Characteristics of Household Solid Waste and its Management Options in the Urban Areas, Jessore, Bangladesh

Rezaul Karim[1], Nabila Nawshin[2]

[1]Jessore University of Science and Technology, Department of Environmental Science and Technology, Jessore-7408, Bangladesh,

[2]Jessore University of Science and Technology, Department of Environmental Science and Technology, Jessore-7408, Bangladesh

Abstract: *This project was carried out on the household waste management system in ward # 8 of Jessore Pourashava. The main work of this project was the characterization of household waste and its management system in the urban areas, starting from the storage to dumping area of the household waste. It is found that household wastes are not properly managed in ward # 8 and anyone has no tension about the household waste. Different types of household wastes are found during survey time such as biodegradable, non-biodegradable, recycling matters, reusable wastes etc. A total of approximately 0.40 ton of solid waste was generated by 53 households over the 15 days used for the assessment. Half of this total quantity of solid waste emanated from households in the middle income family whilst low- and high-income households contributed 32% and 18% respectively. The greater proportion of waste emanating from low-income households is due to relatively larger household size as compared to middle- and high-income households. However, the average per capita waste generation rate in the low area (0.13kg/cap/day) was almost equivalent to that of middle and high income family with 0.128 kg/cap/day and 0.133 kg/cap/day respectively. From the project it can be concluded that government need to conscious about the storage, collection, transport and dumping spot of household waste of Jessore Pourashava.*

Keywords: household waste characteristics, management practices, biodegradable waste, disposal, collection

1. Introduction

The substances when discarded from domestic sector are considered as Household Waste or Domestic Waste. Domestic waste is a normal part of everyday life. Household waste can be classified into different groups such as hazardous waste, non-hazardous waste. It can also be biodegradable and non-biodegradable. Household waste causes of environmental pollution. It is also increased toxicity into the environment. Ground water can be contaminated if dumped on the ground. Household waste also can be created human diseases like vomiting, headache, chemical burns, nervous system disorders etc. It is necessary to understand qualitative and quantitative characteristics of solid waste as its improve demands alternatives of handling and treatment [1]. A number of processes are involved in effectively managing of domestic waste. Monitoring of waste, collection, transport, processing, recycling and final disposal household waste are included in the processes. Methods of waste minimization, waste reuse and recycling are preferred options when managing waste. There are many benefits for the environment that can be derived from the use of these methods. These methods can be reduced or prevented the emissions of greenhouse gas, reduce the release of different pollutants, conserve resources, save energy and produce energy, reduce the demand treatment technology and landfill space. Less waste material going to landfill means a reduction in environmental and economic costs, as well as in health and environmental risks associated with land filling [2]

The main objectives of the study are i. to find out the existing household waste management in the urban areas, ii. To characterize these waste in different context and iii. to find out the options for better house hold waste management in the urban areas, Jessore, Bangladesh.

2. Methodology

2.1 Study area

Jossore is a district of Khulna division, Bangladesh, established in 1864. The area of the town is 25.72 sq km [3]. Latitude of the total area is $23^0 8'49.61''$ N and Longitude of the area is $89^0 13'13.77''$E. The district is bounded by Jhenaidah and Magura districts on the north, Satkhira and Khulna districts on the south, Narail and Khulna districts on the east, West Bengal of India on the west [3]

The study was conducted in ward # 8 no of Jessore pourashava. This area is covered from the R .N. Road of Jessore district to the Bezpara Main Road [4].

Figure 1: Map of the study area [5]

2.2 Data collection and analysis

There were used two types of data, primary data by household survey and secondary data from different sources like government reports, scientific and newspaper articles, books and various web resources. Primary data were collected from the survey in the ward 8, Jessore Pourashova to fulfillment the objectives of the report. There were used semi-structured questionnaire, about the household management, where included also their economic profile, family structure, housing and some sort of water and sanitation system.

At first, Waste was initially weighed, 15-day period using the weight, the average waste generation per household (*Wahs*) was computed from the equation below:

$$average\ waste\ generation/household = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n} w_{ij}$$

m = total number of days in the study period (15 days)
n = total number of houses involved in the study (53)

i = ith day on which waste was weighed
j = jth household
Wij = weight of waste on the ith day for jth household (kg)

Then, the weight of waste was divided by the household size (S_j, household size of jth household) to estimate the per capita waste generation rate from each household as:

$$average\ waste\ generation\ rate = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}\frac{W_{ij}}{S_j}$$

Sj = household size of jth household

The composition of waste was sorted by segregation of waste into different categories considered under the study and weighing them individually. The components of each category used for the study are shown in the Table 1.

Table 1: classification of waste component

category	component
Vegetables	Food remains, leaves, peels etc
Paper	Newspaper, toilet tissues, cartons
Plastic	Bottles, bags, sandals,
Grass and wood	Furniture, plants and others
Metal	Metal cans, spoons, blades
Clothes	Textile goods, sox's, old clothes
Glass	Mirror, window glasses
others	Ash, ceramics.

The proportions of each category were expressed as a percentage of the period as in the equation below:

$$proportion\ of\ specific\ waste\ component = \frac{100\%}{W_t}\sum_{i=1}^{n} W_{c,i}$$

Wt = Total weight of waste from all households (15 days)
i = ith day on which weight of waste was measured
n = number of days for study period (30 days)
Wc,i = weight of a specific category of waste component for a particular house measured on the ith day

The total waste generation in Jessore municipality was expressed as

$$total\ waste\ generation = Wahs * N * 365_{\#}$$

N = total number of house hold in Jessore (42,793)

It was selected 53 houses of ward # 8. The wastes were collected from these houses for 15 days and processed for analysis through separation method, weighting and incinerated to know the moisture content. Tables and bar charts were used to present different variables. Data were analyzed through Microsoft Office Excel 2007.

3. Result and Discussion

3.1 Demographic and Socio-economic profile of the study area

Total population of ward # 8, Jessore Pourshova is 19011 in which 38.66% people are female and 40.66% are male. Only 20.67% are children of total population. Most of the town

people are service holder. They are doing job indifferent sectors such as some are bankers, engineers, teachers, businessmen etc. there are different levelSome are low income people and some are middle income and some are high income. Most of the low income people live tin shade house.

3.2 Exiting Waste Management in Jessore urban areas

The existing waste management is not well developed in the Jessore urban areas. This is due to twofold: not properly managed by the different authorities and not concerned about the segregation of household waste which could reduce the amount of waste. Moreover, the residents dump their waste near their houses in the open field, drain, road side etc. The management procedures practiced in Jessore Pourashova is discussed below:

3.2.1 Storage
The householders store their household waste collectively in a dumping buckets or poly-bags. Some houses store their waste for a week and dump them after the end of week. And some householders mainly dump their household waste every day. Some houses of ward # 8 no of Jessore districts are collected their household waste in a big bucket (Table -2)

Table 1: storage system of household waste

| Storage container	%
Plastic bag	10
Open container	85
Closed container	2
Other pill in tard	3

It shows that the most usage storage is an open container used by about 85% of the respondents. Little amount of people storage their waste in a closed container and approximately 9% people storage their waste in a plastic or poly bag. But most of the houses of Jessore town are dumped their waste regularly and they do not like to store of waste for a week. On the context of responsible person for disposal of the house hold waste, it is found that women do the work for the household. Some are found disposed by husband or servants. Low income family members are also disposed their house by the children. But its amount is very low.

3.2.2 Collection
Household wastes are dumped on the road sides, drain sides, open fields, etc. the worker of pourashova collect these waste by vans and trucks everyday or twice per week. There used one truck and 2 vans for the collection of household waste in ward # 8 no of Jessore Pourashava.

3.2.3 Disposal
In Bangladesh, it is very common to dispose the waste outside of the urban areas, especially in the low lands, open government lands, abandoned canals and rivers and also besides the highways. In Jessore district is also followed the rule. After collection of household waste from the houses or from the road sides, drains, yards, etc (figure 2).
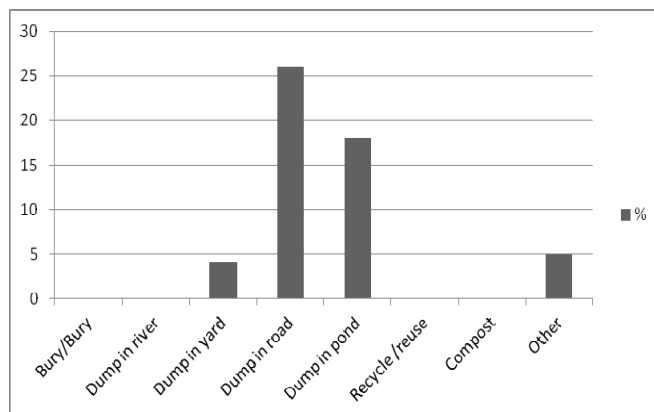

Figure 2: Waste Disposal Method

In this figure, most of the wastes of ward # 8 no are dumped on the roadside. They are not conscious about the bad impact of wastes. High amount of people dump their waste on the road side. Nearly about 30% people dump their waste in the pond and some wastes are collected by the waste truck. Burn, Bury, dump in river amount is almost 0%. In Jessore district main dumping spot is Hamidpur where population density is very low. This open field only used for the dumping of waste. This area is totally polluted by the waste and these wastes pollute air, soil, water also

3.3 Quantities and generation of Household Waste

A total of approximately 0.40 ton of solid waste was generated by 53 households over the 15 days used for the assessment. Half of this total quantity of solid waste emanated from households in the middle income family whilst low- and high-income households contributed 32% and 18% respectively. The greater proportion of waste emanating from low-income households is due to relatively larger household size as compared to middle- and high-income households. However, the average per capita waste generation rate in the low area (0.13kg/cap/day) was almost equivalent to that of middle and high income family with 0.128 kg/cap/day and 0.133 kg/cap/day respectively.
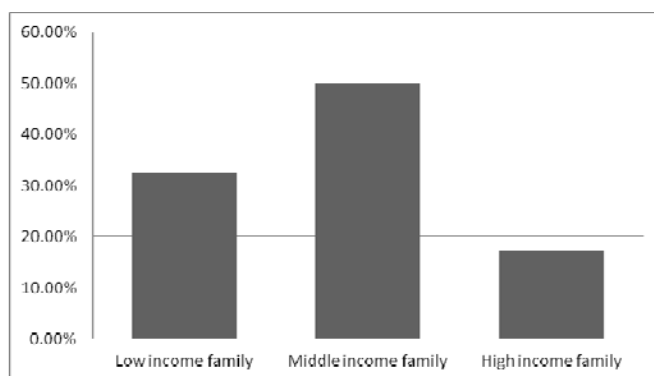
**Figure 3:** variation of waste generation for various families

In Jessore pourashava, total no of household is 42793. Every day in each household, Jessore produced approximately 21457.27 kg wastes per day. So the total waste generation in Jessore is 7846.50 ton waste per year.

Table 2: Total waste generation in Jessore

Component	Average weight HW, g/day	Total household	Total waste (Kg / Day)	Total waste (Ton/Year)
Vegetable	436		18692.21	6822.66
Paper	8.0		358.69	130.92
Plastic	6.0		254.93	93.05
Grass and wood	21	42793	927.22	338.44
Metal	3.5		152.45	55.64
Clothes	3.1		136.63	49.87
Glass	7.3		315.25	115.07
Others	15		659.87	240.85
Total waste			21497.2	7846.5

3.4 Proportion of component of HW

From the segregation analysis of the household, the different components of waste were found (fugure-4).
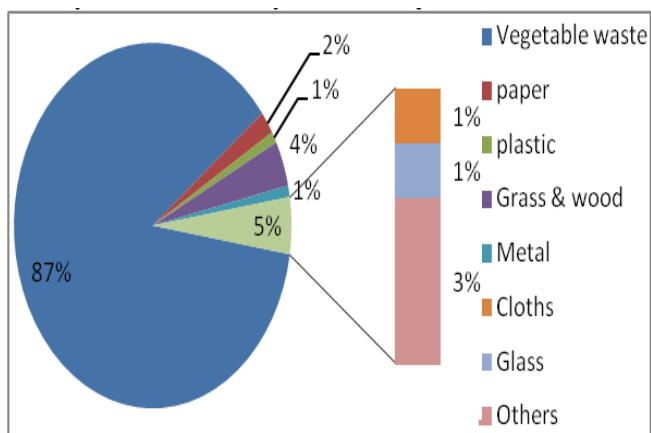
Figure 4: average (% by weight) of HW/ day

The main composition of the household waste is vegetable waste which is easily biodegradable, with approximately 85% by weight. The other parts are found in very low amounts as grass and wood (4%) which is found from garden side of the house or wood found during cooking time, paper (2%), metal (1%) and plastic (1%).

Table 3: Organic and in-organic waste with different families

Component	Low income family	Middle income family	High income family
A. Organic waste			
Vegetable waste	83.02%	88.13%	90.92%
Paper	1.16%	1.46%	3.24%
Grass & wood	7.30%	3.70%	0.46%
Clothes	0.49%	0.64%	0.91%
B. Inorganic waste			
Metal	0.70%	0.78%	0.52%
Glass	0.78%	1.60%	2.37%
Plastic	1%	1.24%	1.37%
Others	5.56%	2.44%	0.20%

3.5 Composition of Household waste in different context

It is found form the segregated waste analysis, there are about 95% wastes combustible, which can be incinerated for energy. In addition, this includes biodegradable waste which could be used for biogas production and also recycled part,

which could be recovered for material.

Table 4: average Percentage composition of Waste

Component	Average % of waste	Combustible	Biodegradable	Other process e.g recycle
Vegetables	86.95%	X	X	
Paper	1.67%	X	X	
Plastic	1.19%			X
Metal	0.71%	X		
Grass and wood	4.31%		X	X
Clothes	0.64%		X	X
Glass	1.47%			X
Others	3.07%	X		
Total	100	96%	89%	7%

3.5.1 Biodegradable and non-biodegradable waste

Most of the household wastes were vegetable wastes which was highly biodegradable into the environment. Nearly about 99% wastes were vegetable wastes. Other biodegradable wastes were paper, grass, wood and cloths. The amount of paper and clothes were so little that their amounts were 0%. Only 1% waste was grass and wood together.
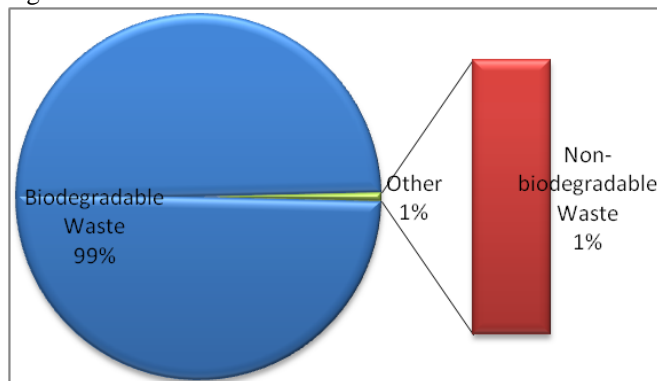
Figure 5: biodegradable and non-biodegradable waste

Vegetable, Paper, grass and wood and clothes are biodegradable wastes. These types of wastes are easily biodegraded by bacteria. From the survey, it is found that most of the biodegradable waste was vegetable waste which percentage was 99%. Only 1% was other wastes from which grass & wood waste 1%. Paper and cloths wastes were so negligible that their percentages were 0%.

For non-biodegradable waste only 18% waste was plastic waste. Other non-biodegradable wastes were metal, glass and other such as ash, dust etc. where amount of metal was 11% and glass was 23%. Amount of other waste was 48% because most of the people in Jessore town cooked in wooden cooker.

3.5.2 Recycling Matters (RC)

Some non-biodegradable wastes can be used as recycling matters. Such as plastic bottles, glass bottles, poly bags, bamboo bags or bamboo materials, metal etc.
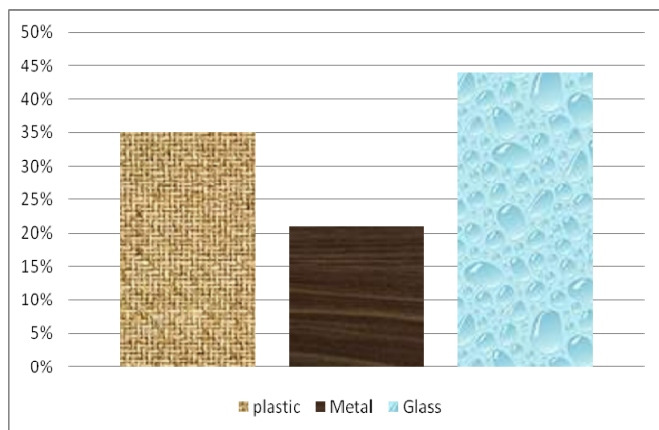
Figure 6: Recycling Matters

From the field data, nearly 43% of glass which were used as recycling matter. Plastic materials used as recycling matter where its percentage was 35% and 21% percentage materials were metals.

3.6 Other Properties

The physical properties e.g. size of waste are discussed. From Jessore Pourashava, everyday 18692.21 kg vegetable wastes are produced by different houses. After drying total weight of household waste found is 6884.75 kg per day. After drying time the total weight of household waste is nearly 80%. That means approximately 20% water is found from the waste.

Chemical Properties

Every element has some chemical properties which are found in the elements. When elements are analyzed with chemical then found the chemical properties. But for the lack of proper facilities of lab and instruments in the university in this time, it could not be identified the chemical composition properly.

3.7 Household Waste Management Options

Household solid waste can be management in different way. But at first awareness of local people is very important. They should need to understand that waste can be wealth by proper managing of household waste. If local people understand that waste can be reused by different ways then they can be interested to be managed household waste and minimized the household waste in different ways such as reuses, recycling, reduce etc. Management systems of household waste in Jessore Pourasove are:

3.7.1 Segregation and Storage of Waste
If we collect household waste in a systematic way then we can be managed and reduced household waste. If every householder use different colour of bucket or bag for dumping of different waste then it will be easy to collect different waste and manage in a short time. For the collection of household waste people can use three colors of bins. These are:

a) **Blue color bin:** Blue color bin or bag is used for dumping food cans, tins and aerosols, glass bottles and jars, drink cans, plastic containers, plastic bottles, cartons etc. Some elements are also not used in the blue color bin such as carrier bags and film, polystyrene, children's toys and large plastic items and aluminum foil etc [6].

b) **Black color bin:** Black color bin is mainly used for the collection of dog waste and cat litter. Moreover other some elements are also used in the black color bin. But stones, soil and building materials are not used to dump in the black color bin [7].

c) **Orange color bin:** Orange color bin is used for the collection of brown cardboard, pizza boxes, cereal boxes, frozen/ chilled food boxes, egg boxes, toilet / kitchen roll tubes, shoes boxes, washing powder boxes, brown envelopes etc. but before collection of these materials people must need to remove all sticky tape and plastic wrapping from the cardboard.

d) Foil backed cardboard; drinks cartons are should not used for dumping into the orange color bin. These materials can be dumped into the blue bin for recycling materials if anyone wishes [7].

3.7.2 Collection
There are different processes or ways to collection of household waste. Such as anyone can be dumped waste directly to the dumping spot or any one can be dumped waste into the collection vans or trucks. If vans and trucks of waste are collected waste from house to house in separate ways such as different color bin wastes are collected by different color vans then it will be easily managed of the household wastes. Before collection of wastes, the wastes are packed in selected colors of bags. Some vans and trucks are used for the collection of different colors of bags and dump into the dumping spot.

3.7.3 Disposal
If these wastes are disposed in different places with their category, then different projects will be run to maintain the waste and reused the waste. Waste disposed mainly depends on the collection of waste. Before dumping of waste need to segregate waste and then collect them. Then some waste will be recovered such as glass, ceramic wastes, paper wastes etc. Some waste will be reused such as paper, poly bags, bamboo materials etc.

3.8 Total Household Waste Management System

Wastes are generated by the household activities. In this time some waste are reduced by the storage, collection and transfer system. Waste can be reduced by the generation point. Then storage, collection and transfer system help to reduce the waste product. After transportation of household it can be processed for the reusing of waste materials. Combustion, Composting, Materials Recovery are the process steps for converting waste materials to other usable form. These recovered or converting materials are selling into the market and customer buy it for their necessary work. After use of converting materials these are disposed into the box or other selected area by which materials can be reused

again. By this process one material can be reused in several times and also by during this process waste generation can be reduced and production of household waste can be limited by using this method.
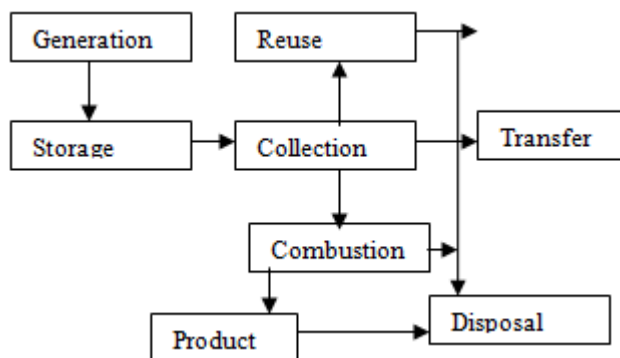

Figure 6: proposed HW management

4. Conclusions

In this study it shows that every day, Jessore Pourashava produced 21497 Kg household waste per day and produced 7846 ton waste per year. In the total amount of the waste 87% is vegetable waste, 4% waste is grass and wood, 1% plastic, 2% is paper waste, and only 1% is metal which are found from the household waste in Jessore Pourashava from my survey data. 3% waste is other types of waste such as dust of the yard or dust from the wood cooker etc. If we properly manage the household waste then we can be reused the household waste or recycled the household waste.

If we will also be managed combustible waste then we will get energy as equivalent to fossil fuel that will help us to meet our energy needs. But lacking of proper existing policies, rules, public awareness all the household wastes become wasted and dumped in an open filed. Public, Government, NGOs' should enhance the proper management system to produce less waste and more recovery of matter and alternative to produce energy.

References

[1] Paraskevopoulou, K. Poulios, A. Koukourikou, N. Kosmidou, and K. Sortikos, *Perspectives for integrated municipal solid waste management in Thessaloniki, Greece*, Waste Manage, vol. 29, pp. 1158-1162, March 2009.

[2] Kinnaman, T.C., 2006. Policy watch: examining the justification for residential recycling. Journal of economic perspectives, 20, pp. 219–232

[3] Jessore Bazar, 2012. *Jessore District Information for you*. [Online] (Updated 16 April 2014) Available at: http://www.jessorebazar.com/jessore-district-information-for-you.html. [Accessed 18 April 2014].

[4] Wikipedia, 2005a. *Jessore district* [Online] (Updated 13 April 2014). Available at: http://en.wikipedia.org/wiki/Jessore_District. [Accessed 14April 2014].

[5] Google Earth. Available at: http://www.google.com/intl/en/earth/download/ge/agree.html

[6] Radford, A., 2012a. *Blue bin.* [Online] Derby: Derby City Council. Available at: http://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/brochuresandleaflets/Blue_Bin.pdf. [Accessed 24 June 2014]

[7] Radford, A., 2012b. *Black bin.* [Online] Derby : Derby City Council. Available at: http://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/brochuresandleaflets/Black_Bin.pdf. [Accessed 24 June 2014]

Author Profile

Rezaul Karim received the B.Sc. and M.Sc. degrees in Environmental Science from Jahangirnagar University, Bangladesh in 2004 and 2006, respectively. During 2007 -2010, he completed another master degree in Sustainable Technology, KTH Sweden. He now is working as an assistant professor, Dept. of Environmental Science and Technology, JUST, Bangladesh.

Nabila Nawshin appeared for the B.Sc. degree in Environmental Science and Technology, JUST, Bangladesh in this year.