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Waste Management

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## Environmental Implications of Mismanagement of Municipal Solid Waste

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Solid waste disposal has become one of the major environmental threats of Indian cities, as large fraction of waste goes for open dumping in and around the city. Bangalore everyday generates around 3000-4000 t of waste. The total USW (Urban Solid Waste) generated in Bangalore and their per capita generation rate has increased in last three decades with increase in population and with change and development of lifestyle. City has quasi centralized collection facility with partial segregation of waste at house level. City waste management are in transition to change from centralized to decentralized waste management with increase of environmental awareness and unscientific waste disposal in centralized waste management. This paper presents a case study conducted in Bangalore to see how mismanagement of waste has caused environmental implications. Currently there are nine waste treatment and disposal sites are permitted from government, but 270 large open dump sites are present in outside the core city area and in the periphery of the city. These open dumps include plastics, organics, construction wastes, fresh indeterminate, old waste and rejects from recycling units. Waste quantity is determined based on visual estimation of area and average density of waste. A large part of it appears to be from the recycling units'

rejects. A total of about 83557 t wastes is scattered around Bangalore city. This type of leakages and spillages in existing waste management leads to environmental problems such as GHG (Green House Gas) emission and blockages of drainage channels, which are discussed in the current study.

**Key words:** Environmental implications, Waste, Bangalore.

## INTRODUCTION

Heterogeneous mixture of substances, which does not have any further use to the society, is often referred to as waste. Approximately, 3000-4000 t/d of municipal solid waste is generated in Bangalore metropolitan city of India and 55% of this waste is contributed by residential houses (Chanakya et al, 2009). Analysis of total solid waste generated in the city shows that the municipal waste consist of high percentage of fermentables (>70%) and the balance being recyclables and inert materials (Chanakya and Sharatchandra, 2005). In fermentable components, vegetable and fruit wastes are dominating and vary from 65 to 90% (Rajabapaiah, 1988; Ramachandra, 2006). These fermentables are biodegradable and can be broken down into simpler compounds by aerobic and anaerobic microorganisms, leading to the formation of GHG (Green House Gases) emission.

Bangalore city employs a quasi-centralized collection system achieving 60% of collection efficiency (Ramachandra and Bachamanda, 2007) which is satisfactory and make the city clean. The waste collection system is in transition from community bin collection to door-to-door collection. The primary collection system transfers the mixed or unsegregated waste from houses to transfer station using lightweight vehicles. At transfer station waste is quickly send to disposal site using heavy weight vehicles. There were seven authorized treatment and disposal sites (Mavallipura, near Doddaballapur, Cheemasandra, Mandur, Sheege Halli, Jannappanabande, Doadabidarahalli) for total collected city waste. Mavallipura, near Doddaballapur and Mandur were receiving most of the waste generated from

the city. Mavallipura and near Doddaballapur have been completely closed in 2012 for further disposal, due to protests from the local people. Currently, Mandur is the only active disposal site, which receives more than 600 t/d of garbage. This limited availability of disposal and treatment sites have affected the collection and transportation of waste from transfer stations. Consequently, odour problem, mosquito menace and increase of street dogs around the existing transfer stations.

Continuous accumulation of waste and reduction in number of disposal sites has increased the number of unauthorized waste disposal sites in and around the city. Inside city has small and temporary dumps, which can be eliminated with increase of collection efficiency. Large and permanent dumps on the outskirts of the city are posing a serious threat to the environment and are the concerns need to be addressed on priority. A study conducted by Lakshmikantha, 2006 shows that there were 60 recorded open sites with many unrecorded sites. Among these, more than 35 sites possess a mixture of domestic and industrial waste. With the close of major disposal and treatment site, there will be increase in number of open dumps.

Sometime wastes are dumped near the storm water drains or inside the drainage network. These dumped wastes are gradually carried to locations of shallow and slow flow where they tend to accumulate until a storm event carries this large mass away. Such large floating mass easily chokes the narrow path below road bridges and results in flooding (Shwetmala et al., 2009; Gupta and Nair, 2011; Gupta and Nair, 2010; Ramachandra and Mujumdar, 2006; ENVIS Report, 2005). The objective of this paper is to

assess the current situation of municipal solid waste management in Bangalore and its corresponding major environmental implications.

## ENVIRONMENTAL IMPACTS

Municipal Solid Waste Management was initiated by urban local bodies, to protect the environment and the society from adverse impacts of increasing waste quantity. Although this has been able to eliminate some impacts that could happen in absence of any planning, but inefficiency of this whole waste management planning has created new environmental impacts.

**1.1 Unauthorized dumping:** Unauthorized dumping is the disposal of waste at private or public places around the city, which is not permitted as per law (Corbyn Lisa, 2008). It is happening in both inside as well as at outskirts of the city. The dumps within city boundaries generally have short life compared to those on the outskirts, which persist longer. In this study, we have tried to capture large dumps situated in the outskirts of the city. It generally occurs near public and private open land, fallow agricultural land and at the foot of small quarry area. Initially when wastes are dumped in these unauthorized dump sites, oxygen is present in the void space which maintain a condition for aerobic decomposition of fermentables. These fermentables degrade in presence of oxygen and generate carbon dioxide in the environment. As these dumpsites persist longer, so continuous disposal of waste at the same place leads to anaerobic degradation. Anaerobic degradation of fermentables liberates methane in the environment (Purkit and Chakrabarty, 2011).

**1.2 Blockage of drainage channels:** Poor and unplanned solid waste management and insensitive attitude among the upstream residents results in waste being dumped into the open drainage channels. Such dumped solid waste cannot be transported through these narrow

streams and results in sewer blockages (Kolsky and Butler, 2000, Ramachandra and Mujumdar, 2009). Solid wastes that enter the drain comprise mainly of fermentables, cloth, plastic and paper. Fermentable organic wastes of the dumped waste (e.g. food and garden wastes) as well as paper are rapidly degraded under such wet conditions leaving behind a predominantly non-biodegradable complex of wastes that occasionally flows in the sewers or remains stuck at vulnerable points along the watercourse. These non-biodegradable wastes flow along with sewage in these drainage channels and gradually accumulate at shallow regions in the path where the flow rates are very low or the wastes encounter physical obstruction due to a shallow nature – especially when the only sewage is flowing in these streams. The extent of such mass accumulating at specific points along the flow gradually increases with increasing quantities of solid waste being discharged into the streams. High intensity rains lead to a large runoff, raising the water levels in the drains rise and releases all the obstructed waste components especially accumulated plastics and cloth that do not undergo rapid degradation. The sudden influx of water as runoff carrying with it a large volume of non-degradable materials (cloths and plastics) results in choking narrow sections of the sewers /flow channel with concomitant rise in water levels in the neighborhood leading to local flood and loss of property and human life.

## METHODOLOGY

A survey was conducted involving volunteers (students from nearby colleges) during 2010-2011 to locate unauthorized open dumps. These volunteers were trained i) to locate dumps, ii) assess the composition, iii) assess the spatial extent of dumps and iv) to mark locations using hand-held pre-calibrated GPS (Global Positioning System). This study was mainly conducted in outskirts of the city in the buffer of 10 km. This study was conducted in two phases: i) locations

were randomly located and area was estimated visually and ii) 10% locations were physically measured and verified by expert group.

In order to analyze the unauthorized dumping of waste in open drainage channels, a random survey in three water catchments and drainage paths in the city namely Vrishabhavathi, Hebbal, Koramangala and Challaghatta valley systems was conducted. This was followed by the field visit during rainy season in 2011 to check the severity of solid waste in drainage channels. Drainage channels were monitored starting from their origin in the upper reaches within the city up to locations where they merge to form very large flow type of drainages/ sewers. Then second survey was conducted in the selected flooding region of the city. The selected areas were Anjanapura temple, National Games Village and Cox Town. These have been identified flood prone areas of Bangalore (Gupta and Nair, 2011). We conducted interviews with at least three local residents in each location to find out the flood level within houses, frequency of flood and duration of flood.

## RESULTS AND DISCUSSION

**Unauthorized dumping locations and quantity:** There were 270 large recorded open dumpsites around the outskirts of the city. These dumps were located in all four zones (North-East, South-East, South-West and North-West) of the city periphery as given in Table 1. South-East zone was having largest number of open dumps, followed by North-East zone of the city. These open dumps include plastics, organics, construction wastes, fresh indeterminate, old waste and rejects from recycling units. Waste quantity was also determined based on visual size of the dump as exact measurement at all these sites are risky and time consuming. Average density

of waste was computed at lab scale experiment to convert waste volume to waste quantity. A large part of it appears to be from the recycling units rejects. About 83557 t wastes is scattered around Bangalore city, which is significantly a large quantity. Construction waste was second highest quantity disposed in illegal dumpsites of Bangalore, it was around 9490 t. As per Municipal Solid Waste (management and handling) rule, 2000, construction waste is not supposed to mix with municipal solid waste, but in most of the places wherever municipal waste was there, there was accumulation of construction waste. A change from centralized waste management to decentralized waste management planning can help to avoid unauthorized waste dumping.

**Blockages of drainage channels:** Total of 97 points around the drain were observed and this observation during floods gave a detailed understanding of the extent of the problem. Among the study locations, 37 was slow flowing, 47 were moderate flow and only 9 locations had rapid flow patterns. The slow and moderate flow streams observed were all encroached upon and were substantially silted and littered with solid wastes. Waste was observed in almost 95% locations, which include plastic and cloths blocking the path of drainage channels. However at a few places Styrofoam, building debris and organic wastes along with plastic and cloth were choking the flow path. Urban flood has become regular phenomenon in Bangalore city, where collection of waste is unsatisfactory. Drains adjacent to slums are prone to dumping of wastes regularly, suggesting of poor or absence of collection facility. Availability of efficient collection and treatment can only minimize illegal dumping of wastes.

**Table 1: Zone wise unauthorized waste disposal sites based on survey**

Waste categories	Zone wise occurrence of waste disposal sites and waste volume								Total volume (m <sup>3</sup> )	Total quantity (tons)		
	NE		SE		SW		NW					
	No.	Volume (m <sup>3</sup> )	No.	Volume (m <sup>3</sup> )	No.	Volume (m <sup>3</sup> )	No.	Volume (m <sup>3</sup> )				
<b>Mixed Fresh (Indeterminate)</b>	9	108.3	16	2512.1	8	1066.2	4	401.1	4088	1656		
<b>Wet Organic</b>	20	451.3	26	34.9	2	1.1	6	121.4	609	247		
<b>Construction Waste</b>	28	2305.0	16	1361.1	19	5203.8	13	620.1	9490	9490		
<b>Plastic</b>	16	94.5	49	90.4	7	105.7	10	169.7	460	41		
<b>Old</b>	1	200.1	1	10.6	0	0.0	2	51	262	157		
<b>Other</b>	5	112.7	5	159.8	3	420.3	2	57.3	750	338		
<b>Recycling</b>	3	159126	2	48.1	0	0.0	0	0.00	159174	71628		
<b>Total</b>	82	162398	114	4217	38	6797	36	1420	174832	83557		

## CONCLUSION

Mismanagement of municipal solid waste management in Bangalore has affected the local environment evident from illegal dumping of solid wastes and building debris in lake beds, open drains, parks and open spaces, etc. Leaching of organic fraction of solid waste has contaminated land and water. Frequent igniting and emissions of GHG's due to organic fractions has contaminated the air environment. Higher episodes of respiratory diseases and vector borne disease further substantiate the poor environmental quality. BBMP has outsourced the collection and transport to the contractors, who were chosen on criteria other than the factors that aid in efficient management of solid waste. Influential contractors collect waste and often dispose in unauthorized locations. Automation of the entire process (such as GPS in collection vehicles), appropriate regulatory mechanism would help in reducing the unauthorized dumps in the city. Bangalore has been experiencing floods even during normal rainfall mainly due to dumping of solid wastes and building debris in storm water drains. Major fraction of solid waste being organic, treatment of waste to either energy or manure would help

in converting waste to the wealth. Reduce, Recycle and Reuse (3R's) apart from removal of contractor mafia couple with the efficient treatment of organic waste can only solve the problem of waste in the city. Source segregation and decentralized treatment and management of waste will help in minimizing the environmental implications due to prevailing mismanagement of solid waste management in most Indian cities.

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