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1. Introduction

Solid waste management is an obligatory function of Urban Local Bodies in Bangladesh. At present there are 522 urban centers in the country including 254 municipalities and 6 City Corporations (BBS, 1997 and NILG, 2002).

With over 3.3% annual growth in urban population in Bangladesh during 1991-2001 census years, solid waste generation has also increased proportionately with the growth of urban population. As such, most of the urban local bodies are finding it difficult to keep pace with the demand for adequate solid waste management and conservancy services provided by the urban local bodies. Consequently, a backlog between demand and supply for solid waste management in most of the urban local bodies is created. Lack of financial resources, institutional weakness improper choice of technology and lack of public awareness about solid waste management has rendered solid waste management services far from satisfactory.

2. Urbanization in Bangladesh

Until 1951, Bangladesh was almost completely a rural-agrarian country with 95.67 percent of the population living in rural areas and only 4.33 percent in urban areas.

Table 1. Urbanization in Bangladesh and Urban Population Growth of Dhaka City

Year	Bangladesh			Dhaka ¹	
	Total Urban Population	Per cent of Urban Population	Average Annual Growth Rate (%)	Population	Average Annual Growth Rate (%)
1951	1819773	4.33	1.69	411279	1.28
1961	2640726	5.19	3.75	718766	5.74
1974	6273602	8.78	6.62	2068353	8.47
1981	13535963	15.54	10.63	3440147	7.53
1991	20872204	20.15	5.43	6487459	6.55
2001*	28808477	23.39	3.27	9912908	4.33

Source: BBS, 1997, *BBS, 2001

Table 1 shows the urbanization pattern in Bangladesh as well as urban population growth of Dhaka City. The level of urbanization was extremely low in 1951 with only 4.33% of the total population living in urban areas. It has increased gradually to 5.19% in 1961 and then very rapidly to 8.78% in 1974, 15.54% in 1981, 20.15% in 1991 and 23.39% in 2001 (BBS, 1991 and BBS, 2001). A recent study by World Bank has estimated that about 40% of the total population in Bangladesh will be living in urban area in Bangladesh by 2025 (ADB, 2000).

Dhaka, the capital of Bangladesh is the primate city of the country as its share of national urban population was 25% in 1981, 31% in 1991 and 34% in 2001 respectively. Dhaka's dominance not only in terms of population, but also in terms of economy, trade, commerce, and administration is obvious. In 1991 among the thirty-four mega cities of the world having a population of more than five million, Dhaka ranked twenty-fifth (BBS, 1997) while in 2000 it ranked eleventh and it is predicted to be the world's fourth largest city by the year 2015 with an estimated population of 21.1 million (Lizin, 2002). The present population of Dhaka mega city is estimated at 11.3 million while that of Dhaka City Corporation (DCC) area at 5.94 million in the year 2004.

¹ Population of mega city

Urban population density in Bangladesh was 2179 persons/sq.km in 1991 and the present density is estimated at approximately 3008 persons/sq.km. Population density of Dhaka megacity was found to be 4795 persons/sq.km in 1991 and the present density is estimated at approximately 8573 persons/sq.km. However, the population density of DCC area is more than three times of the megacity area, as in 1991 it was 15333 persons/sq.km against estimated present density of 18055 persons/sq.km. With limited availability of flood-free land, further densification of population along with haphazard encroachment of peripheral land of Dhaka as well as in urban areas of Bangladesh seems inevitable.

3. Solid Waste Generation in Urban Areas of Bangladesh

Comprehensive waste characterization studies have not been conducted in Bangladesh. In addition none of waste disposal sites in the country is equipped with weighbridge. However, recently Dhaka City Corporation (DCC) at its waste disposal site has installed a weighbridge to measure the amount of waste being disposed. Consequently, there is limited reliable information related to quantity of wastes generated in the urban areas of Bangladesh. Due to lack of information, estimates were made of the amount of waste generated. The estimates were based on the information available from other countries and cities having similar socio-economic condition to those prevalent in Bangladesh.

Solid waste generation in Bangladesh is growing proportionately with the growth of urban population. Table 2 shows the growth in solid waste generation over the years.

Table 2: Total Urban Solid Waste Generation in Bangladesh

Year	Total Population	Urban	Urban Population (% Total)	Waste Generation Rate (kg/cap/day)	Total Waste Generation (Tonne/day)
1991	20872204		20.15	0.49**	9873.5
2001	28808477		23.39	0.5***	11,695
2004	32765152		25.08	0.5***	16,382
2025	78440000		40.0	0.6 **	47,064

** Source: ADBI and ADB, 2000, *** Zurbrugg 2002,

It is evident from the above Table that solid waste generation in urban areas in Bangladesh is growing with the growth of population as well as per capita GNP. In 1991 the per capita GNP was US \$ 213 (World Bank, 1997) while the GNP in 2001 was US \$ 351 per capita and in 2003 it was US \$ 370 (Zurbrugg, 2002).

4. Institutional Arrangement for Solid Waste Management in Bangladesh

Presently, the solid waste management system in Bangladesh is not well organized. However, efforts are under way to improve the organizational structure for solid waste management in different cities/towns. For instance, Dhaka City Corporation has recently established a Solid Waste Management Cell to improve the waste management services in the city.

In most of the city corporations and municipalities there is no separate department for solid waste management. Solid waste management is organized and run by conservancy section of the urban local bodies, whose prime responsibility is maintenance of the sanitation system. The organizational structure of conservancy section is shown in Figure 1.

The number of staff for conservancy varies from city to town depending upon the size of the city and the workload. Some of the cleaners and sweepers are hired on temporary basis. Although, the organizational structure presented in Figure 1 deals with the collection and storage of waste

as well as street sweeping, transportation of waste is done by separate department in the city corporations and municipalities. The chief conservancy officer or the conservancy officer in the pourasahavs has to coordinate with the transport department to get the waste transferred from collection points to designated waste disposal sites.

Generally in most of the urban local bodies have insufficient number of staff involved in waste management activities. In addition to the shortage of personnel, the staffs are handicapped with relatively small amount of resources available to them for management of solid waste in their particular area of operation.

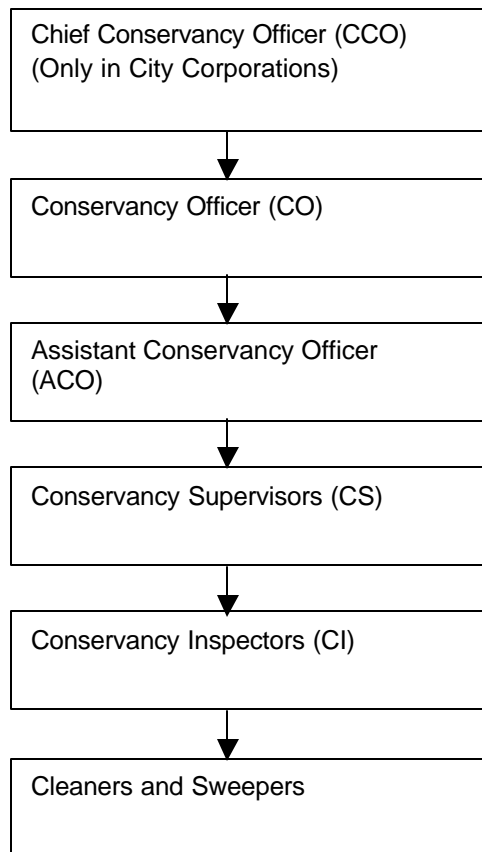


Figure 1: Organizational Structure of Conservancy Section in Urban Local Bodies in Bangladesh

5. Legal Framework for Solid Waste Management

At present there is no separate policy or handling rules for solid waste management in Bangladesh. However, Ministry of Environment and Forest is currently preparing a comprehensive solid waste management handling rules for the country. The existing legal aspects relating to solid waste management can be classified into two groups, which are given below:

5.1. National Level Framework

Environment Conservation Act, 1995 requires that before establishment of industrial enterprise as well as undertaking of projects environmental aspects must be given due consideration and prior environmental clearance is obtained. As such, for the purpose of environmental clearance,

the **Environment Conservation Rules 1997** made under the Act have divided industries and projects into four categories depending upon the pollution load and likely impact on the environment. These categories are: 1) Green, 2) Orange-A, 3) Orange-B and 4) Red. Applicants for environmental clearance for new industries and projects under the Orange-B and Red categories are required to submit an Initial Environmental Examination (IEE) Report and the design of the effluent treatment plant (ETP). An Environmental Impact Assessment (EIA) has to be undertaken and the EIA report to be approved by the Department of Environment (DOE) before installation or import of equipment for any industry or project under Red category. Prior to commissioning of projects falling under orange-B and red category, final clearance from DOE is required. All municipal land fill sites as well as installation of any kind of incinerators fall within red category and environmental clearance from DOE is mandatory.

Apart from Environment Conservation Rules 1997, to improve the waste disposal system the Government has recently formulated some policies and plans, which are:

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

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

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

- Local Government Bodies (City Corporations and municipalities) may transfer, where feasible collection, removal and management of solid waste to the private sector.
- Measures to be taken to recycle the waste as much as possible and promote use of organic waste materials for compost and bio-gas production
- Private sector including NGO participation in sanitation is encouraged (GoB, 1998b).

National Clean Development Mechanism (CDM) Strategy 2004 prepared by the Ministry of Environment and Forest (MoEF) has identified waste sector as one of the potential sectors for attracting CDM finance in the country. CDM allows foreign direct investment (FDI) in projects, which reduces green house gas emissions. The waste sector options prevent methane from bi-methanation processes. The methane collected can be flared or used to generate electricity. The waste sector options for Bangladesh can be landfill gas recovery, composting, poultry waste, and human excreta management using eco-sanitation and wastewater treatment.

5.2 Local Level Legal Framework

There is no adequate legislation in the country to address the growing problems of solid waste. In Bangladesh, solid waste management is entrusted with urban local government bodies. The responsibility of removal and disposal of municipal solid waste lies with the City Corporations and municipalities. The six City Corporation Ordinances and Pourshava Ordinance 1977 are the only local law that gives some idea about disposal of municipal waste. These ordinances contain identical provisions relating to solid waste management, which are as follows:

- The pourshava or city corporation shall be responsible for sanitation of the municipality/city corporation area and for the control of environmental pollution. For this purpose the city corporation or poursahava may cause such measures to be taken as are required by the ordinances.
- A pourashava or city corporation shall make adequate arrangements for removal of refuse from all public streets, public latrines, urinals, drains, and all buildings and land vested in the pourshava or city corporation and for collection and proper disposal of such waste.
- Subject to the general control and supervision of the pourashava/city corporation, the occupiers of all other buildings and land shall be responsible for removal of refuse from such buildings and lands.
- The poursahava/city corporation may, and if so required by the governments shall provide public bins or other receptacles at suitable places and by public notice, require that all refuse accumulating in any premise or land shall be deposited by the owner or occupier of such premises or land in designated bins or receptacles.
- All refuse removed and collected by staff of pourashava/city corporation or under their control and supervision and all refuse deposited in the bins and other receptacles provided by the poursahava/city corporation shall be the property of the pourashava/city corporation.
- A pourashava/city corporation shall provide adequate public drains in the municipality/city area and all such drains shall be constructed, maintained, kept cleared, and emptied with due regard to health and convenience of the public.

6. Technologies/ Methods Used for Waste Recycling, Treatment and Disposal

Waste disposal is an emerging problem in almost all urban areas of Bangladesh. The increase in waste generation can be primarily attributed to factors such as rapid rate of urbanization, rural-urban migration, changing consumption pattern and high population growth rate. While the magnitude of the problem is relatively small and manageable in rural areas, it appears to be growing significantly in urban areas in recent times. Among the major environmental concerns confronted today in the urban areas of Bangladesh are problems relating to proper management of solid waste.

There is no single solution to improve solid waste management system in any city. It must be based on integrated systems with a combination of different methods. There should not be any contradiction between different methods; instead they should be complimenting each other. Sophisticated technologies are beyond the capacity of small and medium towns of Bangladesh. The local authorities spend 520% of their total annual budget to collect, transport and dispose waste. Approximately 50% of this budget is being collected as revenue and the rest comes as grant from the national government.

Presently, a number of commendable steps have been taken by the government to promote low cost, appropriate decentralized community based composting technology based on socio-economic and climatic condition of the country.

6.1 Existing Practice of Solid Waste Management in Bangladesh

Approximately 16,380 of tons of waste is generated in the urban areas of Bangladesh in the year 2004. The waste is generated from different source (domestic, commercial, industrial, street sweeping, health care facilities etc.).

3 (three) 'systems' of waste management are coexisting side by side in Bangladesh. One is the '**Formal System**', where municipalities/city corporations are responsible for Solid Waste Management (SWM). 'Formal system' is based on the conventional system of collection-transportation-disposal of waste carried out by the local authorities. In this system the concept of transfer stations, resource recovery, minimization and recycling are absent.

Next is the '**Community Initiative**' that is based on primary solid waste collection by CBOs and NGOs, 'Community Initiatives' of house-to-house waste collection in neighborhood started due to lack of satisfaction with solid waste management service.

Finally, '**Informal System**' represented by the large informal labor force involved in the solid waste recycling trade chain. Figure 2 shows the existing system of solid waste management in the urban areas of Bangladesh.

Partnership between these three systems is needed to promote effective solid waste management system in the country.

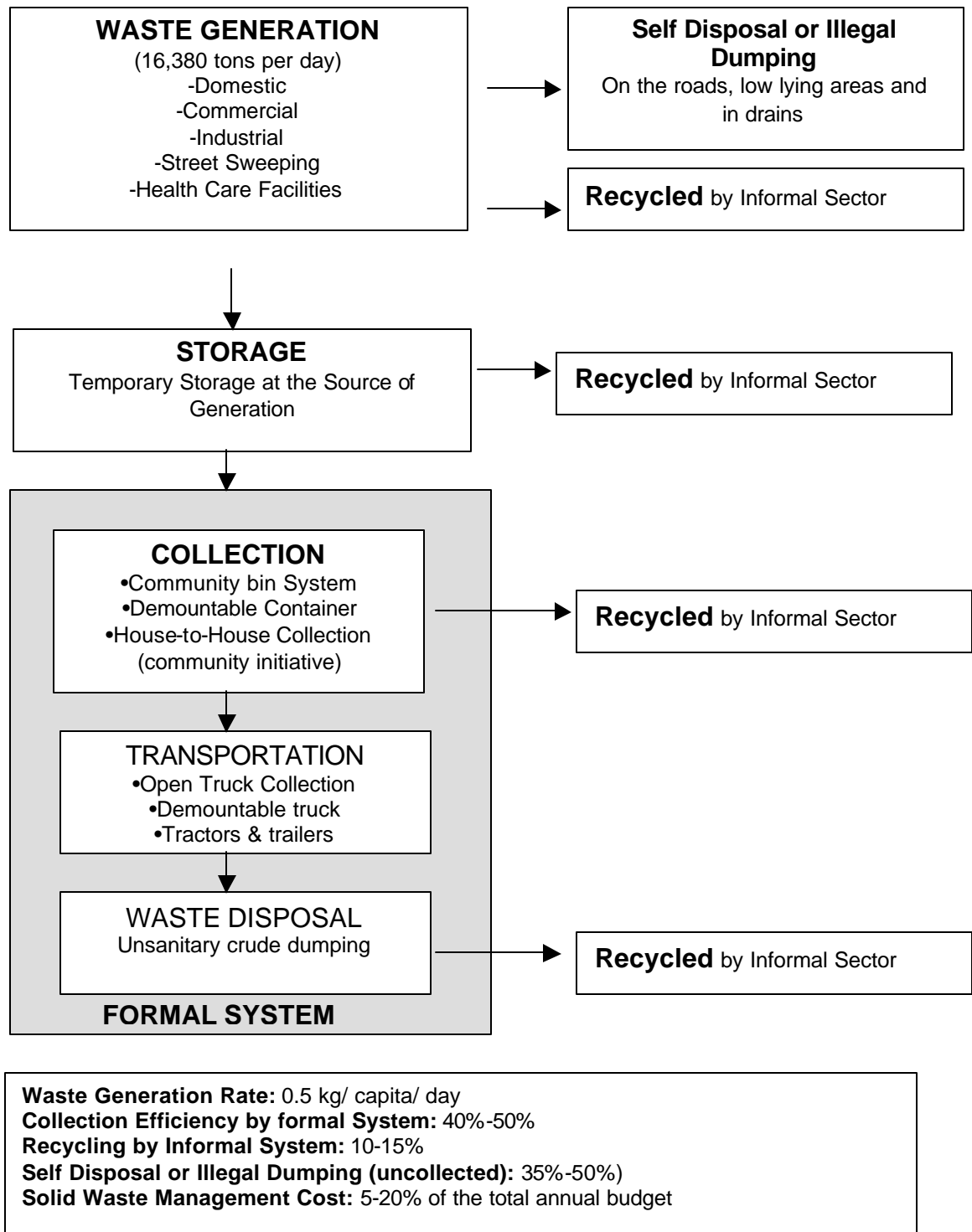


Figure 2: Existing Pattern of Solid Waste Management Process in Bangladesh

6.2 Physical Composition of Solid Waste

The composition and resulting character of municipal solid waste are always dependent on the source of its generation. Each city has a unique blend of activities and resulting waste characteristics. Experience shows that approximately 60% of waste is generated by residential areas of Bangladesh.

In urban areas of Bangladesh solid waste has a very high organic content that varies from 70-85%. Table 3 shows that solid waste of Dhaka City has also similar amount of organic matters. High moisture and organic content coupled with high prevailing temperatures make frequent removals necessary to avoid bad smell due to rapid decomposition of waste. This places additional burden on already over-strained system.

Solid waste, at the point of collection, has a high density. Density will increase as the waste is handled, through loading, transport in carts and vehicles, and eventually by compaction with landfill equipment at a disposal site. Density of waste at the pick-up point ranges from 390 to 540 kg/cubic meter.

Table 3:Composition of Waste of Dhaka City

Waste Composition	Bangladesh (Dhaka) (% by weight)
Food and vegetable wastes	70
Paper Products	4
Plastics	5
Rags	-
Metals	0.13
Glass and ceramics	0.25
Wood	0.16
Garden Waste	11
Other (stones, dirt etc.)	5
Moisture	65

Source: Ahmed, M.F. and Rahman, M.M. 2000

Composition of solid waste shown in the table clearly demonstrate that a major portion of waste of Dhaka city is organic with high moisture content which is suitable for the production of compost fertilizer.

6.3 Technology Used to Manage Urban Solid Waste

Traditional labor-intensive methods are used for solid waste management in Bangladesh. Due to lack of specific guidelines to manage waste in the country, official initiatives to promote segregation of waste at the source is absent. Waste is simply collected from the designated communal dustbins and demountable containers, transported by open 1.5-5 ton capacity trucks, demountable containers, tractors and trailers and disposed in a crude unsanitary way in nearby low-lying areas of the cities/ towns. Collection system is inadequate and involves 4 or 5 times of handling of a particular waste before it is finally disposed at an open dumping site. The waste collection system relies on communal containers located along the roadsides. Some of these containers are stationary concrete bins that are to be entered by workers, who shovel the waste into baskets for manual loading into open trucks. Other containers are demountable that are mechanically loaded by demountable trucks. The premises of this system are that resident will walk to the nearest bin with their waste and put it inside. Unfortunately, that rarely happens. Many residents dump their waste on the ground near the site at increasing distance from the bin as the amount of waste increases throughout the day, loath to walk over any waste to get to the bin. Waste recyclers further complicate the situation by going through the waste for recyclables and

scattering it further. Collection coverage of waste is inefficient and as a result 35%-50% of waste remains uncollected in the urban areas of Bangladesh. Uncollected waste accumulate on open lands, are piled along streets, fill drains and clog sewers. Given country's sub-tropical monsoon climate these uncollected wastes provide ample habitat for flies, cockroaches, rats and other disease vectors. The stagnant water in the clogged drains provides breeding ground for mosquitoes; during flooding the health consequences become enormous.

Recently due to infrequent collection of waste from the communal bins some communities took the initiative to start house-to-house collection of waste from their neighborhoods in several small and large cities of Bangladesh. Under this initiative people pay for house-to-house waste collection service. Local communities, CBOs NGOs and micro-enterprises are initiating these house-to-house waste collection schemes. In 1987, a local resident initiated the first house-to-house collection scheme in a residential area of Dhaka city. These initiatives are creating new employment opportunity for the urban poor. This concept being simple and is becoming popular to the people of the city.

Problem of uncollected waste in urban areas is most prevalent in low-income neighborhoods, where 20% to 50% of the urban dwellers live. Middle-income and high-income neighborhoods tend to take matters into their own hands, hiring their own neighborhood waste collectors and covering the necessary costs.

Toxic and hazardous waste from different sources ends up in the communal bins. There is no separate collection system for these wastes in the city causing health risk for the city as a whole.

Due to scarcity of land in large cities local authorities have been resorting to the practice of dumping garbage at certain selected locations without any consideration to the adverse effects of such dumping.



Figure 3: Demountable container in Khulna city



Figure 4: Crude Dumping site in Dhaka city

7. Recycling and Composting

Approximately 1,20,000 people are involved with the recycling occupation in Dhaka city. Similar recycling activities are also prevailing in other cities and towns of the country. The poor socially disadvantaged people informal sector are primarily involved with waste recovery and recycling practice in the country. Their recycling activity is reducing a significant volume of waste which otherwise would have to be collected by the local authorities. Almost 15 percent (i.e., more than 467.65 tons) inorganic fraction of the waste is recycled in Dhaka city (Sinha, 1993).

Wastes having economic value in the market are reclaimed and salvaged in different stages by informal sector. They separate refuse of higher market values such as paper, bottles, fresh containers, old cloths, shoes etc. and sell them to *feriwallas*/ itinerant buyers. Waste pickers mostly women, children of slums popularly known as *Tokai*, collect waste of low market values from waste bins. These items include broken glass, tin cans cardboard, waste papers, rags, plastics, metals and miscellaneous commercial waste discarded by households. Another group of waste pickers collects recyclable from the unloaded municipal trucks at the final disposal sites. The material collected from waste bins, sweeping accumulation and disposal sites require intermediate processing like washing drying and sorting. The refuse dealers separate the recyclables in proper form and sell them to consumers as well as supply them to appropriate processing small and large manufacturers.

Although *Tokais* extract most of the readily available material from the waste stream, still there remains considerable value in what they leave behind. This value lies in the organic portion of the solid waste, which constitute about 70-80% of the total generated waste, having considerable potential value, if converted into compost through composting. From the perspective of municipality, organic waste recycling through composting not only reduces disposal costs and prolongs the life span of disposal sites, but it also reduces adverse environmental impacts caused by landfill sites, as the organics are mainly responsible for leachate contamination and methane problems. Recycling and returning of organic waste to the soil would significantly contribute to enhancing the sustainability of the urban area. Involving the population in the use of compost promotes awareness of waste resource recovery while composting activities, creates employment and generate income for them.

Experience has shown that in developing countries large centralized and highly mechanized composting plants have often failed to reach their target and had soon to be abandoned due to high operational, transport and maintenance costs. In many cases small-scale decentralized community based composting plants have been considered as a suitable option for treating municipal solid waste as they reduce transport costs, make use of low-cost technologies, based mainly on manual labor, and minimize problems and difficulties encountered with backyard composting.

Waste Concern's experience shows community based decentralized approach to convert waste into resource/ compost/ recyclables with active public-private and community partnership is possible in the country. Government along with NGOs, CBOs and private sectors have taken the initiative to replicate Waste Concern's model of community based approach in 38 communities of 20 cities and another 28 cities are in the pipe line for replication. Recently using Clean Development Mechanism (CDM) under the Kyoto Protocol Waste Concern along with WWR (a Dutch company) took an initiative for a 700 tons/ day capacity composting plant and land fill gas recovery project at the Matuail landfill site of Dhaka city.

Table 4: Technology/ Method Used to Manage Urban Solid Waste:

Activity	Status in Bangladesh
Source Reduction	<ul style="list-style-type: none"> • No official initiatives from the Government • Reuse and recycling is done informally by informal sector. • Segregation of recyclable waste with economic value (such as newspaper, bottles, cans, glass, plastic, metal, rubber and different containers etc.) is done at source by people and sold to buyers. • Soiled recyclables materials from the source of waste, dustbins and dumpsites are retrieved by waste pickers for their survival.
Collection	<ul style="list-style-type: none"> • No provision storage exists at or near the point of source of waste • Waste is collected in the following ways: • Community bin System (brick, concrete or corrugated iron sheet); • Demountable Containers; • House-to-House Collection system • Designated Open Spaces
Transportation	<ul style="list-style-type: none"> • Conventional open trucks, demountable containers and tractors and trailers for the collection of waste. • No provision of transfer stations to transfer waste from the smaller collection vehicle to larger transport. • Multiple handling of waste exists. • Waste mixed with contaminated/ infectious substance • Transportation does not synchronize with the capacity of collection points.
Recycling	<ul style="list-style-type: none"> • Most recycling is done through the informal sector and waste picking. Mainly localized market and imports of materials for recycling. • Presently local government bodies are replicating Waste Concern's model of community based composting in a number of cities • Recently using Clean Development Mechanism (CDM) under the Kyoto Protocol Waste Concern along with WWR (a Dutch company) took an initiative for a 700 tons/ day capacity composting plant and land fill gas recovery project at the Matuail landfill site of Dhaka city.
Incineration	<ul style="list-style-type: none"> • Not common or successful because of high capital and operation costs, high moisture content and low calorific value of waste makes waste not viable for incineration. • At present few incinerators are used to manage health care related waste in a number of town and cities.
Land filling	<ul style="list-style-type: none"> • Usually open crude dumping is adopted. This system is most unhygienic and inefficient. • Causing problem to health and environment • Hospital waste, toxic waste and untreated industrial waste are also disposed of at the municipal landfill.
Costs	<ul style="list-style-type: none"> • 5-20% of annual municipal budget is used for Solid Waste Management



Figure 5: Recycling of inorganic waste by informal sector at the dumpsite of Dhaka city

7.1 Problems of Solid Waste Management in Bangladesh

The main problems and drawbacks of solid waste management in the urban areas of Bangladesh are as follows:

- Absence of national policy to encourage recycling practice;
- Lack of proper handling rules and standard;
- Lack of proper institutional setup in the local bodies to manage solid waste properly;
- Lack of finance, and inefficient tax collection;
- Lack of manpower and infrastructure;
- Incomplete and inefficient waste collection practice;
- Lack of access to municipal solid waste service by huge population;
- Shortage of suitable lands for final disposal of solid waste;
- Lack of public awareness about the health and environmental problems associated with the solid wastes. and
- Lack of partnership between the public sector, private sectors, community people and NGOs and CBOs.

8 Best Practice

8.1 Decentralized Community Based Composting in Dhaka by Through Public-Private-Community Partnerships

In an attempt to recover the value from organic portion of waste, a research based organization, Waste Concern, initiated a community based decentralized composting project in Dhaka city in 1995. The prime goal of this project was to explore technical and commercial feasibility of labor-intensive aerobic decentralized composting technique and to promote the principle of 4Rs (Reduce, Re-use, Recycle, and Recovery of waste) in urban areas of Bangladesh. Activities under the project included house-to-house waste collection, composting of the collected waste in a decentralized manner, and marketing of compost and recyclables.

The innovative approach and success of Waste Concern encouraged the Ministry of Environment and Forest (MoEF) of the Government of Bangladesh to select the Waste Concern as a sub-implementing agency for the project "Community Based Urban Solid Waste Management in Dhaka" with support from UNDP. Launched in September 1998, Waste Concern is implementing their community-based program of waste management in 5 areas of Dhaka city through partnership development with government agencies, private sector, and community groups. In 1999, partnership agreement was signed between public agencies (Public Works Department and Dhaka City Corporation), private sector (Map Agro) and Waste Concern to implement the project.

The Public Works Department (PWD), Dhaka City Corporation (DCC) and Waste Concern have a formal partnership agreement to implement the project.

- Waste Concern mediates with DCC and other government agencies to provide land and logistical support to implement the program as well as with the private sector to market the recyclables and compost.
- PWD and DCC have given Waste Concern permission to use their land and have provided other logistical support such as water and electricity connections to establish community-based composting plants.
- Waste Concern provides capacity building and technical assistance by forming waste management committees called "green force" establishing small-scale composting units (1-5 tons per day capacity) and training communities to manage, operate, and maintain the services.
- Waste Concern mobilizes the community and forms community groups and organizes training programs. Selected community members—mostly women—undergo hands-on training in waste separation, collection, composting, and marketing of recyclable material and compost.

A good market for compost exists in Bangladesh. Waste Concern helps the communities sell their compost to a number of outlets such as fertilizer-marketing companies and nurseries. Waste Concern has been selling its compost for \$0.05-0.09 per kg and recently signed a partnership agreement with the private company Map Agro Ltd. to sell compost to Agro at \$0.05 per kg. Recently, Map Agro requested Waste Concern to install more community-based compost plants to meet the growing demand for enriched compost.

Waste Concern's model relies on community mobilization and capacity building to manage waste and ensure sustainability of the project. After a year of community mobilization and training, Waste Concern hands over the project to the community but continues to monitor it for 3 years.

The community-based decentralized composting program, integrated with door-to-door collection of solid waste, can yield appreciable savings for municipal authorities. Waste Concern's model

shows that only 15% of total waste has to be transported to the landfill site by having decentralized community based composting plants.

The program has significantly cleaned up communities, created jobs for the urban poor, reduced DCC's waste management costs, and created business opportunities for entrepreneurs. The project has become a model, which several city governments and NGOs are trying to replicate. Till August 2004, twenty cities/ towns in Bangladesh have replicated the model in 38 communities.



Figure 6: Community Based Compost Plant of Waste Concern at Dhaka

8.2 Barrel Type Composting Project for the Urban Poor

Successful result of community based composting model helped Waste Concern to realize that a large portion of population residing in the slums of Dhaka city cannot be covered with the model of community based composting approach. A large group of urban poor are not included in the existing model. Almost 30% of the city population is residing in the slum with poor water, drainage, health and waste situation. As they are illegally occupying land and not paying tax, the city authorities are usually reluctant to serve these people. Uncollected waste inside and outside the slums is nuisance and health hazard for the slum dwellers as well as for the whole city. In order to solve this problem Waste Concern came up with an idea of linking waste with income. The Barrel Type Composting model invented by the SEVANATHA, Sri Lanka inspired Waste Concern to implement the concept in the slums of Dhaka.

With some modification and changes Waste Concern with the support from Local Initiatives Facility for Environment (LIFE) of UNDP launched the barrel types composting units in two slums of Dhaka. Later after successful results, this concept is being replicated in a number of slums of Dhaka as well as other cities of Bangladesh. The idea is simple; a specially designed 200 liter bottomless perforated green barrel with a lid was supplied to the slum. One green barrel is provided to a group of six households and placed on a raised base with concrete ring. The cost of each specially designed barrel along with the civil work was around TK. 1800 (US \$ 30). The slum dwellers were imparted with training and motivated to dispose their kitchen waste into the

green barrel. Waste decomposed aerobically into compost in three months time period. Generally, in low-income settlements major portion of the waste generated is biodegradable. Slum dwellers are motivated to dispose their inorganic waste in the yellow barrel provided by WC, which is subsequently carried to nearby DCC dustbins, for final disposal. It was found that from a one 200 liter barrel, compost worth between Tk. 900-1000 could be produced each year. The households sharing the barrel can also share the income from sale proceeds of the compost. This model is successful in achieving a behavioral change by minimizing littering of waste in the slum. The slum dwellers are quite enthusiastic about the project as they are seeing the benefits of clean environment, health benefit and earning extra income from their waste, which was previously creating pollution and nuisance in their slum. This model of barrel type composting demonstrates how slum people can improve their environment and health along with economic benefits.

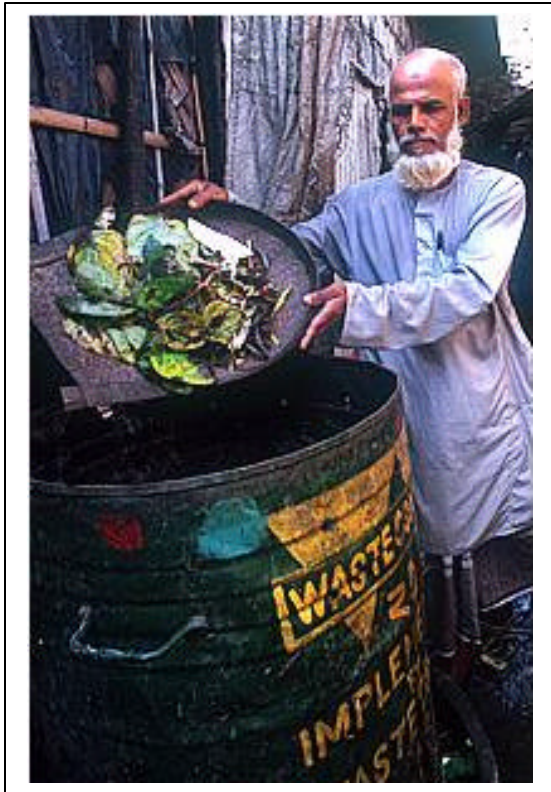


Figure 7: Barrel Type Composting System in Slum and squatters Settlements

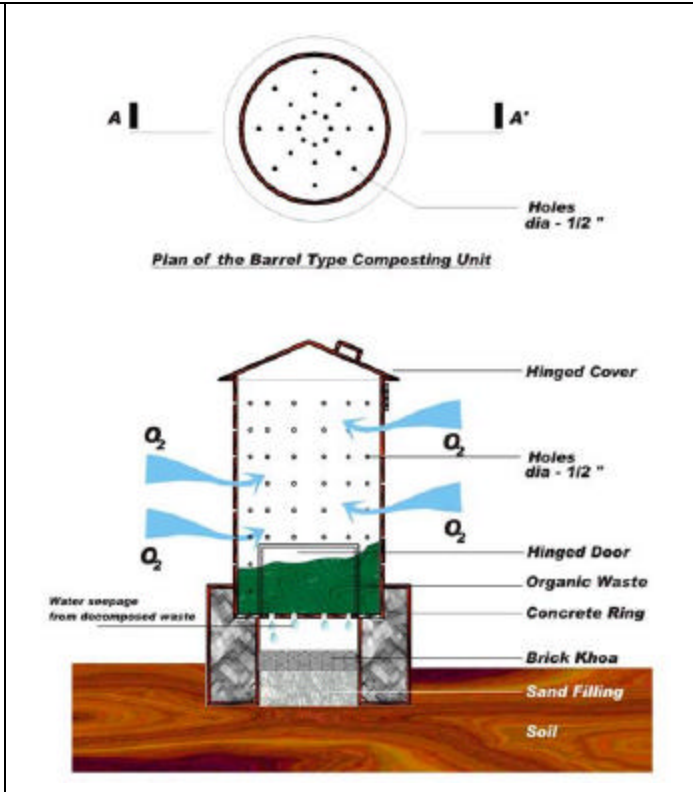


Figure 8: Sectional view of Barrel Type Composting System

9. Recent Development Regarding Solid Waste Management in Bangladesh

There have been several positive developments in the country to improve the solid waste management situation in the urban areas of Bangladesh over the last few years, which are as follows:

- Dhaka City Corporation with support from the JICA is preparing a master plan for the solid waste management of Dhaka city.
- Two projects on landfill gas recovery along with height increase of Matuail landfill site of Dhaka and establishment of 700 tons/day capacity composting plant has been approved by the National CDM Board of the government. This project will be implemented shortly by private sector using CDM financing and public-private partnership approach.

- UNICEF along with 14 city corporations and municipalities and Department of Public Health Engineering have been implementing community based composting projects and barrel type composting.
- Local Government Engineering Department (LGED) with support from ADB has taken initiative to prepare Solid Waste Management Plan for eight secondary towns of Bangladesh.
- UNICEF is also initiating a project to establish Recycling Centers in 24 city corporations/municipalities as well as preparation of solid waste management plan.
- 'Urban Solid Waste Management Handling Rules of Bangladesh' is being prepared under the Sustainable Environment Management Program (SEMP), which is implemented by the Ministry of Environment and Forest (MoEF) and supported by UNDP.
- 'Bio-medical Waste Handling Rules' is also being prepared under SEMF.

10. Future Programs to Improve Solid Waste Management in Bangladesh

In order to improve solid waste management in the urban areas of Bangladesh following issues should be considered:

- Promotion of source-separation of waste.
- Tax incentive for use and production of recycled product
- Promotion of public-private-community partnerships
- Promotion of recycling/ composting/ no-burn technology and less land filling of waste
- Promotion of more waste related projects using Clean Development Mechanism (CDM) opportunity.

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