Waste Concern
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Urban Solid Waste Management Scenario of Bangladesh: Problems and Prospects

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URBAN SOLID WASTE MANAGEMENT SCENARIO OF BANGLADESH: PROBLEMS AND PROSPECTS

1. Background

Bangladesh, being a developing country, is predominantly a rural country. In 1951, the percentage of urban population was only 4.33% of the total population. Since then the rising trend has continued reaching around 24% by the year 2001. Growth of urban population due to large influx of rural-urban migration is triggered by the migrants' poverty at home. The deplorable condition of poor migrants and acute shortage of adequate housing have led to mushroom growth of slums and squatter settlements in urban areas, specially in secondary towns of Bangladesh.

Table 1: Urbanization in Bangladesh

Year	Total Urban Population	Percent of Urban Population	Average Annual Growth Rate (%)
1951	1819773	4.33	1.69
1961	2640726	5.19	3.75
1974	6273602	8.78	6.62
1981	13535963	15.54	10.63
1991	20872204	20.15	5.43
2001*	28808477	23.39	3.27

Source: BBS, 1997; *BBS, 2001

One of the directly related consequences of population growth is the increase in waste generation. With the conventional system of collection, transportation and crude dumping of solid waste, municipal areas of Bangladesh are generally faced with rapid deterioration of environmental and sanitation condition. As such, urban solid waste management has become a major concern for the cities and towns of Bangladesh. Municipal services in most cities and towns are already over-burdened, and simply cannot meet the growing demand for municipal services, resulting in unhygienic and filthy living condition in the neighborhoods.

In order to deal with the prevailing situation in a planned way, proper study is required to analyze the urban waste management scenario of Bangladesh. It is necessary to quantify the amount of waste generated, its composition and physical properties as well as the current management practices so as to identify the problems and future prospects. This study attempts to make a move in this direction.

2. Goals and Objectives

The main goal of this study is to carry out a comprehensive baseline assessment of solid waste management scenario in the urban areas of Bangladesh. The objectives are:

- Estimation of the total quantity of urban waste generated in Bangladesh;
- Analysis of physical composition of waste generated in different urban areas;
- Estimation of density of the waste generated in different urban areas;
- Assessment of present collection efficiency and cost of collection;
- Analysis of existing pattern of urban waste recycling;
- Estimation of land requirement for waste disposal; and
- Estimation of the potential Green House Gas emission.

3. Methodology

In order to achieve the above mentioned objectives two types of survey was conducted in 12 urban areas, including two city corporations and ten pourashavas. Waste generation characteristics of these areas have been used to assume for the remaining areas. In case of Dhaka City Corporation, previous studies by Waste Concern (2000) and JICA (2004) have been considered. Other City corporations' data were collected from either the city corporation office or from BBS (2004) report. Population data have been collected from population census by BBS (1991) and BBS (2002) and then projected to 2005.

The surveys conducted to collect the primary data are described as follows:

3.1 Waste Generation Rate Survey

For determination of waste generation rate, sample survey was conducted in different households representing high, middle, lower-middle and low-income groups. In addition to these, waste generation survey was also conducted in markets as well as in some commercial areas.

3.2 Physical Composition Survey

In order to determine physical composition of solid waste generated in different areas, collected samples were analyzed for physical composition. Moreover, density of waste at the collection point was also determined.

3.3 Secondary Data

Apart from primary data, secondary data were collected from the pourashava office, reports and studies by ADB, JICA, BBS and World Bank as well as field observation made by waste concern.

4. Findings

4.1 Total Waste Generation

Total number of urban areas in Bangladesh is 514, which includes 6 City Corporations, 298 Pourashavas (Municipalities) and 210 other urban centers. In order to estimate the total waste generated in these areas, each of the City Corporations, all Pourashavas and all urban centers are considered separately for different per capita waste generation rates. The total waste generation rate is estimated considering individual waste generation rates of the city corporations, an average for all the pourashavas and another average for all other urban centers.

For the floating urban population, who spend a significant time of the day in these areas for business, job, study or other purposes but not permanent residents, a 10% increase in total population is considered. Again most of the waste generation surveys were conducted in the dry season. In a study by JICA (2004) it has been found that during wet season the waste generation rate increases by 46%. In another study by Ahmed (1991) this variation was found to be within 15% to 50%. As such to estimate the waste generation rates in wet season an increase of 46% is considered. Finally, average of dry and wet season is considered to arrive at the average waste generation rate, taking into account the seasonal variation.

Table 2: Total Waste generation in urban areas of Bangladesh

City/Town	WGR* (kg/cap/day)	No. of City/Town	Estimated Population (2005)	Total Population** (2005)	TWG*** (Ton/day)		Average TWG (Ton/day)
					Dry season	Wet season	
Dhaka[1]	0.56	1	6,116,731	6,728,404	3,767.91	5,501.14	4,634.52
Chittagong[2]	0.48	1	2,383,725	2,622,098	1,258.61	1,837.57	1,548.09
Rajshahi[3]	0.3	1	425,798	468,378	140.51	205.15	172.83
Khulna[4]	0.27	1	879,422	967,365	261.19	381.34	321.26
Barisal[5]	0.25	1	397,281	437,009	109.25	159.51	134.38
Sylhet[6]	0.3	1	351,724	386,896	116.07	169.46	142.76
Pourashavas[7]	0.25	298	13,831,187	15,214,306	3,803.58	5,553.22	4,678.40
Other Urban Centers[8]	0.15	210	8,379,647	9,217,612	1,382.64	2,018.66	1,700.65
Total	0.41(Avg.)	514	32,765,516	36,042,067	10,839.75	15,826.04	13,332.89

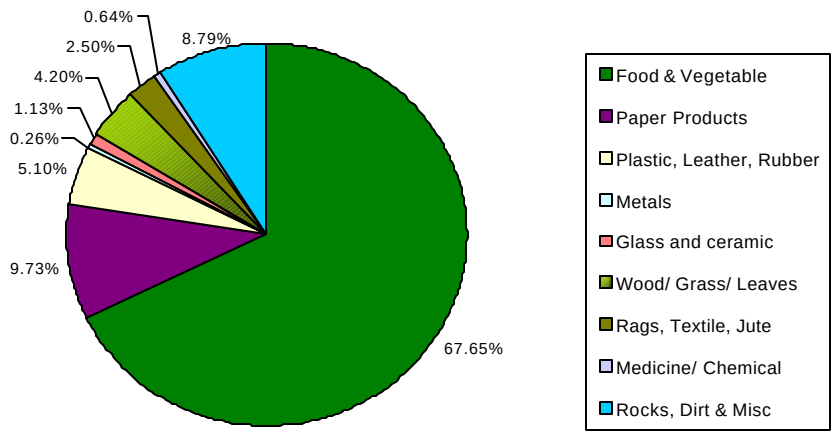
*WGR= Waste Generation Rate,
** Including 10% increase for floating population,
***TWG= Total Waste Generation, which increases 46% in wet season from dry season
Source: [1]JICA (2004), [2]Chittagong City Corporation, [3]Field Survey, [4]Sinha (2000), [5]Field Survey, [6]Sylhet City Corporation, [7, 8]Field Survey

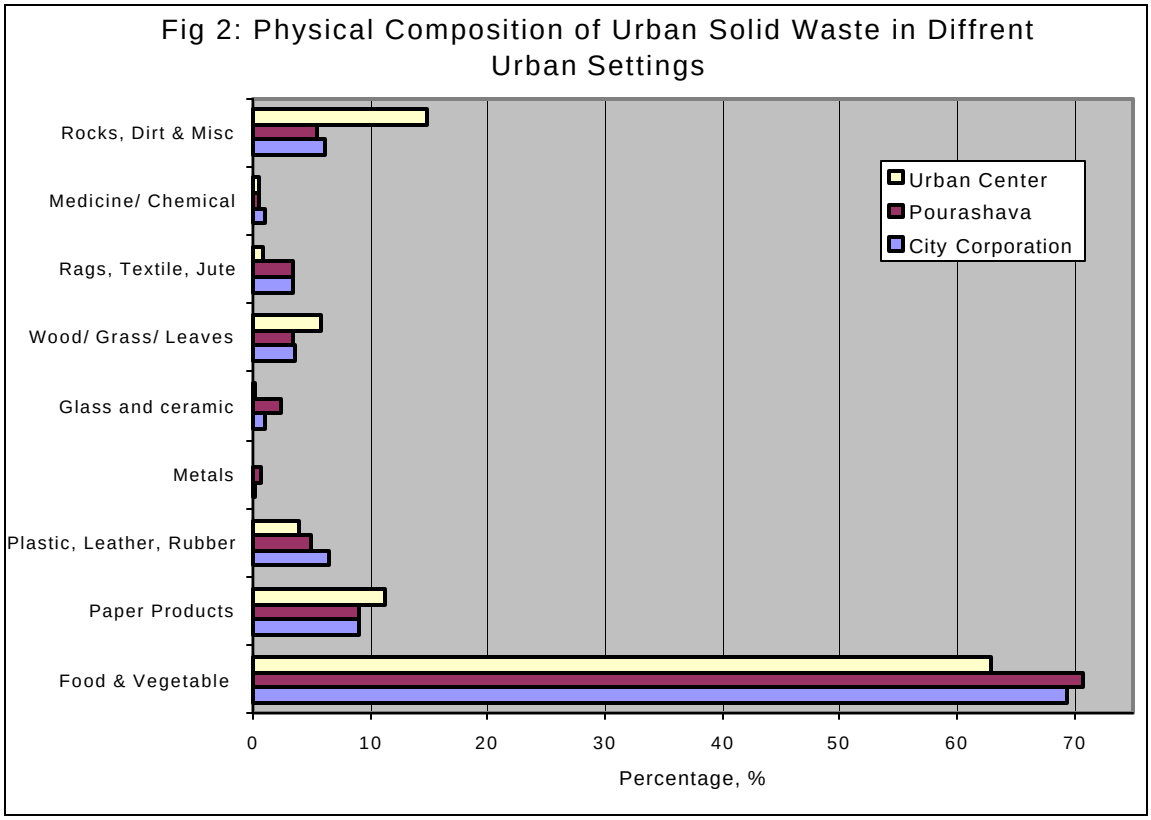
From Table 2 it is found that total waste generated in the urban areas of Bangladesh per day is 13,332.89 tons. Based on the total estimated urban population of the year 2005, per capita waste generation rate is computed as 0.41 kg/capita/day.

4.2 Physical Composition

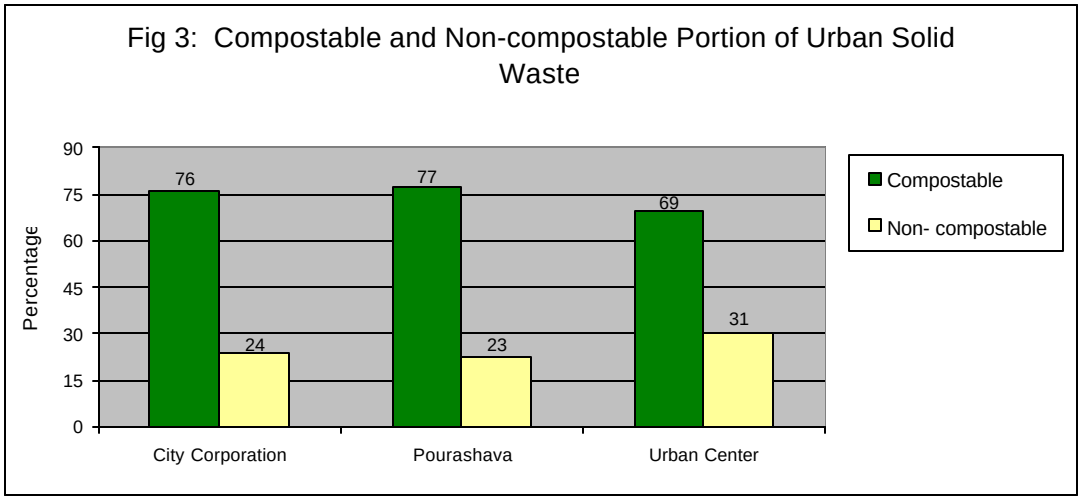
Composition of solid waste depends upon a number of factors, such as food habit, cultural tradition, socio-economic and climatic condition. Composition of solid waste varies not only from city to city but even within the same city itself and also seasonally. Physical composition of solid waste from different urban areas of Bangladesh is given in Annex 1. Figure 1 shows the average proportion of different components in urban solid waste of Bangladesh and figure 2 shows the composition in different urban settings.

Fig 1: Average Physical Composition of Urban Solid Waste





Among different components the total percentage of compostable (including food, vegetable, rags, jute, wood, grass, leaves etc.) waste was found to be comparatively higher. Figure 3 shows the percentage of compostable and non-compostable parts in different urban solid waste.



It is seen from Figure 3 that a substantial portion (69% to 77%) of solid waste in the urban areas is compostable. Average compostable content of the waste is 74% with the remaining 26% being non-compostable. The large quantity of organic contents present in urban solid waste composition indicates the necessity for frequent collection and removal. This also indicates good potentials for recycling of organic waste for resource recovery.

4.3 Density of Waste

Density of waste varies with season. Some of the waste generation surveys were conducted in wet season, July and others in dry season, January and February. Table 3 presents the densities of solid waste in different urban areas at collection point, on truck and at landfill.

Table 3: Density of Urban Solid Waste

City / Town	Collection Point Density* (kg/m^3)	On-truck Density** (kg/m^3)	Landfill Density** (kg/m^3)
Dhaka	235.00	470.00	940.00
Chittagong	284.00	568.00	1136.00
Rajshahi	333.00	666.00	1332.00
Khulna	299.04	598.07	1196.14
Barisal	314.07	628.14	1256.28
Sylhet	306.55	613.11	1226.21
Pourashava	272.22	544.44	1088.87
Other Urban Center	260.00	520.00	1040.00
Average	288	576	1152

*Source: Field Survey, **Estimated

The average density of urban solid waste at collection point is estimated as 288 kg/m^3. This density may vary depending on the season. Based on the survey it is also estimated that the average on-truck density as 576 kg/m^3 and average landfill density without any compaction as 1152 kg/m^3.

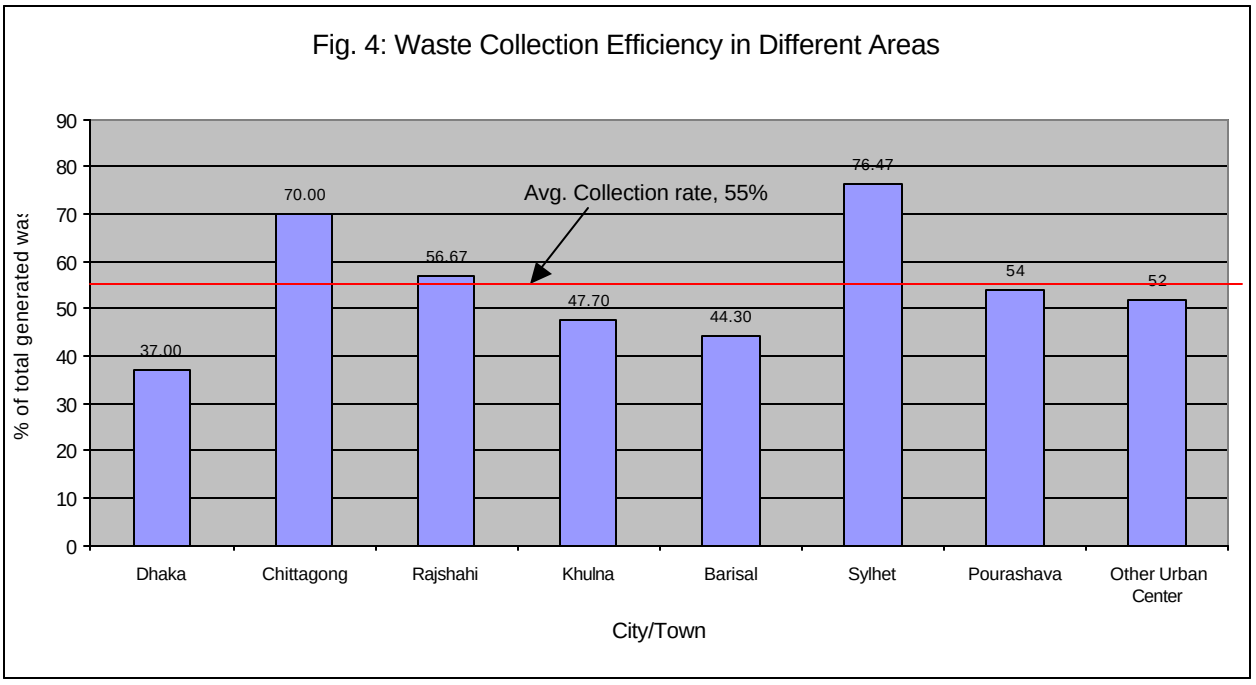
4.4 Collection of Waste

In majority of the urban areas, community bin system of waste collection is being practised in Bangladesh. Recently, in some areas NGOs have introduced door-to-door collection of solid waste. But the coverage of neither communal dustbin system nor house-to-house waste collection system is sufficient yet. Moreover, no specific rule and criterion is followed while placing dustbins. The practice of widely spaced communal bins is usually a failure because the demand placed on the households goes beyond willingness of the residents to co-operate. Table 4 shows the waste collection rate in different cities and urban centers. It also shows the number of cleaners, trucks and the cost for per ton of solid waste management based on per day collection of solid waste and the annual conservancy budget.

Table 4: Urban Solid Waste Collection Rate and Cost of Collection

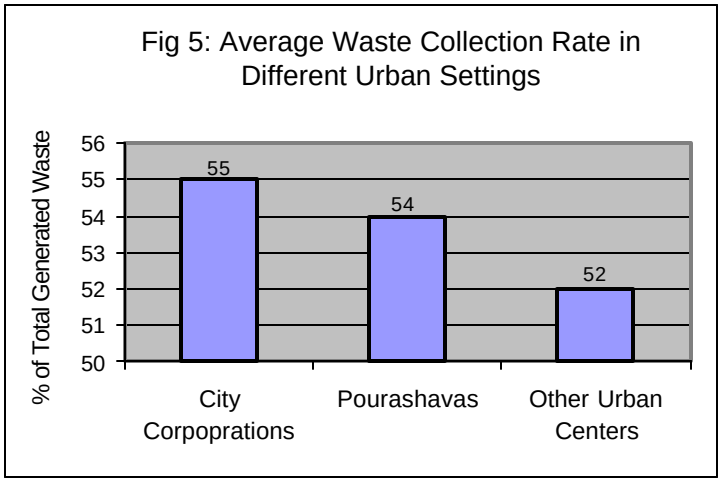
City/Town	TWG*, (Ton/day)	Waste Collection Rate, %	No. of cleaners/1000 pop	No. of trucks/15000 pop	Cost per ton, Tk.
Dhaka[1]	4,634.52	37.00	1.2	0.5	669.98
Chittagong[2]	1,548.09	70.00	0.77	0.6	411.59
Rajshahi[3]	172.83	56.67	0.8	0.5	235.56
Khulna[4]	321.26	47.70	0.62	0.48	986.00
Barisal[5]	134.38	44.30	1.24	0.23	1932.00
Sylhet[6]	142.76	76.47	0.85	0.72	1562.00
Pourashava[7]	4,678.40	54.42	1.05	0.54	447.85
Other Urban Center[8]	1,700.65	52	0.55	0.42	312.00
Total	13,332.89	Avg. 55	-	-	-

TWG= Estimated Total Waste Generation,
Source: [1]JICA (2004), [2]Chittagong City Corporation, [3]Field Survey, [4]Sinha (2000), [5]Field Survey, [6]Sylhet City Corporation, [7, 8]Field Survey



It can be seen that in different cities and urban centers waste collected per day by the municipality varies from 37% to 77% (average 55%) of the total generated waste with the present level of infrastructure.

Figure 5 shows the comparative performance of City Corporations, Pourashavas and other urban centers. It can be seen that the average waste collection efficiencies vary within a close range (52% to 55%) and there is a trend showing better performance with the size of the settings and the extent of urbanization.



The collection cost varies from Tk. 235 to Tk. 1932 per ton of waste. The number of cleaners also falls quite short behind the standard in almost all the cities/towns. While the number of cleaners for satisfactory manual cleansing is 2-5 per 1000 population (Trivedi, et.al. 1992), in most urban areas it varies from 0.55 to 1.2 per 1000 population. An investigation has been made to identify if there is any correlation of waste collection efficiency with the number of cleaners, number of trucks and annual budget for solid waste management.

It has been found that there is barely any correlation with either the expenditure on solid waste management (Fig 6) or the number of cleaners (Fig 7) with the waste collection efficiency. But it may be seen from Figure 8 that a good correlation exists between the number of trucks and the waste collection efficiency.

Fig.6: Relation of Waste Collection Efficincy with Expenditure for Solid Waste Management

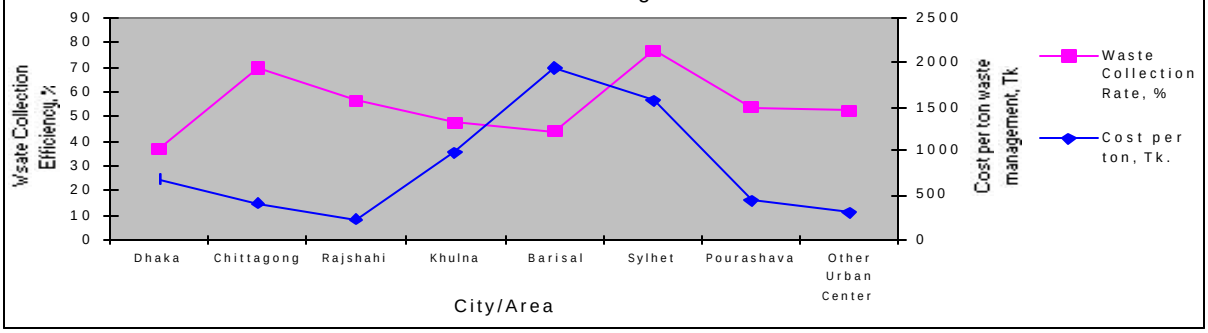


Fig. 7: Relation of Waste Collection Efficiency with the Number of Cleaners

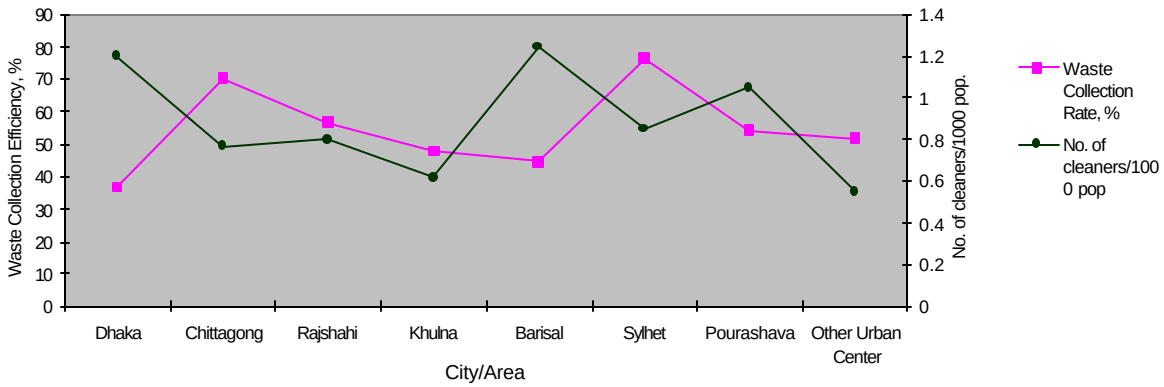
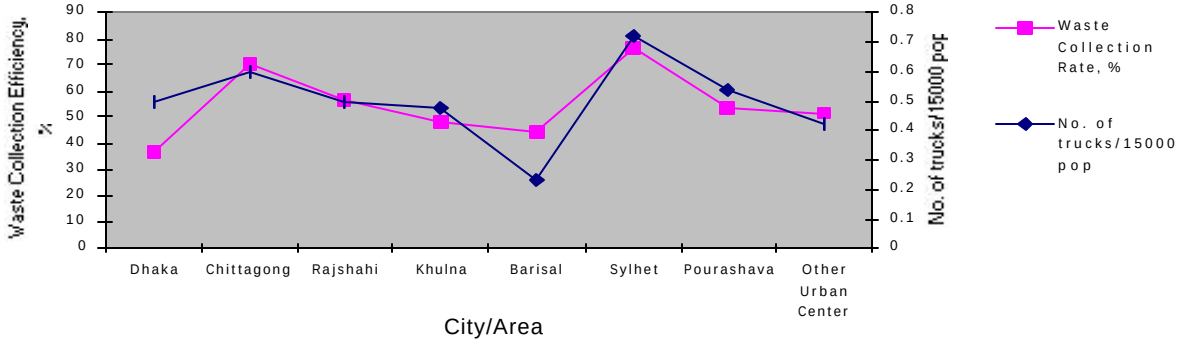


Fig. 8: Relation of Waste Collection Efficiency with the Number of Trucks



4.5 Recycling of Waste

Informal sector is playing an important role in Bangladesh in recycling of solid wastes. The existence of waste, mainly inorganic, has opened quite an extensive scope for various groups of the community to utilize it profitably. Informal sector is also playing a prominent role in collection of recyclable materials. All the buyers of the recyclable items belong to the informal sector and only a few formal manufacturers are involved in using recyclable items as raw material. Although recycling of solid waste is not included in the national environmental policy, waste has become the main source of income for several groups of the informal sector.

Table 5 shows the percentage of waste recycling in cities and urban centers and the savings made through this informal sector per year which is calculated from the cost per ton of waste management given in Table 4.

Table 5: Informal Recycling of Urban Solid Waste and Savings through Recycling

City/Town	TWG* (Ton/day)	No. of City/Town	% of Inorganic Waste Recycling**	Savings through recycling per year, (Tk. million)
Dhaka	4,634.52	1	15.00	170.00
Chittagong	1,548.09	1	12.45	28.96
Rajshahi	172.83	1	6.7	1.00
Khulna	321.26	1	6.00	6.94
Barisal	134.38	1	5.42	5.14
Sylhet	142.76	1	4.23	3.44
Pourashava	4,678.40	298	3.89	8,862.52
Other Urban Center	1,700.65	210	4.00	1,627.50
Total	13,332.89	514	-	10,705.5

*TWG= Total Waste Generation, **Source: Field Survey

It may be seen from Table 5 that informal sector is responsible for recycling from 4% to 15 % of the total solid waste generated in different cities and urban centers. It is estimated that informal sector has been able to save Tk 10,705.5 million annually through recycling of 4% to 15% of the total generated waste.

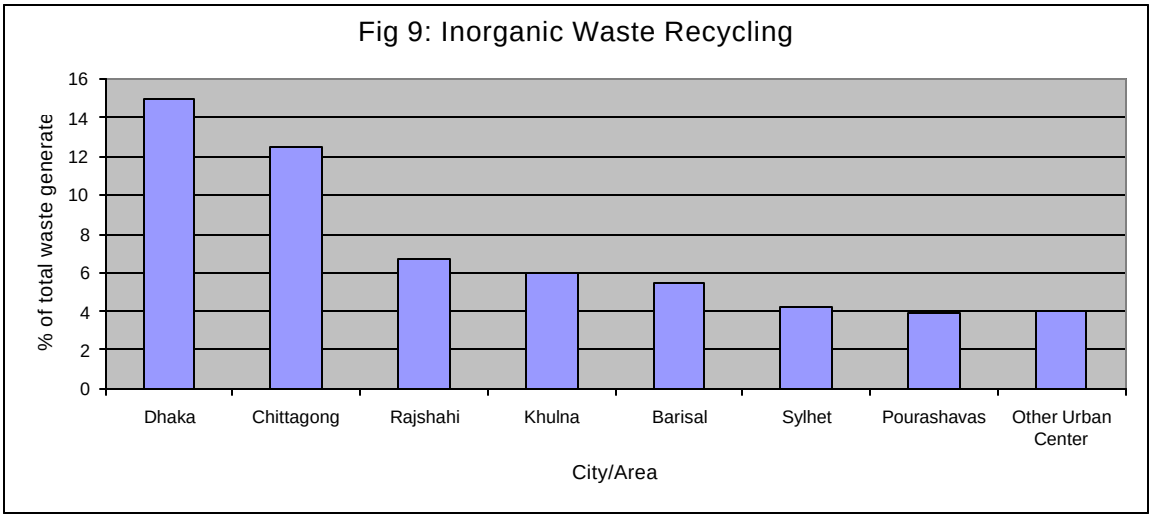


Figure 9 shows the rate of inorganic waste recycling in different city corporations, pourashavas and other urban centers from which it is evident that the rate decreases with the decrease in the size and urbanization of the city.

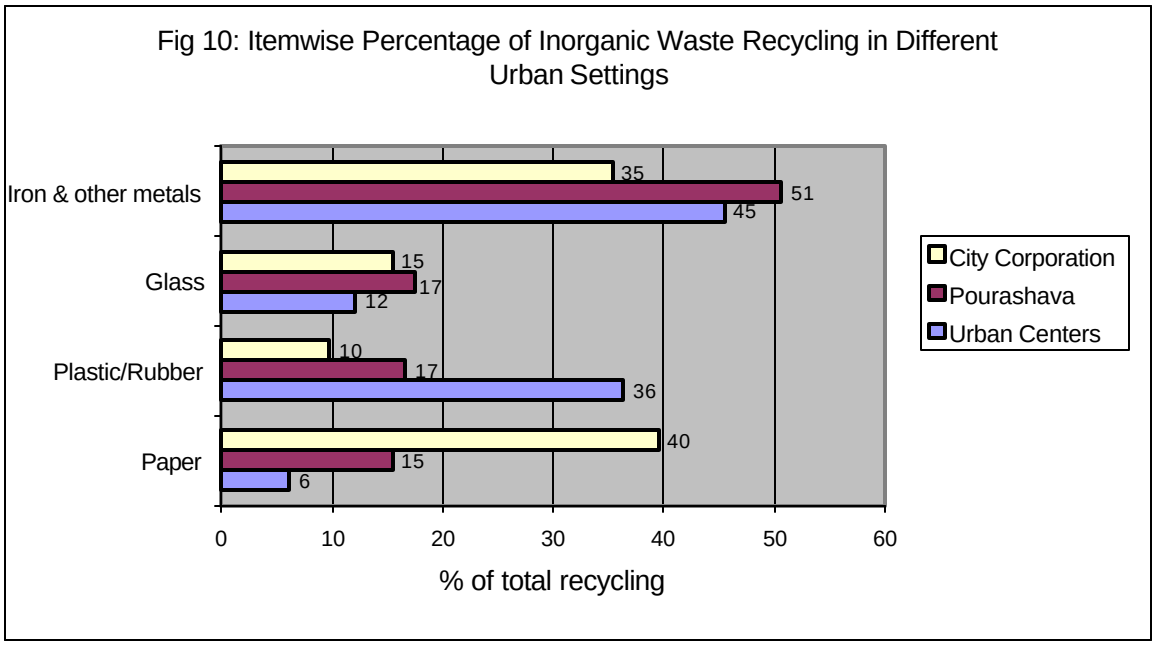


Figure 10 presents comparative picture of item-wise distribution of inorganic waste recycling in different types of urban areas. It may be seen that the average percentages of different recyclable items vary considerably among city corporations, pourashavas and other urban centers without showing any definite trend.

5. Waste Disposal

Disposing of solid waste in open dumps is the most common method used for final disposal of urban solid waste. In some cities and towns there are designated dumping sites where the collected waste is dumped in unsanitary manner. No waste segregation, waste compaction or daily top seal are used in these dumpsites. The case is even worse in areas where there is no specific dumpsite. The collected waste is disposed through crude dumping in low-lying areas, nearby water bodies or on a vacant lot. Much of the uncollected waste is also disposed in the same manner. The entire waste disposal system is unsanitary which needs urgent improvement.

5.1 Land Requirement

Generally, density of waste at landfill sites in this sub-continent has been found as 1.1 ton/ m^3 without any compaction (Cointreau, 1986). Table 6 presents the landfill volume and area required for disposing the generated waste per year with the present collection rate and 100% collection efficiency.

From Table 6 it may be seen that considering 4 meters height the total area required per year to dispose the total generated urban waste is 273.21 acre. Based on the rate of waste collection the total landfill area required for waste disposal for 4 meters depth of filling per year works out as 137.24 acres.

Table 6: Landfill Volume Requirement per Year for Urban Solid Waste Disposal

City / Town	TWG* (Ton/day)	Waste Collection Rate, %	Landfill area required with 4m depth, acre per year	
			With existing collection efficiency	With 100% collection efficiency
Dhaka	4,634.52	37.00	35.14	94.97
Chittagong	1,548.09	70.00	22.21	31.72
Rajshahi	172.83	56.67	2.01	3.54
Khulna	321.26	47.70	3.14	6.58
Barisal	134.38	44.30	1.22	2.75
Sylhet	142.76	76.47	2.24	2.93
Pourashava	4,678.40	54.42	52.17	95.87
Urban Center	1,700.65	52	18.12	34.85
Total	13,332.89	-	137.24	273.21

*TWG = Total Waste Generation

Since there is a high content of compostable waste in the urban solid waste composition, composting is obviously a viable option for reducing the load on the landfill. At the same time, revenue can be earned from sale of compost as organic fertilizer, biogas and trading reduction of GHG emission along with reduced cost of purchasing landfill area. The following table shows the landfill area required after diverting 50% and 74% of total generated waste for composting along with the area required for developing composting plants.

Table 7: Area Required for Landfill and Composting Plant

City / Town	Landfill area required with 4m depth, acre per year			Area required for composting plant, acre	
	Without Composting	50% Composting	74% Composting	50% Composting	74% Composting
Dhaka	94.97	54.61	34.43	55.15	81.62
Chittagong	31.72	18.24	11.50	18.42	27.26
Rajshahi	3.54	2.04	1.28	2.06	3.04
Khulna	6.58	3.79	2.39	3.82	5.66
Barisal	2.75	1.58	1.00	1.60	2.37
Sylhet	2.93	1.68	1.06	1.70	2.51
Pourashava	95.87	55.12	34.75	55.67	82.40
Urban Center	34.85	20.04	12.63	20.24	29.95
Total	273	157	99	159	235

The comparative picture presented in Table 7 reveals that without composting the total land area required is 273 acre whereas with 50% composting it is reduced to 157 acres and with 74% composting it is further reduced to only 99 acres per year. Table 7 also shows that the area required for composting plant for the diverted 50% and 74% of compostable waste work out around 159 acres and 235 acres respectively.

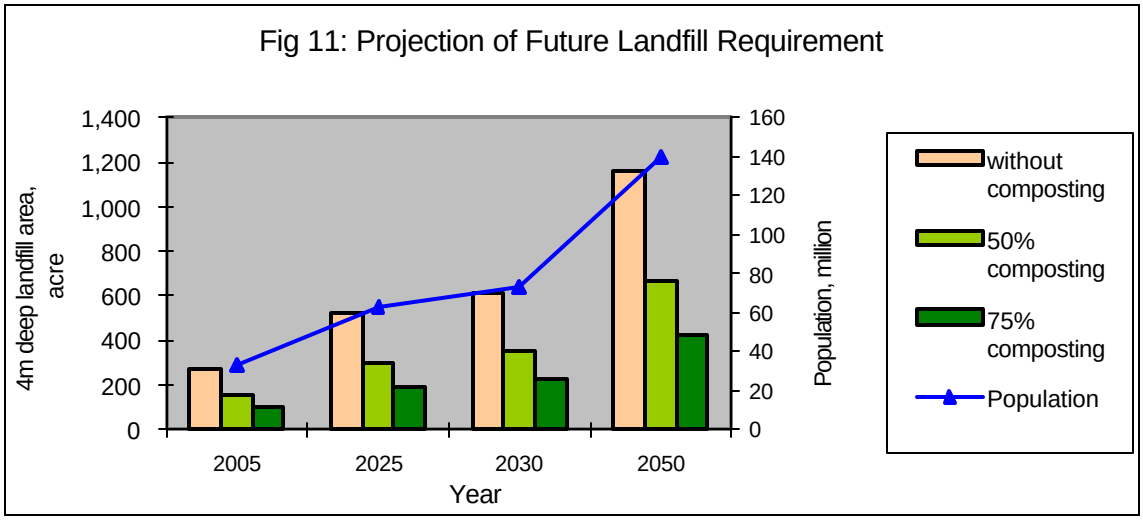


Figure 11 shows the trend of future landfill area requirement without composting and with composting. It may be seen that by the year 2050 the landfill requirement without composting will exceed 1000 acres. On the other hand, in the same year with 75% composting landfill requirement will be only around 400 acres – a substantial reduction of over 60 percent.

5.2 Green House Gas Emission

One of the environmentally harmful consequences of unsanitary waste disposal is the emission of green house gases (methane, carbon dioxide etc.). Since the final disposal of urban solid waste in Bangladesh is yet to be sanitized, it has been coupled with the unutilized high organic content of waste, which contribute to increased GHG emission potential. Table 8 presents the scenario of GHG emission potential of urban solid waste in different urban parts of the country.

Table 8: Green House Gas Emission Potential of Urban Solid Waste

City/Town	TWG*, (Ton/day)	GHG emission potential, million ton CO_2e / year
Dhaka	4,634.52	0.76
Chittagong	1,548.09	0.25
Rajshahi	172.83	0.03
Khulna	321.26	0.05
Barisal	134.38	0.02
Sylhet	142.76	0.02
Pourashava	4,678.40	0.77
Other Urban Center	1,700.65	0.28
Total	13,332.89	2.19

It is estimated that 2.19 million ton CO_2e is emitted per year from the total generated urban waste. This high GHG emission potential indicates the necessity of proper waste management and disposal system along with the prospect of trading the reduction of GHG emission with developed countries. Based on per ton price of US $ 6, the total income that can be earned per year through sale of Certified Emission Reduction (CER) is US$ 13.14 million.

6. Conclusion

In this study, the total urban waste generated throughout the country is found around 13,333 tons/day. This finding varies from the value (17,000 tons/day) that can be projected from the study by World Bank (1998). Based on the present total urban population, per capita waste generation rate as found in this study is 0.41 kg/capita/day. This estimate corresponds to the patterns of municipal waste generation rate determined by Cointreau (1982) ranging from 0.4 to 0.6 kg/capita/day for low-income countries.

Physical composition analysis of the waste shows that there is a mixture of different types of components with a significant portion (around 74%) of them being compostable. This high amount of organic content indicates the necessity of frequent collection and removal as well as having a good prospect of organic waste recycling through composting.

The collection point density of urban solid waste is found around 284 kg/m^3, which may vary with dry and wet season. The value is also within the typical range (250-500 kg/m^3) determined by Cointreau (1982) for low-income countries.

Existing infrastructure for waste management shows that waste collection efficiency in different urban areas varies from 37% to 77% with an average of 55%. Sylhet, Chittagong and Rajshahi City Corporations are better performing ones than others. Yet the overall waste collection situation is not very satisfactory. Huge amount of uncollected waste, a high percentage of which is organic, creates nuisance and pollutes the local environment quickly. Therefore, frequent removal is absolutely necessary for sound and hygienic surroundings.

In the midst of limited capacity of municipal corporations to manage the waste, informal sector is playing a vital role by recycling a certain quantity of wastes - mainly the inorganic portions. Around 4 to 15% of the total generated waste is being recycled by the informal sector. It is estimated in the study that every year Tk. 10,706 million is being saved through recycling. It is also found that the average rate of recycling varies with the size of the city such as in the city corporations it is around twice as much as in the pourashavas and other urban centers.

Ultimate disposal of urban solid waste is done crudely in open dumps, lowlands or water bodies in an unsanitary manner. As a result, the surrounding environment of the dumpsites is barely hygienic. The increasing demand for landfill is also a big problem for the authority to find suitable lands for dumping wastes. At current waste generation rate the total land required per year with existing collection efficiency and 100% collection efficiency will be 141 acres and 273 acres respectively with a depth of 4 meters. Composting the organic portion of the waste can reduce this high demand for landfill site since around 74% of the total waste is organic. It is estimated that composting 50% and 74% of the total generated waste with 100% collection efficiency the area required for landfill will be reduced to 157 acres and 99 acres respectively per year with 4 meters of depth. Thus composting can reduce a significant amount of landfill load. The remaining inorganic portions can be recycled; thereby reducing the expenditure to be incurred on landfill to a minimal.

7. Future Prospects

Although the present urban solid waste management scenario as discussed above is far from satisfactory, several findings and estimations in the study reveal that there are sufficient opportunities to handle and improve the situation. Institutional/organizational strengthening of the conservancy section should be given the top priority as without proper set-up, adequate manpower and equipment it will not be possible to realize the desired improvements.

Promotion of recycling of both organic and inorganic waste can reduce the cost of collection, transportation and disposal of waste. It is found in the study that suitable landfill area for waste disposal will hardly be available in near future if the current waste disposal practice continues. In the United Nations Environment Programme (UNEP), 'waste reduction' is placed in the urban environmental accords with one of its recommended implementation action being 'zero waste to landfills and incinerators by 2040'. Action 6 of UNEP sets a target for reducing per capita waste disposal to landfill and incineration by 20% in 7 years through "user-friendly" recycling and composting programmes.

In Bangladesh informal sector is contributing from 3% to 15% recycling of inorganic wastes. If waste recycling gets proper government attention and assistance and if operated in environmentally sound manner, the rate can be increased to meet the UNEP target. The rate of recycling can be further increased through practicing source separation, which needs substantial awareness raising.

Since around 74% of the total generated waste is compostable the amount of waste to be disposed in landfill can be significantly reduced by composting of organic waste. In some parts of the world like Europe, disposal of organic waste in landfill is going to be banned by the year 2010. In addition, revenue can be earned from the sale of compost. Furthermore, harnessing Clean Development Mechanism (CDM) financing through implementing composting project can generate US $ 13.14 million per year from the sale of CERs.

To improve the situation, there is a need for effective solid waste management policy for Bangladesh. At present, under the Sustainable Environment Management Program (SEMP), the Ministry of Environment and Forests (MoEF) is preparing a Solid Waste Management Handling Rules. The issues related to waste separation, waste reduction, recycling, public-private and community partnership, appropriate technology, innovative local solutions, harnessing CDM opportunities in waste sector are given special emphasis in rules.

As a signatory of UNEP's Green City Accords, Bangladesh is committed to comply with the urban environmental accords. As such, waste reduction is one of the liabilities to implement. Composting and recycling of urban solid waste of Bangladesh is considered as the most suitable as well as financially prospective options for fulfillment of the UNEP accord.

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ANNEXTURE

Annex 1: Physical Composition of Urban Solid Waste

City / Town	Component, %													Total	Compostable, %	Non-Compostable, %
	Food & Vegetable Waste	Bones	Paper Products	Plastics	Rags, Textile, Jute	Glass	Leather, Rubber	Metals	Ceramic	Soil, Ash	Wood/ Grass/ Leaves	Medicine/ Chemical	Rocks, Dirt & Misc			
Dhaka	70.12	0.85	4.29	4.1	4.57	0.12	0.61	0.13	0.13	6.43	0.16	3.48	5.01	100	74.85	25.15
Chittagong	69.45	0.36	5.73	4.31	4.73	0.23	0.48	0.14	0.18	2.86	4.84	2.34	4.35	100	79.02	20.98
Rajshahi	62.43	0.48	6.32	7.99	3.41	1.34	0.00	0.00	0.00	2.75	11.00	0.10	4.18	100	76.84	23.16
Khulna	84.57	0.77	3.75	2.02	5.19	0.61	1.5	0.17	0.22	0	0.93	0	0.27	100	90.68	9.32
Barisal	53.55	0.55	28.65	7.16	0.81	1.38	0.28	0.04	0.00	1.30	0.33	0.05	5.89	100	54.69	45.31
Sylhet	75.77	1.65	5.22	5.34	1.64	0.89	0.64	0.24	0.65	2.59	3.87	0.12	1.38	100	81.28	18.72
Pourashava	70.70	0.90	8.96	3.58	3.37	2.02	0.39	0.63	0.33	3.32	3.33	0.46	2.02	100	77.40	22.60
Urban Center	62.93	0.31	11.25	3.47	0.75	0.06	0.13	0.02	0.02	11.25	5.74	0.44	3.62	100	69.42	30.58
Average	68.69	0.73	9.27	4.75	3.06	0.83	0.50	0.17	0.19	3.81	3.78	0.87	3.34	100	75.52	24.48

Source: Field Survey 2005