1,000 small to large industries in Dhaka Metropolitan area disposing a significant amount of toxic and hazardous wastes contributing environmental degradation in and around Dhaka City. These industries mainly include chemicals, textiles, dying and printing, tannery, iron and steel, metal plastic, rubber and tobacco. Wastes from industries are dumped into the municipal bins and near-by low lying areas. There is no separate waste management system for industries. There are 149 tanning industries in Hazaribagh area in Dhaka producing 18,000 litres of liquid waste and 115 tons of solid waste during peak time and 75 tons during off-peak time. Liquid waste is dumped into the Buriganga river. Solid wastes are collected by the DCC and parts of these wastes are used by the scavengers. Wastes from tanneries contain sulphuric acid, chromium, ammonium sulfate, ammonium chloride, calcium oxide which may seep into the groundwater. These wastes have adverse impacts on human being and can cause diseases like fever, headaches, respiratory and skin diseases.

There are over 500 small to large clinics and hospitals in Dhaka City. Based on an inventory by the Directorate of Health, the present average clinical waste generation in hospitals and clinics is calculated using 1 kg/bed/day and extra 200 kgs a year for clinics. The calculation shows that about 20 tons of hospital wastes are generated in the city. About 20 % of this total waste is infectious and hazardous. Hospital wastes are dumped to the nearest municipal bins indiscriminately. It is most likely that the waste collectors, neighbors and people will be infected from these materials. Moreover these dustbins are usually open. Therefore, spread of infectious organisms through various means from hospital wastes pollute the environment and increase the risk of infection diseases.

2.2.2 On-going Initiatives by DCC

DCC collects only half of the generated solid waste and the rest is left behind to dump in low-lying areas or to be collected by the scavengers. Decomposition of mixed solid waste in humid tropical climate in Dhaka City causes obnoxious conditions and hazards in the surrounding areas. DCC has 5,200 conservancy and 135 supervisory staff for the solid waste management in Dhaka City. DCC has 378 garbage-carrying trucks (1.5 – 5.0 ton capacity), 104 demountable trucks, and 3,000 hand carts to carry out conservancy service.

The reasons reported for the unsatisfactory solid waste management in Dhaka City are mentioned below.

a) Negligence of duties and non-accountability

DCC cleaners and sweepers do not follow their work schedule properly. There is no official action for such negligence of duty because of staff grouping and loosely defined accountability.

b) Reporting system and office hierarchy

Sweepers and cleaners report to the Inspector-in-charge, who in turn is responsible to a zonal conservancy officer. Zonal conservancy officer report to the Chief Conservancy

officer, who in turn is responsible to the Mayor. Although this hierarchy seems apparently sound, there are many ways to avoid the responsibility as there are no recording systems for the cleaners activities at the local level.

c) Lack of coordination

Lack of coordination among different divisions of DCC involved in the solid waste management leads to unnecessary delay and inefficiency.

d) Lack of professional workers

Most of appointments of cleaners and sweepers in DCC are made without any competitive selection procedure.

2.2.3 Local Initiatives in Solid Waste Management

People in some areas of Dhaka City have come forward with some local initiatives for the solid waste management. The primary objective is to vendor a solid waste collection service from door to door so that the locality remains clean. Only household solid wastes are collected from door to door and carried to the nearest DCC bins or demountable containers for the DCC trucks to collect them for final disposal.

Local initiatives in the solid waste management has created positive impacts on the environment of the city. The localities with these initiatives are more clean. The initiatives have been able to bring changes in the level of people's awareness. The households are now highly conscious about the management of solid waste.

However there are problems being faced by the initiators of solid waste management in the localities as mentioned below:

a) Initial Investment

Initial investment, particularly for the equipments is the major problem for organizing committee of door-to-door collection.

b) Community participation

People need to be convinced for participation in the local initiative of solid waste management. Some people are not happy to pay for such a door-to-door collection service.

c) Time of collection

The collection time was a problem for cleaners. Many households want the cleaners to collect waste in the afternoon.

d) Service charge collection

Service charge collection is a problem, as people do not want to pay as they are paying DCC a conservancy charge for solid waste collection.

2.2.4 Recommendations to Improve services of DCC

- The DCC solid waste management system needs to be improved. Some strict official enforcement should be undertaken for negligence of duties of cleaners and sweepers.
- A Recording system for cleaners activities at the local level should be introduced and maintained properly.
- Coordination and cooperation among different divisions of DCC involved with the waste management should be improved.
- Professional cleaning staff and sweepers should be employed.
- Public awareness of the waste management should be raised through mass media for cooperation from city dwellers.
- Private initiatives in waste management should be introduced in all areas and this should be supported by all concerned.
- A separate management system may be introduced for toxic and hazardous wastes.

Chapter 3
Supplementary Information of SWM in Dhaka City

3.1 Waste Generation

3.1.1 Waste Amount

(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 tabulated in Table 3.1-1 as follows. The average waste generation rate from domestic source ranges between 0.21 kg/c/day and 0.59 kg/c/day and the weighted average proved 0.34 kg/c/day.

Table 3.1-1 Survey Results of Unit Waste Generation Rate

sources	unit	dry	wet	average
domestic waste				
High Income Group	kg/c/day	0.588	0.438	0.513
Middle Income Group	kg/c/day	0.371	0.428	0.400
Middle-Low Income Group	kg/c/day	0.279	0.346	0.313
Low Income Group	kg/c/day	0.326	0.345	0.336
lowest income group	kg/c/day	0.314	0.205	0.260
weighted average	kg/c/day			0.340
business waste				
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: 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 out of the population of 5.728 million with average generation rate of 0.34 kg/c/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 3.1-2. The waste generated by those non-resident people coming to Dhaka is considered being contained in this category of waste and street waste stated hereunder.

Table 3.1-2 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
sum	143,609					1,035

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

Source: Number of sources is referred to the licensing list of Department of Revenue of DCC and the rest are from the 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 an 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 3.1-1. 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** and the amount from fixed sources are 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 3.1-1. 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.

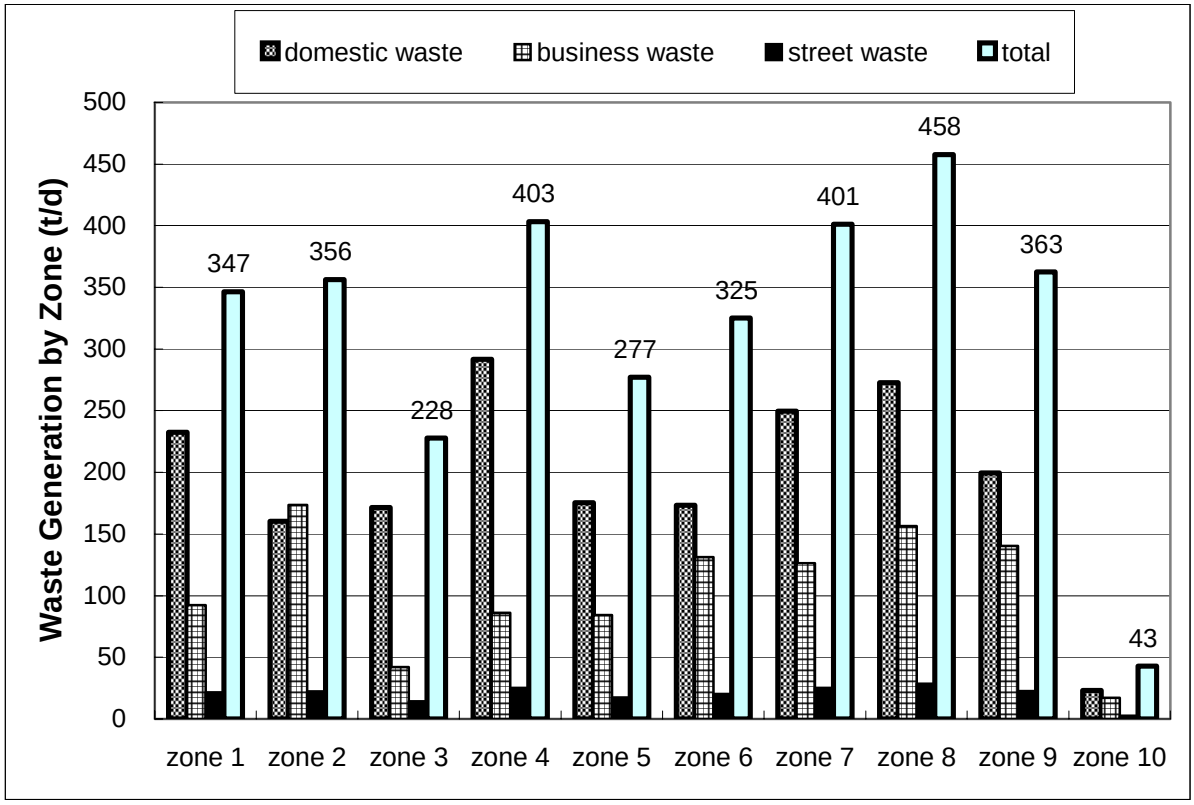


Figure 3.1-1 Assumed Waste Generation Amount by Zone

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

The Survey was conducted in dry and wet seasons for the intention to measure the loaded weight of every vehicle entering to Matuail, Gabtoli, and Uttara. However, due to unexpected delay of Custom clearance of weighing machine, actual measuring was conducted only at Matuail in wet season. Accordingly, the waste amount of Matuail in dry season and Gabtoli and Uttara in dry/wet seasons was estimated based on the average loaded weight of each type/capacity of Matuail data in wet season.

Table 3.1.3 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 dump sites 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 transportation vehicles increased 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 account for 65 %, Barri band account for 30% and Uttra account for the remaining 5% in weight of the collected waste.

Table 3.1.3 Incoming Waste Amount to Disposal Site (t/d)

survey time	Matuail		Berri Band		Uttara		total	
	waste amount carried (t/d)	Nos. of incoming vehicle (unit/d)	waste amount carried (t/d)	Nos. of incoming vehicle (unit/d)	waste amount carried (t/d)	Nos. of incoming vehicle (unit/d)	waste amount carried (t/d)	Nos. 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: Study Team)

The Table 3.1-4 indicates the daily average of incoming waste amount transported to three disposal sites based on the survey in dry/wet seasons. Waste transported from Zone-5 recorded the largest amount of 197 t/d followed by Zone-6 at 175 t/d and Zone-2 at 156 t/d. 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 % as shown in Figure 3.1-2. The average collection ratio in the survey period is estimated at 40 % approximately.

Table 3.1-4 Incoming Waste Amount and Estimated Waste Generation Amount

zone	estimated generation volume		observed volume at dumpsite		collection rate	
zone 1	347	t/d	103	t/d	30	%
zone 2	356	t/d	156	t/d	44	%
zone 3	228	t/d	75	t/d	33	%
zone 4	403	t/d	126	t/d	31	%
zone 5	277	t/d	197	t/d	71	%
zone 6	325	t/d	175	t/d	54	%
zone 7	401	t/d	141	t/d	35	%
zone 8	458	t/d	89	t/d	19	%
zone 9	363	t/d	113	t/d	31	%
zone 10	43	t/d	18	t/d	42	%
total	3,200	t/d	1,193	t/d	37	%

The gap of collection ratio between Zone-5 and Zone-8 is considered natural by 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 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 time by the time of secondary collection. There is much less space for voluntary dumping in the area. The situation in Zone-8 is quite contrastive 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.

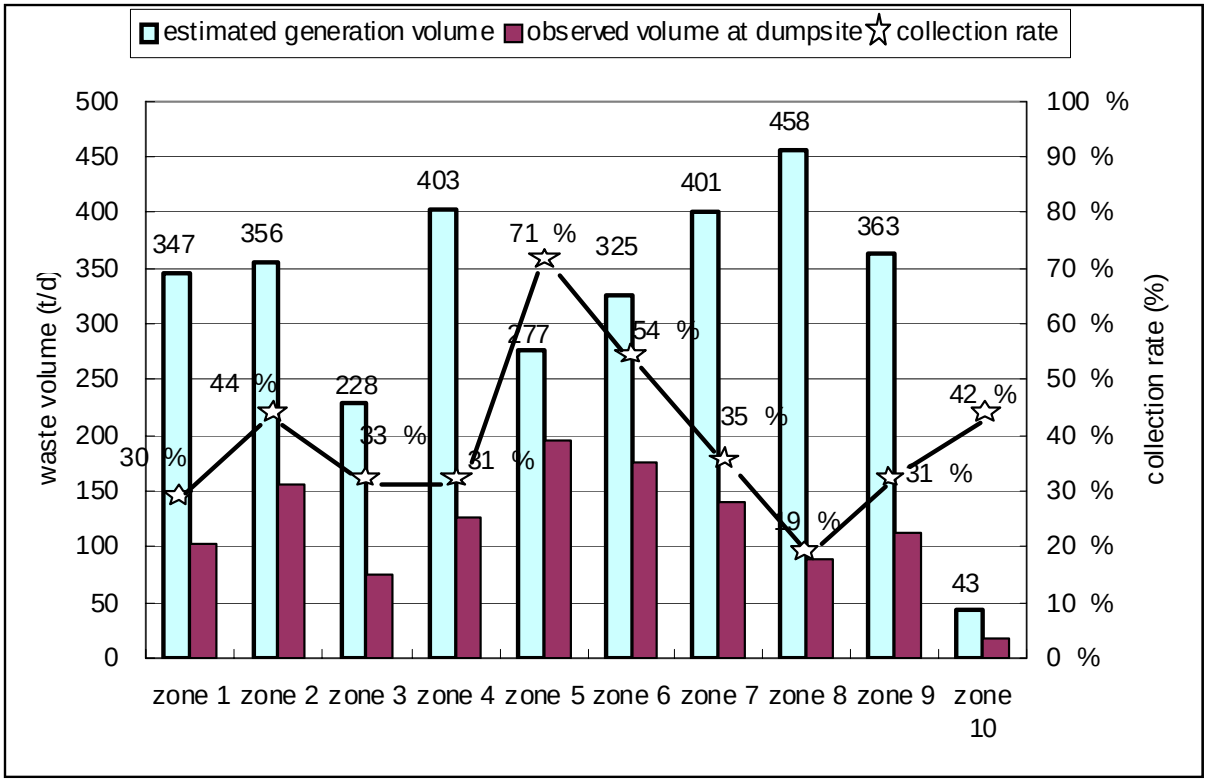


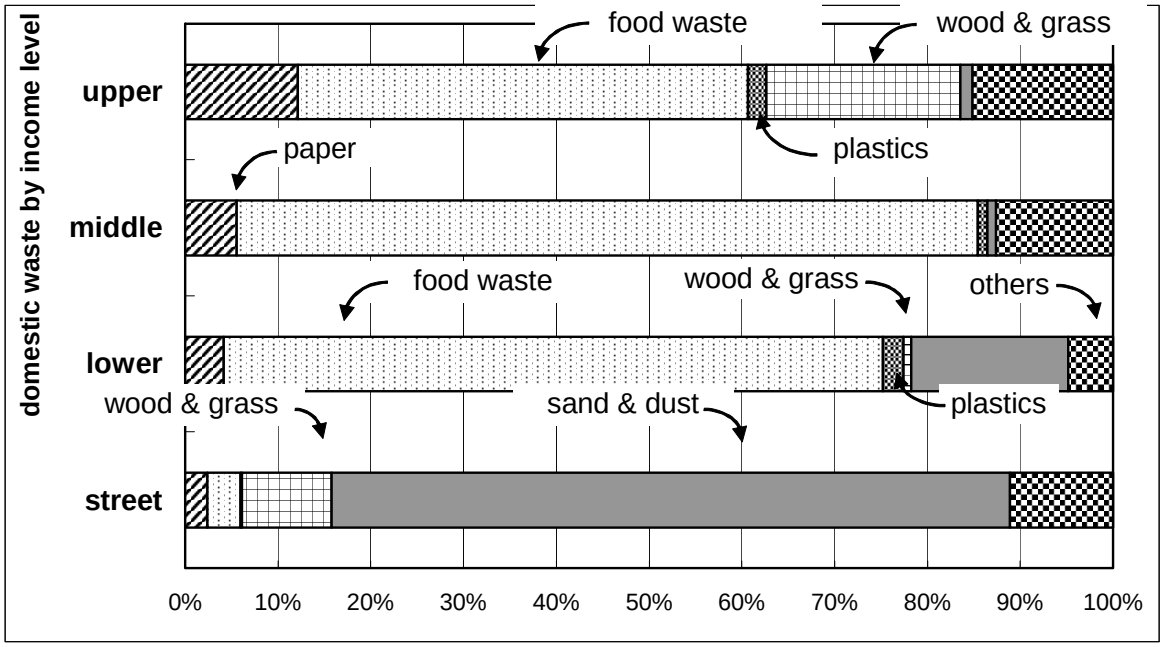
Figure 3.1-2 Incoming Waste Amount and Estimated Waste Generation Amount

3.1.2 Waste composition

(1) Physical Composition

a) Domestic Waste

The domestic waste abounds in organic waste including food waste and its content becomes higher in rainy season than that of 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 more than 80 % in the domestic waste throughout the year.. The survey result is shown in Figure 3.1-3 and Table 3.1-5



others: rubber, leather, fiber, metal etc.

Figure 3.1-3 Physical Composition for Dry Season

Table 3.1-5 Physical Composition of Waste

source category	Income Level	Composition (%)					
		Paper	Food Waste	Wood & Grass	Plastics	Sand & Dust	Others
Dry Season							
Domestic	Upper	12	49	21	2	1	15
	Middle	6	80	0	1	1	13
	Lower	4	71	1	2	17	5
	average	**7**	**66**	**7**	**2**	**6**	**11**
Business	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		2	4	10	0	73	11
Wet Season							
Domestic	Upper	13	64	8	6	0	9
	Middle	10	72	4	8	0	7
	Low	8	69	10	4	4	5
	average	**10**	**68**	**7**	**6**	**1**	**7**
Business	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		1	11	16	1	60	10

Source: JICA StudtyTeam

b) Other Waste

The composition survey of commercial waste (others) indicates that the rainy season's food waste weight percentage and rainy season's are almost the same. The survey result also indicates that the food waste weight percentage of restaurant is highest of 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.

(2) 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 3.1-6.

Table 3.1-6 Apparent Bulk Density of Waste

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

Source: JICA StudyTeam

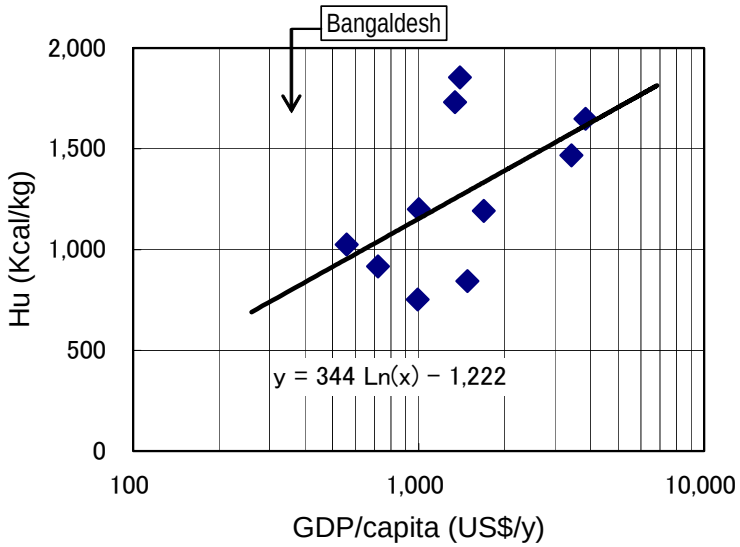
(3) Moisture Content

The moisture content analyzed by component of samples acquired in the composition survey found it ranges 65 to 80 % for the mixture of waste on average. Most of samples of rainy season show higher value than dry season as shown in Table 3.1-7. For example moisture content of food waste is 1.5 times higher in rainy season than dry season.

Based on the result of the moisture contents, estimation of lower calorific value (Hu) is calculated. As the result the Hu is estimated at 550 to 850 kcal/kg. This value indicates that the average waste in Dhaka does not sustain combustion without support of auxiliary fuel because the minimum value of Hu for self-combustion is required at 1,200 kcal/kg. Much less applicable technology is power generation out of waste, that requires at least 1,500 kcal/kg of Hu.

formula for estimation of calorific value
Hu=45B－**6**W=**45**（B – P）+ 80P – 6W
Hu: Low calorific value（Kcal/kg）
B: Combustible matter（**%**）
W: Moisture contents（**%**）
P: Plastics (%)

Relationship between GDP/Capita and Hu (28 countries) is shown in Figure 3.1-4. 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 3.1-4 Relation between GDP/capita and HU

Table 3.1-7 Moisture Contents of Waste Components

Items			Recyclable Papers	Other Papers	Food Waste	Textile	Grass	Wood	Plastic Sheet	Polyethylene Bottle	Other Plastic Bottles	Rubber	Leather	Others
Moisture Contents														
	Dry Season		7.36	8.79	50.93	13.16	31.87	8.69	0.52	2.16	5.45	1.21	10.28	3.21
	Rainy Season		10.52	25.07	74.79	35.87	63.56	25.26	25.11	2.53	7.1	1.48	15.11	5.64
Combustible Matter			58.4	58.4	16.2	66.9	65.9	65.9	74.3	74.3	74.3	76.6	67.7	0
Waste Composition														
Wet Season	Domestic	Upper	6.35	5.77	48.54	2.58	19.55	1.37	0	1.91	0.04	0.11	0	13.78
		Middle	4.48	1.1	79.82	1.8	0	0	0	0.59	0.49	0	0.22	11.5
		Low	3.05	1.12	71.03	0.93	0.75	0.07	0.19	0.93	1.09	0.21	0.49	20.14
	Business	Restaurant	0.08	1.75	96.95	0.18	0.1	0	0	0.21	0.14	0	0.07	0.52
		Shop, Hotel	2.67	1.69	88.97	0.92	0.13	0.62	0	0.44	0.71	0	0.67	3.18
		Market	1.33	3.77	53.13	1.63	22.87	0.25	1.67	0.99	0.81	0.08	0.27	13.2
		Public Faclity	11.59	23.18	19.46	1.43	24.89	0	0	0	0	0.43	0	19.02
	Street		0	2.37	3.59	2.2	9.18	0.49	0	0.16	0	2.2	0.73	79.08
Dry Season	Domestic	Upper	6.35	6.39	63.65	2.84	7.86	0.39	1.52	0.9	0.5	0	0	9.6
		Middle	4.32	5.53	71.79	1.4	3.18	0.81	2.56	1.08	1.48	1.21	0.13	6.51
		Low	3.21	4.7	68.92	1.92	7.37	2.78	0.53	0.18	0.06	0.15	0.28	9.87
	Business	Restaurant	0.69	1.81	95.97	0	0	0	0.82	0.28	0	0	0	0.43
		Shop, Hotel	4.13	3.6	88.97	0.12	0	0.04	0.92	0.34	0.12	0	0	1.76
		Market	1.17	1.85	67.36	3.67	14.16	0.28	0.4	0.78	0	0.15	0.78	9.4
		Public Faclity	11.16	19.98	19.29	0	16.4	0	5.03	3.44	0	2.41	0	22.29
	Street		0.02	1.29	10.79	5.82	15.8	0.03	1.27	0.06	0	0.21	0.08	64.63

3.2 Primary Collection

3.2.1 Primary Collection in Waste Collection System

In Dhaka City, waste collection consists of two parts, namely primary collection and secondary collection (see Figure 3.2-1). DCC is responsible for secondary waste collection to remove waste from DCC's dustbins/containers, and transport the waste to final disposal sites. Residents are responsible to bring their waste to DCC's waste collection points where dustbins/containers are located. NGOs/CBOs/private sector provide primary collection services to collect waste from 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 prevelent in Dhaka City.

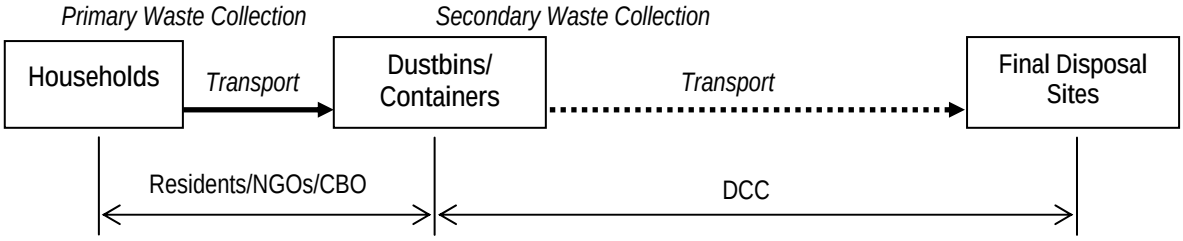


Figure 3.2-1 Waste Collection System in Dhaka City

3.2.2 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. 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[2] from all public streets[3], 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 dust-bins 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**

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

[2] "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. The word "waste" is used in place of "refuse" everywhere in this report.

[3] "public street" is defined as a street maintained by the Government.

any premises or land shall be deposited by the owner or occupier of such premises or land in such dust-bins 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 dust-bins and other receptacles provided by the Corporation shall be property of the Corporation.

According to the above, 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 take responsibility of primary waste collection where such dustbins or receptacles are not provided.

3.2.3 NGOs, CBOs and private initiatives in Primary Waste Collection

(1) Initiation of Local Door-to-Door Waste Collection System

The first door-to-door collection in Dhaka City was started in Kalabagan in 1987. Booming of the construction business in Dhaka took away the vacant lands where people used to dispose their waste and residents started throwing waste anywhere on the roads. In the area, the roads and lanes were narrow so that DCC could not place waste bins. Bad smells from wastes and clogged drainages were getting to be big problems.

This situation forced one local organization to introduce door-to-door waste collection system using rickshaw vans. The local organization purchased two rickshaws and modified them into vans. Each rickshaw van was manned with three waste collectors. They blew a whistle they carried as they passed and collected waste from each house and disposed of them at DCC dustbins located on the main road, far from the area.

At the beginning, local residents did not cooperate with the activities therefore he did not charge any fee for the collections and provided the services for first two months using his own money. People gradually started to trust the system and paid Tk.10 per month as collection charge. The coverage area was expanded and divided into four divisions. Now four different CBOs are providing door-to-door waste collection services in those divisions. The success story of door-to-door waste collection activities in Kalabagan was broadcasted by several TV programs.

(2) Recent Prevalence of Door-to-Door Waste Collection Activities by Local Initiatives

It is in recent years that door-to-door waste collection activities are prevailing in Dhaka City. Due to high pressure of population increase, the vacant lands/marsh where people used to dispose their waste have been disappearing in Dhaka City. People have been recognizing the scattering waste around roads and drains as environmental problems. In order to improve such issues, various local civil societies or CBOs started door-to-door waste collection activities duplicating the system introduced in Kalabagan.

At present, there are various types of organizations/individual persons, as shown below, providing door-to-door waste collection services in Dhaka City.

- NGOs: such as Waste Concern which engaged in composting projects in combination with door-to-door collection in several areas in Dhaka City, and composting projects in slum areas
- NGOs/CBOs: those got permission from DCC and providing door-to-door collection services covering wider areas. Compared with CBOs, NGOs are not locally oriented, community-scaled organization. Their services cover several wards or wider area of a ward. Some NGOs are registered with Ministry of Social Welfare.
- CBOs/local organizations: Those mostly registered with Ministry of Social Welfare, under the Voluntary Social Welfare Agencies (Registration and Control) Ordinance, providing door-to-door collection services in local areas in community scale. Some of them include other activities such as social welfare, micro-credit, health, education, night security, etc. Compared with NGOs, CBOs have limited capacity of activities.
- Organized communities/resident associations covering very small areas: Formal/informal local resident associations in small scale sharing cost of waste collection and hiring workers for waste collection.
- Sports clubs/youth clubs: Local clubs involved in door-to-door collection services usually in small scale. Some of the clubs include the activities of relief and rehabilitation at flooding, culture as well as sports.
- Private companies: Private sector providing door-to-door waste collection services in such areas as Gulshan, a high income residential area. In addition to waste collection, they provide various services such as cleaning of the areas, caring gardens, etc. They charge higher fee to the residents than other areas and provide various quality services in the areas.
- Government staff associations: In the government staff colonies in Dhaka City, there is a system of door-to-door collection provided by the associations.
- DCC cleaners: Where there are no organizations providing door-to-door collection services, mainly in Old Dhaka, DCC cleaners are informally collecting waste from house-to-house and residents pay some fee to them.
- Individual persons: Those who engaged in door-to-door waste collection usually as business to earn income. Mostly they own one rickshaw van and cover small area.

It is said that more than 130 organizations were providing the door-to-door waste collection services in 1999[4]. 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. Variety of organizations and individual persons is working in this

[4] Decentralized Composting, Waste Concern

field in large to small scale, in many cases using only one or two rickshaw vans, and the number is still increasing.

There are two different types of CBOs involved in the activities of door-to-door collection. One is the organizations that have been originally established for other purposes such as social welfare, micro-credit, etc. and recently included door-to-door waste collection in their activities.

Another is the local organizations which were newly established in recent years especially for the purpose of improvement of solid waste management. Particularly such cases are seen in the population growth areas. Due to high pressure of population increase, landowners started to reclaim the lands and construct buildings. Vacant lands and marsh, where people used to throw their waste, disappeared and residents started to throw waste anywhere on roads and into drains. Organizations which provide collection service have been established in such areas spontaneously.

Case of northern part of ward No. 11:

In the northern part of Ward 11 in the past, there were many marsh lands and the population was not so big therefore people were throwing their waste in the vacant lands. After 1997, population started to increase rapidly because the government constructed a road in the area and the landowners started to reclaim the lands and construct buildings. DCC cleaning service did not cover the area, DCC containers were far from the area, and waste were scattering around the areas. The first local organization consists of land holders who started door-to-door waste collection activities in 1998, and a second organization was established in 1999. Since then, 5 more local organizations were established during 2000 to 2003 in order to provide door-to-door waste collection services. Now the entire northern part of ward 11 is covered by the services provided by those seven organizations. Residents bring their waste everyday to the containers located outside the ward.

Shah Shaheb Nagar Social Welfare Society (see Local Organization 2, Figure 3.2-2) is one of the organizations in the northern part of Ward 11. The organization consists of around 200 land holders. The population in the area is more than 10,000 including land holders and renters. Their activities include night security, door-to-door waste collection, waster supply, road maintenance, local health program, awareness program for health and waste management, etc. They have two rickshaw vans and six workers (2 van drivers and 4 waste collectors). Residents including renters pay Tk.10 per month for waste collection.

At present, there is a plan to establish a committee consisting of the representatives of those seven organizations to coordinate and strengthen their capacity to improve the living environment.

It is one of typical case that many local organizations are dealing with waste management in a ward. The study team is now conducting NGOs and CBOs activities survey and the ward 11 is one of the study areas. The survey will show the situation in

detail in ward 11 including southern part of the ward, where other 5 organizations are working for solid waste management.

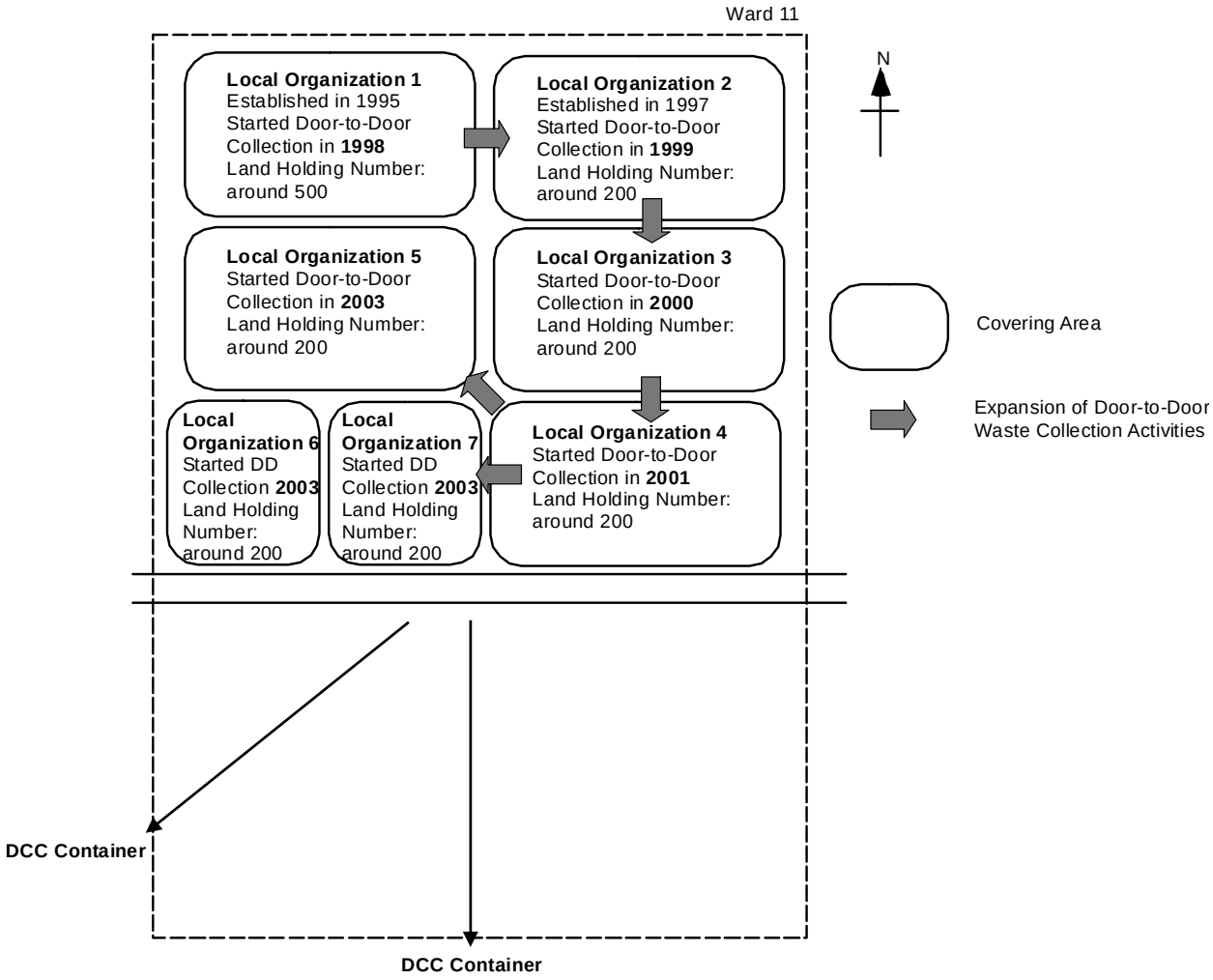


Figure 3.2-2 Expansion of the Door-to-Door Waste Collection Services by Local Organizations in Northern Part of Ward No. 11

(3) Method of Primary Collection

Rickshaw vans are used for primary collection. Usually one rickshaw van is manned with one van driver and one/two helpers. They go to each house, collect 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 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.

The design of rickshaw vans is similar in any part of Dhaka City. Photo 2.2-1 shows the rickshaw vans used for primary collection in Dhaka City. Waste collectors hang sacks at the edge of rickshaw vans and segregate the recyclable waste into the sacks. The height of vans is high in order to collect larger amount of waste at one time, however it is not easily manageable. The maintenance of wheels, that easily break, is also the problem.

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

(4) Financial Situation of NGOs/CBOs engaged in Primary Collection

NGOs/CBOs charge the waste collection fees to residents ranging from Tk.10 to Tk.50 per month in most of the middle and low income residential areas. In high income residential areas such as Gulshan, some NGOs/CBOs charge Tk.50 to Tk.100 or more per month.

Usually at the beginning stage of the activities, NGOs/CBOs face difficulties in collecting the service charges from local residents. Even though they succeed to collect fees from most of the residents and the total amount is enough to maintain the operation, it is not easy for them to invest for further expansion of the activities, especially for the one working in small scale. One rickshaw van costs about Tk.9,000- Tk.12,000. If NGO/CBO could charge a little higher to the residents and all residents pay collection fees to them, they would enjoy better financial condition and buy additional rickshaw vans.

(5) Workers for Primary Collection

There is a difference on monthly salaries of rickshaw van drivers and helpers. Usually the salaries are ranging from Tk.1,000 to Tk.2,000, however some drivers receive only Tk.500 or others receive Tk.3,000. Salary of primary waste collectors is generally lower than DCC cleaners. They segregate recyclables from collected waste and sell them, that is an important source of additional income for them, amounting around Tk.50/day. Many of them are sending money to their families at villages. NGOs/CBOs employ the workers who used to work as rickshaw puller or waste picker. According to the field surveys, the workers are

satisfied with their work in general because the work is less hard than previous job and they can get stable salary.

3.2.4 Approval of NGOs/CBOs for Primary Collection by DCC

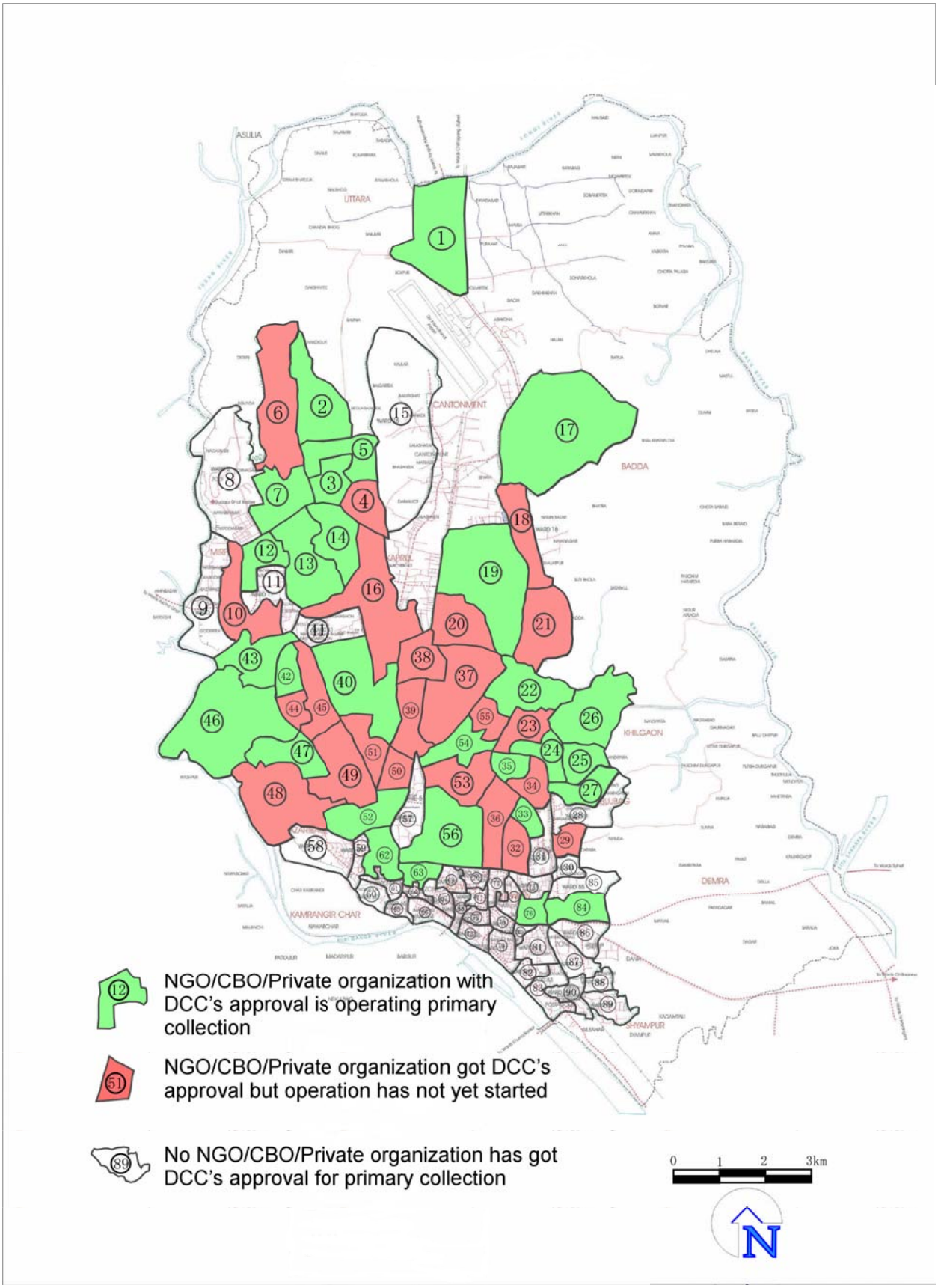
In 2002, DCC introduced an approval system of NGOs/CBOs/private organization for provide door-to-door waste collection services ward-widely. At present, Chief Conservancy Officer has authority to sign the approvals.

DCC was aiming at systemizing the primary collection activities carried out by various different types of organizations/individual persons including those in very small scale. Therefore, DCC give 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 evaluate those proposals and approve them.

The approval of primary collection includes the following conditions.

- Dhaka City Corporation will not provide any financial support to the organization.
- With the help of Commissioner and the residents, the organization will collect waste from house/organization with their own cost, manpower and transport and will dispose into the specific container.
- Dhaka City Corporation will remove the garbage from the container with the existing system.
- The organization will dispose their garbage in the container within the specific time.
- Organization's employee must not segregate the waste outside the container. If they want, they have to finish the separation of organic and inorganic material for selling before disposing the waste in to the container.
- If the prospective organization feels that they need new dustbin/container in that area, DCC will do that after inspection.
- Before and after the start of working, prospective organization should take programs to increase the public awareness for the SWM.
- Before starting the work, prospective organization have to submit a report on the SWM situation of the ward to the conservancy department and last week of every month, they have to submit a report on the quality of their job.
- Approved organization will have to make regular communication with the Conservancy Inspector of that word.

At present, DCC has given approvals to 47 NGOs/CBOs to work in 57 areas, covering 52 words. Not all NGOs who got approvals have started their activities. At least 19 NGOs, members of BIEDF, have not yet started the activities according to BIEDF (See the next section in this Chapter). Figure 3.2-3 shows the distribution of NGOs/CBOs with DCC's approval for Primary Collection.



Source: DCC Conservancy Department and BIEDF

Figure 3.2-3 Distribution of NGOs/CBOs with DCC's approval for Primary Collection

Table 3.2-1 List of NGOs involved in Door-to-Door Waste Collection by Permission of DCC

No.	Name of the NGOs	Ward No.	Area Covered	Starting Date (dd/mm/yr)
1	Bangladesh Smannito Paribesh Unnayan Forum (Bangladesh Integrated Environmental Development Forum)	1	whole ward	05/01/03
2	Mehanati Manush (Daily Laborer)	2	whole ward	05/06/03
3	Fol Bagan (Fruit Garden)	3	whole ward	25/03/03
4	Janata Welfare Society (People's Welfare Society)	4	whole ward	
5	Dishari Organization	5	whole ward	20/10/03
6	Rajjaben Nesa Welfare Foundation	6	whole ward	04/09/03
7	Ziaul Hoque Foundation	7	whole ward	
8	Sukhi (Happy)	10	whole ward	26/11/02
9	Majeda Begum Welfare Foundation	12	whole ward	
10	Association for Integrated Development	13	whole ward	05/01/03
11	Anarkoli Welfare Foundation	14	whole ward	05/01/03
12	Digonto Unnayan Songstha (Digonto Development Organization)	16	whole ward	
13	Desh Kollyan Forum (Desh Development Forum)	17	whole ward	05/01/03
14	Desh Kollyan Forum (Desh Welfare Forum)	18	whole ward	05/01/03
15	Rural Development Society (RDB)/Badda Society	19	whole ward	
16	Somaj Kollyan and Unnayan Songstha (Society Welfare and Development Organization)	20	whole ward	05/01/03
17	Rajjaben Nesa Welfare Foundation/ Badda Society	21	whole ward	05/01/03
18	Association for Integrated Development	22	Half	24/08/03
19	Maloncho Samabai Samitee (Maloncho Cooperative Society)	22	Half	08/06/03
20	Gana Unnayan Songstha (Mash Development Organization)	23	Half	
21	Maloncho Samabai Samitee (Maloncho Cooperative Society)	23	Half	
22	Diptomoy Unnayan Songstha (Enlighten Development Organization)	24	Half	
23	Udoy Seba Songstha (Rising Service Organization)	25	whole ward	
24	Maloncho Samabai Samitee (Maloncho Cooperative Society)	26	whole ward	
25	Aid Bangladesh	27	whole ward	
26	Ujirpur Welfare Foundation	29	whole ward	05/01/03
27	Prodir (Candle)	32	whole ward	
28	Shahjahanpur Winner's Somaj Kollyan Parisad (Shahjahanpur Winner's Society Welfare Council)	33	whole ward	14/07/03
29	Somahar Moonrise Kollyan Bahumukhi Samabai Samitee (Somahar Moonrise Welfare Multipurpose Cooperative Society)	34	whole ward	13/03/03
30	Paira Somaj Kollyan Songstha (Paira Society Welfare Organization)	35	whole ward	13/03/03
31	Samannito Shishu Shastha Songstha (Integrated Child Health Organization)	36	whole ward	28/04/02
32	Welfare Organization for Rootless	37	whole ward	05/01/03
33	Begum Anwara Welfare Foundation	38	whole ward	
34	Rajjaben Nesa Welfare Foundation	39	whole ward	28/04/02
35	Economic Development Association	40	whole ward	28/04/02

No.	Name of the NGOs	Ward No.	Area Covered	Starting Date (dd/mm/yr)
36	Environmental Cleaning Illiteracy and Anti Drag Organization	42	Partial	13/03/03
37	Taj Mahal Noiso Prohori and Cleaning Service (Taj Mahal Night Guard and Cleaning Service)	42	Partial	06/10/03
38	Nirapotta o Poribesh Unnayan Komity (Safety and Environmental Development Comittee)	43	Partial	17/01/04
39	Environmental Cleaning Illiteracy and Anti Drag Organization	43	Partial	20/10/03
40	Mitul Bahamukhi Samabai Samitee (Mitul Multipurpose Cooperative Society)	44	whole ward	13/03/03
41	Welfare Organization for Rootless	45	whole ward	28/04/02
42	Mohammodi Super Cleaners (Pvt.) Ltd.	46	whole ward	07/07/03
43	Paribesh Unnayan Prokolpo	47	whole ward	
44	Standard Activity Society Solve (SASS)	48	whole ward	
45	Dhanmondi Somaj Kollyan Parishad (Dhanmondi Society Welfare Council)	49	whole ward	08/06/03
46	Khandker Brother's Network	50	whole ward	13/03/03
47	Upakulio Sathijon Parishad (Seashore Friends Council)	51	whole ward	26/11/02
48	Khandker Brother's Network	52	whole ward	05/06/03
49	Imam Hossain (Manjil)	52	whole ward	
50	Unity for Social Advancement	53	whole ward	05/01/03
51	Ramna Janakollyan Songstha (Ramna Public Welfare Organizatoion)	54	whole ward	13/03/03
52	Development for Unemployment for Poor and Environment (DUPPE)	55	whole ward	13/03/03
53	Society for Project Implementation Research Evaluation and Training	56	whole ward	28/04/02
54	Bangladesh Agnisena Songsod (Bangladesh Firefighters Association)	62	whole ward	13/03/03
55	Economic Development Association	63	whole ward	05/01/03
56	Welfare Services Forum	76	whole ward	
57	Aid Bangladesh	84	whole ward	24/08/03

Source: DCC Conservancy Department

3.2.5 Coordination among NGOs/CBOs engaged in Primary Collection Services

Bangladesh Integrated Environment Development Forum (BIEDF) is a NGO which have functions to coordinate among 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. It means 74 % of NGOs which received approvals are the members of BIEDF.

At present, those member NGOs are running door-to-door waste collection in 19 wards but in other 19 wards, they are facing difficulties in starting the activities because they can not get full cooperation from different actors in the wards, according to BIEDF.

BIEDF has been supporting the member NGO named AID Bangladesh in implementing a pilot program in Rampura (Ward 22) on solid waste management. The major goals of the programs are[5]:

- To raise public awareness through local campaign including distributing leaflets and posters, arranging rallies and through mass media.
- To promote stakeholders participation and cooperation in waste segregation at sources, door-to-door waste collection and primary disposal of solid waste.
- To construct mini transfer station.

With assistance of DCC and IGES (Institute for Global Environmental Strategies), the program has succeeded in raising people's awareness in the area and local residents are more cooperative in primary collections. However, it seems to take more time to realize the waste segregation at sources and construction of mini transfer station due to the lack of funds.

3.2.6 Actors in door-to-door waste collection activities

There are various actors related to primary waste collection as follows:

- Service providers (Organizations/individual persons)
- NGOs/CBOs with permission from DCC
- Other NGOs
- CBOs/local organizations
- Organized communities/resident associations
- Sports clubs/youth clubs
- Private companies
- Government staff associations
- DCC cleaners
- Individual persons
- DCC at the central level
- DCC conservancy inspectors at word level
- Ward Commissioners/Female commissioners
- Bangladesh Integrated Environmental Development Forum (BIEDF)
- Local people

Ward commissioners/female commissioners are a key in the local level activities. In some wards, there are conflicts among organizations/actors involved in solid waste management sector and that cause obstacles to start or expand door-to-door waste collection activities. Ward commissioners play important roles in mediation and coordination among different organizations. Ward commissioners support the organizations to implement the activities at the local levels and moreover, in some wards, word commissioners/female commissioners themselves are taking initiatives to provide door-to-door waste collection services in their wards.

[5] Presentation of Mr. Md. Nurul Huda at the first Community Based Solid Waste Management Seminar held on March 8, 2004 by DCC and the JICA Study Team.

However, in some wards, ward commissioners obstruct 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. If organizations cannot get ward commissioners' cooperation and support, the organizations will face difficulties in continuing the activities or getting cooperation from local people.

3.2.7 Services Coverage of Primary Collection at the Ward Level

Figure 3.2-4 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. Many NGOs/CBOs who got approval from DCC are targeting to expand their service areas to whole ward. However, there is no ward in Dhaka City where only one or two NGOs/CBOs with DCC's approval cover the whole ward with the authorized status. In most cases, the capacities of approved NGOs/CBOs are not sufficient to provide services in whole ward. In addition, it is difficult for the NGOs/CBOs to take the places of existing local organizations that have been operating primary collection in small scale.

b) Type B: Partial Coverage by various local organizations

This type has been typical situation of wards in Dhaka City except Old Dhaka. As mentioned in the previous section, various local organizations/individual persons/ informal residents associations are providing primary collection services in small scale according to emerging needs of local people. Some areas are remaining where no primary collection services are available. There is no formal system of coordination among the service providers at the ward level. However some ward commissioners play a role of coordination and providing permissions of primary collection to some local organizations. Some organizations obtained DCC's approval in certain ward, however those are usually one of various organizations providing services in the ward.

c) Type C: Full coverage by various local organizations

This type is the progressed situation of Type B, getting typical in Dhaka City, except Old Dhaka. Same as Type B, those who obtained DCC's approval in certain ward are usually one of various organizations providing services in the ward. The number of service providers has been increasing to the extent of covering whole areas in some wards. However, the capacity of local organizations is usually not sufficient to provide services to all households in their coverage areas due to lack of funds for investment. Local organizations are facing difficulties to improve and expand their activities.

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

This type is typical in the wards in Old Dhaka. There are almost no NGOs/CBOs providing primary collection services in Old Dhaka with a few exceptions. DCC

cleaners are informally collecting waste from house-to-house in addition to their formal duties of street sweeping. Two mechanisms of primary waste collection are seen in Old Dhaka. One is managed by "Ponchayt", traditional neighborhood associations. The Ponchayts collect fees from residents and pay to DCC cleaners for their services. Another is based on the individual agreement among DCC cleaners and the residents. The traditional way of door-to-door collection is prevailing in Old Dhaka. Therefore people consider that primary collection is a part of DCC cleaners' works. This conditions cause some difficulties in promoting new activities such as primary collection operated by NGOs/CBOs.

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 parts of Dhaka City.

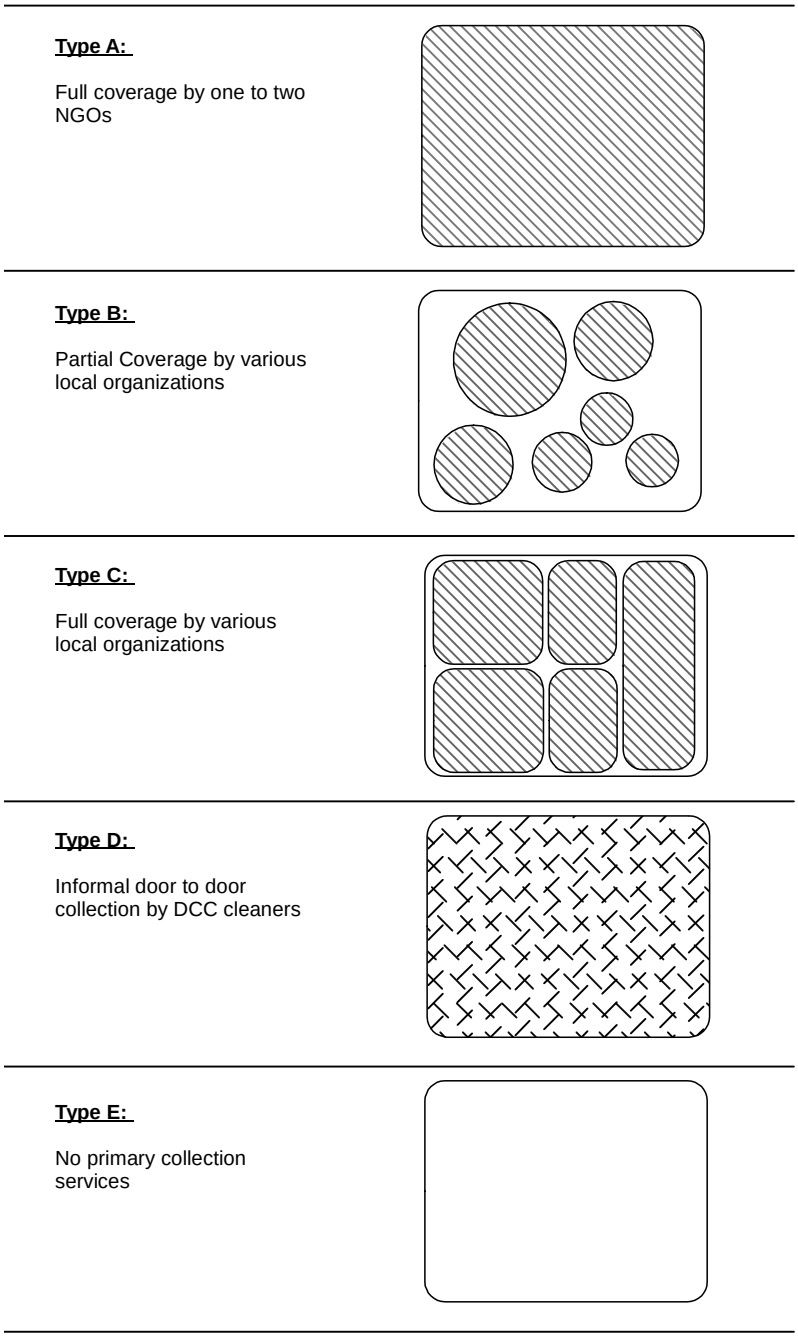


Figure 3.2-4 Types of Service Coverage of Primary Collection at the Ward Level

3.3 Secondary Collection/Transport and Road/Drain Cleaning

3.3.1 Secondary Collection & Transport

3.3.1.1 Procurement Plan of Collection & Transport Vehicles and Waste Containers

(1) Type of Collection and Transport Vehicles

a) Basic selection

At present, open trucks and container carriers are the main vehicles for waste collection and transport operation. These vehicles are operated in linking with the storage facilities, dustbins and waste containers. The following Table 3.3-1 briefly shows the specific features of each type of vehicles together with some other types of vehicles considered as the alternative types. From the Table, open truck has an advantages in procurement cost while the container carrier has an advantage in loading/unloading efficiency. Other types of vehicles such as open dump truck, arm roll truck and compactor truck are more costly although the functions are better than that of the existing vehicles.

Table 3.3-1 Comparison of Collection and Transport Vehicles

Type of Vehicle		Basic Feature	Remarks
Existing Vehicles	Open Truck	• low cost • long loading time • long unloading time	
	Container Carrier	• medium cost • efficient in Loading/Unloading	
	Trailer Truck	• fit the large volume generator	
Other Types of Vehicles	Open Dump Truck	• medium cost • long loading time • efficient in Unloading	• The bed of dump truck is higher than that of open truck
	Arm Roll Truck	• medium cost • efficient in Loading/Unloading	
	Compactor Truck	• high cost • less loading time • less scattering waste • cause effluent by squeezing raw waste • efficient in Unloading	• less compaction for raw waste dense waste

b) Comparison of Open Truck and Container Carrier

Time and motion survey conducted by the Study Team and analyzed in Chapter 3 of Main Report shows that the collection and transport capacity of container carriers are higher than that of the open trucks by 4 time and carry more than 2 tons/hour. Furthermore container carrier shows a better cost-performance as shown in Table 3.3-2

Table 3.3-2 Comparison of Cost-Performance between CC and OT

cost item		**Container Carrier (3 ton)**	**Open Truck (3 ton)**
Initial Cost	vehicle*	Tk 2,665,000	Tk 2,058,000
	container	Tk 58,000	none
	service life	10 years	15 years
	no. of containers allocated	3 per truck at present	none
	container life	3 years	none
	cost per year	Tk 2,665,000/10 yrs+Tk 3 x 58,000/3 yrs: Tk 324.500	Tk 2,058,000/15 yrs: Tk 137,200
running cost	fuel cost	42 liters @Tk 35 x 365 days: Tk 536,550	21 liters @Tk 35 x 365 days: Tk 268,275
	driver	1 person @Tk 7,000 x 12 month: Tk 84,000	1 person @Tk 7,000 x 12 month: Tk 84,000
	cleaner	1 person @Tk 4,000 x 12 months: Tk 48,000	3 person @Tk 4,000 x 12 months: Tk 144,000
total cost	per year	Tk 993,050	Tk 633,475
performance item		**Container Carrier**	**Open Truck**
collection volume	daily	3 ton x 3 trips x 80%: 7.2 t/d	3 ton x 1.5 trips x80%: 3.6 t/d
	annual	7.2 t/d x 365 day: 2,628 t	3.6 t/d x 365 days: 1,314 t
unit cost		Tk 993,050/2,628 t**: Tk 378/t**	Tk 633,475/1,314**: Tk 482/t**

source: DCC

note: * Actual price of purchase in the past is modified for the year 2004 by the Study Team

Figure 3.3-1 shows the survival rate by type of trucks according to the age of trucks. The service lives of trucks are estimated at 10 years for container carriers and 15 years for open trucks by assuming the time of retirement is that the survival rate comes down to 30 % for each vehicle.

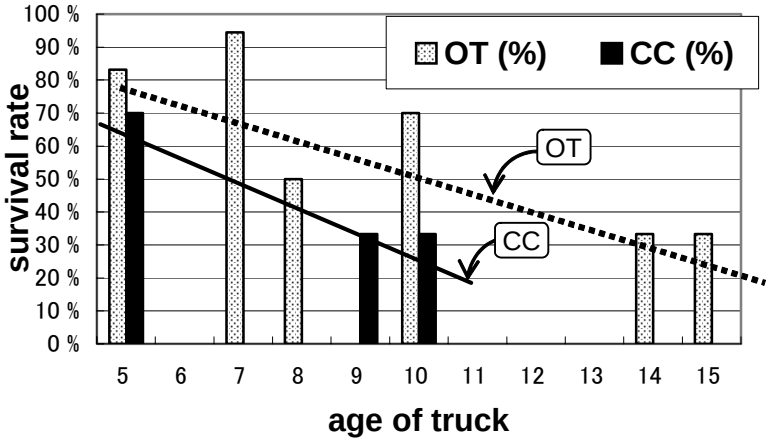


Figure 3.3-1 Comparison of Service Life by Truck Type

With this comparison, the container carrier gives in general better performance than open truck. Among open trucks, 1.5 ton trucks, which is suitable to enter the narrow passages common in old Dhaka, are usually loaded more than 100 % of its capacity. The similar case is seen with trailer trucks placed at major markets. These types of open trucks are deemed effective in current collection system to cover the special area or special source of waste generation. Among container carriers, 3 ton carrier is used at better loaded rate to the capacity so that the type and size is considered the main truck in the future plan for capacity expansion.

(2) Consideration of Aging of Vehicles for Planning

DCC procured 362 numbers of collection and transport vehicles since 1989. Out of 362 units of 2-axis vehicles, the present inventory list shows 340 units and 22 vehicles are disused or missing from the list. The numbers of vehicles under repair fluctuate but 60 to 70 number of vehicles are always in repair and 60 units are in repair as of September 2004. Accordingly, the numbers of vehicle in service is 280 units plus three 20 ton-trailers at present. New vehicles have not been procured since 1999. Figure 3.3-2 shows the historical records of the vehicles procured and the vehicles in service by type and the purchased year.

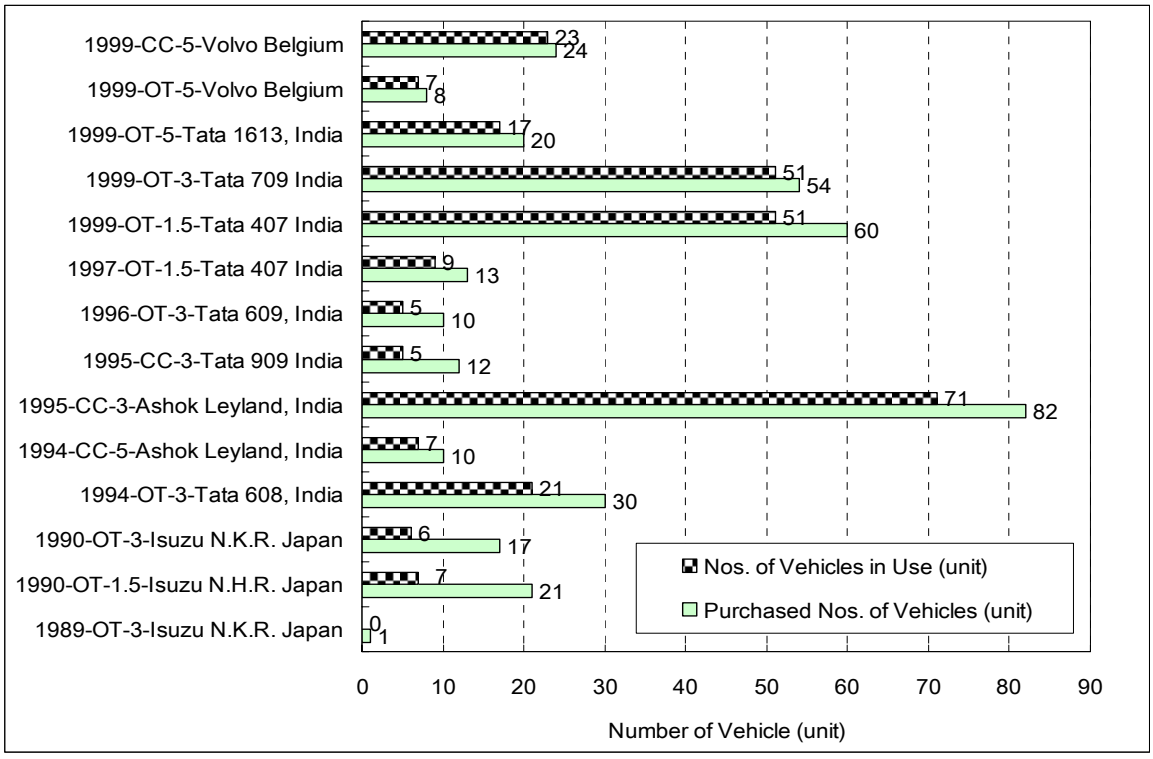


Figure 3.3-2 Numbers of Vehicles Procured and In-Operation

Most of the vehicles purchased in 1999 are in service but only 34 % of the vehicles purchased in 1989 and 1999 are remained in service. The rate of aging was analyzed with 340 units of existing number of vehicles at the base year in 2004 and obtained the linear regression equation as indicated in Figure 3.3-3. Based on the analysis, it was determined that all the vehicles in the first 5 years after procurement shall remain in service and the vehicles used after 15 years shall disuse. Moreover, the numbers of vehicles aged from 6 years to 14 years shall disuse gradually based on the residual ratio computed from the linier regression equation.

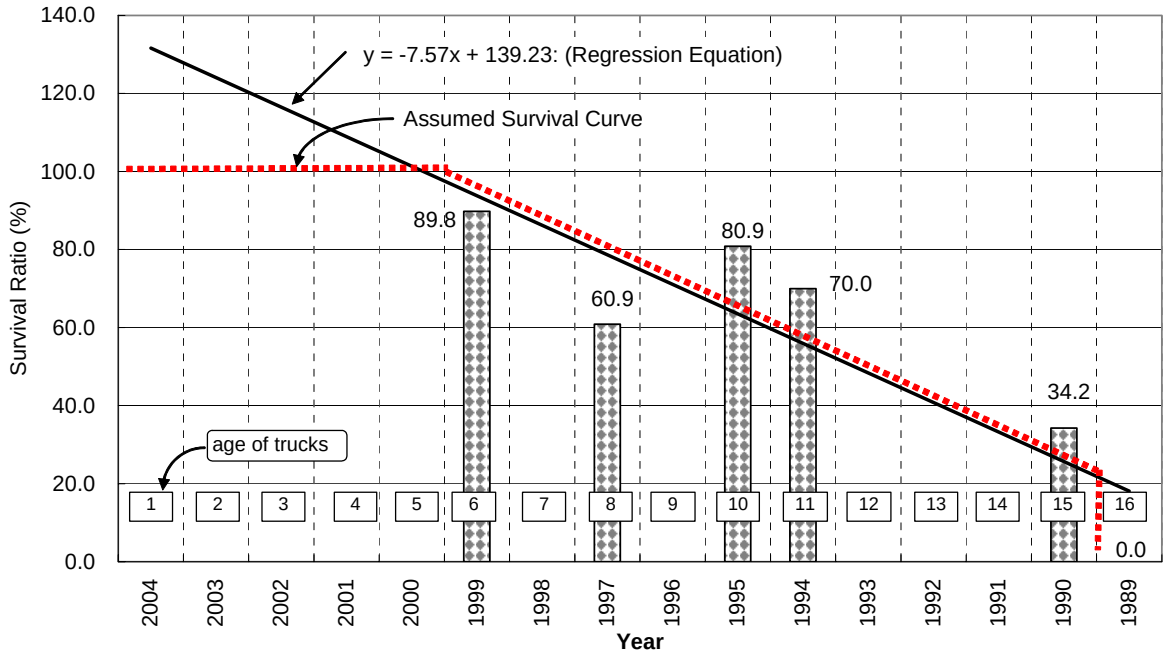


Figure 3.3-3 Service Life of Collection Truck

The following Table 3.3-3 indicate the summary to determine the residual ratio of vehicles by age after procurement and be adopted in estimation of the required numbers of vehicles in formulation of collection and transport plan.

Table 3.3-3 Adopted Residual Ratio of Vehicles by Year

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

(3) Increase of Trucks for Collection and Transport in Future

a) Number of Trucks

Table 3.3-9 shows the reduction of the existing trucks according to the residual ratio. Finally all the trucks now in use are assumed to be out of use by 2015. Table 3.3-10 shows the planned input of trucks that meet the required expansion of transport capacity. The new trucks also undergo the reduction in number according to the same residual ratio as they get old. Table 3.3-11 gives the total stock of trucks during the planning period. As the result of purchase, the number of trucks will reach a peak in year 2013 with 113 units more than present stock of 343 units. Finally the total will come down to 384 units in 2015, 41 units more than present.

The Principle of new truck input is assumed as follows.

- 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) Transport Capacity

Table 3.3-12 to Table 3.3-13 show the fluctuation of transport capacity that is caused by the retirement of trucks by age and additional input of trucks in future. In the estimate of transport capacity, the following assumption is adopted by type of trucks.

Table 3.3-4 Assumption of Truck Operation

Type of truck	frequency of dumping per day	loaded rate
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 %

Table 3.3-4 shows the total capacity of existing trucks and new ones in future. The potential capacity includes the contribution of those trucks in repair, while the actual capacity is deducted the trucks in repair. Present operation rate is observed at 84 % as of September 2004. The future operation rate is assumed at 90 % and the present rate is assumed to be improved by 1 % per year up to 90 % in 2010.

(4) Increase of Waste Containers in Future

a) Reduction in Number by Age of Container

Table 3.3-5 shows the history of container purchase since 1994. DCC procured 340 pieces of waste container before year 2000, however, those containers are considered mostly exhausted. Another 704 pieces were procured in years 2000 and 2001 and 150 more were added in year 2004. DCC provided the latest figure of containers in use in September 2004: 260 pieces for 3 ton carrier and 123 pieces for 5 ton carrier.

Table 3.3-5 History of Waste Container Purchase

brand	capacity	year of purchase	nos.	source fund	remarks
Ashok	5 ton	1994	20	EIP (Env. Imp. Proj.)	with 10 carriers
Ashok	3 ton	1996	240	EIP (Env. Imp. Proj.)	with 60 carriers
Ashok	3 ton	1996	44	EIP (Env. Imp. Proj.)	with 22 carriers
Tata	3 ton	1995	12	EIP (Env. Imp. Proj.)	with 12 carriers
Volvo	5 ton	1999	24	Belgium Loan	with 24 carriers
Ashok	3 ton	2000	386	Flood & Rehabili. Project	
Ashok	3 ton	2001	188	Flood & Rehabili. Project	
Ashok	3 ton	2004	150	Normal	
Ashok	5 ton	2000	10	Flood & Rehabili. Project	
Volvo	5 ton	2000	50	Normal	
Ashok	5 ton	2001	20	Flood & Rehabili. Project	
Volvo	5 ton	2001	50	Normal	
subtotal before year 2000			340		
subtotal of year 2000 & 2001			854		
	total		1,194		

DCC procured in total 854 pieces of containers in the last 5 years and still uses 383 pieces, 45 % of original quantity. Those containers in use contain many of deteriorated ones so that the reasonable residual rate is considered lower than 45 % in 4 to 5 years. For the future procurement, the residual ratio is assumed as follows.

Table 3.3-6 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 as shown in Table 3.3-15.

b) Number of Containers

The number of container is planned to be four times as much as the number of corresponding carriers. With this quantity of container, container carriers can achieve 4 trips per day by carrying different containers for each trip. Table 3.3-16 shows the planned quantity of container carriers that meet the required expansion of transport capacity in future. Table 3.3-17 shows the number of containers to be procured and in service during the planning period. As the total of existing and new containers, the planned placement is shown in Table 3.3-18.

(5) Summary of Truck and Container Procurement

Table 3.3-7 gives the summary of major equipment of collection and transport.

Table 3.3-7 Procurement Plan

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

(6) Deployment of Collection and Transport Staff

a) Number of Staff

According to the proposed procurement plan, the numbers of truck crew and dispatchers are estimated in Table 3.3-19 and summarized in Table 3.3-8.

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

Table 3.3-8 Summary of Planned Staffing for Collection and Transport

Required numbers of truck drivers increase from 266 persons in 2004 to 612 persons in 2015. On the other hand, the numbers of truck cleaners are satisfied if only the present figure of 964 persons is kept throughout the planning period. Though the demand of container cleaner rises constantly, the demand of open truck cleaner and special cleaner falls down. The rise and fall of demand of truck cleaners offset each other as a whole and the shift of cleaner type becomes inevitable. Dispatchers are assigned both for dispatching instructions and for time keeping of the truck crew. They are deployed with two person per Zone except for Zone 9 and Zone 10 where private service providers are operating instead of DCC. In total, 16 dispatchers shall be deployed for 8 Zones.

b) Composition of Crew for Collection & Transport

To estimate the required number of crew member, the following composition is assumed.

- 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 is aiming at ensuring 4 trips a day to dump site because present achievement of container carrier is 3 trips at most and need special measure to increase the frequency by one more trip. The number of cleaner is set minimum 2 persons in a crew and placed larger number as the size of truck becomes bigger in order to save time for loading waste.

Table 3.3-9 Reduction of Trucks by Age (unit)

Type of Trucks	Capacity (ton)	Purcahse Year	Nos. in 2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	5	1994	10	9	8	8	7	6	0	0	0	0	0	0
CC	5	1999	24	22	20	19	17	15	13	11	9	8	6	0
	subtotal		34	31	28	27	24	21	13	11	9	8	6	0
CC	3	1995	93	86	79	72	65	58	51	0	0	0	0	0
OT	5	1999	26	24	22	20	18	16	14	12	10	8	6	0
OT	3	1989	1	0	0	0	0	0	0	0	0	0	0	0
OT	3	1990	13	12	0	0	0	0	0	0	0	0	0	0
OT	3	1994	27	25	23	21	19	17	0	0	0	0	0	0
OT	3	1996	10	9	8	8	7	6	5	5	0	0	0	0
OT	3	1999	53	49	45	41	37	33	29	25	21	17	13	0
	subtotal		104	95	76	70	63	56	34	30	21	17	13	0
OT	1.5	1990	12	11	0	0	0	0	0	0	0	0	0	0
OT	1.5	1997	13	12	11	10	9	8	7	6	5	0	0	0
OT	1.5	1999	58	54	49	45	40	36	32	27	23	18	14	0
	subtotal		83	77	60	55	49	44	39	33	28	18	14	0
Trailer	20	1998	3	3	3	2	2	2	2	1	1	1	0	0
total			343	316	268	246	221	197	153	87	69	52	39	0

Table 3.3-10 Increase of Trucks by Purchase (unit)

Type of Trucks	Capacity (ton)	Purcahse Year	Nos. of Purchase	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	3	2007	17	0	0	17	17	17	17	17	16	14	13	12
CC	3	2009	54	0	0	0	0	54	54	54	54	54	50	46
CC	3	2011	88	0	0	0	0	0	0	88	88	88	88	88
CC	3	2013	117	0	0	0	0	0	0	0	0	117	117	117
	subtotal		276	0	0	17	17	71	71	159	158	273	268	263
CC	5	2007	10	0	0	10	10	10	10	10	9	8	8	7
CC	5	2009	10	0	0	0	0	10	10	10	10	10	9	8
CC	5	2011	10	0	0	0	0	0	0	10	10	10	10	10
CC	5	2013	10	0	0	0	0	0	0	0	0	10	10	10
	subtotal		40	0	0	10	10	20	20	30	29	38	37	35
OT	1.5	2007	30	0	0	30	30	30	30	30	28	25	23	21
OT	1.5	2009	20	0	0	0	0	20	20	20	20	20	18	17
OT	1.5	2011	20	0	0	0	0	0	0	20	20	20	20	20
OT	1.5	2013	25	0	0	0	0	0	0	0	0	25	25	25
	subtotal		95	0	0	30	30	50	50	70	68	90	86	83
TT	20	2011	3	0	0	0	0	0	0	3	3	3	3	3
total			414	0	0	57	57	141	141	262	258	404	394	384

Table 3.3-11 Transition of Quantity of Trucks (existing + additional, unit)

Existing + Additional Truck in stock (unit)

Type of Trucks	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	5	34	31	28	37	34	41	33	41	38	46	43	35
CC	3	93	86	79	89	82	129	122	159	158	273	268	263
OT	5	26	24	22	20	18	16	14	12	10	8	6	0
OT	3	104	95	76	70	63	56	34	30	21	17	13	0
OT	1.5	83	77	60	85	79	94	89	103	96	108	100	83
TT	20	3	3	3	2	2	2	2	4	4	4	3	3
total		343	316	268	303	278	338	294	349	327	456	433	384

Existing + Additional Truck in use (unit)

Operation Rate		84 %	85 %	86 %	87 %	88 %	89 %	90 %	90 %	90 %	90 %	90 %	90 %
Type of Trucks	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	5	30	26	24	32	30	36	30	37	34	41	39	31
CC	3	76	73	68	77	72	115	110	143	142	245	241	236
OT	5	24	20	19	17	16	14	13	11	9	7	5	0
OT	3	83	81	65	61	55	50	31	27	19	15	12	0
OT	1.5	67	65	52	74	69	84	80	93	86	97	90	75
TT	20	3	3	3	2	2	2	2	4	4	4	3	3
total		283	268	231	263	244	301	266	315	294	409	390	345

Table 3.3-12 Reduction of Capacity by Retirement of Trucks (t/d)

Type of Trucks	Capacity (ton)	Purcahse Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	frequency to dump per day	loaded rate(%)
CC	5	1994	160	144	128	128	112	96	0	0	0	0	0	0	4	80
CC	3	1995	893	826	758	691	624	557	490	0	0	0	0	0	4	80
CC	5	1999	384	352	320	304	272	240	208	176	144	128	96	0	4	80
OT	3	1989	5	0	0	0	0	0	0	0	0	0	0	0	2	80
OT	1.5	1990	36	33	0	0	0	0	0	0	0	0	0	0	2	100
OT	3	1990	62	58	0	0	0	0	0	0	0	0	0	0	2	80
OT	3	1994	130	120	110	101	91	82	0	0	0	0	0	0	2	80
OT	3	1996	48	43	38	38	34	29	24	24	0	0	0	0	2	80
OT	1.5	1997	39	36	33	30	27	24	21	18	15	0	0	0	2	100
OT	3	1999	254	235	216	197	178	158	139	120	101	82	62	0	2	80
OT	1.5	1999	174	162	147	135	120	108	96	81	69	54	42	0	2	100
OT	5	1999	208	192	176	160	144	128	112	96	80	64	48	0	2	80
Trailer	20	1999	60	60	60	40	40	40	40	20	20	20	0	0	1	100
total			2,453	2,261	1,987	1,824	1,641	1,462	1,130	535	429	348	248	0		

Table 3.3-13 Increase of Capacity by Purchase of Truck (t/d)

Type of Trucks	Capacity (ton)	Purcahse Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	frequency to dump per day	loaded rate(%)
CC	3	2007	0	0	0	163	163	163	163	163	154	134	125	115	4	80
CC	3	2009	0	0	0	0	0	518	518	518	518	518	480	442	4	80
CC	3	2011	0	0	0	0	0	0	0	845	845	845	845	845	4	80
CC	3	2013	0	0	0	0	0	0	0	0	0	1,123	1,123	1,123	4	80
CC	5	2007	0	0	0	160	160	160	160	160	144	128	128	112	4	80
CC	5	2009	0	0	0	0	0	160	160	160	160	160	144	128	4	80
CC	5	2011	0	0	0	0	0	0	0	160	160	160	160	160	4	80
CC	5	2013	0	0	0	0	0	0	0	0	0	160	160	160	4	80
OT	1.5	2007	0	0	0	90	90	90	90	90	84	75	69	63	2	100
OT	1.5	2009	0	0	0	0	0	60	60	60	60	60	54	51	2	100
OT	1.5	2011	0	0	0	0	0	0	0	60	60	60	60	60	2	100
OT	1.5	2013	0	0	0	0	0	0	0	0	0	75	75	75	2	100
TT	20	2011	0	0	0	0	0	0	0	60	60	60	60	60	1	100
total			0	0	0	413	413	1,152	1,152	2,276	2,245	3,559	3,483	3,394		

Table 3.3-14 Transition of Transport Capacity by Retirement & Purchase (t/d)

Potential Capacity (t/d) (Existing + Additional Truck)

Type of Trucks	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	frequency to dump per day	loaded rate(%)
CC	5	544	496	448	592	544	656	528	656	608	736	688	560	4	80
CC	3	893	826	758	854	787	1,238	1,171	1,526	1,517	2,621	2,573	2,525	4	80
OT	5	208	192	176	160	144	128	112	96	80	64	48	0	2	80
OT	3	499	456	365	336	302	269	163	144	101	82	62	0	2	80
OT	1.5	249	231	180	255	237	282	267	309	288	324	300	249	2	100
TT	20	60	60	60	40	40	40	40	80	80	80	60	60	1	100
total		2,453	2,261	1,987	2,237	2,055	2,613	2,281	2,811	2,674	3,906	3,731	3,394		

Actual Capacity (t/d) (Existing + Additional Truck)

Operation Rate		84 %	85 %	86 %	87 %	88 %	89 %	90 %	90 %	90 %	90 %	90 %	90 %
Type of Trucks	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	5	457	422	385	515	479	584	475	590	547	662	619	504
CC	3	750	702	652	743	693	1,102	1,054	1,374	1,365	2,359	2,316	2,272
OT	5	175	163	151	139	127	114	101	86	72	58	43	0
OT	3	419	388	314	292	266	239	147	130	91	73	56	0
OT	1.5	209	196	155	222	209	251	240	278	259	292	270	224
TT	20	50	51	52	35	35	36	36	72	72	72	54	54
total		2,061	1,922	1,709	1,947	1,808	2,326	2,053	2,530	2,406	3,516	3,358	3,054

Table 3.3-15 Reduction of Existing Containers by Age (unit)

Purchase Year	Capacity (m^3)	Nos. of Purchase	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2000	3 ton	386	35	0	0	0	0	0	0	0	0	0	0	0
2001	3 ton	188	75	17	0	0	0	0	0	0	0	0	0	0
2004	3 ton	150	150	150	150	60	14	0	0	0	0	0	0	0
2000	5 ton	60	53	0	0	0	0	0	0	0	0	0	0	0
2001	5 ton	70	70	6	0	0	0	0	0	0	0	0	0	0
subtotal	3 ton	724	260	167	150	60	14	0	0	0	0	0	0	0
subtotal	5 ton	130	123	6	0	0	0	0	0	0	0	0	0	0
total	0	854	383	173	150	60	14	0	0	0	0	0	0	0

note: 340 containers purchased before 2000 are not included

Table 3.3-16 Number of Container Carriers in Service (existing + additional: unit)

Type of Vehicles	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	3	93	86	79	89	82	129	122	159	158	273	268	263
CC	5	34	31	28	37	34	41	33	41	38	46	43	35
total		127	117	107	126	116	170	155	200	196	319	311	298

Table 3.3-17 Number of Additional Containers (purchase & in service, unit)

Additional Container (unit)			service life 3 years			service life 4 years								
Year of Purchase	Capacity (m^3)	Nos. of Purchase	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2005	6	166	0	166	166	166	111	55	0	0	0	0	0	0
2006	6		0	0	0	0	0	0	0	0	0	0	0	0
2007	6	203	0	0	0	203	203	203	203	135	68	0	0	0
2008	6		0	0	0	0	0	0	0	0	0	0	0	0
2009	6	255	0	0	0	0	0	255	255	255	255	170	85	0
2010	6	30	0	0	0	0	0	0	30	30	30	30	20	10
2011	6	216	0	0	0	0	0	0	0	216	216	216	216	144
2012	6	63	0	0	0	0	0	0	0	0	63	63	63	63
2013	6	613	0	0	0	0	0	0	0	0	0	613	613	613
2014	6	75	0	0	0	0	0	0	0	0	0	0	75	75
2015	6	147	0	0	0	0	0	0	0	0	0	0	0	147
	subtotal	1,768	0	166	166	369	314	513	488	636	632	1,092	1,072	1,052
2005	12	80	0	80	80	80	53	27	0	0	0	0	0	0
2006	12	32	0	0	32	32	32	21	11	0	0	0	0	0
2007	12	36	0	0	0	36	36	36	36	24	12	0	0	0
2008	12	15	0	0	0	0	15	15	15	15	10	5	0	0
2009	12	70	0	0	0	0	0	70	70	70	70	47	23	0
2010	12		0	0	0	0	0	0	0	0	0	0	0	0
2011	12	60	0	0	0	0	0	0	0	60	60	60	60	40
2012	12		0	0	0	0	0	0	0	0	0	0	0	0
2013	12	50	0	0	0	0	0	0	0	0	0	50	50	50
2014	12	50	0	0	0	0	0	0	0	0	0	0	50	50
2015	12		0	0	0	0	0	0	0	0	0	0	0	0
	subtotal	393	0	80	112	148	136	169	132	169	152	162	183	140
total		2,161	0	246	278	517	450	682	620	805	784	1,254	1,255	1,192

Table 3.3-18 Planned Placement of Container (existing & additional, unit)

Capacity (m^3)	Nos. of Container in service	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
6	required (carrier x 4)	372	344	316	356	328	516	488	636	632	1,092	1,072	1,052
	planned placement	260	333	316	429	328	513	488	636	632	1,092	1,072	1,052
12	required (carrier x 4)	136	124	112	148	136	164	132	164	152	184	172	140
	planned placement	123	86	112	148	136	169	132	169	152	162	183	140

Table 3.3-19 Required Number of Drivers and Cleaners (person)

Existing + Additional Truck in use (unit)

Operation R.			85 %	86 %	87 %	88 %	89 %	90 %	90 %	90 %	90 %	90 %	90 %
Type of Vehicles	Capacity (ton)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC	5 & 3	106	99	92	110	102	151	139	180	176	287	280	268
OT	5	24	20	19	17	16	14	13	11	9	7	5	0
OT	3	83	81	65	61	55	50	31	27	19	15	12	0
OT	1.5	67	65	52	74	69	84	80	93	86	97	90	75
	OT total	174	166	136	152	140	148	124	131	114	119	107	75
TT	20	3	3	3	2	2	2	2	4	4	4	3	3
total		457	434	367	416	384	449	389	446	408	529	497	421

Required Number of Driver & Cleaner (CC driver on 2-shift) (person)

Type of Worker	size of truck	number of crew	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CC driver	2 types	2	106	198	184	220	204	302	278	360	352	574	560	536
OT+TT driver	4 types	1	160	167	137	153	141	149	125	132	115	120	108	76
driver total		1 or 2	266	365	321	373	345	451	403	492	467	694	668	612
CC cleaner	2 types	2	112	396	368	440	408	604	556	720	704	1,148	1,120	1,072
OT cleaner	5 ton	5		100	95	85	80	70	65	55	45	35	25	0
OT cleaner	3 ton	4		324	260	244	220	200	124	108	76	60	48	0
OT cleaner	1.5 ton	3		195	156	222	207	252	240	279	258	291	270	225
OT cleaner	subtotal		852	619	511	551	507	522	429	442	379	386	343	225
	cleaner total		964	1,015	879	991	915	1,126	985	1,162	1,083	1,534	1,463	1,297

Driver Deployment Plan (CC driver on 2-shift) (person)

status		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
required staffing			365	321	373	345	451	403	492	467	694	668	612
planned staffing	total	266	365	365	373	373	451	451	492	492	694	694	694
	CC		198	228	220	232	302	326	360	377	574	586	618
	OT+TT		167	137	153	141	149	125	132	115	120	108	76

Cleaner Deployment Plan (CC Cleaner on 2-shift) (person)

status		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
required staffing			1,015	879	991	915	1,126	985	1,162	1,083	1,534	1,463	1,297
planned staffing	total	964	964	964	964	964	1,126	1,126	1,162	1,162	1,534	1,534	1,534
	CC		345	453	413	457	604	697	720	783	1,148	1,191	1,309
	OT+TT		619	511	551	507	522	429	442	379	386	343	225

(7) Procurement Schedule and Cost

a) Procurement Schedule

Implementation of procurement plan for collection and transport vehicles and equipment shall be started in 2005 with planning, preparation of specifications and bid document for tender and contract in the following year in 2006. The first procurement of vehicles since 1999 shall be made in 2007 together with the procurement of waste containers. Bidding and procurement of new vehicles and containers shall be schedule every other year thereafter. Procurement of tools and consumables shall be started in 2005 through the annual budget of DCC and continue regularly thereafter.

b) Procurement Cost

Unit costs are presented in Table 3.3-20. Unit cost of each item was analyzed for the cost as of December 2004. All the unit cost is derived basically from the cost of DCC and some adjustment for procurement of the better quality vehicle and equipment.

Table 3.3-20 Unit Cost Analysis of Collection & Transport Vehicles and Equipment

Items			Cost (Taka)	
1.1 1,395,000 Taka- 3 ton-Tata 409 in 1995			1,395,000	
Adjustment of cost for 2004				
Exchange Rate in 1995	40.8	Taks/US, Data Annual Report, Bangladesh Bank, 2000-2001		
Exchange Rate in 2004	60			
Increase of Exchange Rate	147%			
Inflation 2004/1995	30%			
Adjusted Cost of 3ton CC			2,667,000	
1.2 1,489,000 Taka- 5 ton-Ashok in 1994			1,489,000	
Adjustment of cost for 2004				
Exchange Rate in 1994	40.2	Taks/US, Data Annual Report, Bangladesh Bank, 2000-2001		
Exchange Rate in 2004	60			
Increase of Exchange Rate	149%			
Inflation 2004/1994	33%			
Adjusted Cost of 5 ton CC			2,963,000	
1.3 826,000 Taka- 1.5 ton-Tata 407 in 1997			1,395,000	
Adjustment of cost for 2004				
Exchange Rate in 1997	45.4	Taks/US, Data Annual Report, Bangladesh Bank, 2000-2001		
Exchange Rate in 2004	60			
Increase of Exchange Rate	132%			
Inflation 2004/1997	23%			
Adjusted Cost of 1.5 ton OT			2,274,000	
1.4 6,000,000 Taka- 20 ton-Trailer in 1998			6,000,000	
Adjustment of cost for 2004				
Exchange Rate in 1998	48.1	Taks/US, Data Annual Report, Bangladesh Bank, 2000-2001		
Exchange Rate in 2004	60			
Increase of Exchange Rate	125%			
Inflation 2004/1998	20%			
Adjusted Cost of 20 ton Trailer			8,981,000	
2.1 6 m3 Container		48,000 Taka-Obtained from Conservancy Dept. Adjustment for assemblying the better quality-20 % up	58,000	
2.2 12 m3 Container		60,000 Taka-Obtained from Conservancy Dept. Adjustment for assemblying the better quality-20 % up	72,000	
3.1 Cleanig Tools for Truck Cleaners for OT-1.5 ton-3 truck cleaners per two years			950	per truck per two years
Bamboo Basket	3	per person at 50 Taka		
Kodal	3	per person at 150 Taka, Rake Plough		
Plough	1	per truck at 150 Taka		
Shovel	1	per truck at 200 Taka		
3.2 Cleanig Tools for Truck Cleaners for OT-3ton-4 truck cleaners per two years			1,150	per truck per two years
Bamboo Basket	4	per person at 50 Taka		
Kodal	4	per person at 150 Taka, Rake Plough		
Plough	1	per truck at 150 Taka		
Shovel	1	per truck at 200 Taka		
3.3 Cleanig Tools for Truck Cleaners for OT-5ton 5 truck cleaners per two years			1,350	per truck per two years
Bamboo Basket	5	per person at 50 Taka		
Kodal	5	per person at 150 Taka, Rake Plough		
Plough	1	per truck at 150 Taka		
Shovel	1	per truck at 200 Taka		

Items	Cost (Taka)

4.1	Broom for Cleaners	12	each per two years, 1 broom per month	360	
4.2	Hand Cart	600	30 units per Ward per two years	3,500	per unit
5.1	Supply of Consumables for Truck Cleaners		per person per two years	1,820	per cleaner per two years
	Gloves	1	per person at 30 Taka		
	Ganboots	1	per person at 300 Taka		
	Mask	1	per person at 30 Taka		
	Raincoat	1	per person at 300 Taka		
	Fluorescent Vest	1	per person at 200 Taka		
	Soaps	96	each per year at 10 Taka per piece, 4 soaps/month/head		
5.2	Supply of Consumables for Road Cleaner		per person per two years	1,520	per cleaner per two years
	Gloves	1	per person at 30 Taka		
	Mask	1	per person at 30 Taka		
	Raincoat	1	per person at 300 Taka		
	Fluorescent Vest	1	per person at 200 Taka		
	Soaps	96	each per year at 10 Taka per piece, 4 soaps/month/head		

Based on the unit cost, the cost for procurement of collection and transport vehicles, waste containers, tools and consumables for cleaners were estimated for the period of 2005-2015. The total cost in the period reach at 1,590 Million Taka approximately as summarized in Table 3.3-21. The procurement cost of vehicle, 1,317 Million Taka, is a major cost and takes about 83 % of the total cost. The following Table 3.3-21 shows the required quantity of procurement of each equipment and the cost for annual base procurement. In the period of 2005-2015, the annual financing amount ranges from 8 Million Taka to 535 Million Taka. Annual financing amount increase in the years when vehicles are procured.

Table 3.3-21 Summary of Procurement Cost of Trucks, Containers and Equipment

(unit:1,000 Tk.)

items	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	total
CC 3 ton	0	0	54,407	0	172,822	0	281,635	0	374,447	0	0	883,310
CC 5 ton	0	0	35,556	0	35,556	0	35,556	0	35,556	0	0	142,224
OT 1.5 ton	0	0	81,864	0	54,576	0	54,576	0	68,220	0	0	259,236
TT 20 ton	0	0	0	0	0	0	32,332	0	0	0	0	32,332
Container for CC 3 ton	9,628	0	11,774	0	14,790	1,740	12,528	3,654	35,554	4,350	8,526	102,544
Container for CC 5 ton	5,760	2,304	2,592	1,080	5,040	0	4,320	0	3,600	3,600	0	28,296
Tools for OT 1.5 ton cleaner	73	57	52	47	42	37	31	27	17	13	0	396
Tools for OT 3 ton cleaner	109	87	81	72	64	39	35	24	20	15	0	546
Tools for OT 5 ton cleaner	32	30	27	24	22	19	16	14	11	8	0	203
Tools for road cleaner	2,170	2,170	2,170	2,170	2,170	2,170	2,170	2,170	2,170	2,170	2,170	23,871
hand cart for road cleaner	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	4,725	51,975
Safety goods for truck cleaner	1,754	0	1,754	0	1,754	0	1,754	0	1,754	0	1,754	10,527
Safety goods for road cleaner	9,163	0	9,163	0	9,163	0	9,163	0	9,163	0	9,163	54,975
total	33,415	9,373	204,165	8,118	300,724	8,730	438,841	10,613	535,236	14,881	26,338	1,590,435

(8) Other Alternatives

a) 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 where the space is limited to place waste container and collecting bulky waste.

b) Procurement of Trailer Truck

Trailers are used to collect waste from markets where large amount of waste is 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 a alternatives at the site of large waste generators.

c) Procurement of Compactor Truck

Considering the better sanitation or environment along the roads, dustbins and containers are not appropriate facilities since the waste is stored there all the time. Discharge of waste at the designated stations and time and collection by compactor truck will be the better alternative in terms of maintaining sanitation/environment or beautification along the road. Bell collection, driving the compactor truck slowly with bell/music sound to inform the waste generators, will be other alternative to bring about better sanitary condition along the road. It is worth to introduce either stationary collection or bell collection at the main roads and other place where the space is limited to place waste containers for maintaining sanitation and beautification in the town.

3.3.1.2 Operation and Management Plan of Collection & Transport System

(1) Improvement of Operation Plan

a) Division of Zones for Transporting Waste to Landfill Sites

Presently, approximately two-thirds of waste discharged in Dhaka is transported to Matuail Dispsal Site and one-third is transported to Bali Band. After closure of Bali Band and open of Amin Bazar Disposal Site, the spatial condition of Wards for accessing to the disposal sites will change.

The following Figure 3.3-4 shows the spatial relation of Zones to the disposal sites in future. All the Zone is covered within 15 km radius from either Matuail for Zone-1 to Zone-5 or Amin Bazar for Zone-6 to Zone-10. The future waste generation amount of each 5 zones is estimated almost half and half.

With regard to the said spatial relation, the whole DCC's Zones shall be divide into the coverage area of either Matuail or Amin Bazar for the benefits of transport distance, time and the fuel cost consequently.

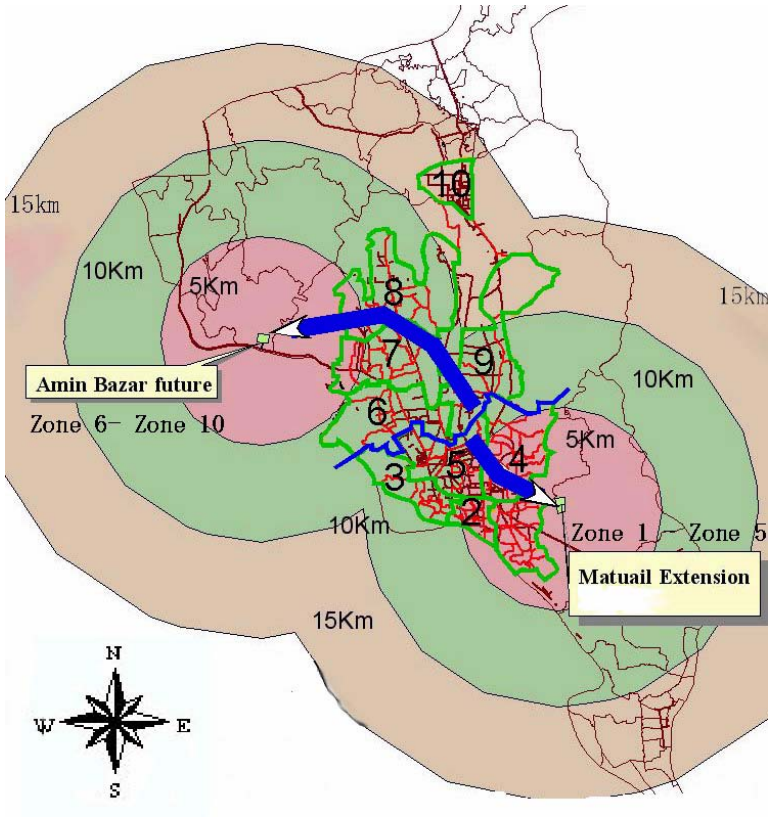


Figure 3.3-4 Division of Zones with Relation to the Future Disposal Sites

b) Working Hours of Secondary Collection and Transport

Present working hours for collection and transport of waste extends to 24 hours in a day. However, the peak hour of the numbers of incoming vehicles to Matuail appears two times in a day at 8 a.m. and 1 a.m. The number of incoming vehicles to Matuail in the morning collection time zone from 6:00 a.m. to 2:00 p.m. takes about 40 % and the night collection time zone from 10:00 p.m. to 6:00 a.m. takes about 46 %.

The Graph suggests that the disposal site can be closed in the time zone from 2:00 p.m. to 10:00 p.m. and so the working hours of the staff of collection and transport and of landfill operation may be regulated with two shift work to lighten the burden for long working hours.

Fixing the working hours for collection and transport also focus the discharge of waste at pre-determined time by the waste generators in future for the advanced waste collection method such as stationary collection and/or bell collection by compactor trucks.

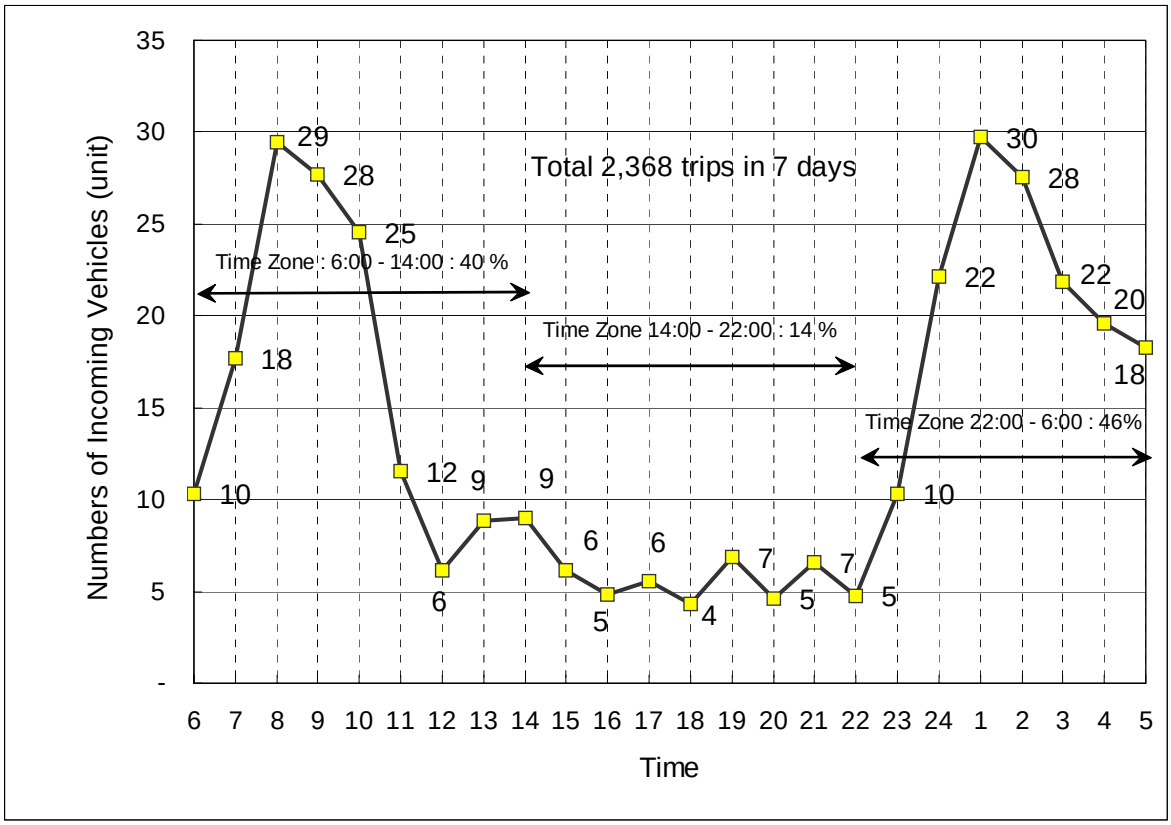


Figure 3.3-5 Hourly Average Number of Incoming Vehicles at Matuail (July 25-32, 2004)

c) Maximizing the Rated Capacity of Truck

The actual loading weight of open truck 5 ton and container carrier 5 ton are more or less 60 to 70 % in average to the rated loading capacity of the trucks.

As long as those vehicles are used some more years, some means to load full of waste to the truck shall be considered. The 5 ton open truck with 4 truck cleaners occupy a space for the cleaning tools and men on the bed of a truck and waste container of 5 ton container carriers are not full in many cases. Furnishing a rack on the roof top of driver's cabin or rear side of the bed of truck will reduce the unused space of the truck. The open truck of 5 ton do not have a space for seating with 4 truck cleaners. Reducing the number of 5 ton open truck cleaners to 3 men and supplemented by the street cleaners working nearby the dust bins can solve the problem and assigning the more numbers of street cleaners can even reduce the waste loading time.

Loading ratio of 5 ton container carrier at 70 % cause the interval of the waste containers and/or a nature of light bulk density of waste. Widening the interval of waste containers will cause the waste generators to carry waste long distance and increasing the container volume is also limited. Meanwhile, collection and transport plan is formulated to use 3 ton container carrier with 6 m^3 container due to overall efficiency for transporting waste, however, the average loading weight of 6 m^3 container is 2.1 ton against the rated loading capacity of 3 ton container carrier. Those unknown elements including the frequency of collection of containers, location of containers, actual

containment volume of waste, etc. shall be surveyed and analyzed by DCC hereafter to design the suitable location of waste containers.

d) Reducing the Loading Time of Open Truck

Time and Motion Survey conducted by the Study Team revealed that the present loading time of open truck takes 45 % to 56 % of total collection and transport time. Reducing 50 % of the loading time or 2hours assuming the working hours for 8 hours will increase the transport capacity by the rate of 0.5 t/hour to 0.6 t/hour.

In order to shorten the unloading time, manpower of street cleaners will be helpful. Some of the man street cleaners working nearby the dustbins shall assist the truck cleaners after two hours morning sweeping work. This operation require the open truck to have a regular time collection work everyday to tie up with the manpower of street cleaners.

e) Phase-out of Dustbins and Appropriate Setup of Waste Containers

Collection and transport plan propose the shifting of main collection vehicles from open trucks to container carriers gradually in consideration of the higher collection and transport efficiency of the container carrier by 4 times of the open trucks. Dustbins collected by open truck shall replaced by 6 m^3 containers accordingly.

Dustbins and waste containers concentrate the south area of DCC as shown in Figure 3.3-9 originally prepared for SWM GIS maps. The GIS data also shows 688 places of dustbins with 3,837 m^3 and 383 units of 6m^3 & 12 m^3 waste containers of 3,036 m^3 in the collection service area of DCC. The present storage volume of dustbins and containers, 6,873 m^3, are equivalent to store waste approximately 1,700 ton, which is about half of the waste generation amount of 3,200 t/d estimated for 2004. As the collection ratio of waste increases, the storage capacity of receptacles of waste shall be increased by placing 6 m^3 waste containers accordingly.

Responding to the procurement/operation of new container carriers, new containers shall be placed to the location of dustbins to be abandoned or at the appropriate place where is not an obstacle to the traffic and convenient for access by the container carriers. In addition, placement of waste containers at new locations will also be required due to the present shortage of the volume of receptacles and for the additional volume derived from the yearly increase of waste generation amount and the plan to increase the waste collection ratio from 44% at present to 61% in 2015.

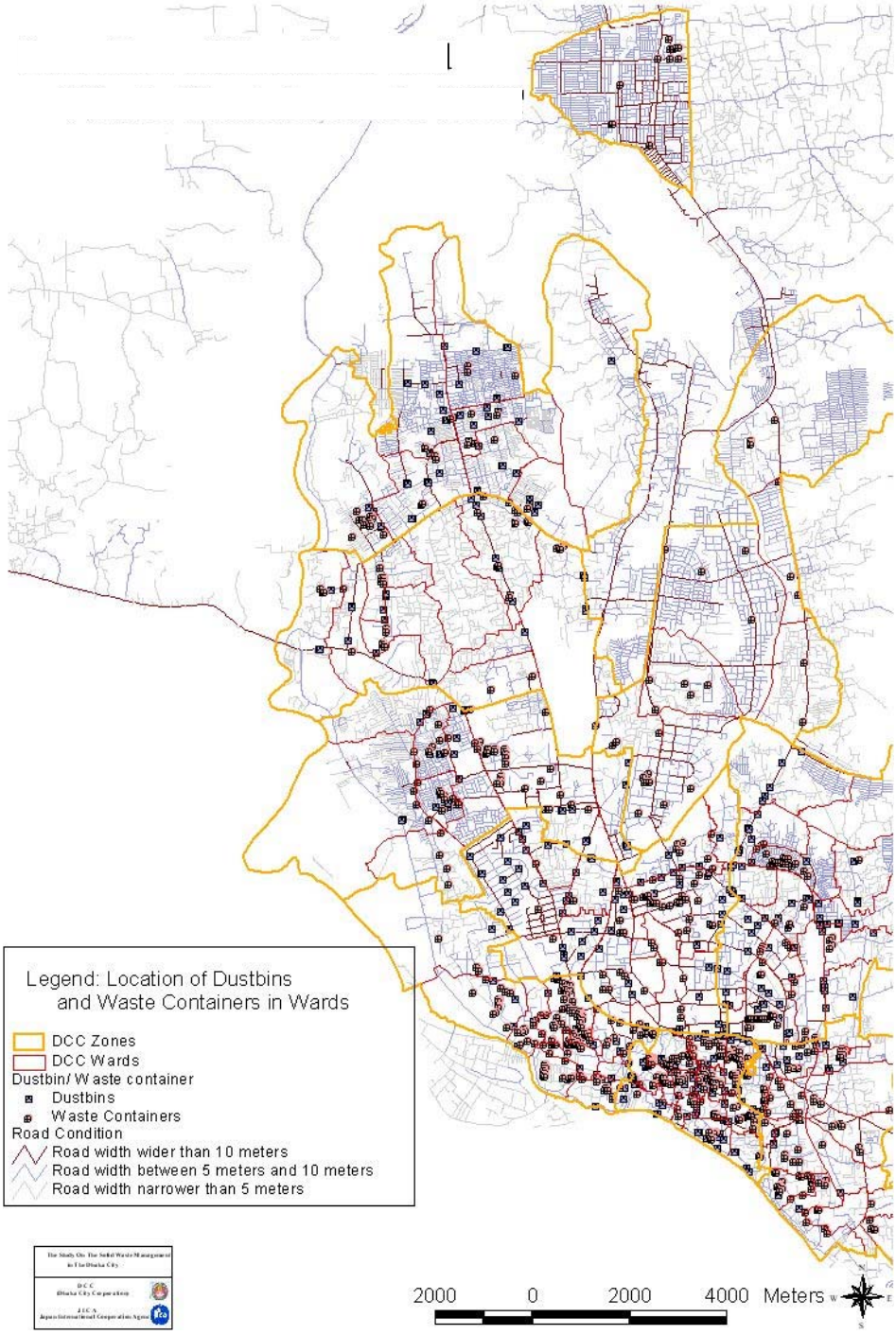


Figure 3.3-6 Location of Dustbins and Waste Containsers in DCC
(As of September 2004)

Taking up Ward-6 for the case study, the setup of new waste containers is designed as presented in Table 3.3-22.

Table 3.3-22 Required Numbers of 6 m^3 Waste Containers in Ward-6

Item / Year	2004	2010	2015
Waste Generation Amount - ton/day (m^3/day)	85 (340)	106 (424)	127 (508)
Planned Waste Collection Amount - m^3/day	150-44%	223-52.5%	335-66%
Existing Volume of Waste Containers - m^3	71	71	71
Required Volume of New Waste Containers – m^3	74	152	264
Required Numbers of 6 m^3 Containers - unit	13	26	44

As shown in the Table, thirteen(13) units of 6 m^3 containers shall be placed immediately to achieve the collection ratio of 44 % at 2004. For reference, the new containers were setup in relation with the location of existing containers as shown in Figure 3.3-7. These new locations and the numbers of waste containers per site shall be verified at each site in consideration of the site conditions and the served population.

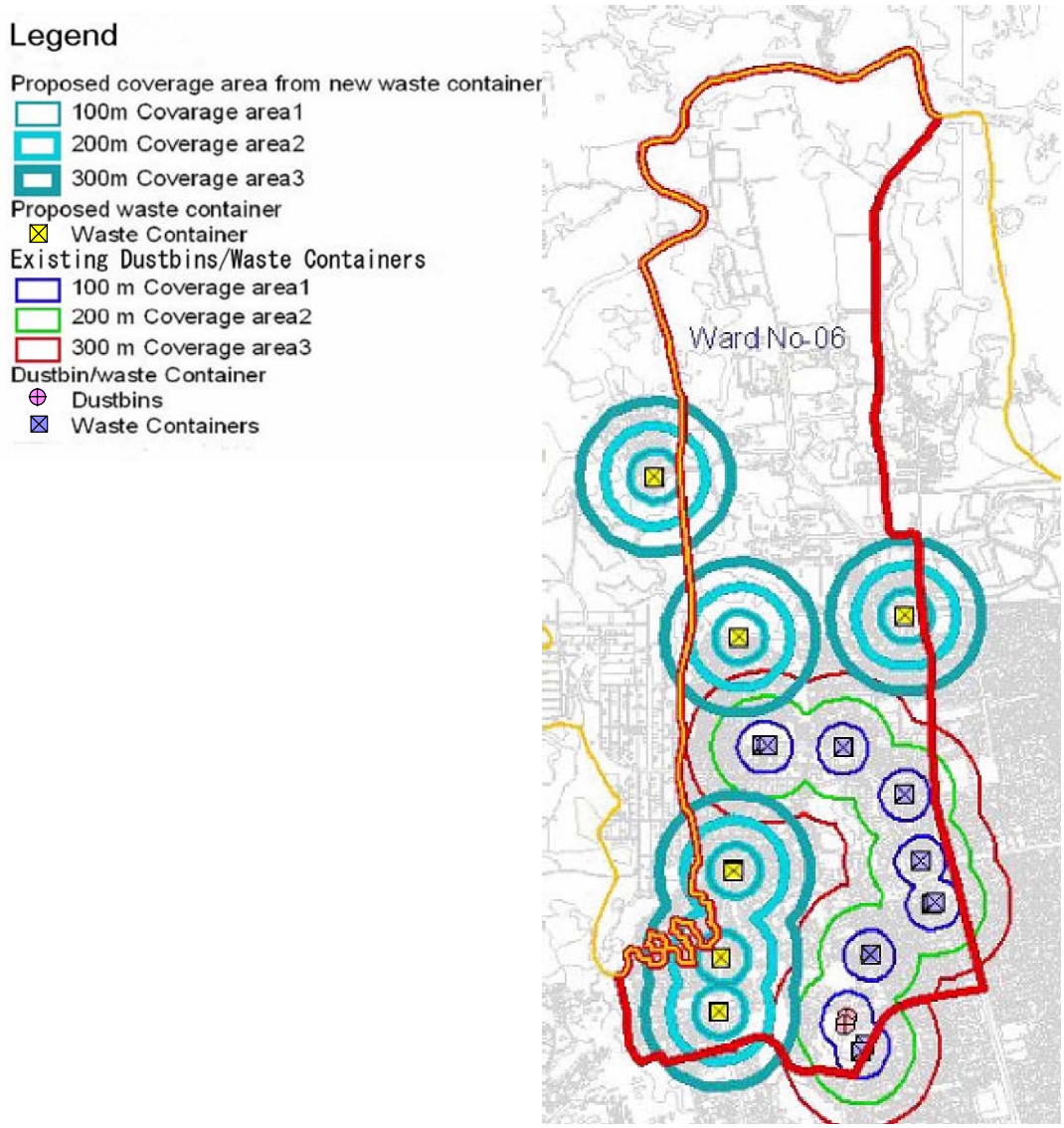


Figure 3.3-7 Urgent Setup of New Containers in Ward 6 (Case Study)

f) Management Information Systems and Geographic Information Systems for SWM

Chief Conservancy Officer, Supervising Engineer of Waste Management Division (WMD) and other key manage class staff engaged in solid waste management for DCC need a management information system (MIS) and Geographic Information Systems (GIS) to provide accurate and regular information to enable them to monitor performance, make effective decisions to carryout their responsibilities.

On-going Pilot Project-B is focusing to collect some of the important data to accumulate for establishing a database for MIS. Some of the GIS maps for SWM were prepatred by the Study Team, for example, waste generation amount map for Wards, location map of dustbins and waste containers, etc. These database for MIS and GIS shall be accumulated, developed, analyzed, updated and made available for upgrading the SWM services.

WMD shall have a responsibility to maintain the MIS and GIS assisted by Urban Planning Department, where Ward GIS maps are being prepared. The team members for MIS and GIS shall be recruited from the Department concerned and from the private sector to form a effective database systems for SWM.

Collection of data of existing facilities/equipment and data and information of SWM, monitoring and recording of the activities of SWM should be based on a number of inventory and performance indicators which are useful to the managerial staff for making quick decision.

Especially, the MIS shall cover all the data and information of SWM activities including collection, disposal and financial data and information. However, the management decision on financial matter is complex and it shall be excluded from the MIS and be developed separately by DCC. MIS and GIS shall be developed only with the reliable data, information and analysis. Accordingly, the data and information to be collected for MIS and GIS shall be made simple for quantifying the indicators and the collection, accumulation and analysis of data shall be initiated with the following items.

- 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
- Ratio 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;

3.3.1.3 Out-sourcing Plan of Collection and Transport

(1) Contract Out for Secondary Collection and Transport

Basically, the contract out of DCC's services to the service providers shall have an advantage to DCC in the cost of the services and the quality of services at least the same level with the performance of DCC or the better services. There are two major factors to consider about the out-sourcing the secondary collection and transport that is a) Financial Aspect, and b) Performance of Services.

a) Financial Aspect

The first factor, financial aspect, is a key factor for DCC to maintain the public services through investment of the service providers. Due to weak financial capability, it is hard for DCC to procure collection and transport vehicles timely to meet with the service demand. However, the service providers will be able to perform the collection and transport services through furnishing a sufficient numbers of vehicles or extending the working hours.

Efficiency of work will influence to the cost of collection and transport services. Except for the efficiency of work of the truck cleaners, long transport time decrease the overall efficiency per trip. Transport time increase as the service area is far from the disposal site. Those area will be Zone-3, Zone-5, Zone-6, Zone-9 and Zone-10 after completion of the disposal sites at Matuail Expansion and Amin Bazar. Out-sourcing the collection and transport services to the service providers in the said Zones will bring about benefits to DCC.

b) Performance of Services

The second factor, performance of services, will the second issues to consider about out-sourcing the collection and transport services.

DCC have contracted the secondary collection and transport services with five service providers for all the Wards, 8 Wards, in Zone-1 and Zone-2 since 2003. At the time of renewal of the contract after one year of the contract, one of the five service provider was rejected for signing the renewal due to poor performance of the services.

However, the performance of service providers is largely dependent on the regulated services through monitoring, inspection, instruction and control by DCC. Therefore, maintaining the service level shall be made through strengthening the daily job for the conservancy inspectors and officers.

(2) Contract Procedures

Contract processes shall strictly comply with the rules and regulations of Bangladesh prescribed in "The Public Procurement Regulations, 2003" and " The Public Procurement Processing and Approval Procedures (PPPAP)". In addition, the following tender procedure is recommended for the standard procedures widely practiced in tendering.

a) Definition of Contract, Strategy and Requirements

- Selection of the Wards for Out-sourcing
- Preparation of Feasibility Study and Implementation Plan
- Securing Financial Sources,
- Preparation of Specifications and Tender Document,
- Preparation of Tender Evaluation Criteria

b) Prequalification

- Research for potential tenderers and preparation of long/short lists
- Announcement for the Prequalification,
- Prequalification and selection of pre-qualified tenderers

c) Invitation to Tender

- Delivery of Invitation to Tender to the Pre-qualified Tenderers
- Handover of Tender Document

d) Preparation of Tender and Tender Open

- Cost Estimate by the Tenderers and Filling the Form of Tender,
- Tender Opening,
- Tender Analysis and Selection of the Tenderer

e) Contract Award and Signing of Agreement

- Post Tender Negotiation and Finalization of Contract Price,
- Award of Contract and Signing,

(3) Monitoring and Evaluation of the Performance of Private Service Providers

After award of the contract, the system for contract control and monitoring shall be established to ensure the execution of the service contract to meet with the required performance stipulated in the contract agreement. The arrangement for the post contract stage for management of the contract shall consist of monitoring the performance of the services and monitoring the terms and conditions of the contract. For the purpose to construct the effective monitoring system, the following items are proposed to be conducted by the conservancy inspectors and the participants of the communities.

- Documentation for the failure or default of the services and instructions
- Documentation of the site conditions for variation of the contract,
- Documentation for termination of the contract and relief measures,
- Documentation of the public monitors for the performance of the services

The monitoring system practiced at present evaluate the performance of the services at 13 monitoring places through eyesight and it shall be maintained after reviewing and objectifying the evaluation method. In addition, measuring the transport amount of waste is one of the method to monitor the performance of the service providers. Installation of weighing bridge and measuring the load weight at the disposal site will be a key factor for improvement of the performance of the services and the incentives for the service providers if the conditions of contract stipulates the payment on actual base of waste transported to the disposal site. In this case, the service contract shall be shifted from the lump sum contract to the type of performance contract to pay for the actual service performed by the service provider.

3.3.1.4 Capacity Development of Collection and Transport Staff

Capacity development for the staff of solid waste management will be carried out under the programs of human resource development and management. Those programs will be divided into at least the followings groups.

- Managerial staff including a Director and managers
- Planning, engineering, implementation and supervisory staff including engineers, technicians and inspectors,
- Field work staff including dispatcher, truck driver, heavy machine operators, etc. and cleaners

This subsection deal with the capacity development of the field work staff for collection and transport work.

(1) Functions and Responsibility of Collection and Transport Staff

Dispatcher/Time Keeper (2 person per Zone)

Responsible for ;

- recording the attendance book of drivers and cleaners,
- arrangement of sufficient numbers of collection and transport vehicles to each Ward and collection area within the Zone,
- instructing the operation procedures to the drivers and cleaners,
- scheduling of drivers and workers for waste collection operation,
- substitute for the absent driver, and
- preparation of daily work report and report to the chief conservancy inspector of the Zone

Waste Collection Vehicle Driver

Responsible for;

- driving a collection and transport vehicle safely as scheduled,
- conducting a daily checks of the vehicle before and after operation,
- washing vehicle and/or container after operation,
- reporting the result of operation to the dispatcher/time keeper

Truck Cleaners

Responsible for;

- loading waste from dustbins/road side depots and unloading at the disposal site for the open truck cleaners and hooking chains for the container carrier cleaners,
- sweeping and loading waste droppings nearby dustbins/roadside depots, and
- instructing the primary collection service labors and the citizen to discharge waste properly into the dustbins and waste containers.

The conservancy inspector is not directly involved with the collection and transport services but his functions and responsibilities are described herewith due to the nature of his assignment for inspection of cleanliness of the Ward area and maintaining the cleanliness is a result of good performance of collection and transport work as well as the street sweeping.

Conservancy Inspector

Responsible for;

- assisting the chief conservancy inspector to monitor and inspect the Ward area,
- monitoring and inspecting the performance of street cleaning work and collection and transport work,
- monitoring and inspecting the entire Ward area periodically to maintain cleanliness, sanitation and aesthetical beauty of the service area,
- monitoring and inspecting the performance of the service providers of primary collection and secondary collection services, and
- linking with the community people for complaints of the cleansing work,
- coordinate with the dispatcher/time keeper to dispatch special collection of waste discarded in the service area, and
- preparation of daily monitoring and inspection report and report to the chief conservancy inspector of the Zone.

(2) Basic Conditions for Capacity Development

Capacity development of the staff not only the collection and transport staff but also all the staff engage in SWM services shall be carried out under the basic conditions described in the following paragraphs.

a) Establishment of Effective and Efficient Organizational Setup

Capacity building shall be made through establishment of legal, organizational and staff arrangements of DCC, especially Department of Conservancy, Waste Management Division, etc. for implementation, operation & maintenance, and management of SWM system for smooth implementation of the master plan.

b) Acquisition of Collection and Transport Staff

Required numbers of staff shall be acquired sufficiently and timely. The staff may be acquired through the staff from the existing setup for the drivers and the cleaners and/or from the other Divisions/Departments of DCC for the dispatcher/time keeper and conservancy inspectors.

c) Training of Personnel

Training programs shall be carried out both for the existing staff and new staff. Wherever the sources of staff acquisition, the assigned staff must be trained adequately to perform the functions and responsibilities to the services assigned to him/her.

(3) Training Programs

All the staff is required to have specific and periodic training for the purpose to perform a better quality public services of SWM for maintaining the cleanliness, sanitation and conservation of the environment. The followings 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 DCC in collaboration with a international agency to assist DCC for implementation of the training programs.

(4) Human Resource Management

For the purpose to develop and acquire the better human resources, human resource management system shall be established in DCC. The human resource management system shall cover the following functions.

- Establishment of Basic Personnel Records and Functions
- Preparation of Annual Human Resource Acquisition and Development Plan
- Formulation and Implementation of Training Programs
- Improvement of Performance of the Staff
- Arrangement for Occupational Injury/Disease

As well as the training programs mentioned above, an effective and efficient human resource management system shall be established by the efforts of DCC in collaboration with a international agency to assist DCC for the matter concerned.

Above all, improvement of performance of the staff is a key for the capacity development of collection and transport staff. Some of the items required for improvement of performance of the staff is presented as follows.

- annual appraisal of performance of each member of the staff against the agreed objectives or targets through assessment by individual staff members and by the chief staff;
- improving morale and motivation as the civil servants through good leadership, encouragement and motivation to the staff, imposing more responsibilities for the assigned tasks; and
- rewarding for a good performance, for example, bonus and/or linking promotion to performance.

3.3.1.5 Improvement of Health Risks of Cleaners/Drivers

Cleaners are facing health risks through daily cleansing work due to low awareness for sanitation and insufficient outfit for handling waste. Immediate measures shall be taken for the sake of protecting the cleaners from health risks and injury. Those measures summarized in the followings shall be taken to ;

- prevent injury of cleaners for daily cleansing work,
- prevent cleaners from traffic accident,
- raising awareness for sanitation,
- supply appropriate tools and working clothes & outfits periodically, and
- assist/compensate the cleaners occupational disease.

Improvement of method of work and raising awareness of individual cleaner will be able to help considerably the cleaners from the health risks. These issues will be solved through the training programs mentioned earlier

DCC has supplied tools and working clothes to the cleaners sometimes although the outfits of the cleaners in the fieldwork at present are not appropriate. Supply of the tools, working clothes and outfits of the following items shall be made periodically and on demand base.

- Tools for individual truck cleaner including rake plough and basket,
- Tools for each open truck including plough, scoop and broom
- Consumables for individual truck cleaner including long boots, gloves, working clothes, mask, and soaps,

In addition to the issues discussed above, assistance and/or compensation of the cleaners suffered injury/occupational disease in working hours are also the major issues to take measures. However, the matter concerned shall be discussed not only the conservancy workers but also taken measures for all the member of DCC staff and the issue was not dealt in this study.

3.3.1.6 Simplification of Procedures for Repair of Vehicles

(1) Shortening the Present Long Procedures for Repair Work

The following Figure 3.3-8 shows repair work flow of vehicles practiced at present. Even though there are spare parts at Mechanical Division or Store and Purchase Department, vehicles are repaired after passing many steps in different Departments/Divisions in DCC. In case there are no spare parts in DCC, the vehicles are repaired by private workshop through bidding and contract once in a half year or so. In some cases, even after the repair work completed, the vehicles are not delivered to the user waiting for the final official procedures in DCC. During the long repair period, Transport Division/ Conservancy Department have to carryout collection and transport work without substitution vehicles and it forces to operate the existing vehicles two shifts.

It is required to review the current processes to shorten the days for approval in each section or skipping the unimportant/unnecessary/duplicated official procedures in DCC. In addition,

the bidding for repair work shall be called regularly every week or every month and as required.

Minor repair work carried out by Mechanical Division-1 faces shortage of spare parts will be avoidable as the annual purchase plan of spare parts are financed.

(2) Regular Maintenance Work

Breakdown of vehicle is avoidable as the driver is careful to the condition of the vehicle. The system for regular check, maintenance and light repair shall be established by DCC involving the drivers and Mechanical Division-1. The regular maintenance system shall be established by DCC supported by a international assistant agency.

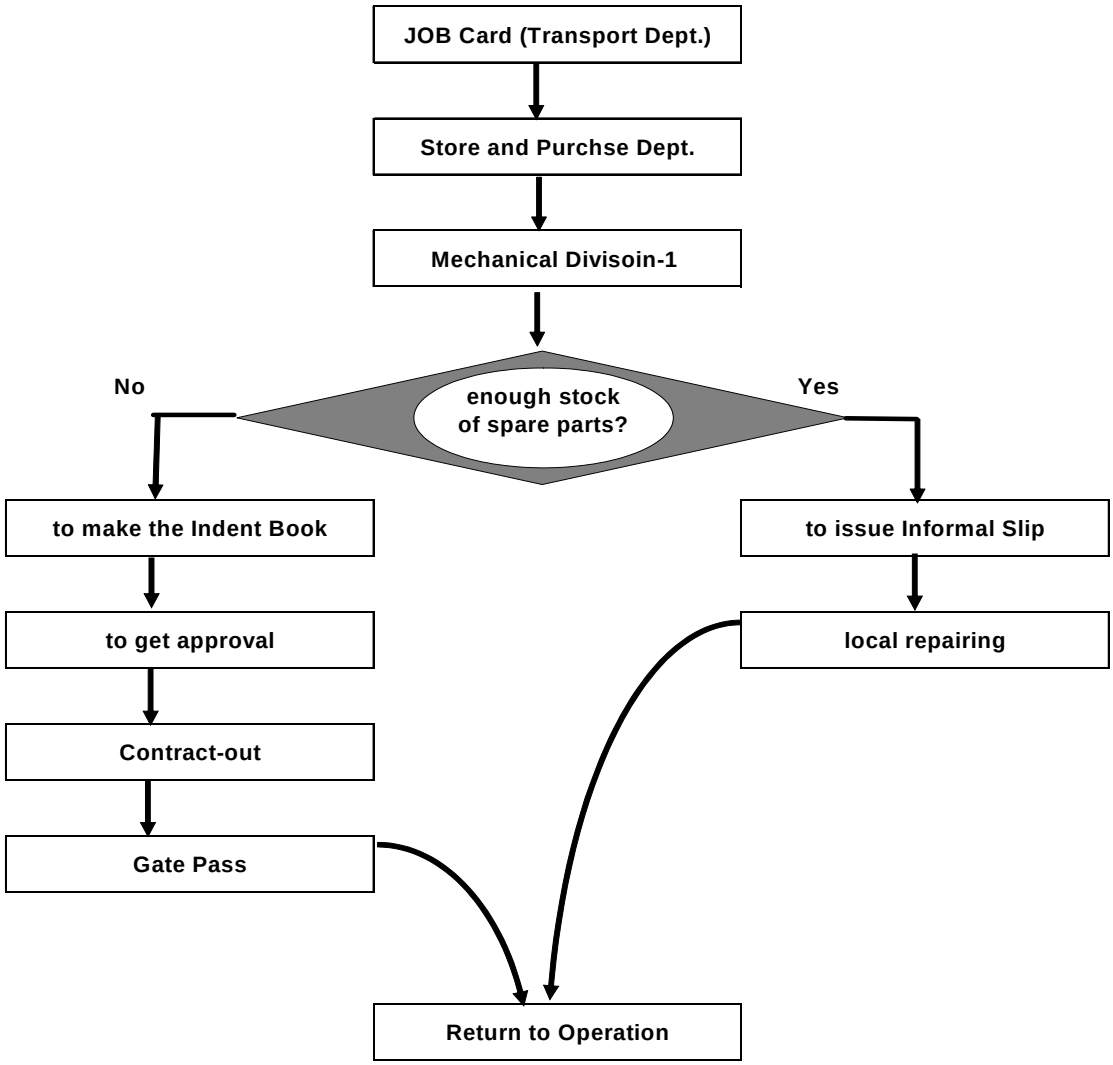


Figure 3.3-8 Current Repair Work Flow in DCC

3.3.2 Road and Drain Cleaning

3.3.2.1 Standardization of road & drain cleaning

(1) Identified problems and objectives of Standardization of road & drain cleaning

DCC has responsibility of cleaning work for "DCC Road" (which DCC has to maintain) and these roads are as shown Table 3.3-23. The term "Carpeting Road" can be defined as asphalt road and "Pavement Road" is paved road with brick. "CC Road" means paved road with concrete and cement. Soil Road is not paved. "Foot Path" is sidewalk. Total road length amount of DCC Road is 1,934.7km and are shared by Carpeting Roads and CC Roads at 50% and 25% respectively. Also DCC has responsibility of drainage cleaning. As the Table 3.3-24 indicate that total drainage length amount in DCC is 1,279.3km Road Cleaners are in charge of road cleaning of "DCC Road".

Table 3.3-23 Zone-wise roads of DCC

	Carpeting Road(km)	Pavement Road(km)	CC Road(km)	Soil Road(km)	Foot Path(km)	Total(km)
Zone1	50.1	1.7	122.3	0.0	20.0	194.1
Zone2	22.5	0.0	48.9	0.0	0.5	71.9
Zone3	35.0	0.0	72.7	2.1	12.8	122.6
Zone4	78.1	6.9	72.6	18.5	35.2	211.3
Zone5	98.8	0.0	54.5	0.0	119.0	272.3
Zone6	99.1	9.4	25.3	25.6	29.9	189.3
Zone7	68.9	48.5	52.2	21.9	16.7	208.2
Zone8	271.6	10.7	1.6	2.0	16.0	301.9
Zone9	143.7	14.2	26.1	4.6	69.7	258.3
Zone10	103.0	0.0	0.0	0.0	1.8	104.8
Total	970.8	91.4	476.2	74.7	321.6	1,934.7

Data source：DCC Zone office

Table 3.3-24 Zone-wise drainage of DCC

	Drainage(km)
Zone1	154.8
Zone2	97.1
Zone3	124.8
Zone4	125
Zone5	153.3
Zone6	79.9
Zone7	130.9
Zone8	131.6
Zone9	131.9
Zone10	150
Total	1279.3

Data source：DCC Zone office

Based on the above data, it is useful to look more closely at some of the more important features of cleaners working behavior. Each cleaner's cleaning road length is not equal each other. Road cleaning length by one cleaner's daily work (road length/person) is shown Figure 3.3-9. Road cleaning length in Zone2 is around 100m, however in Zone 1, Zone3 and Zone4, the road length/person is around 200m. In Zone 5 and Zone 7 it is over 400m. In Zone 8 cleaning length /person is over 600m. Zone9 is swept by private services. It is obvious that cleaning length by cleaner's daily work is not equal in each Zone.

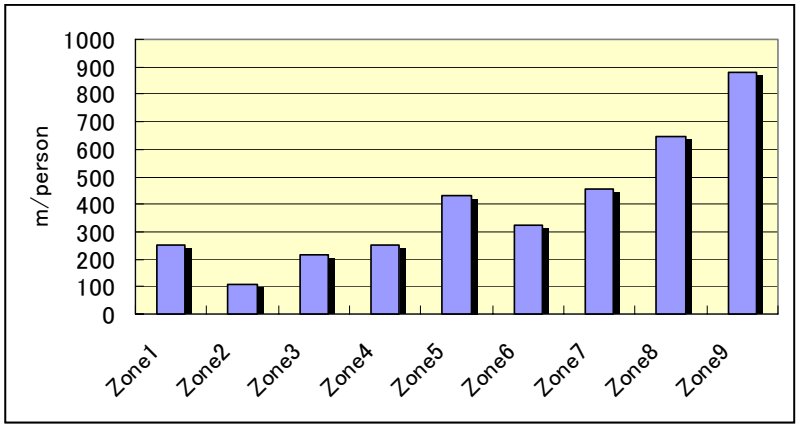


Figure 3.3-9 Zone-wise Road Cleaning Length/person

a) Cleaners' working time

Working time for DCC cleaner is 2 hours to 8 hours a day. Usually road cleaning is finished by traffic moving at morning around 8 o'clock. Amount of working time is under 3 hours, 3 to 6 hours and over 6 hours at 15.7%, 60% and 24.3% respectively.

On these ground, each cleaner has different working time for road cleaning.

Table 3.3-25 Working hours of cleaner

		DCC Cleaner	Private Cleaner
Working hours	> 6 hours	15.7 %	62.5 %
	3-6 hours	60.0 %	37.5 %
	< 3 hours	24.3 %	0.0 %
Starting time of work	at 4:00am	32.8 %	9.4 %
	At 5:00am	50.7 %	34.3 %
	After 6:00am	16.5 %	56.3 %
Complete the work Before 8:00am		35.7 %	0 %
Average working hour		4.12 hours	6.14 hours
Duration of work	- Max	8 hours (6:00-14:00)	8 hours (6:00-11:00 & 14:00-17:00)
	- Min	2 hours (7:00-9:00)	4 hours (6:00-10:00)

Source: JICA Study Team Interview

b) Cleaning manner

Keeping cleaners work under observation, each cleaner is cleaning roads by different ways. Some cleaner is cleaning up road concurrent with drain cleaning. Some cleaner sweeps away the road garbage into drainage and after that picks up garbage from the drainage.

On the other hand, in spite of deep drainage filled with drain, deep drain cleaner uses a not suitable rake which is used usually dry drainage cleaning.

It is needed standardization cleaning manner.

It should be concluded, from what has been said above, that standardization of road cleaning and drain cleaning is needed.

(2) Strategic approach to improvement of standardization of road and drain cleaning.

In order to successfully address the above issue for improvement of standardization of road and drain cleaning, the following strategic approaches should be taken in master plan. .

- To establish to reach consensus system on standardization of work between DCC side and cleaners side.
- To involve CCO, DCCO, CO Ward Inspectors and cleaners.
- To improve the quality of cleaning work.

In general, improvement of standardization of road and drain cleaning means that conventional work manner should be changed gradually. To arrive at consensus of work manner, a committee should be organized.

(3) To establish "Committee for improvement of standardization of road and drain cleaning"

a) Functions of the Committee.

To discuss the standardization of cleaning work and to make consensus between DCC side and cleaners, committee should be established. The committee consists of CCO, Deputy CCO, CO, CSI and cleaners. Secretariat is set in DCC. CCO convenes the committee members for meeting. Finally the committee should make "the cleaning work standardization of road and drain cleaning manual."

Subjects of standardization
- work time
- work manner
- task
- Daily cleaners work process
  - Work start meeting(taking over, check cleaning goods, cares)
  - Working
  - Work end meeting(taking over, cares)
  - Recording

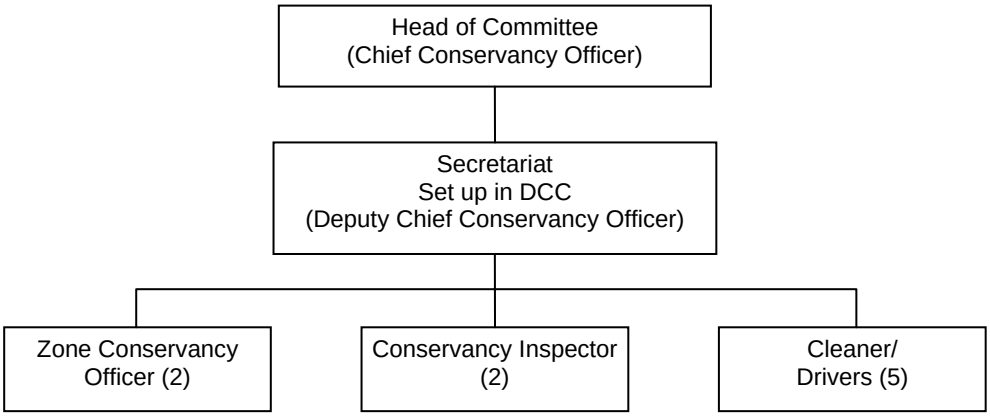


Figure 3.3-10 Organization of Committee for improvement of standardization

3.3.2.2 Capacity development of cleaners

(1) Problems and objectives for Capacity development

More than 90% of cleaners want to continue to work as cleaners because they get the colony facilities and get enough time for additional job. The result of survey can say neither the cleaners' appreciation of the significance for the public cleansing by DCC nor their daily cleaning job. However the society looks down upon cleaners as downtrodden people of lower class, therefore it is difficult that cleaners to get to appreciate the significance of the public cleansing by DCC or their daily cleaning job.

For working creatively and productively of daily cleaning works, it is important for the cleaners to recognize or appreciate the significance of the public cleansing by DCC or their daily cleaning job. This awareness or wakening makes cleaners holding their knowledge of cleaning manner in common. Further more this awareness raises the level of cleaners work manner. Finally it makes sustainable progress and improvement of public cleansing by DCC voluntarily.

(2) Strategic Approach to improvement of capacity development

In order to successfully address the above issue for capacity development of cleaners, the following strategic approaches should be taken in master plan. .

- To involve all of the cleaners.
- To enhance cleaners' knowledge about cleaning works and significance of public cleansing service.
- To check the result of training of cleaners.
- To improve the quality of cleaning works.

(3) Strengthening of enlightenment for cleaners

First of all, CCO points out the training leader who has responsibility of cleaners training. CCO organizes "Cleaners Training Team". The team consists of CCO, DCCO, two CO selected from 10 Zone, two ward inspectors selected from 90 wards and two cleaners.

a) To make training tools

"Cleaners Training Team" makes training tools for cleaners.

i) Text book : The contents of text book consist of significance of the public cleansing by DCC and standardized daily cleaner's job.
ii) Training Video Tape

b) To conduct teachers training

All wards Inspectors are trained by "Cleaners Training Team" as teachers for cleaners.

The contents of teacher's training are shown as follows:

- To understand the current situation of solid waste management in Dhaka.
- To understand the significance of solid waste management in Dhaka
- To understand the standardized daily cleansing manner.
- To check the result of training for cleaners.

c) To train all cleaners

To train all cleaners and to check the result of training improve training program. The final target is to appreciate the significance of the public cleansing for cleaners and the significance of their daily cleaning job in order to make sustainable progress and improvement of public cleansing by DCC.

3.4 Solid Waste Treatment and Disposal

3.4.1 Solid waste treatment

(1) Composting by NGO

A NGO (Waste Concern) collect domestic waste and composting organic waste after separation. There is a manual composting plant at Mirpur operating from 1995. Landowner (Lions Club) allows Waste Concern to use his land without any charge. 20 staffs consisting two (2) administrators, seven (7) collectors and 11 plant workers operate the plant. The collectors collect domestic waste from approximately 1,000 houses in adjacent residential area using rickshaw ban. Waste is sorted at the plant in organic waste, reusable waste and other waste. Organic waste is used for composting and reusable waste is sold to dealers and other waste is discharged at nearest dustbin. The plant process approximately 2 ton/day of waste and produce 0.5 ton/day of compost. Fermentation process will takes around 60 days. It is noted that all fermentation area is covered by roof to avoid rainfall in rainy season.

The NGO also install holed barrels (compost barrel) at several slum areas. Residents put organic waste in these barrels for fermentation. The NGO buy this organic waste every 3-month and put into composting process for further fermentation at the plant in Mirpur.

(2) Recycling by waste picker and private

Recycling and scavenging of reusable material is carried out every stage in solid waste flow, separating reusable material at generation source, scavenging by cleaner and primary collector, scavenging at dust bin and/or container by waste picker, scavenging at loading work and at disposal site. Although DCC staffs do some of scavenging work, DCC has no official control on this recycling activity including waste pickers at Matuail landfill site.

Reusable material picked up above activity is sold to dealers for further processed.

3.4.2 Final disposal

(1) Existing landfill sites in Dhaka

Solid waste collected and transported by DCC and/or contractor was disposed at Matuail, Berri Band and Uttara in March 2004 as shown in Table 3.4-1. In July, Matuail and Berri Band sites are also operating but Uttara site is not operating because the site is inundated in wet season.

Table3.4-1 Existing landfill sites in Dhaka

Name	Operation at March 2004	Operation at July 2003
1. Matuail (Official)	Landfill from central platform Constructing surrounding road 6 heavy equipment were working	Landfill from surrounding road. Flood in July, 2004 5 heavy equipment were working 890 ton/day and 338 trips/day
2. Berri Band (Temporary)	Landfill at the block protected from river 2 heavy equipment were working	Landfill at the adjacent block but it is open to river 2 heavy equipment were working 410 ton/day and 153 trips/day
3. Uttara (Temporary)	Landfill at the block but it is open to river One bulldozer was working	Not operating and the site are inundated.

(2) Matuail Landfill Site

a. Facilities

Matuail landfill a site is located the southeast side of city and distance is 7 km from city center. Solid waste collected from Zone 1 to Zone 6 is disposed at this site. Estimate amount of solid waste disposed at this site will be approximately 890 ton/day. The facilities and equipment provided in this site is shown in Table 3.4-2.

As shown in Table 3.4-1, surrounding embankment is constructed but no leachate collection facilities and pond. Also it is noted that solid waste is filled without covering soil. Therefore all rainfall on the site will be contaminated and become leachate. Also, no drainage system is provided.

Table 3.4-2 Facilities at Matuail landfill site

Facilities	Description
Fence	Not installed
Surrounding embankment	Constructed
Access road	Constructed
Weighbridge	Not installed
Control room	Not available (Old one is abandoned)
Liner facility	Not installed
Leachate collection facility	Not installed
Leachate pond	Not installed but some part is functioning as a pond
Gas removal facility	Not installed
Strom water drainage	Not installed (drainage of west side is not separated with leachate)
Operation road	Constructed
Dumping platform	Constructed
Landfill equipment	Bulldozer 3 units, Excavator 2 units, Wheel dozer 1units

At the Matuail landfill site, the project for rehabilitation of Access road (Surrounding embankment) has started this fiscal year (2003/2004). The project components and project cost is shown in Table 3.4-3. This project is conducted under the supervision of Zone-1 Civil Engineering Division of Engineering Department. The project is planned to provide dumping platform to be used for coming rainy season.

Table 3.4-3 Rehabilitation of Surrounding embankment project

Project	Length of road	Plat-form	Budget	Contract amount	Progress (Jan. 31)	Starting & closing date
South-east	385 m		TK 19,971,342	TK 19,971,342	100%	6/24-9/21
East	180 m	1	TK 19,672,492	TK 19,670,525	60%	10/15-1/22
North-east	170 m	1	TK 19,724,991	TK 19,715,129	51%	11/24-3/20
Total	735 m	2	TK 59,368,825	TK 59,356,996		

b. Water pollution

As mentioned above, Matuail landfill site has surrounding embankment. At the dry season (from November to April), almost no discharge and/or leakage of leachate from landfill site except small discharge at west side. But leachate water level is high even in dry season. Although leakage amount of leachate at west side is small, a small pond and plant is affected by leachate. It may be probable that contaminated rainwater and leachate may overflow in rainy season (from May to October). Therefore, some measure to prevent water pollution will be required.

(3) Berri Band Dumping Site

Berri Band is a flood protection band located at west side of Dhaka City. Berri Band dumping site is the area between this flood protection band and brick factory. One bulldozer and one wheel dozer is working in this dumping site but no other facilities is installed. This site is also filled without soil covering. It is informed that the site is private land and owner request to DCC to fill by solid waste.

In the dry season there is no discharge of leachate. As the site is located outside the flood protection band, the site may be flooded in rainy season. Also, it is noted that there are several place filled and/or dumped by solid waste along the flood protection band. It is necessary to stop illegal dumping along this important facility.

(4) Utara dumping site

Utara dumping site is located north side of Dhaka City and a low land along the Tongi River. The landowner is International University of Business, Agriculture and Technology (IUBAT) and requested to reclaim by solid waste. But the site is outside of the flood protection bank and is old riverbed. Therefore this site has flood in rainy season.

(5) Legitimacy of existing dumping sites

According to the Environmental Conservation Rules 1997, the project of new landfill site for solid waste disposal is categorized in the red group which are required the Environmental Clearance by Department of Environment including approval of IEE and EIA. However, all landfill sites used by DCC have no EIA for commencement of operation while the Rules came to power after Matuail site was constructed and started operation. Section 7 of

Environmental Conservation Rules, 1997 provides procedure for issuing Environmental Clearance Certificate to the industrial units and project by the following four categories:

(a) Green;
(b) Orange-A;
(c) Orange-B;
(d) Red

Schedule-1 of the Rules specifies industries and projects included in the four categories: 69 types of industrial units and projects are listed in the Red Category. Among 69 types, landfill by waste is nominated as "43. Land-filling by industrial, household and commercial wastes." Therefore it is probable that new landfill sites such as Berri Band and Utara are requested to satisfy the Environmental Clearance according to the Environmental Conservation Acts and Rules if there is no exemption in the rule for small scaled or temporary facilities of this kind.

3.4.3 Closed landfill site

There are several closed landfill sites in Dhaka City as shown in Table 3.4-4. At Magdapara closed site, a stadium is already constructed. Also, Jatrabari Market is developed at closed landfill site. This site was developed only few years after landfill operation was stopped. When the site is developed, site was covered by the soil. Concerning Bashetek closed site, no covering soil was done but slum rehabilitation project is ongoing.

As mentioned above, closed site was developed within a few years although the site will have several problems such as settlement and methane gas generation. It shows that demand of such land will be still high. Also, covering soil will be carried out at the development. If covering soil will be conducted at the landfill operation, environmental pollution and vector could be reduced from operation stage dramatically.

Table 3.4-4 Closed Landfill Sites

Closed landfill site	Closed year	Present land use
Magdapara	1998	Stadium
Jatrabari & Damra	1997	Jatrabari Market
Mirpur (Gabtori bus stand)	1985	Bus station
Mirpur (Chalkbari)	1998	Open field
Gulshan (Pragati Sharani Basundhara)	2001	East (right) side: Filling station West (left) side: Slm and Kacha Ghar (shopping moll consists of bamboo huts)
Lalbag (Shahid Nager)	2000	Slum area
Lalbag (Shosan Ghat)	1999	Slum area
Kamrangichar	1999	Slum area
Bashentek	2002	Slum rehabilitation project (seems to be housing development) is ongoing at this site.
Kulsi	1990	Journalist's residential plot

3.4.4 Equipment of final disposal

Heavy equipment used in landfill site is shown in Table 3.4-5. Mechanical Division 2 has many heavy equipments but working ratio is very low especially on chain mounted bulldozer and excavator. It has 15 chain-mounted bulldozers and six (6) chain mounted excavator but only 4 bulldozers and 2 excavators are working. Table 3.4-6 is the list of heavy equipment with its present condition. It is necessary to have operation records of each equipment with record of monthly and yearly operation hours.

Table 3.4-5 Heavy equipment used for landfill

Unit

No.	Name of equipment	Quantity	Conditions		Remark
			Not Working	Working	
1	Chain mounted bulldozer	15	11	4	
2	Tire dozer	8	4	4	
3	Pay loader	9	3	6	
4	Chain excavator	6	4	2	
5	Wheel excavator	2	1	1	
6	Hydraulic crane	2	1	1	
Total		42	24	18	Working ratio 43%

Table 3.4-6 List of heavy equipment

	Name of equipment	Register No.	Year of purchase	Condition	Remark
1	Bulldozer –2		1980	Not work	
2	Bulldozer –3		1980	Not work	
3	Bulldozer –5		1980	Not work	
4	Bulldozer –6		1980	Not work	
5	Bulldozer –7		1980	Work	
6	Bulldozer –8		1980	Not work	
7	Bulldozer –9		1980	Not work	
8	Bulldozer –12		1996	Not work	
9	Bulldozer –13		1996	Not work	
10	Bulldozer –14		1996	Not work	
11	Bulldozer –15		1996	Work	
12	Bulldozer –16		1996	Work	
13	Bulldozer –17		1996	Not work	
14	Bulldozer –18		1996	Not work	
15	Bulldozer –19		1996	Work	
16	Tire dozer –1		1980	Not work	
17	Tire dozer –2		1980	Not work	
18	Tire dozer –3		1980	Work	
19	Tire dozer –4		1997	Not work	
20	Tire dozer –5		1997	Work	

	Name of equipment	Register No.	Year of purchase	Condition	Remark
21	Tire dozer –6		1997	Work	
22	Tire dozer –7		1997	Not work	
23	Tire dozer –8		1997	Work	
24	Pay loader-1		1980	Work	
25	Pay loader-2		1980	Not work	
26	Pay loader-3		1980	Not work	
27	Pay loader-4		1980	Work	
28	Pay loader-5		1980	Not work	
29	Pay loader-6		1997	Work	
30	Pay loader-7		1997	Work	
31	Pay loader-8		1997	Work	
32	Pay loader-9		1997	Work	
33	Chain Excavator-1		1980	Not work	
34	Chain Excavator-2		1980	Work	
35	Chain Excavator-3		1996	Not work	
36	Chain Excavator-4		1996	Work	
37	Chain Excavator-5		1996	Not work	
38	Chain Excavator-6		1996	Not work	
39	Wheel excavator-7		1997	Work	
40	Wheel excavator-8		1997	Not work	
41	Hydraulic crane-1	SHO-11-0028	1996	Work	
42	Hydraulic crane-2	SHO-11-0029	1996	Not work	

3.4.5 Environmental Clearance

(1) Category of solid waste management facilities

According to the Environmental Conservation Rules, Environmental Clearance is required for a new project for final disposal, as “Earth Filling, Industrial/Domestic/Commercial waste” is listed in Red Category. It is noted that Engineering workshop (above capital of TK 1,000,000) and Motor vehicle repair workshop (above capital of TK 1,000,000) are listed in Red Category. Therefore, construction of new final disposal site and new workshop will be required the Environmental Clearance according to the Environmental Conservation Act and Rules.

(2) Process and Requirement on Red Category Project

The requirement and procedure for Environmental Clearance is shown in Figure 5.2-6. The process is divided in two stages, a. Obtaining site clearance and b. Obtaining Environmental Clearance.

The Application should enclose:

i) Feasibility Study Report for proposed industry/project

ii) Initial Environmental Examination report (IEE) including TOR for EIA

iii) Process flow diagram

iv) Layout plan with location of ETP

v) Drawing of ETP

vi) Time flame (Applicable for new industries only)

vii) Environmental Management Plan (EMP) along with process flow diagram, layout plan with location of ETP and information on ETP (Applicable for existing industries only)

viii) Pollution effect abatement plan and emergency plan

ix) A NOC from local authority to abate pollution in case of an emergency

x) Relocation or Rehabilitation plan (if any)

DOE issues Site Clearance within 60 working days from date of application. Then industry will submit for approval of the EIA and ETP design. Also industry may start land and infrastructure development. It is noted that installation of ETP will start after approval of EIA and ETP design.

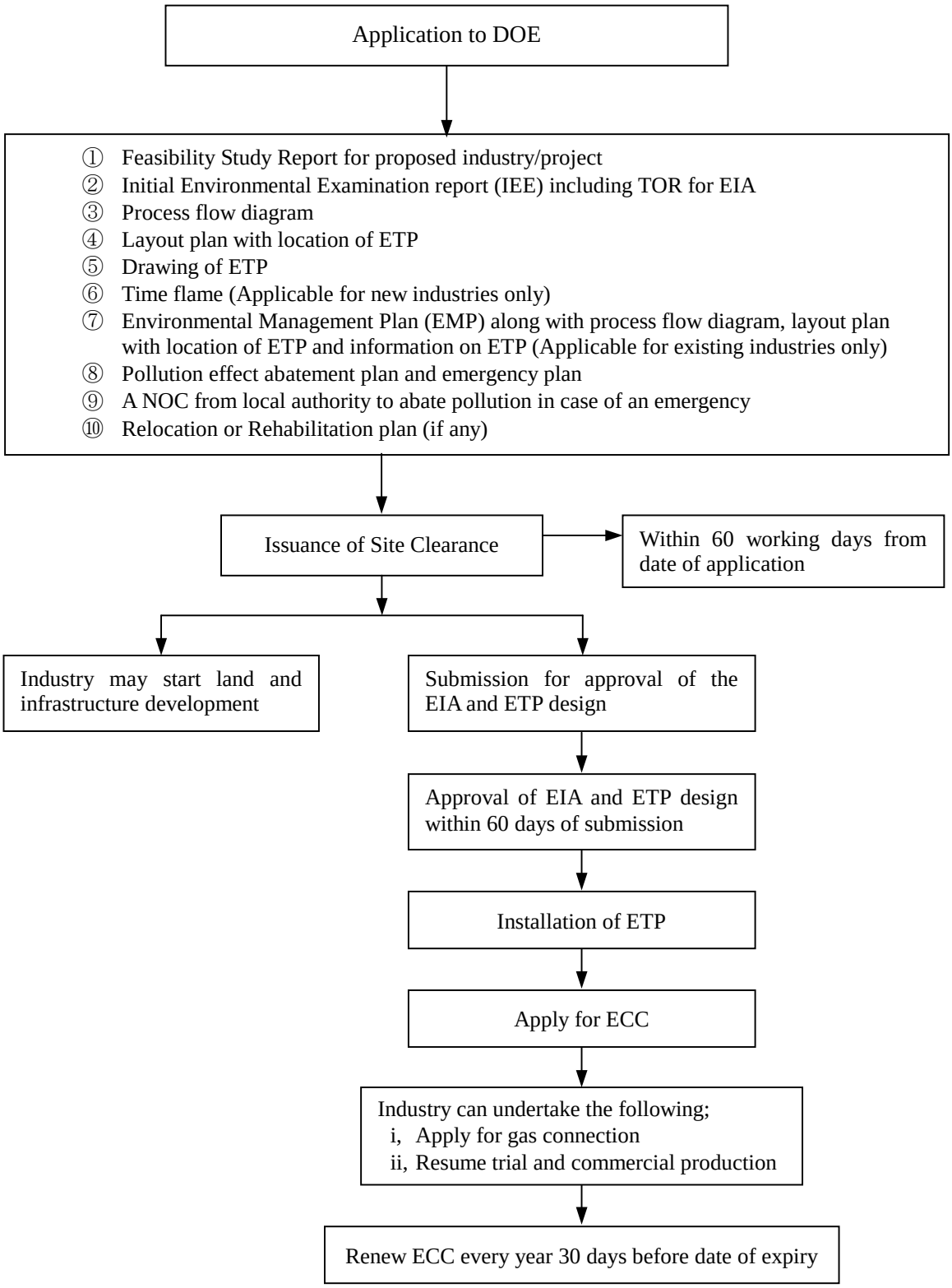


Figure 3.4-1 Procedure for Environmental Clearance (Red Group)

3.5 Recycling/Compost

3.5.1 Overview of Present Situation

(1) Outline of Recycling Activities in Dhaka City

a) Economic situations and recycling industry in Dhaka City

Main industry in Dhaka City is manufacturing. The next major employment sector is governmental works. Above all, the garment industry, which contributed largely to economic growth and with more than 90% of the manufacture units located in Dhaka City.

According to "Bangladesh Statistical Year Book 2001"and "Profile of Dhaka City", it could be estimated that the actual labor force which does not include unemployed persons in Dhaka City approximately 1.16 million. On the other hand, it is reported that more than 0.1 million people are dependent on and involved in the recycling activities in Dhaka City at present. This means that approximately 10% of the total labor forces in Dhaka City gathers around recycling sector. Among those people, approximately 74,000 peoples are engaged in recovering material out of various points of the stream of municipal solid waste. Nowadays recycling forms practically one of the important industries in Dhaka City.

b) Stakeholders of Recycling Activities

Recycling stakeholders of municipal solid waste is composed of three principal groups as shown in Figure 3.5-1, namely collector, buyer and factory/shops for recycled products.

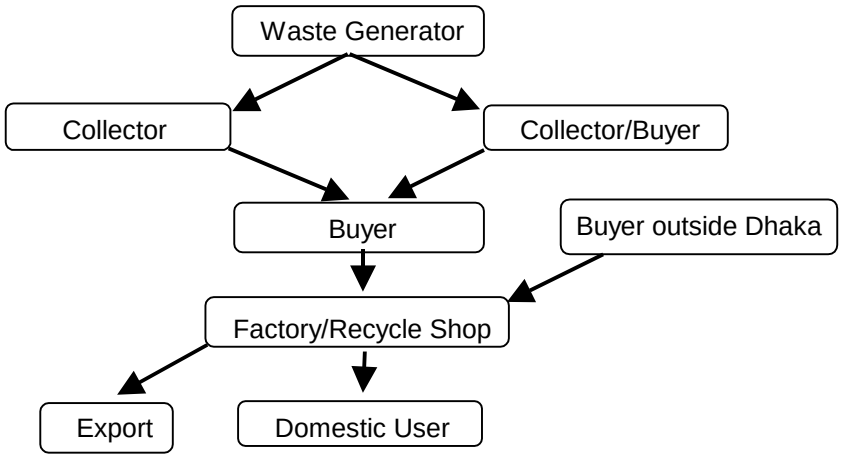


Figure 3.5-1 Basic Structure of Recycling Stakeholders of Municipal Solid Waste

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, which function as collector and buyer. They are called as feriwalla and 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 coming to recycling factories in order to meet the requirement of production.

c) Major Recyclable Wastes out of Municipal Solid Waste

Although recyclable wastes in Dhaka City varies from paper to bone, main recyclable wastes and recycled products from the municipal solid wastes in Dhaka City are shown in Table 3.5-1.

Table 3.5-1 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: Study Team)

The Study Team conducted additional interview surveys with manufacturers to get more realistic volume of main recycled materials in Dhaka City because the foregoing survey gave too big volume of material recovery. The figure of previous survey mainly depended on personal guess of large number of waste collectors. The large number of interviewee and small volume of their output were likely to accumulate uncertainty of the total volume gained as the sum of their answers. In this connection, the additional interview is expected to give more reliable figure of recycled volume because it covers most of destination of recycled materials by getting information from less number of interviewees. Estimated recycled waste volumes are described in the following sections.

(2) Plastic Recycled Waste Volume

a) Estimation Method

According to our interview surveys to manufactures of plastic recycling factories, plastic recycling factory in Dhaka City could be divided into three categories due to the material volume (see Table 3.5-2).

Table 3.5-2 Category of Plastic Recycling Factory

Material Volume	Category
more than1000 kg/day	Large Scale
500 to 999 kg/day	Medium Scale
1 to 499 kg/day	Small Scale

(Source: Study Team)

On the other hand, there are approximately 200 for plastic shoes and 300 for other plastic products factories are operating in Dhaka City, according to the Plastic Shoes Factory Owners Association (Paduka Factory Malik Somity) and Plastic Product Producers Association (Plastic Drobbo Prostut Karok Association). Table 3.5-3 shows estimated number of plastic recycling factories in each category.

Table 3.5-3 Estimated Number of Plastic Recycling Factories in Dhaka City

Types of Factory	Large Scale	Medium Scale	Small Scale	Total
Plastic Shoe	20	50	130	200
Other Plastic Products	25	70	205	300
Total	45	120	340	500

Source: Plastic Shoes Factory Owners Association and Plastic Product Producers Association.

Also, average material volume per factory and material collection ratio from Dhaka City for each category could be assumed based on the interview results to the manufactures.

b) Estimation Results

The estimation results of plastic recycled wastes are summarized in Table 3.5-4. It could be estimated that total plastic recycled wastes from Dhaka City is approximately 103 ton per day. These wastes used for domestic products.

Table 3.5-4 Estimation Results of Plastic Recycled Wastes

Plastic Shoes				
Category	Average material volume (kg/day /factory)	Material collection ratio from Dhaka City (%)	Number of factories	Daily used volume from Dhaka City (kg)
Large scale	1,500	50	20	15,000
Medium scale	650	50	50	16,250
Small scale	200	50	130	13,000
Total			200	44,250
Other Plastic Products				
Category	Average material volume (kg/day /factory)	Material collection ratio from Dhaka City (%)	Number of factories	Daily used volume from Dhaka City (kg)
Large scale	2,000	40	20	20,000
Medium scale	650	40	50	18,200
Small scale	250	40	130	20,500
Total			200	58,700
Grand Total				**102,950**

(Source: Study Team)

(3) Paper Recycled Waste Volume

a) Estimation Method

There are many pulp and paper recycling factories are operating near Dhaka City, but only ten of them use paper recyclable wastes coming from Dhaka City according to the interview surveys. The ratio of paper recyclable wastes from Dhaka City is very dependable on the factory. Therefore, it is calculated all the materials based on interviews to five factories, then it is assumed the average paper recycled wastes per factory (See Table 3.3-5).

b) Estimation Results

The estimation results of paper recycled wastes are summarized in Table 3.5-5. It could be estimated that total paper recycled wastes from Dhaka City is 168 ton per day. These wastes used for domestic products.

Table 3.5-5 Estimation Results of Paper Recycled Wastes

Name of the company	Material volume (kg/day)	Material collection ratio from Dhaka City (%)	Daily used volume from Dhaka City (kg)
Asia Paper	25,000	80	20,000
Hashem Paper	20,000	30	6,000
MEB Pulp and Paper	60,000	50	30,000
Maguna	20,000	75	15,000
Shah Jalal Newsprint	130,000	10	13,000
Sub Total			84,000
Average volume per company			16,800
Number of paper recycling company using wastes from Dhaka City			10
Grand Total			**168,000**

(Source: Study Team)

(4) Glass Recycled Waste Volume

a) Estimation Method

Glass recycling factory in Dhaka City is divided into two categories due to the material volume according to the interview surveys (see Table 3.5-6).

Table 3.5-6 Category of Glass Recycling Factory

Material Volume	Category
more than 10,000 kg/day	Large Scale
1 to 1,500 kg/day	Small Scale

(Source: Study Team)

There are eight glass recycling factories, which use glass recyclable wastes from the municipal solid wastes of Dhaka City. Average material volume per factory and material collection ratio from Dhaka City for each category could be assumed based on the interviews.

b) Estimation Results

The estimation results of glass recycled wastes are summarized in Table 3.5-7. It could be estimated that total glass recycled wastes from Dhaka City is approximately 24 ton per day. These wastes used for domestic products. However, many of the factories are using imported glass raw material to produce recycled glass products.

Table 3.5-7 Estimation Results of Glass Recycled Wastes

Category	Average material volume (kg/day /factory)	Material collection ratio from Dhaka City (%)	Number of factories	Daily used volume from Dhaka City (kg)
Large scale				
Glass sheet	12,000	30	1	3,600
Other glass	15,000	40	3	18,000
Small scale	1,200	40	4	1,920
Total	-	-	8	23,520

(Source: Study Team)

(5) Metal Recycled Waste Volume

a) Estimation Method

Metal recycling materials can be classified into i) ferrous metal (steel), ii) non ferrous metal (aluminum, etc.), but the demand of steel products are very huge compared to non ferrous recyclable wastes. Therefore, this metal estimation is focused on ferrous (steel) recycled wastes, which is coming from municipal solid wastes of Dhaka City.

According to Steel Re-rolling Mills Owners Association and Bangladesh Steel Mills Owners Association, there are 306 steel recycling factories, which are using municipal metal scraps from Dhaka City. Also average materials volume and material collection ratio from Dhaka City for each category could be assumed based on the interviews to the above associations.

b) Estimation Results

The estimation results of metal (steel) recycled wastes are summarized in Table 3.5-8. It could be estimated that total steel recycled wastes from Dhaka City is approximately 41 ton per day. These wastes used for domestic products.

Table 3.5-8 Estimation Results of Steel Recycled Wastes

Category	Average material volume (t/d)	Material collection ratio from Dhaka City (%)	Number of factories	Daily used volume from Dhaka City (ton)
Re-rolling Mills				
Large scale	40	1.0	30	12.00
Small scale	20	1.0	54	10.80
Sub-total	-	-	84	22.80
Steel Mills				
Large scale	50	0.5	40	10.00
Small scale	20	0.5	20	2.00
Sub-total	-	-	60	12.00
Cast iron Mills				
Large scale	1.5	5.0	12	0.90
Small scale	0.5	7.0	150	5.25
Sub-total	-	-	162	6.15
Grand Total				**40.95**

(Source: Study Team)

(6) Other Recycled Waste Volume

The Study Team conducted a series of hearing survey with recyclable waste collectors to get the volume of their output by type of recyclable material. As the summary of information from 22 respondents, they collect other materials than 4 major recyclables at the rate of 22 % of total output in weight. The contents of other wastes are shown in Table 3.5-9.

Table 3.5-9 Other Recycled Wastes

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

(Source: Study Team)

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

(7) 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 at downstream like container sites and dump sites is undertaken by individual persons and amounts comparably low as shown in Table 3.5-10.

Table 3.5-10 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 at downstream, the Study Team made an interview survey and found they belong to low or middle low income group in Bangladesh as shown in Table 3.5-11. Collectors at upstream of waste stream are considered gaining higher income than those at 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 moves to upstream.

Table 3.5-11 Features of Material Collector at Dump Sites & Containers

Features	Working at dump sites	Working at containers
number of informant	45 persons	25 persons
income level of majority	2,000 to 7,000 Tk/month	2,000 to 5,000 Tk/month
gender or age	mostly female at Matuail but mostly male at Berri Band	male adult and children
working hours	6:30 to 14:00 (7.5 hrs.)	7:00 to 17:00 (10 hrs.)
residence location	73 % live far from sites	neighborhood
commuting measure	by bus, rickshaw, CNG, DCC truck or walk	On foot
Living condition	all informants have water supply, electricity, toilet at home	19 informants (76 %) have water supply, electricity, toilet (mostly shared basis) at home
electric instrument	TV owned by 24 %	TV owned by 20 %

(Source: Survey on waste pickers by the Study Team)

(8) Compostable Wastes and Compost Products Volume

At present, there are five small-scale compost plants, which uses compostable municipal wastes from Dhaka City. These plants are located within Dhaka City; i) Green Road area, ii) Balley Road area, iii) Dholpur area; iv) Mirpur area; and v) Kalyanpur area. The three plants have 3-ton capacity and the other two have 5-ton capacity to produce compost per day. The total capacity of 5 plants comes to 19 t/d and this figures stands for the total capacities of composting in Dhaka City according to Waste Concern, which is the pioneer of small-scale compost plants there.

The plants are operating at lower level than capacity of 19 t/d because of weak demand of compost products derived from kitchen waste. They are at present producing compost products approximately less than 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 valuated by far lower than those of other materials according to the interview survey with manufacturers and dealers.

Table 3.5-12 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 drops

(Source: Study Team)

3.5.2 Evaluation of Present Situations

The present recycling system is evaluated from the following points of view:

- Contribution to municipal waste reduction
- Coexistence with SWM
- Economic aspects
- Social aspects.

(1) Contribution to Municipal Solid Waste Reduction

As previous section described, each recycling activity is contribute to municipal waste reduction. Table 3.5-13 shows tentative calculated recyclable waste and recycled waste based on the surveys.

Table 3.5-13 Estimated Major 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 150 samples from five categories, which did not contain metal factory at all. In addition, 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: Study Team)

According to the above calculation, paper and plastic contribute much to the municipal solid waste reduction in Dhaka City, while composting contributes very little to the waste reduction though the compostable waste shares 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 dust bins or containers cause negative impacts to keep the street clean and to remove waste efficiently because recyclable waste collectors spread waste around there for their convenience. They do not return the remaining waste to dust bin or container after they finish picking material. This suggests some adjustment of activity between waste collection by DCC and material recovery by waste pickers are necessary to make both side's interest in peaceful coexistence. At the dump site, there also needs some adjustment of activity in waste dumping and spreading by DCC to keep 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 our 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 the 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 share negligibly small amount that meets limited demand of small-scale users. From economic points of view, kitchen waste derived compost is valuated lower than the products made of the other material. The circumstances make the kitchen waste derived compost hard for business that may distribute product to wider users of agriculture.

(4) Social Aspects

Visible full-time workers engaged in recycle are material collectors at dumpsites and containers. They are working mostly individual basis and earn Tk. 3,000 to 5,000 /month. The income level of them is comparable to those of garment industry workers gaining Tk. 3,000 to 3,500 /month. They are raising almost same money as the workers of leading industry of Bangladesh. Material collectors at upstream get in general higher income than those at downstream. Therefore material collectors as a whole are regarded average workers in this country, not distressed vocational group.

3.6 Industrial Waste

3.6.1 Industrial Waste Sector Coverage

3.6.1.1 Industrial Waste Sector Coverage

Industrial wastes are all types of wastes in liquid, semi-solid and solid generated from industrial activities, mostly from factories of manufacturing and processing industries. Origin of industrial wastes may include remains of input materials, by-product of manufacturing and processing, and residues of products. Hence types or characteristics and amounts of industrial wastes are highly varied not only by industries but input materials and processes employed. In this sector industrial solid wastes generated in huge amount and industrial solid waste containing hazardous and toxic constituents are targeted wastes since the former may consume a space of DCC's landfill site quickly if disposed there and the later may pose a serious environmental and health problems if not managed appropriately.

3.6.1.2 Activities of Sector Group

As the first step of the study following surveys were carried out to identify problems existing in industrial wastes management in Dhaka, focusing on hazardous wastes management. Methodologies of the survey employed were a review of the survey reports and research papers conducted in the past, and sites visit of several industries and waste dumpsites both in legal or illegal.

(1) Review of the Past Study

Quite a few study or survey on industrial and hazardous waste management in Dhaka has been conducted by the international aid organizations and universities. Results and data drawn in those study and survey are only sources to understand status of industrial and hazardous waste management in Dhaka and to identify problems encountered since practical survey or analysis of industrial and hazardous waste is beyond the scope of this study as mentioned in the Inception Report.

(2) Survey at the Waste Dumpsite

Currently some parts of industrial solid wastes generated in Dhaka are dumped at the Matuail waste dumpsite. Others may be piled or stored in the premise of factories or dumped at open areas illegally. This survey included observation of both legal and illegal dumping sites where industrial and hazardous wastes were dumped.

(3) Identification of Major Waste Generator

There are many industries and factories in Dhaka that potentially generates industrial wastes. The size of industries counted by the amount of products or the number of employer seems to be widely ranged. The amount of industrial wastes may be proportional to the size of industries. Hence in order predict the amount of industrial wastes generation in Dhaka spatial

distribution of major industries is identified with information of industries classification, employee number or amount of products. Industries that may produce hazardous or toxic wastes are also noted while identifying distribution of industry.

3.6.1.3 Member of Sector Group

Jahir Uddim Patwary, Mechanical Engineering Division 2 and Takashi Ikeguchi of JICA Study Team are a member of this sector group.

3.6.2 Existing Conditions

3.6.2.1 Industry distribution in Dhaka

(1) Major Industrial Area

According to a land use map of Dhaka in 1995, major industrial zones are located in Mohammadpur, Hazaribag, Lalbagh, Shyampur, Demra, Tejgaon, and Badda. According to the statistical data[1] published in January 1993 number of industries with employee number of 10 or more is 6,919 in Dhaka, and regional distribution of them are shown in Table 3.6-1.

Table 3.6-1 Number of manufacturing establishments by district in 1989-1900.

District	Industry classification by BSIC										
	3000	3100	3200	3300	3400	3500	3600	3700	3800	3900	Sub-total
Cantonment	0	10	22	10	1	8	6	1	10	1	69
Demra	0	51	113	36	29	79	25	59	224	16	632
Dhamrai	0	27	8	0	0	4	10	3	20	0	72
Dhamondi	0	23	336	18	27	49	6	4	69	16	548
Dohar	0	3	4	3	0	0	1	0	1	0	12
Gulshan	0	15	139	16	9	14	3	0	39	4	239
Keraniganj	0	33	41	6	2	20	94	6	116	11	329
Kotwali	1	60	197	6	151	139	9	6	169	99	837
Lalbagh	2	171	169	16	46	260	16	5	197	121	1,003
Mirpur	0	42	219	26	12	82	26	5	78	8	498
Mohammadpur	0	19	103	10	11	36	32	0	27	10	248
Motijheel	0	26	169	26	101	56	3	6	112	7	506
Nawabganj	0	5	5	7	1	0	5	0	0	0	23
Ramna	1	20	76	5	33	23	2	4	67	4	236
Savar	0	27	107	9	7	27	40	16	47	2	282
Sutrapur	0	51	132	54	180	83	3	7	210	20	740
Tejgaon	1	27	132	45	33	106	17	36	233	15	645
Sub-total	5	610	1972	293	643	986	298	158	1619	334	6,919

Note: BSIC number is explained in Table 3.6-3.

This statistics shows data in 1989-1990 and districts may not necessarily coincide with current districts in DCC because of a reform of jurisdiction area in 1992. Although current number of factories is surely different from those in Table 3.6-1 district distribution of factory location in Dhaka can be guessed by Table 3.6-1. According to this Table manufacturing establishment in Dhaka are mostly located in the districts of Lalbagh, Kotwali, Sutrapur, Demra, Tejgaon, Dhamondi, and Motijheel.

[1] Directory of Manufacturing Establishments 1989-90, Bangladesh Bureau of Statistics, January 1993.

(2) Industry Classification and Number and Scale of Industry

Several information are available about number of industries by classification; however, since classification rule and criteria are different among them the number of industries is also different. Some of them are summarized in Table 3.6-2. Total number of factories in Table 3.6-1 is, however, far below the number mentioned in previous Section.

Table 3.6-2 Number of Factories in Dhaka by Industry.

Case 1[2]		Case 2[3]	
Industry	Number	Industry	Number
Tanneries	182	Tannery	160
Pharmaceuticals	77	Textile	166
Transformers, Switchgear	9	Pharmaceutical	106
Dyeing & Varnish	15	Chemical	18
Ceramics	2	Pesticide/Insecticides	4
		Rubber/Plastics	23
		Iron, Steel mills	30
		Others	47
Total	285	Total	554

In the Statistics referred in Footnote 1 is shown the number of manufacturing establishments by industry classification defined by the Government. Table 3.6-3 summarizes the number of industries by industry classification. Textile Wearing Apparel and Leather Industry (BSIC: 3200), Fabricated Metal Product, Machinery and Equipment (BSIC: 3800) and Chemicals, Petroleum and Coal (BSIC: 3500) covers 66% of total number of factories in Dhaka. Number of workers engaged in those three industries is 294,740 accounting 78% of total manufacturing employment in Dhaka.

Textile Wearing Apparel and Leather Industry is concentrated mostly at Dhamondi, Mirpur, and Kotwari area, while Chemicals, Petroleum and Coal industry at Lalbagh, Kotwali, and Tejgaon according to Table 3.6-1. Fabricated Metal Product, Machinery and Equipment industry is located mostly at several districts such as Demra, Tejgaon, Sutrapur, Kotwali and Lalbagh.

[2] Selected Industry Directory 1988, Directorate of Industries.
[3] M.H.Rahman, Waste Management in Greater Dhaka City, Journal of the IPHE, India, Vol.1992, No.2

Table 3.6-3 Number of Factories and Employer Number by Industry Classification (1989-90)

BSIC No.	Industry	Factory No.	Employer No.
3000	Not adequately defined	5	205
3100	Food, beverage and tobacco	613	16,773
3200	Textile wearing apparel and leather industry	1,973	209,419
3300	Wood, wood product including furniture	293	6,011
3400	Paper, paper products, printing & publishing	644	18,875
3500	Chemicals, petroleum, coal, rubber and plastics	986	36,899
3600	Non-metal, mineral except petroleum and coal	298	22,630
3700	Basic metal industries	158	9,922
3800	Fabricated metal product, machinery & equipment	1,619	48,422
3900	Others	334	7,807
Total		6,919	376,963

The size of industries expressed by the distribution of employer number shows that except for BSIC No. 3200 (Textile Wearing Apparel and Leather Industry), 3600 (Non-metal, Mineral except Petroleum and Coal) and 3700 (Basic Metal Industry), most factories seem to be small industries with number of employer below 30 (See Figure 3.6-1).

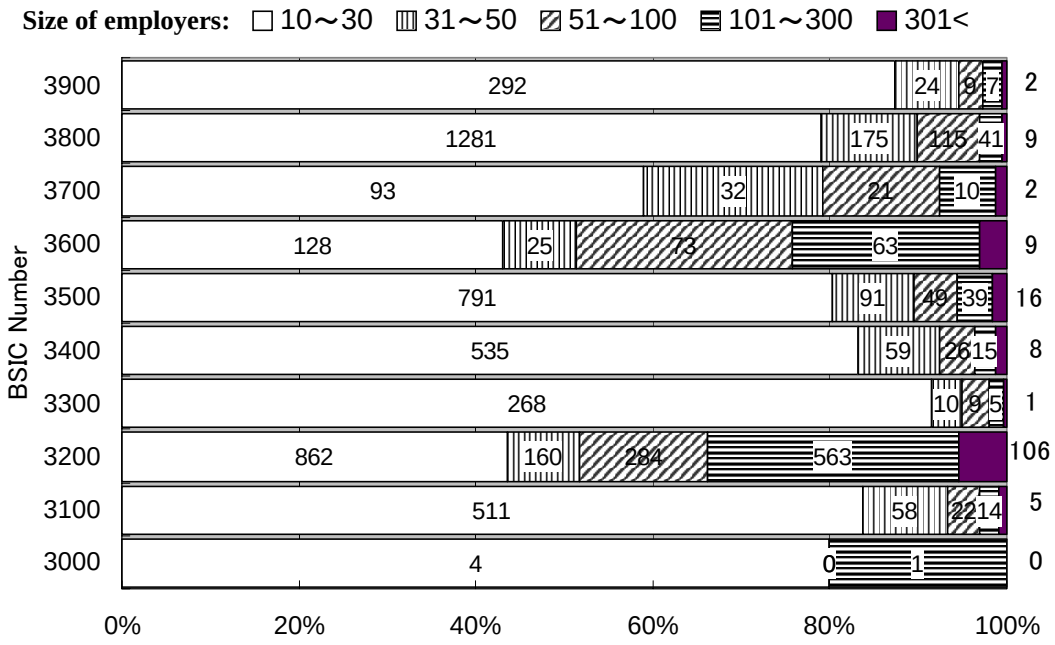


Figure 3.6-1 Employer Size Distribution by Industry Classification (1989-90)

Table 3.6-4 Industry Number and Employer Number and Gross Product Value

Industry	No. of Industry	No. of employer	Gross value of product
Acids, Alkalites and Saltes	1	6	96
Agricultural Machinery Equipments	8	221	14,803
Allopathic and Medicines	141	9,302	3,055,553
Articles of Pulp, Paper	5	974	391,396
Ayure-Vedic Medicines	13	917	133,541
Bakery Products	250	6,542	1,215,340
Bangles (Except Precious)	6	85	4,268
Basic Copper, Copper Alloy	11	484	227,640
Batteries Manufacturing	139	1,890	256,136
Bolts, Nuts and Rivets	38	1,052	135,224
Book Binding, Other Arts	48	598	15,499
Bricks, Tiles, Clay Products	5	694	96,809
Button, Studs, Hooks Manufacturing	6	77	4,669
Candle Manufacturing	7	31	1,622
Cards and Stationery	9	183	29,532
Carpets and Rugs	3	342	40,540
Cement Products Manufacturing	8	110	7,190
Chemical Products N.E.C.	13	166	6,022
China, Ceramic Products	5	2,267	670,028
Cigarettes Manufacturing	5	4,576	8,157,281
Confectioneries	80	1,217	105,956
CottonTextiles	27	15,487	1,313,829
Cutleries Manufacturing	13	297	25,476
Cycles and Padicabs Manufacturing	23	469	60,196
Dairy Products	5	731	296,842
Distilled Rectified Spirts	2	194	6,817
Dyeing, Bleaching Textiles	122	4,522	408,061
Dyes, Colours and Pigments	7	92	7,342
Edible Oils	37	879	1,378,915
Edible Salt	14	345	85,224
Electric Bulbs and Tubes	8	836	788,368
Electrical Apparatus	95	1,720	68,942
Electrical Appliances	5	173	22,941
Appliances	11	173	44,135
Electronic Components	1	53	24,566
Fabricated Metal Products	56	1,093	54,520
Fruits and Vegetables	3	47	10,443
Fur Dressing and Dyeing	1	21	0
Furniture and Fixtures	74	686	69,455
Glass Products Manufacturing	11	841	236,869
Grain Milling	39	1,456	1,595,821
Hand and Edge Tools Manufacturing	8	102	4,379
Handloom Textiles	5	194	236,635
Heating, Cooking Equipment	14	309	15,249
Homeopathic, Biochemicals	5	152	9,176
Industrial Chemicals Nec	6	105	18,754
Industrial Machinery	16	331	32,389
Inedible Vegtable Oils	3	95	34,811
Ink (All Kinds) Manufacturing	3	68	15,862
Insulated Wire and Cables	9	146	23,019
Iron and Steel Foundries	8	187	30,952
Iron and Steel Industries	3	218	186,276
Iron and Steel Re-Rolling	33	1,636	2,143,708
Jewellery, Precious Metals	28	85	1,988
Jute Textiles	8	11,520	843,807
Knitting Mills	14	248	32,339
Leather Footwear	65	1,093	56,830
Leather Products	9	133	12,141
Machinery and Equipments	25	463	56,536
Manufacture of Gur	1	18	1,397
Manufacture of Pencils	1	50	3,701
Manufacturing of Dental Instruments	1	36	3,754
Manufacturing of Pen and Ball Pen	9	247	19,010
Manufacturing of Plastic Footwear	36	511	54,770
Manufacturing of Rubber Products	3	50	4,147
Manufacturing of Rubber Products	166	3,645	781,047
Manufacturing of Sewing Machines	1	12	1,039

Table 3.6-4 Industry Number and Employer Number and Gross Product Value (continued)

Industry	No. of Industry	No. of employer	Gross value of product
Matches Manufacturing	10	5,195	424,659
Metal Barrels and Drums	10	107	16,643
Metal Decorative Handicrafts	1	8	248
Metal Stamping Etc	9	734	178,523
Metal Trunks Manufacturing	4	64	3,077
Metal, Wood Work Machinery	8	86	6,300
Miscellaneous Food Products	37	1,773	766,256
Miscellaneous Plastic Products	96	1,321	378,392
Motor Cycles, Autorickshaws	4	63	7,716
Motor Vehicles Production	51	1,206	132,713
Musical Instruments Products	3	39	1,140
Narrow Fabrics	31	503	30,806
Other Manufacturing (Brooms/Brushes)	5	42	7,211
Paints and Varnishes	4	86	13,555
Paper Board Manufacturing	4	194	18,144
Perfumes and Cosmetics	11	499	116,884
Pesticides, Insecticides	4	56	5,746
Photo Typesetting	1	11	821
Plumbing Equipment	31	975	278,050
Polythene Products Manufacturing	14	441	77,638
Pottery, China, Earthenware	1	36	1,995
Prepared Animal Feeds	1	15	741
Printing of Book Map Etc	118	2,003	176,615
Printing of Newspaper	92	5,143	651,380
Printing, Publishing Books	188	4,782	696,784
Products of Optical Goods	10	109	10,888
Pulp and Paper Manufacturing	3	414	117,689
Radio and Television	21	1,483	649,504
Razors and Blades Manufacturing	1	488	66,367
Readymade Garments	552	180,466	25,564,495
Rebuilding of Tyres, Tubes	4	60	3,813
Refractories Manufacturing	1	219	34,386
Resins, Plastic Materials	1	34	3,081
Rice Milling	1	53	5,573
Saw and Planing Mills	248	2,698	492,562
Ship Building, Repairing	31	962	50,409
Sign and Advertisement	5	99	4,036
Silk, Synthetic Textiles	112	3,827	356,153
Soap and Detergents	110	4,360	3,771,775
Soft Drink Manufacturing	5	1,003	424,771
Spooling and Thread Ball	14	142	3,689
Sports Goods Manufacture	14	183	23,857
Structural Metal Products	60	842	67,879
Tanning and Finishing	293	10,420	8,845,232
Tar and Alkatra Manufacturing	5	167	121,267
Textile Machinery	10	199	14,760
Textile Manufacturing NEC	1	144	9,042
Tin Cans and Tinware	11	178	27,620
Tobacco Stemm, Redrying	1	14	697
Toys, Non-Power Driven	1	170	8,151
Umbrella, Walking Sticks	60	1,869	190,933
Unani Medicines	5	80	5,299
Utensils - Copper/Brass	6	34	1,001
Utensils Manufacturing - Aluminium	109	3,363	577,063
Utensils-Steel	3	31	5,493
Wire Products Manufacturing	10	150	32,880
Wood and Cork Products	1	32	1,670
Wooden Furniture Manufacturing	35	926	70,147
Zarda and Quivam	5	28	1,414
Total	4,322	324,132	71,247,256

Industry information described in Table 3.6-1, Table 3.6-3 and Figure 3.6-1 are based on industry classification of 4-digit level BSIC categorization. On the contrary Table 3.6-4 shows more detail industry categorization and number of factories that are included in each categorization together with employer's number as well as gross value of annual product[4]. Although those information are based on the Bangladesh Census of Manufacturing Industries (CMI) 1991-92 that was published in 1997, rule or criteria of the Census are not clear. Total number of factory and employer are 4,322 and 324,132, respectively, which are less than those shown in Table 3.6-3 that is based on data in the Directory of Manufacturing Establishments 1989-90.

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

3.7 Medical wastes

3.7.1 Hospital wastes incineration in Dhaka

There is no documented information on incineration of hospital wastes on site. Only information to get any idea of hospital incinerators is by the reports published in the past, the articles in the recent newspapers, or by personally obtained information. Table 3.7-1 is the summary of such information obtained in the Study. Some hospitals burn their wastes in the open pit or in barrel in their premises. Those disposal methods are, however, excluded from incineration technology. Study team visited five hospital incinerators in operation in the Study area to survey the detail of the technology and operation of incinerators.

Table 3.7-1 Information on hospital incinerators in Dhaka appeared in the various sources of publication.

No	Hospitals	Description	Source	Remarks
1	Aga Khan University Hospital	Incineration cost: $0.08/bed/day	1	Out of Study Area
2	Dhaka Medical College Hospital (DMCH)	Two of three units have been inoperative because of fund lack of funds	2	This incinerator is referred frequently
3	International Center for Diarrhea Diseases Research, Bangladesh (ICDDRB)	Wastes from several other hospitals* are co-incinerated with a charge.	3	*: Monowara Hospital, Ibn Sine Hospital, Central Hospital, Medinova Hospital, Care Bangladesh, Dhaka Community Hospital, etc.
4	Bangladesh Research Institute for Diabetic, Metabolism and Endocrine Diseases (BIRDEM)		3	
5	Maternal and Child Health Training Institute		4	
6	Institute of Child Disease and Maternity Health (ICMH), Matuail		5	
7	Combined Military Hospitals （CMH）		5	Out of Study Area
8	Shahid Sohorwardi Hospital		3	A plan to install (cost: Tk.1.4million)

Source:
1. Habibur Rahman, Healthcare waste management in Dhaka City, Bangladesh, Warmer Bulletin 75, Nov. 2000.
2. For instance, The Daily Star June 27, 2004.
3. Roteb-Solid Waste Consultancy B.V., Waste landfilling and Hospital Waste Incineration in Dhaka, Bangladesh, February 1998.
4. Hearing Survey results of This Study by other group.
5. Information from a local staff of the Study.

3.7.2 Survey of hospital incinerators

3.7.2.1 Dhaka Medical College Hospital (DMCH)

Dhaka Medical College Hospital (DMCH) is a general hospital having 1,400 beds, the largest beds number in DCC, located at densely populated area in Motijheel. Incinerator building was constructed at a cost of Tk27 lakh during the Awami League rule[1] at the left hand side of the DMCH, facing to a busy traffic road in front of DMCH.

Three units of incinerator were built by the Asian Development Bank's fund in 2000. Two were used for burning mainly used gauze, vials, bandage, cotton, discarded foods, blood and separated body parts, while the other for syringes, needles, saline drips, medicine bottles and other plastic materials. Although two out of three units were inoperative due to technical problems, hospital cannot fix them because of a shortage of repair and maintenance fund[2].

Front view

Side view

Rear view

Furnace is a UK-made system (TECHTROL) with a throughput capacity of 35 kg/hr/unit, having a fixed grate with two burning chambers partitioned by a buffer wall. Estimated cross section of the unit is drawn in ANNEX-1. The planned amount of wastes incineration by three trays is 500 kg/day. Operation hour of incinerator is from 7.00am to 9:00pm. Each chamber has a burner with city gas as an auxiliary fuel and combustion temperature of two chambers is set beforehand and adjusted automatically to these set values while burning.

[1] The Daily Star Web Edition Vol.4, No.336, May 10, 2004.
[2] The Daily Star Web Edition Vol.4, No.336, May 10, 2004.

Waste charging door

Furnace bed

Bottom ash

Two workers are assigned for incinerator operation. One is a bus helper and the other is an electrician. They do not receive any training for medical waste management nor waste incineration. They just switch of starter of incinerator on and off[3]. The bottom ash is removed from incinerators to ash storage pit adjacent to the incinerator building once every 10 to 15 days. Ash is dumped at the Matuail dumpsite together with ordinary wastes.

Switch box for furnace operation

Ash storage container

Stored ash

According to the local newspaper, some medical wastes generated from DMCH were sorted and sold to a dealer or other healthcare facilities by cleaning staff (Ayas) for recycling or reuse. Those include saline bags, syringes, and needles. Ayas carry those items in plastic bag and sell them to the shops in Chankharpul. Saline bags, syringes and needles are bought at Tk20/kg, and plastic items like PET bottle are at Tk10/kg[4]. This kind of business is controlled by some union leaders of DMCH[5].

DMCH has a small electric furnace in the incinerator building to disinfect some infectious wastes sharp wastes including infected needles and others. Capacity of this furnace is not so large as incinerators, but it ensures sterilization of infectious agents because an electric furnace can attain to a higher temperature.

[3] The Daily Star Web Edition Vol.4, No.336, May 10, 2004.
[4] The Daily Star Web Edition Vol.4, No.336, May 10, 2004.
[5] The Daily Star, June 29, 2004.

Electric furnace for sterilization of infectious sharps

3.7.2.2 International Center for Diarrhea Diseases Research, Bangladesh (ICDDRB)

This hospital was affiliated to a diarrhea diseases research center that is one of a international research program participated by USAID, JICA and so forth. This center is located in Mohakhali area where several medical institutions under control of the government are concentrated. The incinerator is housed in a tin-made shanty surrounded by a chain link fence in a courtyard of complex.

Incinerator was installed in 1994 from UK (INCINCO) at a cost of Tk2.5 million. System has one furnace with a fixed grate and two combustion chambers partitioned by a buffer wall. The throughput capacity is 28 kg/h with a combustion temperature of max. 900 C. A city gas is used for a supplementary fuel. Operation hour is from 1:00pm to 3:00pm in general. 50 kg wastes are incinerated daily on average. About 2.5kg ash are produced per 50kg wastes incineration. Ash is dumped at the Matuail dumpsite. Two staffs are working for this incinerator. Black smoke is appeared when incinerated plastic items.

Incinerator shanty

Front view

1st buffer wall

Burning condition

Auxiliary burner

Buffer wall

Bottom ash

Monitor of combustion temperature set

3.7.2.3 Maternity & Child Health Training Institute (MCHTI)

Maternity & Child Health Training Institute (MCHTI) was established by WHO in 1953, and reconstructed by JICA in 2000. The number of beds was increased from 20 to 173 by this reconstruction, however, since the nurse is not enough in number, only 100 beds are used.

Incinerator, installed in 2000, is a Japanese-made (INCINER KOGYO) with a fixed grate and two chambers partitioned by a buffer wall in the furnace. Throughput capacity is 20 kg/h and combustion temperatures in the primary and secondary chamber are 400C and 700C, respectively. Operation hour of the facility is from 11:00am to 13:00pm, and operation frequency is 2 days per a week. Kerosene is used for auxiliary fuel but it cost much and is rationed by the government.

The system has no air pollution control devices except for a settling chamber incorporated in the furnace. The amount of ash is 3~4 kg/week and ash is stored in the dustbin and transported to the Matuail dumpsite for a final disposal. One staff is working with operation of incinerator and has received training with an operation manual.

Front view

Burning condition

Rusted chimney

Charging door

3.7.2.4 Bangladesh Research Institute for Diabetic, Metabolism and Endocrine Diseases (BIRDEM)

This hospital is a private specialized hospital for diabetic, metabolism and endocrine diseases, and located in the center of city where other several large hospitals are adjacent to it. Hospitals were always crowded with both outpatient and inpatient. The number of staff was about 2,000, out of which 200 were physicians, and the beds number was 500.

Hospital incinerator was housed in the back yard of hospital building, close to the boundary wall of building. The house was small and narrow in space in which only incinerator was equipped. The incinerator, at a glance, was rusted at some places and seemed to be old even though it was installed in 1998. The waste is brought in plastic bag by wards cleaners and put into the furnace daily. Operation hours are 2 or 3 hours.

The waste burned in this incinerator was limited to an anatomical waste. The amount of waste burned daily was 30~40kg.

The incinerator was a Japanese-made incinerator with a single chamber. City gas is used as an auxiliary fuel. There are no prominent air pollution control devices so that, while operation, a slight black smoke is said to detect at the chimney outlet. Bottom ash is removed twice a week and put in the plastic bag to be brought to DCC's dumpsite.

Two workers are assigned for incinerator operation, but they have do not received any training for incinerator operation. Operation manual provided by a supplier was already lost. Regular incinerator maintenance is not conducted.

Rusted chimney

Charging door

Incinerator shed

3.2.2.5 Institute of Child and Mother Health Hospital、Matuail（ICMH）

This hospital was relocated from the downtown in 1999 to the current site in Matuail area, close to the DCC's waste dumpsite. Old hospital is still functioned as a branch hospital. The number of hospital staff is more than 200 of which 75 were physicians. Waste management in this hospital was rather well conducted. Waste is separated at sources into mainly 4 items, using different containers. Syringe, for instance, is disposed in the box made by used corrugated paper box. Other (non-hazardous) wastes are disposed into plastic container with different colors, i.e. black, red and green. Those containers are carried by handcart to a waste collection spot in the hospital yards. Ordinary waste like municipal solid waste is transported by a rickshaw ban to the Matuail waste dumpsite.

Hazardous hospital wastes including sharps were incinerated by on-site incinerator. This two-chamber incinerator was a USA-made and installed in 1999. Throughput capacity is 300 ft^3 at

one time and the amount of waste incinerated is 15~20kg/day. Cost of initial investment was Tk960,000. City gas is used as auxiliary fuel and operation frequency is irregular, generally once in a few days. Only dust removal is an air pollution control devices used in this system. Details of this device was unclear, but outlook of the device showed a kind of settling chamber which seemed ineffective for a smaller particulate matter.

Frequency and amount of ash removal were not cleared, but ash was removed irregularly to dump at the Matuail dumpsite together with other waste. The cost of ash disposal is included in the transportation cost paid for rickshaw driver (i.e. free of charge for disposal). Two workers for incinerator operation were contracted from a maintenance company. Service contract fee is Tk36,000. They have operation manual of incinerator and have received training for operation. Chemicals and consumption cost about Tk12,000 and maintenance & repair cost are Tk50,000.

Incinerator shed

Incinerator front

Combustion temperature monitor

Inside furnace

Draft vane & Dust removal

Chimney erection

Auxiliary burner

3.7.3.Summary of hospital incinerators survey

Five (5) incinerators out of the reported seven (7) incinerators operated on site of the hospitals were visited to survey a status of incinerator operation and waste management. Two out of five incinerators, i.e. at ICDDRB and MCHTI, were in operation as a daily duty when visited. Other three incinerators were in preparation or after completion of daily wastes burning. Generally surroundings of incinerators were clean and neat except for BIRDEM where incinerator was housed in a small and old shed. Relatively newly installed units at DMCH, MCHTI, and ICMH seemed to burn wastes effectively.

Table 3.7-2 is a summary of site visits and outline of incinerators, including basic information of hospitals and operational information. Most units have a fixed grate or a fixed bed, with two combustion chambers except for BIRDEM that has one chamber. Two combustion chambers were not two independent chambers but were made by partitioning one chamber by a wall with opening for a flue gas on the upper part of the wall. By using this portioning wall in the furnace residence time of combustion gas becomes rather longer so that complete combustion is likely ensured. On the contrary two-chamber furnace with independent two furnaces can be operated under starved air condition at the primary chamber and after burned at the secondary chamber with sufficient air supply. This type of furnace is commonly used for hospital waste incineration in Japan and other countries.

Thanks to a cheaper price of city gas most incinerators use city gas as auxiliary fuel except for incinerator of MCHTI that was designed to use kerosene as auxiliary fuel which is common in Japan. As result operation cost of this incinerator seems to be high compared to others. The amount of waste incinerated at surveyed hospitals is 20~50kg on average. Exception is 500kg/day of DCMC. If counted only hazardous wastes the amount of wastes burned seems to be far less than 500kg. This means daily amounts of hazardous hospital waste required

incineration or a special care in other word seems to be 20~50kg at large scale hospital in Dhaka. Considering this fact hazardous hospital waste generation in Dhaka can be estimated to be a few tons per day if accounted for the number of large hospitals with a bed number of 300 and more.

Environmental pollution such as air pollution caused by incinerator and soil and water contamination resulted from an ill handling of incinerator residue are those issues to be considered with higher attention. Most systems surveyed had not sufficient or any measures to prevent such environmental pollutions. As already known and also pointed out by staffs in charge of incinerator operation at visited hospitals, some toxic air pollutants like dioxins are likely emitted from a bad operated incinerators. Irrespective with the scale of risk of such pollutants hospital waste incinerators should be equipped with minimal devices to minimize emissions of such pollutants.

Incinerator operator or staff in charge of waste management in the hospitals should be trained and given a necessary knowledge for hospital waste management to ensure occupational safety. Except for BIRDEM they did neither receive any training of incinerator operation nor have an operation manual of incinerator. Even other hospitals that delivered training to staff, contents of training and understanding of trained staff should be examined periodically to meet a new requirement of the date.

Table 3.7-2 (1)

	Dhaka Medical College Hospital (DMCH)	International Centre for Diarrhea Diseases Research, Bangladesh (ICDDR,B)	Bangladesh Research Institute for Diabetic, Metabolism and Endocrine Diseases (BIRDEM)
BASIC INFORMATION			
a. Speciality	General	Diarrhea diseases	Diabatic, Metabolism, Endocrine
b. No. of employee (permanent)	1427	NA	2000
c. No. of doctor	NA	NA	300
d. No. of beds	1,400	250	500
INCINERATOR INFORMATION			
a. Installation year	2000	1994	1998
b. Type of incinerator	Fixed grate, 2 chambers	Fixed grate, 2 chambers	Fixed grate, 1 chamber
c. No. of incinerator	3 units	1unit	1unit
d. Throughput capacity	35 kg/hr (per unit)	28 kg/hr	NA
e. Manufacturer	TECHTROL(UK)	INCINCO(UK)	NA
f. Installation cost	NA	£ 6,500	NA
g. Types of waste incinerated	Infectious solid waste	Solid medical waste	Anatomical waste
h. Amount of waste incinerated	500 kg/day	50 kg/day	30~40 kg/day
i. Operation hours/frequency	From 7:00 am to 9:00 pm	From 1:00 pm to 3:00 pm	3 hrs/day
j. Combustion temperature	Automatically adjusted	Max.900℃	NA
k. Auxiliary fuel (kind)	City gas	City gas	City gas
l. Flue gas treatment	None	None	None
m. Amounts of fly ash removal	None	None	None
n. Amount of bottom ash removal	None	2.5 kg/50 kg-waste	NA
o. Ash disposal frequency	Once per 10 to 15 days	NA	Twice/week
p. Ash storage and transportation	Concrete bin / DCC	NA	Plastic bag / DCC
q. Place of ash disposal	Matuail dump site	Matuail dump site	DCC dump site
r. Ash disposal fee	None	NA	None
MANAGEMENT INFORMATION			
a. No. of worker (for incinerator)	2 technicians	2	2 (2 shifts)
b. Operational manual	Yes	Yes	None
c. Operation training	Yes	Yes	None
d. Maintenance frequency	Every 2 months	Every 6 months	Irregular
e. O&M cost	NA	NA	NA
REMARKS	・Newspaper said because of inability of fix by local agent, incinerator had been stopped operation （Daily Star, June 27, 2004). ・Another newspaper reported because of fund shortage two of three incinerators had been remained inoperative (Daily Star, May 10, 2004).	・Black smoke generates whenever plastics waste is charged. ・Replacement and minor fix are conducted by mechanical division staff of the hospital. ・There is no agent of the incinerator supplier in Bangladesh.	・Although incinerator is housed in a small room, surface of furnace is rusted, and thus looks older than 6 years. ・Maintenance section said that incinerator was donated in the international cooperation project of the hospital and was a Japanese-made. ・It is said a slight smoke from chimney is recognized during an incinerator operation.

Table 3.7-2 (2)

	Maternal and Child Health Training Institute (MCHTI)	Institute of Child and Mother Health (ICMH)
BASIC INFORMATION		
a. Speciality	Maternity and Child Health	Child & Mother Health
b. No. of employee (permanent)	ca.75	>200
c. No. of doctor	50	75
d. No. of beds	100	80
INCINERATOR INFORMATION		
a. Installation year	2000	1999
b. Type of incinerator	Fixed grate, 2 chambers	Starved air, Fixed grate, 2 chambers
c. No. of incinerator	1unit	1 unit
d. Throughput capacity	20 kg/hr	300ft3
e. Manufacturer	INCINER KOGYO(JAPAN)	SPRONZ INCINERATOR CORP.(USA)
f. Installation cost	NA	960,000Tk
g. Types of waste incinerated	Inorganic waste	Infectious waste
h. Amount of waste incinerated	NA	15~20 kg/day
i. Operation hours/frequency	From 11:00 to 13:00, 2 days/week	NA
j. Combustion temperature	400℃(primary), 700℃(secondary), Max850℃	NA(Indicator Max. 1400C for 1, 2nd burner)
k. Auxiliary fuel (kind)	Kerosene	City gas
l. Flue gas treatment	None	Settling chamber
m. Amounts of fly ash removal	None	NA
n. Amount of bottom ash removal	3~4kg/week	NA
o. Ash disposal frequency	NA	NA
p. Ash storage and transportation	Dust bin outside hospital, DCC	Dust bin, transported by Rickshaw ban
q. Place of ash disposal	Matuail dump site	Matuail dumpsite
r. Ash disposal fee	None	None
MANAGEMENT INFORMATION		
a. No. of worker (for incinerator)	1	2 from contractor and 1 from hospital worker
b. Operational manual	Yes	Yes
c. Operation training	Yes	Yes
d. Maintenance frequency	Before operation	NA
e. O&M cost	NA	98,000Tk/year
REMARKS	・Kerosene is expensive and provided only by the government, and is not purchased by the hospital. ・Waste is segregated into inorganic and organic on the street. ・Local agent of the incinerator can fix when troubled.	・Maintenance cost includes Service Contract fee(12X3,000Tk), Chemicals & Consumptions (12,000Tk), and Repair & Maintenace (50,000Tk) ・Plastic bag and PVC syringe are sterilized by autoclaving and recycled.

3.7.4 Medical establishments and their beds number in Dhaka

Depending on ownership or operational entity hospitals are classified into governmental hospital, private hospital and other hospital in Dhaka. This classification, however, is not common classification frequently used by the Ministry of Health and Family Welfare. In the Health and Population Statistical Report 1999-2000 published by Unified Management Information System, DGHS, Mohakhali, Dhaka, health facilities having appellation of "Hospital" include District Hospitals, Medical College Hospitals and Specialized Institutions & Hospitals that are under control of DGHS, Ministry of Health & Family Welfare. According to the Memo. No. DGHS/Dir. Hosp/HWM/2004/572 which is a reply to the inquiry of the Study Team, Ref: SWMC/Co-ordinator/80(1), dt.13/4/2004, there are 13 Specialized Hospitals and 5 Medical College Hospitals under DGHS. There is no District Hospitals in Dhaka.

In addition there are several hospitals under another DG of the Ministry of Health & Family Welfare, i.e. Directorate General of Family Welfare as well as under other Ministries. Further there are international hospitals and many private hospitals and clinics both registered and unregistered. These include private medical college hospitals, clinics, and clinics with diagnostic laboratory. In the said reply DGHS identified 262 private registered bedded clinics in Dhaka as of September 30, 2003. If counted only clinics in the study area there are 244 clinics.

Besides hospitals and clinics there are a lot of diagnostic centers as a generator of hospital wastes. Diagnostic centers are defined as a diagnostic facility without beds. However the exact number of a diagnostic center is unknown because many of them are unregistered. One report said there are 450 diagnostic centers of different sizes in Dhaka[1]. In this report the number of beds in hospitals and clinics (excluding diagnostic centers) estimated to be 12,093 to calculate hospital waste generation in Dhaka.

Putting together other information and data obtained and heard during the study beds number of medical institutions in the Study area[2] was estimated about 12,000 as shown in Table 3.7-1. In the report[3] released in August 2004 the number of health care facilities in Dhaka division is 299 and their bed number is 10,978. These include health care facilities under the Ministry of Health & Family Welfare and private facilities, and do not include district hospitals (with bed number of 1,000) and Thana health care facility (with bed number of 3,142). Considering beds number form different sources estimated bed number, i.e. 12,000 would be a reasonable value to estimate hospital waste generation in the Study area.

[1] M. Rahman, Study on the Solid Medical Waste Management in Dhaka City, Report prepared for Japan International Cooperation Agency, October 2003.
[2] Savar, Cantonment, Keranigonj, Narayanganj and Airport area are excluded from the Study area.
[3] Ministry of Health and Family Welfare, Action Plan for Improved Health Care Waste Management in Bangladesh 2004-2010, Part I: Main Report, August 2004.

Table 3.7-1 Hospitals and clinics and their bed number 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
		Defence	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.

3.7.5 General information on hospital waste generation

3.7.5.1 Definition of hospital waste

There are several nomenclatures to express medical waste such as clinical waste, medical waste, healthcare waste, and hospital waste. Medical waste required a special care for handling are also called in many ways. There is no international standardized nomenclatures for these waste so far. These nomenclatures are used by a judgment of countries, hospitals, and individual hospital doctors or researchers. In the Study a definition or classification of hospital (solid) waste followed the classification used in the Manual[4] as shown in Figure 3.7-1. In this classification wastes generated hospitals (including clinics) are categorized as hazardous and non-hazardous wastes. Hazardous wastes are further classified into three types of wastes by infectious nature or origin of wastes, i.e. infectious waste, sharps and non-infectious.

[4] DGHS, Ministry of Health and Family Welfare, Manual for Hospital Waste Management, June 2001.

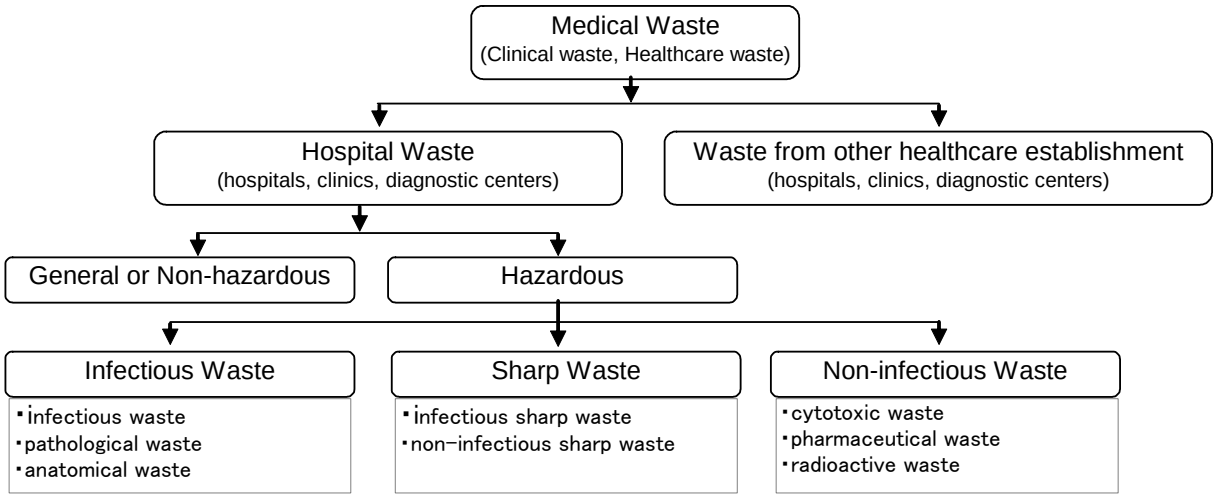


Figure 3.7-1 Hospital (solid) waste classification in Dhaka.

3.7.5.2 Hospital waste generation rate

Generation of wastes from health care establishment not only differ from country to country but also among the health care establishment within the same countries. Wastes generation of hospitals and clinics also have the same characteristics as this tendency. Overall waste generation both quantitatively and qualitatively depends on many factors such as:

- Types of health care establishment,
- Hospital specialization,
- Waste management system in the establishment,
- Number of patients and bed numbers,
- Cultural value,
- Economic status, and
- Educational level, etc.

In general it is said that health care waste is generating more in the high-income countries rather than to the low and middle-income countries. Also a university hospital and some specialized hospitals are likely to generate more wastes than a general hospital as shown in the following data.

Table 3.7-2 Health care waste generation according to national income level[5].

National income level	Annual waste generation (kg/population)
High-income	
All health care waste	1.1~12.0
hazardous health care waste	0.4~5.5
Middle-income	
All health care waste	0.5~3.0
Hazardous health care waste	0.3~0.4
Low-income	
All health care waste	0.5~3.0

[5] Commission of European Union, 1995 (cited in Situation Assessment and Analysis of Hospital Waste Management, DGHS, Ministry of Health & Family Welfare, 2000)

Table 3.7-3 Quantity of hospital wastes in industrialized countries[6] (kg/bed/day).

Type of hospital	Norway	Spain	UK	France	USA	Netherlands
University hospital	3.9	4.4	3.3	3.35	5.24	4.2~6.5
General hospital				2.5	4.5	2.7
Maternity		3.4	3.0			
Mental hospital		1.6	0.5			1.3
Geriatric		1.2	9.25			1.7

Followings are data of hospital waste generation in various countries. It is kept in mind that units of waste generation are different by data sources and nomenclature or definition of waste are not necessarily identical.

Table 3.7-4 Some data of hospital wastes generation rate.

Wastes	Country	Year	Generation rate	Unit	Remarks
Clinical waste[7]	Belgium	1998	1.4	kg/patient/day	
	France	1998	1.9	kg/patient/day	
	Germany	1998	0.4	kg/patient/day	
	Greece	1998	1.4	kg/patient/day	
	Ireland	1998	2.6	kg/patient/day	
	Italy	1998	1.0	kg/patient/day	
	Netherlands	1998	0.6	kg/patient/day	
	Portugal	1998	1.5	kg/patient/day	
	Spain	1998	0.6	kg/patient/day	
	UK	1998	5.5	kg/patient/day	
	USA	1998	2.2	kg/patient/day	
Hospital waste	Hong Kong[8]	1999	0.12	kg/bed/day	
	Thailand[9]	1995~	0.11	kg/bed/day	Bangkok Metropolitan Authority
			0.43	kg/bed/day	Department of Health
			0.65	kg/bed/day	Pollution Control Department
	USA		10.4	kg/bed/day	
			4.18	kg/bed/day	
	Japan		2.52	kg/bed/day	
			1.9	kg/bed/day	
			1.7~4.0	kg/bed/day	
Hazardous hospital waste	Bangladesh[10]	1998	0.17	kg/bed/day	Survey at 8 hospitals ranged 0.10~0.30 kg/bed/day.
Non-hazardous hospital waste	Bangladesh[11]	1998	1.0	kg/bed/day	Survey at 8 hospitals ranged 0.66~1.52 kg/bed/day.
Infectious waste	Japan		0.5	kg/bed/day	
			0.33	kg/bed/day	
			0.65	kg/bed/day	

[6] Managing Medical wastes in Developing Countries, WHO/PEP/RUD/94.1, WHO 1994.
[7] E.Krisiunas, et al., Hong Kong Hospital Authority Clinical Waste Management Program: A Model for Success, Waste Management: The Challenge for Asian Cities, Proc. ISWA, Hong Kong, Oct.23-26, 2000.
[8] Same as footnote 7.
[9] S.Kerdsuwan, Experience of hospital waste incineration in Thailand, Waste Management: The Challenge for Asian Cities, Proc. ISWA, Hong Kong, Oct.23-26, 2000.
[10] H. rahman, Healthcare Waste management in Dhaka, Bangladesh, wamer Bulletin 75, Nov. 2000.
[11] Same as footnote 10.

Empirical equations to estimate hospital waste generation were developed in Japan based on the questionnaire survey at nearly 300 hospitals in 2002 as follows:

For all hospital waste: Y = 1.36 X/1,000 + 1.19 (n=113, R2=0.6408)

while, Y is waste generation rate (kg/bed/day), and X is a bed number.

For hazardous hospital waste: Y = 0.82X/1,000 + 0.118 (n=273, R2=0.6488)

while, Y is hazardous hospital waste generation rate (kg/bed/day), and X is a bed number.

Since effective respondents number were different between hazardous and non-hazardous hospital waste generations sample number (n) to deduce those equations are also different. Those equations are plotted in Figure 3.7-2 and 3.7-3, for all hospital waste generation and hazardous hospital waste generation, respectively. In those figures, survey results conducted in Dhaka in 1998 were also plotted. Considering the differences of economical status between two countries, above empirical equations can give rough estimation of all waste generation of hospitals in Dhaka as far as bed number below about 600. However hazardous waste generation in Dhaka hospitals are far less than predicted values as bed number increases more than 100.

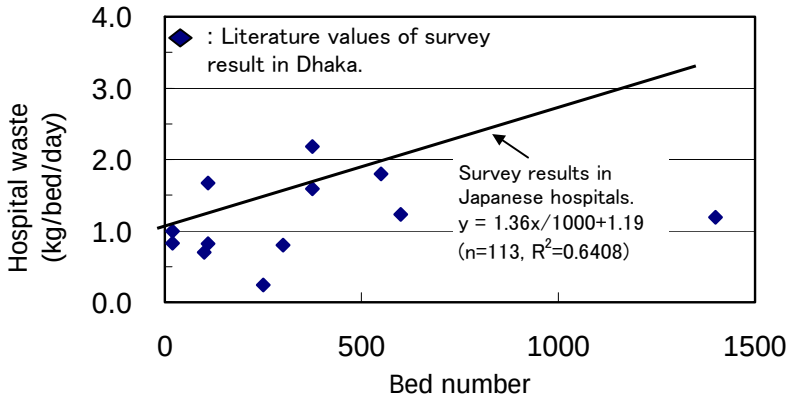


Figure 3.7-2 Hospital waste generation rate in Dhaka.

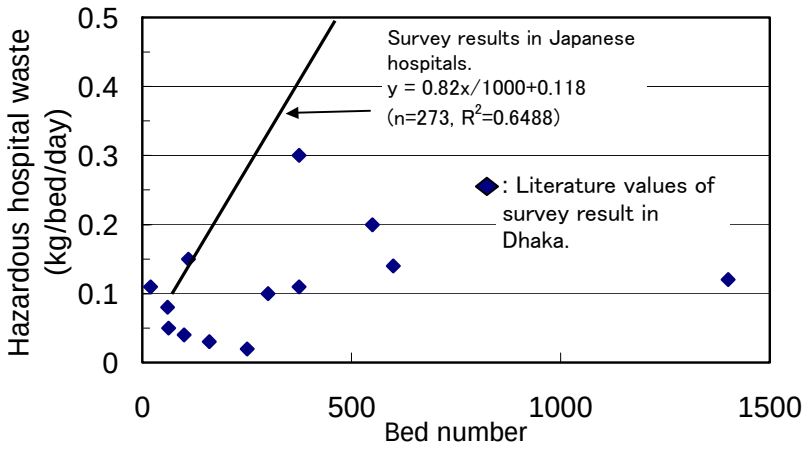


Figure 3.7-3 Hazardous hospital waste generation rate in Dhaka

3.7.5.3 Estimation of hospital waste generation in Dhaka

Hospital waste generation rate is expressed in various way (unit) in the past literature. Amounts per patients are mostly plausible, but such data are a quite a few, and a distinction between in- and out-patient is unclear in such data. Most widely used and a convenient expression is the amount of waste per bed as shown in Figure 3.7-2 and 3.7-3.

From Figure 3.7-2 and 3.7-3, generation rates of total hospital waste and hazardous waste are taken as 0.6~1.9 kg/bed/day and 0.05~0.2 kg/bed/day, respectively. As mentioned in the previous Section waste generation rates differs by many factors. Especially in the same country a type of hospital may be major factor to determine the differences if existed. Hence the maximum values of waste generation may be come from a university hospital or some specialized hospitals. Recent survey[12] in the Secondary and Tertiary level hospitals in Bangladesh shows that total hospital waste generation rate and hazardous waste generation rate are 0.78 kg/bed/day and 0.14 kg/bed/day, respectively. These are included in the above mentioned ranges.

Total number of bed in the Study area is about 12,000 as mentioned in Section 1, then all hospital waste generation is calculated as 7.2~22.8 ton/day, while a hazardous hospital waste as 0.6 ~2.4 ton/day in Dhaka. In this calculation diagnostic center is excluded since they do not have bed. If 1 kg of waste is generated from diagnostic center daily on average as proposed in the report, total amount of waste generated from diagnostic center is 450 kg/day since the number of diagnostic center accounts for 450 in Dhaka as mentioned in Section 1. Since according to the field survey conducted a ward inspector, the number of diagnostic center in the Study area is less than 450[13], the amount of waste generated from a diagnostic center can be negligible compared to the amount of wastes generated from hospitals and clinics.

In the past various information on hospital waste generation in Dhaka are revealed in the several literatures. These are summarized in Table 3.7-5 together with values estimated above in this study as reference. Although estimation method of these values are not clear, the amounts shown in Figure 3.7-5 are 10 times more than those estimated in this paper even if the maximum values are considered.

Table 3.7-5 Hospital waste generation in Dhaka appeared in the past literatures.

Amounts	Author (Year)	Remarks
255 t/d	Rahman & Ali (2000)	Cited in N.Aktar, Bangladesh Environment 2002, pp.674-689.
200 t/d	Kaji (1998)	Cited in N. Aktar, Bangladesh Environment 2000, pp.444-460.
200 t/d	EcoFile, Vol.7, No.4, 2004	20% out of 200t/d are infectious.
300 t/d	The Daily Star, June 27, 2004	
7.2~22.8 t/d	This study	Total hospital waste
0.6~2.4 t/d	This study	Hazardous hospital waste

[12] S. Rahaman, Private communication in 2004.
[13] A. Ishii, private communication in 2004.

Annex

Private Registered Bedded Clinics in Dhaka

ANNEX

Private Registered Bedded Clinic in Dhaka

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
1	Ad-deen Hospital	2, Boro Mogbazar	**Ramna**	89	735-3391
2	Afroja Metarnity Clinic	241/1 South Zatra Bari	**Demra**	8	761-4633
3	Ahmed Medical Center	91/1 Shawnkar	**Dhanmondi**	30	811-3628
4	I Chi Hospital	H#2,R#34,Sectore# 9	**Uttara**	50	891-6290
5	Akand Clinic	H# 1 B, R# 11/2,Block- B Section # 10,	**Mirpur**	10	801-5855
6	Al-Manara Hospital Pvt. Lmited	5/4 Block-F	**Mohammadpur**	26	912-1387
7	Al-Biruni Hospital	23/1 Khiljee Road,	**Mohammadpur**	10	711-5753
8	Al-Care Health Centre Ltd.	86 Shat Moshjid Road,	**Mohammadpur**	20	712-1568
9	Al-Magreebi Eye Hospital	Shatmashjid Road	**Mohammadpur**	30	713-5451
10	Al-Markajul Islami Hospital	H# 27, R# 3,	**Mohammadpur**	20	324609
11	Al-Raji Hospital Pvt. Limited	12, Tej Kuni Para,	**Tejgaon**	20	711-7775
12	Anonno Narsing home	390/2 South Pike Para,	**Mirpur**	3	801-3500
13	Anirban Narsing Home	14/27 Shahjahan Road,	**Mohammadpur**	10	319436
14	Araf Diagonistic & Clinic	197, Badda Bazar,	**Badda**	4	800301
15	Ayesha memorial Specialized Hospital	74/G, Aroz Para,	**Gulshan**	13	9122689
16	Azimpur Narsing home	107/1 Azimpur	**Lalbugh**	4	8611017
17	Avenue Medical Centre Private Limited	Block-A,	**Mohammadpur**	7	9111086
18	BC General Hospital	H# 71/1, R # 9/A	**Dhanmondi**	10	8611017
19	BM Hospital	H # 2, R# 2, Kolwala Para	**NA**	4	8611352
20	Baitus Sharaf	159 **Air Port Road**	**Air Port**	9	317094
21	Bangladesh Services Private Limited	H# 39, R # 9/A	**Dhanmondi**	18	9121779
22	Bangladesh Medical College & Hospital	**Dhanmondi**	**Dhanmondi**	212	7120792
23	Banu Clinic	75/C Asad Avenue,	**Mohammadpur**	3	312248
24	Barba Rehabilitaion Center for Addictade People	NA	**NA**	10	604107
25	Bornali Narsing Home	Plot # 3, Sec- 1, Block - C,	**Mirpur**	10	8017873
26	Bashundhara Hospital Private Ltd.	**Lalmatia**	**Mohammadpur**	20	315600
27	BAVS Metarnity	9/5 Main Road Mirpur	**Mirpur**	10	8616734
28	BDM Hospital	5/19 Humayun Road	**Mohammadpur**	50	8113491
29	Bengal Nersing home Private Limited	70/ c lake circus ,	**Dhanmondi**	27	313673
30	Cardi Hope Heart Centre	12 South Avenue,	**Gulshan**	13	605214
31	Care Land Hospital Private Limited	C 257, Khilgaon	**Khilgaon**	10	7351434
32	Rehabitation Centre for Paralyzed	CRP, Savar	**SAVAR**	46	7710464
33	Central Hospital Limited	H # 10/a, Road 5,	**Dhanmondi**	150	9660015
34	Chankhar pool General Hospital	10-10/1.-, Nobab Ktra,	**Lalbagh**	10	7301127
35	Chaina Bangla Hospital	Sectore -4, H # 15, Shayesta Khan Avenue. (old dhaka)	**NA**	2	8913006
36	Khristian Medical Centre	6/3 Norda Baridhara	**Gulshan**	10	8813375
37	City Hospital Private Limited	69/1/1 Pantha Path	**Tejgaon**	30	8617852
38	City Narsing Home	52/1 Elephant Road	**Dhanmondi**	2	506818
39	City Narsing Home	4/2 Sobhan Bagh	**Tejgaon**	20	327520
40	Comfort Narsing Home Private Limited	H # 10-B, R # 6,	**Dhanmondi**	20	8124990
41	Conscious Health Services Limited	H # 25/ A R# 6,	**Dhanmondi**	16	9665544
42	Crecent Hosptal & Diagonistic Center	22/2 Babar Road,	**Mohammadpur**	25	9117524
43	Dekes Centre	14 Shahid Faruk Road,	**Demra**	7	7209673
44	Deep Clinic	Parboti Nagar, Thana Road	**SAVAR**	10	7710066
45	Delt amedical Center Ltd	H # 20, R # 4,	**Dhanmondi**	21	8617141
46	Delt amedical Center Ltd	26/2 Drus salam Road,	**Mirpur**	10	8617141-43
47	Desh Nursing Home	27 Elephant Road	**Dhanmondi**	2	8616117

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
48	Desh Clinic	Savar Thana Bus Stand,	**SAVAR**	10	7711100
49	Dhaka Community Hospital	190/1 Walse Gate , Boro Magbazar	**Ramna**	26	9351190
50	Dhaka General Hospital Ltd.	17, Hatkhola Lane,	**Kotawali**	20	235351
51	Dhaka New Netal Hospital Ltd.	H # 34, R # 14/A,	**Dhanmondi**	10	8212588
52	Dhaka Renal Hospital & Cardiak Center	5 Green Corner,	**Dhanmondi**	10	8610928
53	Dhaka Aurthropadic Hospital	843 Biatul Aman Housing Society,	**Mohammadpur**	10	9112684
54	Dhaka Children's Hospital	Sohorwardy,	**Tejgaon**	305	8116061
55	Dhanmondi Clinic Pvt. Ltd	H # 2, R# 8,	**Dhanmondi**	22	8616015
56	Dhanmondi eye Clinic	H # 50, R # 8/A,	**Dhanmondi**	10	
57	Dhanmondi Narsing Home	H # 27-A, R # 11,	**Dhanmondi**	13	319950
58	Dhanmondi South East Hospital	R # 5, Dhanmondi	**Dhanmondi**	12	9669904
59	Dr. Meherun Nessa Clinic	H # 5, R # 5,	**Dhanmondi**	9	509964
60	Dr. Nurul Islam Clinic	110 Green Road	**Dhanmondi**	8	
61	Dr. Sultana Poli Clinic	565 Uttar Nakhal Para	**Tejgaon**	6	312889
62	Elizabeth Clinic	5/4 Monipuri Para,	**Tejgaon**	10	
63	Enam Clinic	Thana Road ,	**SAVAR**	10	7710368
64	Farabee General Hospital	Road 14, House 8/3,	**Dhanmondi**	20	8122491
65	Farida Clinic	165, Shantinagar	**Motijheel**	12	8321160
66	Gana Shashto Hospital	H14/ E, R # 6,	**Dhanmondi**	30	807208
67	Gastro lever Clinic	Green Road	**Dhanmondi**	14	8620960
68	General Medical Hospital	103 Elephant Road	**Dhanmondi**	20	503968
69	Green Eye Hospital	H # 31, R # 6,	**Dhanmondi**	10	8612412
70	Green Spare Clinic Ltd.	12 Green Road	**Dhanmondi**	20	8611617
71	Green Land Hospital	Sectore - 7, Uttara Model Town,	**Uttara**	10	8715189
72	Gulshan Group Clinic	H # 17, Road # 57,	**Gulshan**	10	
73	Gulshan Mother & Children Clinic	H # 11/ A, R # 48,	**Gulshan**	10	8822738
74	Health Care Centre	11/ 1 Ranking Street,	**Sutrapur**	10	249024
75	Helen Pasha Clinic	257/1 Elephant Road	**Dhanmondi**	7	310696
76	Holly Care Clinic	107/2 Kakrail	**Motijheel**	10	
77	Holly Family Red Crecent Hospital	Boro Mogh Bazar, Easkaton Garden Road,	**Ramna**	304	8311721
78	Haque Narsing Home	154 RK Mission Road,	**Sutrapur**	2	9553842
79	Ibne Sina Clinic	H # 58 A, R # 8-A,	**Dhanmondi**	50	9126625-7
80	Ibrahim Memorial Diabetich Hospital	Shah Bag	**Ramna**	282	8616641
81	Ideal Narsing Home	50-A, Shanti Nagar	**Motijheel**	10	9357385
82	Impact Jibon Tory Vashoman Hospital	4/5 Iqbal Road	**Mohammadpur**	14	9893266
83	International Hospital Limited	6 Easkaton Garden	**Ramna**	10	9333739
84	Islami Bank Hospital Ltd.	24/B outer Road, South Shah jahan Road,	**Mohammadpur**	60	9336421
85	Islami Aroggo Shadan Ltd.	H # 35, R # 1,	**Dhanmondi**	30	8612798
86	Islamia Eye Hospital & M A Ispahani of	Firm Gate	**Tejgaon**	300	8112856
87	Jable -E- Nur General Hospital	H # 21, R # 7/A,	**Dhanmondi**	20	9131300
88	Jahanara Clinic & Path	H # 2, R # 2, Sectore-1,	**Uttara**	18	8912929
89	Jono Sheba Nursing Home	R # 1, H # 7,	**Mirpur**	10	9113944
90	Japan Bangladesh Friendship Hospital	H # 27, R # 114,	**Gulshan**	30	8828855
91	Joly Clinic	Savar Bazar Road,	**SAVAR**	4	7711086
92	Judi Maternity	75, Green Road	**Dhanmondi**	2	313528
93	Kabir Eye Centre	7/1 Nawab Street,	**Sutrapur**	10	231417
94	Kalpana Narsing Home	6/1 Bacharam Dawry,	**Kotawali**	1	
95	K. C. memorial Clinic Ltd.	35 Sarwardy Avenue,	**Badda**	20	8814299
96	Kishowar Narsing Home	20 Shanti Nagar	**Motijheel**	10	463396
97	Lake View Clinic	Plot#5,Block#7,R#7-A	**Gulshan**	8	88114887
98	Latifa Poli clinic	30 Kalwala Para,	**Mirpur**	10	804860
99	Life Line Medical Services Limited	Rahman Mansion , 75	**Gulshan**	10	8826677

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
100	Lionce Eye Hospital	Lionce Building,	**Tejgaon**	45	3131990
101	Luna Clinic	680/1 Boro Magh Bazar	**Ramna**	4	415147
102	M.S. Clinic of Sergery & Midaifery	Go-19, Mohakhali	**Gulshan**	10	608252
103	Mala Nersing Home	31 East Hazi Para	**Rampura**	3	841625
104	Mallika Nersing Home	H # 37/A, R # 4/A,	**Dhanmondi**	7	500412
105	Medi Aid Clinic	62 Lake Circus,	**Dhanmondi**	18	9112076
106	Medi Stone Lithetripsy Clinic	218 Outer Circuler Road, Boro Mogh Bazar	**Ramna**	7	405092
107	Memory Medical Centre	22, New Eskaton	**Ramna**	16	8314317
108	Metropolitan Medical Centre	Mahakhali	**Gulshan**	30	606364
109	Mirpur General Hospital	R#1, H# 35, Section-10,	**Mirpur**	10	805444
110	Modern Clinc of Sergery & Midwaifary	H # 58,R # 131,	**Gulshan**	10	602067
111	Modern Metarnity Clinic	17 Paribagh	**Ramna**	6	502428
112	Modern Narsing Home	148/7, South Zatra Bari	**Demra**	8	249396
113	Mohanagar Clinic	48/A Dhanmondi	**Dhanmondi**	10	
114	Maitry Narsing Home	5/b Malibagh	**Ramna**	4	401961
115	Monorog Clinic	H #1,Block-A,Road-1,Section-11	**Mirpur**	50	9005050
116	Monorom Metarnity	803 / 2, Mirpiur-2	**Mirpur**	60	8316254
117	Monowara General Hospital	22/6/2 North Golap Bagh, Biswa Road,	**Demra**	20	7514717
118	Musaf Nursing Home	H # 7,R# 7,sectore-4	**Uttara**	6	609632
119	Miotijheel Nursing Home	30/9 Purana Paltan, VIP Road	**Motijheel**	10	9337685
120	Maushumi Clinic	76/1 Nazimuddin Road,	**Lalbagh**	2	
121	Mss the Eye Pavilion Ltd.	H # 25/11, R # 13/ A,	**Dhanmondi**	10	8111404
122	Mujibunnessa Eye Hospital	H # 11, R # 28 (old)	**Dhanmondi**	5	501841
123	Mukti Maternity	24 Shidheshwary	**Ramna**	2	
124	Mukti Nursing Home	233/B Khilgaon, Chawdhuri Para	**Khilgaon**	20	416189
125	Nafiz Clinic	Joy Para Dohar	**NA**	7	06223-8139
126	Naz Clinic	H # 75, R# 8/a	**Dhanmondi**	33	8114835
127	Neurologi Hospital	22/1 Topkhana Road,	**Ramna**	35	9558701
128	New Al-Raji Hospital	32 Green Road	**Dhanmondi**	12	329186
129	New Dhaka Clinic	Armani tola,	**Lalbagh**	20	7313359
130	New Ara Hospital	1 Momen bagh,	**Motijheel**	20	9339204
131	New Hope Clinic	B-2 Ganda Anandapur,	**SAVAR**	10	7710639
132	New Mukti Clinic	301 Elephant Road	**Dhanmondi**	12	8621889
133	New Rampura Nersing Home	375, Rampura VIP Road	**Rampura**	NA	
134	Nibedita Nursing Home	H # 27, R # 7,	**Dhanmondi**	28	8111281
135	Nibedita Shishu Hospital	11/1 Wary Street,	**Ramna**	25	7119473
136	Nila Maternity	69 Shantinagar	**Motijheel**	5	9343210
137	Niramoy Clinic	Dhanmondi	**Dhanmondi**	NA	
138	Nirban Addiction rehabilitation Centre	184/1 North Shahjahanpur	**Motijheel**	10	9352108
139	Nirupom hospital Pvt. Ltd.	H # 69, R # 11/A,	**Dhanmondi**	20	8114429
140	O G S B Metarnity	Eid Gah, Cristian Road	**Mirpur**	20	8618580
141	O S B Eye Hospital	Plot 9/ 1	**Mirpur**	20	9003088
142	Padma Genera Hospital Ltd.	290 Shonargaon,	**Narayanganj**	21	9661528
143	Pally Maternity	40/2 Kallan pur Main Road	**Mirpur**	3	9000249
144	Paricharja	179 Boro Magh Bazar	**Ramna**	3	8312211
145	Park View Nursing Home	New Easkaton	**Ramna**	22	407150
146	Prashanti Hospital Limited,	3 Shanti Bagh,	**Ramna**	20	8318699
147	Rabeya Clinic	Jabeshar , Aricha Road	**NA**	10	06220-746
148	Rhima Ali Clinic	3/B Malibagh Chawdhuri Para	**Ramna**	10	833689

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
149	Rahima Matenity Hospital	H#1, R#5, Block-A,Secton-6,Mirpur	**Mirpur**	10	803193
150	Rahmaniya Clinic	38 sher shah shuri Road,	**Mohammadpur**	3	
151	Rajdhani Clinic	3 Outer Road, Malibagh	**Ramna**	20	839713
152	Rash mono Poli Clinic	20 Outer Road, Malibagh	**Ramna**	117	8317819
153	Renesa Health Centre Ltd.	H # 60, R # 4/A	**Dhanmondi**	12	8626899
154	Retina & Eye Centre	H # 17, R # 109,	**Gulshan**	9	9884588
155	Rina Nursing Home	83/84 Chankhar pul	**Lalbagh**	2	
156	Ripon Clinic	639/Ko Boro Mogh Bazar	**Ramna**	2	
157	Rag Mukti Nursing Home	23/3 Shyamoli	**Mirpur**	20	813664
158	Royal Hospital	31 New Easkaton	**Ramna**	20	83113096
159	Sadman Nursing Home	Gulshan South Avenue	**Gulshan**	2	
160	Samiya Nursing Home	4/95, Block- A Joint Quarter,	**Mohammadpur**	10	8116365
161	Savar General Hospital	Bazar road,	**SAVAR**	9	7711443
162	Shahid Mansur Ali Medical College Hospital	Plot 1/c, R # 17, Section-11,	**Uttara**	150	8917978
163	Shaheen Maternity	H # 64/ B, R # 8 A,	**Dhanmondi**	NA	
164	SPRP & General Hospital	135 New Easkaton Road	**Ramna**	38	9339089
165	Shahjalal Poly Clinic	23/14 Khiljee Road,	**Mohammadpur**	10	810523
166	Shamarita General Hospital	Pantha Path,	**Tejgaon**	100	9131901
167	Shyamoli Aorthropadic & General Hospital private Ltd.	P C Culture Housing,	**Mohammadpur**	10	9121832
168	Sheba Clinic	Gha-25/1, Khilkhet Bazar,	**Cantonment**	10	8912688
169	Sebika Clinic	243/A, West Agargaon,	**Tejgaon**	10	9116710
170	Shima Nursing Home	464/3, Rampura	**Rampura**	2	7281337
171	Shishu Clinic	H# 27/A, Road# 6,	**Dhanmondi**	13	505427
172	South Asia Hospital Ltd.	69/E, Green Road	**Dhanmondi**	20	8616565
173	Stone Crash Hospital	H# 48, Road# 48/A,	**Dhanmondi**	10	8129402
174	Shobahan Nursiing Home	Daina Cinema Building Complex, Postagola	**Lalbagh**	10	7412728
175	Sumana Clinic	4 Patuatuli,	**Kotawali**	30	240407
176	Shadesh Clinic	250/2, South Jatrabari	**Demra**	4	7510179
177	Taslima Clinic	116, Santinagar	**Motijheel**	10	9350884
178	Techno Orient Ltd.	7/9, Sir Syed Road,	**Mohammadpur**	10	8129521
179	The Baraka Kidney Hospital and Research Institute	12 New Eskaton Road	**Ramna**	24	9350884
180	The Eye Clinic	137/2, Boro Mogbazar	**Ramna**	6	403238
181	The Garden Clinic and Nursing Home	11 Santinagar	**Motijheel**	7	9356692
182	The Kidney Hospital and Diagnostic Center	161/A, Lake Circus,	**Dhanmondi**	10	8122019
183	The Marks ENT Clinic and General Hospital	Plot-A/3, Mirpur-14	**Mirpur**	42	9871527
184	The Mother and Child Care Center	H# 13, Road# 6,	**Dhanmondi**	10	8615792
185	The Health Hospital Ltd.	81/B/2, Hosseni Dalan,	**Lalbagh**	10	7300977
186	The New Aroggo Niketon	Block# A, Plot# 6, Pallabi,	**Mirpur**	12	9000701
187	The Specialized Hospital	H# 44, Road# 10A,	**Dhanmondi**	10	8115465
188	Trauma Center and Orthopedic Hospital	H#19, Road# 28,	**Dhanmondi**	10	8116969
189	Udoyan Poly Clinic	280, New Eskaton	**Ramna**	10	9351100
190	Shahin Meternity	H# 64(2), Road# 8/A,	**Dhanmondi**	4	
191	Uposom Hospital	107/1, South Badda,	**Gulshan**	7	9887597
192	Uposom Nursing Home	H#17, Road#25,	**Dhanmondi**	10	
193	Euro Care Medical Center	H# 73, Road# 9/A,	**Dhanmondi**	5	9126113
194	Usha Clinic	2/1, Kalabagan	**Dhanmondi**	12	7131185
195	Utsorga Nursing Home Pvt. Ltd.	67, Shiddeshori Road	**Ramna**	10	
196	Uttara Medical Center	H# 5, Road# 35,	**Uttara**	10	
197	Wari Clinic	4/1, Hare Street,	**Kotawali**	5	
198	Women and Children Hospital	H# 10/A, Road# 29,	**Dhanmondi**	150	8113313
199	Your Health Nursing Home	7 Gopibagh,	**Motijheel**	4	231422

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
200	ZH Shikdar Womens Medical College Hospital	Dhanmondi	**Dhanmondi**	500	8115751
201	Zaman'a Clinic	F-89, Road# 3,	**Gulshan**	30	600600
202	Shefa Nursing Home	17/7, Block-C, Babar Road,	**Mohammadpur**	20	9111758
203	Dhaka Nursing Home	386, Road# 16,	**Dhanmondi**	13	504227
204	Mirpur Maternity Clinic	17/A/A Mazar Road,	**Mirpur**	2	
205	Yamagata Dhaka Friendship Hospital	6/7 Block-A,	**Mohammadpur**	14	9129354
206	Neuro Science Institute	35 Shorwardy,	**Gulshan**	20	8814299
207	Akinahar Eye Hospital	3/8 Tajmahal Road,	**Mohammadpur**	9	323235
208	Mirpur Holy Cresent Hospital Pvt. Ltd.	South Bongsal, Mirpur-1	**Mirpur**	20	9000633
209	Light House Clinic	H#20, Road# 14, Sector# 6,	**Uttara**	10	8922789
210	Mamatamoyi Clinic	338/16C, Khilgaon	**Khilgaon**	10	9348868
211	Uttara Central Hospital	H#1, Road# 7, Sector# 1,	**Uttara**	15	8911551
212	Dip Jele Jai Clinic Pvt. Ltd.	R# 5E, Road#13, Sector# 1,	**Uttara**	10	171805259
213	New Mukti Clinic	22/10, Block-B, Babar Road,	**Mohammadpur**	15	8621889
214	The Baraka General Hospital Ltd.	739, Outer Circulr Road,	**Motijheel**	50	9337534
215	Green View Clinic	25/3, Greean Road	**Dhanmondi**	10	8610313
216	Dhanmondi Hospital Pvt. Ltd.	H# 17/E, Green Road	**Dhanmondi**	10	8628849
217	Khalikun Nessa Genera Hospital	61 Becharam Deuri,	**Lalbagh**	20	7312449
218	Bangladesh Community and General Hospital Ltd.	North Jatrabari	**Demra**	20	241523
219	Fashion Eye Hospital Ltd.	98/6-A, Elephant Road, Boro Mogbazar	**Ramna**	10	9338986
220	Meditech General Hospital Pvt. Ltd.	H# 21, Road2, Nikunja,	**Uttara**	10	8918345
221	Christian Medical Hospital Pvt. Ltd.	52, **Tejkuni Para**	**Tejgaon**	15	8813375
222	Millennium Heart and General Hospital Ltd.	4/9, Block-F,	**Mohammadpur**	30	9002533
223	Al Helal Specialized Hospital Ltd.	Rokeya Soroni, Senpara,Mirpur 10	**Mirpur**	27	9006820
224	Arafat Medical Pvt. Ltd.	39, Mitford Road,	**Lalbagh**	30	7319461
225	God's Gift Nursing Home	H# 5, R# 5, Sector# 6, Isha Khan Avenue,	**Uttara**	10	8911431
226	Pan Pacific Hospital Traning and Research Institute Ltd.	Outer Circular Road,	**Motijheel**	60	9349794
227	Arab Bangladesh General Hospital	H# 7/3, Block# A,	**Mohammadpur**	40	8118261
228	Medi Prime Orthopedic and General Hospital	1/7, Humayan Road,	**Mohammadpur**	10	325601
229	Center For Assisted Reproduction	23/2, Shyamoli Estate-2	**Mirpur**	10	9132548
230	Arimo General Hospital	Matuail Madrasa Bus Station, Sharif Para,	**Demra**	10	019-340867
231	Prothoy Medical Clinic Ltd.	Road# 12A, Block-DWN (A),	**Gulshan**	30	8821399
232	Dr. Shamima Hayder Clinic	8, Azimpur Road	**Lalbagh**	56	9673199
233	Dhaka Madani Hospital	381/A, DIT Road,	**Rampura**	20	8314524
234	Medi Health General Hospital	Matuail,	**Demra**	10	7518217
235	Shirin Clinic	8/2, Kadom Tola, First Lane,	**Khilgaon**	10	8316741
236	Bangladesh Hearth and Chest Hospital	H#47, Road# 27,	**Dhanmondi**	20	9114166
237	Pent Star Hospital	161/1, Lake Circus,	**Dhanmondi**	30	9113131
238	Al Baraka Hospital Pvt. Ltd.	North Jatrabari	**Demra**	30	7515855
239	Keith General Hospital Pvt. Ltd.	H# 65, Road# 6, Sector# 4,	**Uttara**	10	017-365497
240	Shahana Clinic	Keranigonj	**Keranigonj**	10	7771188
241	Dhaka Pediatric and New Netal Hospital	H#48/1, Road#2/1,	**Dhanmondi**	30	8614656
242	Mother Care Hospital	3/10, Lalmatia	**Mohammadpur**	12	9119355

Sl. No.	Name	Address	Name of Thana	Number of Bed	Telephone Number
243	Lion Dr. Jafar Khan Eye Hospital and Faco Center	1/B, 12 Kalwalapara, Mirpur 1	**Mirpur**	6	9010866
244	Kolatia Clinic and Diagnostic Center Pvt. Ltd.	Kolatia,	**Keranigonj**	10	0171-661279
245	Salvation Specialized Hospital and Research Ltd.	H#36, Road# 3,	**Dhanmondi**	20	9674114
246	Manamo General Hospital and Diagnostic Center	Kamarpara,	**Uttara**	10	8014694
247	Fuad Al Khatib Hospital	2/2, Kallayanpur,	**Mirpur**	18	9007188
248	Jahangir Nagar Hospital Ltd.	Shamibagh,	**Sutrapur**	30	7125125
249	Popular Clinic and Diagnostic Center	H#11/A, Road# 2,	**Dhanmondi**	11	9669480
250	Oncology Center	2/8 A, Road# 3, Block# A,	**Mohammadpur**	10	8918138
251	Chowdhury Clinic	38/1, Agamosi Lane,	**Lalbagh**	2	7300476
252	Vision Eye Hospital	H# 27, Road# 27,	**Dhanmondi**	7	
253	Hadi Grud Medication Complex	34, West Jatrabari	**Demra**	10	7511846
254	Prime General Hospital	R K Mission Road,	**Sutrapur**	28	7512425
255	Techno Orient Ltd.	6/9 Sir Syed Road, Block# A,	**Mohammadpur**	10	325843
256	Rampura Nursing Home	375, West Rampura	**Rampura**	2	8314299
257	Renal Hope Kidney Dialysis and Diagnostic Center	H# 37, Road# 1, Block# E,	**Gulshan**	10	8816047
258	Seba General Hospital	72/75, Majed Sardar Road, Chankharpol, Former Nazimuddin Road	**Lalbagh**	10	7300903
259	Bhuiyan Poli Clinic	100, Malibagh	**Ramna**	10	406974
260	Anwara General Hospital	23/1, Panthapath	**Tejgaon**	NA	
261	City Medical Center Pvt. Ltd.	2/24 Babar Road,	**Mohammadpur**	10	
262	Dhaka Central Poly Clinic	67, Kalabagan	**Dhanmondi**	10	
Total Number of Bed				**6362**	

*Information: - September 30th,2003

Private Registered Bedded Clinics in the Study Area of Dhaka (Thanawise)

Sl. No.	Name	Address	Name of Thana	Number of Bed
14	Araf Diagonistic & Clinic	197, Badda Bazar,	**Badda**	4
95	K. C. memorial Clinic Ltd.	35 Sarwardy Avenue,	**Badda**	20
2	Afroja Metarnity Clinic	241/1 South Zatra Bari	**Demra**	8
43	Dekes Centre	14 Shahid Faruk Road,	**Demra**	7
112	Modern Narsing Home	148/7, South Zatra Bari	**Demra**	8
117	Monowara General Hospital	22/6/2 North Golap Bagh, Biswa Road,	**Demra**	20
176	Shadesh Clinic	250/2, South Jatrabari	**Demra**	4
218	Bangladesh Community and General Hospital Ltd.	North Jatrabari	**Demra**	20
230	Arimo General Hospital	Matuail Madrasa Bus Station, Sharif Para,	**Demra**	10
234	Medi Health General Hospital	Matuail,	**Demra**	10
238	Al Baraka Hospital Pvt. Ltd.	North Jatrabari	**Demra**	30
253	Hadi Grud Medication Complex	34, West Jatrabari	**Demra**	10
3	Ahmed Medical Center	91/1 Shawnkar	**Dhanmondi**	30
18	BC General Hospital	H# 71/1, R # 9/A	**Dhanmondi**	10
21	Bangladesh Services Private Limited	H# 39, R # 9/A	**Dhanmondi**	18
22	Bangladesh Medical College & Hospital	**Dhanmondi**	**Dhanmondi**	212
29	Bengal Nersing home Private Limited	70/ c lake circus ,	**Dhanmondi**	27
33	Central Hospital Limited	H # 10/a, Road 5,	**Dhanmondi**	150
38	City Narsing Home	52/1 Elephant Road	**Dhanmondi**	2
40	Comfort Narsing Home Private Limited	H # 10-B, R # 6,	**Dhanmondi**	20
41	Conscious Health Services Limited	H # 25/ A R# 6,	**Dhanmondi**	16
45	Delt amedical Center Ltd	H # 20, R # 4,	**Dhanmondi**	21
47	Desh Nursing Home	27 Elephant Road	**Dhanmondi**	2
51	Dhaka New Netal Hospital Ltd.	H # 34, R # 14/A,	**Dhanmondi**	10
52	Dhaka Renal Hospital & Cardiak Center	5 Green Corner,	**Dhanmondi**	10
55	Dhanmondi Clinic Pvt. Ltd	H # 2, R# 8,	**Dhanmondi**	22
56	Dhanmondi eye Clinic	H # 50, R # 8/A,	**Dhanmondi**	10
57	Dhanmondi Narsing Home	H # 27-A, R # 11,	**Dhanmondi**	13
58	Dhanmondi South East Hospital	R # 5, Dhanmondi	**Dhanmondi**	12
59	Dr. Meherun Nessa Clinic	H # 5, R # 5,	**Dhanmondi**	9
60	Dr. Nurul Islam Clinic	110 Green Road	**Dhanmondi**	8
64	Farabee General Hospital	Road 14, House 8/3,	**Dhanmondi**	20
66	Gana Shashto Hospital	H14/ E, R # 6,	**Dhanmondi**	30
67	Gastro lever Clinic	Green Road	**Dhanmondi**	14
68	General Medical Hospital	103 Elephant Road	**Dhanmondi**	20
69	Green Eye Hospital	H # 31, R # 6,	**Dhanmondi**	10
70	Green Spare Clinic Ltd.	12 Green Road	**Dhanmondi**	20
75	Helen Pasha Clinic	257/1 Elephant Road	**Dhanmondi**	7
79	Ibne Sina Clinic	H # 58 A, R # 8-A,	**Dhanmondi**	50
85	Islami Aroggo Shadan Ltd.	H # 35, R # 1,	**Dhanmondi**	30
87	Jable -E- Nur General Hospital	H # 21, R # 7/A,	**Dhanmondi**	20
92	Judi Maternity	75, Green Road	**Dhanmondi**	2
104	Mallika Nersing Home	H # 37/A, R # 4/A,	**Dhanmondi**	7
105	Medi Aid Clinic	62 Lake Circus,	**Dhanmondi**	18
113	Mohanagar Clinic	48/A Dhanmondi	**Dhanmondi**	10
121	Mss the Eye Pavilion Ltd.	H # 25/11, R # 13/ A,	**Dhanmondi**	10
122	Mujibunnessa Eye Hospital	H # 11, R # 28 (old)	**Dhanmondi**	5
126	Naz Clinic	H # 75, R# 8/a	**Dhanmondi**	33
128	New Al-Raji Hospital	32 Green Road	**Dhanmondi**	12
132	New Mukti Clinic	301 Elephant Road	**Dhanmondi**	12
134	Nibedita Nursing Home	H # 27, R # 7,	**Dhanmondi**	28
137	Niramoy Clinic	Dhanmondi	**Dhanmondi**	NA
139	Nirupom hospital Pvt. Ltd.	H # 69, R # 11/A,	**Dhanmondi**	20
153	Renesa Health Centre Ltd.	H # 60, R # 4/A	**Dhanmondi**	12

Sl. No.	Name	Address	Name of Thana	Number of Bed
163	Shaheen Maternity	H # 64/ B, R # 8 A,	**Dhanmondi**	NA
171	Shishu Clinic	H# 27/A, Road# 6,	**Dhanmondi**	13
172	South Asia Hospital Ltd.	69/E, Green Road	**Dhanmondi**	20
173	Stone Crash Hospital	H# 48, Road# 48/A,	**Dhanmondi**	10
182	The Kidney Hospital and Diagnostic Center	161/A, Lake Circus,	**Dhanmondi**	10
184	The Mother and Child Care Center	H# 13, Road# 6,	**Dhanmondi**	10
187	The Specialized Hospital	H# 44, Road# 10A,	**Dhanmondi**	10
188	Trauma Center and Orthopedic Hospital	H#19, Road# 28,	**Dhanmondi**	10
190	Shahin Meternity	H# 64(2), Road# 8/A,	**Dhanmondi**	4
192	Uposom Nursing Home	H#17, Road#25,	**Dhanmondi**	10
193	Euro Care Medical Center	H# 73, Road# 9/A,	**Dhanmondi**	5
194	Usha Clinic	2/1, Kalabagan	**Dhanmondi**	12
198	Women and Children Hospital	H# 10/A, Road# 29,	**Dhanmondi**	150
200	ZH Shikdar Womens Medical College Hospital	Dhanmondi	**Dhanmondi**	500
203	Dhaka Nursing Home	386, Road# 16,	**Dhanmondi**	13
215	Green View Clinic	25/3, Greean Road	**Dhanmondi**	10
216	Dhanmondi Hospital Pvt. Ltd.	H# 17/E, Green Road	**Dhanmondi**	10
236	Bangladesh Hearth and Chest Hospital	H#47, Road# 27,	**Dhanmondi**	20
237	Pent Star Hospital	161/1, Lake Circus,	**Dhanmondi**	30
241	Dhaka Pediatric and New Netal Hospital	H#48/1, Road#2/1,	**Dhanmondi**	30
245	Salvation Specialized Hospital and Research Ltd.	H#36, Road# 3,	**Dhanmondi**	20
249	Popular Clinic and Diagnostic Center	H#11/A, Road# 2,	**Dhanmondi**	11
252	Vision Eye Hospital	H# 27, Road# 27,	**Dhanmondi**	7
262	Dhaka Central Poly Clinic	67, Kalabagan	**Dhanmondi**	10
15	Ayesha memorial Specialized Hospital	74/G, Aroz Para,	**Gulshan**	13
30	Cardi Hope Heart Centre	12 South Avenue,	**Gulshan**	13
36	Khristian Medical Centre	6/3 Norda Baridhara	**Gulshan**	10
73	Gulshan Mother & Children Clinic	H # 11/ A, R # 48,	**Gulshan**	10
90	Japan Bangladesh Friendship Hospital	H # 27, R # 114,	**Gulshan**	30
97	Lake View Clinic	Plot#5,Block#7,R#7-A	**Gulshan**	8
99	Life Line Medical Services Limited	Rahman Mansion , 75	**Gulshan**	10
102	M.S. Clinic of Sergery & Midaifery	Go-19, Mohakhali	**Gulshan**	10
108	Metropolitan Medical Centre	Mahakhali	**Gulshan**	30
110	Modern Clinc of Sergery & Midwaifary	H # 58,R # 131,	**Gulshan**	10
154	Retina & Eye Centre	H # 17, R # 109,	**Gulshan**	9
159	Sadman Nursing Home	Gulshan South Avenue	**Gulshan**	2
191	Uposom Hospital	107/1, South Badda,	**Gulshan**	7
201	Zaman'a Clinic	F-89, Road# 3,	**Gulshan**	30
206	Neuro Science Institute	35 Shorwardy,	**Gulshan**	20
231	Prothoy Medical Clinic Ltd.	Road# 12A, Block-DWN (A),	**Gulshan**	30
257	Renal Hope Kidney Dialysis and Diagnostic Center	H# 37, Road# 1, Block# E,	**Gulshan**	10
258	Gulshan Group Clinic	H # 17, Road # 57,	**Gushan**	10
175	Sumana Clinic	4 Patuatuli,	**Katawali**	30
50	Dhaka General Hospital Ltd.	17, Hatkhola Lane,	**Katwali**	20
94	Kalpana Narsing Home	6/1 Bacharam Dawry,	**Katwali**	1
197	Wari Clinic	4/1, Hare Street,	**Katwali**	5
31	Care Land Hospital Private Limited	C 257, Khilgaon	**Khilgaon**	10
124	Mukti Nursing Home	233/B Khilgaon, Chawdhuri Para	**Khilgaon**	20
210	Mamatamoyi Clinic	338/16C, Khilgaon	**Khilgaon**	10
235	Shirin Clinic	8/2, Kadom Tola, First Lane,	**Khilgaon**	10
34	Chankhar pool General Hospital	10-10/1.-, Nobab Ktra,	**Lalbagh**	10
129	New Dhaka Clinic	Armani tola,	**Lalbagh**	20
155	Rina Nursing Home	83/84 Chankhar pul	**Lalbagh**	2

Sl. No.	Name	Address	Name of Thana	Number of Bed
174	Shobahan Nursiing Home	Daina Cinema Building Complex, Postagola	**Lalbagh**	10
185	The Health Hospital Ltd.	81/B/2, Hosseni Dalan,	**Lalbagh**	10
217	Khalikun Nessa Genera Hospital	61 Becharam Deuri,	**Lalbagh**	20
224	Arafat Medical Pvt. Ltd.	39, Mitford Road,	**Lalbagh**	30
232	Dr. Shamima Hayder Clinic	8, Azimpur Road	**Lalbagh**	56
251	Chowdhury Clinic	38/1, Agamosi Lane,	**Lalbagh**	2
258	Seba General Hospital	72/75, Majed Sardar Road, Chankharpol, Former Nazimuddin Road	**Lalbagh**	10
259	Maushumi Clinic	76/1 Nazimuddin Road,	**Lalbugh**	2
5	Akand Clinic	H# 1 B, R# 11/2,Block- B Section # 10,	**Mirpur**	10
12	Anonno Narsing home	390/2 South Pike Para,	**Mirpur**	3
25	Bornali Narsing Home	Plot # 3, Sec- 1, Block - C,	**Mirpur**	10
27	BAVS Metarnity	9/5 Main Road Mirpur	**Mirpur**	10
46	Delt amedical Center Ltd	26/2 Drus salam Road,	**Mirpur**	10
89	Jono Sheba Nursing Home	R # 1, H # 7,	**Mirpur**	10
98	Latifa Poli clinic	30 Kalwala Para,	**Mirpur**	10
109	Mirpur General Hospital	R#1, H# 35, Section-10,	**Mirpur**	10
115	Monorog Clinic	H #1,Block-A,Road-1,Section-11	**Mirpur**	50
116	Monorom Metarnity	803 / 2, Mirpiur-2	**Mirpur**	60
140	O G S B Metarnity	Eid Gah, Cristian Road	**Mirpur**	20
141	O S B Eye Hospital	Plot 9/ 1	**Mirpur**	20
143	Pally Maternity	40/2 Kallan pur Main Road	**Mirpur**	3
149	Rahima Matenity Hospital	H#1, R#5, Block-A,Secton-6,Mirpur	**Mirpur**	10
157	Rag Mukti Nursing Home	23/3 Shyamoli	**Mirpur**	20
183	The Marks ENT Clinic and General Hospital	Plot-A/3, Mirpur-14	**Mirpur**	42
186	The New Aroggo Niketon	Block# A, Plot# 6, Pallabi,	**Mirpur**	12
204	Mirpur Maternity Clinic	17/A/A Mazar Road,	**Mirpur**	2
208	Mirpur Holy Cresent Hospital Pvt. Ltd.	South Bongsal, Mirpur-1	**Mirpur**	20
223	Al Helal Specialized Hospital Ltd.	Rokeya Soroni, Senpara,Mirpur 10	**Mirpur**	27
229	Center For Assisted Reproduction	23/2, Shyamoli Estate-2	**Mirpur**	10
243	Lion Dr. Jafar Khan Eye Hospital and Faco Center	1/B, 12 Kalwalapara, Mirpur 1	**Mirpur**	6
247	Fuad Al Khatib Hospital	2/2, Kallayanpur,	**Mirpur**	18
6	Al-Manara Hospital Pvt. Lmited	5/4 Block-F	**Mohammadpur**	26
7	Al-Biruni Hospital	23/1 Khiljee Road,	**Mohammadpur**	10
8	Al-Care Health Centre Ltd.	86 Shat Moshjid Road,	**Mohammadpur**	20
9	Al-Magreebi Eye Hospital	Shatmashjid Road	**Mohammadpur**	30
10	Al-Markajul Islami Hospital	H# 27, R# 3,	**Mohammadpur**	20
13	Anirban Narsing Home	14/27 Shahjahan Road,	**Mohammadpur**	10
17	Avenue Medical Centre Private Limited	Block-A,	**Mohammadpur**	7
23	Banu Clinic	75/C Asad Avenue,	**Mohammadpur**	3
26	Bashundhara Hospital Private Ltd.	**Lalmatia**	**Mohammadpur**	20
28	BDM Hospital	5/19 Humayun Road	**Mohammadpur**	50
42	Crecent Hosptal & Diagonistic Center	22/2 Babar Road,	**Mohammadpur**	25
53	Dhaka Aurthropadic Hospital	843 Biatul Aman Housing Society,	**Mohammadpur**	10
82	Impact Jibon Tory Vashoman Hospital	4/5 Iqbal Road	**Mohammadpur**	14
84	Islami Bank Hospital Ltd.	24/B outer Road, South Shah jahan Road,	**Mohammadpur**	60
150	Rahmaniya Clinic	38 sher shah shuri Road,	**Mohammadpur**	3
160	Samiya Nursing Home	4/95, Block- A Joint Quarter,	**Mohammadpur**	10
165	Shahjalal Poly Clinic	23/14 Khiljee Road,	**Mohammadpur**	10
167	Shyamoli Aorthropadic & General Hospital private Ltd.	P C Culture Housing,	**Mohammadpur**	10
178	Techno Orient Ltd.	7/9, Sir Syed Road,	**Mohammadpur**	10
202	Shefa Nursing Home	17/7, Block-C, Babar Road,	**Mohammadpur**	20
205	Yamagata Dhaka Friendship Hospital	6/7 Block-A,	**Mohammadpur**	14
207	Akinahar Eye Hospital	3/8 Tajmahal Road,	**Mohammadpur**	9

Sl. No.	Name	Address	Name of Thana	Number of Bed
213	New Mukti Clinic	22/10, Block-B, Babar Road,	**Mohammadpur**	15
222	Millennium Heart and General Hospital Ltd.	4/9, Block-F,	**Mohammadpur**	30
227	Arab Bangladesh General Hospital	H# 7/3, Block# A,	**Mohammadpur**	40
228	Medi Prime Orthopedic and General Hospital	1/7, Humayan Road,	**Mohammadpur**	10
242	Mother Care Hospital	3/10, Lalmatia	**Mohammadpur**	12
250	Oncology Center	2/8 A, Road# 3, Block# A,	**Mohammadpur**	10
255	Techno Orient Ltd.	6/9 Sir Syed Road, Block# A,	**Mohammadpur**	10
261	City Medical Center Pvt. Ltd.	2/24 Babar Road,	**Mohammadpur**	10
119	Motijheel Nursing Home	30/9 Purana Paltan, VIP Road	**Motiheel**	10
138	Nirban Addiction rehabilitation Centre	184/1 North Shahjahanpur	**Motihjeel**	10
65	Farida Clinic	165, Shantinagar	**Motijheel**	12
76	Holly Care Clinic	107/2 Kakrail	**Motijheel**	10
81	Ideal Narsing Home	50-A, Shanti Nagar	**Motijheel**	10
130	New Ara Hospital	1 Momen bagh,	**Motijheel**	20
136	Nila Maternity	69 Shantinagar	**Motijheel**	5
177	Taslima Clinic	116, Santinagar	**Motijheel**	10
181	The Garden Clinic and Nursing Home	11 Santinagar	**Motijheel**	7
199	Your Health Nursing Home	7 Gopibagh,	**Motijheel**	4
214	The Baraka General Hospital Ltd.	739, Outer Circulr Road,	**Motijheel**	50
226	Pan Pacific Hospital Traning and Research Institute Ltd.	Outer Circular Road,	**Motijheel**	60
96	Kishowar Narsing Home	20 Shanti Nagar	**Motojheel**	10
49	Dhaka Community Hospital	190/1 Walse Gate , Boro Magbazar	**Ramna**	26
77	Holly Family Red Crecent Hospital	Boro Mogh Bazar, Easkaton Garden Road,	**Ramna**	304
80	Ibrahim Memorial Diabetich Hospital	Shah Bag	**Ramna**	282
83	International Hospital Limited	6 Easkaton Garden	**Ramna**	10
101	Luna Clinic	680/1 Boro Magh Bazar	**Ramna**	4
106	Medi Stone Lithetripsy Clinic	218 Outer Circuler Road, Boro Mogh Bazar	**Ramna**	7
107	Memory Medical Centre	22, New Eskaton	**Ramna**	16
111	Modern Metarnity Clinic	17 Paribagh	**Ramna**	6
114	Maitry Narsing Home	5/b Malibagh	**Ramna**	4
123	Mukti Maternity	24 Shidheshwary	**Ramna**	2
127	Neurologi Hospital	22/1 Topkhana Road,	**Ramna**	35
135	Nibedita Shishu Hospital	11/1 Wary Street,	**Ramna**	25
144	Paricharja	179 Boro Magh Bazar	**Ramna**	3
145	Park View Nursing Home	New Easkaton	**Ramna**	22
146	Prashanti Hospital Limited,	3 Shanti Bagh,	**Ramna**	20
148	Rhima Ali Clinic	3/B Malibagh Chawdhuri Para	**Ramna**	10
151	Rajdhani Clinic	3 Outer Road, Malibagh	**Ramna**	20
152	Rash mono Poli Clinic	20 Outer Road, Malibagh	**Ramna**	117
156	Ripon Clinic	639/Ko Boro Mogh Bazar	**Ramna**	2
158	Royal Hospital	31 New Easkaton	**Ramna**	20
164	SPRP & General Hospital	135 New Easkaton Road	**Ramna**	38
179	The Baraka Kidney Hospital and Research Institute	12 New Eskaton Road	**Ramna**	24
180	The Eye Clinic	137/2, Boro Mogbazar	**Ramna**	6
189	Udoyan Poly Clinic	280, New Eskaton	**Ramna**	10
195	Utsorga Nursing Home Pvt. Ltd.	67, Shiddeshori Road	**Ramna**	10
219	Fashion Eye Hospital Ltd.	98/6-A, Elephant Road, Boro Mogbazar	**Ramna**	10
259	Bhuiyan Poli Clinic	100, Malibagh	**Ramna**	10
1	Ad-deen Hospital	2, Boro Mogbazar	**Ramna**	89
103	Mala Nersing Home	31 East Hazi Para	**Rampura**	3
133	New Rampura Nersing Home	375, Rampura VIP Road	**Rampura**	NA
170	Shima Nursing Home	464/3, Rampura	**Rampura**	2
233	Dhaka Madani Hospital	381/A, DIT Road,	**Rampura**	20
256	Rampura Nursing Home	375, West Rampura	**Rampura**	2
74	Health Care Centre	11/ 1 Ranking Street,	**Sutrapur**	10
78	Haque Narsing Home	154 RK Mission Road,	**Sutrapur**	2

Sl. No.	Name	Address	Name of Thana	Number of Bed
93	Kabir Eye Centre	7/1 Nawab Street,	**Sutrapur**	10
248	Jahangir Nagar Hospital Ltd.	Shamibagh,	**Sutrapur**	30
254	Prime General Hospital	R K Mission Road,	**Sutrapur**	28
11	Al-Raji Hospital Pvt. Limited	12, Tej Kuni Para,	**Tejgaon**	20
37	City Hospital Private Limited	69/1/1 Pantha Path	**Tejgaon**	30
39	City Narsing Home	4/2 Sobhan Bagh	**Tejgaon**	20
54	Dhaka Children's Hospital	Sohorwardy,	**Tejgaon**	305
61	Dr. Sultana Poli Clinic	565 Uttar Nakhal Para	**Tejgaon**	6
62	Elizabeth Clinic	5/4 Monipuri Para,	**Tejgaon**	10
100	Lionce Eye Hospital	Lionce Building,	**Tejgaon**	45
166	Shamarita General Hospital	Pantha Path,	**Tejgaon**	100
169	Sebika Clinic	243/A, West Agargaon,	**Tejgaon**	10
221	Christian Medical Hospital Pvt. Ltd.	52, **Tejkuni Para**	**Tejgaon**	15
260	Anwara General Hospital	23/1, Panthapath	**Tejgaon**	NA
86	Islamia Eye Hospital & M A Ispahani of	Firm Gate	**Tejgon**	300
118	Musaf Nursing Home	H # 7,R# 7,sectore-4	**Uttar**	6
162	Shahid Mansur Ali Medical College Hospital	Plot 1/c, R # 17, Section-11,	**Uttar**	150
4	I Chi Hospital	H#2,R#34,Sectore# 9	**Uttara**	50
71	Green Land Hospital	Sectore - 7, Uttara Model Town,	**Uttara**	10
88	Jahanara Clinic & Path	H # 2, R # 2, Sectore-1,	**Uttara**	18
196	Uttara Medical Center	H# 5, Road# 35,	**Uttara**	10
209	Light House Clinic	H#20, Road# 14, Sector# 6,	**Uttara**	10
211	Uttara Central Hospital	H#1, Road# 7, Sector# 1,	**Uttara**	15
212	Dip Jele Jai Clinic Pvt. Ltd.	R# 5E, Road#13, Sector# 1,	**Uttara**	10
220	Meditech General Hospital Pvt. Ltd.	H# 21, Road2, Nikunja,	**Uttara**	10
225	God's Gift Nursing Home	H# 5, R# 5, Sector# 6, Isha Khan Avenue,	**Uttara**	10
239	Keith General Hospital Pvt. Ltd.	H# 65, Road# 6, Sector# 4,	**Uttara**	10
246	Manamo General Hospital and Diagnostic Center	Kamarpara,	**Uttara**	10

Hospitals and Clinics Information by GIS Group

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
269501	DCC	DCC		Ward No-01	Health centre	Dhaka Eye Care Centre		540626.480	2639352.220	2310	43230	148
269501	DCC	DCC		Ward No-01	Health centre	Azampur Health Centre		541221.620	2639312.860	2439	43230	148
269501	DCC	DCC		Ward No-01	Hospital	Sappro Dental College & Hospital		541031.300	2640233.670	2293	43210	147
269501	DCC	DCC		Ward No-01	Hospital	Al Hera Adhunik Hospital		540696.970	2640139.330	2294	43210	147
269501	DCC	DCC		Ward No-01	Hospital	Aichi Hospital	50	541211.520	2639731.750	2340	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Bangladesh Kuwait Friendship Hospital	-	541377.160	2639637.350	2338	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Hospital		540971.520	2639624.870	2391	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Hospital		541251.550	2639605.550	2342	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Greenland Hospital	10	540939.010	2639445.190	2436	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Jabal-E-Nur Hospital	20	540566.770	2639348.180	2313	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Hospital		540463.100	2639328.990	2311	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Dental Medical Hospital		541095.050	2639218.250	2440	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Maryland Hospital		540962.570	2638546.240	2438	43210	148
269501	DCC	DCC		Ward No-01	Hospital	Uttara Central Hospital	15	541225.440	2638225.520	2362	43210	148
269501	DCC	DCC		Ward No-01	Other facilities	Jahanara Clinic Ltd.	18	541403.510	2637979.780	2437	43240	148
266402	DCC	DCC		Ward No-02	Health centre	GP Medical Centre		537411.500	2634535.580	511	43230	109
266403	DCC	DCC		Ward No-03	Clinic	Akand Clinic	10	538188.090	2632621.110	1267	43220	130
266403	DCC	DCC		Ward No-03	Health centre	Boisakhi Medical Centre		537744.770	2633037.990	1187	43230	130
263004	DCC	DCC		Ward No-04	Clinic	The Marks E and T Clinic and General Hospital	42	539667.620	2631729.790	1273	43220	130
263004	DCC	DCC		Ward No-04	Hospital	Mirpur General Hospital	10	538533.180	2632535.000	1271	43210	130
263004	DCC	DCC		Ward No-04	Hospital	Dhaka Indigenous Medical College Hospital		538798.400	2632366.280	1268	43210	130
266405	DCC	DCC		Ward No-05	Health centre	Radda MCHFP Centre		538837.720	2634291.150	1166	43230	129
264807	DCC	DCC		Ward No-07	Hospital	Rahima Maternity Hospital	10	537725.410	2632907.700	1265	43210	130
264808	DCC	DCC		Ward No-08	Health centre	Barnali Nursing Home (Maternity Service)	10	536434.940	2631838.020	626	43230	110
264808	DCC	DCC		Ward No-08	Hospital	Trust Adhunik Hospital		535835.870	2633075.140	628	43210	110
264808	DCC	DCC		Ward No-08	Hospital	O.G.S.B Maternity Hospital	20	536304.530	2631997.640	627	43210	110
264810	DCC	DCC		Ward No-10	Hospital	Hospital		535540.620	2630523.350	737	43210	111
264811	DCC	DCC		Ward No-11	Hospital	Shapla H.F Hospital		536796.480	2630902.800	781	43210	111
264811	DCC	DCC		Ward No-11	Hospital	Hospital		536359.960	2629980.880	735	43210	111
264812	DCC	DCC		Ward No-12	Health centre	Delta Medical Centre	10	536232.970	2630514.090	782	43230	111

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
264812	DCC	DCC		Ward No-12	Hospital	Dhaka Eye Hospital		536479.320	2631768.880	635	43210	110
264812	DCC	DCC		Ward No-12	Hospital	Fuad Al Khatib Hospital	18	536243.710	2631588.750	630	43210	110
264813	DCC	DCC		Ward No-13	Hospital	National Heart Foundation Hospital		537152.820	2632244.970	631	43210	110
264813	DCC	DCC		Ward No-13	Hospital	OSB Eye Hospital	20	537119.900	2632233.760	632	43210	110
264813	DCC	DCC		Ward No-13	Hospital	Quarter Hospital		537753.500	2630548.870	1429	43210	131
264814	DCC	DCC		Ward No-14	Health centre	Ahsania Mission Cancer Research Centre		538709.430	2632234.390	1210	43230	130
264814	DCC	DCC		Ward No-14	Other facilities	Bangladesh Diabetic Society		537693.850	2632556.350	1270	43240	130
260815	DCC	DCC		Ward No-15	Hospital	BAF Hospital		540436.710	2635197.910	2524	43210	149
260815	DCC	DCC		Ward No-15	Hospital	Hospital		540347.040	2634852.110	2505	43210	149
260815	DCC	DCC		Ward No-15	Hospital	CMH		540640.290	2633162.300	2549	43210	150
260815	DCC	DCC		Ward No-15	Hospital	Govt. Homeopathic Medical College And Hospital		539832.570	2632218.000	1274	43210	130
260417	DCC	DCC		Ward No-17	Health centre	British High Commission Medical Centre		543030.170	2632875.050	4071	43230	170
260417	DCC	DCC		Ward No-17	Hospital	Hospital		543374.620	2634210.540	3961	43210	169
262618	DCC	DCC		Ward No-18	Health centre	Janata Health Centre		543176.330	2632781.800	4070	43230	170
262618	DCC	DCC		Ward No-18	Health centre	British High Commission Medical Centre		543205.640	2632190.610	4121	43230	170
262619	DCC	DCC		Ward No-19	Clinic	Lake View Clinic	8	542732.890	2632072.220	4073	43220	170
262619	DCC	DCC		Ward No-19	Clinic	Gulshan Group Clinic	10	542248.750	2631239.000	2583	43220	150
262619	DCC	DCC		Ward No-19	Health centre	Pulse Medical Centre		541771.840	2631562.850	2689	43230	150
262619	DCC	DCC		Ward No-19	Health centre	Chandshi Medical Centre		541832.290	2631467.580	2690	43230	150
262619	DCC	DCC		Ward No-19	Health centre	Al Homayra Health Centre		541395.530	2631074.630	2691	43230	150
262619	DCC	DCC		Ward No-19	Health centre	Gulf Medical Centre		541798.910	2631011.470	2692	43230	150
262619	DCC	DCC		Ward No-19	Health centre	Nova Medical Centre		541285.640	2630878.030	2905	43230	151
262619	DCC	DCC		Ward No-19	Health centre	Prince Medical Centre		541588.620	2630868.220	2760	43230	151
262619	DCC	DCC		Ward No-19	Health centre	Metropolitan Medical Centre	30	541314.440	2630832.440	2914	43230	151
262619	DCC	DCC		Ward No-19	Health centre	National Medical Centre		541694.450	2630823.260	2761	43230	151
262619	DCC	DCC		Ward No-19	Health centre	Simon Medical Centre		541737.400	2630709.560	2906	43230	151
262619	DCC	DCC		Ward No-19	Hospital	IBN SINA		541709.410	2631575.290	2688	43210	150
262619	DCC	DCC		Ward No-19	Hospital	Mukti Medical Hospital		542087.270	2631086.750	2571	43210	150
262619	DCC	DCC		Ward No-19	Other facilities	International Health Centre Ltd.		541212.960	2631340.430	2584	43240	150
262619	DCC	DCC		Ward No-19	Other facilities	Al Jaber Medicom Ltd.		542870.400	2629346.050	4229	43240	171
262620	DCC	DCC		Ward No-20	Health centre	Al Amin Medical Centre		541958.550	2629470.110	2908	43230	151
262620	DCC	DCC		Ward No-20	Hospital	Cancer Hospital		540976.320	2629475.930	2909	43210	151

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
262620	DCC	DCC		Ward No-20	Hospital	Nipsom & EPI Hospital		540979.700	2629328.830	2910	43210	151
262620	DCC	DCC		Ward No-20	Hospital	TB Hospital		542048.530	2629324.630	2812	43210	151
262620	DCC	DCC		Ward No-20	Hospital	ICDDRB Hospital	250	541630.560	2629194.660	2912	43210	151
262620	DCC	DCC		Ward No-20	Hospital	Infection Diseases Hospital	100	540951.430	2628909.280	2913	43210	151
262620	DCC	DCC		Ward No-20	Other facilities	Society for Assistance to Hearing Inspired Childre		541025.050	2629232.550	2911	43240	151
260421	DCC	DCC		Ward No-21	Hospital	Upasham Hospital		543638.030	2630132.990	4230	43210	171
263622	DCC	DCC		Ward No-22	Hospital	Hospital		543241.420	2627809.340	4433	43210	172
263622	DCC	DCC		Ward No-22	Hospital	Hospital		543189.670	2627794.380	4437	43210	172
263622	DCC	DCC		Ward No-22	Hospital	Dhaka Madani Hospital	20	543093.020	2627770.240	4478	43210	172
263622	DCC	DCC		Ward No-22	Hospital	Hospital		543708.120	2627470.110	4430	43210	172
263626	DCC	DCC		Ward No-26	Hospital	Hospital		544754.340	2626967.290	4350	43210	172
266827	DCC	DCC		Ward No-27	Hospital	Govt. Mohila Hospital		543812.670	2625571.820	4287	43210	172
266827	DCC	DCC		Ward No-27	Hospital	Hospital		544303.600	2625220.610	4294	43210	172
266828	DCC	DCC		Ward No-28	Health centre	Urban Primary Health Centre		544174.910	2624796.210	4532	43230	173
266830	DCC	DCC		Ward No-30	Hospital	Shutitaly Hospital		543973.180	2623157.430	4679	43210	173
266830	DCC	DCC		Ward No-30	Hospital	Prime General Hospital	21	543973.360	2623122.550	4678	43210	173
265431	DCC	DCC		Ward No-31	Hospital	Railway Hospital		543579.910	2624774.720	4515	43210	173
265433	DCC	DCC		Ward No-33	Hospital	Hospital		543221.310	2624863.320	4627	43210	173
265434	DCC	DCC		Ward No-34	Hospital	New Ara Hospital	20	542891.570	2625487.210	4479	43210	172
265434	DCC	DCC		Ward No-34	Hospital	The Baraka Hospital		543006.640	2625296.890	4398	43210	172
265434	DCC	DCC		Ward No-34	Hospital	Islami Bank Hospital	60	543403.990	2624917.450	4681	43210	173
265436	DCC	DCC		Ward No-36	Hospital	Dhaka Medical College Hospital		542411.590	2624905.410	3407	43210	153
265436	DCC	DCC		Ward No-36	Hospital	Police Hospital(Razarbagh Polish Hospital?)		542774.180	2624746.230	4574	43210	173
265436	DCC	DCC		Ward No-36	Hospital	Hospital		542187.790	2624599.960	3303	43210	153
269037	DCC	DCC		Ward No-37	Health centre	Thana Health Complex		541533.040	2627819.120	3127	43230	152
269039	DCC	DCC		Ward No-39	Health centre	Dushtha Health Centre		540349.910	2627688.070	2956	43230	152
269039	DCC	DCC		Ward No-39	Health centre	Biman Medical Centre		540196.690	2627030.880	3117	43230	152
269039	DCC	DCC		Ward No-39	Hospital	Al Razi Hospital	20	540059.130	2627292.320	3118	43210	152
269039	DCC	DCC		Ward No-39	Hospital	Charity Mission Hospital		540336.170	2627244.710	3119	43210	152
269040	DCC	DCC		Ward No-40	Hospital	Dhaka Shishu Hospital		537849.340	2628846.210	1425	43210	131
269040	DCC	DCC		Ward No-40	Hospital	Mental Health Institute Hospital		537795.860	2628786.540	1426	43210	131
269040	DCC	DCC		Ward No-40	Hospital	(Shahid) Suhrawardi Hospital	375	538094.680	2628425.200	1428	43210	131
269040	DCC	DCC		Ward No-40	Hospital	Quarter Hospital		538042.890	2628236.390	1498	43210	131

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
269040	DCC	DCC		Ward No-40	Hospital	Islamia Eye Hospital	300	539517.220	2627261.750	1684	43210	132
269040	DCC	DCC		Ward No-40	Hospital	Islamia Eye Hospital		539517.220	2627261.750	6133	43210	132
269040	DCC	DCC		Ward No-40	Hospital	Life Line General Hospital		539870.610	2626698.420	1552	43210	132
269040	DCC	DCC		Ward No-40	Hospital	Shamrita Hospital	100	539523.130	2626598.360	1525	43210	132
269040	DCC	DCC		Ward No-40	Other facilities	RIHD (Rehabilitation Ins. Hospital for Orthopaedic	500	537993.290	2628864.160	1424	43240	131
265041	DCC	DCC		Ward No-41	Hospital	Lions Eye Hospital	45	538919.480	2629565.050	1431	43210	131
265041	DCC	DCC		Ward No-41	Hospital	Probin Hospital		538637.370	2629409.740	1430	43210	131
265041	DCC	DCC		Ward No-41	Hospital	Al-Markajul Islami Hospital	20	537550.750	2629224.500	1433	43210	131
265041	DCC	DCC		Ward No-41	Other facilities	National T.B Control Project		537799.100	2628992.800	1432	43240	131
265045	DCC	DCC		Ward No-45	Health centre	Libya Bangladesh Brotherhood school Medical Centre		537552.530	2626843.460	1680	43230	132
265045	DCC	DCC		Ward No-45	Hospital	Al Beruni Hospital	10	537646.300	2628868.290	1437	43210	131
265045	DCC	DCC		Ward No-45	Hospital	Dustha Shastha Hospital		537682.960	2628576.060	1435	43210	131
265045	DCC	DCC		Ward No-45	Hospital	Mediprime Orthopaedic & General Hospital	10	537810.370	2628450.790	1436	43210	131
265045	DCC	DCC		Ward No-45	Hospital	Yamagata Dhaka Friendship Hospital	14	538270.180	2627179.360	1681	43210	132
265045	DCC	DCC		Ward No-45	Other facilities	Al Manar Medical Service Ltd.	26	538119.370	2627669.830	1683	43240	132
265045	DCC	DCC		Ward No-45	Other facilities	Drug Addicted Clear and Rehabilitation Centre		538137.860	2627561.600	1682	43240	132
265047	DCC	DCC		Ward No-47	Health centre	Euro Care Medical Centre	5	537809.480	2625991.500	1689	43230	132
261649	DCC	DCC		Ward No-49	Health centre	Dental Care Centre		538186.660	2625725.820	1692	43230	132
261649	DCC	DCC		Ward No-49	Health centre	Heart Centre		538199.140	2625710.060	1691	43230	132
261649	DCC	DCC		Ward No-49	Hospital	Vision Eye Hospital	7	538144.180	2626712.980	1705	43210	132
261649	DCC	DCC		Ward No-49	Hospital	The Farabi General Hospital	20	538284.320	2626358.610	1704	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Nirupan Hospital	20	538417.660	2626132.430	1703	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Women's and Childrens' Hospital	150	538461.340	2626016.270	1702	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Nur General Hospital		538517.080	2625922.200	1699	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Hospital		538230.920	2625885.190	1701	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Dr. Salauddin Hospital		538391.320	2625835.480	1700	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Ganashastha Nagar Hospital	30	539284.070	2625579.920	1695	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Central Hospital	150	539425.440	2625567.690	1569	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Dental Surgery and Prosthesis		539199.060	2625379.120	1694	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Stone Crash Hospital	10	538595.030	2625359.370	1698	43210	132
261649	DCC	DCC		Ward No-49	Hospital	Malekatun Nesa General Hospital		538527.920	2625318.770	1697	43210	132

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
261649	DCC	DCC		Ward No-49	Hospital	Dhaka ENT Hospital		538472.210	2625223.840	1690	43210	132
261649	DCC	DCC		Ward No-49	Other facilities	City Nursing Home		537789.750	2626359.280	1686	43240	132
261649	DCC	DCC		Ward No-49	Other facilities	Rainbow Heart Ltd.		537857.140	2626249.550	1688	43240	132
261649	DCC	DCC		Ward No-49	Other facilities	Medinova Medical Centre		538556.140	2625864.140	1760	43240	132
261649	DCC	DCC		Ward No-49	Other facilities	LAB AID		539355.570	2625376.210	1570	43240	132
261649	DCC	DCC		Ward No-49	Other facilities	Popular Diagnostic Centre	11	539188.060	2625087.530	1693	43240	132
261650	DCC	DCC		Ward No-50	Hospital	Padma General Hospital	21	540287.580	2626007.430	3130	43210	152
261651	DCC	DCC		Ward No-51	Hospital	Neurology Foundation Hospital		539324.770	2626204.650	1585	43210	132
266653	DCC	DCC		Ward No-53	Hospital	Addin Hospital	89	541558.120	2626133.440	3120	43210	152
266653	DCC	DCC		Ward No-53	Hospital	Capital Hill International		541805.390	2625991.980	3121	43210	152
266653	DCC	DCC		Ward No-53	Hospital	Holy Family Red Crescent Hospital	304	541432.020	2625936.820	3115	43210	152
266653	DCC	DCC		Ward No-53	Hospital	SPRP Hospital	38	541198.190	2625716.350	2973	43210	152
266653	DCC	DCC		Ward No-53	Hospital	Manawara Hospital	20	541820.500	2625669.150	3122	43210	152
266653	DCC	DCC		Ward No-53	Other facilities	Keshwer & Nursing Home	10	542184.800	2625467.730	2976	43240	152
266654	DCC	DCC		Ward No-54	Clinic	Rajdhani Clinic	20	541964.800	2626133.970	3123	43220	152
266654	DCC	DCC		Ward No-54	Health centre	Govt. Outdoor Dispensary		541876.250	2626673.960	3125	43230	152
266654	DCC	DCC		Ward No-54	Hospital	Medistone Hospital	7	541713.160	2626319.840	3124	43210	152
266656	DCC	DCC		Ward No-56	Hospital	Govt. Hospital		541771.940	2624147.070	3279	43210	153
266656	DCC	DCC		Ward No-56	Hospital	Dhaka Medical College Hospital	###	540854.610	2623615.950	3533	43210	153
266657	DCC	DCC		Ward No-57	Health centre	Ibrahim Memorial Diabetics Centre	282	540691.940	2625070.240	3116	43230	152
266657	DCC	DCC		Ward No-57	Hospital	International Hospital		540423.760	2625861.290	3131	43210	152
266657	DCC	DCC		Ward No-57	Hospital	D.U. Hospital		540820.690	2623917.740	3408	43210	153
266657	DCC	DCC		Ward No-57	Other facilities	Bangabandhu Sheikh Mujub Medical University Outdoo (BSMMU)		540400.990	2625059.820	3128	43240	152
262858	DCC	DCC		Ward No-58	Hospital	Hospital		538296.870	2623750.390	1911	43210	133
264260	DCC	DCC		Ward No-60	Hospital	Hospital		539454.450	2622544.220	1809	43210	133
264066	DCC	DCC		Ward No-66	Hospital	Salimullah Medical College & Hospital, Mitford	600	541218.240	2622025.030	3406	43210	153
264066	DCC	DCC		Ward No-66	Other facilities	Arafat Medical Pvt. Ltd.	30	541184.440	2622124.770	3404	43240	153
264067	DCC	DCC		Ward No-67	Clinic	New Dhaka Clinic	20	541194.280	2622252.870	3405	43220	153
264068	DCC	DCC		Ward No-68	Hospital	Dhaka Mahanagar General Hospital		541572.290	2622337.170	3403	43210	153
264070	DCC	DCC		Ward No-70	Hospital	Central University Hospital		541413.460	2623333.770	3402	43210	153
264070	DCC	DCC		Ward No-70	Hospital	Hospital		541576.410	2623330.140	3233	43210	153

ADMIN_CODE	DISTRICT	POURASHAVA	UNION	WARD	TYPE2	NAME	BED NO.	X_Coordinate	Y_Coordinate	PUBLICF_ID	GF_CODE	MAP_NO
264071	DCC	DCC		Ward No-71	Health centre	Nazira Bazar Maternity Centre		541807.760	2622779.050	3401	43230	153
264073	DCC	DCC		Ward No-73	Hospital			542076.880	2621646.950	3582	43210	154
268875	DCC	DCC		Ward No-75	Hospital	Bangladesh Homeopathic Medica College & Hospital	50	542758.690	2623216.510	4680	43210	173
268875	DCC	DCC		Ward No-75	Hospital	NTRS Hospital		543526.920	2622920.160	4677	43210	173
268878	DCC	DCC		Ward No-78	Hospital			542331.110	2621979.990	3583	43210	154
268881	DCC	DCC		Ward No-81	Health centre	Outdoor Dispensary		543329.690	2621628.570	4887	43230	174
267683	DCC	DCC		Ward No-83	Hospital	Dist. Veterinary Office & Hospital		543524.700	2620054.560	4886	43210	174
267683	DCC	DCC		Ward No-83	Hospital	Sobhan Nursing Home General Hospital	10	544392.650	2619795.490	4891	43210	174
261284	DCC	DCC		Ward No-84	Hospital	Family Hospital (TPS)		543828.940	2622161.460	4676	43210	173
261285	DCC	DCC		Ward No-85	Health centre	Family Health Centre		544283.870	2622870.580	4543	43230	173
261286	DCC	DCC		Ward No-86	Hospital	Supreme Medical Service		544318.350	2621843.250	4786	43210	174
261286	DCC	DCC		Ward No-86	Hospital	Khan General Hospital		544674.580	2621768.530	4890	43210	174
261286	DCC	DCC		Ward No-86	Hospital	Afroza Nursing Home & General Hospital		544571.930	2621574.850	4889	43210	174
269538	DCC	Uttara Thana	Uttar Khan		Health centre	Taslim Medical Centre	10	542040.370	2638288.830	2442	43230	148
261265	DCC	Demra Thana	Demra (Part)		Hospital	Medi Health General Hospital		547289.020	2622578.730	5128	43210	193
261265	DCC	Demra Thana	Demra (Part)		Hospital	Arimo General Hospital	10	546777.440	2622412.610	5120	43210	193
262600	DCC	Gulshan Thana	Gulshan		Hospital	Hospital		548003.250	2631703.010	5355	43210	210
266865	DCC	Sabuhbagh Thana	Demra (Part)		Hospital	Community Care Hospital		545898.170	2625794.930	5083	43210	192
267600	DCC Thana	Shyampur Thana	Shyampur		Hospital	Hospital (Institute of Child & Mothers Health)		547815.190	2620139.230	5509	43210	214
269576	DCC	Uttara Thana	Dakshinkhan (Part)		Hospital	Hospital (Pvt)		539205.690	2641904.500	1087	43210	127
269538	DCC	Uttara Thana	Uttar Khan		Hospital	Govt. Hospital & Dispensary		544346.120	2640195.190	3835	43210	167
269538	DCC	Uttara Thana	Uttar Khan		Hospital	Hospital		544473.500	2640180.270	3809	43210	167
269538	DCC	Uttara Thana	Uttar Khan		Other facilities	Urban Primary Health U.T.P.S		542176.760	2640197.820	2259	43240	147

3.8 Public Involvement

This section aims to analyze the existing situations on how much people are involved in solid waste management. Therefore, people's awareness and the situations of public involvement in solid waste management, and education and enlightenment that are tools for public involvement are discussed as follows:

(1) People's Awareness

Household Awareness Survey was conducted by the Study Team in February 2004. The survey was composed of Household Questionnaire Survey (340 samples) and Focus Group Discussion (Ward 19: Gulshan, Ward 23: Khilgaon, Ward 61: Lalbag, Ward 84: Saidabad/Jatraban).

a) Findings from the Household Survey

The following are the findings from the household questionnaire survey of upper to lower class households in Dhaka City, excluding slum areas.

Waste Discharge and Primary Collection

- Servants/maids are in charge of waste disposal in 96% of upper class households and in 79% of middle class households, while in 95% of lower class 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 are serviced.
- 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.
- Of the households who receive door-to-door collection services, 80% in newer urban areas are serviced by local organizations/organized communities, and 14% by private companies. In older urban areas, 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.

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 are ranging from Tk. 11 to more than Tk. 100 per month. Of the households paying collection charges, 77% of middle class households pay Tk. 11 to Tk. 20 monthly and 82% of lower class households pay Tk. 1 to Tk. 10.

DCC Services

- Of the household heads respondents, 21% of them 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 newer urban areas mentioned that street sweeping is not provided in their areas.

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.
- 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.

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) Communities and Participation in Solid Waste Management

a) General Feature of “Community” in Dhaka

In Dhaka City, “community” consciousness is very low in general. There are almost no area-based organized communities with strong sense of belonging to certain unit of

residents in certain area. Boundaries of "community" are vague and usually difficult to be identified.

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 keeping strong links with their home villages and relatives. They still identify the village/township of origin to be their real home.[1]

b) Informal Community

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

c) Formal Community

On the other hand, there are various civil organizations known as Community-Based Organizations (CBOs) working in local areas for specific purposes. 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.[2] 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's initiatives. In the solid waste management sector, many related organizations/government institutions use the word "participation" as meaning that people understand and support the activities of them. 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 providing door-to-door collection services, and pay a certain amount of collection charge.

[1,3] Overcoming the Governance Crisis in Dhaka City, Kamal Siddiqui, Jamshed Ahmed, Abdul Awa, Mustaque Ahmed.
[2] The Role of Civil Society Organizations in Urban Development in Dhaka City, Nazrul Islam, Zeenat Mahjabeen, Oriental Geographer Vol.47: No.2: July 2003.

e) Attitude of People as Individual

On the other hand, from the viewpoint of the people, most of the respondents from upper to lower class are not participating in any community activities at present, according to the Household Questionnaire Survey. And 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 answers to the questions regarding willingness to participate in specific activities in solid waste management, i.e. segregation, recycling and composting, though 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 (see Figure 3.8-1)

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 age 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.

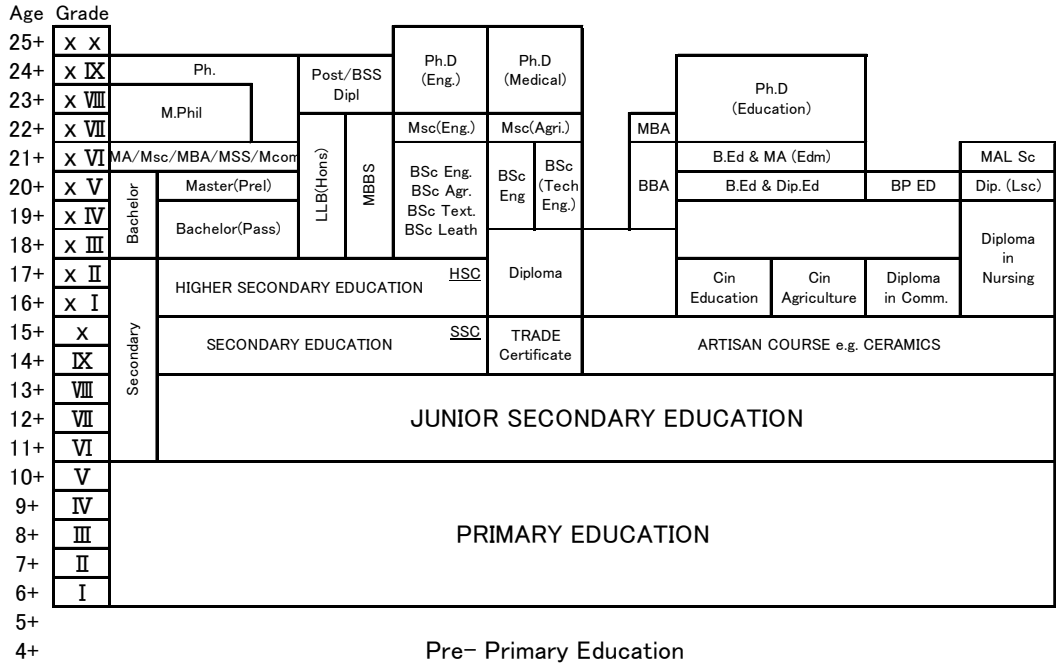


Figure 3.8-1 Education Structure in Bangladesh

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. Number of schools, teachers, students and ratio of girl student is show in Table 3.8-1. 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.

Table 3.8-1 Structure of Primary and Secondary (Grades 6-10) Education in Bangladesh, 1997

	Number of Schools	Teachers	Students	Girl Students
Primary School (grades 1-5)	76,809	309,341	17,667,985	48.9
Secondary School (grades 6-10)	18,573	215,500	6,964,400	50.1

Source: Directorate of Primary Education, World Bank

c) Literacy

Illiteracy indicators in 1997 for Bangladesh, shown in Table 3.8-2, are taken from the World Bank Regional Education Database for South Asia Countries. Average of adult illiteracy for over 15 years old is 61%. Among female population the illiteracy rate is higher than the male—about 1.44 times higher. Among all the age groups more than half are illiterate, so it is very important and necessary to consider the illiterate persons when posters or textbooks are made.

Table 3.8-2 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

c) Policy of Environmental Education

Environmental education is not mentioned in the National Education Policy "NEP2000" of Bangladesh and in the action plan. Related government institutions and NGO are carrying out Environmental Education based on projects, which are supported by donors. It seems that Environmental Education in Bangladesh depends mostly on donors' support because of the financial constraints. Due to lack of coordination between government and NGOs, it is found that same types of activities are repeated in the programs. More often activities such as teachers training, and seminars are found to be duplicated.

e) Curriculum of Environmental Education for Grades 1-10

Environmental Education is included in Science and Social Science. Unit of Curriculum for Grades 1 – 10 is shown in Table 3.8-3. Most of primary schools operate in two shifts and there are seven classes in a shift. The duration of unit is 30 minutes. The teacher teaches not specific subject alone. 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.

Table 3.8-3 Distribution of Classes in a Week

Subject/Grade	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Bengali	6	6	6	4	4	4	4	4	4	4
English	6	6	6	6	6	5	6	6	5	5
Mathematics	6	6	6	6	6	6	6	6	6	6
Science	0	0	6	6	6	6	4	0	0	0
Social Science	0	0	5	5	5	4	4	4	0	0
Religion/General Knowledge	6	6	6	6	6	4	4	3	3	3
Physical Course	0	0	0	0	0	2	2	2	0	0
Physics	0	0	0	0	0	0	0	0	3	3
Chemistry	0	0	0	0	0	0	0	0	3	3
Higher Mathematics	0	0	0	0	0	0	0	0	2	2
Biology	0	0	0	0	0	0	0	0	3	3
Geography	0	0	0	0	0	0	0	0	3	3
History	0	0	0	0	0	0	0	0	2	2
Economics	0	0	0	0	0	0	0	0	2	2
Introduction to Business	0	0	0	0	0	0	0	0	3	3
Bookkeeping	0	0	0	0	0	0	0	0	3	3
Business Initiative	0	0	0	0	0	0	0	0	3	3

Source: School Master (Teacher) of High School

f) Education on Solid Waste

The textbooks for Science and Social Science describe solid waste above third grade. The connection between environmental pollution, infectious diseases and unmanaged solid waste is taught to pupils. A description regarding solid waste is given 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 pose health risks.
- 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 foods makes the road dirty. Using roadsides to store construction materials is a health hazard as well.

Environmental pollution is one of the most serious 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
- Cleanliness of the house: House should be cleaned twice a day.
- Dump the waste in proper place
- Not only house should be clean, areas surrounding the house should also be clean

Grade Three (Science) Introduction to Environment:

Chapter 1-Our Environment

- Taking a bath in the ponds, dumping waste in the ponds, rivers can pollute the waters of ponds and rivers
- Dumped waste beside dustbins can produce bad odor. Also, burning of dumped waste 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 class. There should be a paper-waste basket in the corner to put the waste materials
- Maintain proper sanitation

(4) Informal Environmental Education

Informal environmental education for people is carried out in many sectors. In the health sector, environmental education is introduced for hygiene education and infectious disease control. On the other hand, DCC does not have a division and/or section for informal environmental education, and does not issue informal education materials.

Informal education in environmental and solid waste management programs is available. These programs are implemented by government institutions and NGOs. However, DCC has never carried out informal education regarding environment and solid waste.

(5) Enlightenment

a) DCC Policy for Enlightenment

There is no policy for enlightenment programs within the DDC or at the national level. No institution or organization has been assigned to conduct enlightenment programs relating to environmental protection and solid waste management. Therefore, institutions and organizations are conducting such programs individually using the mass media and materials for creation of enlightenment regarding solid waste management and environmental protection according to the needs of people and communities within a given time frame.

b) Enlightenment Tools by Media

Newspaper

In Bangladesh, at present, there are 17 newspaper companies including 6 that publish newspapers in English and distribute them. The quantity published and distributed is not known for all publishing. The interview with a Bengali newspaper company provided some figures of distribution as follows.

- Daily Janakantha 300,000 (in Dhaka alone 160,000, hereinafter in bracket)
- Daily Prothom Alo 242,000 (100,000)
- Daily Jugantor 320,000 (130,000)
- Observer 18,000 (10,000)
- New Nation 21,000 (5,000)

Table 3.8-4 shows list of newspapers in Bangladesh. Total number of publication is about 3,000,000 and about 1,500,000 are published in Dhaka.

In comparison to other newspapers, three companies, Daily Prothom Alo, Daily Jugantor and Observer, publish articles regarding environment and solid waste. They

give good coverage on several events on solid waste and environment and government-related matters on environmental protection in their newspapers.

Table 3.8-4 Profile of Newspapers in Bangladesh

Name	Year Established	Service area	Readership	Price (taka)	Major coverage (Environment, SWM)
Daily Prothom Alo	1998	Countrywide	242,000 (100,000-Dhaka)	8	5% Env., Politics, Business, Int. affairs, Sports, Editorial
Daily Janakantha	1991	Countrywide	300,000 (160,000-Dhaka)	8	Politics, Business, Sports, Current Affairs, Editorial
Daily Ittefaq	1953	Countrywide	150,000 (80,000-Dhaka)	8	Politics, Business, Sports, Current Affairs, Editorial
Daily Jugantor	2000	Countrywide	320,000 (130,000-Dhaka)	8	10-15% Env. Includes health, sanitation etc, Economy, Sports, Current affairs
Daily Manob Jamin	1998	Countrywide	70,760 (40,000-Dhaka)	8	Tabloid, with the same contents of other newspapers
Observer (E)	2003	Countrywide	18000 (10,000-Dhaka)	8	Current events, Education, Int. news, Sports, Editorial
New Nation (E)	1981	Countrywide	21,000 (5,000-Dhaka)	7	N.A
New Age (E)	2003	Countrywide	18,000 (10,000-Dhaka)	8	Regular events, Metro, Business, Sports
Financial Express (E)	1993	Countrywide	25,000 (15,000-Dhaka)	7	Politics, Business, Education,
Daily Inqilab	N.A	Countrywide	N.A	N.A	N.A
Daily Bhorer Kagoj	N.A	Countrywide	N.A	N.A	N.A
Daily Ajker Kagoj	N.A	Countrywide	N.A	N.A	N.A
Daily Dinkal	N.A	Countrywide	N.A	N.A	N.A
Daily Sangram	N.A	Countrywide	N.A	N.A	N.A
Daily Sangbad	N.A	Countrywide	N.A	N.A	N.A
The Daily Star (E)	N.A	Countrywide	N.A	N.A	N.A
Independent (E)	N.A	Countrywide	N.A	N.A	N.A

Source: JICA Study Team hearing report; (E): English, (N.A) Not available

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 broadcast regular programming and no satellite antenna is required. Table 3.8-5 shows the list of TV broadcasting companies and their statistical data.

Table 3.8-5 TV Broadcasting Companies in Bangladesh

Name	Year Establish	Service area	Viewership	Service hour	Owner ship Status	Major programming
BTV	1964	Nationwide incl. remote areas	N.A	15.00-24.00	Govt.	Education, Agriculture, Some environment, drama etc.
Channel-I	1990	Satellite (Nationwide and International)	60% of the cable subscribers	24	Private	Religious, Talk Show, News, Drama, Wild Life,
ATN Bangla		Satellite (Nationwide and International)	N.A	24	Private	Religious, Talk Show, News, Drama,
NTV	2003	Satellite & Surface (Nationwide and International)	N.A	24	Private	Agriculture, Talk Show, News, Business, Talent Show, Drama
BTV World	2004	Satellite (Nationwide and International)	N.A	24	Govt.	Same as BTV

Source：JICA Study Team hearing report

Radio

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

b) Methods and Materials for Enlightenment Programs and Promotional Activities

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

At present, the print media such as newspapers is not effective to communicate to the poor people because of the 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 promotional activities and environmental enlightenment programs broadcasted in local governmental TV channels. In urban areas, TV is more effective medium than Radio.

c) Enlightenment by related Organizations

Dhaka City Corporation

In DCC, communication with the city population 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 enlightenment activity regarding solid waste and environmental conservation within DCC. DCC does not maintain any communication or coordination between NGOs and other relevant agencies for environmental programs and enlightenment activity. On the other hand, the Conservancy Department announces and publishes notice to city populations for clean-up campaign regarding solid waste management. In 2004, the Conservancy Department distributed 100,000 pieces of stickers to ward commissioner offices, mosques and many other public places.

NGOs

Examples of enlightenment program implemented by NGOs are those found in SEMP and the slum environmental improvement funded by UNICEF. These activities are described in the next section.

3.9 Institutional Aspect

3.9.1 Result of Survey on Current Responsibility Allocation within DCC

The results of the survey on current are listed in Table 3.9-1. The results are summarised as Table 2.1.9-1 in Chapter 2.1.9 of the Main Report.

3.9.2 Proposals for Waste Management Committee and Waste Management Division

Original proposal, which was submitted to Chief Executive Officer (CEO) of Dhaka City Corporation on April 2, 2004, and modified proposal upon the request of DCC, which was also submitted to the CEO on December 22, 2004 are attached.

Table 3.9-1 Required Administrative Activities and Current Implementing Organisations for Solid Waste Management

Activities	*Implementing Organisation*
A. Generation	
1. Estimation of Current Generation	None
2. Projection of Future Generation	None
3. Promotion of Waste Reduction	None
B. Waste Handling at the Source	
1. Control of Waste Carriage to Dust-bins/Containers	None
2. Control of Transport/Disposal by Generators (Large Scale Generator)	None
C. Primary Collection (Door-to-door)	
1. Awareness Campaign to Residents	(Conservancy Dept. starting) (NGO/CBO)
2. Promotion of NGO/CBO Activities	(Conservancy Dept., starting, previously planned by Urban Planning Dept.)
D. Storage at Dust-bins/Containers	
1. Installation of Dust-bins/Containers	
1) Determination of Location	Commissioners, Conservancy Dept. → Mayor
2) Design of Dust-bins	No more new ones
3) Design of Containers	Conservancy Dept. → Mechanical Div.-1 of Engineering Dept.
4) Construction of Dust-bins	No more new ones
5) Manufacturing of Containers	Mechanical Div.-1 of Engineering Dept.
6) Installation Works	Transport Dep.
2. Repair and Replace of Containers	Conservancy Dept. → Transport Dept. → Mechanical Div.-1 of Engineering Dept. →Transport Dept.
3. Repair of Dust-bins	No more Repair
E. Cleaning	
1. Campaign not to Scatter Wastes	(Conservancy Dept.)
2. Legal Actions to Prevent Illegal Dumping or Throwing	None
3. Employment and Deployment of Cleaners	Ward Commissioner, Conservancy Dept.→ Mayor → Establish Dept. → Conservancy Dept.
4. Procurement of Brooms, Baskets and Hand Barrows, hoes, etc.	Conservancy Dept. → Store & Purchase Dept. → Conservancy Dept.
5. Cleaning Works	Conservancy Dept. (Cleaners)
6. Carriage of Road and Drain Waste to Dust-bins/Containers	Conservancy Dept. (Cleaners)
7. Conservancy Inspection (Cleanliness and Works of Cleaners)	Conservancy Dept. (Conservancy Inspectors) → Commissioners
8. Outsourcing of Cleaning Services	
1) Policy Formulation/Planning	Urban Planning Dep. → Mayor
2) Tendering and Contracting	Urban Planning Dept. → Tender Evaluation Committee → Mayor → Urban Planning Dept.
3) Performance Monitoring	Conservancy Dept. → Urban Planning Dept.

Activities	*Implementing Organisation*
F. Secondary Collection and Transport (From Dust-bins/Containers to Disposal Sites)	
1. Plan of Deployment of Conservancy Drivers/Vehicle	Conservancy Dept., Ward Commissioner →Mayor
2. Employment of Drivers	Mayor → Establishment Dept. → Transport Dept. (temporally shifted to Conservancy Dept.)
3. Procurement of Conservancy Vehicles	Mayor → Engineering Dept. → Tendering Committee → Mayor →Engineering Dept. → Transport Dept.
4. Driving Conservancy Vehicle	Transport Dept. (Drivers) (temporally shifted to Conservancy Dept.)
5. Supervising and Monitoring of Drivers	Transport Dept. (Transport Manager) (temporally shifted to Conservancy Dept.)
6. Procurement of Fuel/Lubricant of Transportation Vehicles	Transport Dept. (Transport Manager) (temporally shifted to Conservancy Dept.)
7. Deployment of Truck Cleaners	Conservancy Dept.
8. Procurement of Hoes/Folks/Scoops/ Baskets for Truck Cleaners	Conservancy Dept. → Store & Purchase Dept.
9. Loading and Unloading of Waste to and from Truck	Conservancy Dept. (Truck Cleaners)
10.Construction and Maintenance of Garages (Conservancy Pool)	
1) Determination of Location	Engineering Dept./Transport Dept. → Mayor
2) Design	Engineering Dep. (Civil)
3) Land Acquisition	Estate Dept.
4) Construction	Engineering Dept. (Civil) → Tender Evaluation Committee → Mayor → Engineering Dept.
5) Maintenance/Repair of Garages	Transport Dept. (Transport Manager) (temporally shifted to Conservancy Dept.)
11.Inspection/washing/pooling of Transportation Vehicles	Transport Dept. (Transport Manager) (temporally shifted to Conservancy Dept.)
12.Supervising and Monitoring of Drivers	Transport Dept. (Transport Manager) (temporally shifted to Conservancy Dept.)
13.Repair of Conservancy Vehicles	
1) Construction and Maintenance of Workshops	
a) Determination of Location	Engineering Dept. → Mayor
b) Design	Engineering Dept. (Civil)
c) Land Acquisition	Estate Dept.
d) Construction	Engineering Dept. (Civil) → Tender Evaluation Committee → Mayor → Engineering Dept.
e) Maintenance/Repair of Workshops	Engineering Dept. (Mech.)
2) Procurement of Spare Parts	
a) Planning	Mechanical Div.-1 of Engineering Dept. → Store & Purchase Dept.
b) Purchase	Mechanical Div.-1 of Engineering Dept. → Store & Purchase Dept.
c) Store	Store & Purchase Dept. →Mechanical Div.-1 of Engineering Dept.
3) Repair Works	Transport Dept. → Mechanical Div.-1 of Engineering Dept. →Transport Dept.
4) Outsourcing of Repair Works	
a) Preparation	Mechanical Div.-1 of Engineering Dept.
b) Tendering Contracting	Mechanical Div.-1 of Engineering Dept.
c) Inspection	Mechanical Div.-1 of Engineering Dept.

Activities	*Implementing Organisation*
14.Outsourcing of Secondary Collection and Transport Services	
1) Policy Formulation/Planning	Urban Planning Dep.
2) Tendering and Contracting	Conservancy Dept. (previously by Urban Planning Dept.)
3) Performance Monitoring	Conservancy Dept.
(Transfer)	
(* Ward Transfer Stations)	(start planning by Conservancy Dept.)
G. Disposal	
1. Construction of Disposal Site	
1) Determination of Location	(Conservancy Dept./Transport Dept.)
2) Design	Engineering Dept. (Civil)
3) Environmental Clearance	None
4) Land Acquisition	Estate Dept.
5) Construction	Engineering Dept. (Civil) → Tender Evaluation Committee → Mayor → Engineering Dept.
2. Procurement of Heavy Equipment	
1) Planning	Mechanical Div.-2 of Engineering Dept.
2) Tendering and Procurement	Engineering Dept. (Mechanical Div.-2 → Chief Engineer) → Procurement Committee Mayor → Engineering Dept.
3. Repair of Heavy Equipment	Mechanical Div.-2 of Engineering Dept.
4. Outsourcing Repair Works	Engineering Dept. (Mechanical Div.-2 → Chief Engineer) → Procurement Committee Mayor → Engineering Dept.
5. Recording Incoming Waste (Trucks)	(Conservancy Dept.)
6. Control of Dumping Place	Mechanical Div.-2 of Engineering Dept. (Supervisor)
7. Dressing and Compaction	Mechanical Div.-2 of Engineering Dept. (Operator)
8. Soil Cover	None
9. Leachate Control	None
10.Gas Collection	None
H. Recycling	
* Promotion of Recycling by Coordination with Primary and Secondary Collection, Transport and Disposal Activities	None

(Note: Responsibility allocation varies depending on sources of information)

(Original Proposal)

A Proposal On Institutional Strengthening Of the Solid Waste Management Cell Of Dhaka City Corporation

1. Introduction

(1) Background

The Dhaka City is facing a rapid population growth. According to the preliminary data of 2001 population census conducted by Bangladesh Bureau of Statistics, the population in the jurisdiction of DCC has reached over five million. Although the rate of population growth has been calmed down recently, the growth will continue more rapidly compared to other mega-cities of the world.

Unit generation of waste grows corresponding to the economic development. Waste generation per capita normally increases by increment of consumption. Although reliable information on historical change in unit waste generation has yet to be obtained, long-term observation shows increase of household waste and market waste per capita. The volume of waste will swell according to the population increase multiplied by the increase of unit generation.

The composition of waste varies according economic development and subsequent change in lifestyle accompanied with mass consumption and spreads of various types of commodities.

Environmental concern of residents has become stronger and stronger. Higher demands for environmentally friendly solid waste management are envisaged. Needs for improvement of conditions of dust-bins/containers, transportation and disposal of waste are growing.

(2) Necessity of Systematic and Scientific Approach

The changes in quantity and quality of waste may give large impacts on solid waste management. Despite the importance of information on current and future waste quantity and quality, reliable data and information are rarely available.

Costs for solid waste management may be raising corresponding to the increase of waste volume and heightened environmental concern of residents as well as other factors of rapid urbanisation, such as severe traffic congestion. Information of actual costs, however, has yet to be compiled.

To cope with increasing and varying waste and stronger environmental consciousness with limited resources, it is necessary for DCC to apply systematic and scientific approach, which consists of cycles of planning – implementation – monitoring and evaluation – feed back – planning, and which will allow optimal resource allocation and efficient operation of solid waste management.

The integrated solid waste management is composed of (i) Reduction and control of waste generation, (ii) Collection, (iii) Transportation, (iv) Waste treatment and (v) Disposal. With the systematic and scientific approach, quantity and quality of waste flow are numerically analysed, and component plans are to be formulated and implemented with optimal resource allocation among the components of solid waste management.

(3) Status of Activities for Solid Waste Management

At present Conservancy Department takes main roles in solid waste management. The Department has around 7,500 cleaners for cleaning of public streets, drains and other public places. Transport Department operates conservancy trucks and transport solid waste from public dust-bins/containers to dumping sites. Mechanical Divisions of Engineering Department repairs conservancy trucks and heavy equipment used in dumping sites. Store and Purchase Department and Revenue Depart discharge supportive roles by procuring cleaning appliances and collecting conservancy tax respectively, as parts of their duties.

Non-governmental organisations (NGOs) and community-based organisations (CBOs) have started to take important roles in solid waste management of the city. Since DCC is only responsible of waste of public places, transportation from dust-bins/containers and disposal according to the legislation, the roles of NGOs/CBOs are important for effective and efficient solid waste management. With this understanding, DCC, specifically the Conservancy Department, has started to support and regulate activities of NGOs/CBOs. Their activities, however, remained pilot bases at present.

With recognition of necessity for improvement of solid waste management, DCC requested, through the Government of Bangladesh, to the Government of Japan for a master plan study.

In parallel with the request, DCC has established Solid Waste Management Cell under Chief Conservancy Officer for the better management by the Order No. 329 of the Mayor in August 2003, emphasising coordination among departments involved in solid waste management. The Cell is composed of a coordinator and representatives of the relevant departments of DCC involved in solid waste management.

2. Necessity of Institutional Strengthening of DCC for Solid Waste Management

(1) Required Overall Strengthening

A Study Team, comprised of JICA Study Team with Counter Personnel Unit of DCC, has started a master study since December 2003. At the initial phase (Phase-1), the Team found the necessity for organisation strengthening in the following two aspects

(a) Improvement of Operative Functions

(b) Organisation Strengthening for Integrated Solid Waste Management

(a) Improvement of Operative Functions

Before the formulation of detail organisation strengthening plans for functional divisions, however, it is necessary to further analyse the current deficiencies as well as to study for improvement plans for respective divisions by relevant task forces in the Study Team. As soon as outlines of the improvement plans of respective divisions are determined, **a proposal for organisational strengthening for over all waste management and environment will be submitted separately from this proposal.**

Social Mobilisation

Although the Conservancy Department has started regulation and promotion of activities by NGOs/CBOs, as well as the private sector, the current organisation and staffing of the department do not allow systematic control of the activities, including those for recycling/re-use.

Vehicle Management

Currently, responsibilities for operation and repair works of conservancy trucks are separated to two departments. The separation appears to cause long time procedures and result in un-synchronised vehicle operation and maintenance. Responsibility for efficient use of trucks is not clearly attached to one manager.

Solid Waste Disposal

Three departments in DCC are involved in disposal of solid waste. Staffs belonging to Conservancy Department keep records of incomings trucks at a disposal site, the data on which seem not to be followed up by anyone. Mechanical Division-2 of Engineering Department operates and maintains the heavy equipment used in dumping sites, while Civil Engineering Circles of Engineering Department prepared civil works at respective dumping sites. No systematic selection of the sites to where waste is to be transported. Responsibilities for selection of future dumping sites as well as for adequate dressing and compaction works at existing dumping sites seem not to be clearly defined.

(b) Organisation Strengthening for Integrated Solid Waste Management

Despite establishment of the Solid Waste Management Cell, no full-time staffs were assigned and responsibilities for coordination were added to members of the Cell who have continuously to have existing duties and responsibilities without any incentive to discharge additional ones. The Cell does not have any budget to carry out the duties. Due to low levels of positions of the representatives, the Cell cannot take coordinating and deliberative functions.

(2) Long Term Restructuring Plan

In order to implement integrated solid waste management as a responsible organisation, organisation structure of DCC for solid waste management are to be reformed. There may be necessary to form a single department in charge of and responsible for solid waste management to achieve the integrated and efficient management. Since Conservancy Department takes and is going further to take core roles of solid waste management, merging functions/divisions into the department would be a probable alternative at the moment. After including major functions/divisions the name of the department could be "Waste Management Department".

It would be necessary, however, to further discuss merits and demerits for merging required functions into one department. Long term restructuring plan will be formulated and recommended as an output of the Master Plan Study.

(3) Immediate Reform

For organisation strengthening for integrated solid waste management, immediate actions are required before the start of the next fiscal year. A coordinating/ deliberative body should be organised (Waste Management Committee) with competent representatives from important stakeholders. To realise effective functioning of the coordinating/deliberative body, permanent staff organisation (Waste Management Division) with full-time personnel and budget allocation would be essential.

3. Functions of Waste Management Committee and Waste Management Division (WMD)

(1) The Waste Management Committee (WM Committee)

As far as main duties/responsibilities for solid waste management scatter in different departments, some inter-departmental bodies should be organised for coordinated management. A committee, named Waste Management Committee, composed of heads of related departments are to be formed with chairmanship of Chief Executive Officer (CEO). The member can also includes those from relevant divisions of the Central Government, NGOs/CBOs, the private sector as well as professional or academic institutes.

The committee are responsible for approval and recommendation to the Mayor of drafts and proposal prepared by its staff organisation, i.e., Waste Management Division.

Technical Working Group for the Master Plan Study may be the base for the permanent committee with some modifications, if necessary.

Even after the establishment of Waste Management Division or merging major functions into a department, the committee should continue its functions because the Division/Department alone cannot carry out all responsibilities/duties required for integrated waste management.

(2) Required Functions of Waste Management Division.

2.0 Waste Management Division (WMD) will be responsible to Waste Management Committee as a secretarial office. In case, application for external resources is envisaged for implementation of future projects/programs to be proposed in the Master Plan, **WMD should render one stop service to the external donor agency on behalf of the DCC** for preparation of the projects/programs and also for its implementation

The major functions of WMD are:

2.1 Co-ordination among the Departments of DCC, Government organs, and other organizations.

2.2 Identification of strategic issues on Waste Management & environment.

2.3 Collection, analysis, research/Assessment of data/information on Waste Management and environmental issues.

2.4 Formulation of handling rules/guidelines for Waste Management.

2.5 Formulation of handling rules/guidelines for optimum utilization of existing and future physical acquired resources on Waste Management.

2.6 Human Resources Development for Waste Management and Environmental issues.

2.7 Overall planning, programming, implementation, monitoring & evaluation of infrastructures/projects/facilities on Waste Management and environment.

2.8 Planning, selection, acquisition and implementation of new technology and management for Waste Management and environmental issues.

2.9 Selection & acquirement of vehicles, equipments, machinery etc for Waste Management and environmental activities.

2.10 Planning, selection, development, operation & management of landfills including conservancy equipments.

2.11 Annual operation plan of Waste Management.

2.12 Compilation and adjustment of Waste Management Budget.

2.13 Preparation of financial baseline for Waste Management.

2.14 Feasibility studies for projects on Waste Management & environment.

2.15 Formulation/review of Master Plan.

2.16 Preparation of guidelines and implementation on improvement of drainage for Waste Management & environmental issues.

2.17 Application of GIS for effective and efficient Waste Management.

2.18 Preparation of guidelines for involvement of CBO's & NGO's.

2.19 Preparation of guidelines for public awareness programs.

2.20 Preparation of guidelines for possible privatisation of Waste Management activities.

2.21 Preparation of guidelines for waste reduce, reuse, recycle and recovery.

2.22 Organisation Reform etc.

To achieve systematic and scientific management, control with cycle of planning – implementation – monitoring and evaluation – feed back – planning is required. For coordination to attain efficient management, resource mobilisation for implementation by operational departments is to be consolidated.

Following two groups of functions are necessary to be assigned to WMD as secretarial agency to Waste Management Committee, while operational functions are to be continuously taken by existing or strengthened division.

Planning and Programming.

* Data & Information Collection/Analysis.
* Research/Assessment, Selection of Technology and Management.
* Feasibility Studies.
* Annual Operation Plan of WM including budget preparation.
* Formulation/Review of Master Plan
* Preparation of Projects/Programs
* Operation, Monitoring & Evaluation

Implementation and Management

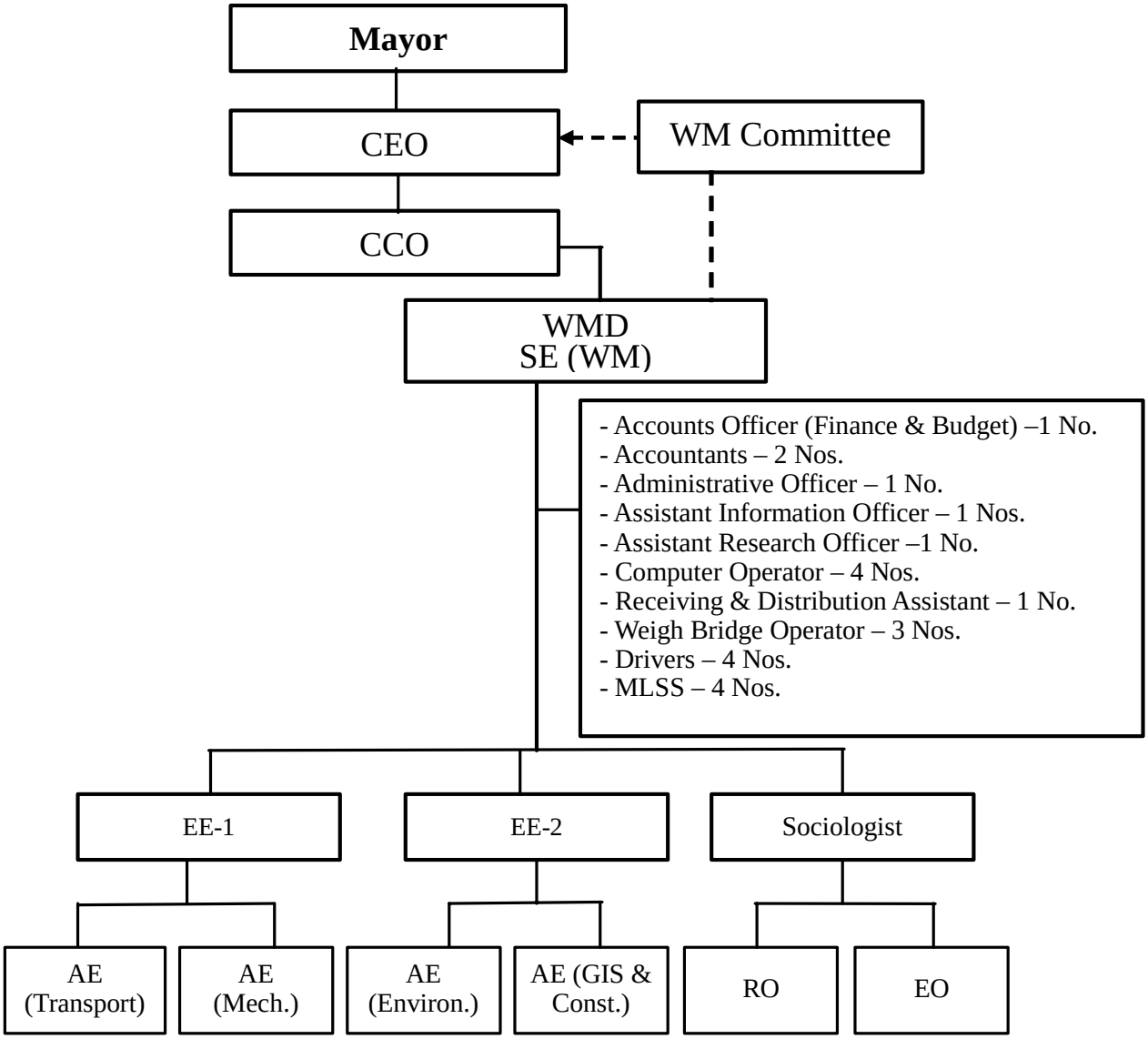
* Compilation and Adjustment of WM Budget.
* Implementation of Projects/Programs.
* Human Resource Development.
* Organisation Reform

(3) Structure of WMD

WMD is to have two sections with respective two groups of responsibilities such as (i) Planning and Programming (ii) Implementation and Management.

The Structure of the Waste Management Division is below as a graph.

Waste Management Division



Note:

1. WMD will be attached to CCO of Conservancy Department.
2. SE (WM) will be responsible to the CEO (Chairman, WM committee) through CCO.
3. Waste Management Committee (WM committee):
   (i) CEO is the chairman of WM committee.
   (ii) SE (WM) is the member secretary.

4. Functions of operating officer.

4.1 Superintending Engineer (Waste Management) SE (WM):

a. Administrative and financial operator of WMD.
b. Member-Secretary to the Waste Management Committee.
c. Preparations of plans, programs, projects and submit to the waste management committee.
d. Review of existing physical resources and submit report to the Waste Management Committee.
e. Establishment of waste management standards for application throughout the Metropolitan area/City.
f. Preparation of medium to long term plan and preparation of business plan for improvement of waste management and environmental issues.
g. The SE (WM) will be an Executive Officer of the WMD, will have to be given the authority to handle the funds on behalf of the DCC. The Executive Engineers should report to the SE (WM), who in turn should report to the Chief Executive Officer of Dhaka City Corporation through Chief Conservancy Officer.

4.2 Executive Engineer –1 (Planning and Programming)

a. Data & Information Collection/Analysis.
b. Research/Assessment, Selection of Technology and Management.
c. Feasibility Studies.
d. Annual Operation Plan of WM including budget preparation.
e. Formulation/Review of Master Plan
f. Preparation of Projects/Programs
g. Operation, Monitoring & Evaluation

4.3 Executive Engineer-2 (Implementation & Management)

a. Compilation and Adjustment of WM Budget.
b. Implementation of Projects/Programs.
c. Human Resource Development.
d. Organisation Reform.

4.4 Sociologist:

Planning, programming & implementation, evaluation for Social aspects activities of waste management and environmental issues. Preparation of guidelines for NGO's & CBO's, Programs for people's awareness and involvement of society for waste management and environmental issues.

4.5 Assistant Engineer (Transport)

Plan, programs, scheduling and operation of transports. Selection of suitable technology, Landfill management, developments of operation plans etc.

4.6 Assistant Engineer (Mechanical)

Plan, programs, scheduling and operation of mechanical equipments and appliances. Development of operation plans, selection of suitable technology and management.

4.7 Assistant Engineer (Environment)

Identifications of environmental issues & problems, implementation of plans and programs etc.

4.8 Assistant Engineer (GIS & Construction)

Application of GIS, preparation & Constructions of landfills and other infrastructure construction regarding waste management and environmental issues.

4.9 Accounts Officer (Finance & Budget).

Collection & compile of financial data & information, analysis of data & information, preparation of budget, preparation of financial guidelines, control of budget for waste management and environmental activities.

4.10 Research Officer.

Collection of information/data, research, analyses the data and information regarding waste management & environmental issues.

4.11 Evaluation Officer.

Evaluations of plans, programs on waste management and environmental issues.

4.12 Assistant Information Officer (CBO/NGO):

Data & information collection on CBO/NGO for waste management and environmental issues.

4.13 Assistant Research Officer (Recycling, Re-Use):

Research and analysis of data & information for recycling, re-use & treatment of the wastes.

4.14 Administrative Officer.

Assist the Superintending Engineer in the administrative matters.

4.15 Accountants:

Compile and preparation of financial data & information regarding waste management and environmental issues.

4.16 Weigh Bridge Operator.

Information & data entry regarding of unloading the wastes and measurement of waste at the landfills site.

5. Staffing for WMD

5.1 Salary structure and number of Staffs:

Sl. No.	Designation	No	Salary Scale
01.	Superintending Engineer (WMD)	1	Tk. 10,700-300 x 8-13,100
02.	Accounts Officer (finance & Budget)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
03	Administrative Officer	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
04.	Assistant Information Officer (CBO/NGO)	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
05.	Assistant Research Officer (Recycling)	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
06.	Accountants	2	Tk. 2,100-120 x 7-2,940 EB-125 x 11-4,315
07.	Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
08.	Receiving & Distribution Assist.	1	Tk. 1,875-90 x 7-2,505 EB-100 x 11-3,605
09.	Weigh Bridge Operator	3	Tk. 1,875-90 x 7-2,505 EB-100 x 11-3,605
10.	Drivers	4	Tk. 1,975-105 x 7-2,710 EB-110 x 11-3,920
11.	MLSS	1	Tk. 1,500-50 x 18-2,400
12.	Executive Engineer (Planning & Programming)	1	Tk. 7,200-260 x 14-10,840
13.	Assistant Engineer (Transport)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
14.	Assistant Engineer (Mechanical)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
15.	Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
16.	MLSS	1	Tk. 1,500-50 x 18-2,400
17.	Executive Engineer (Implementation & Management)	1	Tk. 7,200-260 x 14-10,840
18.	Assistant Engineer (Environment)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
19.	Assistant Engineer (GIS & Construction)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
20.	Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
21.	MLSS	1	Tk. 1,500-50 x 18-2,400
22.	Sociologist	1	Tk. 7,200-260 x 14-10,840
23.	Research Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
24.	Evaluation Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
25.	Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
26.	MLSS	1	Tk. 1,500-50 x 18-2,400

5.2 Qualification & experience of the Staffs

Qualifications and experience of the Key staffs are likely to be as follows:-

SL. No.	Designation	No. of Positions	Qualification & Experience
01.	Superintending Engineer (WM)	01	Bachelor Degree of Engineering with Master's in Business Administration from Recognized University. A minimum of 12 years work experience under local government authority. Foreign training in waste management, Training in project management, Training in project procurement management. Work experience in foreign/donor aided projects - Experience, knowledge, skills and understanding in waste management activities. - Knowledge, skills & understanding in management, financial management & economics. - Knowledge, skills & ability in selection of technology & management for waste management activities. - Knowledge, skills and ability in planning, programming, implementation, monitoring & evaluation of waste management infrastructures/activities. - Experiences & ability in Coordination among the departments, donors/foreign organizations/ international team. - Knowledge, skills & ability for preparation and control of budget for waste management activities. - Knowledge, ability & skills in preparation of financial base line for waste management activities. - Knowledge, skills & ability for preparation of guidelines for waste management. - Knowledge, skills & ability for policy formulation and implementation on waste management activities. - Experience, knowledge, skills & ability for selection of motor vehicles, equipments, machinery and materials for waste management activities. - Understanding & experience in the landfills management. - Understanding Master Plan, knowledge & experience in preparation of Master Plan, ability & skill in implementation of its components. - Preference will be give to those having knowledge, skills and experiences in repair maintenance of motor vehicles, machinery & equipments such as container boxes, trucks, bulldozers, excavator, pay loaders, tyre dozers, drain gully sweepers, desludging trucks/equipments etc related to the waste management activities.
02.	Executive Engineer-1 (Planning & Programming)	01	Bachelor Degree of Engineering from a Recognized University. Master's in Business Administration or Master's in Engineering will be given preference. A minimum of 5 years experience under local government authority. Knowledge, experience, skills in operation, maintenance & management of motor vehicles & equipments.
03.	Executive Engineer-2 (Implementation & Management)	01	Bachelor Degree of Engineering from a Recognized University. Master's in Business Administration or Master's in Engineering will be given preference. A minimum of 5 years experience under local government authority. Knowledge, experience & skills in civil construction and environmental management.
04.	Assistant Engineer (Environment)	01	Bachelor Degree of Engineering from a Recognized University. Master's of Environmental Engineering will be given preference. A minimum of 2 years experience in Waste Management.

SL. No.	Designation	No. of Positions	Qualification & Experience
05.	Assistant Engineer (GIS & Construction)	01	Bachelor Degree of Engineering from a Recognized University. Master's of Civil Engineering will be given preference. A minimum of 2 years experience in Waste Management.
06.	Assistant Engineer (Mechanical)	01	Bachelor Degree of Engineering from a Recognized University. Master's of Mechanical/industrial & Production Engineering will be given preference. A minimum of 2 years experience in Waste Management.
07.	Assistant Engineer (Transport)	01	Bachelor Degree of Engineering from a Recognized University. Master's of Metallurgy and Materials Engineering will be given preference. A minimum of 2 years experience.
08.	Research Officer	01	Bachelor of Engineering or Master's in relevant subject from Recognized University. Understanding waste management issues and work experience in waste management will be given preference.
9.	Evaluation Officer	01	Bachelor of Engineering or Master's in relevant subject from Recognized University. Understanding waste management issues and work experience in waste management will be given preference.
10.	Assistant Information Officer	01	Passed Higher Secondary Certificate with Technical Training. Work experience in waste management will be given preference. A minimum of 5 years experience in relevant field.
11.	Assistant Research Officer	01	Passed Higher Secondary Certificate with Technical Training. Work experience in waste management will be given preference. A minimum of 5 years experience in relevant field.
12.	Accounts Officer (Finance & Budget)	01	BBA (Finance/Accounts) or equivalent Degree from a Recognized University. MBA (finance/Accounts)/ CA(CC), CMA (Intermediate) will be given preference. A minimum of 3 years experiences.
13.	Accountants	02	Graduation Degree in commerce from Recognized University. Work experience in waste management will be given preference. A minimum of 3 years job experience.
14.	Computer Operator	04	Passed Higher Secondary Certificate with work experience in the Project work. A minimum of 2 years job experience.
15	Weigh Bridge Operator	03	Passed Secondary School Certificate with two years experience in the relevant field.
16	Driver	04	Read up to class Eight. Valid Driving Licence and Driving experience is essential. A minimum of 5 years job experience.
17	MLSS	04	Read up to class Eight.

5.3 Staff appointments:

DCC established a Solid Waste Management Cell by Hon'ble Mayor's order No.- 329, dated 23/08/2003 (Annxure-1). As agreed upon between DCC & JICA (Annxure-2), DCC formed a Counter Part Personnel Unit for collaborative work with JICA Study Team by Hon'ble Mayor's order no. 426 dated 08/09/2003 (Annxure-3). It is to be mentioned here that major objectives of the present Master Plan study are (i) Improvement of the performance of DCC staffs on Solid Waste Management & (ii) Technology transfer through the Counter Part Personnel Unit during the study. Solid Waste Management Cell and Counter Part Personnel Unit are headed by a Co-ordinator. In the proposal, the designation of the Co-ordinator of Solid Waste Management Cell is re-named as Superintending Engineer (Waste Management). Mr. Anwar Hossain Patwary, Executive Engineer, DUTP, DCC has been appointed as the Co-

ordinator for Solid Waste Management Cell and Counter Part Personnel Unit by Hon'ble Mayor's orders.

Mr. Patwary has sufficient academic qualifications, training, knowledge, experiences, skills and ability that demand for overall planning, programming, implementation, monitoring & evaluation of waste management activities of DCC. The team recommends for full time appointment of Mr. Anwar Hossain Patwary to the position of Superintending Engineer (Waste Management) of Waste Management Division. The other positions of the Waste Management Division should be filled up full time by the staffs deployed in the Solid Waste Management Cell and Counter Part Personnel Unit as per their qualifications, knowledge, experiences, skills and ability.

(Modified Proposal)

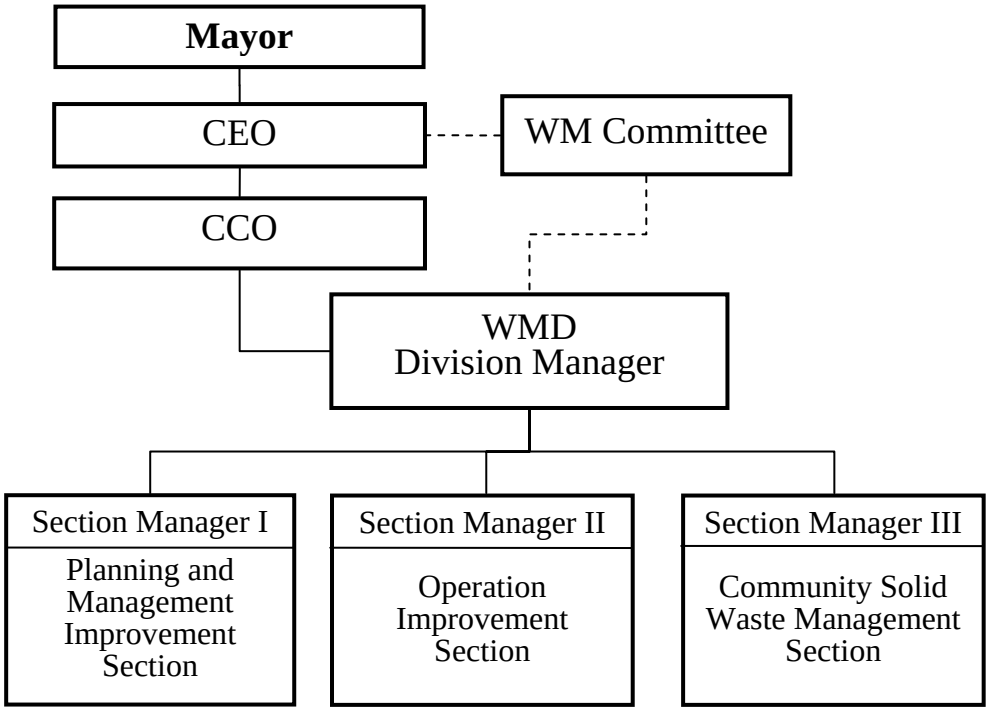
Proposal for Composition of Waste Management Division (WMD)

Regarding the "A proposal on Institutional Strengthening of the Solid Waste Management Cell of Dhaka City Corporation" (Establishment of Waste Management Division), Study Team, consisting of JICA Study Team and DCC Study Team, would like to propose some modification, because of the following reasons:

* Since the direction of the Master Plan on Solid Waste Management has been clarified and immediate needs for the improvement of the solid waste management are being identified, some functions for the Waste Management are to be modified.

* Due to some difficulty for immediate assignment of the staff composition is to be changed.

(1) Organization Structure of Waste Management Division



(2) Functions of the Sections

Planning and Programming Section

a. Data & Information Collection/Analysis
b. Research/Assessment, Selection of Suitable Technology
c. Feasibility Studies
d. Annual Operation Plan on SWM including budget preparation
e. Formulation/Review of Master Plan
f. Monitoring & Evaluation

g. Compilation and Adjustment of Annual Budget
h. Improvement in SWM Account System
i. Financing Plan
j. Improvement in Management Information System
k. Improvement in Geographical Information System
l. Improvement in Outsourcing (Privatisation) Projects/Programme
m. Human Resource Development
n. Drafting Institutional Reform

Operation Improvement Section

a. Implementation of Trial Projects
b. Working as Core Members for Short-term Improvement Projects/Programs
c. Preparation of Projects/Programs
d. Formulation of Operation Improvement Plans

regarding

1) Secondary Collection and Transport
2) Disposal

Community Solid Waste Management Section

a. Encouragement of People to Participate in SWM
b. Raising Awareness of People in SWM
c. Promotion of Partnership of DCC, Primary Collection Service Providers and Community People
d. Diffusion of Social Consideration and Participatory Approach among DCC Decision-makers and related Staff
e. Supports of Primary Collection Service
f. Supervision of Primary Collection Activities

(3) Required Staff and Jobs

Required Staff	Nos.	Job
Division Manager's Office		
Division Manager (D.M.)	1	* to administer and supervise the Division * to report to Chief Conservancy Officer * to propose and report to Waste Management Committee
Administrative Officer (Administration and Legal Matters)	1	* to assist D.M. in administrative matters * to assist D.M. in legal and documentation matters
Accountant	1	* to assist D.M. in accounting matter
Computer Operator	1	
Receiving and Distributing Assistant	1	
Lower Clerk (LDA)	1	
Driver	1	
MLSS	2	
Planning and Management Improvement Section		
Section Manager I	1	* to administer and supervise the Section * to report to the D.M.
Computer Operator	2	
Drivers	1	
MLSS	1	
Planning Officer	2	* to prepare feasibility study reports and action plans * to draft annual operation plan of DCC on solid waste management * to assist formulation of annual operation plans of the departments divisions and smaller units on solid waste management
Monitoring/ Evaluation and Co-ordination Officer	1	* to monitor and evaluate projects/programmes and activities related to solid waste management * to prepare monitoring/evaluation reports * to assist and co-ordinate to take necessary countermeasure
Human Resource Development (HDR)	1	* to prepare HRD plans and implement of HDR Programs * to prepare the drafts for organisational and legal reform programme
Account Officer (Budget, Finance and Accounting System)	1	* to compile and control solid waste management budget * to prepare action plans to improve solid waste management account system * to prepare financing plan for solid waste management
Assistant Account Offers	1	* to assist the accountant officer
MIS & GIS Officer	1	* to improve management information system * to improve geographical information system
Privatisation Officer	1	* to evaluate privatisation pilot project and other outsourcing * to propose
Operation Improvement Section		
Section Manager II	1	* to administer and supervise the Section * to report to the D.M.
Computer Operator	1	
Driver	1	
MLSS	1	
Collection Officer	1	* to improve secondary collection of solid waste
Assistant Collection Officer	1	* to assist Collection Officer
Transport Officer	1	* to improve transport

Required Staff	Nos.	Job
Assistant Transport Officer	1	* to assist Transport Officer
Landfill Officer	1	* to improve disposal
Assistant Landfill Officer	1	* to assist Landfill Officer
Weigh Bridge Operator	2	* to operate weigh bridge at disposal site
Community Solid Waste Management Section		
Section Manager III	1	* to administer and supervise the Section * to report to the D.M.
Computer Operator	1	
Driver	1	
MLSS	1	
Community Solid Waste Management Facilitator	2	* to expand and improve ward solid waste management system * to prepare plans and implement on awareness programmes * to supervise and support primary collection activities
Assistant Community Solid Waste Management Facilitator	2	* to assist Community Solid Waste Management Facilitator

(4) Salary Structure of the Staff

Required Staff	Nos.	Salary Schedule
Division Manager's Office		
Division Manager (D.M.)	1	Tk. 10,700-300 x 8-13,100
Administrative Officer (Administration and Legal Matters)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Accountant	1	Tk. 2,100-120 x 7-2,940 EB-125 x 11-4,315
Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
Receiving and Distributing Assistant	1	Tk. 1,875-90 x 7-2,505 EB-100 x 11-3,605
Lower Clerk (LDA)	1	Tk. 1,875-90 x 7-2,505 EB-100 x 11-3,605
Driver	1	Tk. 1,975-105 x 7-2,710 EB-110 x 11-3,920
MLSS	2	Tk. 1,500-50 x 18-2,400
Planning and Management Improvement Section		
Section Manager I	1	Tk. 7,200-260 x 14-10,840
Computer Operator	2	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
Drivers	1	Tk. 1,975-105 x 7-2,710 EB-110 x 11-3,920
MLSS	1	Tk. 1,500-50 x 18-2,400
Planning Officer	2	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Monitoring/ Evaluation and Co-ordination Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Human Resource Development (HDR) Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Account Officer (Budget, Finance and Accounting System)	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Assistant Account Officer	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
MIS & GIS Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Privatisation Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Operation Improvement Section		
Section Manager II	1	Tk. 7,200-260 x 14-10,840
Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
Driver	1	Tk. 1,975-105 x 7-2,710 EB-110 x 11-3,920
MLSS	1	Tk. 1,500-50 x 18-2,400
Collection Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Assistant Collection Officer	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625

Required Staff	Nos.	Salary Schedule
Transport Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Assistant Transport Officer	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
Landfill Officer	1	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Assistant Landfill Officer	1	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625
Weigh Bridge Operator	2	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
Community Solid Waste Management Section		
Section Manager III	1	Tk. 7,200-260 x 14-10,840
Computer Operator	1	Tk. 2,550-155 x 7-3,635 EB-170 x 11-5,505
Driver	1	Tk. 1,975-105 x 7-2,710 EB-110 x 11-3,920
MLSS	1	Tk. 1,500-50 x 18-2,400
Community Solid Waste Management Facilitator	2	Tk. 4,300-185 x 7-5,595 EB-195 x 11-7,740
Assistant Community Solid Waste Management Facilitator	2	Tk. 3,400-170 x 7-4,590 EB-185 x 11-6,625

(5) Qualification and Experience of the Staff

Required Staff	Nos.	Qualification and Experience
Division Manager's Office		
Division Manager (D.M.)	1	Bachelor Degree of Engineering/Natural Science/ Business Administration/ Law from recognised university is required. A minimum of 12 years work experience under relevant authority. Relevant training in waste management, project management, and procurement management is necessary. The following experience, knowledge, skills, etc., will be give preference. - Experience, knowledge, skills and understanding in waste management activities. - Knowledge, skills & understanding in management, financial management & economics. - Knowledge, skills & ability in selection of technology & management for waste management activities. - Knowledge, skills and ability in planning, programming, implementation, monitoring & evaluation of waste management infrastructures/activities. - Experiences & ability in co-ordination among the departments, donors/foreign organizations/ international team. - Knowledge, skills & ability for preparation and control of budget for waste management activities. - Knowledge, ability & skills in preparation of budget and accounting system for waste management activities. - Knowledge, skills & ability for preparation of guidelines for waste management. - Knowledge, skills & ability for policy formulation and implementation on waste management activities. - Experience, knowledge, skills & ability for selection of motor vehicles, equipments, tools and materials for waste management activities. - Understanding & experience in the landfills management.
Administrative Officer (Administration and Legal Matters)	1	Bachelor Degree of Law from a recognized University with advocate ship. Seven years or more experience under local government authority in any post will be given preference.
Planning and Management Improvement Section		
Section Manager I	1	Bachelor Degree of Engineering/Business Administration/Natural Science from a recognized university is required. A minimum of 7 years experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.

Required Staff	Nos.	Qualification and Experience
Planning Officer	2	Bachelor Degree of Engineering/Economics/Business Administration or Master Degree any other subject from a recognized university will be given preference. A minimum of 3 years (in case of Engineering/Economics/ Business Administration), 5 years (in case of other subjects) experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Monitoring/ Evaluation and Co-ordination Officer	1	Bachelor Degree of Engineering/Economics/Business Administration or Master Degree any other subject from a recognized university will be given preference. A minimum of 3 years (in case of Engineering/Economics/ Business Administration), 5 years (in case of other subjects) experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Human Resource Development (HDR) Officer	1	Bachelor Degree of Law/Economics/Business Administration or Master Degree of any other subject from a recognized university will be given preference. A minimum of 3 years (in case of Economics/ Business Administration), 5 years (in case of Master degree in other subjects), 7 years (in case of Bachelor Degree of other subjects) experience in relevant field. Knowledge, experience, skills in solid waste management is necessary.
Account Officer (Budget, Finance and Accounting System)	1	BBA (Finance/Accounts) or equivalent Degree from a recognized university. MBA (finance/Accounts), CA (CC), CMA (Intermediate) will be given preference. A minimum of 3 years experiences.
Assistant Account Officer	1	Graduation Degree in commerce from recognized university. Work experience in waste management will be given preference. A minimum of 3 years job experience.
MIS & GIS Officer	1	Master Degree of Information System from a recognized university will be given preference. A minimum of 3 years experience in relevant field.
Privatisation Officer	1	Master Degree from a Recognized University will be given preference. A minimum of 3 years experience under government authority. Knowledge, experience, skills in solid waste management is necessary.
Operation Improvement Section		
Section Manager II	1	Bachelor Degree of Engineering/Business Administration from a recognized university or Diploma in Sanitation will be given preference. A minimum of 5 years (in case of Bachelor Degree), 10 years in case of Diploma), experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Collection Officer	1	Bachelor Degree of Business Administration, Master Degree of any other subject from a recognized university or Diploma in Sanitation will be given preference. A minimum of 3 years (in case of Bachelor Degree), 7 years in case of Diploma), experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Assistant Collection Officer	1	Bachelor Degree in any subject from recognized university. Work experience in solid waste management/transportation will be given preference. A minimum of 3 years job experience.
Transport Officer	1	Bachelor Degree of Engineering /Business Administration or Master Degree of any other subject from a recognized university or Diploma in Sanitation will be given preference. A minimum of 3 years (in case of Bachelor or Master Degree), 7 years in case of (Diploma), experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Assistant Transport Officer	1	Bachelor Degree in any subject from recognized university. Work experience in solid waste management/transportation will be given preference. A minimum of 3 years job experience.
Landfill Officer	1	Diploma in Engineering from a recognized institution. Bachelor Degree of Engineering from a recognized university will be given preference. A minimum of 3 years (in case of Bachelor Degree), 5 years (in case of Diploma) experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.

Required Staff	Nos.	Qualification and Experience
Assistant Landfill Officer	1	Diploma in Engineering or equivalent subject from recognized institution. Work experience in solid waste management will be given preference. A minimum of 3 years experience in relevant field.
Weigh Bridge Operator	2	Passed Higher Secondary Certificate (HSC) with 2 years experience in the relevant field.
Community Solid Waste Management Section		
Section Manager III	1	Bachelor Degree of Business Administration, Master Degree of Sociology/Social Welfare from a recognized university or Diploma in Sanitation will be given preference. A minimum of 5 years (in case of Bachelor or Master Degree)/10 years in case of Diploma), experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Community Solid Waste Management Facilitator	2	Bachelor Degree of Business Administration, Master Degree of Sociology/Social Welfare/Social Science from a recognized university or Diploma in Sanitation will be given preference. A minimum of 3 years (in case of Bachelor or Master Degree)/5 years in case of Diploma), experience under local government authority. Knowledge, experience, skills in solid waste management is necessary.
Assistant Community Solid Waste Management Facilitator	2	Bachelor Degree in any subject from recognized university. Work experience in community activities will be given preference. A minimum of 3 years experience in relevant field.

3.10 Financial/Management Aspect

3.10.1 Budget Preparation

(1) 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 Rule, the budget shall be prepared and sanctioned in a prescribed manner and shall be submitted to the Government by the 1st day of June each year.

The Revised Budget before the expiry of the Financial Year1 is, if necessary, also prepared and sanctioned in compliance with the Ordinance and Rule. Financial year starts in July and ends in June in Bangladesh.

(2) Budgeting Process

< Programmed Procedures and Deadline >

According to Accounts Department, the budget of DCC shall be prepared, sanctioned through the following procedures and deadline as illustrated in Table 3.10-1.

① Budgeting request from Chief Account Officer to all relevant Department/Zone in late February

② Preparation by each Department/Zone by the 1st half end of March

③ Review and Consolidation by Department concerned by end of March

④ Review and Consolidation of Draft Budget by Accounts Department by the 1st half end of April

⑤ Review and Examination of Draft Budget, and recommendation to Mayor by Finance & Establishment Standing Committee in the 3rd quarter of April

⑥ Approval of Mayor at the end of April

⑦ Preparation of Final Draft Budget by Accounts Department by the 1st half end of May

⑧ Special Budget Meeting of Municipal Committee in the 3rd quarter of May

⑨ Submission to the Government by the end of May

[1] The denomination of "Financial Year" is commonly used in official documents, such as budget statements of the Government of Bangladesh and DCC, in Bangladesh 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 3.10-1 Budget Procedures and Schedule

Month	Feb	Mar				April				May			
Week	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
①	■												
②		■	■										
③				■	■								
④						■	■						
⑤								■					
⑥									■				
⑦										■	■		
⑧												■	
⑨													■

Source: Information from Accounts Department

< Actual Budgeting >

The budget should be formulated by the concerned Department/Zones in accordance with the above schedule within 3 months which begins late February and concluded by the end of May. But this schedule may not have been followed properly. In fact last year, above ④ (Review and Consolidation of Draft Budget by Accounts Department) was made in the middle of May, despite scheduled in the first half of April, because several concerned departments did not follow the schedule. It is said that adequate budgeting requires at least several months for each department to prepare draft budget through frequently consulting with accounts department. However, most of departments of DCC spend only one month, in which accurate and achievable projection of incomes and expenditures can hardly be prepared.

3.10.2 Budget and Actual Amount

(1) Original Budget

Summary of DCC budget is shown in Table 3.10-2. So-called general budget is denominated "Revenue Budget" in Bangladesh and the capital budget "Development Budget".

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

Revenue expenditures amount 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 a largest expenditure accounting for 45-48% of all revenue expenditures.

Department-wise budget is prepared only, so that it is quite difficult to extract and separate the SWM budget amount from it.

Table 3.10-2 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 Gov. Grant	0	0	2,000	1,000	1,000	250
		Gov/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

(2) Revised Budget

The Revised Budget of current financial year is also prepared based on the current budget reviewed at the 3rd quarter level that is used for both adjusting the current original budget and estimating the coming year budget. In this regard, the Revised Budget plays an important role. However, there is no basis for continuous monitoring both of budgeted incomes and expenditures during the year. Actions for balancing the budget are taken only in the 4th quarter on the basis of the Revised Budget by achieving the following traditional manner; Revenue Department calculates 10-month actual income and then estimates the rest of 2-month income, and forwards it to Accounts Department.

Usually revised revenue incomes are lower than original budget revenue incomes as shown in Table 2.10-2. As a result, original budget revenue expenditures are cut down through immediate discussion with each department by suspending on-going works, material procurement, and postponing payment to suppliers. Simultaneously it is instructed to the tax officers to drive tax collection more than usual especially from taxes in arrears.

(3) Actual Income and Expenditure

Summary of actual income and expenditure of DCC own account is shown in Table 3.10-3.

The problem is that revenue incomes were collected only 70% (average over the three financial years from 2000-01 to 2002-03) of budgeted amounts. This income gap was usually a substantial amount and might compel DCC to squeeze and cut down preferentially the own source development expenditures and recurrent expenditures aside from salary/wages.

Table 3.10-3 Actual Income and Expenditure of DCC Own Account (Taka in million)

Items			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 Gov. 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-tures	Revenue	Salary/wages	464	504	607	634	24
		Others	476	487	364	504	19
		Total	940	991	971	1,138	
	Development	Own source/Gov. 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 1 year to add up actual income & expenditure figures after closing financial year and moreover it is quite difficult to extract from it the SWM own expenditure by Department as well as by operation. Accordingly, the Study Team estimated actual SWM cost by Department and by operation for the above 4 years which are presented in detail in Chapter 2.2.7 – (2) of Main Report.

3.10.3 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 that are respectively explained below.

(1) Revenue Income

General or current revenue in other countries is referred as “Revenue Income” in DCC.

DCC has as many as 19 regular revenue income items of its own as shown in Table 3.10-.4. Among these items, five (5) income items contribute around 83% to total revenue incomes that are 1) Holding Tax, 2) Market Rent, 3) Market Salami, 4) Trade License, and 5) Property Transfer Fee. (No.13 of Road Cutting Fee is not considered in calculation because this is offset by relevant expenditures and not effectively regarded as revenue income.)

But it should be noted that substantial amount of arrears has remained mostly in the account of Holding Tax, Market Rent and Trade License according to Budget Report. This has brought one of causes that chronically constrict financial conditions of DCC. In fact, actual revenue income in financial year of 2002-03 was collected only 70% of budgeted amounts, while Holding Tax also only 65% as shown in Table 3.10.4.

Table 3.10-4 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 a 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% 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 %
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

Holding Tax is the largest income resources to DCC. The system of Holding Tax is summarized below.

< Holding Tax System >

Holding Tax is composed of Property Tax 7%, Conservancy Rate 2% and Lighting Rate 3%, and imposed on annual value of property that taxpayers own. 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 list that are prepared manually.

[General Valuation List]

A valuation list of properties shall be prepared and reassessed once in every 5 years interval 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 none of this has been made at all since then for some 15 years in DCC.

Decision of Reassessing

DCC has finally decided to re-start the 5-year reassessment this year to catch up with increase of expenditures, and introduced a new assessment system for it. The new system is called 'self-assessment system' that means assessment by taxpayers themselves.

Planned schedule was: the assessment forms delivery in July, the collection in August, checking/reassessing /registering works by the end of 2004, and new tax bill delivery to taxpayers in July 2005.

The assessment forms were already delivered to taxpayers as scheduled. However, the forms have not been collected entirely yet, because the court ordered DCC to suspend the system according to the appeal of some taxpayers. At moment, it is unclear when will be the court judgment.

Obviously taxation income can be expected to increase by applying the new system; estimated at least more than 2.5 times when considering the hike of consumer price index during the period over the 15 years (cf. Some taxpayers simulated the tax calculation according to the attached guidance and became aware that taxation amount will soar 5 times more than current.)

[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.

Tax Bill and Collection

The tax bill is prepared based on the General Valuation List and/or interim valuation, and delivered directly to the house of tax payers from July to August 15. The bill is payable in 4 installments, respectively due on 1) September 30, 2) November 30, 3) January 31, 4) and April 30. There are several tax incentives (rebates). For example, if tax payers pay all tax before September 30, they will receive 10% incentives (rebates) on tax bill. Roughly 60% of tax payers in Zone-10 enjoy the incentive, while supposedly only 10-20% in Zone-1. The bill can be paid at selected banks, at zone office or at house; respectively 25%, 30% and 25% in Zone-10, and the rest of 15% with delay in payment. Delinquent payment shall be imposed a penalty at a rate of 15% on delinquent amount. Tax history of each tax payer is recorded in

Demand and Collection Register. All recording is made by hand. And all items in the tax bill are also filled manually.

< Market Rent >

Also market rent is big financial resources to DCC revenue income. DCC has been providing market places and increasing the number in response to demand of dwellers both for good quality of services and employment opportunity accompanied with a rapid population growth. DCC currently owns and rents some 105 markets. The rental agreement has been made between around 25,000 tenants. The area per tenant is roughly $70ft^2$ 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 is collected in 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. 20million that corresponds to 30% of original budget amount.

< Trade License Fee >

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

(2) Government Grant

This is the basic inter-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 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.

(3) 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 aided funds from the Government and/or the governmental organizations. 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. 1,900million is appropriated for the first time from the Program for DCC development budget through the Ministry of LGRD. The Program has just started this year and can be appropriated through the Ministry both for development and non-development budget including personnel expenditures. Therefore, DCC is strongly recommended to request it to the Ministry for constant appropriation; then DCC should pay the utmost attention to the Government budget schedule in order to advance it in time.

3.10.4 Other Financial Reports

(1) Annual Statement of Accounts

According to the Ordinance Part III Chapter-1, an annual statement of the accounts shall be prepared after the close of every financial year and shall be forwarded to the government by the 31st December of the following financial year. A copy of the annual statement of accounts shall be placed at a conspicuous place in the office of DCC for public inspection, and all objections or suggestions concerning such accounts received from the public shall be considered by DCC and brought to the notice of the audit authority.

The annual statement generally explains all administration and execution actually taken by DCC like annual report broadly published by private companies. However, none of the annual statements might be prepared and exist. This causes the actual managerial performances and financial conditions very much unclear and nontransparent to the public.

(2) Balance Sheet

On the other hand, 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 years' B/S; nevertheless the last 3 years B/S from June 2001 are not available now because of under the preparation.

Table 3.10-5 shows B/S of Year 1996, 1999 and 200 that are only 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. 5.2billion during 4 years over the period of 1996/2000, mostly caused by increase of building/structures Tk. 4.0billion, transport equipment Tk. 0.5billion, and receivables account Tk. 0.7billion. This Tk. 5.2billion of assets increase was funded by own source (Tk. 4.6billion) and loan and/or the like (Tk. 0.6billion). According to the preliminary information, receivables (mostly Holding Tax arrears) of June 2003 soared to Tk. 1.47billion that equals to an annual increase of 8% from June 2000.

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

Table 3.10-5 B/S as of Financial Year End of 1996, 1999 and 2000 (Taka in million)

Balance Sheet Items			June 1996	June 1999	June 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	Account 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

3.10.5 On-going Networking System Project

It is a big surprising scene indeed to see always large and thick registry books in every department of DCC. Actually almost all slips, journals, registry books, data file that are used in DCC are written, kept and managed manually. This has brought DCC a crucial impediment in providing an immediate and accurate data/information necessary for top management decision making and achieving effective administration with it. It is a common sense in DCC that several months are inevitable to get an approval of the top management.

< 1st Stage; up to June 2004 >

Understanding the increasing necessity to enhance management and control, DCC has taken decisions to establish an effective and independent organizational function of Information Technology (IT) in it and been implementing Networking System Project (the Project) under the financial support of World Bank. The Project is sub-project of "Dhaka Urban Transport Project (July/1998-June/2004), IDA of WB". The objectives of the Project are 1) establishing Networking System, 2) procuring office computers, 3) software development, 4) website development, and 5) providing computer training to DCC staffs. The Project is completed by the end of June/2004. The summary of the Project is shown in Table 3.10.6.

Currently there are 60 stand-alone computers in DCC. Further 40 computers are under procurement. In addition, 30 computers are installed by the Project. In total 130 computers will be deployed in DCC. Though the computer allocation per staff is still so small, a great part of management system of DCC is expected to improve and advance especially in personnel management of Establishment Department, billing/collection management of Revenue Department, payment/accounting management and budget control of Accounts Department, and store inventory and purchase control of Store and Purchase Department. In the project, 60 staffs were already trained, and they are expected to take leading roles for the enhancement of IT in DCC.

Table 3.10-6 Summary of Networking Project

Project Name	Supply and Installation of Computers and others Accessories for Dhaka City Corporation	Customized Software Development, installation and Maintenance for Dhaka City Corporation
Project Component	30 computers in total 20: Headquarter Offices 10: Zone Offices	1. Personnel Management System 2. Payroll, Market Rent and Electricity Charge Billing System 3. Store Inventory Control System 4. Trade License Management System 5. General Accounts and Budgetary Control System 6. Technical Specification for Training 1) Systems Administrator Team – 10 persons 2) Operation Group – 60 persons
Project Cost	Tk. 4.9million	Tk. 2.3million
Financial Resources	75% from IDA of WB 25% from Government	75% from IDA of WB 25% from Government
Work Order	November/2003	November/2003
Completion	By the end of June	

< 2nd Stage; after June 2004 >

DCC will install more 10 computers, totaling 50 computers in network. However, many staffs seem to be reluctant to use computers although many of them were trained. In order to function networking system well, it might be necessary to give them a further training.

Appendix 1 Methodology of SWM Cost Estimates

1.1 Department-wise

1.1.1 Conservancy Department (Cleaning of Road, Drain and Market)

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= (Number of staffs) x (Salary)
	Staff: Temporary cleaner, permanent cleaner, C.O. C.S.I and C.I
	Salary: Basic salary + Allowance (basic salary multiplied by house aid 40-50%, dearness 10%, and provident fund 10% ＋ 2 months of basic salary for festival bonus ＋ 480Tk for medical aid etc.) No allowance for temporary cleaner.
2. Supply of material	= (DCC total supply of material) x 100%
3. Dust bin	= (DCC total dust bin) x 100%
4. Sweepers' colony	= (DCC total sweeper' colony) x 100%
5. Equipment & assets	= (DCC total equipment & assets) x (SWM estimate: 15%)

1.1.2 Transport Department (Transportation)

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= (Number of staffs) x (Salary)
	Staff: Drivers and others
	Salary: Basic salary ＋ Allowance
2. Fuel	= (DCC total fuel) x (light vehicles/total vehicles: 80%) x (SWM cars in operation /DCC cars in operation: 280/420) x (SWM car mileage efficiency: 1.3)
	SWM vehicles mileage efficiency 1.3 means SWM cars consume gasoline 1.3 times as more as passenger's cars.
3. Electricity & water	= (DCC total electricity & water) x (SWM estimate: 2%)

1.1.3 Engineering Department: Division Mechanical-1 (Repair of Vehicle)

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= (Number of staffs) x (Salary) x (SWM estimates: 75%)
	Staff: Mechanics, assistant mechanics, helpers, welders, painters, other workers, and assistant & sub-assistant engineers
	Salary: Basic salary ＋ Allowance
2. Repair & maintenance	= (Mechanical-1 repair & maintenance) x (SWM estimate: 75%)
3. Electricity & water	= (DCC total electricity & water) x (SWM estimate: 5%)
4. Parts of motor car	= (DCC total parts of motor car) x (SWM car/DCC cars: 350/488) x (SWM car efficiency: 1.1)
5. Equipment & assets	= (DCC total equipment & assets) x (SWM estimate: 10%)

1.1.4 Engineering Department: Division Mechanical-2 (Repair and Operation of Heavy Equipment of Landfill)

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	Operator = (Number of staffs) x (Salary)
	Others = (Number of staffs) x (Salary) x (SWM estimates: 21%)
	Others: Mechanics, assistant mechanics, helpers, assistant engineers, and head mechanics
	Salary: Basic salary + Allowance
2. Repair & maintenance	= (Mechanical-2 repair & maintenance) x (SWM estimate: 25%)
3. Fuel	= (DCC total fuel) x (Mechanical-2: 20%) x (SWM estimate: 25%)
4. Electricity & water	= (DCC total electricity & water) x (SWM estimate: 2%)

1.2 Operation-wise

1.2.1 Cleaning of Road, Drain & Market

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	Staffs: (Conservancy Department) − (Truck cleaner)
2. Supply of material	= Conservancy Department
3. Dust bin	= Conservancy Department
4. Sweepers' colony	= Conservancy Department
5. Equipment & assets	= (Conservancy Department) + (Eng. Department Mechanical-1)

1.2.2 Collection & Transportation

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= (Transport Department) + (Truck cleaners of Conservancy Department)
2. Fuel	= Transport Department
3. Electricity & Water	= Transport Department

1.2.3 Final Disposal

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= Disposal site operators of Eng. Department Mechanical-2
2. Fuel	= Eng. Department Mechanial-2

1.2.4 Repair Works

Cost Items	Methodology of Cost Estimates
1. Salary & Allowance	= (Eng. Department Mechanical-1) + (Eng. Department Mechanical-2 minus disposal site operators)
2. Repair & maintenance	= Eng. Department (Mechanical-1 + Mechanical-2)
3. Electricity & Water	= Eng. Department (Mechanical-1 + Mechanical-2)
4. Equipment & assets	= Eng. Department Mechanical-1

Appendix 2 Department-wise SWM Expenditures by Items

2.1 Conservancy Department (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		182.7	214.5	265.7	278.5
	Repair & Maintenance		-	-	-	-
	Fuel		-	-	-	-
	Water & Electricity		-	-	-	-
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	9.8	8.1	5.4	14.7
	Special Conservancy		-	-	-	2.7
	Total		192.5	222.6	271.1	295.9
Development Expenditures	Dustbin		0.1	0.8	0.5	0.2
	Sweeper's Colony		3.7	5.0	5.1	6.7
	Equipment & Assets		15.3	14.4	2.6	2.1
	Total		19.1	20.2	8.2	9.0
Total			211.7	242.8	279.3	304.8

2.2 Transport Department (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		16.2	16.8	17.4	18.0
	Repair & Maintenance		-	-	-	-
	Fuel		49.2	55.5	64.9	86.4
	Water & Electricity		0.6	0.9	1.2	1.2
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		65.9	73.2	83.5	105.6
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		-	-	-	-
	Total		-	-	-	-
Total			65.9	73.2	83.5	105.6

2.3. Engineering Department: Division Mechanical-1 (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		4.2	4.5	4.6	5.5
	Repair & Maintenance		8.6	17.5	9.2	12.1
	Fuel		-	-	-	-
	Water & Electricity		1.0	1.7	2.3	2.3
	Supply	Car Parts	58.6	27.2	11.8	31.6
		Body: Truck & Handcarts	-	0.8	1.7	3.8
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		72.5	51.7	29.6	55.2
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		10.2	9.6	1.7	1.4
	Total		10.2	9.6	1.7	1.4
Total			82.7	61.3	31.4	56.5

2.4 Engineering Department: Division Mechanical-2 (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		1.6	1.7	1.8	1.9
	Repair & Maintenance		1.1	0.2	0.8	0.6
	Fuel		3.5	4.0	4.7	6.2
	Water & Electricity		0.1	0.2	0.3	0.3
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		6.3	6.1	7.6	9.0
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		-	-	-	-
	Total		-	-	-	-
Total			6.3	6.1	7.6	9.0

Appendix 3 Operation-wise SWM Expenditures by Items

3.1 Cleaning of Road, Drain and Market (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		161.4	189.3	233.6	244.9
	Repair & Maintenance		-	-	-	-
	Fuel		-	-	-	-
	Water & Electricity		-	-	-	-
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	9.8	8.1	5.4	14.7
	Special Conservancy		-	-	-	2.7
	Total		171.2	197.4	239.0	262.3
Development Expenditures	Dustbin		0.1	0.8	0.5	0.2
	Sweeper's Colony		3.7	5.0	5.1	6.7
	Equipment & Assets		25.6	24.1	4.4	3.4
	Total		29.4	29.9	10.0	10.3
Total			200.5	227.3	249.0	272.6

3.2 Collection & Transportation (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		37.5	41.9	49.5	51.5
	Repair & Maintenance		-	-	-	-
	Fuel		49.2	55.5	64.9	86.4
	Water & Electricity		0.6	0.9	1.2	1.2
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		87.3	98.3	115.6	139.2
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		-	-	-	-
	Total		-	-	-	-
Total			87.3	98.3	115.6	139.2

3.3 Final Disposal (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		1.0	1.1	1.2	1.2
	Repair & Maintenance		-	-	-	-
	Fuel		3.5	4.0	4.7	6.2
	Water & Electricity		-	-	-	-
	Supply	Car Parts	-	-	-	-
		Body: Truck & Handcarts	-	-	-	-
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		4.6	5.1	5.8	7.4
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		-	-	-	-
	Total		-	-	-	-
Total			4.6	5.1	5.8	7.4

3.4. Repair Works (Taka in million)

Cost Items			1999-00	2000-01	2001-02	2002-03
Revenue Expenditures	Salary & Allowance		4.8	5.1	5.3	6.1
	Repair & Maintenance		9.6	17.7	10.0	12.7
	Fuel		-	-	-	-
	Water & Electricity		1.2	1.9	2.6	2.6
	Supply	Car Parts	58.6	28.1	13.5	35.3
		Body: Truck & Handcarts	-	0.8	1.7	3.8
		Material	-	-	-	-
	Special Conservancy		-	-	-	-
	Total		74.2	52.7	31.4	56.8
Development Expenditures	Dustbin		-	-	-	-
	Sweeper's Colony		-	-	-	-
	Equipment & Assets		-	-	-	-
	Total		-	-	-	-
Total			74.2	52.7	31.4	56.8

3.11 Privatization of SWM

3.11.1 Initiation of the Project

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

3.11.2 TOR for Contractor

The Terms of Reference (TOR) for the project distributprepared by DCC in the bidding process is summarized in Table 3.11-1. The working areas mentioned in TOR include all roads, markets, parks, footpaths, surrounding area of dustbins in the ward. Scope of work includes transportation of the waste from dustbins to landfill site. The four organizations awarded shall report the performance of works to DCC periodically. The organizations awarded 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 in next year.

Table 3.11-1 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. Success Factors	1. Proper management and proper service providing 2. Lowering the pollution of environment 3. Clean and hygiene city 4. Development of manpower and job creatingon 5. Reducing the expenditures relating to cleaning and health sector 6. Introduction of new technology and improved waste management 7. Raising the public awareness about the environmental pollution and proper waste management, separation of organic/inorganic waste, and reducing the waste
6. 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
7. Other descriptions	Requirements for methodology and quality of service, cleaning frequency, working time, grading the service, etc

Source: Urban Planning Dept., DCC

In the tendering, the selection of successful organizations wereis madeselected based on the criteria as shown in Table 3.11-2. Then financial proposal iwas requested fromto theose tenderers that scored more than 80 points in total.

Table3.11-2 Selection Criteria for Tender

Criteria	Score	Criteria	Score
1.Existing real capability & logistic facilities	10	5.Capability & experience of the responsible personnel	20
2. Experience related to SWM	10	6.Capability of recruiting, logistic and quality of service	10
3. Experience in other works	5	7. Presentation of proposal	5
4. Technical proposal	40	Total	100

Source: Urban Planning Dept., DCC

3.11.3 Progress of Project in the First Term

The project was awarded to 4 organizations that were; BIEDF (Bangladesh Integrated Environment Development Forum), MIRUD (Mission for Rural Urban Development), Messer's Rhythm and LN Corporation. From the interview with these organizations, their operation and management regarding the project was summarized in Table 3.11-3.

To start with the project, the organizations employed generally slum dwellers especially as cleaners. Total number of field staffs employed and deployed by the organizations was smaller than the number deployed by DCC before privatization. At the beginning, conservancy supervising inspectors and conservancy inspectors of Zone #9 and #10 of DCC gave a practical training to cleaners employed by the organizations.

The organizations also reduced the number of dustbins in response to demand to reduce environmental pollution and unsightliness after consultation with DCC and local communities; in fact, the number of dustbins in the area of 3 organizations interviewed was cut from 111 before privatization to 73 at present.

It is noted that the larger number of field staffs is deployed in ward #1 and #19 reflecting the big size of area. Also it should be noted that some areas of Uttara and Bearri Band actually are used as dumping sites, despite Matuail being directed in TOR, by getting permission or receiving compulsory order from DCC.

Chapter 4
Interim Report on Pilot Project A

4.1 Rationale

According to the Household Awareness Survey in May 2004, most residents of Dhaka City do not intend to facilitate and participate in activities for solid waste management. This finding is borne out by the fact that only DCC and NGOs/CBOs, with few stakeholders, have been involved in solid waste management in Dhaka. This is likened to a top-down approach to solid waste management.

People's consciousness of solid waste management is at a low level and DCC's idea of people's contribution for solid waste management seems vague. However, residents are placed in a very important position in solid waste management because they are the ones that generate waste, and they are indispensable for effective waste collection, among other things. There can be no good solid waste management without a resident's collaboration. It is indispensable that residents be involved in solid waste management.

It would be impossible to properly address the above issue if each concerning party with waste management were to individually pursue solutions. It is necessary that each party, DCC, ward administration, residents and NGOs/CBOs, has a good relationship with one another for master plan preparation. This is extremely important if the master plan is to be implemented with the least amount of difficulty.

It is necessary to develop an implementable, workable and sustainable mechanism for implementation of master plan with a sure grasp of uncertain factors for success, especially the social factor. In Dhaka City, a sub-system of master plan will be practiced and verified to know just how strong the relationship is among each planning component. A model for community involvement in solid waste management in Dhaka City will be developed through Pilot Project-A. At the same time, DCC staff members could brainstorm to come up with ideas of community involvement in solid waste management, learn necessary skills and obtain experience through on-the-job training. Furthermore, it is expected that capability of DCC will be developed enabling them to expand their community involvement in solid waste management smoothly and effectively by the completion of this JICA study.

4.2 Objectives

The objectives of the pilot project are:

- to find a workable, sustainable and effective mechanism and system on ward level solid waste management; and
- to feed back to master plan formulation the output of the pilot project.

In order to achieve the above objectives, the following institutional model and technical model will be developed:

➔ Model for institutional arrangement in order to operate solid waste management smoothly and effectively at ward level

➔ Model for solid waste management methods including waste discharge, collection and transportation

4.3 Framework of Pilot Project

(1) Approach of Pilot Project

In general, a community is used as management unit in order to involve residents in what is acceptable solid waste management for most people. However, in Bangladesh, the relationship of communities is weak and their administrative boundaries are not clear. Communities have different problems and solutions on the issue of solid waste management, based on local situations including land use, population distribution, and road network, so that management issues are based on local situations as well.

The smallest administrative unit in Dhaka City is provided as ward. Ward Commissioners, the representatives of ward, are elected directly by residents. Deployment of road cleaners, deep drain cleaners, truck cleaners is drawn up by Ward Commissioners and determined through negotiation with DCC. Therefore, it seems reasonable that primary collection should be managed at ward level as well.

Residents should be also involved in primary collection because residents generate waste on one hand and they enjoy the benefit of solid waste management on the other hand. It is proposed that Ward Solid Waste Management Committee and Ward Solid Waste Management Working Group be established as community-based group. For the pilot project, ward level SWM should be institutionalized within the community level, in order for residents to accept solid waste management system easily and provide detail management based on local situations.

(2) Process of Pilot Project

The pilot project is to be carried out in the manner shown in Figure 4.3-1. There are three phases as follows:

- Phase 1: Preparation
- Phase 2: Scoping and Planning
- Phase 3: Implementation

The pilot project is now at Scoping and Planning Phase. Schedule of the pilot project is shown in Figure 4.3-2.

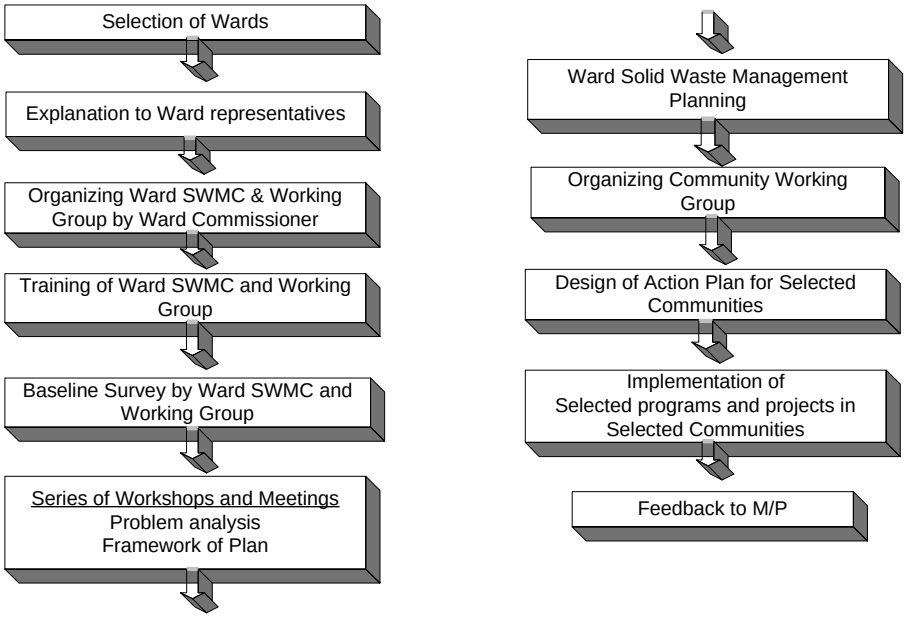


Figure 4.3-1 Process of Pilot Project A

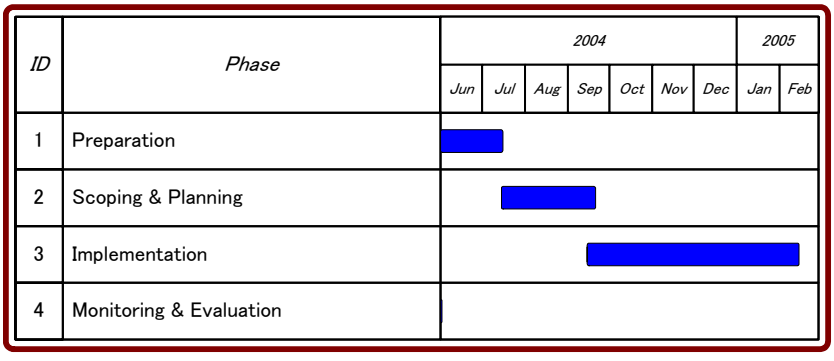


Figure 4.3-2 Schedule of Pilot Project

(3) Methodology

a) Criteria for Selection of Targets Wards

The pilot project aims to develop a model for institutional system and technical system so that pilot wards should be typical and/or representative wards of Dhaka City. According to observation of Dhaka City by the Study Team, there are two parameters for grouping wards in Dhaka City. One is historical parameter. Dhaka City can be divided into three areas based on development history: fringe area, older urban area and old Dhaka area, and then there is the new urban area. The other parameter is the development way, which shows characteristics of wards such as planned developed area and spontaneously developed area or uncontrolled developed area.

It is mentioned that target wards for the pilot project should be typical in order to expand to other wards. Therefore, wards with different characteristics should be selected among the 90 wards of Dhaka City. Finally, "New Urban Area and Planned Developed Area" and "Old Dhaka Area and Spontaneous Developed Area" were selected as target wards (see Table 4.3-1). These models can be modified for wards of Older Urban Area. Selection of wards for the pilot project has been discussed between DCC and the Study Team. Willingness of Ward Commissioner and community leaders is also considered for the selection of wards. And so, Ward 6 as "New Urban Area and Planned developed area" and Ward 65 as "Old Dhaka Area and Spontaneous Developed Area" were selected.

Table 4.3-1 Criteria of Target Wards for Pilot Project

	Planned Developed Area	Spontaneous Developed Area
New Urban Area	Ward 6	
Older Urban Area		
Old Dhaka Area	Non	Ward 65

b) Establishment of Organization

Operational structure of the pilot project and role of related organizations are shown in Figure 4.3-3 and Table 4.3-2, respectively. Ward Solid Waste Management Committee and Ward Solid Waste Management Working Group were established at Ward 6 and Ward 65. Members of Committee and Working Group were appointed by Ward Commissioner. DCC–JICA Joint Study Team for Pilot Project is supporting for formulation of Ward Solid Waste Management Plan. During implementation phase of management plan, DCC–JICA Joint Study Team will coordinate between DCC and community side for smooth implementation. For example, if community side will collect waste, DCC will send collection vehicle. This kind of collaboration and coordination is required. Level of collaboration and coordination works depends on contents of plan; however, DCC Zone Office should be involved in the pilot project.

Table 4.3-2 Roles of Related Groups for Pilot Project Implementation

Related Groups	Proposed Members	Roles
Ward Solid Waste Management Committee		
	• Ward key persons • Representative of people's 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		
	• Residents' representatives • Volunteers	➔ Support Ward SWM Committee technically ➔ Support Community Unit Working Group ➔ Encourage residents for SWM at ward level ➔ Arrange and implement SWM activities with residents
DCC Supporting Group		
	• DCC Zone Office (CO, CSI) • DCC Conservancy Inspector • DCC Counterpart Group	➔ Support Ward SWM Committee and Ward SWM Working Group, Community Unit SWM Working Group ➔ Coordinate between Ward SWM Committee and DCC
JICA Study Team		
	• All Study Team members	➔ Support SWM Committee, Ward SWM Working Group, Community Unit SWM Working Group through DCC technically ➔ Support implementation of selected projects
Monitoring and Evaluation Group		
	• Ward Commissioner and Women's Commissioners • Chief Conservancy Officer • Zonal Executive Officer • Team Leader of JICA Study Team	➔ Monitor and evaluate Pilot Project ➔ Advise and guide DCC Supporting Group and JICA Study Team

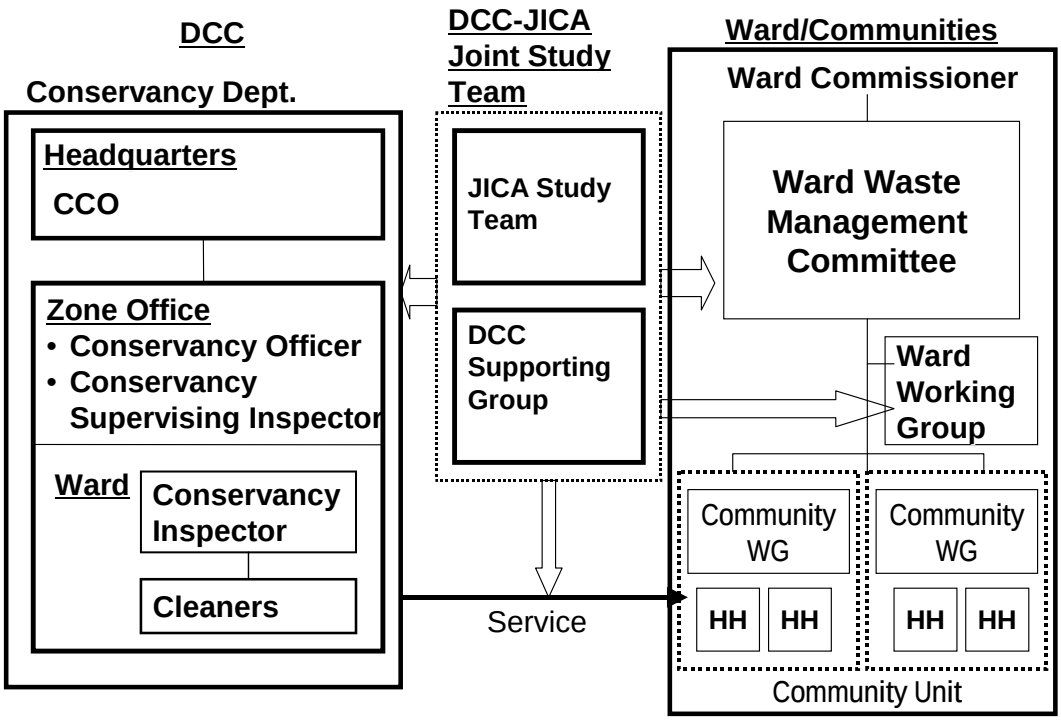


Figure 4.3-3 Implementing Organization for Pilot Project

c) Training Seminar for Ward Solid Waste Management Committee and Working Group

A Training Seminar was held on August 7 and 8, 2004 at DCC. This seminar was for Ward Solid Waste Management Committees and Ward Solid Waste Management Groups. DCC counterparts were also invited. The objectives of the seminar were to:

- build skills for Committee members and Working Group members;
- share problems and issues for solid waste management among committee members/working members, DCC and the Study Team; and
- share solid waste management issues and develop communication between Ward 6 and Ward 65.

Program of Training Seminar is shown in Table 4.3-3.

Table 4.3-3 Training Program for Ward Solid Waste Management Committee and Working Group

Training Program for Ward SWM Committee and Working Group
Pilot Project for
The Study on Solid Waste Management in Dhaka City
August 7 – 8, 2004

Program

Day 1 (August 7)

Participants: Members of Ward Solid Waste Management Committees
Members of Ward Solid Waste Management Working Groups

9:30	-	10:00		Registration
10:00	-	10:15		Introduction of Participants by *Chairperson of Ward Solid Waste Management Committee, Ward 6 and Ward 65*
10:15	-	10:30		Opening Speech of Training Program by *Mr. Sohel Faruquee, Chief Conservancy Officer of DCC*
10:30	-	10:50		Introduction of Clean Dhaka Master Plan by *Mr. Anwar Hossain Patwary, Coordinator of Counterpart Personnel*
10:50	-	11:20		Overview of Pilot Project by *Dr. Akinori Sato, Deputy Team Leader, JICA Study Team*
11:20	-	11:30		Coffee Break
11:30	-	12:15		Solid Waste Problems and How They Affect Our Life by *Mr. Shafiul Ahmed, Acting Team Manager of Water and Sanitation Program, World Bank*
12:15	-	12:30		Q & A
12:30	-	13:15		Basic Knowledge of Solid Waste Management by *Mr. Hiroshi Abe, Solid Waste Management Facility Planner/Environmental Specialist, JICA Study Team*
13:15	-	13:30		Q & A
13:30	-	14:30		Lunch
14:30	-	15:15		Concept of Community Involvement in Solid Waste Management by *Mr. Monir Alam Chowdhury, Pilot Project Coordinator*
15.15	-	15:30		Q & A

Facilitated by Mr. Monir Alam Chowdhury

Day 2 (August 8)

Participants: Members of Ward Solid Waste Management Working Groups

10:00	-	10:45		Planning Process of Ward Solid Waste Management by *Dr. Akinori Sato, Deputy Team Leader, JICA Study Team*
10:45	-	11:00		Q & A
11:00	-	11:45		Alternatives of Waste Collection System for Dhaka City by *Mr. Masaharu Takasugi, JICA Study Team*
11:45	-	12:00		Q & A
12:00	-	13:00		Lunch
13:00	-	15:00		Participatory Planning Method by *Mr. Hara Naoki, JICA Study Team*
15:00	-	15:15		Coffee Break
15:15	-	16:00		Further Activities by *Mr. Monir Alam Chowdhury, Pilot Project Coordinator*
16:00	-	16:10		Closing Remarks by *Mr. Anwar Hossain Patwary, Coordinator of Counterpart Personnel*

Facilitated by Mr. Monir Alam Chowdhury

d) Baseline Survey

Baseline survey was conducted at Ward 6 and Ward 65 in order to prepare Ward Profiles. Ward Profile is basis of Ward Solid Waste Management Plan. The Study Team worked with mainly Ward Solid Waste Management Working Group. The following are expected from the baseline survey and Ward Profile:

- Ward Profile will be used for preparation of Ward Solid Waste Management Plan.
- Ward residents get a firm grasp of the existing situation.
- Ward Profile can be used for discussion materials by ward residents.

The contents of baseline survey are in Table 4.3-4:

Table 4.3-4 Items of Baseline Survey for Pilot Project-A

No.	Items	Contents
1	Geography & History	
	1.1 Geography	☐ location ☐ land area
	1.2 History	☐ year of establishment of ward ☐ historical changes
2.	Ward Administration	
	2.1 Organization	☐ organization chart ☐ member list of ward administration
	2.2 Administrative service	☐ roles of ward ☐ roles of each administrative group
	2.3 Budget and Expenditure	☐ ward budget (2002, 2003, 2004) by item ☐ ward expenditure (2001, 2002, 2003) by item
	2.4 Ward Projects and Programs	☐ projects and programs list
3.	Socio-economic Conditions	
	3.1 Population	☐ population by sex, age group
	3.2 Household	☐ number of households ☐ type of household building
	3.3 Land Use	☐ land use map ☐ land area
	3.4 Social setting	☐ Culture • location map of mosque, church, temple • population ratio by religion ☐ Education • literacy rate • location map of school ☐ Public Health • nutrition • major cause of morbidity • major cause of mortality ☐ Women's roles in ward
	3.5 Sanitation	☐ Water supply (major sources of water) ☐ Toilet (type of toilet facilities)

No.	Items	Contents
	3.6 Ward infrastructure	☐ Transportation and road network • type of transportation • bus terminals • road network map ☐ Electricity • coverage area
	3.7 Commerce and industry	☐ major industry
4.	Environmental Conditions	☐ Water environment • ponds • water ways and drainage ☐ Vegetation and park • vegetation map • parks map
5.	Solid Waste Management	☐ Waste dumping areas ☐ Primary collection (CBOs activities) ☐ Secondary collection (Containers /dustbins) ☐ Road cleaning ☐ Deep drain cleaning ☐ Recycling activities

e) Ward Solid Waste Management Planning

Ward Solid Waste Management Plan covers the whole ward regarding solid waste management based on the existing conditions and problems. It is proposed that Ward Solid Waste Management Plan be revised every three years.

Planning process for Ward Solid Waste Management is shown in Figure 4.3-4. Workshop method was adopted for planning such as participatory method. Mainly Ward Solid Waste Management Committee and Working Group have been involved in the planning process.

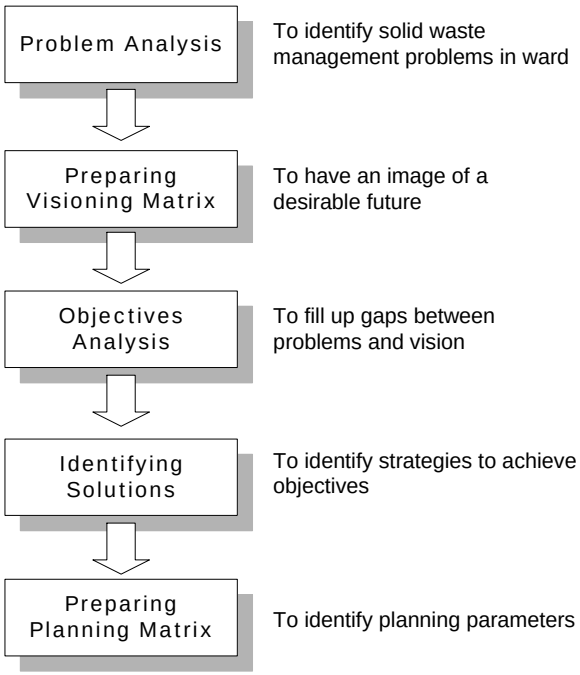


Figure 4.3-4 Planning Process for Ward Solid Waste Management

4.4 Major Activities

After the selection of Ward 6 and Ward 65 as Pilot Project sites, kick-off meetings were held in each site, which signaled the official commencement of the project. Major activities of the pilot project are as follows:

Table 4.4-1 Major Activities for Pilot Project

Period: July 15 – September 9, 2004

Date	Ward 6	Ward 65
7/15	Kick-off Meeting Ward Commissioner and 120 residents were in attendance. The Study Team explained objectives, method, and schedule of Pilot Project. It was confirmed that residents would participate in the pilot project.	Kick-off meeting Ward Commissioner and 100 residents were in attendance. The Study Team explained objectives, method, and schedule of Pilot Project. It was confirmed that residents would participate in the pilot project.
7/21	Meeting with commissioner and local leaders To discuss schedule To explain roles of Ward Solid Waste Management Committee and Working Group	---
7/22	---	Meeting with Commissioner To explain objectives of Pilot Project and roles of Ward Solid Waste Management Committee and Working Group
7/28	Meeting with Commissioner and candidate members of SWM Committee and Working Group (total of 120 persons) To explain roles of Ward Solid Waste Management Committee and Working Group	---
7/29	---	Meeting with Commissioner and candidate members of SWM Committee and Working Group To explain detail of Pilot Project
8/1	Meeting with Commissioner To discuss roles of Committee and Working Group To appoint about 10 Committee members and 10 Working members	Meeting with Commissioner To discuss roles of Committee and Working Group To agree on no salary for members of the Committee and the Working Group To appoint about 10 Committee members and 10 Working members
8/7 - 8	Training Seminar for Ward Solid Waste Management Committee and Ward Solid Waste Management Group at DCC 1st day Participants (for Committees and Working Groups) Ward 6: Ward Commissioner Committee members: 10 persons (1 was absent) Working Group members: 8 persons (3 were absent) Ward 65: Ward Commissioner Committee members: 10 persons (3 were absent) Working Group members: 10 persons (3 were absent) 2nd day Participants (for Working Groups) Ward 6: Working Group members: 8 persons (3 were absent) Ward 65: Working Group members: 10 persons (3 were absent)	

Date	Ward 6	Ward 65
8/12	Mapping Session with Working Group and some Committee members Field reconnaissance on containers and dustbins and dumping area with Working Group and some Committee members	---
8/16 -	Baseline Survey was commenced	---
8/26	Workshop on Problem Analysis Participants: Committee members Working Group members	---
8/30	---	Workshop on Problem Analysis Participants: Committee members and Working Group members
9/3	Planning Workshop on Visioning, Objectives Analysis Participants: Committee members Working Group members	---
9/8	---	Planning Workshop on Visioning Participants: Committee members Working Group members
9/9	Planning Workshop on Identifying Solutions (1) Participants: Committee members Working Group members	---
12/2	---	Meeting on implementation of Ward Solid Participants: Committee members and Working Group members
12/3	Meeting on implementation of Ward Solid Participants: Committee members and Working Group members	---
12/6	---	Meeting on implementation of Ward Solid Participants: Committee members and Working Group members
12/7	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members	Practice of Drama on Solid Waste Participants: Volunteers
12/8	CBO Meeting on improvement of waste collection Participants: Committee members, Working Group members, Community Unit Working Group members and CBO	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members
12/9	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members	---
12/10	---	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members
12/11	---	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members
12/12	---	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members

Date	Ward 6	Ward 65
12/15	Site Investigation on the existing containers/dustbins and proposed sites of containers etc. Participants: Committee members, Working Group members	---
12/16	Site Investigation on slum area	---
12/22	---	Community Meeting Participants: Committee members, Working Group members and Community Unit Working Group members
12/23	---	Exhibition of Solid Waste Drama

4.5 Further Activities

Ward Solid Waste Management Planning was already completed. During December, we discussed about action plans for priority community units. It also includes closing dustbins and setting up containers, design of rickshaw van, collection system. At Ward 65, first Drama on Solid Waste was presented by volunteers.

From January 2005, Ward Solid Waste Management will be implemented.

Chapter 5

Interim Report of Pilot Project B: Management Information Acquisition

5.1 Terms of Reference of the Project

5.1.1 Objectives

Dhaka City Corporation (DCC) undertakes cleaning works by deploying about 7,000 staff and hundreds of transport vehicles and heavy equipment. In the course of the task execution, operation records are just accumulated at each station of activity, namely garages and workshops. It is urgently necessary the top management of Conservancy Department to grasp the actual figure of operation as soon as possible to evaluate the usage of such resources as manpower, vehicle and heavy equipment in on-going situation.

This project is envisaged to introduce a prototype of management information system (MIS) to assist the top management in acquiring necessary information from the working fronts under his control. The prototype of MIS is formulated to verify the effectiveness and practicability of MIS to Conservancy Department of DCC. As the project is aiming at gaining data from the existing deployment of staff to the sites, the output database does not necessarily cover the entire aspects of operation for the moment. However, the structure of database itself is designed able to describe the entire figure of operation if only sufficient staff is assigned to record the missing part of operation in future. As the result of the project, the database and handling software will be reserved together with equipment for the future use of DCC.

5.1.2 Scope of Work

The work is defined in the form of tasks of the consultant under the subcontract with the JICA Study Team as follows.

(1) Procurement and Installation of Equipment and Material

The consultant shall purchase necessary equipment and supplementary material for implementation of the project. After getting approval of Work Plan no.1, the consultant shall immediately start procurement of equipment and material and install them to the designated

place. The following list shows minimum requirement of equipment that covers the demand of data inputting in accordance with the pace of data generation. The consultant may propose in the bid another procurement list of equipment within the contract amount considering the volume of data to be handled. The contents of target data and the volume are shown in Attachment A.

Table 5.1-1 Procurement List of Equipment

items	quantity	specifications
Desk-top computer	4 units	sufficient function and capacity attached with software for handling database in this project
Laser printer	1 unit	sufficient function for daily checking and periodical monitoring of operation by display software
UPS	4 units	enough capacity to cover the set of computer and scanner
Supplementary material	4 sets	extension power cable, plug adaptor and others depending on the condition of location provided by DCC

(2) Target Data Acquisition

The consultant shall conduct collection and inputting data to computer in the manner shown below unless there is no special suggestion attached. Prior to commencement of data collection and inputting, the consultant shall confirm the workability of input form on the equipment procured for this project. Target data are the following 6 kinds of operation records.

a. Transport vehicle logbook at Saidabad
b. Transport vehicle logbook at Zone 7 & 8 Office
c. Transport vehicle record coming to Matuail dump site
d. Heavy equipment operation record at Matuail dump site
e. Transport vehicle repair record at Workshop 1
f. Heavy equipment repair record at Workshop 2

(3) Method of Data Acquisition

The Consultant shall acquire records of operation and repair for consecutive 3 months on approval of work plan no. 2 by the JICA Study Team. Records in logbook are prepared by drivers and lent to the consultant until the time next turn of operation starts for each of transport vehicle.

Records of vehicle and heavy equipment at Matuail dump site are lent to the consultant. The consultant shall make a copy of logbook or other form of record provided by DCC staff for inputting and checking afterward the input data. The consultant shall return the logbook and recording sheet from Matuail to DCC immediately after taking copy.

As for repair record, the consultant shall prepare a progress recording sheet according to code number of repair request for every vehicle and fill out the progress by asking the staff of DCC regularly at the Workshop.

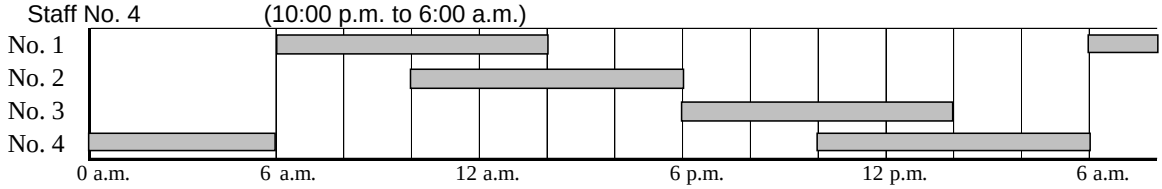
The responsible staff of DCC for respective target data is as follows. Every record shall be verified after inputting everyday if it satisfies the required form of input. The problematic record shall be taken out and confirmed the fact with the recorder of DCC on the next day.

Table 5.1-2 Mehod of Data Acquisition

target data	form of record	form of data acquisition	interval of data acquisition
a. vehicle logbook at Saidabad	book	scanning	everyday
b. vehicle logbook at Zone 7 & 8 Office	book	scanning	everyday
c. vehicle record coming to Matuail dump site*	sheet	scanning	everyday
d. heavy equipment operation record at Matuail dump site	sheet	photocopy	everyday
e. vehicle repair record at Workshop 1	sheet	interview	every Tuesday
f. heavy equipment repair record at Workshop 2	sheet	interview	every Tuesday

note *: Recording sheet is prepared by DCC staff in 4 shifts as defined below.

Staff No. 1 (6:00 a.m. to 2:00 p.m.),
Staff No. 2 (10:00 a.m. to 6:00 p.m.),
Staff No. 3 (6:00 p.m. to 2:00 a.m.),
Staff No. 4 (10:00 p.m. to 6:00 a.m.)



(4) Compilation of Database

The consultant shall transform input data to the database by using appropriate software everyday. The database shall satisfy the demand of display stated in this scope of works and specifications.

(5) Development of Display Program

a) Display of Specific Indexes

The consultant shall prepare programs for displaying the list of indexes accompanied by some subordinate indexes based on the database. The list shall be given an appropriate form that enables tallying, printing and other usage with ease.

b) Displaying Linked List of Transport Vehicles

The consultant shall prepare a linked list of transport vehicle for checking discrepancy of operating hour at Matuail and respective garages. The list shall be given an appropriate form that enables checking in short time.

c) Displaying Visible Chart

The consultant shall prepare a series of software that help top management of Conservancy Department have a quick image of the above mentioned lists by using appropriate chart on the screen and hard copy.

(6) Preparation of Operating Manual

a) Operating Manual

The consultant shall prepare an operation manual of scanner, database and displaying software for further use of DCC. The manual shall refer to maintenance of database and recovery measures against most probable problem that may occur in operation. The manual shall also include the sample outputs of list and chart developed in the contract together with the instruction how to make them.

b) Technical Transfer

The consultant shall instruct the staff of DCC appointed to the charge how to use and maintain the database for one week at the end of contract.

(7) Proposal on further development of the system

The consultant shall propose further development of the system that makes the system completed in the contract more effective and practical to the daily routine of DCC.

5.2 Implementation of the Project

5.2.1 Frame of Implementation

The implementation body is in principle Dhaka City Corporation under the initiative of Chief Conservancy Officer. JICA assists DCC by dispatching a consultant with the task stated in the Terms of Reference stated above. As the basic demarcation between DCC and the consultant, the Minutes of Understanding (MOU) was concluded by Chief Executive Officer and the deputy leader of the JICA Study Team as attached hereto. According to the MOU, DCC staff are responsible for recording waste management activities as source data and provides the space for the consultant to work together with office furniture. The consultant is responsible to provide equipment and recording form to DCC staff and make the raw data provided by DCC staff into database. Once database is compiled, the consultant prepares potential management information as the guide to establish practical system of Management Information System.

5.2.2 Structure of Implementation on Site

(1) Location-wise Staff Requirement and Duties

DCC and the consultant deploy the following staff for data collection and compiling database at respective locations of operation illustrated in Figure 5.2-1.

1 Zone 8 Office / Garage

DCC Staff: 2 persons – 1 person for day shift and 1 person for night shift
[Duties-Filling the data sheet from logbook daily and transfer filled data sheet to DEO at Zone 7 Office in the following day.]

2 Zone 7 Office / Garage

DCC Staff: 2 persons – 1 person for day shift and 1 person for night shift
[Duties-Filling the data sheet from logbook daily and transfer filled data sheet to Data Entry Operator (DEO) in the following day.]

Consultant: 1 person, Data Entry Operator (DEO)
[Duties-Enter the data into the database using customized software and modify the data as per correction sheet]

Consultant: 1 person, Data Controller (DC)
[Duties-Take print-out of data and verify with original data sheet. Make correction on print-out and handover to DEO for correction.]

3 Workshops – Workshop 1 & Workshop 2

DCC Staff: 2 persons. 1 person for Workshop 1 & 1 person for Workshop 2
[Duties-Filling the data sheet regarding “vehicle repair record” and “heavy equipment repair record” once in a week and transfer filled data sheet to DEO of Saidabad Garage in the following day]

4 Saidabad Garage

DCC Staff: 4 persons (2 each shift) for Saidabad Garage
[Duties-Filling the data sheet from logbook daily and transfer filled data sheet to Data Entry Operator (DEO) in the following day.]

Consultant: 1 person, Data Entry Operator (DEO)
[Duties-Enter the data into the database using customized software and modify the data as per correction sheet]

Consultant: 1 person, Data Controller (DC)
[Duties-Take print-out of data and verify with original data sheet. Make correction on print-out and handover to DEO for correction.]

5 Matuail Dump Site

DCC Staff: 8 persons (2 each shift) for Matuail Dump Site
[Duties-Filling the data sheet (in, out and weight of vehicle trip wise) daily and transfer filled data sheet to Data Entry Operator at Nagar Bhaban in the following day.]

6 Nagar Bhaban

DCC Staff: 2 persons for Nagar Bhaban
[Duties-get orientation with system, which is on-the-job training. They will manager of the application software after completion of pilot project B]

Consultant: 1 person, Data Entry Operator (DEO)
[Duties-Enter the data into the database using customized software and modify the data as per correction sheet]

Consultant: 1 person, Data Controller (DC)
[Duties-Take print-out of data and verify with original data sheet. Make correction on print-out and handover to DEO for correction.]

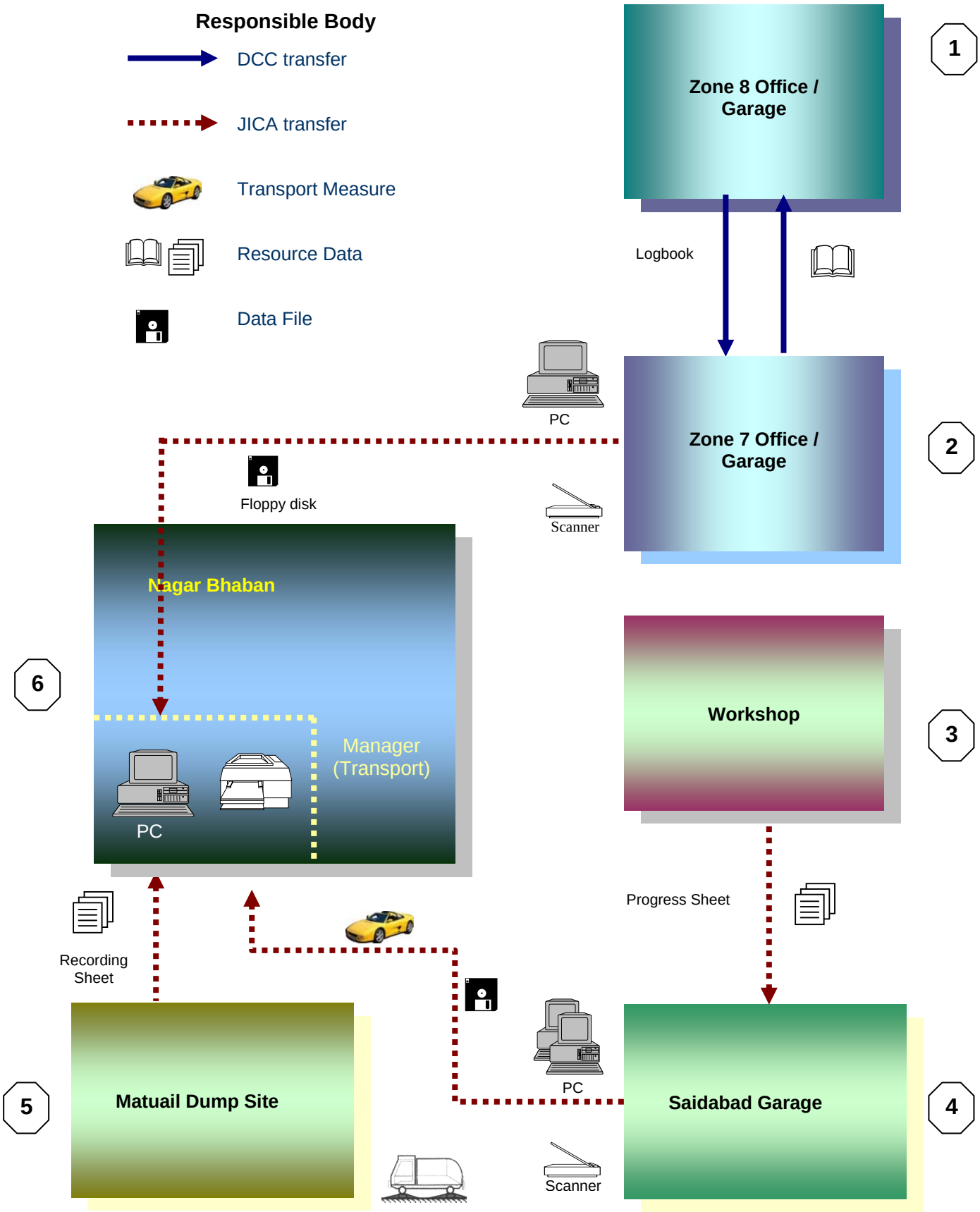


Figure 5.2-1 Location of Target Operation for Data Acquisition and Compiling

(2) DCC Staff Assigned to the Project Implementation

A meeting was held on 9-Aug-04 in the project office at Nagar Bhaban. In that meeting, DCC representatives have proposed some names of responsible persons from DCC for filling data sheet. Location wise list of the contact persons, responsible person from DCC is furnished in Table 5.2-1. DCC representatives to the meeting were Mr. Khandher Millatul Islam, Manager Transport and Mr. Dewan Md. Shah Alam, Deputy Chief Conservancy Officer and Engr. Anowar Hossain Patwary, Co-ordinator of CPU.

Table 5.2-1 DCC Staff Assigned to Pilot Project Implementation

Location	Contact Person	Person in Charge of Data Sheet(s)
Zone 8 Office	Mr. Nurul Hossain, Conservancy Officer, Mr. Mollah Moniruzzaman, TS	Mr. Bashudev Sarker, CSI Mr. Benozir Ahmed, CI
Zone 7 Office	Mr. Nurul Hossain, Conservancy Officer, Mr. Mollah Moniruzzaaman, TS	Mr. Moniruzzaman, CSI Mr. Shahabuddin Ahmed, CSI
Workshop 1	Mr. Ekramul Huque Khandakar, Assistant Engineer, Mechanical Division 1	1 person to be nominated
Workshop 2	Mr. Nurul Jaman, Sub-assistant Engineer, Mechanical Division 2	1 person to be nominated
Saidabad garage	Mr. Mijanur Rahman, Account Assistant, Transport Department Mr. Md. Faruque, Account Assistant, Transport Department	Mr. Mizanur Rahman, Accounts Asstt. Mr. Md. Faruque Mr. Shirajul Islam 1 person more to be nominated
Matuail dump site	Mr. Sanjib (6:00 a.m. to 2:00 p.m.), Mr. Liton (10:00 a.m. to 6:00 p.m.), Mr. Kalam (6:00 p.m. to 2:00 a.m.), Mr. Shahajahan (10:00 p.m. to 6:00 a.m.)	Mr. Sanjib Mr. Liton Mr. Kalam Mr. Shahajahan 4 more persons to be nominated
Nagar Bhaban	Mr. Dewan Md. Shah Alam, DCCO	

5.2.3 Schedule of Implementation

The project was started with data acquisition on September 1, 2004 and finished in January. The implementation seemed a tough work to those DCC staff involved in the project. As the result the progress proved uneven by targeted operation as shown in Table 5.2-2. For example, recording of workshop repair was started one month behind the schedule due to the delay of preparation of initial list of vehicles under repair. The original form of record for initial state and progress had covered much broader items to record, however, it was simplified by cutting off the contents into half for the staff in charge to catch up the time of commencement. Furthermore the progress of repair was reported only once in the project period though it was scheduled to be once a week.

The recording of conservancy vehicle reception and heavy equipment operation at Matuail dump site was substantially conducted by the consultant staff. DCC could not deploy sufficient number of staff to the recording work. Furthermore 4 DCC staffs for 24 hour operation were not always working at the point of duty. They sometimes disappeared and

come back the point of duty from time to time but never undertook the recording work whenever they were in the position. On the other hand, the staff from Transport Department tried hard to achieve their task. Owing to their efforts, recording work for conservancy vehicle at garages was completed throughout the project period.

Table 5.2-2 Execution of Pilot Project-B

work item	leading role	2004 Aug.	Sep.	Oct.	Nov.	Dec.	2005 Jan.	Feb.
Preparatory work: by DCC & JICA	DCC, JICA/ contractor				spent longer time for preparing initial list under repair			
Recording	DCC Staff							
Matuail Vehicle Reception	Concervancy Dep't					supported by consultant		
(load checker repair)						vehicle weight eye-measured instead of using load checker		
Matuail Heavy Eqpmt. Operation	Concervancy Dep't					supported by consultant		
Garage Vehicle Operation	Transport Dep't					record was not given to consultant everydy		
Workshop Repair	Engineering Dep't					record was given only once in 9 weeks		
Formulation of data base and processing	JICA/ contractor							
Technical transfer and reporting	JICA/ contractor							
Assignment term of the study team								

planned
executed as stated in TOR
executed in modified manner

5.3 Use of Operation Record

5.3.1 Acquired Operation Record

The operation record accumulated for 3 months of project period is summarized in Table 5.3-1. All the data is stored in the form of table by using Microsoft Access, ready-made database software which is installed in each computer prepared by the consultant. Therefore DCC staff can also handle and develop the data files with those computers by themselves provided that the computers are transferred by JICA to DCC.

Regarding the vehicle operation, the project gained an entire record for three-month continuous operation for both transport and landfill. Regarding vehicle repair to the contrary, the project gained little information to evaluate the activity quantitatively. It seems very

difficult for Mechanical Division to repot real time progress of their work to the top of the city management.

Table 5.3-1 Operation Record Acquired in the Project

name of data	remarks	designed number of items per record	number of record acquired
Heavy vehicle operation	daily operation record for each heavy vehicle at Matuail	12	488
Logbook	daily operation record for each truck and carrier at Garages	26	32,596
vehicle list	list of conservancy vehicle owned by DCC	9	417
vehicle operation	daily operation record for each truck and carrier at Matuail	30	18,400
Workshop status	weekly progress record of repair at WS	10	69
Workshop	initial list of vehicles under repair	19	118

5.3.2 Development of Database Application

Data accumulated in several databases are able to use for management purpose by processing with certain tabulation and graphic tools. Some of samples are shown below which are under development in the form of display programs.

(1) Heavy Vehicle Operation

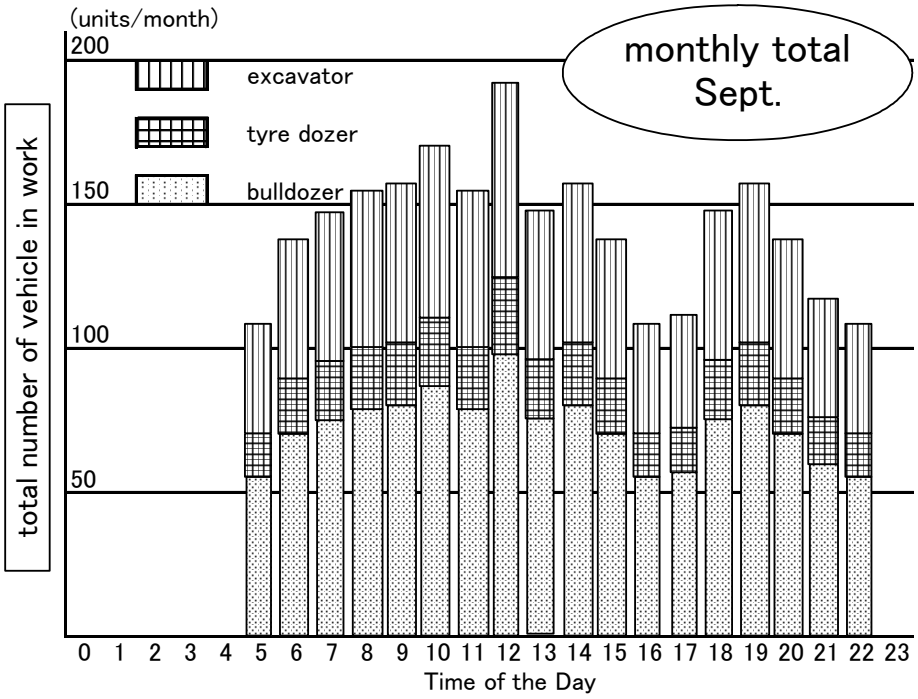


Figure 5.3-1 Monthly Total Operation Hours by Heavy Vehicle

(2) Logbook of Conservancy Vehicle Operation

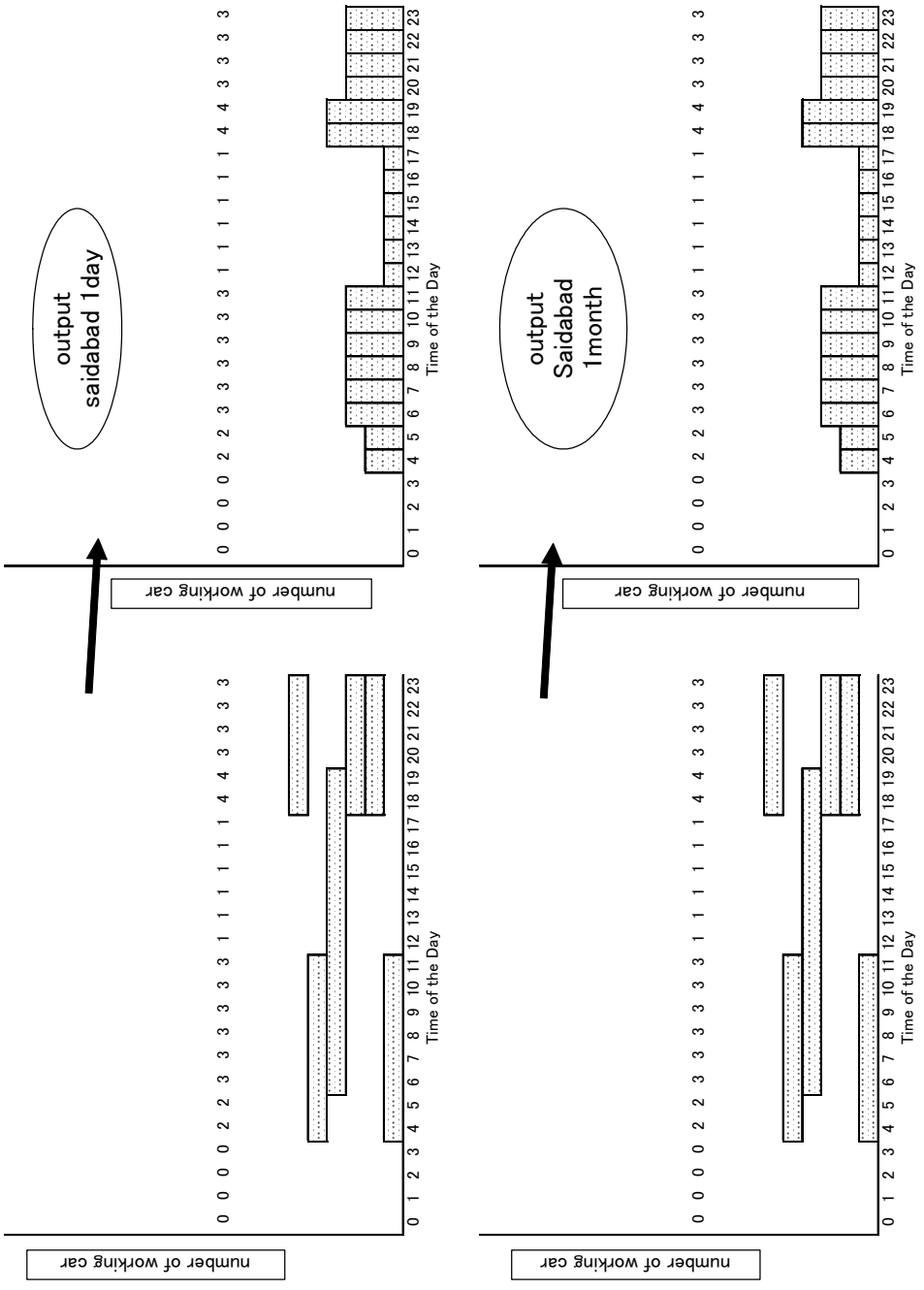


Figure 5.3-2 Total Working Hours of Vehicles

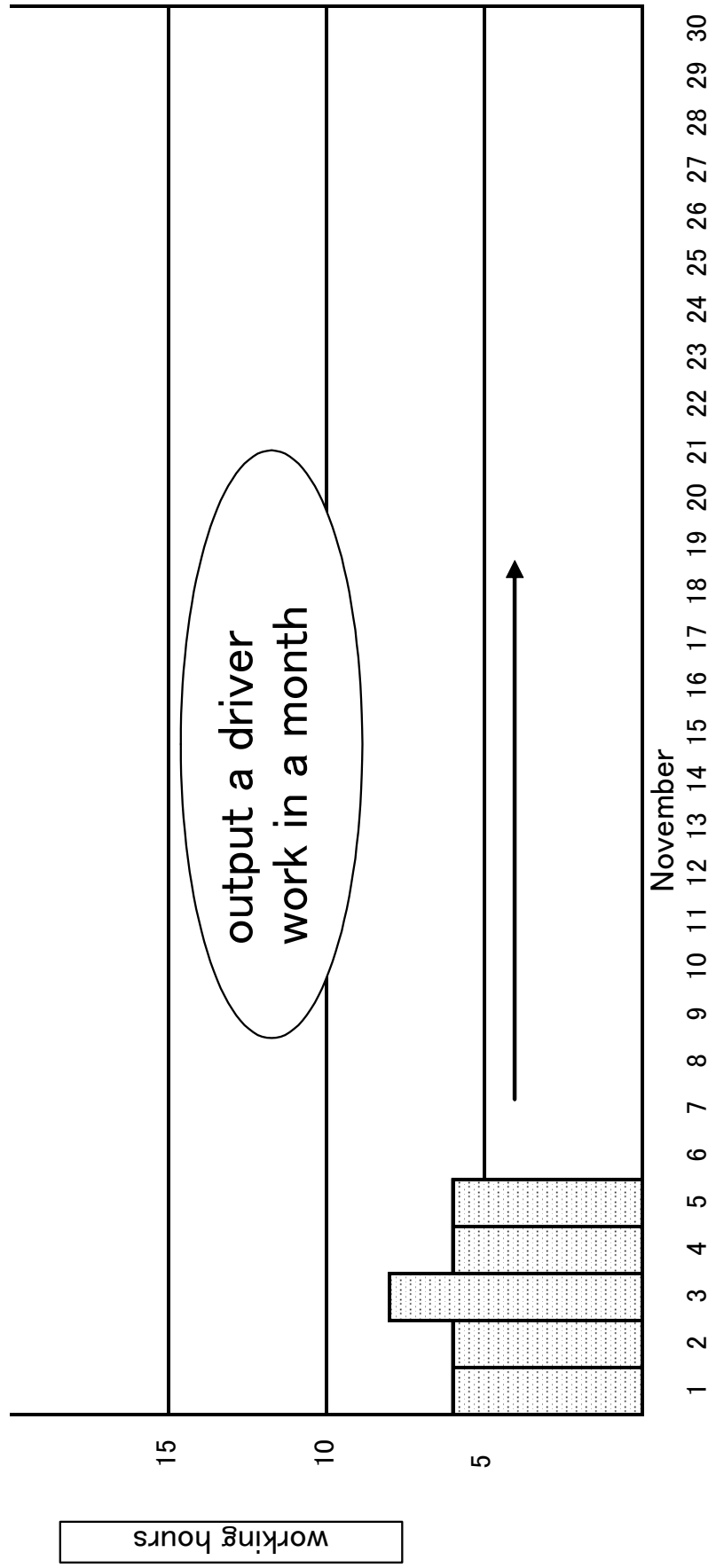


Figure 5.3-3 Daily Working Hours of Drivers

Table 5.3-2 Number of Trips to Job Areas

Number of Trips to JobArea on a Day

JobArea	CarNo					total
	JobArea_1	JobArea_2	JobArea_3	JobArea_4	JobArea_5	no. of trips
BAKSHI BAZAR						
BANGRAM						
BANOGRAM						
BONGRAM						
DAINIK BANGLA						
DOINIK BANGLA						
GREEN ROAD						
HATIR POOL						
Journalist Plot						
JURAIN						
Kachukhat Tamanna						
KAKRAIL						
Kuchu Khat Tammana						
MOGHBAZAR						
MOULABIBAZAR						
NAGAR BHABAN						
Rain Khola Bazar						
RAMPURA						
Rokaya Shoroni						
T&T						
ZERO POINT						

Number of Trips to JobArea in a Month

JobArea	CarNo					total no. of trips		
	JobArea_1	JobArea_2	JobArea_3	JobArea_4	JobArea_5	September	October	November
BAKSHI BAZAR								
BANGRAM								
BANOGRAM								
BONGRAM								
DAINIK BANGLA								
DOINIK BANGLA								
GREEN ROAD								
HATIR POOL								
Journalist Plot								
JURAIN								
Kachukhat Tamanna								
KAKRAIL								
Kuchu Khat Tammana								
MOGHBAZAR								
MOULABIBAZAR								
NAGAR BHABAN								
Rain Khola Bazar								
RAMPURA								
Rokaya Shoroni								
T&T								
ZERO POINT								

Table 5.3-3 Fuel Consumption by Vehicle Type

month	car type	total trips	total fuel supply	rate of fuel per trip (l/trip)
Sept.	DCC OT 1.5 t			
	DCC OT 3 t			
	DCC OT 5 t			
	DCC dump 5 t			
	DCC CC 3 t			
	DCC CC 5 t			
	Private OT 5 t			
	DCC long 22 t			
month	car type	total trips	total fuel supply	rate of fuel per trip (l/trip)
Oct.	DCC OT 1.5 t			
	DCC OT 3 t			
	DCC OT 5 t			
	DCC dump 5 t			
	DCC CC 3 t			
	DCC CC 5 t			
	Private OT 5 t			
	DCC long 22 t			
month	car type	total trips	total fuel supply	rate of fuel per trip (l/trip)
Nov.	DCC OT 1.5 t			
	DCC OT 3 t			
	DCC OT 5 t			
	DCC dump 5 t			
	DCC CC 3 t			
	DCC CC 5 t			
	Private OT 5 t			
	DCC long 22 t			

(3) Incoming Vehicle Operation to Matuail

Table 5.3-4 Measured Loaded Weight (September)

Measured Loaded Weight (September)

(1) DCC open truck capacity: 1.5 ton

sl. No.	date	vehicle no.	measured weight (t) trip 1	trip 2	trip 3	trip 4	trip 5	trip 6	trip 7	trip 8	trip 9	trip 10	total	trip total
1														
2														
3														
4														
5														
6														
total														
average													A	B

Average A A1 = total weight/total vehicle (t/d/vehicle)
A2 = total weight/total trip (t/d/trip)
Average B total trip/total vehicle

(2) DCC open truck capacity: 3 ton

(3) DCC open truck capacity: 5 ton

(4) DCC dump truck capacity: 5 ton

(5) DCC container carrier capacity: 3 ton

(6) DCC container carrier capacity: 5 ton

(7) Private open truck capacity: 5 ton

Table 5.3-5 Eye-measured Loaded Weight (September)

Other Data of Loaded Weight by Percentage*Capacity (September)

(1) DCC open truck capacity: 1.5 ton

sl. No.	date	vehicle no.	estimated weight (t) trip 1	trip 2	trip 3	trip 4	trip 5	trip 6	trip 7	trip 8	trip 9	trip 10	total	trip total
1														
2														
3														
4														
5														
6														
total														
average													A	B

Average A A1 = total weight/total vehicle (t/d/vehicle)
A2 = total weight/total trip (t/d/trip)
Average B total trip/total vehicle

(2) DCC open truck capacity: 3 ton

(3) DCC open truck capacity: 5 ton

(4) DCC dump truck capacity: 5 ton

(5) DCC container carrier capacity: 3 ton

(6) DCC container carrier capacity: 5 ton

(7) Private open truck capacity: 5 ton

(8) DCC long vehicle capacity: 22 ton

Table 5.3-6 Daily Total Load Coming to Matuail

date	measured estimated load (t/d)									
	DCC OT 1.5 t	DCC OT 3 t	DCC OT 5 t	DCC dump 5 t	DCC CC 3 t	DCC CC 5 t	Private OT 5 t	DCC long 22 t	other vehicle	total
04-09-01										
04-09-02										
04-09-03										
04-09-04										
04-09-05										
04-09-06										
04-09-07										
04-09-08										
04-09-09										
04-09-10										
04-09-11										
04-09-12										
04-09-13										
04-09-14										
04-09-15										
04-09-16										
04-09-17										
04-09-18										
04-09-19										
04-09-20										
04-09-21										
04-09-22										
04-09-23										
04-09-24										
04-09-25										
04-09-26										
04-09-27										
04-09-28										
04-09-29										
04-09-30										
total										
average										
04-10-01										
04-10-02										
04-10-03										

continued to Nov. end

Table 5.3-7 Daily Total Trips Counted at Matuail

date	number of trip									
	DCC OT 1.5 t	DCC OT 3 t	DCC OT 5 t	DCC dump 5 t	DCC CC 3 t	DCC CC 5 t	Private OT 5 t	DCC long 22 t	other vehicle	total
04-09-01										
04-09-02										
04-09-03										
04-09-04										
04-09-05										
04-09-06										
04-09-07										
04-09-08										
04-09-09										
04-09-10										
04-09-11										
04-09-12										
04-09-13										
04-09-14										
04-09-15										
04-09-16										
04-09-17										
04-09-18										
04-09-19										
04-09-20										
04-09-21										
04-09-22										
04-09-23										
04-09-24										
04-09-25										
04-09-26										
04-09-27										
04-09-28										
04-09-29										
04-09-30										
total										
average										
04-10-01										
04-10-02										

continued to Nov. end

Table 5.3-8 Average Unloading Time at Matuail

Unloading time = (time-out) – (time-in) for One month

(1) DCC open truck capacity: 1.5 ton

sl. No.	date	vehicle no.	time spent (minutes) trip 1	trip 2	trip 3	trip 4	trip 5	trip 6	trip 7	trip 8	trip 9	trip 10	total	trip total
1														
2														
3														
4														
5														
6														
total														
average													A	

Average A total time/total trip

(2) DCC open truck capacity: 3 ton

(3) DCC open truck capacity: 5 ton

(4) DCC dump truck capacity: 5 ton

(5) DCC container carrier capacity: 3 ton

(6) DCC container carrier capacity: 5 ton

(7) Private open truck capacity: 5 ton

(8) DCC long vehicle capacity: 22 ton

Summary Unloading time

month	monthly total unloadir (minutes) CC OT 1.5	DCC OT 3	DCC OT 5	CC dump 5	DCC CC 3	DCC CC 5	rivate OT 5	CC long 22	ther vehicle
September									
October									
November									
total									
	monthly total trips								
September									
October									
November									
total									
average									

average = total unloading time/total trips

(4) Vehicle Maintenance by Workshop

Table 5.3-9 Number of Car by Repair Mode

Conservancy Vehicle

type	capacity	number of car						
		stock	operating	under repair	DCC repair	contract out	ready to deliver	missing
open truck	1.5 ton	94		22			6	
	2 ton	18		5			0	
	3 ton	106		15			4	
	5 ton	36		2			0	
container truck	3 ton	94		13			5	
	5 ton	34		3			0	
trailer truck	22 ton	3		0			0	
total		385		60			15	

Landfill Vehicle

type	capacity	number of car						
		stock	operating	under repair	DCC repair	contract out	ready to deliver	missing
bulldozer								
excavator								
tyre dozer								
dump truck								
total								

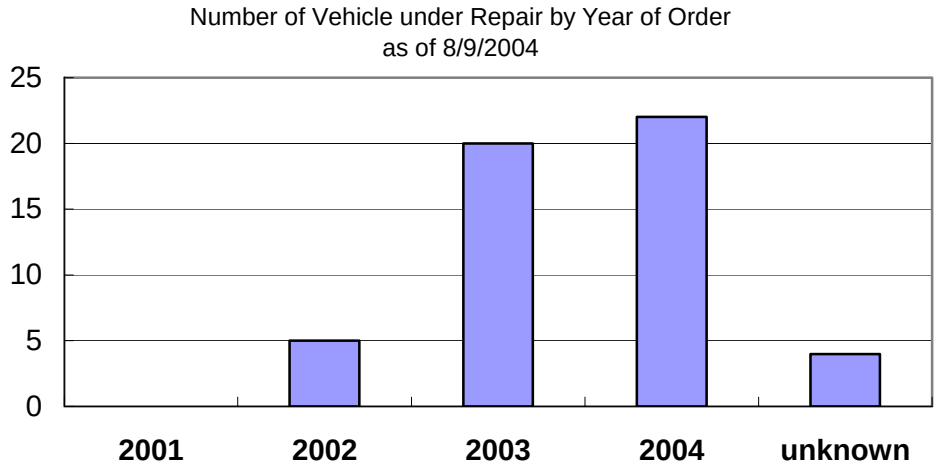


Figure 5.3-4 Number of Car under Repair by Year of Order
(Heavy Vehicle)

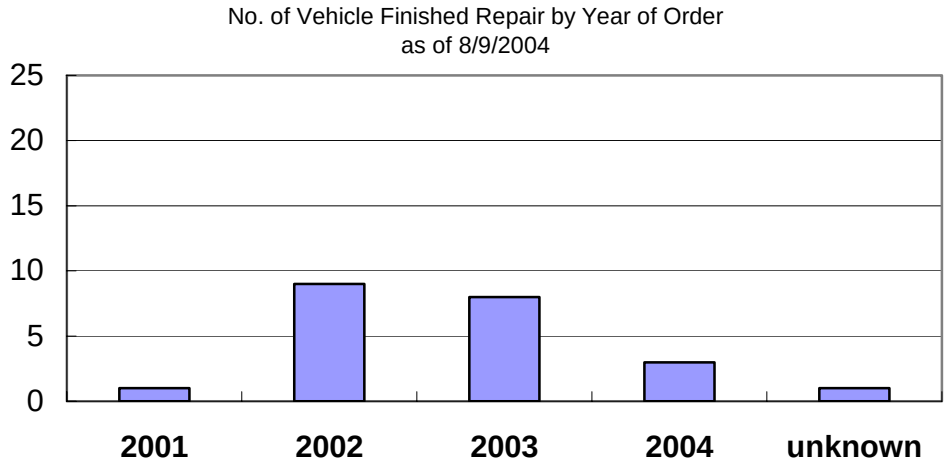


Figure 5.3-5 Number of Car Finished Repair by Year of Order
(Heavy Vehicle)

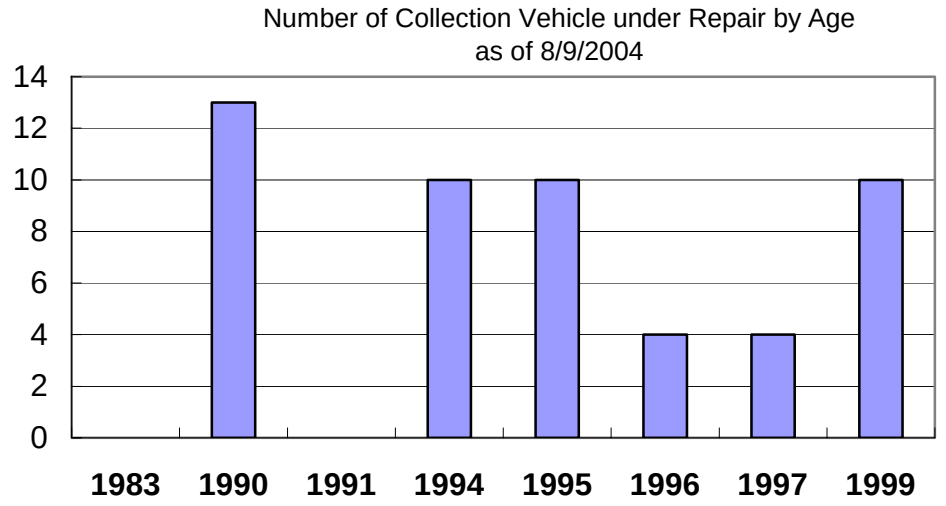


Figure 5.3-6 Number of Car under Repair by Age
(Heavy Vehicle)

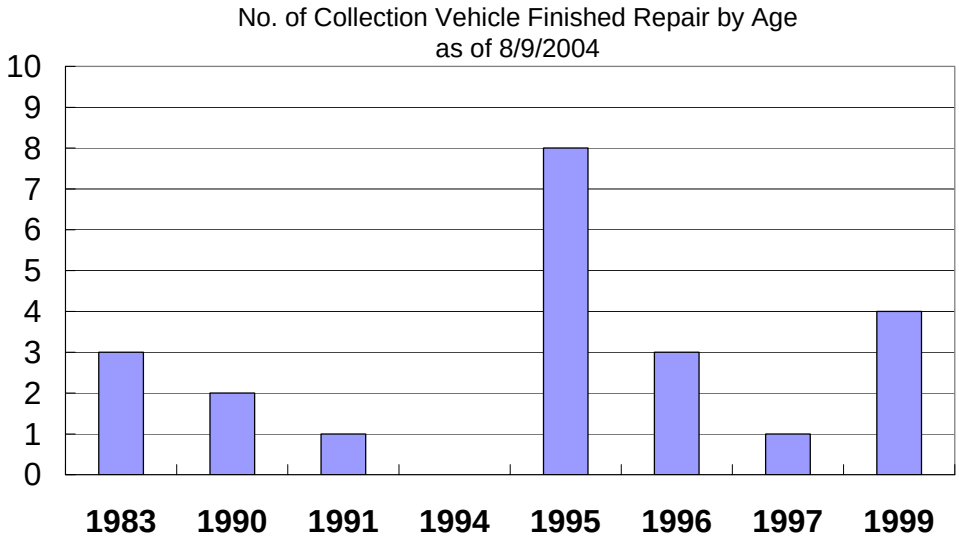


Figure 5.3-7 Number of Car Finished Repair by Age
(Heavy Vehicle)

5.4 Findings of the Project

5.4.1 Adaptability of DCC Staff to Monitoring of Operation

It is systemized to record daily operation at the garage and the workshop but not destined to report periodically to their superiors for their check. Conservancy Department instructs ward inspectors to record daily operation of road cleaning, however, they are just laid up at respective zone offices instead of reporting regularly to the higher officers of the commanding chain. The records of cleaning work are at present not used for evaluation of activity of staff in the charge. There is no recording system for vehicle acceptance at any dump site and heavy equipment operation for landfill either.

This project aimed at introducing two different activities to the daily routine by grade of present recording practice as shown in Table 5.4-1.

Table 5.4-1 Introduction of New Recording System

present practice	corresponding activity	new recording system
adopts daily recording	a. Transport Department Garage b. Mechanical Division Workshops	convert handwriting record into electronic file
no recording	Conservancy Dept. at Matuail for vehicle acceptance and landfill equipment operation	a. manual recording for 24-hours everyday b. convert handwriting record into electronic file

In this project, the conversion of record to electronic file is assigned to the consultant having capable staffs ready to answer the kind of task due to limited time for implementation though it must be undertaken by DCC staff in view of utmost goal of the project.

Even for those DCC staffs so far executing daily recording, it seems difficult to finish recording within the day of operation. The requirement of timely recording means an additional burden to them because they have somehow managed to fill out everyday record by

finding time in a few weeks of interval. Furthermore for those so far had no experience of daily recording, it seems beyond their adaptability in such short time period as assumed for the pilot project. They are not accustomed to staying without intermission at the location of work as long as they are assigned to work. This difficulty results in their dependent manner of participation in the project.

5.4.2 Adaptability of Portable Load Checker

The project adopted a portable load checker which had been used for waste amount survey for two times in dry season and wet season, for a week each time. The equipment has a simple structure and needs a lot of care in the use for measurement. It requires precise placement of wheel of vehicles that causes very careful guide of vehicle onto the censor of equipment. This work for guiding vehicles to the right position on the equipment requires at least two staff in addition to measurement and recording. It becomes apparent this much labor intensive measurement does not suit to daily routine for long term operation.

In spite of careful guide of vehicle, vehicle sometimes fell off the sensor. The sensor bounced and fell down to the ground pulling the signal cable attached to it when a vehicle fell off the sensor. Some vehicles pushed forward or backward the sensor when they climbed onto it or leaving. This kind of rough behavior injured electric connection of equipment for sometimes in two weeks at the beginning. The consultant made an instant repair of injured electric cable, however, the equipment became completely out of work soon. After that the measurement of loaded weight was changed into “eye-measurement” instead. The equipment was brought to Japan for repair and came back at the end of the recording period, end of November.

As a conclusion, the portable load checker should not be expected as part of Management Information System that would be introduced in future. Instead of portable and simple load checker, an automated weighing bridge with larger capacity is recommendable to the purpose.

5.4.3 Adaptability of Recording Equipment

The project prepared a set of electronic apparatus as follows. Procured equipment all showed enough performance in both quality and quantity to implement the project. The set of equipment will be able to work also for the Management Information System in future.

- 4 units of computer with software and UPS
- 1 unit of laser printer

5.4.4 Discrepancy of Vehicle Operation Record

Vehicle operation was recorded by two different sources, at garage based on logbook and at Matuail based on identifying the car and driver. Two records of different sources must be in accord each other, however, they showed an apparent difference particularly in number of trips as shown in Figure 5.4-1.

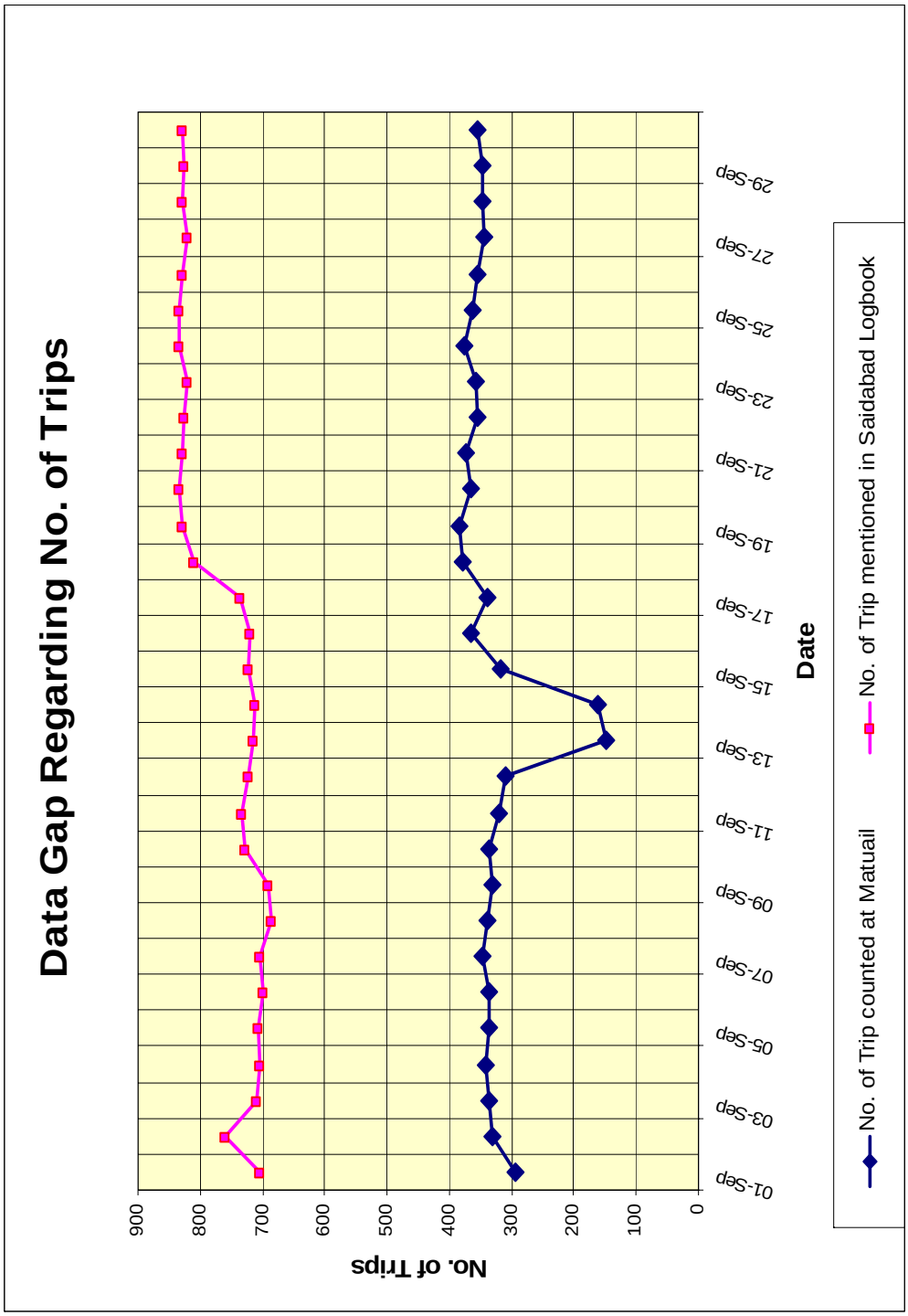


Figure 5.4-1 Data Gap on Number of Trips to Matuail

The number of trips recorded in logbook finds almost twice as many as that is recorded at the entrance of Matuail dump site. The number of trips at Matuail is counted by the consultant staff in this project. The remarkable case happened on September 13 to 14 when we had 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 of count at Matuail in the chart while the number of trips by logbook does not show abnormal situation at all. The record at Matuail has less possibility to undergo some artificial modifications over the data than that of logbook. On the other hand, the logbook is filled by Accounts Assistant at Saidabad garage based on the report from each driver. The number of trips and job area for each trip are counted as the basis of estimation of fuel consumption.

The discrepancy is too big to justify recording operation by spending a considerable manpower and time for this purpose. The fact must be clarified before going further to introduction of Management Information System (MIS). The clarification should be executed by DCC itself if it intends to go for MIS regardless the efforts is envisaged within its capacity or counting foreign assistance.

5.5 Interim Evaluation of the Project

5.5.1 Inadequate Staff Deployment and Task Definition to Monitoring of Operation

Target operation of the project ranges three departments and the duty of record and report are set as shown in Table 5.5-1.

Table 5.5-1 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

5.5.2 Proposed Solution for Conservancy Department

Conservancy Department assigns four inspectors at Matuail dump site at present. The four staffs are divided into two crews and take up the two-shift work on site, however, their duty is not clearly defined. The pilot project requested them to record traffic and load of conservancy

vehicles for 24 hours on four-shift. The four-shift resulted in two different staffing alternately, namely single staff and double staffs for peak hours. The number of staff was too few to cope with the request of recording. It was necessary much more staff at work but Conservancy Department could not afford to deploy additional staff. The similar recording work had been carried out by four people in the subcontracted waste amount survey. Then the shortage was compensated by the consultant as the emergency case. Moreover the request of recording had an unacquainted nature to them that forced them to keep position at the entrance of dump site and continue to work throughout the working hours.

It is necessary to solve the restrictive factors stated above in order to make the collection and transport operation manageable. It is also the major premise to introduce MIS in the future. The measures for the solution are proposed as follows.

(1) To Shift the Source of Trip Number from Logbook to Reception Record at Dump Site for Matuail

The present record of number of trips to dump site in the logbook seems to have some intentional deformation. To avoid manipulating record, the source of information should be shifted to the record at Matuail at least for those coming there.

(2) To Establish Job Description for Recording

DCC shall define the tasks of entrance control at Matuail dump site where the study team proposes formulation of a task force for managing landfill operation.

(3) To Assign Enough Number of Staff or Out-sourcing at the Entrance of Dump Site for Recording

DCC shall assign enough number of staff for entrance control of conservancy vehicle and others to come in for dumping waste at Matuail. The study team recommends that two crews with two staff in each crew be deployed to cover the assigned task.

(4) To Install a Fully Automated Weighing Bridge Which Enables One-shot Measurement

To make the record at dump site more convincing, it is recommended to install a weighing bridge at the entrance of Matuail dump site, only one official facility of DCC. For future extension, additional equipment need to be installed one unit for each site.

(5) To Train Recording Staff to Realize Reliable Recording

Recording work requires patience as well as the skill of recording necessary items without causing any delay in transport of waste. Present level of DCC inspector at Matuail needs much improvement. Moreover DCC needs additional new staffs to assign to entrance control at Matuail. It is recommended DCC train both existing and fresh staff by the time the weighing bridge is installed and getting ready for operation.

(6) To Send Record to the Top Management and Transport Department to Valuate Driver and Fuel Consumption

It is recommended that the four computers are used for MIS by connecting each other through internet. The study team requested CCO to install four T&T telephone lines to realize the connection on September 22. In addition to those computers procured in this project, the study team recommend to install three more units for the use of the task force proposed by the study team.

5.5.3 Proposed Solution for Transport Department

The study team appreciates the current practice of recording with logbook that covers most of the requirement of management in view of the items to be filled with. The defect of present system is the record is not used for the purpose of management except for refilling the fuel. The fuel provision to each vehicle is processed by means of "fuel ticket" as shown in Figure 5.5-1. The process for the payment of fuel cost starts from the approval of Manager Transport by getting signatures in three-connective sheet of "fuel ticket". The "fuel tickets" are prepared by an Accounts Assistant everyday or every other day for all conservancy vehicles. The work volume for ticketing gives a significant burden to the Account Assistant and Manger Transport because of huge number of vehicles. Further more the Account Assistants are writing logbooks in place of drivers in principle everyday. Thus the top officers at the front of collection and transport spend considerable time for repeating work with fixed pattern instead of managerial work.

The reason why the logbook is not used for managerial purpose is that the volume and the form of data are inconvenient for the managing staff to review. This problem can be solved only when DCC introduces a well-designed MIS into managing routine, however, there still remain other problems to be solved in waste collection and transport.

(1) To Fill Out Logbook Everyday by Drivers Themselves

This is considered to be a part of the task of drivers. Moreover those drivers working in Mirpur write logbook by themselves even now. It is an urgent need to release two Accounts Assistants from extra job that enables them to take care of managerial matter of collection and transport.

(2) To Review Contents of Logbook

The item of "fuel consumption" is not an objective record much less created by drivers. This indicates the less necessity of containing this item in the logbook. The figure shall be evaluated by objective information like type of vehicle, load transported, number of trips by origin and destination and running distance. Among these information, the number of trips to Matuail can be provided separately by Conservancy Department which records incoming traffic of conservancy vehicle.

(3) To Decentralize the Valuation of Driver and Fuel Consumption

As part of institutional reform, the study team proposes shift the task of conservancy vehicle control from Saidabad Garage to each Zone as is adopted in Mirpur at present for Zone 7 and Zone8.

(4) To Recover and Keep Function of Distance Meter of All Vehicles

Most of conservancy vehicles are not equipped distance meter in the cabin. The distance record is an essential data as the basis of rational valuation of fuel consumption so that the function must be recovered. It is also necessary to keep 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 them as target of repair by Mechanical Division-1. The drivers shall be imposed responsibility for the function of distance meter as well as the vehicle as a whole.

5.5.4 Proposed Solution for Mechanical Division of Engineering Department

As for Landfill operation, there is no job description and no job record either. As for repair of vehicles, there is a record of status: under repair, under process of repair order, waiting for delivery after repair, however, there is no rule for periodical report of the progress to the top management and vehicle users like Transport and Conservancy Department. As experienced in the pilot project B, it takes 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 left uninformed when they can expect the completion of repair.

The repair usually takes long time. Half of vehicles that finished repair in 2004 had taken two years since the request of 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. If the delay of repair derives from the fundamental rules of Mayor's decision over tender, there is no hope to shorten the time spent for repair. In that case DCC should go to partial privatization of collection, transport and landfill operation. DCC may keep the ownership of vehicles or may not provide vehicles to the partner in the contract for operation.

Another reason of long time consumption for repair is considered to be extreme use of vehicle longer than 10 years. Older vehicle tends to cause failure more frequently than new ones but there is no definite rule to abandon aged vehicles. If DCC keeps the direction to own the vehicles for both collection/transport and landfill, the shorter use of them should be taken into consideration in view of total expenses per:

a) cumulative total amount of waste carried or,
b) cumulative total distance run or,
c) cumulative total hours operated.

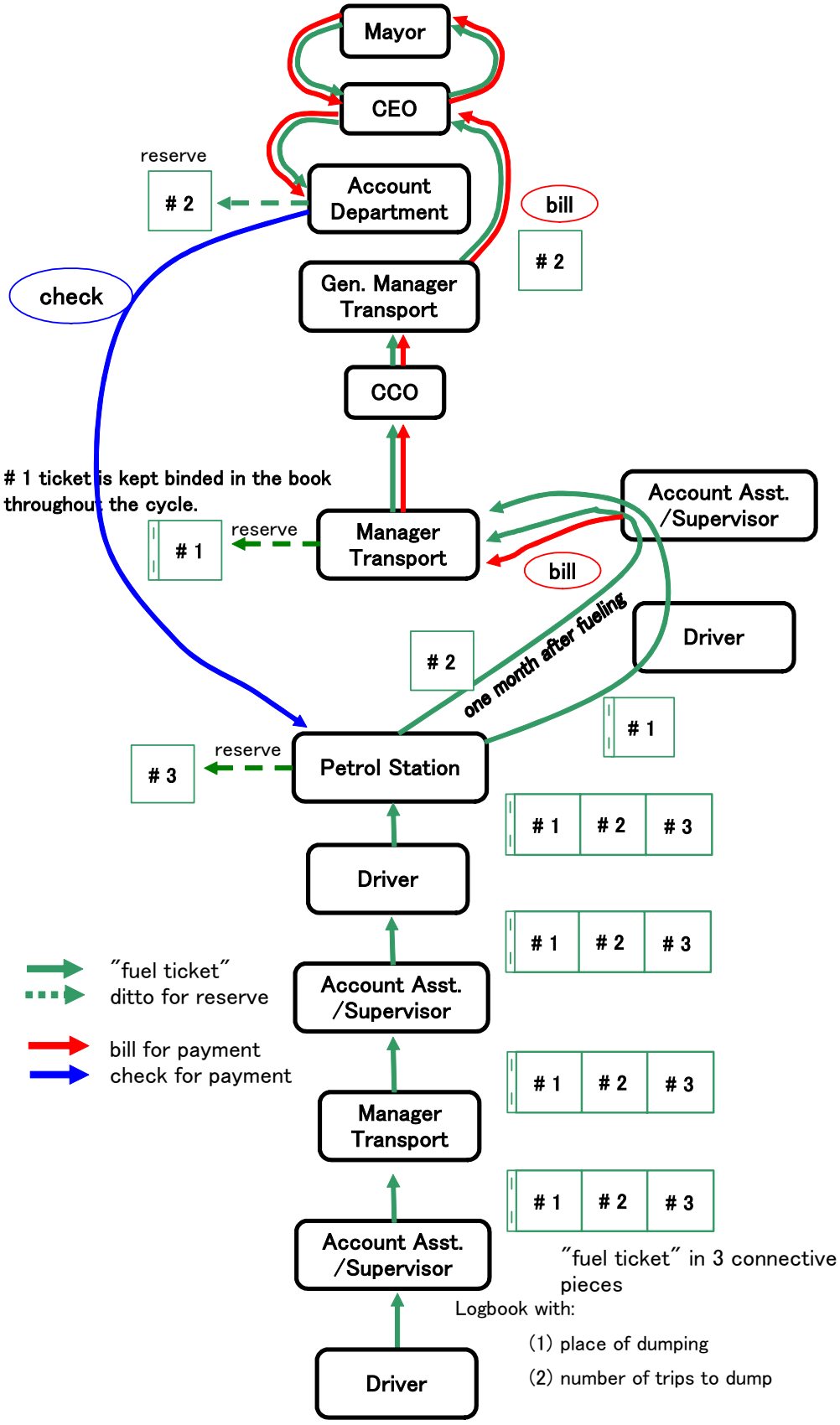


Figure 5.5-1 Procedure to Authorize Payment by "Fuel Ticket"

Chapter 6

GIS Report

6.1 Charts

6.1.1 The use of GIS

The objective of GIS in the study was to prepare tabular data for the present evaluation and the future prediction about solid waste ands to prepare map production to support master plan. There were three types of the use as follows:

- For tabulation
  In addition to population data and the analysis data about SWM facilities, primary collection service and transport on the ward-wise and the zone-size, tabular data was prepared by GIS overlay operation by using land use and building and others for the purpose of the present evaluation and the future prediction in SWM.
- For map preparation
  GIS was used for preparation of maps relating to that of master plan in the study by using analytical function and map production's function for its system to provide with.
- For Facility Management
  In order to grope the future facility management of solid waste management, surveyed data was designed to GIS data in the primary service which contained waste container and dustbin, location of illegal dumping site and open dumping spots, and medical facilities which special waste generated such as hospitals, clinics and diagnostic centers.
  GIS data was developed by the study.

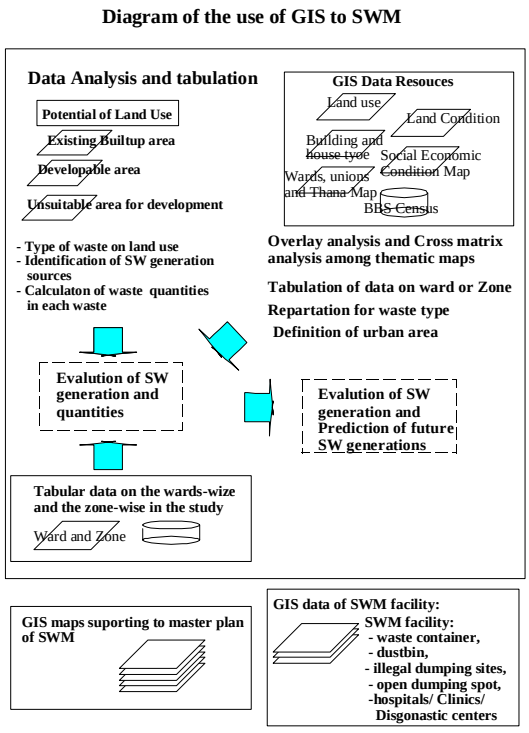


Figure 6.1-1 Diagram of the use of GIS

Diagram of the use of GIS in the study is shown in Figure 6.1-1.

In order to apply GIS to the study, it is necessary to make the use of GIS clear and also makes it clear to design of database in the process. GIS can not solve problems and issues, but GIS can support the practical planning as a supporting tool. Contribution of GIS activity in the study is mentioned in Figure 6.1-2. From point of view about Facility Management in GIS, if once established those databases, updating and maintenance make it easy in DCC. Also the truth of installation's numbers became obvious.

Process of Master plan	Process of Study	The use of GIS
Study and Preparation of master plan	Survey activities relating to preparation for master plan	Production of Geographic Information data in the study Production of Geographic Information data using existing data
↓	↓	↓
Preparation of master plan	Practical condition for preparation of master plan: - Prehension, - Analysis, - Evaluation, - Prediction	GIS functions: - Display of information - Data query and display - Survey and analysis: - Overlay and tabulation by query - Link of relevant data -Production of thematic map and evaluation map, - Map printing
↓	↓	↓
Implementation of master plan	Monitoring and Maintenance of master plan	Application development for Solid waste Management: Monitoring of plan, Supporting plan, Updating of database, Facility Management and other application developments

Figure 6.1-2 Relation between the process of study and the use of GIS

GIS data resources used in the study were as follows:

- Tabular data and analysis data on the ward-wise such as population, statistic data in the study
- SWM facility data concerning to the primary collection such as waste container, dustbin、illegal dumping site and open dumping spot、medical facilities about hospitals, clinics, and diagnostic centers.
- Thematic maps of Geographic Information produce by the JICA study in SOB: The Study on Urban Information Management for Greater Dhaka City
- land use, land condition, social economic condition and building and housing type relating to solid waste generation sources, road condition concerning to accessibility to collection vehicle and administrative boundaries concerning to population census and grand elevation relating to flooding to make an influence for SWM operation in flood season.

In the study area it was extremely difficult to acquire the latest and the most reliable basic data, so it became important data resources for topographic map and thematic maps compiled on those base maps.

6.1.2 Main GIS resources

6.1.2.1 GIS data resources in the Study

The field survey data was compiled to GIS data about waste container and dustbin including those capacities for primary collection service, location of illegal dumping sites and open dumping spots, and location of medical facility of hospitals, clinics and diagnostic centers which was relating to special waste generation sources. Field survey was carried out by the cooperative work between DCC and the Study team. All the survey forms in the field were compiled to tabular data and data made properties to link to location data of GIS data. But location of dumping sites was not identified on maps because surveyors could not identify locations on maps. The procedure of GIS data preparation is explained in the Appendix-1:"Preparation for GIS Data of the SWM/Facility". GIS preparation is also explained in the chapter2 in the supporting report. Contents of GIS data are shown in Table 6.1-1.

Table 6.1-1 Lists of data preparation

Item of GIS data	Contents of GIS data
Data specification of Container box and dustbin	Point data of those facilities. Data includes specification of volume capacities: (1) Zone number, (2)Ward number, (3)Type of facility,(4)Sub-id number of each facility, (5)No. of Dustbin/ container, (6)Description of Container box/ Dustbin Location,(7)Container box/ Dustbin specification (inch),(8)Container box/ Dustbin specification (inch),(9)Container box/ Dustbin specification (inch),(10)Actual Volume of Container (ton),(11) Actual Volume of Dustbin(ton)
Data specification of Medical facilities	(1)Zone number, (2)Ward number,(3)Type of facility,(4)Sub-id number of each facility,(5)description of Hospital/Clinic/Diagnostic center, name, address & Bed no.

There are two types of tabular data in ward-wise and zone-wise which are the analysis data relating to evaluations and predictions of SW generations, transport and etc. Those data were projected to demography data of GIS outputs. The first data relates to data analysis in the Study. The second relates to cross tabulations between thematic maps and tabular units in each ward and in each zone, which data was prepared by the ovelay operation in GIS. This theme is mentioned in the next chapter.

6.1.2.2 GIS databases in JICA Study

In addition to the study, GIS data was produced by the incorporation of the JICA study in close cooperation with Survey of Bangladesh:The Study on Urban Information Management for Greater Dhaka City in the People's Republic of Bangladesh". The study has been carried out the during the period from November 2002 to July 2004. The following thematic map and GIS basic data were produced for the Study: land use map, land condition map, socio economic condition map and building and housing type map, administrative boundary map and road condition map. All thematic maps were produced on topographic map based on photogrammetry method. Thematic maps were prepared by the conventional interpretation

method with reference of existing maps and exiting materials, and spot's field verification survey.

So that the study could get necessary data by using supplied data for GIS operation such as overlay, query and tabulation. The contents of data are referred to GIS Database Development for SWM Study in Appendix-2. GIS preparation is also explained in the chapter2 in the supporting report. The summary of GIS data is shown in Table 6.1-2.

Also GIS basic data which was as a general thematic item in digital mapping and which there were administrative boundaries of unions and wards, roads, public facilities and hydrographic data about waterline, were used for overlay's information on thematic maps.

Table 6.1-2 Lists of data preparation

Item of GIS data	Categories of GIS data
Land use data	(1)Housing area,(2)Industrial area,(3)Commercial area,(4)Mixed area (Housing & commercial),(5)Public facilities(Government office, institute, school, hospital, religious establishment, monument),(6)Park, (7)play ground and public green area,(8)Brick field (Brick factory), (9)Cultivated low land (Normal flood area),(10)Cultivated high land (Safe area from normal flood),(12)Forest,(13)Bush,(14)Grass land, (15)Open space,(16)Unclassified/restricted area,(17)Road(over 5 meters)/railway,(18)Swamp and marsh,(19)Water bodies such as river, lake and pond
Land condition data	(1)Flat area lower than 4.0 m called low-lying area,(2)Plateau higher than 4.0 m called alluvial terrace,(3)Swamp and marsh,(4)Water bodies such as river, lake and pond,(5)Natural embankment also called natural levee (lower than 4.0 m),(6)Natural embankment also called natural levee (higher than 4.0 m),(7)Former riverbed (lower than 4.0 m),(8)Former riverbed (higher than 4.0 m),(9)Location of drainage pump;
Social-economic condition data	(1)Residential area (High socio-economic condition) such as "Dhanmondi",(2)Residential area (High socio-economic condition) Area where foreigners are mainly livingsuch as "Gulshan" and "Banani",(3)Residential area (Middle socio-economic condition.) excluding item (1),(2) and (4),(4)Residential area (Low socio-economic condition): the slum and an area where low-income group is living,(5)New developing residential area (plan & on going) collected by hearing survey in the site,(6)Mixed area,(7)Main restaurant,(8)Main hotel Prior to commencement of field survey,(9)Market/shops,(10)Big katcha bazaar (Authorized by DCC),(11)Supermarket such as Agora
Building and housing type data	Building Type(1)1～3 stories",(2)"4～6 stories",(3)"More than 7 stories" and (4)Slum. Housing Type:(1)Apartment houses,(2)Big commercial building, private office & shop(Large commercial buildings, offices and shops),(3)Public offices(Government building office, public service office),(4)Factory , (5)Religious facilities, mosque, temple, church,(6)Health facilities (hospital, big clinic),(7)Education facilities, (8)Houses Detached Houses;
Data concerning to the flood hazard	(1)Measurement of elevation of flood marks of 1998 by leveling survey (2) DEM calculated from 1:5,000 scale digital topographic maps (3)Identification of inundated areas by the interpretation of SPOT Satellite image of 1998 and 2002
Administrative boundary data:	(1)Urban area: Division, District, Thana, Ward (2)Rural area: Division, District, Thana, Union
Road condition data	Road Width:(1)Road width less than 5 m,(2)Road width between 5 m and 10 m,(3)Road width more than 10 m Road Type: Status of pavement:(1)Paved: metal on topographic map,(2)Unpaved: un-metal on topographic map

6.1.3 Development of GIS output

According to the available data, GIS data outputs were compiled to support master plan. Items of GIS outputs were determined as shown in Table 6.1-3. There are several combinations of GIS outputs' productions as follows:

- New data entry of existing data resources in the study
- Some of existing print maps were compiled to thematic maps on topographic maps in the JICA SOB Study by digitizing.
- Recompilation of existing thematic maps
- By means of re-compilation of land use map that is one of key information of the Study, new types of thematic maps were produced for type of present waste, the future potential of those wastes, the estimation of SW generators, and the prediction about SW amount and so on.
- Some of thematic maps were produced by combinations of thematic maps among land use map, land condition map, socio economic condition map and building and housing type map, administrative boundary map and road condition map.
- Demography data of tabular data in the ward-wise and in the zone-wise
- Tabular data relating to the primary collection, collection and transport, service providers, the analyzed data for the present SW generations and those quantities and the prediction of those data was projected to ward boundaries or zone boundaries.
- Recompilation of existing thematic maps
- Thematic maps of existing maps scale were compiled to thematic maps on 1:10,000 maps: land use map, land condition map, socio economic condition map, building and housing type map, administrative boundary map and road condition map;
- Considered with the influences of operations of primary collection service and transport, flooding level corresponding to the grand elevation was simulated by re-compilation of DEM data.

The coverage area of GIS outputs is shown in Figure 6.1-3. The detailed map compositions of those outputs are explained in the chapter2: Electronic Media.

Table 6.1-3 Lists of GIS outputs

Item	Map Item	Contents of Data	Resources and notes
1. Land-use and Rezoning	Ward and Zone map	DCC Zones and DCC Ward boundaries	Zones boundaries and Ward boundaries in DCC
	Buildup Area Map	Urban growth of Dhaka city	Urban Growth of Dhaka City in DCC Guidebook: Urban area in 1960, in 1980, in 1990 and in 2002
	Land-use map, Rezoning map, Regional geographical maps (Present and Future)	Present land use map	GIS data for Land use map for SWM in SOB JICA Study
		Land use planning map	RAJAK: DMDP Dhaka Urban Area Plan 1995-2005 DMDP Structure Plan 1995-2015
	Protection area map	Protected area against any development such as public facilities, historical buildings/facilities.	DCC Guidebook, topographic map in SOB JICA Study and land use map and etc.
2. Solid Waste Generation Sources and The Relevant	SW Generator sources map	SW discharge map in each Ward using land use map to estimate area of SW type	Population data(BBS, Study Team) Study result of SWM Discharge(data and other data usable to estimate the unit SW discharge rates)
	Location map of large scale/ Special SW generators	Supposed area of Large Waste Generation＆Special Waste Generation: Large building, market, medical facilities, industrial area, restaurant and government office	GIS data of Land use map, Building and Housing Type Map and socio economic condition map for SWM in SOB JICA Study, Public facility data in SOB JICA Study
3. Primary collection and Secondary collection service map	Primary collection service map	Demography data of primary collection service supported by the Study results	Ward map,Study result about Dustbin/Container storage capacity map: numbers of dustbin and container, storage capacity of volumes, Type of container(D,3C,5D), facility condition of those facilities
		Accessibility map to dustbin and container box	Buffering map with 100m interval to existing Dustbins and existing Container boxes
	Collection/Transportation capacity map	Demography data of Collection/ Transportation Capacity and Evaluation map of Disposal and collection of SWM capacity in each ward	Ward map, Study result about Collection and transportation capacity: Open/Covered Truck: number, capacity(1.5 ton, 3 ton, 5 ton), working zone, working ward; Container Carrier: carrier number, type of capacity(3 ton, 5 ton), working zone, working ward
		Accessibility map of heavy vehicles for collection/Transportation	Road condition map, Location map of waste container and dustbin
		Flood risk area in collection service	Combination map by accessibility map of heavy vehicles for collection/Transportation and natural condition map for flooding.
	Primary and secondary service system: map	Demography data of collection system/Service in private sector in wards	Ward map, Study result of service providers: DCC, NGO, Private sector
	Open space /Area Map Analysis of potential disposal sites	Suitability map for Disposal Site using land use map processed by buffering analysis from open space	GIS data of Land use map for SWM in SOB
	Location map of SWM facilities	Facility map of SWM: DCC/Zone office, Dustbins, Waste containers, Disporsal site, Illegal Dumping sites etc	Surveyed results of waste container and dust-bin, Hospital and clinic data in the JICA SOB study in 2004.
4. Utility map of sewer and drainage	Sewer network	Location map of main sewerage network and lift stations	Primary sewerage system map, WASA in 1993
	Drainage network	Drainage pipe and related facilities:	Embankment, Proposed embankment, R.C.C. Flood wall, Sluice gate, Storm sewer main line, Pumping station, Channels, Box cover WASA in 1994

Item	Map Item	Contents of Data	Resources and notes
5. Re-compilation of existing GIS data:	1:10,000 Base map	Blank map for SWM	Ward boundaries and zone boundaries, roads, buildings, hydrographic data from GIS basic data in the JICA SOB study in 2004
	Land condition map	Recompiled map of land condition map	Land condition map in the JICA SOB study in 2004
	Social economic condition map,	Recompiled map of social economic condition map	Social economic condition map in the JICA SOB study in 2004
	Building and housing type map	Recompiled map of building and housing type map	Building and housing type map in the JICA SOB study in 2004
	Administrative boundary map,	Recompiled map of administrative boundary map	Administrative boundary map in the JICA SOB study
	Road condition map,	Recompiled map of administrative boundary map	Road condition map in the JICA SOB study: Road width for accessibility of heavy vehicle and road surface of pavement status.
	Natural condition map for flooding	Flooding level on grand elevation	Recompiled DEM data and contour in the flooding level in the JICA SOB study

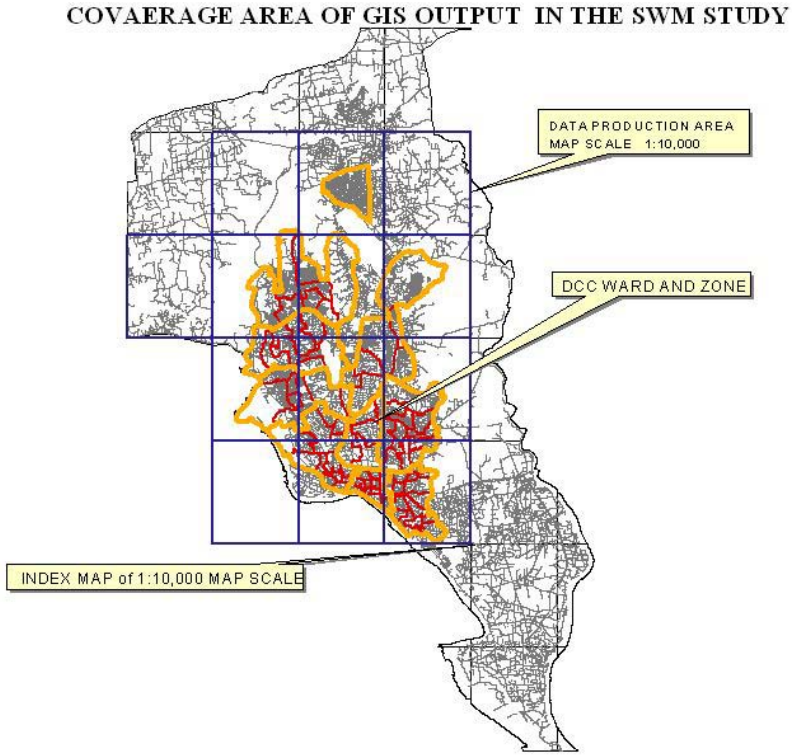


Figure 6.1-3 Coverage area of data preparation

6.1.4 Problems about data resources

In the production of GIS data, there were problems relating to administrative boundary and census data as follows:

- Administrative boundaries are not shared on accurate map with among relevant agencies.
- Statistic data relating accurate boundaries, especially population data, is not reliable because of the above reasons.

DCC manages the jurisdiction of Ward, but it became fact that the definite boundaries had demarcation problems because of those conflictions between DCC and Ward commissioners. Those problems are not solved on maps yet and the definite boundaries among DCC map and available maps don't coincide to each other. It was very hard to decide those boundaries so that GIS ward map was compiled to thematic map by delineation of boundaries on topographic map the JICA study prepared.

Though population data is an important key data for the present evaluation of solid waste management and the future prediction of that, data reliability is quite lack because ward boundaries is not opened on the accurate map among agencies.

UPD is preparing for 90 GIS ward maps which data are built by field survey activities to map geographic futures at the present. But this data still have demarcation problems about ward boundaries. However if those data will be demarcated after completion of data mosaics, the boundaries makes it reliable with growing of consensus. Statistic data including number of populations, household, house and building will be more reliable than BBS data to the near future.

6.1.5 Recommendations

(1) Establishment of management frame for the use of GIS

A goal for the GIS installation in each organization of DCC is reconfirmed, and aim of database development makes it clear. The frame of the GIS application and the development of a database is established to make it promote the integration of the information.

The following item is made the target of the GIS installation for the business model of DCC:

- SWM: Facility management for SWM facilities, primary collection and secondary collection service, collections and transport service, monitoring of dumping and environmental management and others.
- Urban planning: Land use planning, urban development planning, building control, public facility management and public services, urban facilities management, education and medical, transportation, disaster management, environmental management and others
- DCC business control management: residence registration, building and housing registration and taxation and others.

(2) Completion of GIS ward map and data cleaning

UPD GIS ward maps should be cleaned against all of the data for the use of GIS operation. The present data may be satisfied for cartography purpose, but data is not available for GIS operations because data specifications are not good for every data in all wards. There are no rules and no unifications about data as follows: different naming of file name in each ward, different data structure among files in each ward, demarcation problems of definite boundaries and etc.

GIS ward map have accurate information based on field survey, so data makes it reliable to clean.

(3) Capacity building of Human resource

Human resources in charge of GIS must be developed to implement GIS operation in the practical management. Operational abilities of GIS stuffs should be increased through on job training. It is necessary to grow GIS stuffs and to educate the operation skill.

(4) Establishment of information infrastructure

Information Infrastructure should be established by data exchange among relevant agencies. There are several tasks to support GIS data to relevant agencies and to uses GIS data from relevant agencies in Bangladesh government. There is not much reliable topographic maps to cover with Dhaka Metropolitan Area. A large scale of topographic map are preparing by SOB though the JICA study at the present. The map is produced by photogrammetry method with field verifications. In order to establish shareable database among agencies, accurate maps are requested to SOB. Infrastructure is a key ward to successful GIS data.

APPENDIX-1

Preparation for GIS Data of the SWM/Facility

APPENDIX-1

1. Preparation for GIS Data of the SWM/Facility

The SWM needs to manage those facilities which relate to primary collection service about dustbin and container box. However installation numbers of those facilities already counted in the planning but it was still hard to manage operation records with those locations and those statuses at the present. Also these data were not accurate and reliable for the use of data in planning. There are GIS ward maps in UPD of DCC, which provide with locations of dustbins and waste containers, but data is not covered with the whole wards at the present so that those data are not available. On this background field DCC and the Study team organized the survey team to dispatch surveyors and WARD inspectors in October in 2004.

In order to survey those facilities and those locations including illegal dumping sites or opened dumping sites and medical facilities such as hospitals, clinics and diagnostic centers, the surveyors went to the field with the survey form and maps in DCC area.

Considered with the preparation of those databases developments for SWM Facility Management, GIS makes it effective to manage and to support Facility Management for updating of maintenance of data systematically. Those approaches will continue to establish one of Urban Planning Information as a GIS.

A general flow chart of GI, so called Geographical Information, development is shown in Figure A1-1. The main objective in the Study is to establish basic information for SWM/Facility Management, considered with the future use of GIS data for SWM in DCC.

To perform the good response, database management especially the encoding with systematizing of code is a key of information between GIS data and databases.

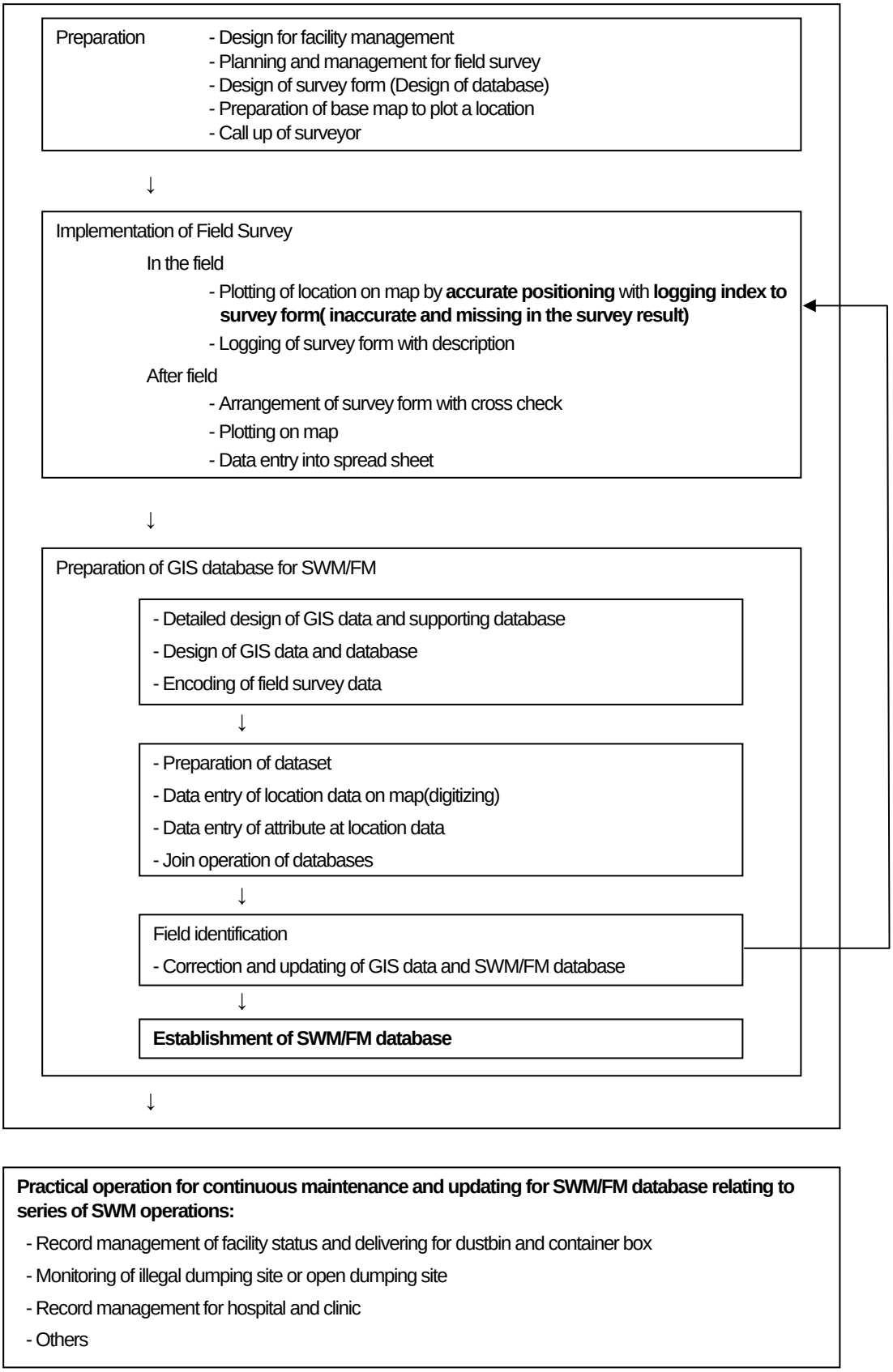


Figure A1-1 Flowchart for Primary SWM/Facility Management database preparation

2. Design of encoding for survey data

To arrange the survey data to database, the following encoding was established by combinations of information and numbers in the study. The encoding uses 9 digits' code and the rule for encoding is shown in Table A1-1. According to this encoding rule, all the survey data are being compiled to database at the present for database and GI data. See the following tables for data specification.

Table A1-1 Encoding design for SWM/FM data in the study

Item	Digit	Note
- Zone number:	2 digits	Zone number in DCC
- Ward number:	3 digits	Ward number in DCC
- Type:	2 digits	Type 1: Container box Type 2: Dustbin Type 3: Illegal dumping site Type 4: Open dumping spot Type 5: Medical facilities: Hospital, clinic, diagnostic center
- Sub-number:	3 digits	Sub-sequential number in each type in each ward

Table A1-2 Data specification of Container box and dustbin

Data field	Note
1. Zone number: 2 digits	Zone number for encoding
2. Ward number: 3 digits	Ward number for encoding
3. Type: 2 digits	Facility type for encoding
4. Sub-id number: 3 digits	Sub-sequential number in each facility for encoding
5. No. of Dustbin/ container	Record number in MSExcel sheet
6. Description of Container box/ Dustbin Location:	Describe the location such as road name, House no., Park, Shop, Building or any others for identification.
7. Container box/ Dustbin specification (inch):	Length of facility dimension
8. Container box/ Dustbin specification (inch):	Width of facility dimension
9. Container box/ Dustbin specification (inch):	Height of facility dimension
10. Actual Volume of Container (ton)	Actual volume calculated by 3 dimension of waste container
11. Actual Volume of Dustbin(ton)	Actual volume calculated by 3 dimension of dustbin
12. Dustbin capacity	Record counter of dustbin
13. Container capacity (3 ton)	Record counter of waste container
14. Container capacity (5 ton)	Record counter of waste container
15. Remarks (Broken/ Running) etc.	Description of facility status

Table A1-3 Example of spread sheet data for container box and dustbin

SN	Zone	Ward	Type	Sub-no	No. of Dustbin/ container	Container box/ Dustbin Location (Road name, House no., Park, Shop, Buliding or any others for identification)	Container box/ Dustbin specification (inch). Length	Width	Hight	Actual Volume of Container (ton)	Actual Volume of Dustbin (ton)	Dustbin capacity	Container capacity (3 ton)	Container capacity (5 ton)	Remarks (Broken/ Running) etc.
1	1	77	1	1	1	Narinda road, goria moth temple	120	60	57	1.614			3		
2	1	77	1	2	2	16, folder street, beside bokul tola	138	54	78	2.286				5	
3	1	77	1	3	3	east side of dholaikhal, at cross section	117	60	52	1.436			3		
4	1	77	1	4	4	1 no. noar street (muchi potti)	117	57	55	1.443			3		
5	1	77	1	5	5	47/2, -Dojhori shaha street	90	52	60	1.104			3		
6	1	77	2	1	6	Narinda goria moth temple	60	36	30		0.255	D			25% broken
7	1	77	2	2	7	9/5, nabab street (bolda garden)	66	39	36		0.364	D			5% broken
8	1	77	2	3	8	30, tipu sultal road	60	36	36		0.306	D			75% broken
9	1	77	2	4	9	10 padma nidhy lane	60	36	36		0.306	D			90% broken
10	1	77	2	5	10	222, lalmohon shaha street	60	48	36		0.408	D			95% broken
11	1	77	2	6	11	74, lalmohon shaha street	66	54	42		0.589	D			Running
12	1	77	2	7	12	45, Narinda road, in front of girls school	60	48	30		0.340	D			95% broken
13	1	77	2	8	13	26, Narinda road	60	36	30		0.255	D			10% broken

Table A1-4 Data specification of Illegal dumping site and open dumping site

Data item	Note
1. Zone number: 2 digits	Zone number for encoding
2. Ward number: 3 digits	Ward number for encoding
3. Type: 2 digits	Facility type for encoding
4. Sub-id number: 3 digits	Sub-sequential number in each facility for encoding
5. No. of illegal dumping site and open dumping site	Record number in MSExcel sheet
6. Description of illegal dumping site location and area(ft2)	
7. Description of open dumping spot(ft2)	

Table A1-5 Example of Illegal dumping site and open dumping spot

SN	Zone	Ward	Type	Sub-no	illegal dumping site location & area(ft2)	Open dumping spot (ft2)
1	1	77	4	1	1 no. AK. Shane road 10x6	
2	1	77	4	2	26, 29 ware street 8x6	
3	1	77	4	3	24/c, Tipu sultan road, 8x6	
4	1	77	4	4	18/1, Dojhori shaha street 8x6	
5	1	77	4	5	15-3-16 no. lalmohon shaha street, 30x3	
6	1	77	4	6	122123 lalmohon shaha street, (Chini Mia passege	
7						
8	1	77	4	7	19, dozhori shaha street 8x6	
9						
10	1	77	4	8	50, dozhori shaha street 8x6	
11						
12						
13						

Table A1-6 Data specification of Medical facilities

Data item	Note
1. Zone number: 2 digits	Zone number for encoding
2. Ward number: 3 digits	Ward number for encoding
3. Type: 2 digits	Facility type for encoding
4. Sub-id number: 3 digits	Sub-sequential number in each facility for encoding
5. Hospital /Clinic/Diagnostic center name, address & Bed no.	

Table A1-7 Example of Medical facilities

SN	Zone	Ward	Type	Sub-no	Hospital /Clinic/Diagnostic center name, address & Bed no.
1	1	77	3	1	Kabir Eye center hospital, 9/1, nabab street
2	1	77	3	2	Alim Dental care, 17/11, Benzin street, wari
3	1	77	3	3	Paromita child care Foundation, 17, Benzin street, wari
4	1	77	3	4	Sumon child care & ----- 17, renkin street
5	1	77	3	5	Health care hospital 11/1, benkin street
6	1	77	3	6	Nibedita Baby hospital, 11/1, Hair street
7	1	77	3	7	National Health care network, (Diabetis hospital),
8	1	77	3	8	25, Tipu sultan road
9					
10	1	77	3	9	Rangking pathology center, 15 rankin street
11	1	77	3	10	Rangking Dental care, 14, rankin street
12	1	77	3	11	Nazia diagnostic center, 37 Narinda road

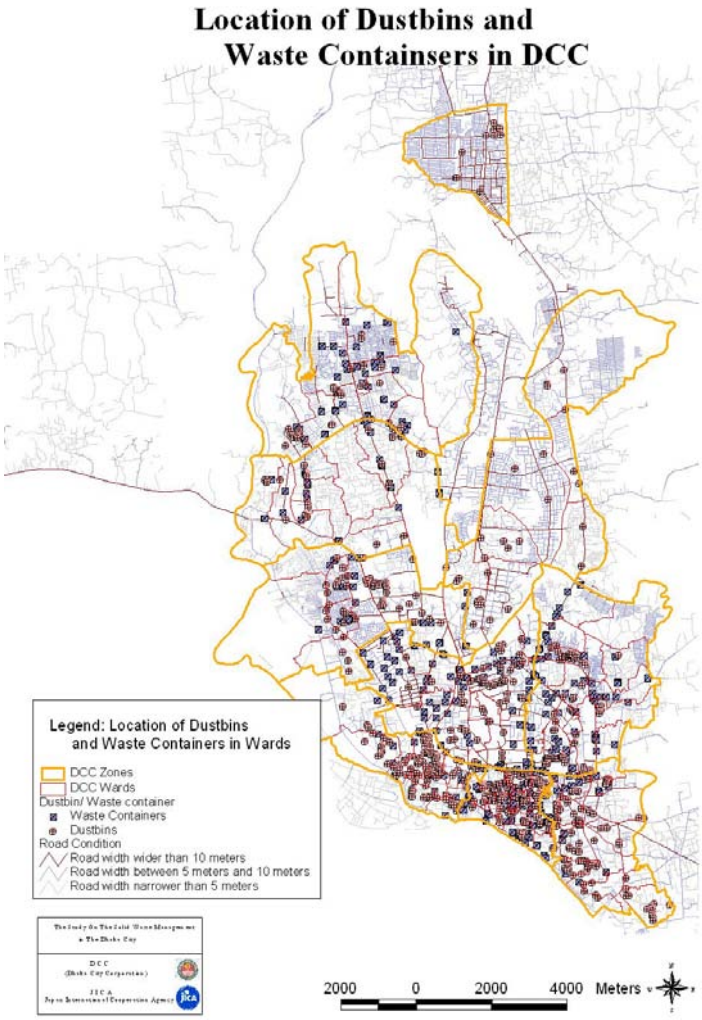


Figure A1-2 Present location of container box and dustbin in DCC area

3. Procedure to GIS data in ARCVIEW Version 3 series

GIS software of ARCVIEW was used for data preparation of SWM/FM according to the flow chart in Figure A1-3. The GIS operation in ARCVIEW3 is introduced in the Chapter3.3 ”Operation’s Manual”. The instruction of GIS operation was transferred to counterpart personnel in charge of GIS in the Study.

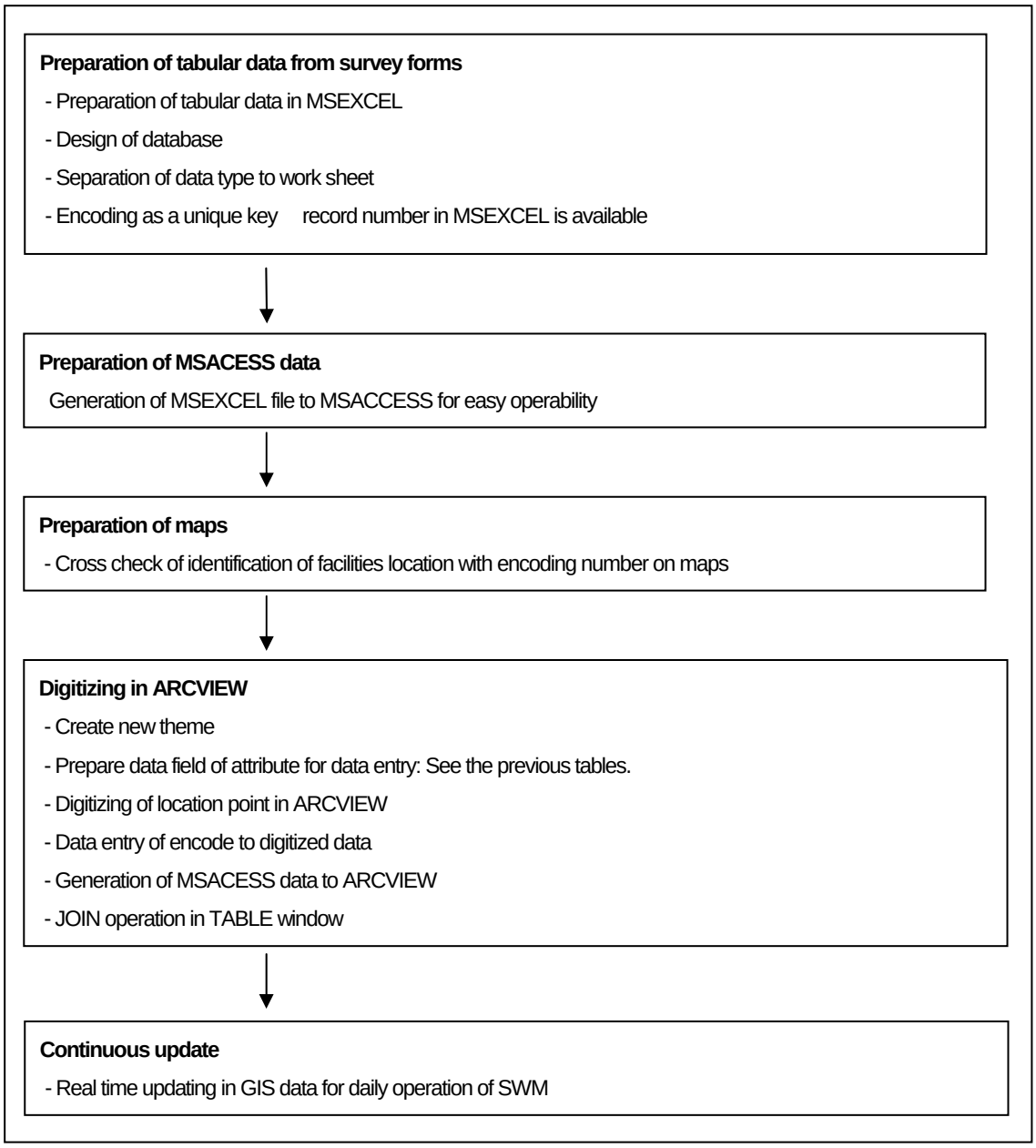


Figure A1-3 Flowchart of GIS operation in ARCVIEW Version 3 series

APPENDIX-2

GIS Database Development for SWM Study

APPENDIX-2

1. GIS Database Development

GIS databases for the SWM Study were supplied by the extensive activity in the JICA Study "The Study on Urban Information Management for Greater Dhaka City in the People's Republic of Bangladesh". Based on the cooperation of the SWM study, the JICA Study in SOB organized additional study team for GIS data creation and sent the Team to Bangladesh from 28 January 2004 for the field survey in the Study area including to Dhaka Metropolitan Area about 581 km^2 which was as same as 1:5,000 scale topographic mapping area. The Study area for GIS data creation for Solid Waste Management is shown in Figure A2-1.

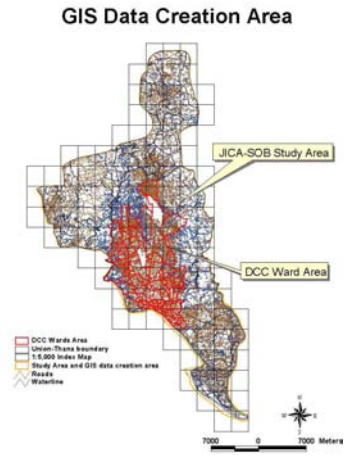


Figure A2-1 "GIS Data Creation Area for Solid Waste Management"

1.1 GIS Data Development

Necessary countermeasures for urban planning management and others were insufficient due to the reasons of this rapid urbanization of Dhaka Metropolitan Area with many urban problems issues and the lack of precise large-scale topographic maps. As the above reasons, the JICA Study in SOB carried out preparation of GIS data with cooperation of counterparts of SOB together with surveyors.

The objective of the Study is as follows:

1) To produce the useful GIS data for planning of Solid Waste Management in Dhaka City,

2) The following GIS data were be produced.

- Land Use data
- Land Condition data
- Social Economic condition data
- Building and housing type data
- Administrative boundary data of ward and union-thana and the related data of census data in BBS
- Road condition map: Road condition and road width
- Thematic maps relating to flooding: Drained area and pumping station for flood control management and the past flood level
- Digital Elevation data
- Solid Waste Management facility(location of land fill site and dumping site)

The draft of pencil drawing maps plotted on 1:5,000 scale topographic map were prepared by the interpretation method and the sampling survey and also related data to generate to GIS data was collected in Bangladesh. GIS data was produced with digitizing and handling data in Japan.

2. GIS data and data items

2.1 Land Use Data

Land use map was produced to support the urban planning by the photo interpretation method with field verification using topographic map and aerial photo. Particular in solid waste management, land use data will be used for the estimation of total volume of solid waste at a certain area from the viewpoint of different land use type. Land use map was classified to following categories in Table A2-1 and in Figure A2-2.

2.2 Land Condition Data

Particularly land condition data is essential for development planning in Dhaka Metropolitan Area where was formulated on vast flat alluvial plain with small relief by the Ganges River and the Brahmaputra River (Confluence point of both rivers). Land condition map was referred to map in "Urban Geology of Dhaka, Bangladesh" of ESCAP as mentioned in Table A2-1 and in Figure A2-3.

2.3 Social-Economic Condition Data

To estimate the solid waste volume in Dhaka Metropolitan Area, Social-Economic condition data was created taking into account facilities which produce large volume of solid waste generation and economic condition of residential type in residential areas. Furthermore, information on facilities with large volume of solid waste generation such as main hotels, restaurants, markets and foreigner's residential areas were added to socio-economic condition data. Category of socio-economic condition data with field checks in the sampling areas was defined in Table A2-1 and in Figure A2-4.

2.4 Building Type and Housing Type Data

"Building Type" and "Housing Type" to buildings was prepared by interpretation with field check with sampling surveys against mapping features of buildings in 1/5,000 digital mapping data. Those categories are shown in Table A2-1 and in Figure A2-5. To consider with the use to estimate population growth and local populations from building counts with census data for the SWM study, counts of building type and housing type could be generated to properties of wards and unions in the study area.

2.5 Administrative Boundary Data and Related data

Administrative boundary is the key and important information for planning programs linking with statistic data. "Ward" in DCC area and "Union - Thana in the area outside DCC" were compiled on 1/5,000 map by delineation with arrangement referenced with DCC wards maps and RAJAK's information. However there were many difficulties to identify definite boundaries on maps and to generate census data into those boundaries because of structural common data problems among the Bangladesh agencies. The tentative boundaries were compiled to map. It is very hard to create exact administrative boundary data only based on existing data. See Figure A2-6.

2.6 Road Type and Road Width Data

The road type and road width are key-factors to select garbage collection route by vehicle in the solid waste management study. Considered with accessibilities to judge whether the collection vehicle and rickyisya can drive through designated road or not, width passable by collection vehicle without any trouble is 5 meters by the width of double traffic lanes. Road width was classified to the following categories by the interpretation of 1:5,000 scale topographic maps and mosaic air photo map and sampling survey for road type and road width as shown in Table A2-1 and in Figure A2-7.

Furthermore, adding the information of road type such as metal and un-metal as the condition for the smooth collection of solid waste by vehicle, the following classification also was determined for road type of pavement status: paved and unpaved in the topographic map

2.7 Thematic Map relating to Flood Control Management

Thematic maps relating to flood control was compiled to correspond to flood risk in planning.

Drainage area and pumping stations for drained water in the flood action control was prepared to GIS data to consider relations between flooding control and planning according to existing report and maps. It supposed to need these information for planning in the time of flood hazard. Also the past flood level was checked in the spot leveling survey for the flood level in 1998 and other year. See Figure A2-8.

2.8 Digital Elevation Data concerning to flooding hazard

Flooding is the worst natural disaster in Dhaka Metropolitan Area annually and many projects are being carried out to protect the area from the disaster. In order to simulate the flooding level in the planning, the Study Team prepared Digital elevation Model used by 1:5,000 scale digital topographic maps. Flooding level was checked by the spot leveling survey and satellite image of 1998. As the result annual flood level was checked about 4 meters. See Figure A2-9

2.9 Solid Waste Collection Points and Routes Data

Based on data supplied from the SWM Team, solid waste facility especially dumping site and land fill site was compiled to facility map shown in Figure A2-10. About waste disposal collection route (road width is more than 5 m), all the motor-able roads are covered by road condition data in the above mentioned. those routes correspond to the whole road inside DCC area.

3. Data problems and data issues

The GIS data was created not only to support the planning of solid waste management but also to be able to use for the various projects to solve the urban problems that become serious year by year in Dhaka Metropolitan Area.

However, due to the reasons of short period for field survey, insufficient and incomplete existing data that can be used for GIS data creation and so on, it is necessary to understood that the GIS data created by the Study is the proto type GIS data.

SOB and other organizations in Bangladesh are necessary to create more suitable GIS data for the purpose of each organization by using this proto type GIS data by reviewing contents of GIS data items, additional survey and so on by themselves.

There were many difficulties to identify definite boundaries on maps and to generate census data into those boundaries because of structural data problems which there were commonly about data resources among the Bangladesh agencies. Organizations of Bangladesh Government do not have precise data concerning the administrative boundary and other data resources.

Meanwhile, in Bangladesh, up to present, precise large-scale digital topographic maps has not been created at Dhaka Metropolitan Area and this is one of the problems at the stage of planning and execution of various projects. "The Study in SOB was implemented from November 2002 to July 2004 and precise 1:5,000 scale digital topographic maps and GIS basic data that can be used as a basic data for GIS data creation was produced by the study. Therefore, it will become possible to unify accuracy, scale and standard of GIS data created by the many organizations in Bangladesh independently up to now by using the results of this study.

This means that creation of interoperable GIS data (same accuracy, scale, standard and so on) is the future task in the field of GIS in Bangladesh.

Table A2-1 Item of GIS Data and Categories

Item of GIS data	Categories of GIS data
Land use map	(1)Housing area,(2)Industrial area,(3)Commercial area,(4)Mixed area (Housing & commercial),(5)Public facilities(Government office, institute, school, hospital, religious establishment, monument), (6)Park, (7)play ground and public green area, (8)Brick field (Brick factory), (9)Cultivated low land (Normal flood area), (10)Cultivated high land (Safe area from normal flood), (12)Forest, (13)Bush, (14)Grass land, (15)Open space, (16)Unclassified/restricted area, (17)Road(over 5 meters)/railway, (18)Swamp and marsh, (19)Water bodies such as river, lake and pond
Land condition data	(1)Flat area lower than 4.0 m called low-lying area, (2)Plateau higher than 4.0 m called alluvial terrace, (3)Swamp and marsh, (4)Water bodies such as river, lake and pond, (5)Natural embankment also called natural levee (lower than 4.0 m), (7)Natural embankment also called natural levee (higher than 4.0 m), (8)Former riverbed (lower than 4.0 m), (9)Former riverbed (higher than 4.0 m), (10)Location of drainage pump;
Drainage pump station	Location of pump station for flood control in drained area on going and planning for flood control
Drainage area	Drained area on going and planning for flood control
Social-Economic Condition Data	(1)Residential area (High socio-economic condition) such as “Dhanmondi”, (2)Residential area (High socio-economic condition) Area where foreigners are mainly livingsuch as “Gulshan” and “Banani”, (3)Residential area (Middle socio-economic condition.) excluding item (1),(2) and (4), (4)Residential area (Low socio-economic condition): the slum and an area where low-income group is living, (5)New developing residential area (plan & on going) collected by hearing survey in the site, (6)Mixed area, (7)Main restaurant, (8)Main hotel Prior to commencement of field survey, (9)Market/shops, (10)Big katcha bazaar (Authorized by DCC), (11)Supermarket such as Agora
Building Type and Housing Type Data	Building Type:1~3 stories”, “4~6 stories”, “More than 7 stories” and Slum. Housing Type: House Detached houses, Apartment houses, Big commercial building, private office & shop(Large commercial buildings, offices and shops) , Public offices(Government building office, public service office), Factory , Religious facilities, mosque, temple, church, Education facilities, Health facilities (hospital, big clinic)
Census data	Number of populations and households in 2001 and those results of trial estimation of 2004 population from 2001 population conducted by BBS were obtained as a reference source.
Data concerning to the Flood Hazard	(1)Measurement of elevation of flood marks of 1998 by leveling survey (2) DEM calculated from 1:5,000 scale digital topographic maps (3)Identification of inundated areas by the interpretation of SPOT Satellite image of 1998 and 2002
Administrative Boundary Data:	(1)Urban area: Division, District, Thana, Ward (2)Rural area: Division, District, Thana, Union
Road Condition Data	Road Width: (1)Road width less than 5 m, (2)Road width between 5 m and 10 m, (3)Road width more than 10 m Road Type: Status of pavement: (1)Paved: metal on topographic map, (2)Unpaved: un-metal on topographic map
Related data for Solid waste m Management	Location of solid waste management facility about dumping site and landfill site

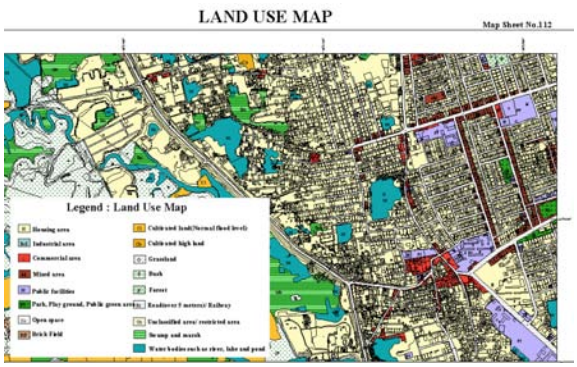


Figure A2-2 Land Use data

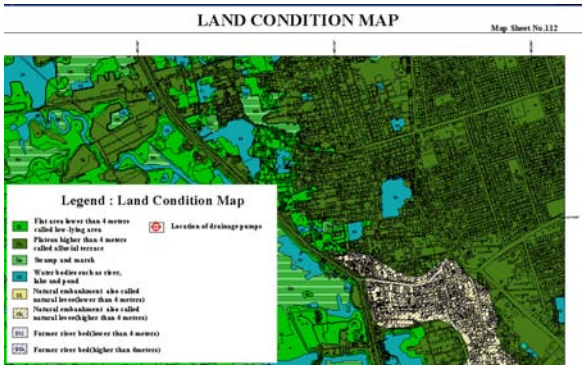


Figure A2-3 Land Condition Data

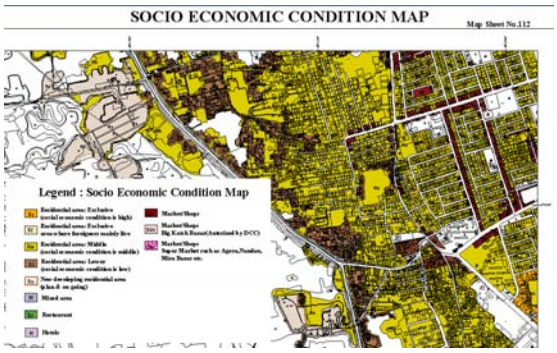


Figure A2-4 Social Economic condition data

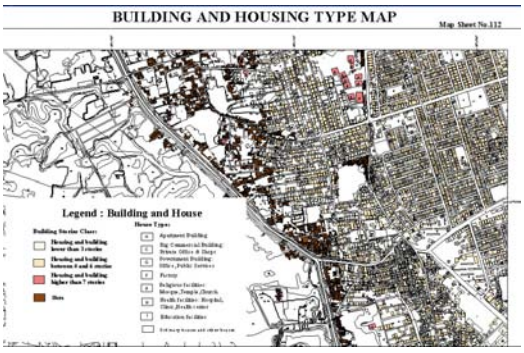


Figure A2-5 Building and housing type data

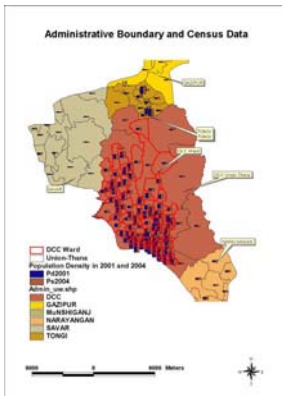


Figure A2-6 Administrative boundary data of ward union-thana

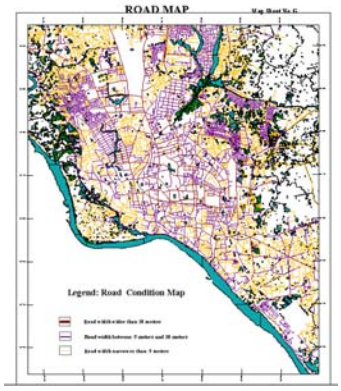


Figure A2-7 Road condition map: Condition and width

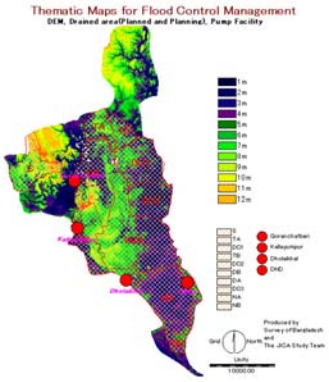


Figure A2-8 Maps relating flooding control management and DEM

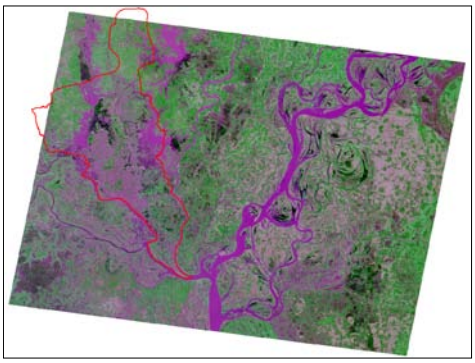


Figure A2-9 Annual Flooding on SPOT Image (21 November 2002)"
Annual flood level: DTM (H = 4 m)

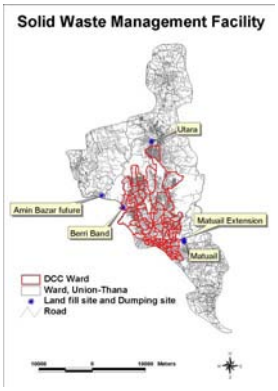


Figure A2-10 Solid Waste Management facility (location of land fill site and dumping site)

6.2 Electronic Media

GIS outputs were prepared by using GIS data resources in the Study. There are several types of output productions which are produced by combinations of compilation of thematic themes, by single theme, by combinations of themes and database tables with conditions.

GIS data in the SWM study has mainly been supported by the JICA SOB study. Especially there are four important thematic maps to produce a series of thematic maps in the study: land use map, land condition map, social economic condition map and building and housing type map. However the uses of those GIS data are limited in the JICA study at the present. Because the electronic data is not still opened by SOB yet according to the regulation of the Bangladesh government. But SOB is trying to make efforts to open the electronic media of the general use and the policy handling and new regulation are proceeding on the way. The GIS output in the JICA Study will be delivered to DCC in the near future.

The following explains map composition to formulate GIS outputs.

6.2.1 Land-use and Rezoning

6.2.1.1 Ward Boundary Map

Map sheet of DCC ward map was compiled on topographic map by delineation of the boundaries. There are 90 wards and 10 zones in DCC area. Data description is shown in Table 6.2-1. The boundary unit is used for demography data to plot statistic data of study result on the unit. See Figure 6.2-1.

However there are problems and issues about demarcations of those boundaries. It is very hardest compilation on maps, so it is necessary for DCC GIS maps to arrange and to demarcate those boundaries processed by merge of all boundaries.

Table 6.2-1 Data description of Ward boundary map and zone map

Item	Description
Map title	DCC Ward map and Zone map
Contents	Ward boundaries: 90 wards in DCC Zone map Zone boundaries: 10 Zones in DCC 5 kilometer buffer from Disposal site: Matail and Amin bazar
Map scale	1:40000
Data resource	DCC Ward map with a scale of 1:20,000
Map legend	DCC wards in DCC area DCC zones in DCC area Union out of DCC area 5kilometer buffer from Matail and Amin bazar

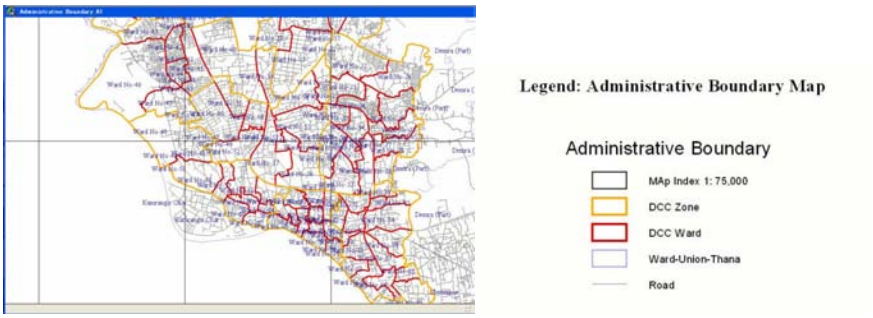


Figure 6.2-1 Ward map and Zone map

6.2.1.2 Buildup Area Map

Figure of Urban growth of Dhaka City in Dhaka City guide map was untried to GIS data to display the changes of urban areas about 4 times of urban area in 1960, in 1980, in 1990 and in 2002. Those areas are corresponding to amount of urban area and populations. See Figure 6.2-2.

However those areas are inaccurate, it is difficult to transform data on topographic map, so it is necessary for those maps to be able to compile the area on exact maps to record the urban area changing.

Table 6.2-2 Buildup area map

Item	Description
Map title	Buildup area map
Contents	Map includes the history of urban area in 1960, in 1980, in 1990 and in 2002.
Map scale	Un-scaled
Data resource	Urban Growth of Dhaka City in DCC guide map

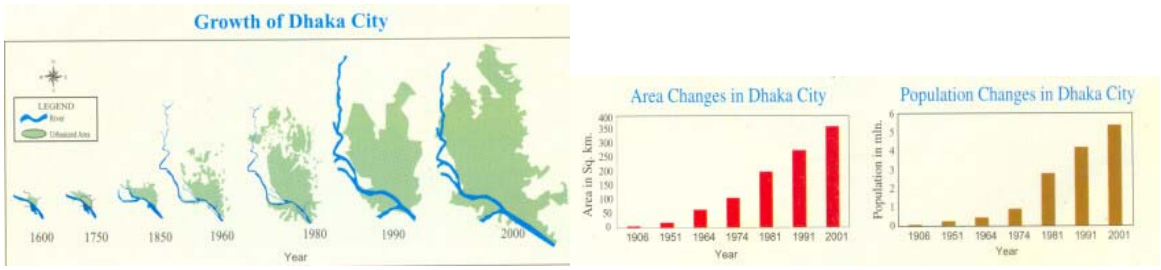


Figure 6.2-2 Change of urban area Change of population

6.2.1.3 Land-use map, Rezoning map, Regional geographical maps(Present and Future)

(1) Present Land-use map

Land use map was produced to support SWM study by the JICA-SOB study. Thematic map was compiled by conventional interpretation method using aerial photo taken in 2002 and related materials of land use. Land use map is very important for urban planning for urban development. Legend of land use map is shown in Table 6.2-3 and Figure 6.2-3.

Table 6.2-3 Data description of present land use map

Item	Description
Map title	Present land use map
Content	Thematic map of present land use interpreted by latest topographic map and materials with field survey in the Dhaka metropolitan area
Map scale	1:10,000
Data resource	Present land use map produced by the JICA SOB Study
Map legend	(1)Housing area, (2)Industry area, (3)Commercial area, (4)Mixed area, (5)Public facilities, (6)Park, Play ground, urban green area, (7)Brick field, (8)Cultivated lowland(Normal level), (9)Cultivated highland (Elevation> 4m), (10)Forest , (11)Bush, (12)Grassland, (13)Open space(Blank area), (14)Unclassified area/ Restricted area, (15)Roads/Railways, (18)Swamp, (19)water area such as rivers, ponds and lakes

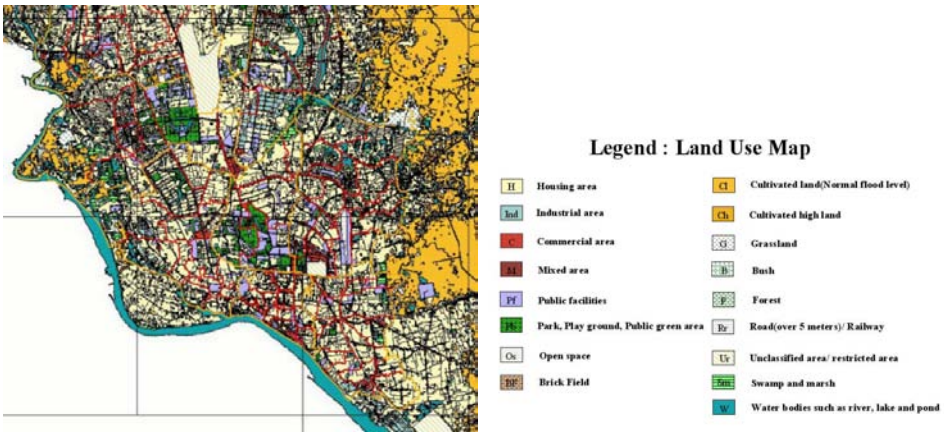


Figure 6.2-3 Present land use map

(2) Land use planning map: DMDP Dhaka Urban Area Plan 1995-2005

Land use plan map was produced in the report in the master plan of Dhaka city Map for the cross checking the present development between the future's plan and the present status. See Table 6.2-4 and Figure 6.2-4.

Table 6.2-4 Data description of land use plan map**:** DMDP Dhaka Urban Area Plan 1995-2005

Item	Description
Map title	DMDP Dhaka Urban Area Plan 1995-2005
Contents	Land use planning map in RAJAK
Map scale	1:10,000
Data resource	**RAJAK Land use plan map:** DMDP Dhaka Urban Area Plan 1995-2005
Map legend	(1)Existing railway,(2)River with single line, (3)River with double line,(4)Existing bridge,(5)Existing embankment, (6)Proposed embankment,(7)Airport restriction zone boundary, (8)Open space zone,(9)Restricted areas,(10)Existing mixed use planned zone,(11)Existing mixed use spontaneous zone,(12)Proposed mixed use spontaneous zone,(13)Proposed mixed use planned zone,(14)Restricted flood protection reserves,(15)Water supply protection zone,(16)Industrial moderate hazard zone

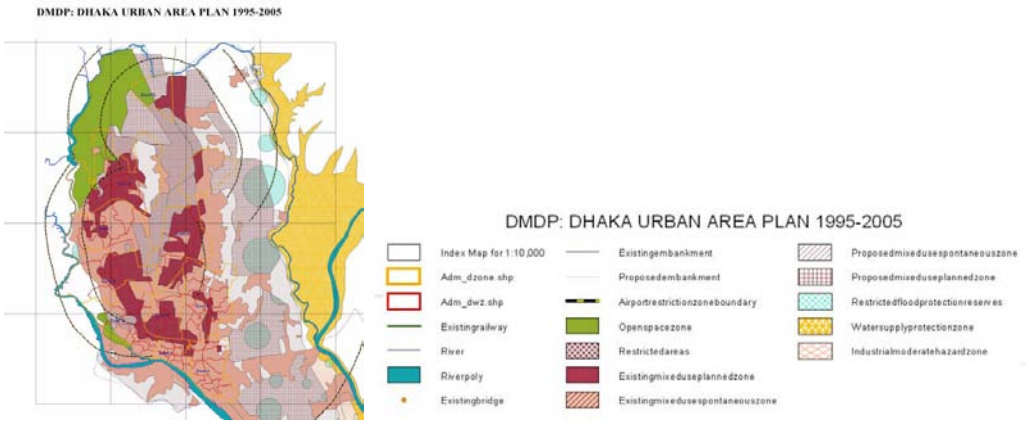


Figure 6.2-4 DMDP Dhaka Urban Area Plan 1995-2005

(3) Land use planning map: DMDP Dhaka Structure Plan 1995-2015

Land use plan map was produced in the report in the master plan of Dhaka city Map for the cross checking between the future's plan and development results. See Table 6.2-5 and Figure 6.2-5.

Table 6.2-5 Data description of Land use plan map: DMDP Dhaka Structure plan 1995-2005

Item	Description
Map title	Land use plan map: DMDP Dhaka Structure plan 1995-2005
Contents	Land use planning map in RAJAK
Map scale	1:10,000
Data resource	**RAJAK land use plan map:** DMDP Dhaka Structure plan 1995-2005.
Map legend	(1)Rajak boundary,(2)Existing primary road,(3)Existing secondary road,(4)Existing tertiary road,(5)Existing mainline,(6)Roads,(7)Existing main bridge,(8)Main river khals,(9)Existing flood embankment,(10)Existing flood walls,(11) Proposed bridge,(12)Proposed eastern bypass, (13)Proposed primary road,(14)Proposed flood embankment, (15)Proposed flood walls,(16)Mass transport, (17)Establishment urban,(18)Agricultural high value areas, (19)Agricultural areas,(20)Urban fringe areas,(21)Proposed flood retention pond, (22)New development areas, (23)Peripheral urban development areas,(24)Proposed recreation areas, (25)Main flood flow areas,(26)Sub flood flows areas, (27)Watershed protection areas,(28)Special areas, (29)Cantonments security zone

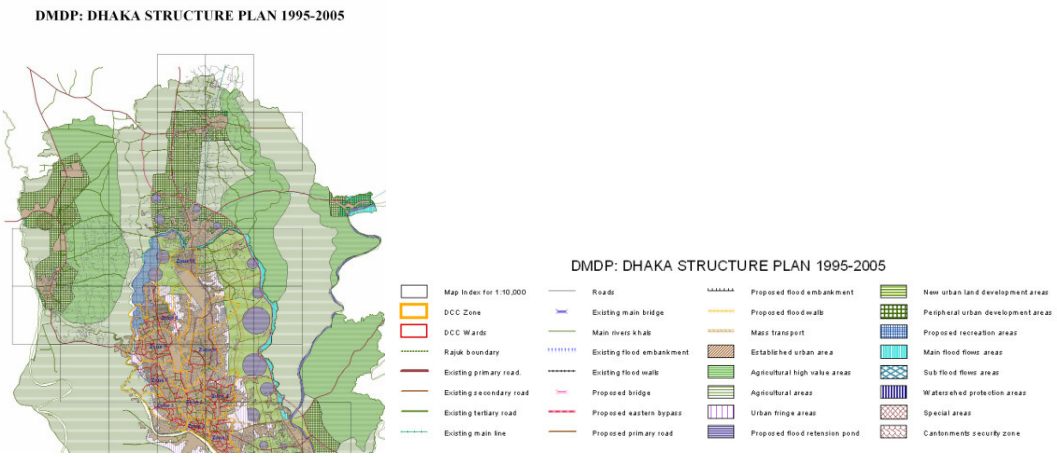


Figure 6.2-5 DMDP Dhaka Structure plan 1995-2005

6.2.1.4 Protection area map(Public Facilities, Historical Buildings/Facilities)

Protection area map which showed the un-developable areas and the important buildings in historical place and in heritage, were produced on map with a scale of 1:10,000.

The map was compiled by present land use map and public facility maps from DCC maps, DCC GIS map and SOB map. The location point was identified by reference of materials.

Topographic map of JICA SOB Study used public facility map in UPD/DCC for topographic survey in mapping. See Table 6.2-6 and Figure 6.2-6.

Table 6.2-6 Protection area map

Item	Description
Map title	Protection area in urban development
Contents	Thematic map for protection area against development
Map scale	1:10,000
Data resource	Land use map from JICA-SOB study DCC map and GIS ward map
Map legend	Areas from present land use map: - Public Facilities - Park, Play ground, urban green area - Unclassified area/Ristricted area - Roads/Railways - Forest - Other area Important building and historical sites

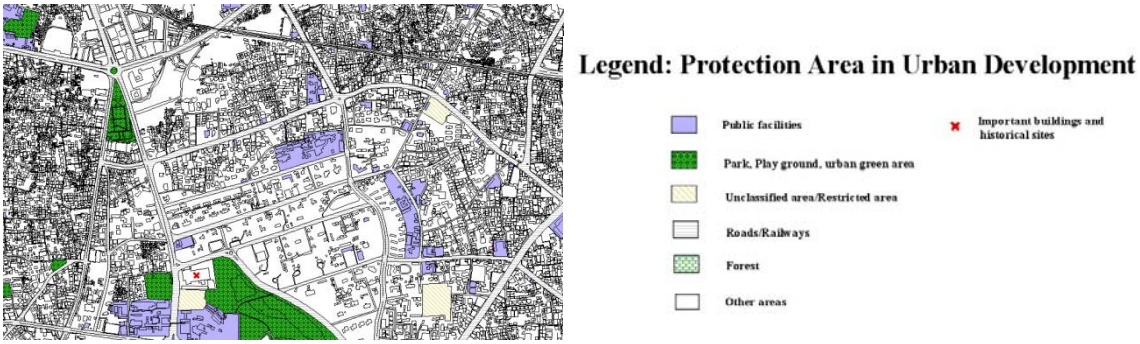


Figure 6.2-6 Protection area in urban development

6.2.2 Solid Waste Generation Sources and The Relevant

6.2.2.1 SW Generation Sources Map

For the preparation of solid waste generation source map, thematic map for type of waste map was compiled by grouping of categories in land use map. There are four types of wastes relating to land use map as shown in Table 6.2-7.

To estimate quantity volumes of solid waste, total amount of SW generation volumes will be predicted with discharge rates in wards-wise waste types. Predicted volumes in each ward-wise waste are shown as a demography data on wards or zones. See Table 6.2-8 and Figure 6.2-7.

Table 6.2-7 Tables of type of waste in land use map

Type of waste	Land Use	Land use category
Domestic waste	Built-up Area	(1)Housing area
Commercial waste	Built-up Area	(2)Industry area
		(3)Commercial area
		(4)Mixed area
		(5)Public facilities
Other waste	Other built-up area	(6)Park, Play ground, urban green area
		(14)Unclassified area/ Restricted area
		(15)Roads/Railways
Future waste area: Developable area	Open space	(13)Open space(Blank area)
	Vegetation	(12)Grassland
		(11)Bush
Developable area with conditions	Cultivated land	(9)Cultivated highland (Elevation> 4m)
		(8)Cultivated lowland(Normal level)
Protection area	Vegetation	(10)Forest
Un development area	Brick fields	(7)Brick field
	Swamp	(18)Swamp
	Water bodies	(19)water area such as rivers, ponds and lakes

Table 6.2-8 Solid waste Generation source map

Item	Description
Map title	Solid waste discharge map
Contents	Location map of areas and buildings for SW Discharge
Map scale	1:10,000
Data resource	Land use map produced by the JICA-SOB study Statistic data in the study: population from BBS, predicted population and study data about SWM discharge
Map legend	(1)Type of domestic waste,(2)Type of commercial waste,(3)Type of other waste,(4)Future potential waste, (5)Future potential waste with the conditioned,(6)Protected area for development, (7)Un-development area

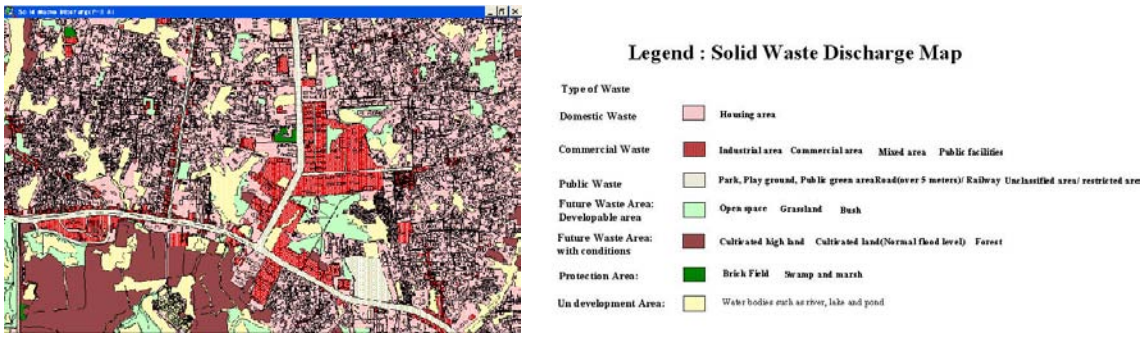


Figure 6.2-7 Solid Waste Generation Source map

6.2.2.2 Location Map of Large scale/Special SW generators

Location map of Large scale/Special SW generators is compiled as a discharge sites on maps with a scale of 1:10,000 as follows:

- Large scale building,
- Market,
- Special SW generators: hospitals, clinics and factories,
- Restaurants,
- Educational buildings, government buildings.

All data resources are based on the JICA studies. GIS databases for SWM study are combined to a map: building and housing type map, public facilities from the field survey's results in the study. See Table 6.2-9 and Figure 6.2-8.

Table 6.2-9 Large Scale/Special SW generators map

Item	Description
Map title	Large scale Special SW generators map
Contents	Thematic map for large scale SW generators
Map scale	1:10,000
Data resource	Building and housing type map and social economic condition map produced by the JICA-SOB study GIS basic data produced by the public facility data in JICA SOB study
Map legend	- Large scaled buildings: Hotels, apartment building - Markets/Shops: Markets/Shops, Big Kancha Bazar(Authrized by DCC), Super market such as Agora, Nandan,Mira Bazar etc., Big Commercial buildings:Private office&Shops - Special Wastes: factory, health facilities: hospital, clinic, health center - Restaurants: restaurant - Public buildings: government building, office, public services - Education facilities

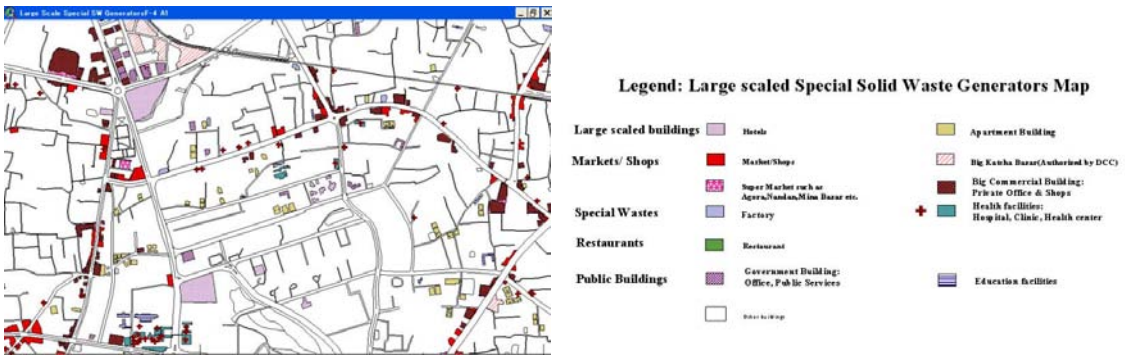


Figure 6.2-8 Large scaled Special SW generators map

6.2.3 Primary Collection and Secondary Collection Service Map

6.2.3.1 Primary Collection Service Map

(1) Dustbin/Waste container storage capacity map

Results relating to the primary collection service in the study were compiled to demography map on DCC Wards and DCC Zones about those themes as shown in Table 6-2-10 and Figure 6-2-9. None spatial database is linked to GIS data of DCC zone or DCC wards.

Table 6.2-10 Dustbin/Waste container storage capacity map

Item	Description
Map title	Dustbin/Waste container storage capacity map
Contents	Demography data of Dustbin/Waste container storage capacity
Map scale	1:100,000
Data resource	Surveyed results in the SWM study
Map legend	Statistic data in the study: - Numbers of dustbin and waste container, - Storage capacity of volumes, - Type of waste container (D, 3C,5C), - Facility condition of those facilities

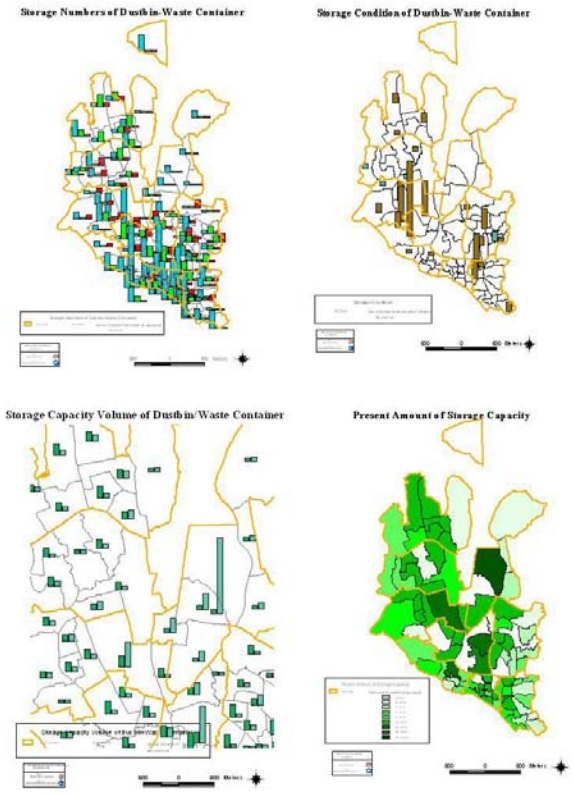


Figure 6.2-9 Demography data about Dustbin/Waste container storage capacity

(2) Accessibility map to dustbin and waste container

To extract the spatial coverage area from dustbin/waste container in the primary collection service, thematic map of display accessibility to those facilities was compiled on maps by the buffering analysis to assist the adequate operation of the primary collection. None spatial database is linked to GIS data of DCC zone or DCC wards. See Table 6.2-11 and Figure 6-2-10.

Table 6.2-11 Accessibility map to dustbin and waste container

Item	Description
Map title	Accessibility map to dustbin and waste container
Contents	Coverage area of accessibility to dustbin and waste container
Map scale	1:100,000
Data resource	Location map of dustbin and waste container GIS base map from GIS basic data in the JICA SOB study
Map legend	DCC zones DCC wards Dustbin/ Waste Container Buffer area with 100m interval from dustbin and waste container Road condition

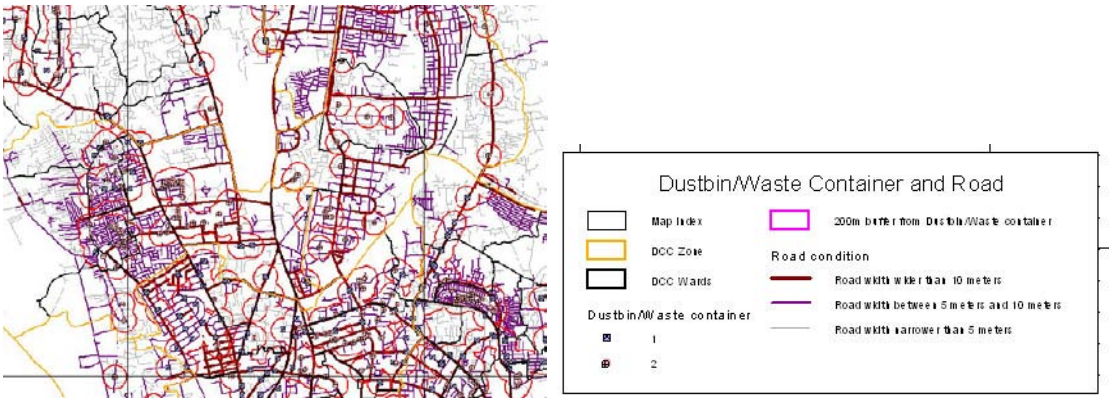


Figure 6.2-10 Accessibility map to dustbin and waste container

6.2.3.2 Collection/ Transportation Capacity Map

(1) Capacity of transportation and operations

Thematic maps relating to ward-wise transportation capacities were compiled to demography data. Ward-wise data included numbers of existing transport vehicles and those capacities, amount of total volume of the operation vehicle in wards and the processing abilities by the predicted amount of quantity in 2004 and amount of volumes in each ward. Data items are as follows:

- Number of open/covered truck and the capacity: 1.5 ton, 3 ton, 5 ton;
- Number of container carrier and the capacity: 1.5 ton, 3 ton, 5 ton;
- Total amount of transportation's volumes of tracks and container carriers based on the working operation of collection and transportation;
- The predicted volumes of SW in 2004 in the study;

None spatial database is linked to GIS data of DCC zone or DCC wards. See Table 6.2-12 and Figure 6.2-11.

Table 6.2-12 Capacity of transportation and operations map

Item	Description
Map title	Dustbin/Waste container storage capacity map
Contents	Demography data of Dustbin/Waste container storage capacity
Map scale	1:100,000
Data resource	DCC Ward map, capacity data of dustbins and waste containers in the field survey in the SWM study
Map legend	Tabular data in the study: - Number of open/covered truck and the capacity(1.5 ton, 3 ton, 5 ton) - Number of container carrier and the capacity(1.5 ton, 3 ton, 5 ton - Total amount of transportation's volumes of tracks and container carriers based on the working operation of collection and transportation - The predicted volumes of SW in 2004 in the study -Open/Covered Truck: number

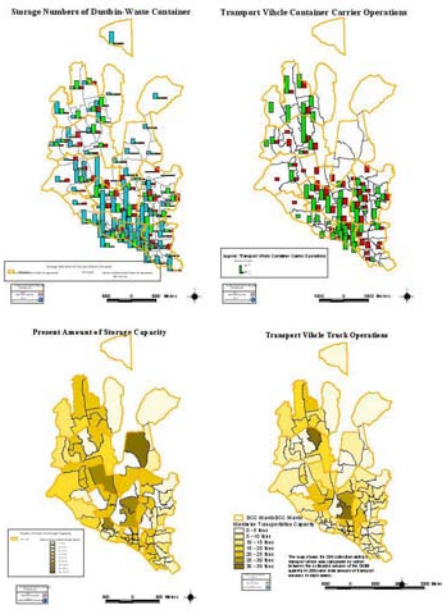


Figure 6.2-11 Capacity of transportation and operations

(2) Accessibility map of heavy vehicles for collection/Transportation

To extract the accessibility of collection vehicle from main road over 5meters, thematic map of buffer area corresponding to accessibility of heavy vehicle for collection/Transportation was compiled on maps by the buffering analysis to assist the adequate operation of transportation. See Table 6.2-13 and Figure 6.2-12.

Table 6.2-13 Accessibility map of heavy vehicles for collection/Transportation

Item	Description
Map title	Accessibility map of heavy vehicles for collection/Transportation
Contents	Accessibility of heavy vehicle along main road over 5meters.
Map scale	1:10,000
Data resource	Road network data from GIS basic map data in the JICA SOB study
Map legend	DCC zones DCC wards Dustbin/ Waste Container Buffer area with 100m interval from dustbin and waste container Road condition Buffer area with 100m interval from existing road over 5m width

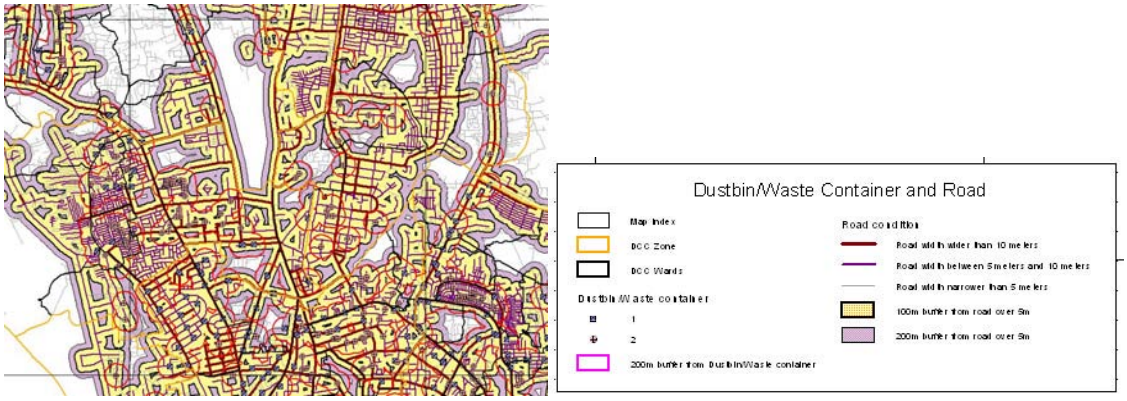


Figure 6.2-12 Accessibility map of heavy vehicles for collection/Transportation

(3) Flood risk area in Collection Service

In order to estimate SWM operation in the flood season, the flood risk area was overlayed on accessibility map to dustbins and waste containers and the service coverage area of transportation vehicles of accessibility map from main road. See Table 6.2-14 and Figure 6.2-13.

Table 6.2-14 Accessibility map of heavy vehicles for collection/Transportation

Item	Description
Map title	Flood risk area in Collection Service
Contents	Accessibility of heavy vehicle along main road over 5meters in Flood season. In flood condition map grand elevation and contour map were overlaid on map of accessibility of heavy vehicle along main road over 5meters.
Map scale	1:10,000
Data resource	Topographic map in the JICA SOB study
Map legend	DCC zones DCC wards Dustbin/ Waste Container Buffer area with 100m interval from existing road over 5m width Road condition Flooding level: - 4meters to 6 meters on Grand elevation - Contour with 1m interval

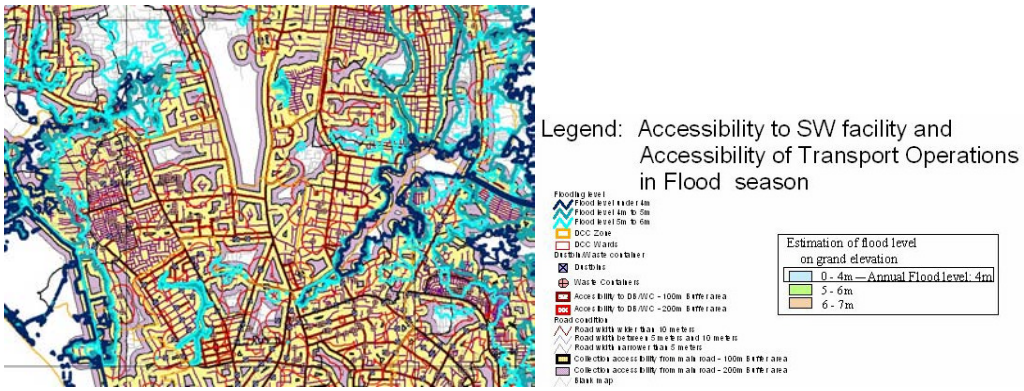


Figure 6.2-13 Flood risk area in Collection Service

6.2.3.3 Primary and secondary service system: DCC, NGO, Private sector

Ward-wise data relating service providers about DCC, NGO's and private sectors was compiled on wards map as a data of private and secondary collection. Lists of private service providers Figure 6.2-14 in the progress report of the study is as shown in Figure 6.2-14. None spatial database is linked to GIS data of DCC zone or DCC wards.

Table 6.2-15 Primary and secondary service system: DCC, NGO, Private sector

Item	Description
Map title	Primary and secondary service system: DCC, NGO, Private sector
Contents	Primary and secondary service system: DCC, NGO, Private sector
Map scale	1:100,000
Data resource	Figure4.2.2 in the progress report in the phase2 of the SWM study GIS base map from GIS basic data in the JICA SOB study
Map legend	- Service provider information about primary and secondary service by DCC, NGO and Private sector

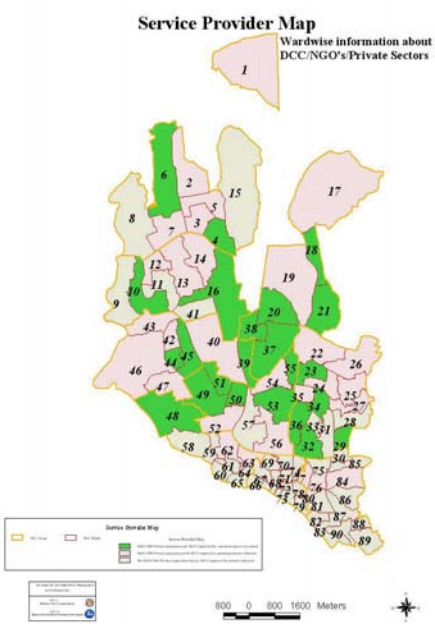


Figure 6.2-14 Primary and secondary service system: DCC, NGO, Private sector

6.2.3.4 Open space/Area Map Analysis of potential disposal sites

As the suitable site for the potential disposal sites, open spaces including grassland and bush were mapped to extract the potential area from land use map and thematic map to show accessibilities to those areas was produced by the buffering analysis which interval was 200 meters each within 1 kilometers. See Table 6.2-16 and Figure 6.2-15.

Table 6.2-16 Open space/Area Map Analysis of potential disposal sites

Item	Description
Map title	Open space/Area Map Analysis of potential disposal sites
Contents	Suitability of disposal sites by query of openspace including grassland and bush and buffer area from those sites to accessibility for suitable disposal site.
Map scale	1:10,000
Data resource	Land use map produced by the JICA-SOB study
Map legend	- Open spaces in land use: open space, grassland and bush - Buffering area with 200m interval

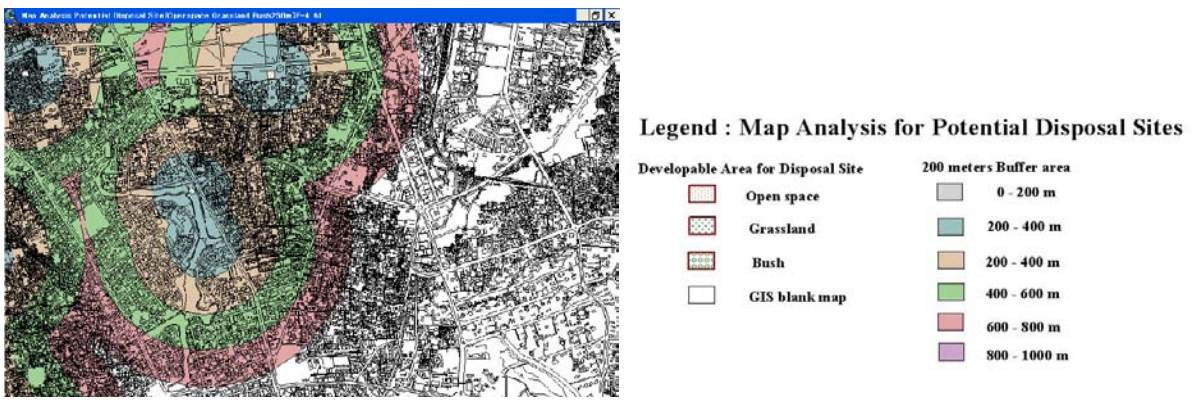


Figure 6.2-15 Map analysis for potential disposal sites

6.2.3.5 Location map of SWM Facilities

Location map of SWM facilities were compiled to a thematic map for facility management as follows: - DCC/Zone office, Dustbins, Waste containers, Disposal site, Dumping sites etc in the study. The field survey for dustbin, waste container, illegal dumping site, open dumping spot and medical facilities was carried out by DCC and the SWM study. Survey forms at location including facilities specifications surveyed in the field were compiled to GIS data for SWM/FM to the future.

But illegal dumping sites and open dumping spots were not identified on maps still. See Table 6.2-17 and Figure 6.2-16.

Table 6.2-17 Data description of location map for SWM facilities

Item	Description
Map title	Location map for SWM facilities
Contents	Location map for SWM facilities and related facilities in the study: DCC zone office, dustbin and waste container, existing disposal sites and future disposal sites(planning)
Map scale	1:10,000
Data resource	Topographic map in the JICA study, Dhaka guide map in SOB, existing maps and materials in DCC and the SWM study
Map legend	DCC/Zone office and Ward commissioners office SWM facilities: Dustbin and waste container Disposal site Dumping site and land fill site

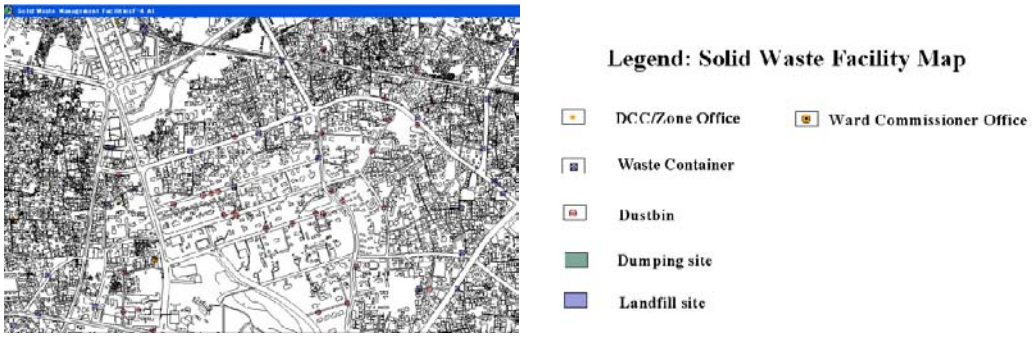


Figure 6.2-16 Solid waste management facility map

6.2.4 Utility map of Sewer and drainage

6.2.4.1 Sewer network map

A paper map of sewer network map was compiled to thematic maps for the SWM study to calculate total length of sewerage for cleaning. See Table 6.2-18 and Figure 6.2-17.

Table 6.2-18 Data description of sewer network map

Item	Description
Map title	Sewerage map
Contents	Location map of main sewer network and sewerage lift stations
Map scale	1:10,000
Data resource	Primary sewerage system map Dhaka Water Supply and Sewerage Authority in 1993
Map legend	- DCC zone - DCC ward - Location of Sewerage Lift Station - Larger Diameter Sewer network 200mm and smaller diameter Sewer have not been shown

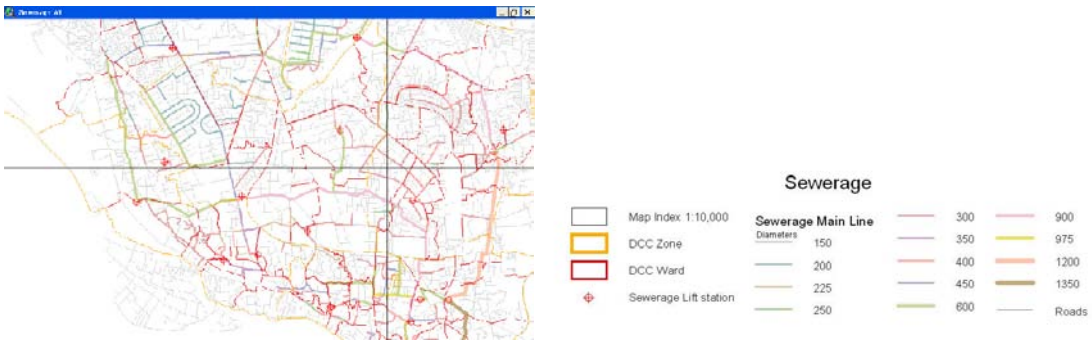


Figure 6.2-17 Sewer network map

6.2.4.2 Drainage network map

Drainage map relating to drainage clean in SWM was compiled to thematic map. Also drainage plan is the important facility for urban development and flood control against the river flooding at Dhaka Metropolitan area. See Table 6.2-19 and Figure 6.2-18.

Table 6.2-19 Data description of drainage map

Item	Description
Map title	Drainage map
Contents	Map showing location of drainage pipe and related facilities
Map scale	1:10,000
Data resource	Dhaka Water Supply and Sewerage Authority in 1994
Map legend	- Location of drainage network - Facilities: Embankment, Proposed embankment, R.C.C. Flood wall, Sluice gate - Storm sewer main line - Pumping station, - Channels - Box cover

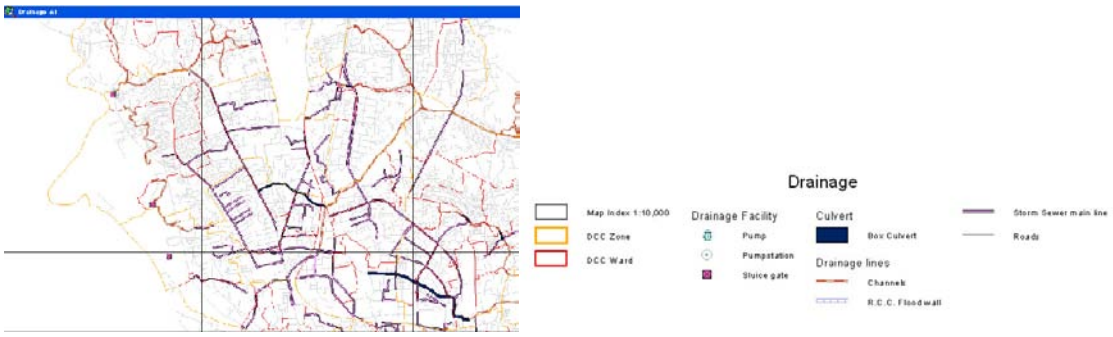


Figure 6-2-18 Solid waste management facility map

6.2.5 Re-compilation of existing GIS data

6.2.5.1 GIS Base map

GIS map was compiled to 1:10,000 map scale by GIS basic data in the SWM study area with consideration of the present DCC area and the surrounding areas. The map is the blank map for survey activities for SWM study. See Table 6.2-20 and Figure 6.2-19.

Table 6.2-20 Data description of 10,000 GIS Base map

Item	Description
Map title	GIS base map
Contents	Base map with a map scale of 10,000 was compiled by GIS basic data and necessary blank map for drawing.
Map scale	1:10,000
Data resource	GIS basic data in the JICA SOB study in 2004
Map legend	Blank map prepared by geographic futures: Roads, buildings and housings, hydrographic data

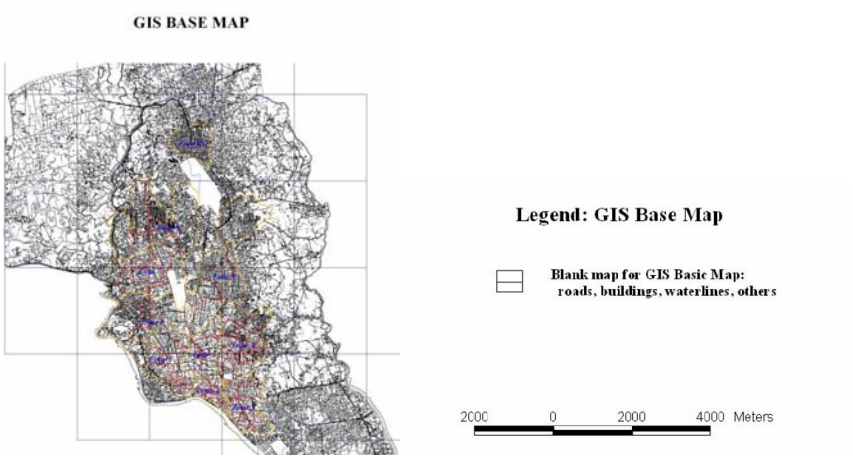


Figure 6-2-19 GIS base map

6.2.5.2 Land condition map

Land condition map was re-compiled to 1:10,000 map by compilation of original map with a map scale of 1:5,000. See Table 6.2-21 and Figure 6.2-20.

Table 6.2-21 Data description of land condition map

Item	Description
Map title	Land condition map
Contents	Recompiled map of land condition map with a map scale of 5,000
Map scale	1:10,000
Data resource	Land condition map in the JICA SOB study in 2004
Map legend	(1)Flat area lower than 4.0 m called low-lying area, (2)Plateau higher than 4.0 m called alluvial terrace, (3)Swamp and marsh, (4)Water bodies such as river, lake and pond, (5)Natural embankment also called natural levee (lower than 4.0 m), (7)Natural embankment also called natural levee (higher than 4.0 m), (8)Former riverbed (lower than 4.0 m), (9)Former riverbed (higher than 4.0 m), (10)Location of drainage pump;

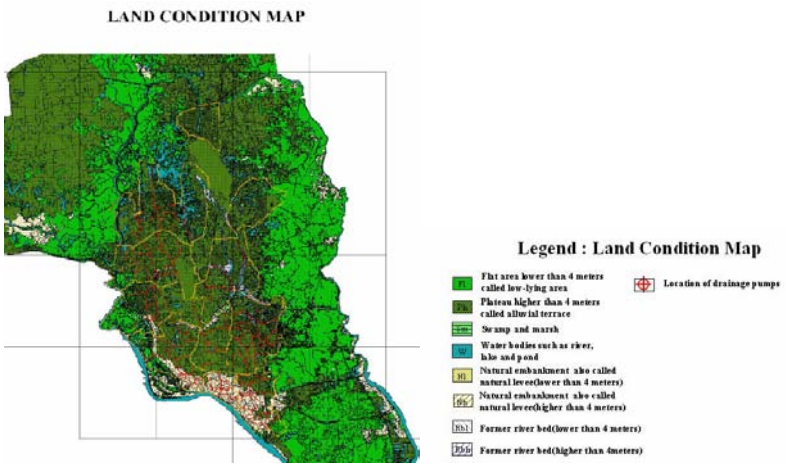


Figure 6.2-20 Land condition map

6.2.5.3 Social economic condition map

Social economic condition map was re-compiled to 1:10,000 map by compilation of original map with a map scale of 1:5,000.See Table 6.2-22 and Figure 6.2-21.

Table 6.2-22 Data description of social and economic condition map

Item	Description
Map title	Social economic condition map
Contents	Recompiled map of social economic condition map with a map scale of 5,000
Map scale	1:10,000
Data resource	Social economic condition map in the JICA SOB study in 2004
Map legend	(1)Residential area (High socio-economic condition) such as “Dhanmondi”, (2)Residential area (High socio-economic condition) Area where foreigners are mainly livingsuch as “Gulshan” and “Banani”, (3)Residential area (Middle socio-economic condition.) excluding item (1),(2) and (4), (4)Residential area (Low socio-economic condition): the slum and an area where low-income group is living, (5)New developing residential area (plan & on going) collected by hearing survey in the site, (6)Mixed area, (7)Main restaurant, (8)Main hotel Prior to commencement of field survey, (9)Market/shops, (10)Big katcha bazaar (Authorized by DCC), (11)Supermarket such as Agora

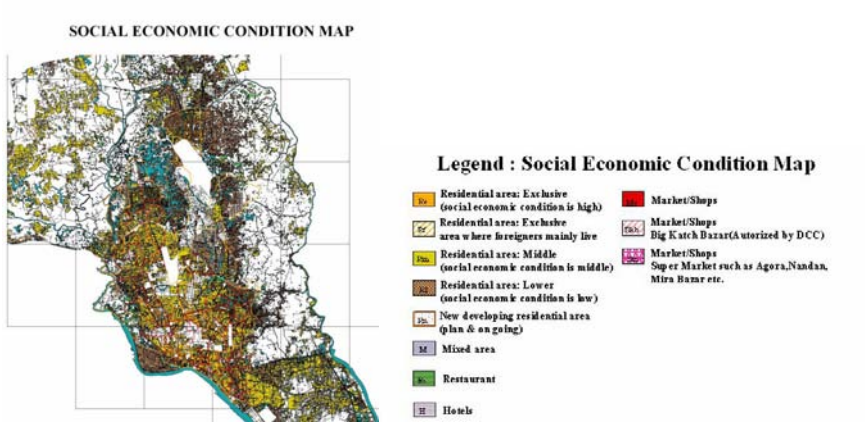


Figure 6.2-21 Social economic condition map

6.2.5.4 Building and housing type map

Building and housing type map was re-compiled to 1:10,000 map by compilation of original map with a map scale of 1:5,000. See Table 6.2-23 and Figure 6.2-22.

Table 6.2-23 Data description of building and housing type map

Item	Description
Map title	Building and housing type map
Contents	Recompiled map of building and housing type map with a map scale of 5,000
Map scale	1:10,000
Data resource	Building and housing type map in the JICA SOB study in 2004
Map legend	Building Type:1～3 stories", "4～6 stories", "More than 7 stories" and Slum. Housing Type: House Detached houses, Apartment houses, Big commercial building, private office & shop(Large commercial buildings, offices and shops) , Public offices(Government building office, public service office), Factory , Religious facilities, mosque, temple, church, Education facilities, Health facilities (hospital, big clinic)

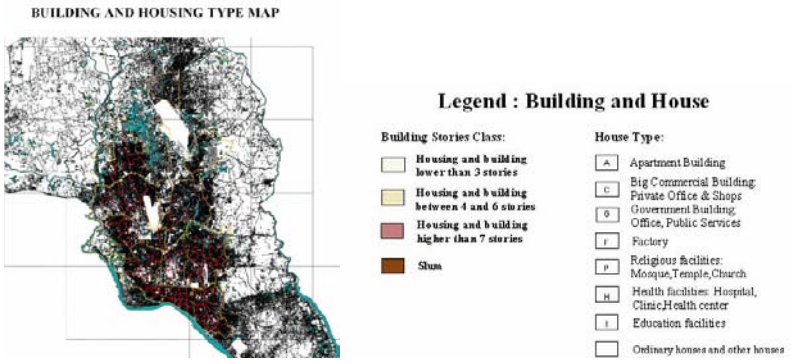


Figure 6.2-22 Building and housing type map

6.2.5.5 Administrative boundary map

Administrative boundary map about union-ward was re-compiled to 1:10,000 map by compilation of original map with a map scale of 1:5,000. See Table 6.2-24 and Figure 6.2-23.

Table 6.2-24 Data description of administrative boundary map

Item	Description
Map title	Administrative boundary map
Contents	Recompiled map of administrative boundary map with a map scale of 5,000
Map scale	1:10,000
Data resource	Administrative boundary map in the JICA SOB study
Map legend	Administrative code, name of Ward and Union and other information: (1)Urban area: Division, District, Thana, Ward (2)Rural area: Division, District, Thana, Union

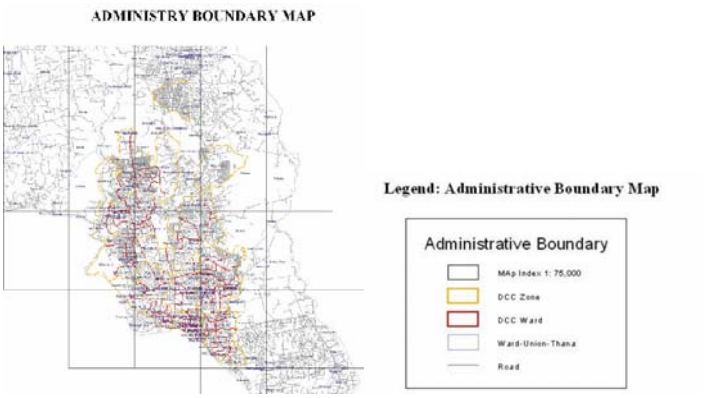


Figure 6.2-23 Administrative boundary map

6.2.5.6 Road condition map

Road condition map was re-compiled to 1:10,000 map by compilation of original map with a map scale of 1:5,000. See Table 6.2-25 and Figure 6.2-24.

Table 6.2-25 Data description of road condition map

Item	Description
Map title	Administrative boundary map
Contents	Recompiled map of administrative boundary map with a map scale of 5,000
Map scale	1:10,000
Data resource	Administrative boundary map in the JICA SOB study
Map legend	Road Condition Data Road Width: (1)Road width less than 5 m, (2)Road width between 5 m and 10 m, (3)Road width more than 10 m Road Type: Status of pavement: (1)Paved: metalled on topographic map, (2)Unpaved: unmetalled on topographic map

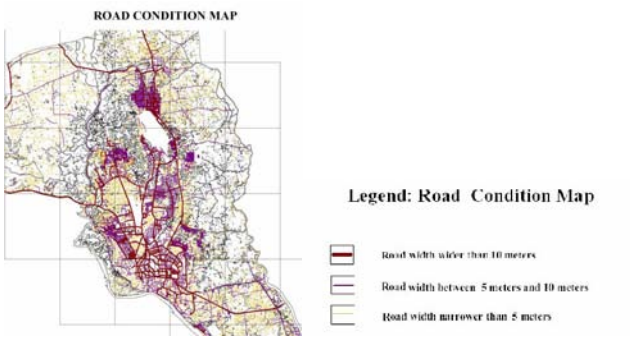


Figure 6.2-24 Road condition map

6.2.5.7 Flood condition map for flood risk

In the flooding season in Dhaka metropolitan area, the SWM operation is under affection of the flooding risk. Annual flooding level is 4m on grand elevation. Corresponding to the SWM operation, critical flooding level was compiled to thematic map relating to grand elevation. If the level exceeds will reach to 6 meters, The flooding makes service bad. Also the drained area and the location of pumping station in the flood action plan were compiled on this thematic map. See Table 6.2-26 and Figure 6.2-25.

Table 6.2-26 Data description of Flood condition map

Item	Description
Map title	Table5.7 Data description of Flood condition map
Contents	Contour of ground elevation in topographic map
Map scale	1:10,000
Data resource	DEM data in the JICA SOB study
Map legend	- Flooded level on grand elevation from 4m to 7m - Existing drained area and future proposed drained area -Location of drained pump

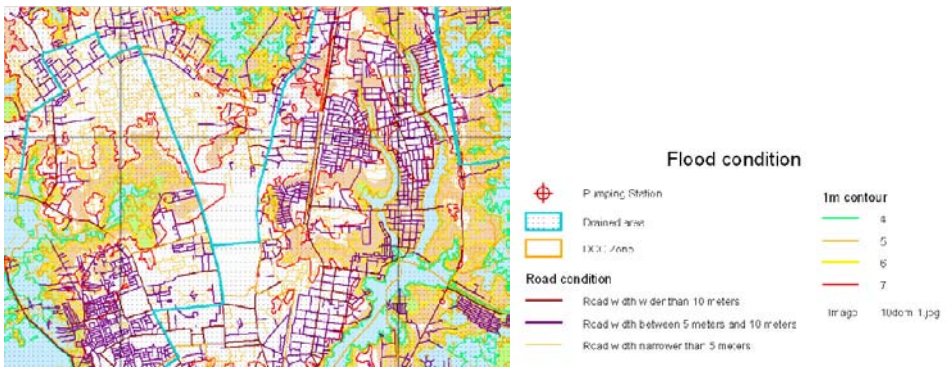


Figure 6.2-25 Flood condition map