

Dhaka City Corporation Bangladesh

Feasibility Study for Solid Waste Management

to

Control Environmental Hazard & Pollution

in

Dhaka City Corporation

**Paper Presented to the First Meeting of
the Kitakyushu Initiative Network
Kitakyushu, Japan. 20-21 November 2001**

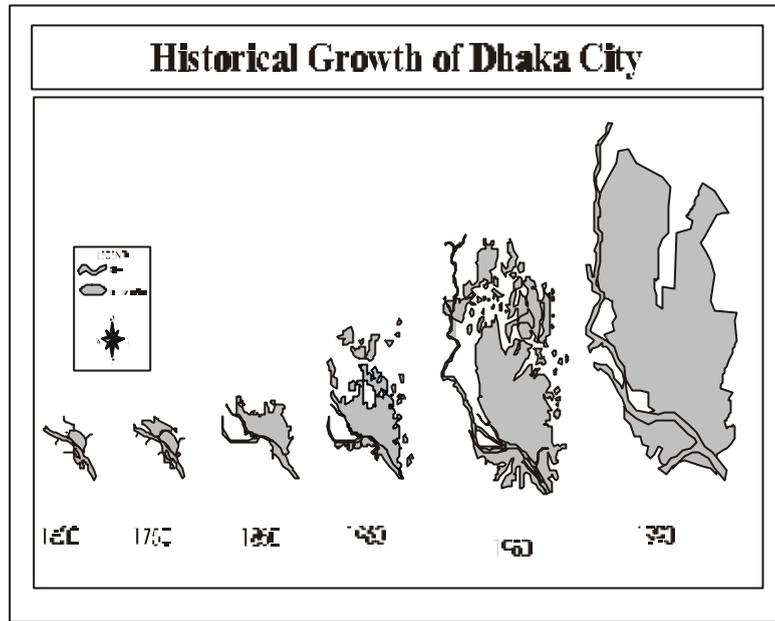
**K. M. Nurul Huda
Chief Executive Officer**

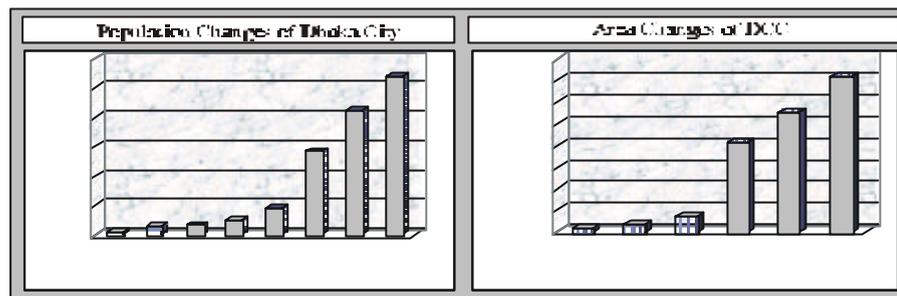
1. General Information

Dhaka Profile

Demographic: According to a report of UNFPA the total population of Bangladesh is 140.4 million. The rate of birth is 3 per cent. The rate of increase of population in the Dhaka City Corporation (DCC) is about 6 percent. In last 10 years the urban population in Bangladesh has been increased from 20 to 29 percent. By next 10 years Dhaka city will be one of the four largest mega cities in the world. Growth of population in the DCC area has also been very rapid. The total population in Dhaka City grew from only 0.104 million in 1906 to 5.4 million in 2001. The population growth rate was 4.15 percent in 1991 and 7 percent in 2001. The rapid rise in population of Dhaka City has been caused mainly by high immigration of people from rural areas. It has also happened due to territorial expansion and natural growth of the native city population. The density of population 1500 per sq. km. is the highest in the world. Dhaka City thus has come to be known as one of the mega cities in the world. But the city's expansion is comparatively lower than its size of population.

Population and Area Changes of Dhaka		
Year	Area (Sq. km)	Population (million)
1906	6	0.104
1951	18.1	0.27
1964	-	0.48
1974	-	0.92
1981	208	2.82
1986	71.6	2.7
1991	276	4.23
1996	140	5.15
2001	360	5.4





Geographic : Shaikh Alauddin Islam Khan the then Provincial Governor of the Moghul Emperor established his capital on the bank of the river Buriganga in 1608 and named it Dhaka. Dhaka is on a piece of flat land. It is the Capital City of Bangladesh. The total area of the city was only 6 k. m. in 1906 beside the river Buriganga. The aerial exposition of the city has been changed dramatically. The Metropolitan City of Dhaka is now comprised with an area of 360 sq. km. The rapid increase of population in the city needs further expansion for urbanization at the rate of 10 percent. On the demand of population DCC has been planned for extension up to 1550 sq. km. calling Greater Dhaka. The rivers- Turag, Shitalakha, Balur and Buriganga surround this area.

Environment: A recent report of UNFPA claims that Dhaka is one of the most polluted cities in the world. Urban environmental issues are mainly of three types: air pollution, water pollution and municipal waste. Of them, air pollution is very dangerous in respect of human lives, sufferings and economic loss. Suspended particulate matter (SPM), carbon monoxide (CO), sulfur dioxide (SO₂), and air-borne lead are responsible for air

pollution problems. Other components of air pollution are Carbon Dioxide (CO₂), Hydrogen Sulfide, Hydrogen Chloride, Hydrocarbons, N_x, S_x, Ozone, wind bound particulate, Photo Chemical Oxidant, Asbestos, Beryllium, Lead, Venial Chloride, Benzene, Arsenic etc. Some local study and research show that SPM and ambient SO₂ levels in Dhaka are about 4 times and 5 times higher than Bangladeshi standard respectively. Again, the figures of these two areas exceed 12 times and 10 times of the World Health Organization (WHO) standard respectively. Air pollution causes headache, burning of eyes, pains on throat, bronchitis, breathing problems, heart disease, anemia, mental problems, kidney disease and even cancer. Again acid rain causes due to excessive sulfur and nitrogen emission from vehicles and industries.

World Health Organization and United Nation Environmental Program estimate that two-third of more than 1.8 billion people of the cities are living at risk of SO₂ and of other vapor bound particles. Every year about 3 million people on earth die of diseases related to air pollution. Another report shows that respiratory diseases due to dust, smoke SPM etc claims around 300,000 to 700,000 lives in one year in the developing countries. A recent World Bank report claims those four major cities in Bangladesh loss about 15000 lives each year due to air pollution. Deaths due to air pollution exceed 6 percent of the total annual figure. An estimated 6.5 million people of four big cities of Bangladesh suffer from acute respiratory infections caused due to air pollution. Again 850 million dwellers of the four cities could be saved from minor illness had there be an air pollution at the standard set by the developed countries. An ADB sponsored report shows that 3,850 premature deaths could be saved had there be a reduction of SPM concentrations in Dhaka to the Bangladesh air quality standard. Economic cost in

relation to such deaths and illness in Bangladesh may reach US dollar 800 Million in a year.

Water is life. Billions of people round the world do not have access to safe water for drinking, bathing and to sanitation and sewerage facilities. In Dhaka city more than 3 million people do not have legal access to supply water. Equal number do not get adequate amount of water for bathing, washing etc. About 41 per cent city dwellers get full time water. But no water is safe to drink and use. This indispensable component of life cycle, when gets contaminated, carries as good as 80 different kinds of germs that are dangerous to human life. Of the water-borne diseases- diarrhoea, cholera, dysentery, typhoid, jaundice, malfunctioning of stomach, skin diseases etc are worth mentioning. Of about 900 million people suffer from diarrhoeal diseases, more than 3 million children die each year. The main river of Dhaka city, the Buriganga, is getting severely polluted day by day. Rapid increase of urban population, discharge of household and industrial waste, disposal of metered waste from tanneries and poor sanitation system are the main causes of water pollution of the river. Low dissolved oxygen concentration and high concentration of chromium, bacteria and heavy metal in the water are the threats to the aquatic life and environment at around the river.

Of waste

Disposal of solid waste is another area of concern in the cities. Solid waste problem in Dhaka city is very acute in comparison to many cities of the developing countries. Daily production of solid waste in Dhaka City is more than 4000 Metric Tons. Of them 200 Metric Tons hospital and clinical waste is a mixture of toxic chemicals, radioactive

elements and pathological substances. 15 to 20 percent of medical wastes are highly dangerous for human lives. These waste when dumped with other municipal wastes in the open land poses threat to serious health hazard to the city people. The nature of solid waste is getting changed with the change of time and development. Of the solid wastes plastic and polyethylene goods also cause problems towards human health, environment and drainage system. These goods are cheaply and easily available in the markets. The users do not care to reuse them. They rather throw these things out of the door and window. An Inception Report on Control & Management of Polyethylene bags in Bangladesh shows that people of Dhaka City alone use 600 million bags a day. The process of recession of floodwater in Dhaka City during the huge flood was delayed. Logging in the drainage system due to polyethylene was one of the major reasons for the delaying process. Polyethylene and Plastic materials are not biodegradable. Natural process cannot decompose it. Polyethylene remains intact in the soil, disturbs the flow of nutrients to the soil and hinders entering sunlight. It destroys the beneficial bacteria of soil compaction. In the long run it affects the foundation of physical infrastructures, if there is any on the plastic dumpsite.

Socio-economic: Of the total population in the city about 64.1 per cent are literate. The rest are illiterate knowing no alphabet. Among the youths more than 10per cent are unemployed. Another 10 per cent are underemployed. Economic indicator shows that the per capita income of the people of Bangladesh is nearly US\$ 450. GDP is US\$14.89 million. Around 55 per cent people live below the poverty line in Dhaka. A half of those poor people live in slums and squatter settlements. The slum population has been raised to about 3 million within a decade time. Access to water supply, sanitation, solid waste

management and other civic and social services by this huge poor population are extremely limited.

Land use: Land is very scarce in Dhaka City. Only 360 sq. km. of land has to accommodate residences, offices, services and facilities to more than 5.4 million people. An International Airport, the River port, the central Railway Station and Inter District Bus Terminals are all located in Dhaka city. Being the Capital City of Bangladesh, central govt. offices, Secretariat, big educational institutions, hospitals etc are also set in Dhaka. Again major economic activities like business, commerce and industries have been developed in Dhaka over the years. The city should have enough circulation places. There should be more water bodies within the city for natural recycling of air borne and water bond pollutants. There was no designated place for disposal of wastes at the initial time. The public land was the only place for waste disposal of the city. A good number of areas have been raised from low lying ditches to high places for construction of bus terminals, play grounds and even residential sites. At present DCC has acquired one piece of big land at the outer strip of the city for disposal of waste. It would be very difficult to acquire more land for further disposing of wastes unless alternatives are explored.

Institutional: Institutional footing of local govt. in Bangladesh bears a long and profound heritage. Local govt. experts has traced out that there existed some kind of local govt. system in the Indian subcontinent during the period of Vedic (1500 BC-1000BC). This local govt. system was mainly based in the rural areas to look after local problems like-security, law and order, punishment of crime, settlement of disputes,

management of communal land, collection of revenue on behalf of the state, supervision of endowment for religion, medical and other charitable work, provision of banking facilities and burial. The urban local government bodies in big cities in the Indian sub-continent were set up in Madras in 1688 followed by Calcutta and Bombay (Now Mumbai) in 1726. Dhaka Municipality was however established in 1864. The urban body used to maintain vital statistics of the urban areas, manage cemeteries, slaughterhouses and sweeper colonies. It controlled the markets, checked the weighing, measurement and supervised local prices. It also levied local taxes, market dues, and transit duties. There was no formal law or rules to regulate local govt. until The Bengal Municipality Act was enacted in 1842.

a. Municipality: There are two tiers in urban local govt. bodies City Corporations and Municipalities. Municipalities are comprised with smaller urban towns with less population. All 64 district headquarters are municipalities on hereditary basis. In addition to that nearly 203 sub-district headquarters in the country have been upgraded to municipalities. These municipalities cater the civil services to the urban people.

Big municipalities are divided into a number of wards depending on the size and population. Commissioners are elected directly by popular vote. There is one Chairperson of a Municipality. He is similarly elected directly by popular vote. An elected representative represents each ward.

b. Metropolitan City: On consideration of size, population and law and order situation govt. in 1970s upgraded four big municipalities of the country into

Metropolitan Cities. The advantages of the Metropolitan city are that it has independent policing, judicial system and separate regulations suitable for cities' problems to control law and order situation.

- c. **City Corporation:** Considering the size, population, civic problems and importance govt. has again created four Municipal Corporations at the four Divisional headquarters in 1980. Govt. have upgraded another two city corporations in 1999. The City Corporations in Bangladesh are-

- (i) Dhaka City Corporation
- (ii) Chittagong City Corporation
- (iii) Khulna City Corporation
- (iv) Rajshahi City Corporation
- (v) Barisal City corporation
- (vi) Sylhet City Corporation

The City Corporation is divided into suitable wards. DCC is thus divided into 90 wards. Adult taxpayers of the municipalities are eligible for voters. The Mayor and Commissioners are directly elected by popular votes of the city dwellers. Elected Commissioners represent their respective ward. There are, however 18 positions of Commissioners kept reserved for women. These positions are elected in a prescribed manner from the contestant women candidates. The Institutional head of the City Corporation is Mayor. Mayor of Dhaka City Corporation holds the status of a full Cabinet Minister. Mayors of other City Corporations hold the status of State Minister. The Mayor of City Corporation

along with ward Commissioners constitutes Councils of City Corporation. These Councils are responsible for formulation of policies, approving annual budget undertaking development schemes and execution of projects and programs of the respective City Corporation. The tenure of such representative bodies is five years. The Mayor chairs the Council meeting. In case of his absence the senior member of the panel of Mayor chairs the meeting.

- d. Members of the Council:** There are two categories of members in the Council- Elected representatives and expert members. Elected representatives are the permanent members of the Council during the tenure of the terms. Expert members are appointed by the govt. by designation.
- e. Official Representative:** The expert members are called official representatives. They can participate in the proceeding of the meeting and can give expert opinion on their respective subjects. They cannot however, vote in favor or against any motion.
- f. Transaction of business:** The Council is supposed to sit at least once in a month. The Chief Executive Officer prepares agenda of the meeting. On approval the agenda by the Mayor The Chief Executive Officer arranges the meeting of the Council. He then notifies the members of both categories giving at least seven days time. Again, there are a number of Standing Committees appointed by the Council for disposing of departmental activities.

- g. Decision Making Process:** The Chairperson places proposal on any specific subject before the Council for discussion. The members take floor for discussion/debate and reach decision. The Council tries to achieve consensus on the proposal. In case there is a difference of opinion among the members on any motion, the matter is decided upon by voting. Vote by simple majority favors the proposal. In case the members are divided into a half the Chairperson may like to give his casting vote.
- h. Executive Agencies:** There are 12 executive departments in DCC. The Departments are-
- 1) **Administration and Establishment:** Looks after recruitment, appointment, transfer, posting, career planning, welfare and benevolence of the officials and staff.
 - 2) **Engineering :** Responsible for all kinds of civil works, street lighting and electrical work, mechanical works and construction markets and other establishment.
 - 3) **Primary Health:** Management of city hospital, mosquito control, enforcement of pure food supply regulations, registration of births and deaths, preventive health care, taking care of live stocks of the city and supervision of slaughterhouses.
 - 4) **Social Welfare:** Management of graveyards and burials, education, cultural and recreational activities, management of library.
 - 5) **Revenue Collection:** Assessment and collection of tax, tolls, fees, rates and rent.

- 6) **Accounts and Audit:** Preparation of annual financial statement, payment of bills and salaries and keep papers updating for govt. audit, maintenance of ledger book and cashbook.
- 7) **Conservancy:** Cleaning of streets, maintenance of drains, disposal of all types of wastes, management of dumpsites and management of waste carrying vehicles.
- 8) **Estate Management:** Responsible for management and administration of immovable properties of the City Corporation, eviction of the unauthorized occupants on the land and properties of the Corporation, procurement or disposal of immovable property of the Corporation.
- 9) **Store and Purchase:** Responsible for purchase of all purchasable items except vehicles and heavy engineering equipment and supply of store materials as per requisition of the respective departments.
- 10) **Transportation:** Procure, maintain, fuel, and manage all the vehicles of the Corporation.
- 11) **Law:** Takes care of legal matters of DCC including contesting to the courts for protection of the interest of DCC.
- 12) **Public Relations:** Takes coverage of press and media and keeps the Mayor informed of reports published in different Dailies concerning DCC.

The territory of DCC is divided into 10 administrative zones. Govt. personnel called Zonal Executive Officer heads each zone. He is aided by other departmental staff to supervise and execute the decision of the Corporation. These Departments and zones are responsible for execution of decision of the Council within their respective jurisdiction.

- i. Official on Deputation:** There are a few positions in the City Corporation kept reserve for the officials of the National govt. Govt. for a specified period give posting officials for working with City Corporation on a set of terms and conditions. Govt. may withdraw/replace any such officials at any time for public interest.
- j. Official of the Corporation:** The City Corporation is run and managed as per an Ordinance passed by the Parliament of the country. The Ordinance provides with a kind of schedule. This schedule provides with the manpower, classes of officials, their pay structure and areas of responsibilities. These officials as described in the schedule are the permanent strength of the Corporation.
- k. Sources of Fund:** Own sources of fund of the City Corporation are household tax, rents from markets, shops and establishments, fees from licenses, tolls from different temporary public places.
- l. Govt. Allocation:** Corporation's own resources are not enough to cater different development activities of the city. Govt.'s financial support has therefore become a regular phenomenon for the Corporation. In the annual budget more than 50 percent fund comes from govt. treasury in the form of block allocation.

- m. Annual Budget:** Every year at the end of financial year (June-July) an annual Budget is prepared, placed before the Councils in a formal meeting and get it approved.

Urbanization:

The trend of urbanization is very high in all the cities of the world. DCC is not an exception. About 160000 people migrate globally from rural places to urban cities. About 1.8 billion people are the citizens of cities in the world. The proportion of the world's population living in large towns or cities has grown from around 5 to 50 percent over the past two centuries. Demographers estimate that by 2030 approximately two-thirds of whole population will live in large towns or cities. The trend of urbanization in DCC is 7 per cent a year. But alarming situation is that 6 per cent of the total migrated people are poor. They are socially and economically displaced persons. They are the victims of river erosion, unemployment, natural calamity and insecurity. They settle in the slums. There are already about 3 million very poor people living in different slum of the city. They do not pay any tax to DDC. They are not in the roll of holdings. They live in very subhuman conditions and create nuisances such as law and order situation, pollution, and pressure on normal services like water, electricity, land, and traffic congestion and so on so forth.

National Govt. Plans and Programs for Solid Waste Management: City's solid waste management is entrusted with DCC. DCC is a corporate body under the administrative control of Ministry of Local Govt., Rural Development and Cooperatives.

Govt. at this moment does not have any specific plan or program for municipal waste management. But scientific and hygienic disposal of Municipal Solid Waste (MSW) is a prime concern of the govt. of Bangladesh. In December 2000 Cambridge (Bangladesh) Ltd. a private organization has presented its documents on treatment of MSW in presence of Syeda Shajeda Chowdhury, the then Minister for the Ministry of Forest and Environment. She directed the participant officials to send their recommendations for formulation of a national policy on waste disposal.

Again a number of studies and works have been done since early 1990s by different foreign and local bodies to suggest out ways and means for proper disposal of municipal waste. Such a study of Cambridge (Bangladesh) Ltd. may show a light of vision to come out of municipality waste problems. The presentation and discussion thereby have surfaced a few areas on technology, economy, performance, suitability, dependability, responsibility, and capacity of Waste to Electrical Energy (WEE) Project. The elements of the Cambridge (Bangladesh) Ltd. were found closely similar to those of the Tecom Systems Ind. Canada.

On the question of proven technology, Cambridge (Bangladesh) Ltd. submits that Integrated Environmental Technology, LLC (IET) is the manufacturer of Plasma Enhanced Metal (PEM)- TM system. IET has operated three PEM-TM systems ranging in size from 0.5 Ton Per Day (TPD) to 10 TPD at its Technology Center located in Richland, WA. IET has sold three systems in sizes ranging from 1 TPD to 10 TPD on commercial terms. These are-

i. Allied Technology Group, Inc, 2025 Battelle Boulevard, Richland,

- ii. Asia Pacific Environmental Technology, 1088 Bishop Street, Suit 1130 Honolulu, HI 96813, and
- iii. Miyazaki, Japan.

Main elements of the presentation-

- a. Proposal of two independent MSW treatment plants having disposal capacity of 2000 MTD,
- b. Total power generation capacity of the plants- 300 Mw,
- c. Total land requirement for the plants- 60 acres,
- d. Rate of electricity – 6.0 Cent/Wh at 80per cent plant factor,
- e. Plant Cost- US\$ 563 Million app.,
- f. Annual O & M Cost- US\$ 28 Million,
- g. Annual Fuel Cost (Gas) US\$ 28 Million, and
- h. Project takes 3 years for completion.

Responsibilities of the Proponents-

- A. Establishment of the Plant on (Built Operate and Own) BOO basis with 100per cent Foreign Investment,
- B. Ensure pollution free treatment of (MSW) of Dhaka City,
- C. Ensure 250 Mw Power supply from two plants,
- D. Provision of supplying 50 Trucks, and
- E. Transfer of the plants to Govt. of Bangladesh after 20 years.

Responsibilities of Govt. of Bangladesh as proposed-

- 1. Delivery of waste at plant site without cost,
- 2. Land without cost + LLA,
- 3. Exemption of CD, ST, VAT and all other Taxes,
- 4. Supply of Natural Gas for 200 Mw Power Plant,
- 5. Provision of Fuel Supply Agreement,
- 6. Power purchase agreement for 20 years from the plants, and
- 7. Guarantees of all payment

Observations made from the presentation-

- (A) WEE project requires approval of the govt.
- (B) Bangladesh does not have proper technology for better treatment/disposal of MSW

- (C) Municipal waste threatens general health of the inhabitants of Cities,
- (D) The cost per unit of power generation from PEM-TM system is high,
- (E) PEM-TM system could not go for proven commercial venture,
- (F) There is no PEM-TM plant beyond 10 MTD capacity of waste treatment,
- (G) City scale of managing waste 2000 MTD plant is not experienced,
- (H) The proposed 2000 MTD capacity of waste treatment plant seems very big,
- (I) No indication if supply of 50 trucks is one time basis or replacement basis,
- (J) Costing and ways & means are not included for supplying electricity to the National Grid, and
- (K) A Committee constituted by the Supreme Court of India suggests that “Local bodies should not experiment with any expensive technology until after adequate experimentation and one or two successful pilot projects, to the scale corresponding to the technologies, they have been proven and can be adopted in local conditions.”

Existing national and local laws, regulations, ordinances, and regulatory measures related to solid waste management:

There is no independent law in Bangladesh to address the problems of solid waste. In Bangladesh, solid waste management is entrusted with the local govt. bodies. The responsibility of removing MSW and disposing of it lie with the City Corporation. The national policies, laws, rules and committees that Bangladesh have are all related to environmental issues. The important of them are-

- A. National Environmental Policy, 1995
- B. Na Environmental Conservation Act, 1995
- C. Bangladesh Environmental Conservation Rules, 1997
- D. Separate Ministry named Ministry of forest and Environment
- E. Separate Directorate named Directorate of Environment

- F. The Industrial Act, 1937 and 1992 to provide Regulations for industrial waste management
- F. National Agenda
- G. National Committee for Formulation of Integrated Environmental Guidelines.

The Dhaka City Corporation Ordinance, 1983 is the only local law that gives some shadow lights on disposal of municipal waste. The Ordinance 1983 and the Bangladesh Environment Conservation Act 1995 (EPA). deal only with the control and disposal of radioactive substances having a provision of penalty up to 5 years imprisonment or fine of one lac taka or both. Dhaka Municipal Ordinance 1983 has a provision for the removal of refuse from all public streets, public latrines, urinal drains, and dustbins and for collection and disposal of such refuse. The Environmental Policy 1992 simply intends to restrict disposal of municipal, industrial or agricultural wastes in rivers, ponds and drains, discourages open truck transportation and day time collection of waste. These legal foundations give a general guideline about the duties or responsibilities of Dhaka City Corporation. The Bangladesh Environmental Conservation Rules, 1997 has developed some waste disposal standards for the industrial discharge and made mandatory environmental clearance for setting up new industries. The National Policy For Safe Water Supply & Sanitation 1998 refers to the empowerment of setting tariffs, by-laws & other needs concerning to waste management and given emphasis on organic waste recycling such as compost, bio-gas. The policy also suggests for transfer of the collection, removal and management of solid waste to the private sector where feasible.

But the implementation of the regulations are weak and public awareness level is low. No initiative has been taken to inform the people about the rules and regulation. The enforcement mechanism is slow and bureaucratic.

The worth mentioning national level initiatives are-

- a. Waste to Energy Program
- b. Installation of Catalytic Converter and Diesel Particulate Filter in motorized vehicles to control air pollution
- c. Installation of Composed Natural Gas (CNG) in motorized vehicles to reduce emission

Important Projects under implementation are–

- (A) Community based Urban Solid Waste Recycling Program
- (B) CNG conversion of Petrol and Diesel run Vehicles
- (C) Conversion of Two-stroke Auto-rickshaw into Four-stroke Powered Engine
- (D) Chrome Recovery Pilot Plant for the Treatment of Tannery Waste
- (E) Public Awareness Program Against the use of Polyethylene
- (F) Urban Transport and Environment Improvement Study
- (G) Air Quality Management Project
- (H) Save the Buriganga Project
- (I) Dhaka Urban Transport Project
- (J) Saidabad Surface Water Treatment Project
- (K) Dhaka Integrated Flood protection Project

The Prime Minister of the country heads the National Committee for Formulation of Integrated Environmental Guidelines. Govt. of Bangladesh is thus concern of the environmental situation of its capital city. The above list of laws, initiatives and projects,

however, relates to total environmental issue of the country. It clearly shows that there is inadequacy of both national and local laws towards solving the problems of municipal waste. There is no separate law or regulation or system for segregation of harmful hospital waste from normal waste. Ministry of Health and Family Welfare is to ensure not to dispose of harmful waste without treatment.

Industrial waste that carries even toxic substance are disposed of in the same manner of disposing of other wastes. Urban environment could have improvement provided there would be- effective policy and regulation, sufficient enforcement mechanism, coordination, high level of education, proper contribution of expertise and professional, good governance, appropriate and modern- piloted, proven, cost-effective and sustainable technology, financial support with proper financial accounting system and high level of public awareness and participation.

There is a requirement of obtaining Environmental Assessment Certificate before establishment of any industry. But many industrialists take the advantage of weak enforcement mechanism of environmental law of the country. They build up industries without caring environmental impact. There is thus a need to build up institutional and operational capacity of the govt. and that of its line organizations to bring the violators of environmental law into book.

Present status of solid waste management

Solid Waste Generation: Households, street sweeping, garden trimming, construction rubbish, market places, industrial units, commercial establishments, hotels, restaurants,

clinics and hospitals are the major sources of wastes in Dhaka City. Municipal wastes may be of types: soft, liquid and hard. Soft waste includes vegetables, fruits, and food staff of hotels, restaurants and households substances. More than 1000 industries of different sizes and categories, 500 clinics and hospitals and 149 tanning industries in Hazaribag area are producing significant amount of toxic and hazardous waste every day. Tannery and Chemical industries produce liquid waste to an amount of 18000 liters per day. Hard wastes are pieces of wood, cloths, iron & steel, polyethylene materials, plastics, paper, rubber, textiles waste etc. Slum dwellers are mostly responsible for unplanned and scattered disposal of MSW, pollution of city environment and creation of unhygienic and social problems. As such the proper disposal of waste is an ever-increasing phenomenon. This problem is coupled with scarcity of land for dumping, increasing distances to disposal sites, traffic congestion, and inadequate budget allocation in waste disposal sector.

Composition: Different reports on solid waste show that the average production of solid waste by an individual in a day of a developing country ranges from 0.45 to 0.50 kg. It is almost similar to that of SAARC countries. The socio-economic, cultural and political change, seasonal varieties and industrial development contribute to the change of solid waste generations rate in Dhaka as well as in Bangladesh. The production of MSW is on the upward trend due to the reason of increasing trend of population and economic activities in the city.

In the purview of management and legal aspects, the specific definition of solid waste has not been developed. In a broader sense all wastes other than liquid wastes can be categorized as solid waste.

Solid waste may be of four types:

- (I) Domestic waste
- (II) Commercial waste
- (III) Industrial waste
- (IV) Hospital/clinical waste

Some of these wastes are detrimental to the health of city dwellers as well as to the environment. Scientific and hygienic disposal of MSW is a problem of the cities in the world. Developed countries apply advanced technologies in disposing of MSW. Developing countries cannot do that as appropriately as they should. They however, apply different local methods to address the problem. Different studies conclude that the Municipality alone cannot handle the problems of disposing of it. Involvement and participation of public sector, private organizations, Non-Govt. Organizations (NGO) and members of community can give better result in this area of concern. Anything does not come to direct use of people are waste.

Components of solid waste has been categorized as–

- | | |
|---------------------|------------------------------|
| (1) Food | (8) Shredded skins & leather |
| (2) Paper | (9) Hospital/clinical |
| (3) Polythene | (10) Industrial |
| (4) Cloth | (11) Others |
| (5) Garden trimming | |

- (6) Brick, wood, metal & glass
- (7) Leaves & branches

Recycling: There is a 4 Rs concept in handling the MSW problems-

- ▶▶ Recycling,
- ▶▶ Reducing,
- ▶▶ Reusing, and
- ▶▶ Recovering

Asian Development Bank organized a workshop in June 2001 in Manila on solid waste management. Govt. officials, donors, NGOs, representatives of private organizations and city executives participated in the workshop. The 4-Rs concept came into a fruitful discussion in the workshop. The discussants agreed that recycling but reducing, reusing and recovering processes at the source of origin can help effective and efficient disposal of MSW of a city. MSW of Bangladesh contains about 60 percent moisture. Reducing the waste at the point of loading can help effective handling of rest 40 percent waste of the total.

There exist some unplanned recycling, reusing and recovering practices on waste in Bangladesh. Three of them are:

- (a) at the households
- (b) by slum children
- (c) by refuse pickers.

Extensive informal activities consist of waste pickers, itinerant waste buyers, waste dealers, wholesalers and small recycling enterprises make a significant contribution to the overall waste management process. In Dhaka, wastes that have market value are being reclaimed or salvaged for recycling. Recycling contributes to resource conservation as well as environmental protection. Recycling of paper, plastic, glass, metal etc. plays a very important role in the economic sphere and a large number of poor people are dependant on it. Recycling of inorganic portion of wastes is done in three levels. **First level** of recycling starts at the household normally carried out by the servants & often the housewives. The recovered materials in the households are old newspapers, empty bottles, containers, old cloths, shoes etc. and sell them to street hawkers.

The **Second level** is the scavenging operation carried out mostly by slum children locally known as 'Tokai'. The items include broken glass, waste paper, rag, plastics, metals etc. discarded by households.

The **Third level** of the scavenging operation takes place at the dumpsite done by the refuse pickers, when refuse is unloaded from municipal trucks at the disposal site. The salvage materials at the dumpsite have the lowest quality & price. It includes rags, torn cloths, glass, pieces etc.

The major component of municipal waste is organic food waste that has a potential value and can be converted into organic compost. The organic food wastes have also a

potential value for conversion into organic fertilizer. A local NGO, Waste Concern is taking the pioneering role with the research, development and marketing of the compost from the municipal organic waste.

Urban Management Program in a world- wide study observes that for the self- serving reason of reducing its workload and cutting its costs, if not for humanitarian and environmental reasons, local govts. should do everything possible to encourage recycling of waste from the source by private sector initiatives. The best way to encourage recycling is to provide financial incentives (low-cost loans, loan guarantees, tax exemptions) and to set up concession arrangements with the private sector, including the informal sector of waste pickers.

At the heart of recycling is the buy-back center. The buy-back center purchases recyclables from individuals, processes them to meet industrial requirements, and sells them to industry. Because buy-back activity could lead to significant reductions in the quantity of waste that the govt. has to collect. Govt. should be willing to provide buy-back centers with financial support.

In most developing countries, buy-back centers are purely market driven and receive no govt. support. Their profits are solely based on the difference in price received from industry versus that paid to individuals (dump site waste pickers and door-to-door waste collectors). Unfortunately until govt. in developing countries stop open dumping and recognizes the cost associated with disposal, it is unlikely that they will give buy-back centers the equivalent of a tipping fee for every Metric Ton recycled and thus diverted

from disposal. Financial incentive of the local govt. would supplement the efforts of collecting MSW from the source of origin.

Existing Situation:

- A. Present Management:** Normally the households bring their refuse to the nearby communal bins/containers located on the street side. In areas of the city, community has arranged house to house collection of garbage with their own initiatives and efforts. Street sweeping is done manually and debris are loaded from the kerb-side into the handcarts and delivered into the collection bins. The wastes are transported by fleet of open (flat bed) or closed vehicles (with vertically sliding shutter on both sides) from the old part of the city where the roads and the lanes are narrow. Demountable container system (hydraulically operated) is working where roads are wider. Every vehicle has got specified areas and route through which they move to collect wastes. The uncollected wastes are through in open spaces, and on streets; that clogs drainage system creating serious environmental degradation & health risks. In Dhaka, wastes that have market value are being reclaimed or salvaged for recycling.
- B. Street Sweeping:** Street sweeping is done manually with brooms and debris and loaded into handcarts. Women cleaners are mainly doing the street sweeping jobs. One pair of sweepers is assigned to each beat for sweeping and cleaning the roadside and the areas surrounding the community. One sweeper sweeps along the roadsides and in the lanes. She forms small heaps of sweepings along the kerb and it is the second sweeper's task to load these piles into her handcart and carry them to the nearest community containers. Sweeping is mostly done in

the early morning. The busy streets sweeping of busy streets are done at nighttime.

- C. Drain Cleaning:** Roadside drains in the residential areas are cleaned by the storm sewer cleaners who heap the silt along the drains & left it to dry for a period of time. The heaps are then loaded into wheel- barrows & then transported into the trucks at an interval.
- D. Waste Storage and Collection:** Normally the households bring their refuse to the nearby communal bins/containers located on the street side, while in some specific areas community has arranged house to house collection of garbage with their own initiatives and efforts. Cleaners are engaged by DCC to collect the street sweeping, drain silt and refuse accumulated by them earlier, together with the refuse dumped by house owners, shop-keepers etc. and store them at the nearest collection point or dustbins provided by the city corporation. There are about 3000 handcarts for local carriage of wastes from lanes, drain silt and sweepings. In DCC area there is no specific rule for placement of the collection bins. For conservancy service, about 7000 cleaners and 118 supervising and managerial staffs are deployed for sweeping of the streets and collection & disposal of wastes.
- E. Waste Transportation:** Dhaka City Corporation has a fleet of 220 open/covered trucks and 128 demountable container trucks of varying capacity for transport of garbage to the landfill site. Workers who travel with vehicles and help the

manual unloading at the disposal site, transfer the wastes from bins to the vehicles. About 20 percent of the fleet is out of service for repair and maintenance. Sometimes trucks are hired to face the emergency waste transportation. The transport department controls and monitors the activity of the vehicle fleet. Recent survey on waste transportation in three different disposal sites reveals that about 2400 tons of garbage is being carried to the landfill site, which is 60 percent of the generated wastes.

- F. Waste Disposal:** Land filling is the cheapest and most prevalent method of MSW disposal for land reclamation. The waste is presently being disposed of mainly on a lowland (Matuail) about 3 kilometer outside from the Corporation area and a number of minor sites which are operated as uncontrolled manner without any proper earth cover and compaction. The uncontrolled dumping in low-lying areas is an environmental hazard that has a chance for polluting the ground water.
- G. Good practices in waste management:** In addition to the traditional practices of waste management in Dhaka and some other cities, some good practices are being taken place, which compliment and supplement the efforts of the municipal authorities. These are-
- ▶ Community based House-to-House waste collection
 - ▶ Encouraging effort of organic waste recycling
 - ▶ Management of clinical wastes

- ▶ Development of Public-Private-Community - Partnership, a model of co-management and sharing
- ▶ Activity of civil society and environmental awareness group
- ▶ Development of micro-enterprises in waste recovery and recycling
- ▶ Involvement of NGOs and media in environmental awareness program.

Collection System: A centrally controlled system is employed for the collection of solid wastes in Dhaka. The domestic, commercial, industrial and clinical wastes are deposited to the collection bins mostly made of concrete located on the streets at frequent intervals. The masonry or concrete bins are of variable sizes but are normally one meter wide, one meter high, and two meters long. All parts of the city are not covered with these bins. People resort to throwing of household wastes on streets and footpaths, in open drains and ditches. For some local problems all 7000 sweepers cannot be made available for sweeping on a regular basis.

A moderately large fleet of collection vehicles of varying capacities does the collection of solid wastes from the collection bins. From 1992 an improvement in primary solid waste collection system took place with community participated house-to-house collection by rickshaw vans and hauling to community bins. Presently as many as 140 local initiatives are working and the participation of local initiatives are growing slowly.

The secondary collection of solid wastes from roadside community bins or demountable containers is done by DCC employing both stationary container system and container system. The recently introduced container system employs vehicles that are equipped

with hydraulically operated hoisting arms to move large detachable containers between the floor of the vehicles and the ground. Both stationary bins and container systems have their merits and demerits and the success of either system depends primarily on efficient management, proper operation and maintenance of vehicles, optimum scheduling and routing of collection vehicles. Presently DCC has 509 demountable street containers with 6m³ and 12m³ capacity and 2000 concrete bins for temporary storage facilities.

Of Dumping: The solid wastes collected from various parts of Dhaka City are disposed of on low lands at selected locations in the city. 52 Acres land of Matuail is now the only dumping ground of wastes. More than 25 kilometers from many parts of the city. Wastes are dumped in uncontrolled manner without any proper earth cover and compaction. It creates negative environmental effects due to generation of lichgates, gases, odor, noise, dust, and potential fire hazard. The present rate of dumping may take 2 years to fill the site. DCC has dumped its wastes into the following areas in last 10 years-

1. Dholai Khal area,
2. Bhasan Teck Housing,
3. Islambagh,
4. Royer Bazar on private plot,
5. Hazari Bagh private land,
6. Mugdapara Jheel,
7. Tejgaon Kunipara,
8. Jatrabari near Police Station

Treatment: DCC does not have any treatment plant at this moment. It does not even have any sanitary landfilling site within or out side the city. The disposal operation is poorly organized with wastes being spread without the provision of daily soil cover. Collection crews as well as scavengers are in direct contact with the solid wastes and the residents of the neighborhood areas are exposed to serious health risks associated with air, surface and groundwater pollution from landfill leachate. Currently DCC is practicing crude dumping process in order to keep the cost of waste disposal down but at the cost of serious public health risks and environmental pollution. There is only one incineration plant at International Cholera and Diarrhea Disease Research, Bangladesh with a capacity for treatment of hazardous waste of its own.

Solid waste related data: More or less 14 percent of the total municipal budget is used for solid waste management, which is approximately Tk. 26/- (0.5 US \$) per capita per year. The number of cleaners per thousand populations in Dhaka is nearly one. Waste densities (350 to 450 kg/cu.m) and moisture contents (50 to 70 percent by wt.) are much higher than the wastes in developed countries. Generally it contains a high organic (60 to 70 percent) and low combustible matter.

Table: Waste Generation in Dhaka City.

Year	Generated waste (tons per day)
1990	2500
1990	2210
1991	1366
1991	1540
1992	1500
1996	2000
1998	2250

1999	3550
2000	4000

Table: Sources and Characteristics of Urban Waste in Dhaka City

Type of Waste	Waste Generation Tons / Year	Waste Generation (Percentage)	Quantity (per cent) Varies in season
Domestic	244,550	46.8	40-60
Street Sweeping	114,245	21.85	20-30
Industrial	71,175	13.65	10-15
Commercial	89,425	17.15	5-20
Clinical	2,920	0.56	.5-.6
Total	522,185	100per cent	

Source: World Bank Survey Report.

The physical composition of waste components varies with the location and season of the year. A component wise tabular information is given below:

Table: Composition of Solid Waste in Residential and Commercial and Industrial Areas

Component (percent by dry wt.):	Mixed waste	Industrial waste	Residential waste	Commercial waste
Food and veg. waste	70.12	26.37	59.91	62.05
Paper products	4.29	7.59	11.21	6.28
Plastic, rubber & leather	4.71	6.01	17.67	4.62
Metals	0.13	-	0.15	0.28
Glass & Ceramics	0.25	-	-	0.37
Wood	0.16	-	-	-
Garden wastes, tree trimmings, & straw	10.76	4.32	8.76	2.86
Cloths	4.57	46.2	-	18.93
Rock, dirt & Misc.	5.01	9.49	2.30	4.62
Moisture Content(per cent)	65		50	54

Source: GOB and World Bank, 1998

Figure: Chemical Composition of Wastes in Dhaka City:

Constituents (per cent by wt)	Residential waste	Commercial waste	Industrial waste	Mixed waste
Moisture	50	54	60	59
Carbon(C)	26.06	17.81	9.90	12.70
Hydrogen (H)	3.53	1.92	2.00	2.25
Nitrogen(N)	1.62	0.46	0.58	0.62
Sulfur(S)	0.01	0.02	Negligible	Negligible
Ash	18	22	25	22
Oxygen(O)	0.78	3.79	2.52	3.43
Calorific value,Btu/lb	2600	2254	1680	1968

Source: BCSIR'1998

Projected solid waste data for future: The trend of increase of population in the city is very high. Every year some 60000 people are added to the population of the city. In next 10 years the population of Dhaka city will approximate 17 million. DDC needs to foresee the consequence of solid waste with estimated rise of population.

Existing and future plans and programs of the Dhaka city on solid waste management: The traditional way of disposing of MSW is land filling. The present practice of waste disposal in Bangladesh is totally unacceptable. It is in no way a sanitary land filling and thus is not scientific and hygienic. It is now becoming difficult in many areas because of declining capacity and adverse environmental impacts. Landfills are also a major source of methane emission, a potent green house gas. Many developed countries are now using MSW as raw materials of alternative production. Tiles, slabs, glasses etc are the hard materials now being produced from hard substances

of MSW in the developed countries. Again, fertilizer, synthetic gas, and electricity may be produced from organic parts of MSW through different thermal technologies.

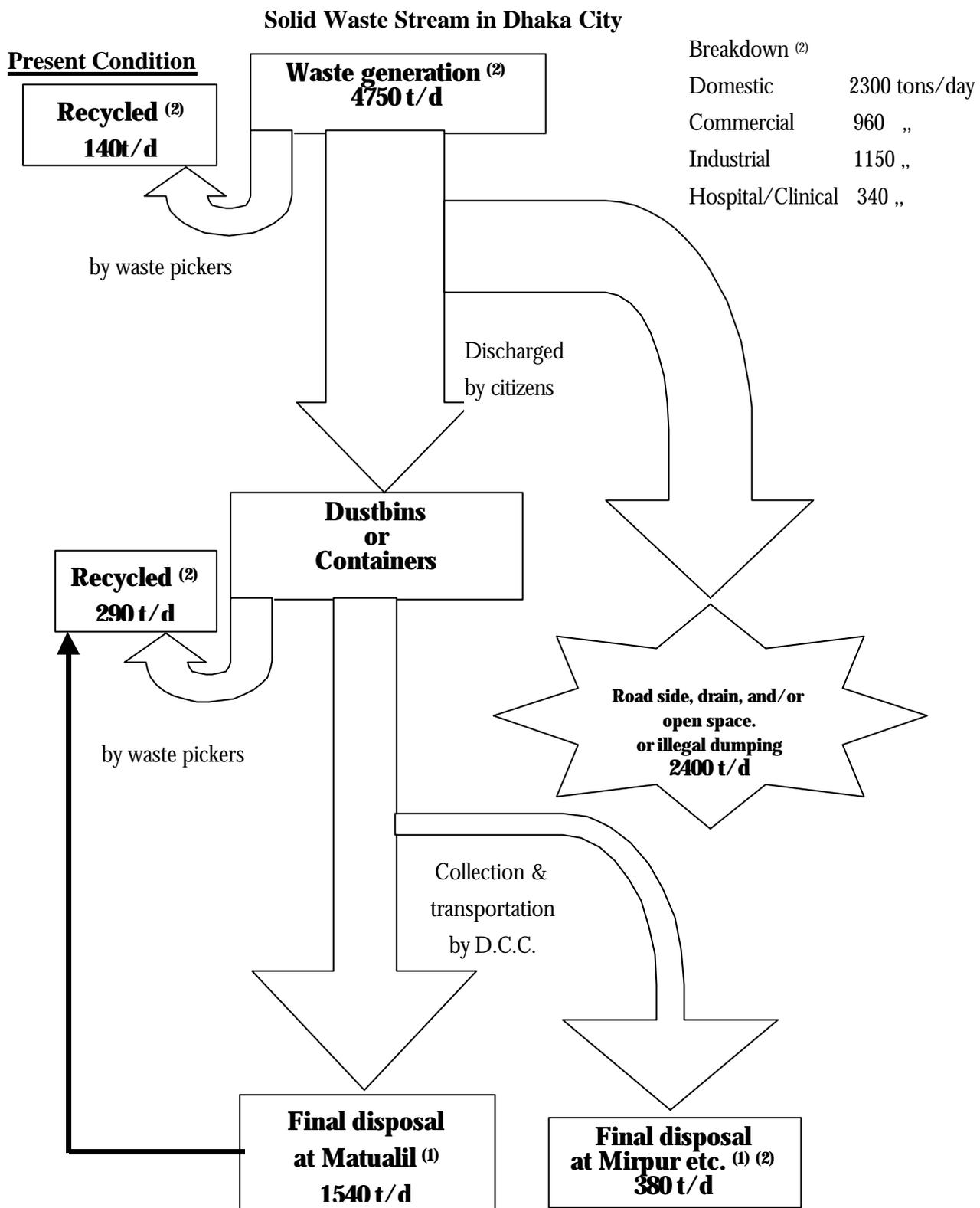
Other methods of MWS treatment are incineration, composting, anaerobic etc. Of them, incineration method is a popular technology for burning hazardous waste through certain high temperature. Modern environmental study shows that this method also generates potentially hazardous ash materials and harmful air pollutants such as dioxins and nitrogen oxide. It is now facing public opposition in the advanced countries. The latest available method of waste treatment is plasma technology. It is claimed that the plasma technology can help produce electrical energy from waste. All kinds of wastes such as Municipal, medical & pathological, industrial, hazardous and toxic, tires, coal ash, contaminated soil and low level radio active waste can be processed in one system. Some foreign investors are learned to be interested to build plants in Dhaka on Built Operate and Transfer (BOT) basis to produce electricity from MSW.

The existing plans and systems are not adequate for solving the MSW in an appropriate way. At present the only dumping site of MSW is situated at a corner place of the city. The scavenger crew carries MSW from different distant places of the city to the dumping site. It takes lot of time and fatigue for the scavengers to dispose of MSW. Future plan is to acquire more land at four suitable corners of the city so that MSW can be disposed of from shorter places. DCC and govt. are planning to introduce technology for scientific treatment of MSW. At least four foreign organizations have shown interest to sale their technology for MSW treatment and producing electricity out of it.

Keeping in mind the problems for solid waste management in Dhaka, DCC conducted a study with the help of Japan International Co-operation Agency (JICA). One JICA expert Mr. Keiichi SATO in association with the local counter part of DCC Mr. Md. Anwar Hossain Patwary made study for scientific solid waste management in Dhaka. The study period was February 2000 to August 2000. The study identified problems, formulated tentative solutions and recommended for phase wise implementation plan for solid waste management. The study emphasized for restructuring the organization for solid waste management, preparation of master plan, introduction of improved technology, sanitary landfill, incinerator installation for hospital/clinical/hazardous wastes, starting public awareness program, development manpower for solid waste management and formulation of laws and regulations.

A model of waste stream in DCC is shown on the next page. Present status of Solid Waste Management in DCC has been prepared by Mr. Asaduzzaman of DCC. It is shown in the following page in a flow chart.

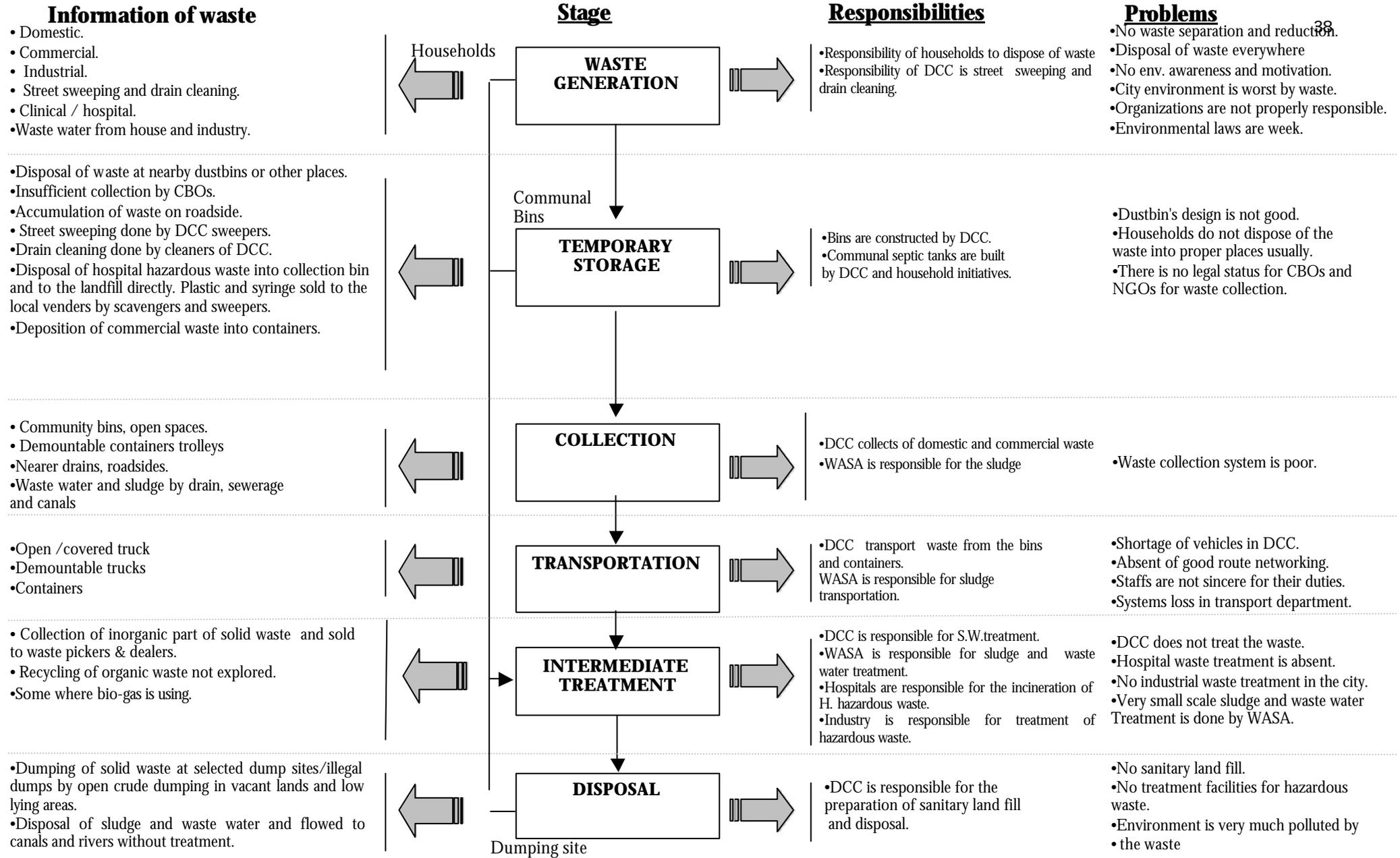
JICA Expert identified the following Solid Waste Stream in Dhaka



Source: (1) Survey of our JICA project, 2000

(2) Survey Conduct under the guidance and Supervision of Dr. Shamsul Haque Bhuiyan,

PRESENT STATUS OF SOLID WASTE MANAGEMENT IN DHAKA CITY



The cost of disposing of MSW is apparently low. Introduction of advanced methodology and technology may incur more money. The extra amount of recurrent expenditure is supposed to fall on the taxpayers of the city. The majority of city dwellers are not rich. The extra financial load on the citizens may affect their livelihood. The authority needs to consider this aspect of social problems.

Role of DCC, NGOs, international organizations:

- A. DCC is solely responsible for management of MSW. Man, machine, money and managerial supports come from DCC. A few NGOs are working for disposing MSW with supports and collaboration of DCC.

- B. Waste Concern an NGO has obtained registration from Ministry of Environment and Forest. Dhaka City Corporation (DCC) and Public Works Department have provided Waste Concern with a piece of land to establish composting plant for processing MSW into organic fertilizers. Members of community have joined in disposal of MSW in Dhaka. At present about 2100 households that cover about 10,500 people have been involved in this self-sustainable program. It has started work in a very limited scale with high a prospect. It works on the principle of 4Rs (Reduce, Re-use, Recycle and Recovery) in dealing with MSW. The communities shoulder the responsibility in monitoring the house-to-house waste collection system including contribution towards its cost. They also undertake the task of appointment of staff for the composing plants. The compost in the form of organic fertilizer is sold to a private Company, Alpha Agro Ltd. who in turn markets the entire product through its countrywide distribution network. Conscious farmers of this country prefer organic fertilizer to chemical one for saving soil from degradation due to the later. Demand of organic fertilizer is mounting among the farmers. It has thus marshaled the scope of opening more plants with MSW. Waste Concern thus demonstrates the concept of PPCP.

- C. Govt. has become concerned over the pertinent problems of disposal of waste. With a prospect of WEE, the Ministry of Environment and Forest convened an inter-ministerial meeting in 1997. The meeting and subsequent committees put forward a set of recommendations to the govt. Govt. gave approval to this WEE project in Executive Committee for National Economic Council on 17 August 1997. On the interest of govt. different groups and organizations have under taken studies since 1990s to address the problems as how to dispose off the city's waste hygienically. Ministry of Energy and Mineral Resource invited proposals from different organizations for investment in this

sector to produce electricity from disposable solid waste of Dhaka City. The organizations submitted proposals are-

- a. M/S Tecom Systems Inc. Canada
- b. M/S Sunshine Buying Ltd., Dhaka
- c. M/S Sabir Traders, Dhaka, and
- d. M/S Flamino Import & Export, USA

DCC invited M/S Tecom System Inc. Canada from these four organizations to conduct a study on the feasibility to produce electricity from solid waste. On completion of study this organization submitted a proposal for establishment of a 100 Mw electricity generation center for producing electrical energy from waste. The meeting constituted a Committee headed by the Director General, Directorate of Environment. As a part of follow up action the committee invited interested organizations to present their technical proposals. Energy Development Ltd. and Tecom Systems Inc. presented their respective technical proposals on 4 Jan 2000. The committee considered the report of Tecom Systems Inc. more acceptable from the economic and management point of view. A comparative statement of these two organizations is tabled below:-

Sl. No	Tecom System Inc	EDL Technologies
1	Plasma Technologies, not incineration is high temperature processing	Pyrolysis Technologies is low temperature process
2	Need no waste sorting before processing	Needs waste sorting before processing
3	No residual, therefore no landfill required. Very small residual that will be in the form of an inert glassy material that will be used for construction in the form of bricks or tiles. No toxic at all.	Landfill required as there will be 6per cent residual in the form of ashes that will require safe disposal. These residual will be very toxic.
4	Capable of processing all types of wastes (Municipal, Medical and Industrial).	Only able to process selected municipal waste, will not process medical or industrial wastes. It will not process heavy metal wastes that come from textile and leather industry waste.
5	Will process batteries and other sources of toxic materials such as PCB	Will not process batteries and other toxic materials. These types of waste materials must be sorted out and then dispose off.
6	Process is very clean and simple. Very little water is required as it is a closed loop system.	Process is complicated. This requires a lot of water as pulp is washed.
7	Will produce more electricity from the given waste	Will produce less electricity from the given waste

Sl. No	Tecom System Inc	EDL Technologies
8	Plants are in operation and well tested	No plant is in operation
9	Electricity sale price offered in lower	Electricity sale price offered is higher
10	Environmentally friendly. Will meet highest environmental standards (EPA, World Bank etc)	Environment friendly. It is no mentioned if the technology meets any standards or not.
11	Company TSI will finance 100per cent of the project	Company will have to get financing from some funding agencies such as World Bank or ADB
12	Include social programs that will help to keep Dhaka city clean and help people to understand the environmental problems	No social program
13	Plasma technology has good economic spin-off. It could be used for solving thermal power station, bricks manufacturing, cement manufacturing and chemical plants emission problem.	Technology has no economic spin-off.

The private organizations, NGOs, and donor agents have taken initiatives to find out ways and means for hygienic disposal of Municipal Waste are-

- a. About 160 local initiatives are collecting waste from approximately 10,000 families and dumping to the nearest bins of DCC with service charge of TK. 10 to TK. 20 per month,
- b. Urban Management Program UMP/UNCHS a program of UNDP has undertaken a study on disposal of household waste,
- c. Waste Concern an USAID funded project NGO has started producing fertilizer from Municipal waste in a small scale. It has a handsome of information on the solid waste disposal, and
- d. Bangladesh and Japan jointly conducted a study a study on Waste treatment. One JICA Expert Mr. Keiichi SAATU with collaboration of experts of Dhaka City Corporation conducted a month long study. The team recommends a project on MSW treatment be funded by JICA.

Recommendations -

- i. Consideration of MSW treatment/disposal scientifically and hygienically on priority basis,
- ii. Compilation of information on MSW from various sources,
- iii. Reaching on specific areas of recommendations as what to do,
- iv. Development of a draft agreement with the Cambridge (Bangladesh) Ltd. on installation of PEM- TM,

- v. Inclusion of Board of Investment to help examine on the proposed 100per cent Foreign Investment,
- vi. Expertise opinion of Petro Bangla on the use of Natural Gas and electricity as well as of World Bank, ADB, JICA, SKAT, BUET etc who are working on solid waste management,
- vii. Calculation of cost on transportation of waste at the proposed sites- Tongi and Meghna Ghat,
- viii. Calculation of cost -benefit ratio considering the expenditure that DCC already incurs on waste disposal,
- ix. Study on the capacity of PEM-TM system to handle waste of 2000 MTD and generating 250 Mw of electricity daily,
- x. Involvement of DCC as a focal point as it is the key player on all kinds of waste disposal of the capital City,
- xi. Utilization of the information and expertise of DCC for better agreement with sponsors,
- xii. Making updated and modified waste management regulations,
- xiii. Examination of Environment Audit Report,
- xiv. Determination of rate or amount of subsidy for the proposed treatment of waste
- xv. Standardization of gaseous emission that does not cause environmental pollution or damage to public health,
- xvi. Selection of site after detail consideration of environmental assessment, consultation of local need and ensuring acceptability (NIMBY- Not In My Back Yard Syndrome, and
- xvii. Regulation for management and handling for different types of waste.

D. A private initiative pioneered under an inspiration and participation of a business leader Mr. Salman F. Rahman in Kalabagan, Dhaka in 1996 deserves appreciation. The drive started with volunteer approach and settled with appointment of persons who to collect MSW from house-to-house with a monthly payment of TK. 10 to 20 from each household. This initiative has been informally replicated in many parts of the city with success. At present more or less 160 private organizations are working round the city. They have engaged about 2000 persons to collect MSW from house-to-house within the city. They carry the MSW into nearby waste bins. Employees of DCC use to carry these MSW to its designated dumpsites.

Hazards from solid waste impact on public health:

The poor management of waste contributes serious health hazards for city dwellers. Solid waste pollution causes at least 49 vector born diseases like typhoid, dengue, diarrhea and others. People

of waste dumping areas as well as the employees who work in landfill have four times more risk of developing bladder, lung and blood cancer or leukemia than others.

In the recent time tremendous changes have occurred for the treatment of disease in terms of technology and drug. Doctors now use variety of drugs, chemicals and radioactive substances for the purpose of modern treatment of patients. Though the hazardous elements constitute only 15 per cent of the total hospital waste, it contains toxic, germs and infectious substances. More over, the used syringes, needles, pathological residues etc are thrown into the dustbins at around the hospitals and clinics. Bangladesh does not have any law or technology for segregation of clinical waste from other waste for sanitary dumping or scientific treatment. Wastes of all kinds including clinical ones are dumped in the same land site. Poor people mostly children knowing nothing of the seriousness of their health hazard collect the clinical reusable materials from the bins and become exposed of life risk diseases. Clinical waste contains radioactive elements having volatile character with high health hazards. Even after dumping the waste under soil, hazardous volatile organic compounds cause numerous detrimental effects on health of the people living at around the dumping ground. Industrial wastes such as tannery wastes contain metals like chrome. Dumping them into depression as land filling materials may cause a major problem on land and environment. It poses a direct health risk to clean-up crew as well as scavengers.

Tanning industries is again a major threat to the health, welfare and environment in the thickly populated area of Hazaribagh in Dhaka. Waste from tannery contains sulfuric acid, chromium, ammonium sulfate, ammonium chloride, and calcium oxides. The impact of the tannery effluents may increase the probability of death and diseases like fever, headaches, respiratory and skin diseases. Effluents from industries like dying, chemical, pharmaceutical and paper are equally hazardous for life and environment. Unfortunately owner of these industries indiscriminately dispose of their dangerous effluents and chemicals into the river causing serious threat to aquatic life and ecosystem. These substances may seep into the ground water and thus may pollute it permanently. It may also bring about undesirable changes in land use.

Dumping of polyethylene on earth leads to soil degradation, loss of agricultural land fertility, blocking up of the cities drainage and sewerage systems, causing water logging and the spread of harmful microbes and bacteria, giving rise to germinate mosquitoes and germs of water bound diseases. Medical experts believe that the prolonged use of polyethylene may cause cancer, skin diseases and other health problems. These hazards are multiplied when it is used for packaging bread, biscuits, potato chips, and other food items. Hydrogen cyanide, a poisonous gas, is

produced when polyethylene is burnt in the open space and in landfills. There is a high risk of health problems to the working people of polyethylene industries.

Capacity and resources of DCC:

DCC is taking conservancy tax of 2 percent on property's annual value. Cost involves in different conservancy services for each Metric Ton of Waste are-

(i)	Collection cost	Tk. 107.00 (US\$ 2.00)
(ii)	Transportation cost (open/closed truck)	Tk. 65.00 (US\$ 1.50)
(iii)	Transportation cost (Demountable container truck)	Tk. 62.00 (US\$ 1.50)
(iv)	Disposal cost	Tk. 103.00 (US\$ 2.00)

DCC's three departments such as conservancy, transport & mechanical engineering are related to solid waste management. Study JICA experts observed the functions and problems of these departments are as follows:

Conservancy Department

Conservancy department is mainly responsible for cleaning and sweeping of solid waste on roads, lanes, by lanes and surface drains of city areas. The cleaners sweep and accumulate the garbage and carry those to the bins or containers. The cleaners use hand brooms, spade, fork and hand wheelbarrows for sweeping & carrying the garbage; the process is mostly manual. So it takes more time to sweep & carry the garbage to the bins, it is found that the efficiency of the sweeping is very low. Sweeping in time is difficult and sometimes impossible. Moreover the street sweeping is risky to the sweepers because of impending accident by motor vehicles in the street.

Every sweeper is given specified roads & areas to clean. There are 135 supervisory officers. The ratio of supervisory officials & field level workers is 3:100. The situation shows that on an average one supervisory officer has to supervise the work of 35 cleaning workers. It seems not practicable.

There are one Conservancy Officer & one or two Conservancy Supervisory Inspector (CSI) in every zone. There are on an average 500 sweepers/cleaners in every zone. The CI or CSI moves by motorbike to monitor and supervise the work of sweepers on his respective area and the Chief Conservancy Officer and Assistant Conservancy Officer use motor transport to supervise the whole DCC area. The average wage of a cleaner is Tk. 75 per day.

Recommendation of the JICA expert:

Phase-I includes the following:

- (I) Immediate procurement of vehicles for carrying of the solid waste. JICA recommends that about 301 of different types of vehicles can serve the purpose.
- (II) Approximately 400 containers of suitable design have to be procured.
- (III) 42Nos. of conservancy equipments have to be procured.
- (IV) Installation of weigh bridge for proper calculation & proper measurement of solid waste in disposal site.
- (V) Arrangement for sanitary landfill.
- (VI) Arrangement for the incineration for hospital & clinical/hazardous waste.
- (VII) A composting plant for house holds/organic wastes.
- (VIII) Training & education of DCC officials & staffs for solid waste management.
- (IX) Re-organizing the organogram of DCC for efficient and effective solid waste management.
- (X) Study tour for the senior officials of DCC, Ministry of LGRD&C, Ministry of Planing, ERD under ministry of finance.

Phase- II

During the implementation of Phase-I, the following measures can be taken:

- (I) Preparation of a master plan for solid waste management in Dhaka City.

Analyze the past experiences

Disposal of MSW helped develop a number of important low-lying adjacent areas of the city. Two inter- district bus terminals, one stadium, commercial and business centers and even residential accommodations have been built on the dump yards MSW. In the past the city was small and population was less. Again there was plenty of low-lying land available for dumping of MSW. At present land has become very scarce and valuable.

Cases of successful and failed solid waste management experiences in Dhaka City:

- A. Cases of successful waste management:** It has been mentioned above that a private initiative has been introduced in the early part of 1990s to collect MSW from door to door. Before that the members of the households were supposed to carry the waste to the

nearby bins. Unfortunately many house hold members, particularly the servants used to scatter the waste on the roadside or drains instead of reaching the nearby bins. At present there are a large number of waste collectors in the city. They carry waste to the places designated for it. Again, a fleet of demountable containers is a new addition to the traditional vehicles that used carry waste from the city places to the dumping site. The advantage of this type of container is that a full of it with waste can be removed and replaced by an empty one by a hydraulic device. Though the operation cost of this type of container is little bit high but it is easier and convenient.

- B. Cases of failed solid waste management:** Transport department provides logistic support to collect the garb ages from the bins or the containers placed in the pre-selected points and transport those to the final dumping depot. There are one General Manager Transport, one Manager Transport and 360 drivers and helpers in the transport department of DCC. The General Manager transport is appointed on deputation from the govt. officials. Generally these officials are lack of previous experiences of managing the large fleet of transports and technical background. The transport management could be better, if a General Manager transport have technical knowledge. Transport Department requires the technical support from Mechanical Engineering division for minor faults. The process is time consuming. Due to this reason off-roaded conservancy vehicles become higher and repair efficiency goes lower. Transport Department does not use the scheduling/program for transport utilization. Programming and scheduling can bring the efficiency of transport utilization. Since the Transport Manager and General Manager generally have no technical background, the identification of faults of the vehicles becomes almost difficult for them. Therefore, the problems written in the job card and real problem in the vehicle are not always similar.

Mechanical Engineering Division plays a vital role in solid waste management of DCC.

Mechanical Engineering Division has been directly related to solid waste management from the beginning. There are two divisions now:

- a. Mechanical Engineering Division-I
- b. Mechanical Engineering Division-II

The functions & Problems identified in these divisions are as follows.

Mechanical Engineering Division-I

Mechanical Engineering Division is responsible for repair maintenance and purchase of conservancy trucks. Transport department sends faulty trucks i.e. the trucks are out of order for use to Mechanical Engineering Division-I. The foreman/Sub. Assistant Engineer with the help of Mechanics check verify, identify the faults and defects and recommended for repair maintenance to the authority. The procedure for getting approval is always lengthy and time consuming. As a result the repair & maintenance work efficiency become low. Hence the off-road vehicles goes up.

Mechanical Division- II

The function of Mechanical Engineering Division II is dressing & compaction of Solid wastes at the final dumping depot. It applies chain dozers, excavators, pay loader, wheel dozer, hydraulic cane, forklift, power trailer, etc. The division performs the purchase repair & maintenance works. But the procedure is long and it similar to mechanical division - I.

Reasons and failure in the solid waste management system of DCC.

- Waste collection coverage is only 60per cent, uncollected 40per cent wastes spread on across roads causing aesthetic and health problem.
- Wastes are simply piled or heaped on the ground near containers, discharging offensive odors.
- Existing Ordinance describes a general guideline about the duties and responsibilities of DCC.
- The present law does not provide any penalty for illegal disposal of wastes or littering in the streets.
- Inter departmental coordination problem, duplication of efforts and resources.
- Waste management employees are not well trained, lack of commitment and sincerity among the employees.
- Public campaign and awareness programs on solid waste management for educating and motivating the city dwellers are absent.
- To achieve 100per cent collection, transpiration & dumping, DCC's present strengths of conservancy vehicles need to increase.
- The manual sweeping efficiency is low and unsafe. Mechanized sweeping system may be an effective alternative.
- Hospital/clinical wastes are dumped in same bins, and transported by same trucks and disposed of in the same landfill. Hazardous & infections clinical/hospital wastes need to

be collected & transported separately by specially designed conservancy trucks.

- In absence of weighing bridge proper management of solid waste, amount of disposal at the final dumping depot cannot be ascertain/calculated. Weighing bridge can give better managerial efficiency.
- DCC applies crude dumping method at the final disposal depot. The leach ate of garbage contaminates under ground water and organic/inorganic gases pollutes air and environment. The produced gases in the final dumping depot may cause severe explosion. Arrangement of sanitary landfill is required to minimize the environmental degradation.
- To minimize future landfill side, one of the ways may be to reduce the volume of solid wastes by producing compost. This may lead to increase the life of final disposal depot.

✦ **Financial:** Financial dependency on the central govt. is a major reason for sustaining inefficient management in many sectors of DCC. Management of MSW is certainly included. More than 50 percent money is poured from the govt. exchequer. There are lots of bureaucratic hurdles towards getting the fund released in installments. By that time MSW suffers set back of prolong and chronic problems. More over the budget allocation in the MSW sector is very minimum that cannot meet effective management.

✦ **Participation and partnership:** The sense of participation and partnership could not grow in DCC in the management of MSW. The only NGO, Waste Concern is now working in a small scale with DCC on the concept of partnership. A few ones are showing interest to work with DCC on private or contractual basis.

✦ **Technological:** Technologically DCC is lying at very low profile. At this moment DCC dispose of its waste in traditional way causing hazards to human health and environment. As mentioned above that about five foreign organizations are willing to invest in this sector to produce alternative from MSW.

✦ **Enforcement:** Enforcement sector of DCC is also weak. It does not have independent enforcement agency. It always depends on police department for taking any action against illegal activities by the city dwellers. It does not have court to try the offenders. It again depends on the central govt. for appointment of Magistrate and then to try the cases of offence.

✦ **Program design:** The following program has been designed to dispose of MSW. Implementation of it may help solve problems related to MSW.

Solid Waste Management in Dhaka City

	DESIRED SITUATION	KNOWLEDGE AND SKILL
(1) Ministries (Organizations) Involved	<ul style="list-style-type: none"> * Need of a national policy * Improvement the areas of coordination and integration among the departments under a Good Governance Project. * Strengthening financial and institutional management planning. * Capacity building and institutionalize the activity of the community and integrating with the DCC's own operational program. * Ensure efficient collaborations among stakeholders. * Training of staffs related with solid waste management. * Involvement of Ministry for scientific management of MSW 	<ul style="list-style-type: none"> * Requirement of expert for management of MSW * The waste management related staffs should know how to plan, design, monitor and carryout efficient waste management program.
(2) Laws Related to Waste Treatment	<ul style="list-style-type: none"> *Penalties for violators of rules and regulations. * Measures to increase locally revenues to recover the cost of urban infrastructure * Making laws related to waste treatment at the international standard. 	<ul style="list-style-type: none"> *Amendment of existing laws may help penal action. * Help grow expertise among the existing staff
(3) Planning of Waste Treatment	<ul style="list-style-type: none"> * Integrated planning with all departments responsible for waste generation and disposal 	Induction to the staff of integrated approach

4. Collection and Transportation	<ul style="list-style-type: none"> * Encouraging community based solid waste collection. * Introduction of the covered trucks for waste collection and ensure nighttime collection. * Regular monitoring system following of a standard schedule. * Increase of the salaries of the sweepers and cleaners. * Training to staff related with collection and transportation. * Introduction of waste compression truck * Use the modern modes of transport for regular collection, transportation. * Promotion appropriate technology. * Modification of presents demountable containers design. * Modification of vehicles according to the road width. * Improvement of area wise composting system. 	Providing right person to the right places so that the system works well
5. Intermediate Treatment (Including Recycling)	<ul style="list-style-type: none"> * Introduction of a good intermediate treatment plant. * Installation of central incinerator plant. * Separate incinerator plant for each hospital. * Establishment of recycling plants * Popularizing the composting plant. 	Detail survey can help better policy for plants etc.
6. Final Disposal	<ul style="list-style-type: none"> * Establishment of sanitary land filling sites. * Control of external contamination and earth pollution. 	Person to be engaged should be conversant about sanitary land filling
7. Environmental Education	<ul style="list-style-type: none"> * Enforcement of EIA. * Planning to environmental education for public awareness and motivation. 	Environmental education should be introduced wit school syllabus.
8. Other Items	<ul style="list-style-type: none"> * Introduction of waste analysis techniques. * Introduction of waste composition. 	Engineers on environment can undertake this responsibility.

Major gaps and barriers for efficient solid waste management:

- a. **Institutional:** All activities of DCC are done under the Ordinance made for it. The organizational set up of DCC does not provide with adequate manpower in the conservancy department. As a result about 3000 temporary cleaners have been appointed on daily basis. They do not have job security. They work on the no work – no pay basis. More over some top positions of the conservancy department are lying vacant for long years. This situation causes to suffering in the efficiency of solid waste management. The Ordinance does not provide enough legal action against the violators of the rules. As a result the city dwellers do not care to carry waste to the designated places. They even do not care to put the waste into the nearby bins within a time bound. This area has to be strengthened. For this purpose the relevant sections or provision of the Ordinances should be amended.

- b. **Political:** No amendment in the Ordinance is possible without passing it through the National Parliament. It thus needs political decision. The process of putting it in the Parliament is lengthy and difficult. It involves a good number of ministries and departments. But is not impossible as well. If the problems in the Ordinance can be put forwarded with sufficient logical arguments, the govt. would help to solve them as quickly as it is possible. The conservancy workers are placed at the disposal of the respective ward commissioners under a political decision. The commissioners cannot manage the staff work properly. There are many workers who do not perform their conservancy duty but get wages with the recommendation of the commissioners. This situation needs be examined and suitable change should be brought about.

- c. **Practical:** Dhaka has already become very big city. It is expanding rapidly. There should be a consistent forward plan to manage solid waste for the future. There is no scientific and technological method for disposing of solid waste. As a result huge lands are used for it causing pressure on it as well as harming the environment.

Recommendations:

This paper has highlighted different areas of difficulties towards effective management of MSW of DCC. It might have transpired that the management of MSW in DCC needs be improved. For that purpose a systematic approach should be developed. A pilot study on a specific area of DCC

can help identify the areas of concern and formulation of action to be taken. The areas of the proposed pilot study may include-

1. Selection/Identification of a catchment area.
2. Waste management process.
3. Capacity in terms of finance, human resources, waste carrier vehicles and equipment.
4. Problems for ineffective waste management.
5. Activities of departments of DCC related to Solid Waste of Management to increase their co-operation.
6. Optimum utilization of existing human resources, waste carrier vehicles and equipment.
7. Design an integrated efficient and effective waste management system.
8. Examination of the feasibility to separate wastes from source of origin.
9. Examination of the feasibility of power/energy generation from waste.
10. Study the present system of collection, transportation and disposal of wastes.
11. Study the present total cost for solid waste management.
12. Study the present environmental situation in the catchment area and final dumping depot.
13. Examination of the feasibility of Construction of Sanitary Landfills for waste disposal.
14. Examination of the feasibility of incineration burning of hazardous wastes.
15. Designing/formulating the public awareness program.
16. Examinations of the feasibility of Introduction of polluters pay principle.
17. Examination of the Present Laws, Regulations regarding solid waste management and environmental aspect.
18. Examination of the feasibility of extraction of Landfill gases from old and present dumping depot.

Experts on MSW of DCC believe that the proposed pilot study should be undertaken in a small area rather than in the city as a whole. It was mentioned above that there are 90 wards within DCC and a ward commissioner represents each. Again, there are 10 administrative zones manned by a set of staff. Zones perform the major activities of DCC. Staffs of all departments of DCC are working with the zones having independent office arrangement. Each zone can be treated as a mini DCC. One or two zones can be the ideal area(s) for such a pilot study.

An elaborate database would be required for conducting the study. It may include:

- personal data sheet of the people living in the designated periphery for the study such as name, address, age, sex, level of education, profession, income, social status, migrated or permanent residence etc of every individual should be recorded and programmed.
- environment of the locality that can include the kind of livelihood, commercial, business, trade, industries, shops and establishments, markets and the nature of MSW production from those places etc.
- strength of personnel, such as- number of officers, type of staff, directly related personnel with the management of MSW.
- equipment and machinery such as- assessment in terms of life time, efficiency, requirement, present position, procurement policy etc
- vehicles such as number, type, condition, capacity, management system, life term etc
- financial that may include total budget, budget for the zone concern, sources of income, procedures of expenditure, sector wise expenditure procedure; for example salary and wages, cost of procurement of machinery and vehicles, maintenance etc.

For all these information and up keeping the data some kind format should be developed and used for the purpose of primary collection of data as well as for regular up dating information.

Conclusion:

There is no sanitary land filling in DCC. The crude method of disposing of MSW generates health problems and creates environmental degradation. The existing situation of MSW management is not acceptable from scientific, hygienic and environmental point of view. There is scope to strengthen the institutional and operational aspects of DCC. Present situation may not be enough to handle the whole MSW problems. The machinery and vehicles are all old. Many of them remain out of order. The people working with the MSW management do not have formal training. Mechanical devices can perform better service in sweeping streets than manual sweeping. These areas can be included in the proposed pilot study to improve human quality and capacity.