Challenges and Plausible Solutions of Community based Solid Waste Management (SWM) in Dhaka City from Household to Secondary Collection Point

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Abstract

Solid waste management is one of the biggest challenges of Dhaka city owing to its enormous population and increasing amount of waste generation. This study intends to identify the problems of Dhaka's community based solid waste management up to secondary collection point. Data collection process is conducted by following both space related and time related 'Participatory Rural Appraisals (PRA)'. For obtaining spatial dimension of the area, tools like social and resource map, mobility map and transect walk were used. Similarly, historic timeline, seasonal diagram and daily activity schedule tools were used under time related PRA. Collected data were then analyzed through different PRA techniques like process map, venn diagram, pairwise ranking method, and cause effect diagram. Finally, the study has made an endeavor to come up with all feasible solutions and recommendations that can eventually play noteworthy role in planning and implementing a schematic waste management system of Dhaka City.

Keywords: *Solid Waste, Community, Waste Management, Participatory Rural Appraisal, Sustainable Development*

1 Introduction

Improper management of solid waste is one of the foremost reasons behind environmental degradation in the developing countries (Ahmed and Quader, 2011). Solid wastes constitute growing problem in the urban area and now has been seen as a part of issues arising out of rapid urbanization (Amuda et al., 2014). Challenge regarding solid waste management (SWM) is severe in developing countries but the local authorities in these countries are constrained by limited finances and inadequate services (Schwarz-herion et al., 2008). At present, the cities of the developing nations in Asia are also struggling for managing the municipal solid wastes, which are generated by the augmentative populations (UNEP, n.d.) and the situation in Bangladesh is no exception in this regard.

Dhaka, the capital of Bangladesh is expanding rapidly with a massive growth of population at a rate of 6 percent a year and the solid wastes are being generated at a faster pace along with this (Zahur, 2007). Dhaka South and North City Corporations are responsible for the city's solid waste management. However, both of these organizations are now trying to address this problem although they are facing acute challenges in providing satisfactory service with limited resources (Hai and Ali, 2005). Door to door waste collection system is now an established part of waste management. Nevertheless, lack of awareness and different socio economic factors are leading people to crude open dumping of the wastes in the environment and the wastes of the secondary collection point are not managed effectively (Chowdhury and Afza, 2006). Thus, to understand the solid waste management challenges elaborately, community based solid waste management system has to be analyzed by ensuring the participation of the community itself (UWEP, 1996).

This study aims to explore the present context of the community based solid waste management of different wards of Dhaka city where the community based participatory approach has been taken as a unique strength for

the research purpose. By involving the community, the actual scenario of the solid waste management problems and all plausible solutions for resolving those have been ascertained in this research work.

2 Literature Review

Solid waste refers to any garbage or other discarded materials produced from community activities, treatment plants etc. (New York State Department of Environmental Conservation, 2015) and solid waste management can be defined as the collection, transportation, and disposal of garbage, sewage, and other waste products (Nemerow et al., 2009). This system varies around the world and even among different states or divisions within a country. The developed countries like USA, Canada, Japan, UK, Australia etc. are mostly focused on recycling the wastes concomitant with source separation approach at the household level (Regional Waste Reduction Office, 2015; Wiltshire Council, 2010; Department of Sanitation New York, n.d.). On the contrary, developing countries like India, Sri Lanka, Nepal, Pakistan etc. are reluctant in the issue of source separation, though in some cases it is incorporated informally in small scale (Urban Management Consulting Pvt. Ltd., 2015; Government of Punjab, 2010; Practical Action Nepal, 2008). In Bangladesh, there has been no such rules or standards defined for source separation (Chowdhury and Afza, 2006). Developed countries often ensure a complete waste collection from a community where each household is covered but the developing countries cannot ensure 100% collection of wastes (International Solid Waste Association, 2004) and in Bangladesh it is only 50% (JICA, 2005). In developed countries, curb side, drop off and dumpster collection system are followed mainly for collecting waste from household to secondary collection point (Department of Cultural Affairs and others, 2006; International Solid Waste Association, 2004). On the other hand, in developing countries the primary wastes are generally dumped into communal bins and private house to house waste collectors are engaged for primary collection system (Jayaratne, n.d; and Government of Punjab, 2010).

Tania (2014) has showed in a study that in Bangladesh, there have been private companies and NGOs permitted by the City Corporations for conducting waste collection system in every Ward. A Van puller with his assistant collects waste from door to door and disposes them to the nearest community bin and sometimes when they do not come, the generated wastes are doubled and create odor problems and other health problems (Furedy, 2002). In one study, Enayetullah (1995) has discussed about the problems of waste management system of Dhaka city and Zahur (2007) has also established public private partnership as a solution of waste management problems of Dhaka in one study. But previously, no study has been conducted for exploring the challenges and probable solutions of the community based solid waste management. As community people are the main stakeholders, an environment friendly solid waste management system cannot be developed without their direct involvement. Hence, the focus of this study mainly lies upon the demands of the community people and all problems regarding this issue and solutions of those problems have been designed working hand in hand with the local inhabitants by using different participatory rural appraisal techniques.

3 Methodology

Exploring the present problems of community based solid waste management and providing their solutions are the prime concern of the study. Hence, required data has been mainly collected using Participatory Rural appraisal (PRA) technique, where the local inhabitants, representatives of Ward Commission and people related to solid waste management have been consulted for collecting all data. Mainly, two types of PRA techniques- Space related PRA method and Time related PRA method have been used for collecting necessary information, although the demographic information has been collected from BBS. Using space related PRA method, a social map has been produced by the local people that has illustrated the habitation pattern, road network and position of social infrastructures like school, college, hospital, graveyard, market etc. as well as the land use types of the areas. A mobility map has been produced to identify the movement pattern of the drivers of the waste collecting vans of the study area and a transect map is produced also to explore the spatial dimension of peoples' realities against certain parameters including topography, land type, land usage, ownership, problems, opportunities and solutions with the help of the local inhabitants. Time related PRA method has been used to explore the temporal dimensions of local peoples' realities by producing timeline, seasonal diagram and daily activity schedule. In the study, the timeline depicts information on the early system of managing wastes and evolution of solid waste management system of Dhaka and the seasonal diagrams has explored the seasonal variation on the perspective of waste management. The daily activity schedule has been used also to figure out the daily activity pattern of solid waste management of Dhaka city.

The collected data has been analyzed through various PRA relation methods. The process map is used to provide a pictorial presentation of the overall process of solid waste management and to identify bottlenecks and ways of improving the process and Venn diagram is used to formulate current institutional setup and relationship between various stakeholders in waste management process. After that, various problems have been identified from various stakeholders and pair-wise ranking method has helped in arriving at people's priorities and preferences and leading to developing insights into people's decision making processes and criteria used by them to arrive at their preferences. Then the cause effect diagram has been prepared for top three problems identified from pair-wise ranking method. Thus, after identifying the existing problems, dream maps have been prepared regarding the demands of community people, waste collectors and representatives from waste management office. Finally, some solutions of existing solid waste management system and few recommendations have been generated considering the dream maps and analyzing different case studies from different countries.

4 Existing Operational Process of Solid Waste Management

The existing operational process has been analyzed using PRA tool- 'Process Map' as shown in figure 1 below. The waste management process in Dhaka city is operated mainly by City Corporations, Ward Commissioner office, Waste Management Offices and the local Private Collection Service Provider (PCSP). These institutions work in a consecutive manner and the sequential process starts with taking out the vans by the van pullers and their assistants from Waste Management Office. They drive the van to the assigned location to collect garbage from households and this collection procedure is slightly different for general residential and multistoried apartments. In case of the 4-5 storied residential buildings, the van driver or his assistant collects garbage from each household by stairs and covers two floors at a time. In some cases, the apartment society employs cleaners who follows the same collecting pattern as van pullers and put garbage in the cart provided by the apartment society, which is usually kept in underground garage of the building and when the van comes, the van puller collects the garbage from there. The average monthly payment of each household is Tk. 50 and for apartments it varies from Tk. 100-120 per household. However, some people simply throw waste in the open dumping sites near their homes as they are quite reluctant to pay the monthly fee of the waste collectors.

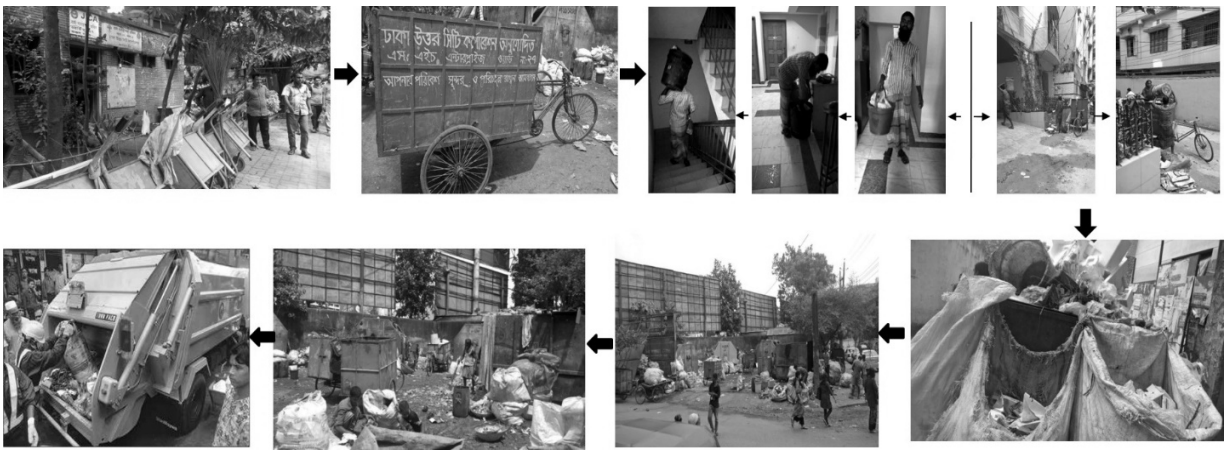

Figure 1. Process Map of Operational Process of Solid waste Management of Dhaka City

Initially, the van puller and his assistants separate the recyclable wastes from the garbage and put the paper, plastic and food wastes in different white sacs tied on backside of the vans. After finishing door to door collection within 2:00 p.m., they drive the waste stuffed van to the Secondary Collection Point. There the employees of PCSP sell the recyclables to the dealers in a rate of Tk. 2.5 per kilogram for paper and Tk. 15 per kilogram for plastics. At midnight, container truck from Dhaka City Corporation comes to collect the waste from secondary collection point and then drive it to Boilapur land fill site located at Aminbazar.

In order to investigate the mobility pattern of the waste collectors, a space related PRA method-'Mobility Map' has been used. After having discussion with the van drivers and van owner, it has been found that each van can collect garbage from 30 households usually and in an average each van owner can provide three vans. These vans often follow different routes for waste collection. For example, in East-Rajabazar-Greenroad area, the followed routes of those three vans are:

a) Route of van A: East Raja Bazar (south) ⟶ Green Road (west) ⟶ Green Road

→ East Raza bazar → Indira Road → Secondary dumping point
b) Route of van B: East Raja Bazar → Indira Road → Secondary dumping point
c) Route of van C: East Raja Bazar → East Raja Bazar (south) → East Raza Bazar → Indira Road → Secondary dumping point

However, some seasonal variations are visible in the amount of generated waste and the issues that vary with this are the number of van used, amount paid, problems of van puller regarding transporting waste and odor problem. From seasonal diagram, it has been recognized that the highest amount of household waste is generated in summer because of the seasonal fruits. The frequent digging of roads and utility lines also disturb the garbage collection procedure. A potential change in waste collection is visible in certain religious festivals especially during Eid-Ul-Adha as there is no specific place for slaughtering animals in Dhaka. As a result, huge animal wastes are generated, which are to be removed immediately by City Corporation using trucks from each road and for this, extra payments of Tk. 100 have to be paid by each household apart from regular fees

5 Current Institutional Arrangement of Solid Waste Management

The institutional Arrangement has been explored using the 'Venn Diagram' tool of PRA technique, where the interdependence and influence between the community and internal stakeholders and between the community and the external stakeholders has been illustrated. From the venn diagram analysis, it has been detected that the inhabitants of the community are directly dependent on the van puller as he is the person responsible for waste collection from their houses. In maximum case, the inhabitants know the van puller or his assistant in person as he is in the direct contact of the dwellers by coming to their doors in daily basis. In contrast, the apartment dwellers are dependent on their owners' associations as these associations take the responsibility of the cleanliness and hygiene of the building. The cleaner is known to all apartment households, thus the relationship among the households and the cleaner is strong. However, the relationship between cleaner and van puller is weak as they consider each other as competitor. Whereas, the relationship between the van puller and PCSP is stout since the van pullers are full time employees of PCSP. The van pullers collect the monthly fee from each household and give the collected money to the supervisor of PCSP and then PCSP offers the van puller and his assistant Tk. 6000 and 5000 per month respectively. The van pullers are liable to the supervisors as they are the owner of these vans. This Waste Management Office is responsible to monitor the PCSPs of the ward while the PCSP is accountable to the Office. However, the relationship between the waste management office and ward commissioner office is weak as they do not usually share much information between them although the ward commissioner provide direction and order to the waste management office regarding waste management decision of City Corporations. City Corporations inform the ward commissioner office about the policy, regulation, legislations and other decisions taken by them and provide waste collection trucks to collect waste from the secondary collection points and hence they share a robust relationship.

6 Identification and Prioritization of Solid Waste Management Problems

Problems regarding solid waste management have been identified through Focus Group Discussion (FGD), which is considered to be a vital tool of participatory approach. In this discussion, community people, waste conservancy inspectors, employees of PCSP, supervisors of recyclables, waste collectors, van drivers, and respected personnel from waste management office participated spontaneously and expressed their views about the problems that they face regarding solid waste management.

Table 1. Identified problems regarding solid waste management

Odor problem	Payment problem
Vans getting out of run	Hygiene problem
Vans facing mobility problem	Source separation problem
Problems of waste collectors in door to door collection from apartments	Lack of peoples' support problem

After identification of problems, those have been prioritized using pairwise ranking method to find out the relative preferences of people. This method compares two problems at a time and frequencies of how many times each of the problems have been preferred is ascertained. From the pair-wise ranking matrix, it has been identified that mobility problem of the vans gets 1st priority, odor problem gets 2nd priority, problems regarding door to door collection get 3rd priority and frequent damage of vans get 4th priority. Payment problem, lack of peoples' support, hygiene problem and source separation problem achieves 5th, 6th, 7th and 8th priority respectively.

After that, the root causes and effects of the first three most prioritized problems have been recognized through FGD and Key Informant Interview (KII) methods of participatory approach, where the participants were asked to identify the causes behind their proclaimed problems as well as the effects of those problems. From the discussion, it has been identified that the drivers of waste collection vans often face mobility problem due to road blockage, which happens because of digging up of roads, different repair works, and severe traffic jam and for waterlogging after heavy rainfall. For this problem, they cannot collect garbage on time and have to put extra labor input. Since the waste collectors do not use any cover while waste collection and dump the garbage at the open dumping point, there results in severe odor problem, which is the second prioritized problem. The garbage remaining a way long time at the secondary collection point is also responsible for generating odor problem. This ultimately results in keeping adjacent roads filthy, creates unhygienic atmosphere and also hinders people from their usual movement. Finally, the third most prioritized problem is the system of door to door collection from some apartments. The waste collectors are not allowed to use the elevators in most cases while collecting garbage from high-rise apartments. Therefore, sometimes they are not even willing to collect garbage from those buildings and sometimes they demand double payment that ultimately creates a havoc in the system.

7 Possible Solution of the Problems

Through FGD and KII, dreams of the stakeholders of solid waste management system have been recognized in regard of managing their problems and based on the dreams, few solutions have been generated through vetting.

7.1 Solution of Problem One: Mobility Problem of Waste Collector Vans

As a solution of this problem, the van pullers have demanded motorized vehicles, the community people have wanted specific place for storing their waste and the supervisor of PCSP has demanded co-ordination among different institutions while digging up of roads. Keeping this in mind, some measures have been generated to solve the problem. Firstly, motorized vehicle as shown in figure 2, can be provided. It will make the task easier while digging up of the roads and will be less labor intensive. There should be a strong coordination among different institutions so that all can work hand in hand. Road digging activities should be carried out in winter, when the amount of garbage remains less as mentioned before. Time of waste collection needs to be altered and should be done when the roads remain less congested. Again, there should be a provision of storage site at the ground level of buildings in case of sudden failure of collecting garbage.

Figure 2. Separate colored covered bins for storing and easy bike for loading and unloading wastes

7.2 Solution of Problem Two: Odor Problem

Regarding this problem, community people have dreamt of having covered buckets and vans. They have demanded that the secondary collection point should have a surrounding boundary so that odor does not spread from it. One of the Waste Conservancy Officers has dreamt of upgrading the secondary collection point into a transfer station and collection of waste by JICA truck twice a day instead of once. He has also wanted source separation at household level so that the collectors need not to separate them on roads, which vastly spreads odor. As per their dream, covered buckets can be provided but as the waste collectors do not agree to use vans having lids, there can be a provision of polythene sheet, which can be used to cover up the garbage after collection. According to waste management officers of DNCC, the secondary collection point can be upgraded into a mini transfer station and landscaping surrounding it can be done also, which will reduce odor (Figure 3). As per as Chief Waste Management Officer, it will be feasible also to provide three different colored large drums for each building (Figure 2). People will store different types of waste there and the collectors will directly collect them.

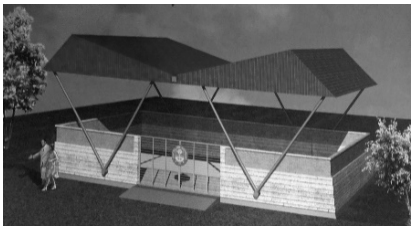

Figure 3. Design of proposed Mini Transfer Station by Dhaka City Corporation

7.3 Solution of Problem Three: Collection of Waste from High-Rise Buildings Using Stairs
For solving this problem, the waste collectors have dreamt of getting permission for using lifts and wanted helpers. They have also demanded that people should keep their garbage at down by themselves. In order to solve this problem, a system can be developed like waste collection system of Ottawa city, Canada (Council of the City of Ottawa, 2001). According to this, one lift can be opened for garbage collection at a specific time of the day and collectors will use it then. They will be provided covered solid plastic bucket so that liquid waste does not sip and odor does not spread in the lift. The collection buckets will have wheels to lessen the labor of the workers as well. The secretary of 'Apartment Owners Association', community people and waste collectors all have agreed unanimously with this strategy.

8 Recommendations

However, some set of recommendations have been initiated considering both the community, where the waste is generated; and the authority, who collect and manage the solid wastes of Dhaka city. The recommendations are subdivided into two parts:

8.1 Recommendations for Community People
The community must adopt the 'Reduce, Reuse, and Recycle (3R)' concept and the source separation concept can be introduced at household level. The children must be addressed that open dumping is an unethical work and keeping the environment of the community clean should be a part of moral education like the Berkley Public School in United States (Berkley Public School, 2014). The youth voluntary organizations can acknowledge the people who are actively participating in the solid waste management in the community for encouraging them. Chief Conservancy officer of DNCC has mentioned an idea that the people who used to be involved in open dumping will be listed and then the names will be announced after Jummah prayer every week so that they become ashamed. In each residential building, the provision of compost bin can be initiated where the household vegetable wastes can be set with soil which eventually be turned into fertilizer (European Compost Network, 2013). Garbage chute can be introduced as well, which is an efficient instrument for combatting the challenges regarding solid waste collection from high rise buildings (Council of the City of Ottawa, 2001). In Bangladesh National Building Code (BNBC), such garbage chute or service elevator can be incorporated also.

8.2 Recommendations for Waste Management Authority
In order to empower the efficient waste management wing of ward commissioner office, man power should be increased and training facility of waste management workers should be introduced. More donor and NGO agencies like JICA might be incorporated in the process. In 2012, 3R project was initiated by Department of Environment, Bangladesh in collaboration with Bangladesh Climate Change Trust in Baridhara (Dhaka Tribune, 2015) but due to lack of knowledge it was failed. After providing training to the authority about some basic ideas and knowledge regarding this system, this project can be started again. All institutions responsible for waste management should be informed of all the latest initiatives and regulations and City Corporations can act as umbrella organization regarding this. Massive Awareness program, imposition of proper rules and regulations, penalties for violation of rules, ward based incentives, provision of financial subsidies for operation of van service etc. can be introduced by government and providing training for using masks, gloves, boots and aprons to waste collectors and compulsory use of such elements while collecting and separating waste should be initiated in each ward as well.

9 Concluding Remarks

Communities in a city like Dhaka are always overburdened with numerous challenges. Solid waste management is one of them and it is faced by different communities in different ways. The existing condition of the waste

collection system at ward level has been reflected in the study which will help for better understanding of the context of the community. The problems concomitant with the solutions have been addressed in the study through which some recommendations regarding community level, administrative level, institutional level and policy level; have been proposed. The overall scenario of the waste management and collection system from household level to secondary collection point has been demonstrated in the study which will create new dimensions for further research works on this issue. In the present world, waste is considered to be wealth and an efficient mechanism of solid waste management can turn the solid wastes of Dhaka into resources for economic development. Furthermore, the well-organized framework of solid waste management will make the environment of the city clean and sustainable for future.

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