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SOLID WASTE DISPOSAL PRACTICES AND REVIEW OF ENVIRONMENTAL IMPACTS A CASE STUDY OF DUMPING SITE

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ABSTRACT

Municipal solid waste is a problem in most cities due to rapid urbanization, unplanned growth, nil segregation at source and unorganized collection of waste. The existing landfills are getting filled, sites for new landfill are hard to get, per capita waste production is increasing and the cost of waste collection etc. is increasing. Municipal waste arises from Residential, Commercial, Institutional and Industrial sources. It is composed of paper, plastics, glass, cloth, metals, organic waste and ashes etc.

Inappropriate solid waste disposal is a major threat to the environments of developing countries since most of the solid waste generated in developing countries end up directly in open dumps which are uncontrolled and overloaded. Air pollution from landfill emissions, ground water pollution from leachates, health problems due to breeding of disease causing pests and social problems such as decreasing land values and aesthetic appeal of an area etc. are some associated problems.

This paper presents a review of current practice of solid waste disposal of Bangalore Mahanagar palika. A case study of one of the solid waste dumping site in Mavallipur village, Bangalore Urban Distrct, India, has been conducted by interaction with BBMP officials, householders of village, and NGO of ESG were interviewed to examine current practices and related environmental problems. The overall environmental impacts associated with current practice of waste disposal in Mavallipur dumping site is presented in this paper.

KEYWORDS: Solid Waste Management (SWM), Waste Management Planning, Geographical Information System (GIS)

INTRODUCTION

Waste is almost always produced whenever we convert a natural resource into a product, though its nature and quantity can vary. Waste cannot be wished away. Moreover, if it is hazardous or toxic, it could even be a harbinger of disease and death, not just for living beings, but for all that sustains life, for example, water, air, soil and food. Contaminated land is one that contains substances that, when present in sufficient quantities or concentration are likely to cause harm, directly or indirectly, to men, the environment, or on occasions to other targets.

The hazard may be associated with the present status of the land, limit the future use of the land; and, require the land to be specially treated before use. Municipal Solid Waste (MSW) Stream comes from residential, commercial, institutional and industrial sources . Source reduction, recycling and composting, waste-to-energy facilities, and land filling are the four basic approaches to waste management. It is estimated that solid waste generated in small, medium and large cities and towns in India is about 0.1 kg, 0.3 – 0.4 kg and 0.5 kg per capita per day respectively.

Studies carried out by National Environmental Engineering Research Institute (NEERI) indicated that the per capita generation rate increases with the size of the city and varies between 0.3 to 0.6 kg/d. In the 2 metropolitan areas, values up to 0.5 kg / capita / day have been recorded. The estimated annual increase in per capita waste quantity is about 1.33% per year.

OBJECTIVES

The objective of this study is to evaluate current solid waste practices and management, and the associated long-term trends, that might have implications on the global environment, to qualitatively identify the environmental implications of these practices and trends. Pollutants from solid waste affect the air, land, and waterways. In addition, solid wastes have other, more indirect impacts, such as the reduction in feedstocks of natural resources because useful materials are disposed of rather than recycled. As part of this study, it is necessary to define the linkages between local solid waste practices and the macro-level impacts they may cause. The results of this report are intended to be used to develop recommendations for changes that will reduce the impacts of solid waste practices in the future.

STUDY AREA

The city of Bangalore is located at a lat. of 12°58′N and long of 77°35′E at an altitude of 921 m above mean sea level .The city is state capital of Karnataka is located on the southern part of the Deccan Plateau at the border of two other South Indian states, Tamil Nadu and Andhra Pradesh. Since the 1980s, Bangalore has enjoyed the reputation of being one of the fastest growing cities in Asia The Bangalore metropolitan area covers an area of 725 sq km, and is the fifth largest city in India.The mean annual total rainfall is about 880 mm with about 60 rainy days a year over the last ten years. The summer temperature ranges from 18 °C – 38 °C, while the winter temperature ranges from 12 °C – 25 °C. Thus, Bangalore enjoys a salubrious climate all year round

METHODOLOGY

Information on the municipality and present MSW management system was gathered through interviews with municipal officials and community, field observations and literature search.

To estimate the total waste generation and the waste composition in the municipality and to assess waste disposal methods and satisfaction with municipal services a zone wise trucks carrying the solid waste to the respective dumping sites. Based on the records available with BBMP, the daily average generation of waste is depicted in the table-1.

The waste generated by these households were studied over a period of one week to gauge the average waste generation per day per capita and per household.

The householders were requested to separately store their waste as organic waste, which includes bio-degradable kitchen and yard waste, paper, plastic, glass, metal and other.

Ground water contamination was estimated through analysis of well water samples taken from wells around the landfill site of Mavallipur and integrated in to the GIS for analysis.

RESULTS & DISCUSSIONS

Household Waste Composition and Waste Generation Rates

The total household waste generation for the BBMP is estimated to be 4650 tons per day as shown in table-1. Since the MSW other than that collected from households is mainly market waste and from light commercial establishments. The physical composition of MSW is given in Table 2, which consists primarily of organic waste.

Table 1: Solid Waste Generation in BBMP

Zone Name	Generation of Municipal Solid Waste (Tonnes /per Day)
East	860
West	850
South	900
Mahadevapura	690
Yelhanka	300
Bommanahalli	410
R.R.Nagara	280
Dasarahalli	360
Total	**4650**

Source: *BBMP, Bangalore, August-2012*

Table 2: Physical Composition of MSW for BBMP Area

Vegetable	0.30
Paper	0.09
Plastic	0.12
Cardboard	0.04
Textiles	0.04
Grass / leaves / wood	0.06
Leather	0.00
Battery	0.00
Electronic item	0.02
Metal	0.01
Organic	0.23
Glass	0.03
Debris	0.05
Biomedical	0.02
Total	**1.00**

Source: *BBMP*

Current Practices of MSW Management

Solid waste collection and disposal in the municipality is handled by the health division of the municipality. Only household waste, light commercial waste and street sweepings are collected as municipal solid waste (MSW). In the past solid waste disposal had not been considered as a main concern due to availability of freely available degraded land. However, land scarcity is now a main problem faced by the municipality. Brahut Bangalore Mahanagar Palike is having eight administrative zones , which have been further divided in to 29 divisions. 60 sub-divisions and 198 administrative wards. Of these, 70% of the area is under private contract system and the remaining 30% of area is managed through Pourakarmikas (municipal sweepers) of the BBMP. Except for few wards in Bangalore there is no door-to-door collection service in Bangalore. The areas not served are mostly un incorporated or illegal settlements and slum areas with small and inaccessible streets. By contract more prosperous areas are better served, kept clean and swept on a regular basis.

The present scenario of MSW management in BBMP area is described herein.

Primary Collection (Door to Door Collection)

- The primary collection is performed using pushcarts & auto tippers
- There are around 11000 pushcarts & 650 auto tippers for Door to Door collection of waste.
- Waste is collected in the unsegregated form as segregation is not practiced at source.

Secondary Collection and Transportation

- There are about 600 MSW transportation vehicles including Compactors, Tipper Lorries, Dumper placers & Mechanical Sweepers both BBMP and contractors. Zone wise details are shown in table-2
- The waste collected from the households is brought to a common point ie., secondary locations from where the waste is shifted to the treatment sites through compactors & tipper lorries.
- Segregation at source & the secondary storage is not happening hence unsegregated waste reaches the processing plants.

Street Sweeping Activity

- Street sweeping is performed both manually & mechanically. In some of the highly commercial activity areas sweeping is done at night & in the VIP areas the sweeping is done twice a day. The street sweeping waste is carried along with the primary collection waste to the land fill sites.
- At present 6 Mechanical sweepers, proposed to procure more in future days.

Waste Disposal

In order to comply with MSW rules, The BBMP has setup processing & Disposal facilities on PPP model. Following are the processing & disposing facilities shown table-3 & figure-1.

Table 3: Processing & Disposing Facilities

Sl. No	Name of the Project & Location	Capacity of the Plant	Technology Adopted
1	M/s Ramky, Mavallipur	600 MTPD	Aerobic Composting & scientific land fill
2	M/s S.G.R.R.L	1000 MTPD	Waste to energy (Presently composting & land filling the inert & combustible. material are stored for RDF)
3	M/s Terrafirma	1000 MTPD	Integrated system where composting, vermi compostin, biomethanization is followed
4	M/s Organic Waste India pvt ltd (yet to start)	1000 MTPD	Integrated system (yet to commission)
5	M/s Organic Waste India pvt ltd (yet to start)	1000 MTPD	Integrated system (yet to commission)
6	BBMP at a) R.R.Nagar b) Chimmasandra c) Mandur d) Nyanappanalli e) Doddabidarekallu	1000 (200 at each location)	Land filling

Source: *BBMP*

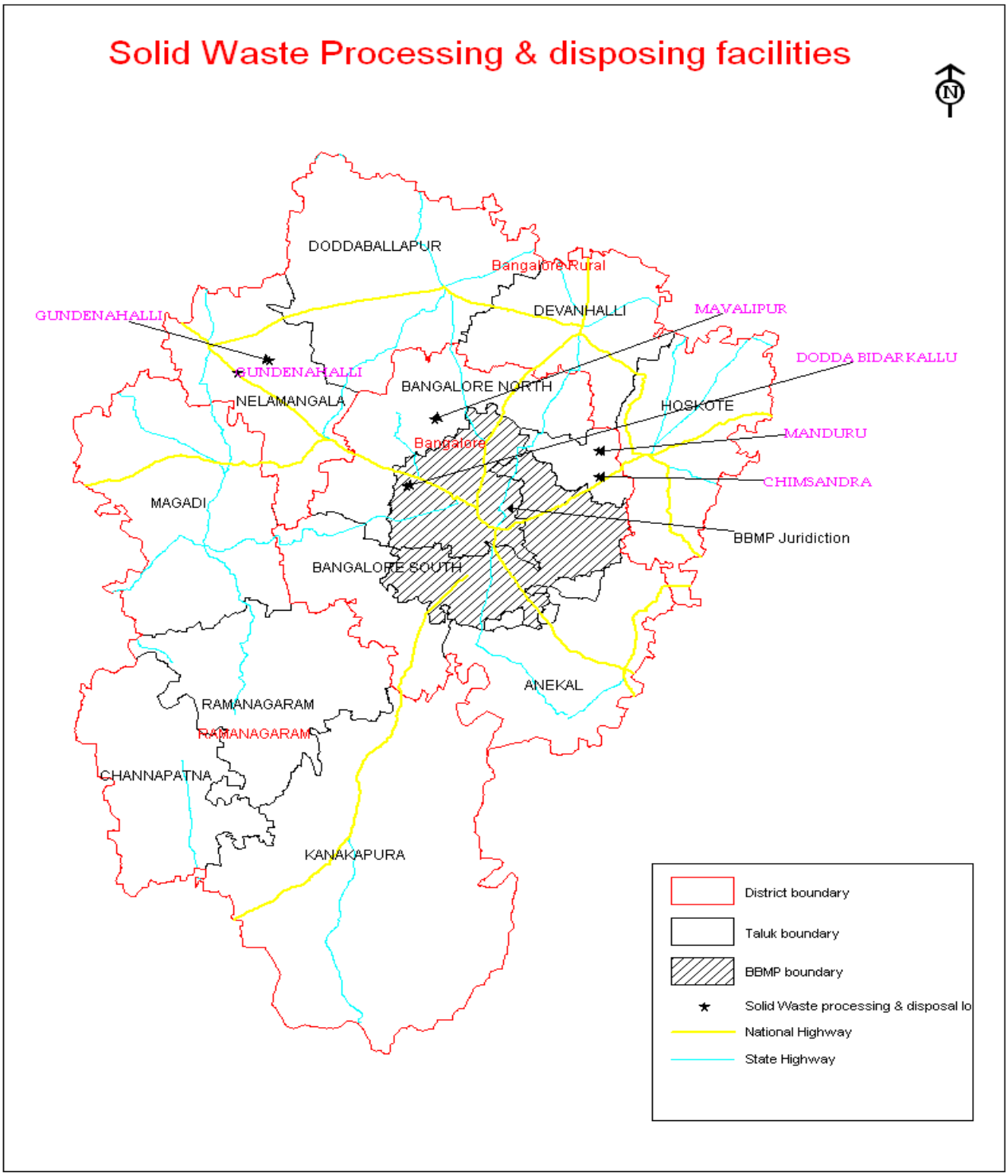

Figure 1

The local authority (BBMP) has taken initiatives to improve the waste disposal methods are as follows.

- The combination of technologies for processing of MSW attempted for sustenance & viability.
- Generally around 30 to 40 percent of inert rejects which includes recyclables are going to the scientific landfill.
- Attempt is being made to utilize all the recyclables.
- Small quantity of Waste Plastic are segregated and used in the construction of pavement roads.8% of Poly blend is mixed in the asphalt .

- It is seen there is possibility of converting the plastics into diesel by following depolymerization technology which is yet to be implemented in large scale.
- BBMP aim is to adopt zero waste management or reduced the quantity of inerts that goes to landfills by less than 10% by recycling other inerts wherever possible.
- Vehicle Tracking System using GPS, To bring in accountability for the distance traveled by the vehicles GPS/GPRS Based Tracking system is implemented. About 350 vehicles are fitted with the GPS
- CCTV cameras have been installed at all the processing sites at the entry and exit points to view the vehicles reached.
- Also a ticketing system using Hand Held Device, which collect the data and send it to the central server for monitoring and analysis.
- The entire truck numbers and operation schedule is automatically down loaded to the Hand Held device through GPRS

E-Waste

Bangalore being the silicon valley huge quantity of e-waste is generated. Recyclers identified by the KSPCB are managing the e-waste at large IT companies. Today the e-waste is one of the rapidly growing environmental problems With extensive use of computers and other electronic equipments coupled with increasing discarding habits, rapid technological change, there is a significant increase in e-waste generation at the household level and public sectors which has to be addressed.

Impacts from MSW Disposal

Over 4650 tonnes of waste is generated in Bangalore every day as depicted in table-1,a good proportion is unhealthily dumped in the peri-urban areas(figure-1) of the city, with farmlands and wetlands becoming prime targets. Often times forest areas are also happy dumping grounds for waste disposal. An out of sight is out of mind attitude pervades the administration and regulatory approach to solid waste management. A detailed study has been carried out using the micro level data & analysed with the help of Geographic Information System(GIS)

Environmental Impacts

Ten ground water samples(Figure-2) from the vicinity of the landfill site at Mavalpur were analysed in July2012 and to assess whether the ground water quality had been affected by the landfill operation. The ground water sample locations were mapped using the GPS points & the the water quality data has been integrated to the spatial data. Using GIS analysis, thematic layers for all the parameters were created & results are discussed.

pH

Near to the dumping site, at 2 locations, the water samples showing a have a pH value beyond range of 6.5 - 7.5. It indicates acidic or alkalinity in the water. It affects the mucous membrane and/or water supply system.

Total Dissolved Solids (TDS) and Total Hardness (TH)

All water samples in Mavallipura were in the permissible range except the Forest land,Koranakunte & leachet pond well sample which was observed to contain water having high TDS and TH. It may causes gastro-intestinal irritation in human.

Sulphate

The desirable limit for sulphate is 200 mg/l, and all samples contained less than half the desirable concentration level except one location.

Nitrates

Nitrate concentration in 8 samples analysed was found to be within the desirable limit of 45 mg/l and in 2 samples near to the dumping sites are exceeding the permissible limits.. There has not been any significant change in concentration of nitrates in water samples from FRLHT and borewell water at Anand's residence.

Fluoride

All samples had fluoride concentrations within the desirable limit of 1mg/l.

Chloride

The desirable limit for chlorides in drinking water is 250 mg/l. Except 4 location samples showed presence of chlorides beyond this limitForest land & leachet pond location wells showed exceedingly high amount of chloride concentration.

Iron

The desirable and permissible concentration of iron in potable water are 0.3 mg/l and 1 mg/l respectively. On looking at the results, we observe that leached pond well has a concentration of 28.5 mg/l which is way beyond even the permissible limit of presence of this cation. Borewell sample obtained from rest of the locations showed presence of iron at concentration of 2.92 to 4.19 mg/l, which a slightly more than the desirable limit of 0.3 mg/l. The rest of the samples showed presence of iron at concentrations between 0.08 – 0.12 mg/l.

Calcium and Magnesium

All samples showed concentrations of calcium and magnesium below the permissible limit of 200 mg/l and 100 mg/l respectively. However, three of the ten samples had concentrations of these elements greater than the desirable limit of 75 mg/l and 30 mg/l. These were samples taken from Koranakunte well, borewell at Anand's residence and the common borewell for Mavallipura village. Borewell water sample obtained from FRLHT, which is at farther away than the rest of the samples has concentration closer to the desirable limit of presence of calcium and magnesium.

Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Potable water should have BOD concentration less than or equal to 2 mg/l. BOD and COD was absent is all samples except two samples i.e. Koranakunte well, and bore well water sample from Nagaraj's residence. In both cases the concentration of BOD is extremely high at 81.6 and 32 mg/l. As per Indian standards water that is used for bathing should also have a BOD of less than 3mg/l whereas here we observe the values are much more than this level too. All other water samples showed zero concentration of BOD and COD.

Bacterial Count

Potable drinking water should have zero faecal contamination. However, on observing the results of analysis for bacterial contamination, we observe that the four samples showed presence of faecal contamination. Sample taken from a borewell at Mavallipura village near leachet pond showed presence of faecal coliforms at a concentration of 2149 MPN/100ml. Fecal coliforms were completely absent from Mavallipur OHT borewell water samples that were analysed.

Several villagers have died as a direct consequence of such dumping of toxic waste,and many more are suffering a wide range of infectious and chronic illnesses. This abhorrent practice of dumping waste has destroyed village commons, farming land, grazing pastures, forests and water sources, and adversely impacted thousands of livelihoods. The pollutants released have contaminated lakes, wells, streams, the air, etc., and is finding its way back into Bangalore's population through food chains

Social Impacts

The interviwed villagers were asked to list down up to problems associated with present day practices of waste disposal as perceived by them. A weightage was then assigned to each response based on the order of priority. Thus adjusted, the main problems identified in order of priority are:

- Unpleasant odor when garbage is transported.
- Breeding of mosquito and flies due to landfill site and garbage on either side of the main road fallen from the garbage trucks
- Loss in property value
- Unpleasant odor due to landfill site
- Traffic congestion due to garbage trucks and tractors
- Falling of garbage bags from garbage trucks on either side of the main road
- Arising of dust when garbage vehicles are going.
- Deterioration of road conditions.
- Increase in floods during the rainy season. Environmental Impacts Associated with Current Waste Disposal Practices…
- Release of smoke and poisonous gases giving rise to safety problems.
- Children affected by various diseases such as skin diseases in the area
- Breeding ground for worms and insects

These responses can be categorized into three subgroups. The first 4 impacts identified are direct impacts felt by the community arising from garbage. The second 4 impacts are problems related to the transport of garbage. The next 4 problems are those considered as less important or indirect.

In addition to these identified problems the survey also revealed that the residents close to the landfill site had suffered significantly more from typhoid and diarrhea than those living further away from the site which may be due to ground water contamination with leachate.

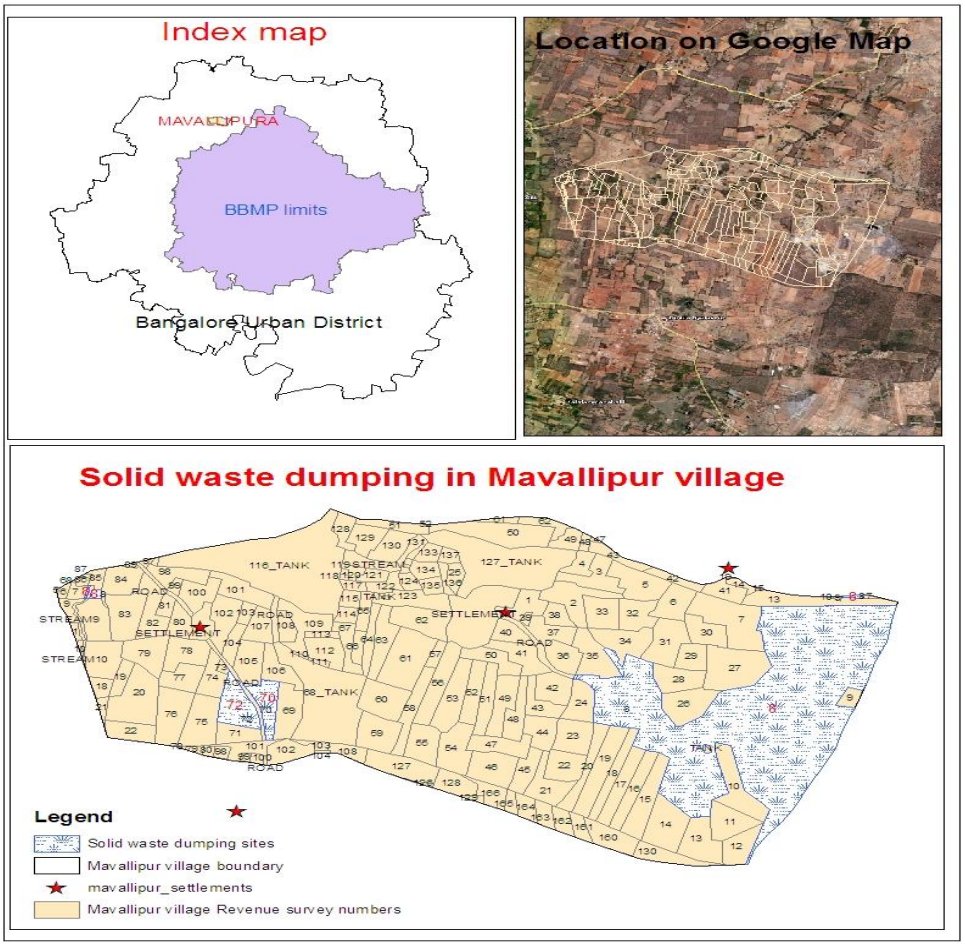

Figure 2

CONCLUSIONS

The above study has very clearly shown that present day waste disposal practices in the municipality has caused severe environmental and social problems. Although fair allocation from resources of the municipality is utilized for the MSW management process the efficiency of its use and distribution is questionable. The emphasis placed on waste disposal as opposed to collection is minimal. The main environmental problems identified in the study are the release of landfill gas and leachate. The significant amount of landfill gas which is generated from the site is released without any constraint to the atmosphere contributing to global warming. Leaching of pollutants into ground water has also been found to be a significant concern due to the high use of ground water for residential purposes and due to the possible illegal disposal of industrial waste along with MSW.

From the public perception as worst impacts of present solid waste disposal practices are seen direct social impacts such as odor, breeding of pests and loss in property values. Transport of the collected waste also appears to cause significant impacts due to increased traffic flows and causing odor while transporting the waste. While combating impacts such as pollution from leachate and gas emissions require heavy capital investments some of the other problems can be easily avoided without much of a financial burden. Covering of waste material while being transported, application of a daily cover on the landfilled waste and careful planning of transportation of collected waste are some of these measures which can be considered by the municipality.

The continuous practice of haphazard waste disposal which in the short term may appear to give an effortless solution is the main reason for these impacts. In addition to municipal lapses lack of law enforcement is also a culprit for

these continuous practices. Responsible agencies such as the BBMP should ensure that the laws and regulations are adhered to. Although an overnight change and improvement in the present day waste management practices cannot be expected without more financial commitments the present situation can be improved upon provided there is adequate understanding of the problem and willingness to do so.

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