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SOLID WASTE SEPARATION AND MANAGEMENT SYSTEM FOR URBAN AREA OF BANGLADESH

Md. Abdullah Ibn Faruk, M. Ashrafuddoula Dipu, Soumitra Das, and M. Touhid Sikder
Department. of Civil Engineering., Ahsanullah University of Science & Technology, Dhaka,

ABSTRACT:

Solid Waste Management is a prime concern in present days regarding the environmental impact. The increased population leads to the growth of urban areas and slums which, in turn, generating a huge volume of waste. Until recently, environment was not an issue in a developing country like Bangladesh and solid waste management was definitely not the prime concern of environmentalists and the government. It is only in very recent times, when certain NGO's started working and highlighting the pathetic state of municipal waste services provision in the country, that the decision makers realized the importance of this particular aspect of environmental management. A large proportion of the waste is not properly managed and dumped in unplanned sites that are creating severe environmental hazards. According to the Economist Intelligence Dhaka is the worst city to live in and according to pollution index report 2015, Dhaka is the 7th most polluted city and Bangladesh is the 9th polluted country in the world. The objectives of the study are to explore the present status of municipal solid waste generation and its management in Bangladesh, to recommend a schematic SWM Model in order to improve the present waste management system, to reduce the use of solid waste for land fill, Waste Segregation for Bio-gas plant & Refuse Derived Fuel (RDF), Reducing MSW waste for land fill purpose, To contribute in the way to reach the goal of 2021, 2040 and millennium development & Meet up the UNEP target. 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 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.

INTRODUCTION

Bangladesh is a densely populated country in the third world. World's eight highest populated country with population of 158.512 million (July 2014) (United Nations, Department of Economic and Social Affairs, Population Division .World population prospect: the 2012 revision) and one of the fastest urbanizing countries, is a land of physical, climatic, geographic, ecological, social, cultural and linguistic diversity. At present there are 522 urban centres in the country including 298 municipalities and 11 City corporations. The annual population growth rate of approximately 4 percent in urban areas in Bangladesh is concentrated in a few large cities. Dhaka with 13 million people accounts for about 40 per cent of the total urban population (UN HABITAT, State of the World's cities 2008-2009).It is predicted that by 2020, 2030 and 2050 about 50, 80 and 100 million people will be living in Bangladesh's towns and cities respectively. The increased population leads to the growth of urban areas and slums which, in turn, generating a huge volume of waste. Until recently, environment was not an issue in a developing country like Bangladesh and solid waste management was definitely not the prime concern of environmentalists and the government. It is only in very recent times, when certain NGO's started working and highlighting the pathetic state of municipal waste services provision in the country, that the decision makers realized the importance of this particular aspect of environmental management. A large proportion of the waste is not properly managed and dumped in unplanned sites that are creating severe environmental hazards. According to the Economist Intelligence Dhaka is the worst city to live in and according to pollution index report 2015, Dhaka is the 7th most polluted city and Bangladesh is the 9th polluted country in the world.

Background study

Solid waste generation has facing myriads of problems with the growth of population. of Municipal Solid Wastes (MSW) continues to remain one of the most neglected areas of urban development in Bangladesh. The 6 metro cities and pourashavas in Bangladesh generate about 13,332 tonnes (Sinha ,

2006) of such wastes per day. Piles of Garbage and wastes of all kinds littered everywhere have become common sight in our urban life. Magnitude and density of urban population in Bangladesh is increasing rapidly and consequently the Civic bodies are facing considerable difficulties in providing adequate services such as supply of water, electricity, roads, education and public sanitation, including MSW.

METHODOLOGY

As Bangladesh still a low income country its highly hard to implement mechanical / auto system to the all sector of waste management like develop country .We should think solution at our perspective that system can be more economic, easy to applied or handle , safe and can be turned into much better option of solid management system in the future. It is seen that both developed and developing country, they collect mixed solid from sources with manual process(now a day's western country turned it into mechanical) and take them to the dumping site than only develop country process the mixed solid waste mechanically and then separated waste take into the plant to convert energy. But in developing country like Bangladesh they just remove some recyclable material at the manual process and maximum waste used as to fill up low land without ensuring any environmental aspect. That creates most environmental Hazarders. We Bangladesh highly shortage of energy and fuel emphasizing this point we should install such a system for solid waste management that we can easily recover energy.

Maximum study shows that in management system they collect mixed waste from sources that means a huge volume of solid waste have to travel that cost much. If u can implement segregation of solid waste in the point of sources its can reduce the volume of solid waste as well as reduce the cost of management.

A statistical data of solid waste generation of Bangladesh is given below with the increase of population:

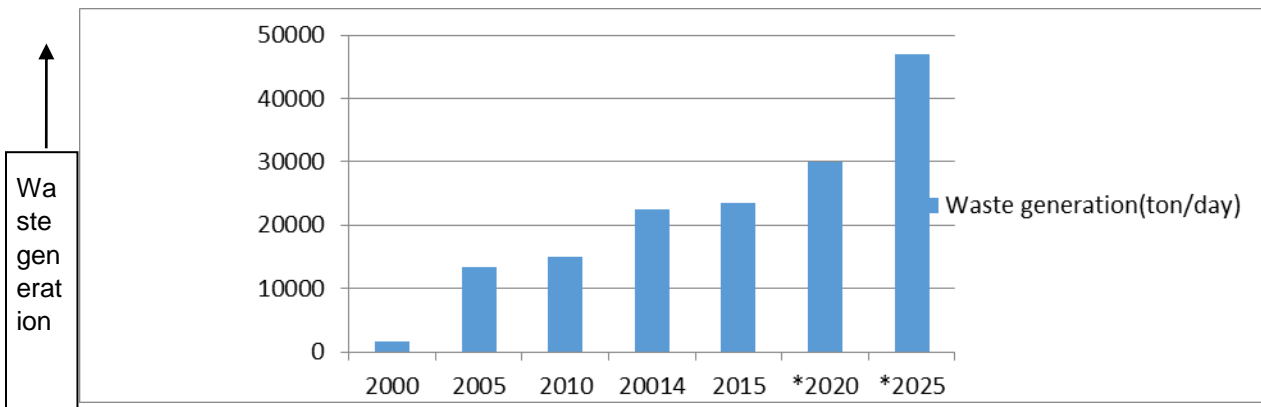
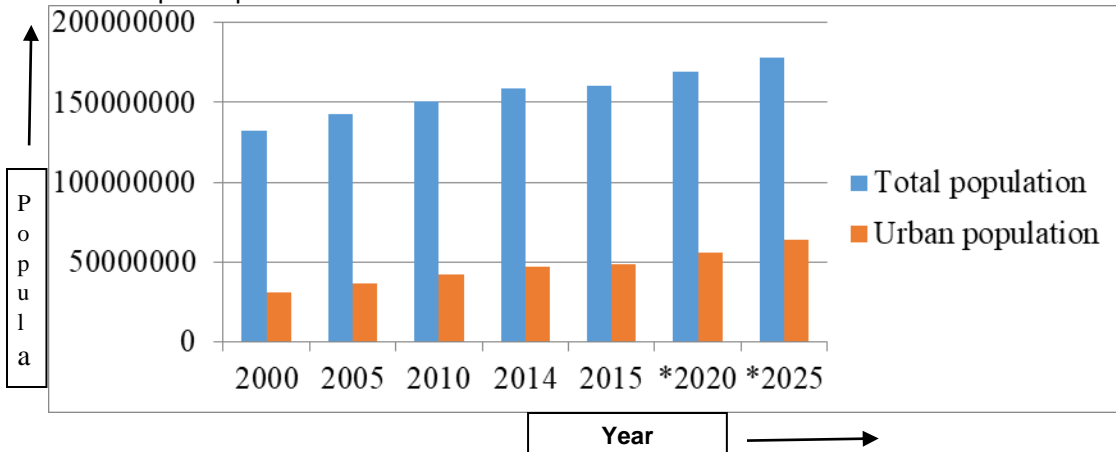
Table 3.1 Bangladesh Population and waste generation scenario

Year	Population	Yearly % Change	Yearly change	% Urban Population	Urban population	Waste generation (ton/day)
2000	132383265	2.01%	2502736	24%	31229212	1700
2005	143,135,180	1.57%	2,150,383	26%	36,694,135	13,332.89
2010	151,125,475	1.09%	1,598,059	28%	42,154,940	15000
2014	158,512,570	1.22%	1,917,608	30%	47,334,620	22400
2015	160,411,249	1.20%	1,857,155	30%	48,724,917	23500
2020*	169,565,959	1.12%	1,830,942	33%	56,100,898	30000*
2025*	177,884,947	0.96%	1,663,798	36%	64,083,052	47000*
2030*	185,063,630	0.79%	1,435,737	39%	72,400,593	-
2040*	195,861,405	0.50%	963,925	46%	89,236,415	-
2050*	201,947,716	0.24%	486,761	52%	105,317,753	-

Source: 1 World Meters, (World Population Prospects, The 2012 Revision), 2 Field 2006

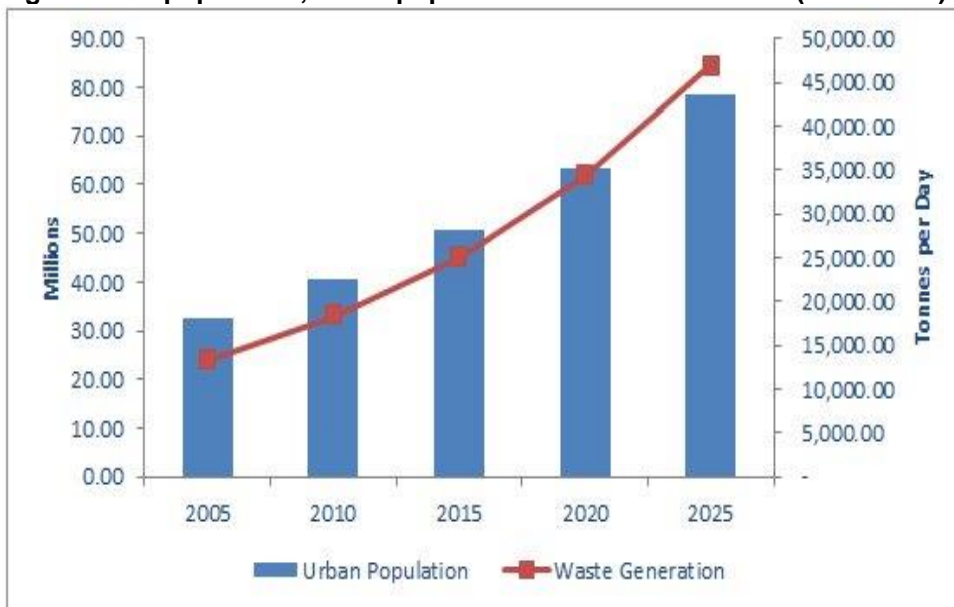
*Future estimation

3.1.1 Graphical presentation



*Future Estimation

Fig 3.1 Total population, urban population & waste Generation (Year basis)



Source: World Bank, Waste Concern, and Frost & Sullivan Analysis

Fig 3.2 Urban Population and Waste Generation, Bangladesh, 2005-2025

Table 3.2 Total Waste generation in urban areas of Bangladesh (2005)

City/town	WGR (kg/cap/day)	Estimated population (2005)	Total population (2005)	TWG(ton/day)		Avg TWG (ton/day)
				Dry season	Wet season	
Dhaka	0.56	6116731	6728404	3767.91	5501.14	4634.52
Chittagong	0.48	2383725	2622098	1258.61	1837.57	1548.09
Rajshahi	0.3	425798	468378	140.51	205.15	172.83
Khulna	0.27	879422	967365	261.19	381.34	321.26
Barisal	0.25	397281	437009	109.25	159.51	134.38
Sylhet	0.3	351724	386896	116.07	169.46	142.76
Pourashavas	0.25	13831187	15214306	3803.58	5553.22	4678.40
OtherUrban Centers	0.15	8379647	9217612	1382.64	2018.66	1700.65
Total	0.41 (Avg)	32765516	36042067	10839.75	15826.04	13332.89

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*WGR= Waste Generation Rate,** Including 10% increase for floating population,***TWG= Total Waste Generation, which increases 46% in wet season from dry season

Source: 1JICA (2005), 2Chittagong City Corporation, 3Field Survey, 4Sinha (2000), 5Field Survey, 6Sylhet City Corporation,

From the Field Survey 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.

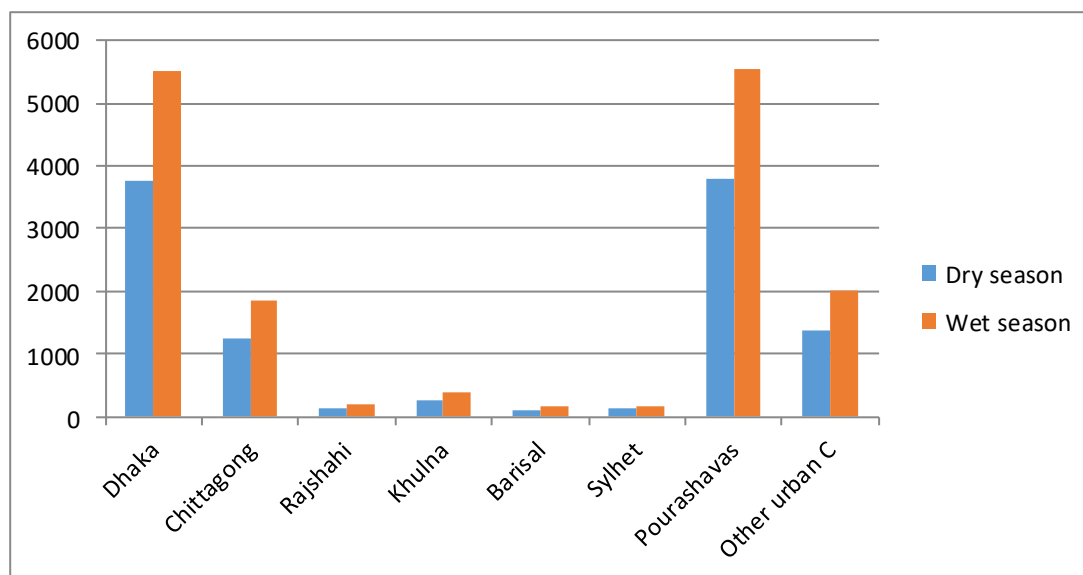
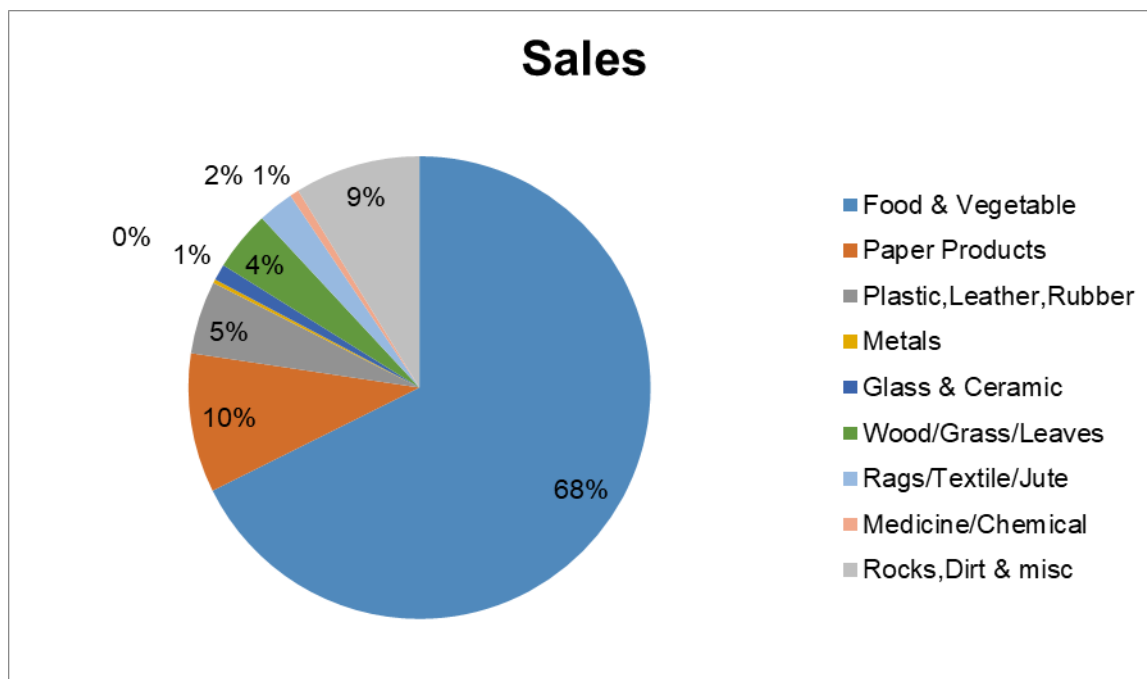


Fig 3.3 Graphical presentation of seasonal variation of waste generation in different urban area

Table 3.3 Relative Composition of waste (By income)

Contents	Low income	Medium income	High income
Organic (putrecible), %	40 to 85	20 to 65	20 to 30
Paper, %	1 to 10	15 to 30	15 to 40
Plastics, %	1 to 5	2 to 6	2 to 10
Metal, %	1 to 5	1 to 5	3 to 13
Glass, %	1 to 10	1 to 10	4 to 10
Rubber, leather, etc., %	1 to 5	1 to 5	2 to 10
Other, %	15 to 60	15 to 50	2 to 10
Moisture content, %	40 to 80	40 to 60	5 to 20

Source : (INTOSAI working group on environmental auditing, 2002)



High organic matter>>(more than 70%)

High moisture content>>(more than 50%)

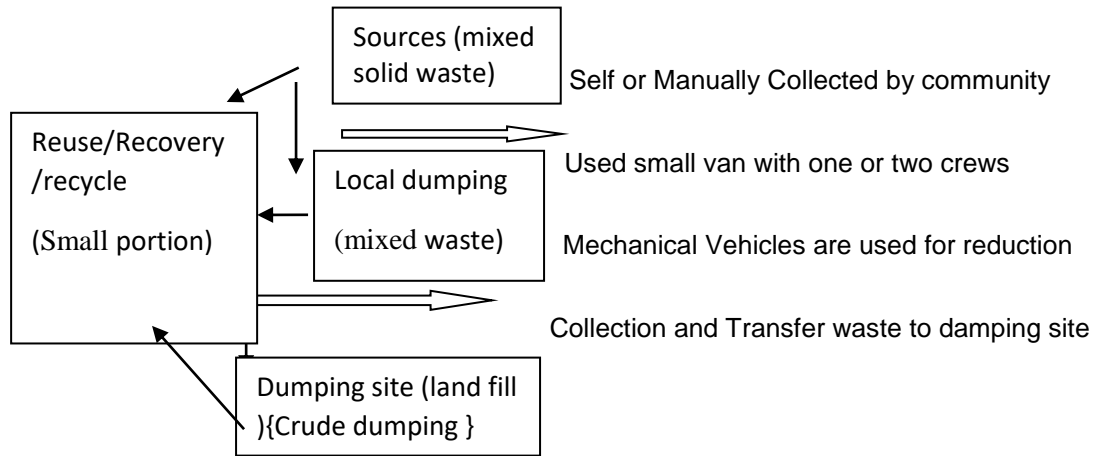
Source : Country Presentation Bangladesh 2nd Meeting of the Regional 3R Forum in Asia 4-6 October 2010Kuala Lumpur, Malaysia

Fig 3.4 Average Physical Composition of Urban Solid Waste In Bangladesh

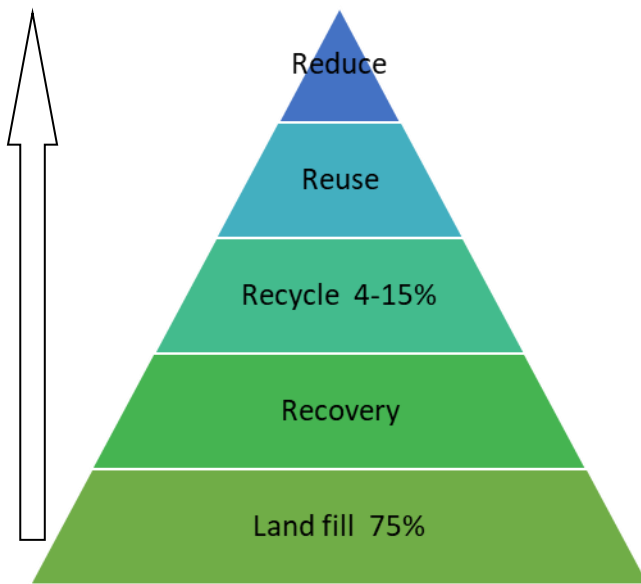
3.1 Present waste management system

In Bangladesh though present practice of MSW is not sufficient and effective but its getting develop day by day .Now a day's almost every big city like Dhaka city corporation both north & south established community based waste collection system .In this process community crews collect mixed waste from source by rickshaw or Hand trolley and take into the container or dustbin or local dumping site mostly situated beside main road ,and then city corporation or Municipal workers collect these waste ,loaded them and transfered to the final dumping site. Flow chart & picture shared below

3.1.1 Present waste management flow chart



3.1.2 Present waste management hierarchy (poor practice)



It has been found that in our present waste management process recyclable inorganic waste is collected for recycling between the secondary collection points and the secondary waste collection truck by waste pickers (popularly known as tokais) and municipal workers and it ranges between 4.29% to 11.19% of the collected waste while at landfill site collection of waste for recycling by landfill tokais is between 0.22-1.22%. Total recycling of inorganic waste in the study areas varies between 4.55% to 12.41% of the generated waste whereas the total amount of inorganic waste varies between 12.13% to 28.30% in the waste stream of the study area. This means that between 37.5% to 44% of the inorganic waste is recycled while major portion remains un-recycled due to the fact the inorganic waste at the landfill site becomes too soiled for recycling by the informal sector. Whatever we see again that almost 75 percent waste from total waste generation are remain unproductive which used for low land fill .As Bangladesh situated in tropical region and waste moisture is nearly 50% its will causes the contamination of source of water as well as great hazarders for environment.

3.2 Our Proposed waste management system

Our proposed System has three part as like existing practice but difference is ,in our system we emphasize segregation of waste in source so that a systematic practice can be introduce as well as maximum waste can be reused ,recovered and recycled. As a result SWM cost will be reduce since municipal authority have to deal with low volume waste including transfer to the final disposal site. On the other hand both people and government can make revenue by selling compost, bio-gas or electricity. Even environment can be kept sound.

Now in below we will discuss how our proposed system work and for that we divided our system in three part

1. Source
2. Local dumping
3. Final dumping

1. Source: In source we can used 2 different bin for segregation of solid waste based on compostable and non-compostable and in future we can use 3 bin. Bin can be coloured for easy understanding of general people. For compostable colour will be green and for non-compostable colour will be blue .In future we can introduce another bin for hazarders waste . Stored waste will be transferred by Improve van or 2 different van or a van with blue bag/bin. In our country perspective as nearly 80% waste are compostable, we can installed single unit bio-gas plant /compost plant .If it is not possible by individual we can do it community based then waste generation automatically will be reduce and maximum problem (like cost of operation, buying improved van or installing improve local dumping site) of this system will be solved. If waste have to be transport to the local site and cant possible to used improved van we can used bag for non-compostable waste so that informal sector can easily take recyclable waste.



Picture : Improved Rickshaw Van

2. Local Dumping: In this part major portion of recyclable or recoverable waste will be collect by informal sector or tokies as waste is segregated. Segregated compostable waste directly have gone to the compost or bio-gas plant and no compostable to the electricity generation plant. In this process 90% waste from total generation of waste will be reduce. Present transportation system is well enough for this system

DATA COLLECTION AND ANALYSIS

4.1 Estimation of unit solid waste generation rates per week for a residential area (based on load count analysis) :

Location: Uttara (sonargong jonopod)

Sector	Population
9	11121
10	11688
11	18935
12	10181
13	17335
14	15803
Total	85063

Source : Dhaka Bureau of statistics 2011

Approximate population of the area = 85063

No. of vans per week = $32 \times 8 \times 7 = 1792$

Average volume of the van = $4.5 \text{ ft} \times 3 \text{ ft} \times 2.25 \text{ ft} = 30.375 \text{ ft}^3$

Average weight of waste per van = 400 kg

Specific weight = 13.17 kg/ft^3

Observation period = 1 week

Total weight = $1792 \times 30.375 \times 13.17 = 716869.44 \text{ kg/wk}$

So,

Unit rate = $\frac{716869.44 \text{ kg/wk}}{(85063) \times (7 \text{ d/wk})}$

= 1.20 kg/capita/d

RESULTS AND DISCUSSIONS

From Data analysis we got that waste generation rate in Uttara (Sector 9-11) is 1.20 kg/cap/day. We know that waste generation rate in Middle Income population ranged 0.8 to 1.5 kg/cap/day and we got 1.20 kg/cap/day .Uttara is for middle and upper middle class people and we see that data analysis satisfy the ranged.

From the graphical presentation of total population (including urban population) and waste generation with increasing yearly, it is observed that both population and waste generation increase with increasing of years. From graph, it is found that in 2025 the population will be more than 150 million and amount of waste generation will be more than 40000 ton/day.

From the Field Survey 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.

5.1 Conclusion

Promotion of recycling of both Compostable and Non-compostable 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 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 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 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 fulfilment of the UNEP accord.

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