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Emerging Financial and Environmental Concerns in Municipal Solid Waste Management of Indian Urban Local Bodies

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Abstract: **Municipal Solid Waste Management is an essential and obligatory function of urban local bodies in India. Improper solid waste management is a threat to the health of people and the environment - pollutes local air, water, land resources, degrades quality of life and also causes global warming. MSW dumped in landfills generates greenhouse gases like methane, which has 21 times more global warming potential than carbon dioxide. Improper solid waste management contributes to 6% of India's methane emissions and is the third largest emitter of methane in India. Improper waste management is also identified as a cause of many human diseases.Garbage on streets spread diseases like malaria, plague; creating a major constrain in achieving the Millennium Development Goals (MDGs).This paper highlights existing scenario and emerging financial and environmental concerns in Municipal solid waste management of urban local bodies. The paper examines present policies and practices addressing specific concerns in India and further provides broad strategies for efficient and effective solid waste management.**

Keywords: **Municipal solid waste, Environment, urban local bodies, health, Millennium Development Goals**

1. INTRODUCTION

As per MSW (Management & Handling) Rules 2000, Municipal Solid Waste (MSW) in India includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes. Municipal Solid Waste Management (MSWM) refers to a systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste. MSWM is essential and obligatory function of ULBs in India, with rapid urbanization and economic growth and an increase in per capita waste generation, annual municipal solid waste generation is estimated to grow more than five-fold from the current level of 70 million tonnes to reach 370 million tonnes by 2030, adding pressure on Urban Local Bodies. [1]

1.1 MSWM policy initiatives and Institutional Arrangements in India

MSWM attained importance since the mid-1990s in the consequences of the plague outbreak in Surat. The Municipal Waste (Management and Handling Rules) were notified by the MoEF in September 2000 making it mandatory for ULBs to improve their waste management systems. At Central level, the Ministry of Urban Development (MoUD) is responsible for formulation of broad policies, programmes and guidelines. The Central Public Health and Environmental Engineering Organization (CPHEEO) is the technical wing of the Ministry and the Central Pollution Control Board (CPCB) plays a monitoring role. At State level, the Department of Urban Development of the concerned State has the overall responsibility for the enforcement of the provisions of the MSWM Rules, 2000; At ULB level, every municipal authority is responsible for MSWM. [2]

2. MUNICIPAL SOLID WASTE MANAGEMENT SCENARIO IN INDIA CITIES

2.1Waste Quantity and Characteristics

Quantity and characteristics are major aspects in solid waste management. Changing lifestyles, increasing urbanization and purchase power has resulted in the change in composition of waste and increase in percapita waste generation. Per capita waste generation depends on population of city. As Population range between 0.1 to 0.5 Million, the per capita waste generation per day is 210 grams; similarly 0.5 to 1 Million Population is 250 grams; 1.0 to 2.0 Million Population is 270grams; 2.0 to 5.0 Million Population is 350grams; 5.0 Million plus Population is 500grams and 0.6 kg/capita/day

generation of MSW has been observed in metro cities [3]. Average percapita waste generation ranges between 0.2 kg and 0.6 kg per day in India. Characteristics of waste are changing.The proportion of non-bio-degradable material increase from 42 to 48% in 1996 to 2005, similarly metals & glass from 1.1 to 2%, Paper and plastic from 5 to 7%. Inert items that comprised around 45% of the total wastes in 1996 reduced to 25% by 2005. [4]

Extensive literature available on status of solid waste management in India cities through studies conducted by different agencies like NEERI (1995), study by Asnani of class-I cities (2006), study by CPCB of 59 class I and capital cities (2007), MoUD *(Service level benchmarking of pilot 28 cities -2009*), MoUD *(Service levels in urban water supply and Sanitation sector: status report-2010-11). Status of SWM in India basing on existing literature are given below in Table1*

2.2 Status of Solid Waste Management in India

Table 8- Status of solid waste management in India basing on existing studies [5] [6] [7] [8]

	Study by Asnani 2006	**Study by CPCB 59 cities 2007**	**Pilot study of 28 ULBs 2009**	**SLB Data 1405 ULBs 2011**
HH level coverage of SWM	38.86%	NA	47.7%	35%
Efficiency of collection of MSW	53.1%	*6 cities with 100 % DTD collection*	75.3%	75.6%
Extent of segregation of MSW	36.47%	NA	19.5%	10.8%
Extent of municipal solid waste recovered	9.18%	*16 cities which are partial and underutilized*	31.17%	14.5%
Extent of scientific disposal of MSW	1.73%	*Only 1 city have facility*	8%	9.7%
Efficiency in redressal of customer complaints	NA	NA	89.1%	54.7%
Extent of cost recovery in SWM services	NA	NA	17.3%	7.3%
Efficiency in collection of SWM charges	NA	NA	31.4%	14.4

2.2.1 Door to Door coverage of solid waste management services: The door-to-door-collection is provided mainly through ULBs, in some cities by resident welfare associations and NGOs.Some ULBs are going in for integrated SWM systems where one agency is responsible for collection, transportation, processing and disposal functions.

***2.2.2 Collection and Transportation of MSW*:** The collection efficiency ranges between 70 to 90% in major metro cities, whereas in several smaller cities it is below 50% [9]. It was observed that weighing of waste is not practiced in a large number of cities and the quantity of waste is estimated based on number of trips/day. Several factors are responsible for low collection efficiency; lack of appropriate collection systems, lack of and/or inadequate collection facilities such as waste disposal bins, collection vehicles etc., lack of funds, lack of and enforcement of appropriate regulations etc.

2.2.3 Segregation of MSW: In India most of the urban areas are lacking in MSW storage at the source. For both decomposable and non-decomposable waste common bins are used to collect the waste without any segregation and disposed. Segregation is mostly done by unorganized sector (scavengers and rag pickers) and rarely done by waste generators. Hence, the efficiency of segregation is quite low as the unorganized sector tends to segregate only those waste materials which have relatively higher economic return in the recycling market. Proper segregation of waste would lead to better options and opportunities for its scientific disposal.

2.2.4 Processing of solid waste: In metropolitan cities like Bangalore, Hyderabad, Ahmedabad, and Kolkata, compost plants have been established and commissioned by private agencies. The plants have installed capacity in the range of 40–700 tonnes/day. A waste-to-energy plant established at Vijayawada by Shriram energy Systems, Ltd., Hyderabad, with a capacity of about 500 TPD of MSW and a power generating capacity of 6 MW, has been in operation since December 2003. Another plant, with a capacity of about 700 TPD of MSW with a power generating capacity of 6.6 MW, established by M/s SELCO International, Ltd., at Gandhamguda near Hyderabad has been in operation since November 2003. M/s Shriram Energy Systems, Ltd., Hyderabad, will commission a third waste-to-energy plant at Vishakhapatnam. A waste to- energy plant (600 TPD capacity) is also underway at Chennai. Vermi composting of MSW has been initiated in five cities i.e., Hyderabad (7 TPD), Nagpur (30 TPD), Pune (50 TPD), Indore (1.25 TPD), and Pondicherry (5 TPD). One biomethanation plant for the treatment of MSW (300 TPD capacity) has been

commissioned at Lucknow to generate electrical energy. Presently, it is in operation but is underutilized. [6]

2.2.5 Scientific disposal of MSW: More than 90% of MSW in India is directly disposed of on open lands. Almost all of the cities have adopted open dumping for waste disposal except at Pune, where a partial sanitary landfill is under development, and at Nashik, where waste disposal is carried out in different cells which have adopted a method of sanitary landfilling. Earth cover is partly provided in a few cities including Mumbai, Kolkata, Chennai, Ahmedabad, Kanpur, Lucknow, Coimbatore, Nashik, Vadodara, Jamshedpur, Allahabad, Amritsar, Rajkot, Simla, Thiruvananthapuram, and Dehradun. [6]

3. EMERGING CONCERNS OF MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA

Policy & technical, financial, environmental, health and social related concerns are emerging in Solid waste management in local bodies of India as discussed below.

3.1 Policy & Technical concern: Impact of solid waste on environment and public health can be reduced by adopting suitable waste processing technologies like composting, pellatization, and bio-methanation, application of technologies other than composting requires strict implementation and monitoring mechanisms and the choice of techniques should be basing on economic and environmental costs considerations.

3.2 Financial concern*:* A major issue in complying with MSW Rules 2000 is the availability of finance resource. Solid waste management accounts highest share of municipal budget which is spent on operation and maintenance rather than capital works .There are three major sources of finance for urban infrastructure including SWM. The *first source* is the own revenues though taxes, non-taxes and user charges. The own sources of revenue constitute between 20-50 percent of total revenues and often not adequate to meet even operation and maintenance and establishment expenditures. Second major source is grants form central and state governments, central government grants are major funding for capital expenditure of urban infrastructure including SWM. A third and major sources of funding that has emerged in recent years is the private sector participation in the form of PPP projects in SWM [10]. Most of own source of revenue is spent on the salaries, transportation and fuel charges. It has been estimated that the ULBs spend about Rs500 to Rs1500 per tonne on solid waste collection, transportation, treatment and disposal. About 60-70%of this amount is spent on collection, 20-30% on transportation, and hardly any fund is spent on Treatment and disposal of waste [9].unlike other services, ULBs do not charge on SWM services. Most of the ULBs have no cost recovery or less than 10 per cent. Most of ULBs like Ahmedabad, Surat etc. levy a collection/conservancy tax which is an integral part of the property tax, the same will not be useful for SWM in most of the cases. In recent years there are efforts by some ULBs to levy user charges. In some ULBs, door-to-door collection charges are paid directly by the residents to the agencies involved in that operation. Imphal has a user fee revenue sharing model also collection efficiency of SWM charges is also very important in efficiency of the cost recovery.

The required investment capital expenditure estimate for the eight sectors of urban infrastructure for the 20-year period from 2012 to 2031 amount to Rs 30.98 lakh crores at 2009-10 prices, SWM sector accounts for account for 1.6 per cent (Rs48, 582 crore) of the total investment requirement. Percapita Investment cost(PCIC)and Percapita Operations and Maintenance costs(PCOM) are Rs 391 and Rs 155 (2009-10 Prices) for Solid waste management sector. [11]

3.3 Environmental & Health: Improper solid waste management affects environment causing air, water, soil pollution, land degradation and scarcity. It also leads to climate change and threat to public health.

3.3.1 Impact on Water and Air: Indiscriminate dumping of wastes and leachate from landfills contaminates surface and groundwater and the surrounding land resources. To assess the impact solid waste disposal of landfills on water quality, Groundwater samples from tube wells, bore wells located around landfill sites, were collected and analyzed for relevant physicochemical parameters, including heavy metals from nine selected cities like Kolkata, Delhi, Chennai, Jammu, Srinagar, Trivandrum, Coimbatore, Kochi, and Hyderabad. Samples collected from cities like Jammu, Srinagar, Trivandrum, and Coimbatore indicated an impact on water quality in terms of excessive concentrations of iron and lead. In Kochi and Hyderabad, deterioration in water quality was observed due to higher chloride and Total Dissolved Solids content than the permissible limits. Overall, it was observed that the landfilling of MSW has an adverse impact on groundwater quality. [6]

**"Studies on Environmental Quality in and around Municipal Solid Waste Dumpsite" in Kolkata, by Biswas A.K., et al. found moderately high concentrations of heavy metal in groundwater surrounding the dumpsite. The study found out that the groundwater quality has been significantly affected by leachate percolation.*

**"Due to influence of solid waste dumping site at Jawahar nagar, Hyderabad. The groundwater is acidic in nature and all samples fall under hard to very hard category. Most of the area near the solid waste dumping site falls in moderately polluted to severely polluted category and fluoride concentration in the northern and southern region of dumping yard exceeded the permissible limit indicating that the water is unsuitable for drinking purpose." [12]*

**A 2010 study by NEERI, "Air Quality Assessment, Emissions Inventory and Source Apportionment Studies: Mumbai" found out that open burning and landfill fires are a major source of air pollution in Mumbai. The study found that about 2% of the total MSW generated in Mumbai is openly burnt on the streets and 10% of the total MSW generated is burnt in landfills by humans or due to landfill fires.*

** Long term health effects experienced by residents living around overflowing landfills are the reasons for the public protests at Jawahar Nagar dumping site (Hyderabad, Andhra Pradesh), Vilappilsala (near Thiruvananthapuram, Kerala) and Mavallipura (in Bengaluru, Karnataka).*

3.3.2 Impact on Land: Practice of unsanitary landfilling not only occupies precious land resources near urban areas; it also degrades the quality of land and soil in the site. Presence of plastics and heavy metals in the soils make it unfit for agriculture and emissions of methane and structural instability of the land make it unfit for construction activities. It would require massive remediation efforts which are time and infrastructure intensive, to make the land useful [13].The land required for disposing waste is also set to increase in response to the increase in waste generation. It is estimates a requirement of more than 1400 sq.km of land for solid waste disposal by the end of 2047 if MSW is not properly handled. [9]

***3.3.3 Impact on environment and climate*:** Improper solid waste management also clogs sewers and drains and leads to floods. Mumbai experienced a flood in 2006 which was partly due to clogged sewers. Landfill sites release landfill gas with 50 to 60 per cent methane by volume. MSW dumped in landfills also generates greenhouse gases like methane, which has 21 times more global warming potential than carbon dioxide. Improper SWM contributes to 6% of India's methane emissions and is the third largest emitter of methane in India. This is much higher than the global average of 3% methane emissions from solid waste. It currently produces 16 million tons of CO2 equivalents per year and this number is expected to rise to 20 million tons of CO2 equivalents by 2020. [13]

3.3.4 Impact on Public Health: Long term exposure of populations surrounding dumpsites to open waste disposal can lead to health problems. Ill health of municipal workers and waste pickers means a threat to public health. Also, contagious diseases can spread rapidly in densely populated Indian cities posing a bigger threat to public health. Improper waste management is identified as a cause of 22 human diseases and results in numerous premature deaths every year.

Inhalation of bio aerosols, and of smoke and fumes produced by open burning of waste, can cause health problems. Also, the exposure to air-borne bacteria is infectious. Toxic materials present in solid waste are determinants for respiratory and dermatological problems, eye infections and low life expectancy. Surat City experienced a plague epidemic in 1994 due to improper SWM. Improper SWM is also a reason for the Dengue epidemic in Kolkata, which affected thousands and killed 25 people. [13]

***3.4* Social concern:** Community participation has a direct bearing on efficient SWM. Yet, the municipal authorities have failed to mobilize the community and educate citizens on the rudiments of handling waste and proper practices of storing it in their own bins at the household, shop and establishment level. [5]

4. INITIATIVES TAKEN AT CENTRAL, STATE AND ULB LEVEL ADDRESSING EMERGING CONCERNS

At **central level,** MoUD has initiated a number of polices and programmes addressing emerging concerns

(i) JNNURM programme linked with reforms including levy of reasonable user charges, encouraging PPP etc.(ii) Service Level Benchmarks to improve efficiency (iii)National Urban Sanitation Policy (NUSP 2008) covering all aspects of urban sanitation. *The City Sanitation Rating exercise has been initiated under the NUSP to create mass awareness and (*iv) National Urban Water Awards for recognizing best efforts in improving water supply. [14]

Resource allocation: a) GOI have provided assistance of Rs.2500 crores under 12th Finance Commission and 11th FYP allocated Rs2212 crores for SWM [9] b) MoUD sanctioned Rs 2, 092 crores(45Projects)and Rs 342 crores(56 Projects) under UIG & UIDSSMT components of JnNURM [15] c) other important source of funding of SWM that has emerged in recent years are PPP projects.

State Level: State governments have taken important initiatives to achieve MSW Rules 2000 as shown below.

Karnataka government formulated the state policy for implementation of Integrated Solid Waste Management (ISWM) based on MSW Rules 2000 laying down guidelines for all the activities.

Gujarat government has set up a state level committee headed by the Principal Secretary, Urban Development and Urban Housing Department.

West Bengal government of has launched a 'West Bengal Solid Waste Management Mission' registered under the West Bengal Societies Registration Act 1961 on 18 May 2005. [5]

***ULB level*:** The Table-2 below **highlights current initiatives ongoing at ULB level and major concern addressed through these initiatives.**

Table 9 Current solid waste management initiatives at ULB level

Initiative	Outcome	Concern addressed
Scientific closure of Goari Dumping site (Greater Mumbai)	Green cover at dumping site & carbon credits for capture methane, revenue from clean development mechanism	*Technical, Financial Environmental & Health*
Mumbai	Involvement of CBOs, Involvement of waste pickers in waste collection	*Social*
Integrated solid waste management at Rajkot	cost recovery by sale of processed waste of 300 MT	*Technical, Financial Environmental & Health*
Regional Landfills at AUDA	Integrated composting facilities for 150 TPD and a scientific landfill site of 50 TPD.	*Technical, Financial Environmental & Health*
Off-Site Real Time Monitoring system for SWM- Hyderabad	Use of GPS and GPRS technology to track SWM system	*Technical*
Nagapur	Involving NGOs and local rag pickers in SWM, resulting in a saving of Rs 20 million and creation of 1500 jobs	*Social and Financial*
Pune	Good example Decentralized onsite integrated waste management system for peripheral and marginalized areas	*Social and Financial*
Biometric Attendance System for workers in Guntur	Effective Human Resource management and cost savings in O&M costs.	*Financial*
MSW Service Charge in Sanand (Gujarat)	Service charge of Rs. 100 per annum per HH as SWM cess.	*Financial*
Citizens Charter in Namakkal	A 10-Point Charter to Achieve Zero-Garbage Status	*Environmental & Health, Social*

AUDA-Ahmadabad Urban Development Authority

5. CONCLUSION AND WAY FORWARD

Strategies addressing emerging financial concerns are: Providing solid waste management due importance in the municipal planning and budgeting taking into account service level benchmarking and learning from peer cities, Encourage PPPs in solid waste sector to implement integrated solid waste management, User charges should be linked with unit cost of production and revised periodically, ULBs must prove creditworthiness and obtain an investment grade credit rating by improving their revenue which supports in accessing funds from market.

Strategies addressing emerging legal, environment and social concerns are: Mandate decentralized onsite integrated waste management system for townships, Encourage regional land fill sites for cluster cities which are close proximity, Enforcement of penalty for littering of garbage in public places and open burning, Encourage participatory planning and community involvement in MSWM, Policies for awareness generation, campaigns to Reduce, Reuse and Recycle of waste. *These strategies lead to efficient and effective solid waste management in India.*

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