

Municipal Solid Waste Management – Centralised Landfills vs valorisation at domestic level- Indian Big cities perspective

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Abstract:

Ensuring an environment friendly disposal of organic solid waste is a sustained challenge to municipal bodies in most countries even after substantial success in segregation of solid waste. The solutions adopted so far including landfill and addition of incineration, composting etc at landfill for management of municipal solid waste lately found technically insufficient and unsustainable to address the issues related to it and so remained unacceptable socially and legally too. Apart from reusing of the waste material and or recycling to extract the valuable elements, transforming of organic waste -comprises protein, sugar and minerals etc - into energy and or valuable material (also called valorization) is expected as a solution of disposal that could have substantial sustainability and is favoring natural resources conservation and put a check on increasing greenhouse emissions. Organic waste composed of agricultural waste, household food waste, human and animal wastes are normally disposed to landfill sites and incinerated. Instead, it should be valorized via Composting and Anaerobic Digestion and output be used in other processes as substrates or raw materials. Also, it is observed in context of big cities like Delhi in India that valorization at local level is effective, efficient and more sustainable as compared to processing it at the landfill level.

Keywords —Solid Waste, Valorisation, landfill, composting, anaerobic digestion

I. INTRODUCTION

Rising in cities population, improved lifestyle and industrialisation in developing countries have resulted in rise in municipal solid waste generation which in turn is toiled as a big challenge to municipal bodies specifically in large cities in terms of its environmentally safe disposal and its management. Municipalities are to understand the complexities involved in handling solid waste.

Without it, investing funds and putting regulations may not be as effective as expected.

In urban areas, rapid growth in solid waste generation and transporting it to dump in landfills is causing sanitary related problems and polluting soil, water and air too. Municipal solid waste is generated mainly from households, markets, commercial & industrial areas wherever human activities are going on. It is generally found in highly heterogeneous forms in terms of physical and chemical characteristics- yard waste, food waste,

plastics, wood, metals, papers, rubbers, leather, batteries, inert materials, textiles, paint containers, demolishing and construction materials and many others that would be difficult to classify- and its heterogeneity posed complexity in sorting and fractionalisation that is prerequisite for putting it to a meaningful treatment process for its utilization as material or energy .

II. SIZE

In India, approximately 143,449 MT of Municipal Solid Waste is being generated daily, out of which around 117,644 Metric tonnes are collected, and about 49,401 Metric tonnes is treated. Generation of waste, land requirement, and the population growth with time have started creating a scarcity of available dump sites. ^[5]Trend of waste generation in all the big cities of India having Population more than 04 million from year (1999–2000) to year (2015–16) is depicted below:

TABLE 1: INDIAN BIG CITIES WASTE GENERATION TRENDS

City	Population 2011	Waste Generation Tonne per day (TPD)				% Change w.r.t (1999–2000)
		1999–2000	2004–05	2010–11	2015–16	
Mumbai (Maharashtra)	12,442,373	5355	5320	6500	11,000	205.42%
Delhi (DelhiState)	11,034,555	400	5922	6800	8700	2175%
Bangalore (Karnataka)	8,443,675	200	1669	3700	3700	1850%
Chennai (Tamil Nadu)	7,088,000	3124	3036	4500	5000	160.05%
Hyderabad (Telangana)	6,731,790	1566	2187	4200	4000	255.43%
Ahmadabad (Gujarat)	5,577,940	1683	1302	2300	2500	148.54%
Kolkata (West .Bengal)	4,496,694	3692	2653	3670	4000	108.34%
Surat	4,467,797	900	1000	1200	1680	186.67%

City	Population 2011	Waste Generation Tonne per day (TPD)				% Change w.r.t (1999–2000)
		1999–2000	2004–05	2010–11	2015–16	
(Gujarat)						

Along with time , urban waste generation has increased manifold and rate of generation has also remained ever increasing. The Delhi and Bangalore zones leading on this trend of waste generation. From the year 1999–2000 to 2015–2016, an increment of 2175% and 1850% respectively is alarming.

III. CENTRALISED LANDFILLING AND ITS IMPACT ON HEALTH & ENVIRONMENTAL:

Urban local bodies are struggling to handle the deluge of solid waste without adequate machinery, tools, funds and fiscal amenities. The urban waste is generally collected and segregated manually in part & parcels by informal means and finally transported to settle at dump sites, those are generally located in the urban periphery areas. Landfills^[5] will require an additional 1400 Sq. Km. of area in India by the year 2047. A regular uncontrolled hike in land prices makes it more challenging to manage land availability.

Landfills as mechanism of waste management is unsustainable if the size of Municipal Waste generation keep on increasing as per the ongoing acceleration. Landfill is expensive and needs big pieces of land. High levels of methane gas and other greenhouse gases are generated by the rotting rubbish in the ground , which contribute greatly to the process of global warming. Waste is trapped in deep pits and or in big heaps at landfills and gets little oxygen to decompose. Fruit & vegetables waste that usually decomposes fast, take long time at landfills to do so. Toxic substances including

arsenic, mercury, PVC, acids, lead, and home cleaning chemicals etc end up in landfills, which leech into the earth and groundwater over time. This creates a huge environmental hazard. The toxic liquid formed at landfills also contaminates our waterbodies, aqua channels also called leachates. Also, the landfill continuously releases hazardous gases and putting the life of nearby area with full of pollutants.

However, Landfill meets a critical infrastructure need – to deal with the residual waste produced by businesses and households. [6] Even if the recycling rates is best, still the whole waste cannot be reused or recycled. Efforts are to be made to keep the waste in least volume to be sent to landfills.

IV. REGULATION AND ECOSYSTEM DEVELOPMENT

Every vigil and responsible government should always keep solid waste management among its priority areas so that the problem of landfill and the problem arising due to landfills are managed. Increased pressure on urbanisation due to population growth and migration of rural population towards cities seeking better civic facilities and for employment, has invited attention for better and improved policies and plan for disposal of solid waste. Improvised & scientific procedures for its disposal and sensitisation of citizen towards environment remained as a challenge to Urban Local Bodies in India. Rules & regulation, legislations which were brought in effect by Government(s) time to time [5] along with their effectiveness is mentioned hereunder:

TABLE 2 : LEGISLATION/STATUTES AND EFFECTIVE IMPLEMENTATION

Year	Legislation/Statutes	Impact
1989	The Hazardous Waste (Management & Handling) Rules	Partially
1994–95	Strategy Paper on MSW Management by NEERI	Effective

Year	Legislation/Statutes	Impact
1998	Bio-medical Waste Handling Rules, 1998	Effective
2000	MSW (Management & Handling) Rules, 2000	Moderate
2005	Report of The Technology Advisory Group on SWM 2005	Moderate
2006	Strategy and action plan-use of compost in cities	Partially
2008	National Urban Sanitation Policy	Partially
2009	E-waste handling Rules-Draft document	Partially
2010	National Mission on Sustainable Habitat	Partially
2011	E-waste Rules, 2011 & Plastic Waste Rules, 2011	Needed revisions
2013	Draft Municipal Solid Waste Rules-2013	Moderate
2014	Draft Manual on Municipal SWM and Handling	Partially
2014	Swachh Bharat Mission (CIM-Clean India Mission)	Partially
2015	(AMRUT) Atal Mission for Rejuvenation and Urban Transformation	Currently running
2016	SWM (Solid Waste Management & Handling) Rules, 2016 (revised) published	Revised & Currently running

V. VALORISATION AT COMMUNITY LEVEL

Provision of recycling the plastic from domestic waste at locality level will avert its reaching to landfill or its lying here & there undecomposed in environment. Such provisions may include production of durable tiles which could be utilised again in locality as pavement developments, flooring etc. National Research Development Corporation (NRDC), India, is now offering technology [1] for manufacturing process wherein shredded waste plastic after mixing with fillers are moulded into tiles with small machinery comprising hydraulic press, oven, moulds etc. As per NRDC, the produce has already qualified the test like flammability test, water absorption, and mechanical strength etc as per ASTM standards, along with successfully carried out test of environmental

stability, resistance against strong acids & strong bases. In Indian context, such setups demand affordable capital investment (in tune of Rs 25-30 million INR) and has enormous potential to sustain financially as cost of production of one sq. feet tile is in tune of 10-15 INR, that has potential to attract a market price of 25-40 INR.

Extraction of scarce elements available in e-Waste with good recycling rates is more economical and less polluting than their extraction from ore^[2]. Availability of gold in e-waste is 100 times more than its ore. Insignificant handling of e-waste results in loss of valuable raw materials viz gold, platinum, cobalt etc and parallelly resulting in polluting the earth and inviting health hazards. Developing countries like India, extraction of elements from e-Waste is giving employment to enormous workforce but it is also true that still primitive means are used in extraction causing health and environment hazards. Regulations are to be supplemented with awareness to handle e-Waste appropriately. All stakeholders are to be given space in value chain - unorganized sector to concentrate on collection, dismantling, segregation etc at community level with in the locality where e-Waste is being produced and other processes like metal extraction, recycling and disposal could be done by the organized sector in their plants.

Around 30 % of our generated domestic waste is generally organic material. Dumping it at landfill will enhance the space requirement at landfill and will release methane that is a potent greenhouse gas. Instead the organic domestic waste can be easily converted into compost that can be added to enrich soil. Basic ingredients of composting^[3] - browns materials (provide carbon) such as dead leaves, branches, and twigs; greens materials (provide nitrogen) such as grass, vegetable waste, fruit scraps, and coffee grounds; and water - in right

amount is important for easy breaking of organic material to develop compost. Consuming organic waste a domestic level or at locality level in making compost will reduce methane emissions from landfills and lowers carbon footprint. Also adding compost to soil enriches its fertility, enhance its ability to retain moisture and suppress plant diseases and pest.

Domestic food solid waste is chemically comprised of fats, cellulose, starch, lipids, protein, and other organic matter and has high valorisation value. Food solid waste consist of high lignocellulosic materials that could be decomposed and exploited by Solid State Fermentation(SSF) Technology^[4] to produce valuable bio-products viz production of glucoamylase enzymes, amylase, cellulose, aroma esters, ethanol, glucoamylase-rich media & protease-rich media for producing succinic acid. Cocoyam peel is a useful substrate for oxy-tetracyclines that is a popular antibiotic to treat many infectious diseases. Food wastes having complex composition are very suitable for microbial growth and through SSF, it would be treated as a good medium for production of produce *Bacillus thuringiensis* (Bt) bio-pesticide.

VI. CONCLUSION :

In India, significant size of manpower in informal sector is involved in recycling of Solid Waste to extract valuable material by using primitive means resulting in health and environments hazards. Despite regulations, the concerns of livelihood, & lack of awareness are important constraints for managing domestic waste in appropriate ways. A suitable model is to be evolved including all stakeholders.

Every solution mainly depends on the awareness of stakeholders herein the general public mainly and waste segregation by them at domestic level.

Once it is achieved, organic waste could be valorised either at landfills or even at community level conveniently. For valorisation of domestic waste in form of such valuable bio products, small scale industries at domestic level or community level are to be developed, so that the waste is consumed very near to its generation point. Reduce, Reuse, Recycle means 3'R' have very important role. Reduction in usage, followed by reusing and recycling of the waste near to home or at home will lead to less size of waste reaching to landfills. Conscious and continuous efforts are to be made in this direction to handle and manage the complications arising out of municipal waste.

REFERENCES

- [1] Recycling of waste plastic bags into useful tiles- A technology offer paper by National Research Development Corporation , India
- [2] Electronic Waste impacting Health and Environment, Its Management -Global & Indian Perspective, Anju R Ahlawat, International Journal of Scientific Research & Engineering Development, pg. 645-649, vol 2, Issue 5, Sept-Oct-2019
- [3] Composting at Home, Environmental Protection Agency, United States: www.epa.gov
- [4] Solid waste issue :Sources, composition, disposal, recycling, and valorisation, Hussein I., Abdel-Shafy, Mona S.M Mansour, Egyptian Journal of Petroleum, Vol 27, Issue 4, Dec 2018, Pg. 1275-1290
- [5] Recent trends in solid waste management status, challenges, and potential for the future Indian cities – A review, Akhilesh Kumar, Avlokita Agarwal, [Current Research in Environmental Sustainability Volume 2](#), December 2020,
- [6] Why landfills bad for environment- a paper by Unisan Limited on Unisanuk.com