



## Review Article

### SOLID WASTE HAZARDS AND STRATEGIES FOR BETTER MANAGEMENT IN INDIA

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#### ABSTRACT

In the past, we used to throw our garbage onto the roadsides for the scavenger animals to scatter and eat. Then that was an acceptable method of handling wastes since the materials we threw were constituted almost totally of organic matters particularly kitchen and food residues. In the rural areas, the wastes used to be dumped in a corner of the household and later used as a manure along with cow dung. But with the progress of civilization and industrialization manufactured consumer goods have taken over a large share of the market. As a consequence we have seen the advent of another kind of scavenger, the rag pickers, who collect from wastes those materials that still have some monetary value.

Now a days even in our small towns we generate hundreds of tons of waste materials – market wastes, kitchen and food wastes, hospital wastes, paper, plastics, metals and glass pieces and many other things. The average daily generation of solid wastes in the metropolitan cities like Calcutta, Delhi, Bombay and Madras amount to approximately 3000 – 5000 metric tons. To manage this tremendous generation of wastes, careful waste management practices have therefore become urgent.

The present paper mainly depends on secondary data. The objective of the paper is to describe the present scenario of solid waste generation, collection, transportation, treatment and disposal methodology in our country. Potential environmental and human health effects resulting from waste generation and disposal are also briefly discussed. This paper would also helps to discuss in detail about different approaches and technologies available for solid waste hazard management. Solid waste policy in India and has also given importance. According to the MoEF Report for 12<sup>th</sup> five year plan, current status, performance during 11<sup>th</sup> plan and recommendations for 12<sup>th</sup> plan for every type of hazards are also discussed. The data presented in this paper have been taken selectively from statistical reports produced by government agencies, international organisations, and from research papers published in the scientific journals.

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## INTRODUCTION

Population growth, increasing urbanization and industrialisation and rising standards of living have all contributed to an increase in both the amount and variety of waste generated in most countries. Furthermore, many countries are now faced with dealing not only with greater volume, but also more dangerous- waste materials. Waste is an unavoidable by-product of human activities. Economic development, urbanization and improving living standards in cities, have led to an increase in the quantity and complexity of generated waste. Rapid growth of population and industrialization degrades the urban environment and places serious stress on natural resources, which undermines equitable and sustainable development.

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In Solid waste, Solid refers to non-soluble material such as agricultural refuse, industrial waste, mining residues, demolition waste, municipal garbage or even sewage sludge. Most of these kind of wastes cannot be recycled or rehabilitated for further use. The present paper mainly depends on secondary data. The objective of the paper is to describe the present scenario of solid waste generation, collection, transportation, treatment and disposal methodology in our country. Potential environmental and human health effects resulting from waste generation and disposal are also briefly discussed. This paper would also helps to discuss in detail about different approaches and technologies available for solid waste hazard management. Solid waste policy in India and has also given importance. According to the MoEF Report for 12<sup>th</sup> five year plan, current status, performance during 11<sup>th</sup> plan and recommendations for 12<sup>th</sup> plan for every type of hazards are also discussed.

The data presented in this paper have been taken selectively from statistical reports produced by government agencies, international organisations, and from research papers published in the scientific journals.

### Solid Waste in India

Presently in India, about 960 million tonnes of solid waste is being generated annually as by-products during industrial, mining, municipal, agricultural and other processes. Of this approx.350 million tonnes are organic wastes from agricultural sources; 290 million tonnes are inorganic waste of industrial and mining sectors and 4.5 million tonnes are hazardous in nature. (Asokan Pappu *et al.* 2004). To safeguard the environment, efforts are being made for recycling different wastes and utilise them in value added applications. Inefficient management and disposal of solid waste is an obvious cause of degradation of the environment in most of the cities of the developing world. Municipal corporations of the developing countries are not able to handle increasing quantities of waste, which results in uncollected waste of roads and in other public places. There is a need to work towards a sustainable waste management system, which requires environmental, institutional, financial, economic and social sustainability. Table 1 depicts that 72.50 percent of total garbage is generated everyday only in urban areas, Mega cities and metro cities of our country.

**Table 1. Quantity of Waste Generation**

TOTAL QUANTITY OF SOLID WASTE		1.15 LAKH TON	
GENERATED IN URBAN AREAS	PER DAY (TPD) OF THE COUNTRY	PER DAY (TPD)	% OF TOTAL GARBAGE
WASTE GENERATED IN 6 MEGA CITIES		21,100 TPD	18.35%
WASTE GENERATED IN METRO CITIES (1 MILLION PLUS TOWNS)		19,643 TPD	17.08%
WASTE GENERATED IN OTHER CLASS-I TOWNS (0.1 MILLION PLUS TOWNS)		42,635.28 TPD	37.07%
		83,378.28 TPD	72.50%

*Source: Central Public Health & Environment Engineering Organisation (CPHEEO), Ministry of Urban Development, Govt. of India.*

### Different waste management approaches

Major metropolitan areas small towns and cities and semi urban and rural areas have different waste management options that depend on their specific local conditions. These include practices like reduction, reuse, recycling, compost making, biofuel production (waste to energy) incineration, landfill etc.

**Reduction:** generation of less wastes through efficient house-keeping, changing wasteful habits and life style would be a positive step.

**Reuse:** This is the small area between avoiding waste and recycling already used materials. A creative way to support reuse of materials is to make them available to those who can use them.

**Recycling:** Recycling is a resource recovery practice that refers to the collection and reuse of waste materials such as empty beverage containers. Almost 50 percent of waste materials have been planned to be recycled in advanced countries. Paper, glass, metals, plastics, food waste, motor oil, batteries, tires, car bumpers and all manner and kinds of scrap metals can be recycled.

All of these activities demand a behavioural change on the part of consumers and manufacturers and necessary support from the government in our country.

**Composting:** It is the biological breakdown of organic matter under airy (aerobic) conditions. The most common form of composting is the layering of leaves, grass and twigs and sometimes kitchen and food wastes in a compost pit or bin. This very simple technology can also be done at the municipal level.

**Incineration:** Incineration is a process of waste management practised since 1970. It is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This method is useful for disposal of residue of both solid waste management and solid residue from waste water management.

### Landfill

Disposal of waste in a landfill involves burying the waste and this remains a common practice in most countries. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly designed or poorly managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate.

### Solid Waste Policy in India

Solid waste policy in India specifies the duties and responsibilities for hygienic waste management for cities and citizens of India. This policy was framed in September 2000, based on the March 1999 Report of the Committee for Solid Waste Management in Class 1 Cities of India to the Supreme Court, which urged statutory bodies to comply with the report's suggestions and recommendations. These also serve as a guide on how to comply with the MSW rules.

### According to Municipality Solid Waste Rules

- Biodegradable wastes should be processed by composting, vermicomposting etc. and landfilling shall be restricted to non-biodegradable inert waste and compost rejects.
- The rules also require municipalities to ensure community participation in waste segregation (by not mixing "wet" food wastes with "dry" recyclables like paper, plastics, glass, metal etc.) and to promote recycling or reuse of segregated materials. Garbage and dry leaves are not allowed to be burnt.
- Biomedical wastes and industrial wastes are not allowed to be mixed with municipal wastes. Routine use

of pesticides on garbage has been banned by the Supreme Court on 28.7.1997.

- Littering and throwing of garbage on roads is prohibited. Citizens should keep their wet (food) wastes and dry (recyclable) wastes within their premises until collected, and must ensure delivery of wastes as per the collection and segregation system of their city, preferably by house-to-house collection at fixed times in multi-container handcarts or tricycles (to avoid manual handling of waste) or directly into trucks stopping at street corners at regular pre-informed timings.
- Dry wastes should be left for collection by the informal sector (sold directly to waste-buyers or given free or otherwise to waste-pickers, who will earn their livelihood by taking the wastes they need from homes rather than from garbage on the streets. High - rises, private colonies, institutions should provide their own big bins within their own areas, separately for dry and wet wastes. (Source: [http://en.wikipedia.org/wiki/Solid\\_waste\\_policy\\_in\\_India](http://en.wikipedia.org/wiki/Solid_waste_policy_in_India))

#### Other initiatives taken by Government of India

- Bio-medical Waste Handling Rules, 1998
- Municipal Solid Waste Management Rules, 2000
- Reforms Agenda (Fiscal, Institutional, Legal)
- Technical Manual on Municipal Solid Waste Management
- Technology Advisory Group on Municipal Solid Waste Management
- Inter-Ministerial Task Force on Integrated Plant Nutrient Management from city compost.

#### Solid waste management: according to the Moef report for 12<sup>th</sup> five year plan

##### Municipal Solid Waste

##### Current status, trends and challenges

As per CPCB estimates, around 57 million tonnes per annum of MSW is presently generated in the country. Based on its physico-chemical characteristics, the MSW generated in Indian cities is suitable for composting. At present, the country has a rated capacity of processing around 6000 tonnes per day of mixed waste into compost. However, the efficiency of the compost plants needs to be enhanced for them to become competitive.

Although nearly 60% of plastic waste is recycled, the management of certain types of plastics like thin polythene bags and PET bottles still remains a matter of concern due to low collection efficiency. The indiscriminate littering and dumping of waste causes severe health risk to people, either through direct exposure or indirectly through contamination of surface and groundwater. The unsanitary disposal sites become prolific breeding grounds for insects and rodents, which act as disease vectors. Burning of garbage in open dumps causes air pollution leading to release of certain extremely hazardous persistent organic pollutants such as dioxins and furans. Solid waste disposal sites in India are often a source of livelihood for the urban poor, who locate their residences in proximity to these sites, making them highly susceptible to health disorders.

##### Performance during the 11th Plan

To enable cities to invest in solid waste infrastructure, a Centrally Sponsored Scheme of Ministry of Urban Development (MoUD) titled 'Jawaharlal Nehru National Urban Renewal Mission was launched in 2005. In this scheme under the Urban Infrastructure and Governance (UIG) component, part-financial assistance is provided to 65 mission cities for improvement in water supply, sewerage, solid waste management, and roads. The smaller and medium cities and towns are covered in another component called Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT).

Mid-term review of the programme reveals that as the first national flagship programme for addressing urbanization, JNNURM has been effective in renewing focus on the urban sector across the country and has helped create a facilitative environment for critical reforms in many states. Investment on the solid waste management systems however is still not high on the city agenda due to poor cost recovery.

##### Hazardous Waste and Biomedical waste

##### Current status, trends and challenges

As per the estimates of CPCB, annually around 7.66 million Metric Ton (MT) of hazardous waste is generated from 40,000 industries in the country, of which landfillable waste is 3.39 million MT (44.26%), incinerable 0.65 million MT (8.50%) and recyclable hazardous waste is 3.61 million MT (47.13%).

The NEP, 2006 accords high priority to hazardous waste management. The action plan on management of solid waste includes the following:

- Develop and implement viable models of public-private-partnerships for setting up and operating secure landfills, incinerators, and other appropriate techniques for the treatment and disposal of industrial and biomedical waste.
- Develop and implement strategies for cleanup of toxic and hazardous waste dump legacies, in particular in industrial areas, and abandoned mines, and reclamation of such lands for future, sustainable use.

**Bio-Medical Waste:** For proper management of Bio-Medical Wastes (BMW) generated in the country, the Ministry of Environment and Forests notified the Bio-Medical Wastes (Management and Handling) Rules in 1998, under the Environment (Protection) Act, 1986. Three amendments have been issued so far.

The Bio-Medical Wastes (Management & Handling) Rules, 1998 provides for segregation, packaging, storage, transportation, treatment and disposal of the bio-medical wastes. As per these Rules, it shall be the duty of every occupier of an institution generating BMW, to take all steps to ensure that such waste is handled without any adverse effect to human health and environment. As per the information provided by the Central Pollution Control Board, the total quantity of biomedical waste generated in our country is about 410 Metric Tons / Day and the total quantity of bio-medical waste treated is 295 Metric Tons /Day. Presently, only about 75

per cent of the biomedical wastes generated in the country is collected, segregated and treated in accordance with the Bio-Medical Waste (Management and Handling) Rules, 1998 and the rest is apparently disposed of without any treatment along with the municipal solid waste.

In addition to the 11,948 captive treatment and disposal facilities developed within some Health Care Facilities (HCFs), there are 177 Common Treatment and Disposal Facilities in operation in the country which were developed mostly by the private entrepreneurs. These common facilities cater to the needs of small hospitals, dispensaries and nursing homes, who are not in a position to set up their own treatment and disposal facilities because of high cost involved. There is still some gap between the BMW generated and treated which -needs to be filled by creating adequate infrastructure in the country.

### Performance during the 11th Plan

Following activities were undertaken by the Ministry to ensure proper handling and management of hazardous and biomedical wastes.

- Funding of treatment storage and disposal facilities (TSDFs) for hazardous waste and common biomedical waste treatment and facilities (CBMWTFs) for biomedical waste
- Notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules 2008 and amendments
- Financial assistance provided for
- Conducting awareness-cum-training programmes on biomedical waste
- Preparation of hazard analysis and offsite emergency plans for 13 districts
- Development of national database on Major Accident Hazard (MAH) installations and chemical accidents
- The CPCB has developed a video film on bio-medical waste management in order to generate awareness about safety standards.
- The Ministry has sponsored a project on GIS based National Hazardous Waste Information System. It is an online web based system, which can give the status of hazardous waste management in the country. The database is required to be regularly updated by all SPCBs on web to ensure updated status at all times.
- In the World Bank funded scheme 'Capacity Building for Industrial Pollution Management' the Ministry has conducted pre-feasibility studies for rehabilitation of hazardous waste contaminated sites. As a follow up, rehabilitation work has been initiated at hazardous waste contaminated sites at Noor Mohammad Kunta (Andhra Pradesh) and Hooghly (West Bengal). The work is expected to be completed in the 12<sup>th</sup> Plan.

### Other wastes

Other solid waste under the mandate of the Ministry include e-waste which is one the fastest growing waste stream and can be sources of health hazard if the recyclable components from it are not salvaged properly.

The key initiative taken for e-waste management includes – Notification of E-waste (Management and Handling) Rules 2011 and providing authorization to e-waste recycling units. Other 'soon to be' waste of concern includes end-of-life CFLs and tube lights which because if their residual mercury content should be dealt carefully.

### Recommendations for the 12th Plan

- To address the problem of indifference in sectoral ministries of environmental issues (e.g. MoH&FW for biomedical waste and MoUD for MSW), environmental cell at the central and state level should be constituted in line ministries. MoEF should sensitize these cells and also monitor their functioning;
- Dedicated budget head should be earmarked in line ministries to address the problems of sanitation and waste management

### Waste Management Scheme

#### Status of the scheme

At present there are 12 ongoing projects in various sectors on Waste Minimisation which are continuing till date. Some of the projects are related to pilot scale demonstration project while others are non-demonstration project including establishment of Waste Minimisation Circle (WMCs). A number of training programmes has also been organized for the SMEs in various sectors of the country during the 11th Five Year Plan. To ensure successful off take, there is a need for enhancement of the pilot scale demonstration project for development of indigenous and economically viable technologies for SMEs. The number of WMCs establishments should also increase proportionately to the number of SME clusters.

#### Achievements of the scheme during 11th Five Year Plan

- Seven demonstration projects of Waste Minimisation have been completed
- Implementation of Waste Minimisation Circles

#### Recommendations for the 12th Five Year Plan

- As there is lot of synergy between the sub-schemes, Waste Minimization and Pollution Prevention Strategies and Clean Technology (ultimately concerned with reduction of waste), these sub-schemes could be merged. Enhancing the actual budgetary allocation of the scheme in 12th Five Year Plan;
- Increasing the existing number of WMCs in the identified clusters. (Source:[http://planningcommission.gov.in/aboutus/committee/wrkgrp12/enf/wg\\_envr.pdf](http://planningcommission.gov.in/aboutus/committee/wrkgrp12/enf/wg_envr.pdf))

#### Satyameva jayate: a shining example of using mass media for creating public awareness

In a very recent episode of Satyameva Jayate, a popular Indian television talk show hosted by Aamir Khan, aired on 16.03.2014, a detail discussion about problems and recommendations for solid waste management was taken place.

### Some important highlights of the episode

- 1 lakh and 60,000 tons of solid waste is generated per day in India.
- First and foremost duty of every household is to separate the wet and dry waste. Waste collection system of Municipality should also be separated.
- If the waste from the dumping area is collected and reused as bio-degradable composting, 90 lakh ton compost per year in India can be generated. Many arid land can become fertile by this process. (Dr. S.R. Maley, Scientist).
- According to Dr. Sharad P. Kale (Scientist, Bhaba Atomic Research Centre), Waste should be called as 'Asset' instead of the used term waste. Dumping land free society should be the aim of India. Everything should go back to nature. We can get 1 ton methane gas, 2 lakhs LPG cylinder if bio-gas can be formed from the waste generated in India every day. This process is effectively applied to the kitchen of Tata Institute of Social Sciences or TISS. The biogas produced from their biogas plant using the residues of kitchen, is reused as fuel for the next day's cooking. Hence, decentralised biogas plant is necessary.
- Sri Ravi Agrawal, Director of Toxics Linc, focussed on the disadvantages of incineration. According to him, though Central Govt. now emphasizes on incineration, this can not be the future of waste management procedure in India. Dioxine (harmful chemical compound) is generated from the incinerators. Besides, there are lots of occupational hazards from incinerators, like, eye-itching, breathing problem, anxiety, cancer etc.
- Two IAS officers of Andhra Pradesh, Shri B. Janardan Reddy and Shri Vivek Yadav, discussed about how they arranged 'Clean City Championship'. The students of some selected schools were said to separate wet and dry waste. The response was tremendous. They claim these types of innovative thinking are necessary for effective waste management. Mr. Reddy said all the meetings related to waste management should be called on dump yard.
- Two representatives of 'Swachh', an association for rag pickers also presented in the show. Kachkari Panchayat and Stree Mukti Sanghathana are also associated with Swachh in order to generate awareness that rag pickers also should have a healthy and hygienic life.
- Lastly, it was said that every ward should adopt decentralised method regarding solid and liquid waste management separately. In India only Bangalore has 80 waste collection centres. But dealing with this huge amount of waste per day, immediately all the mega and micro cities of India should have waste collection centres as early as possible.

### Conclusion: Some Recommendations

Most of the MSW in India is dumped on land in an uncontrolled manner. Such inadequate disposal practices lead to problems that will impair human and animal health and result in economic, environmental and biological losses. During different industrial, mining, agricultural and domestic activities, India produces annually about 960 MT of solid wastes as by-products, which pose major environmental and ecological problems besides occupying a large area of land for their storage/disposal.

Looking to such huge quantity of wastes as minerals or resources, there is a tremendous scope for setting up secondary industries for recycling and using such solid wastes in construction materials. Though many lab processes, products and technologies have been developed based on agro-industrial wastes, non-acceptability of the alternative and newly developed products among users due to lack of awareness and confidence is to be removed. However, environment friendly, energy-efficient and cost effective alternative materials developed from solid wastes will show good market potential to cater to people's needs in rural and urban areas. Public awareness should also be created among masses to inculcate the health hazards of the wastes. Littering of solid waste should be prohibited in cities, towns and urban areas notified by the state government. Moreover, house-to-house collection of MSW should be organized through methods like collection on regular pre-informed timing and scheduling. The collection bins must be appropriately designed with features like metallic containers with lids, and to have a large enough capacity to accommodate 20% more than the expected waste generation in the area, with a design for mechanical loading and un-loading, placement at appropriate locations, etc. Municipal authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions.

In spite of vermicomposting or composting, an open dump or an uncontrolled waste disposal area should be rehabilitated. It is advisable to move from open dumping to sanitary landfilling in a phased manner. Landfilling should be restricted to non-biodegradable, inert wastes and other wastes that are not suitable either for recycling or for biological processing. Although, there are a number of regulations, but unfortunately, clearly there is a large gap between policy and implementation. A new survey should be carried out on the generation and characterization of solid waste in India. Finally, this paper concluded that the lack of resources such as financing, infrastructure, suitable planning and data, and leadership, are the main barriers in effective solid waste management. But, there is a will, there is a way. If we sincerely wish to make our country clean and beautiful, to make our lives more hygienic, no barriers can ever stop this.

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