Short communication

An Overview of Solid Waste Management Scenario and a Comparative Analysis of its Related Legislation in India

Abstract

Solid waste poses a major threat to the environment, aesthetics, and human health which also includes the spread of various communicable diseases. Due to rapid industrialization, urbanization, and uncontrolled population growth, India is witnessing an unresolved problem in terms of solid waste management (SWM). The appropriate execution of SWM can play a pivotal role in achieving sustainable development and is highlighted in many global agendas, visions, and charters. A sustainable SWM may help achieve some of the United Nations' Sustainable Development Goals (SDGs), which is also known as Agenda 2030. It is a set of 17 interlinked global goals that are to be achieved by the year 2030. However, the government is putting in various efforts in terms of bringing various sector-specific stringent laws that make authorities more powerful in the proper enforcement of the rule, and Solid Waste Management Rules, 2016 (SWMR) is one among them. This paper presents a general overview of the solid waste generation and management scenario of our country and a comparative analysis of prevailing SWMR with the Municipal Solid Wastes (MSW) (Management and Handling) Rules, 2000.

Keywords: Communicable diseases, Industrialization, Solid waste, Sustainable Development Goals, Urbanization

Introduction

The term "solid waste" is generally used to describe non-liquid waste material that is generated from our daily activities and generally does not carry any value to the first user. Solid waste comprises both organic and inorganic fractions such as product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper, appliances, *etc*. in different proportions depending upon various factors.

In the Indian scenario, solid waste generally includes degradable (paper, textiles, food waste, straw, and yard waste), partially degradable (wood, disposable napkins, and sludge), and non-degradable materials (leather, plastic, rubber, metals, glass, electronic waste, dust and ash from fuel-burning like woods, coal or briquettes). Usually, solid waste is managed as collection from streets and disposal at landfills.

Ministry of Environment, Forest and Climate Change (MoEFCC, 2000), Government of India, defines solid waste as "commercial and residential wastes generated in a

municipal area in either solid or semi-solid form excluding industrial hazardous waste but including treated bio-medical wastes". Economic and demographic growth of cities, changing lifestyles of people, changing land-use patterns, and technological advancements led to an increase in the quantity and complexity of urban solid waste generation and management. Normally, solid waste is classified according to its source of generation.

Source-based classification

Historically, solid waste sources have remained constant depending on the sector and activity (Tchobanoglous*et al.,* 1977), and these include the following:

i) Residential: This refers to wastes from households and apartments *etc.* and consists of food leftovers, ashes, rotten vegetables, fruits, *etc.*

ii) Commercial: This refers to waste that is generated from stores, restaurants, markets, hotels, auto repair shops and generally consists of food leftovers, glasses, metals, and ashes, *etc.*

iii) Institutional: These types of waste commonly comprise paper, plastic, glasses, *etc.* generated from schools, colleges, offices, prisons, *etc.*

iv) Municipal: It generally consists of non-hazardous substances but sometimes hazardous substances may be present. This includes dust, leafy matter, treatment plant residual sludge, *etc.*, generated from various municipal activities like street cleaning and landscaping, *etc.*

However, in India, solid waste is typically subsumed by residential, commercial, and institutional waste.

v) Industrial: This generally includes the waste generated from industrial activities such as process wastes, ashes, hazardous wastes, *etc.*

vi) Agricultural: This generally includes the waste generated from fields, orchards, vineyards, farms, *etc.* such as agricultural remains, litter, spoiled food grains, vegetables, *etc.*

"It has become a common practice among municipalities that they do not maintain daily data regarding waste generation and its composition within their respective

municipal areas. India has currently a population of about 1210.2 million, of which the population in urban agglomeration is approximately 377.1 million, which consists of about 31.16% of the total population" (Census of India, 2011). "India is one of the least urbanized countries in the world, yet its urban population is the second-largest among the countries of the world" (Ghosh and Kansal, 2014).

"This intense growth in urbanization poses an extra load on the municipalities that ultimately results in the depletion of natural resources" (Gerdes and Gunsilius, 2010). "The nature of solid waste generated in a particular locality depends on the respective suburb, city, country, and seasons. In developing countries, biodegradable food materials and yard wastes normally dominate in solid waste whereas, in developed countries, paper and hardboard dominate" (Joseph *et al.*, 2003; Vishwanathan and Trakler, 2003). "In India, about 80-90% of municipal waste is disposed of in landfills without any scientific practice with open burning that leads to air, groundwater, and soil pollution" (Ahluwalia and Patel, 2018). "Per capita waste generation has also increased at an exponential pace (0.26 kg/day to 0.85 kg/day)" (CPCB, 2018a).

Table 1 shows the predicted decadal growth per capita as well as the total urban municipal waste generated in India.

Table 1: Waste generation statistics of India (Annepu, 2012)

Year	Per capita generation (kg per day)	Total waste generation ($\times 10^3$ Tonnes per year)
2001	0.439	31.63
2011	0.498	47.30
2021	0.569	71.15
2031	0.649	107.01
2036	0.693	131.24
2041	0.741	160.96

The citizens are not very aware of waste management-related issues, and their careless attitude toward their waste creates challenges for municipalities. The likely risk of solid waste at landfill sites is that they emit a variety of greenhouse gases, which lead to environmental pollution and also contaminate groundwater by way of forming leachates (Ngwabie*et al.*, 2019; Li and Zhao, 2001; Ko *et al.*, 2015). "Sound

and micro-dust are other issues during transportation that cause a nuisance for the elderly and newborns" (Yusof *et al.*, 2009). "Management of solid waste at landfill sites is not properly done by municipalities and often attracts the attention of vultures, mosquitoes, various animals, scavengers, and rodents, which could cause health issues and even death to frontline workers and rag pickers" (De Bercegol*et al.*, 2017).

"However, some of the Indian cities like Pune, Panji, Bobbili, Surat, and Alleppy have shown a positive intent toward solid waste management (SWM) strategies selection. It has been also noticed that the municipalities are focusing mainly on the collection part, but advanced treatment is missing. On the other hand, it also requires further improvement to address the SWM issues" (Annepu, 2012). "Resourceful material recovery has been a challenge that could be achieved with the help of the informal sector in the main streamlining of the SWM process. Yet, this can only be achieved with support and funding from government agencies, public awareness, participation, and to eliminate the social taboos" (Annepu, 2012).

Legal Framework for SWM in India

To effectively address the issue of improper waste management in the country, the Government of India has time to time bring policies, regulations, various rules, and reforms that guide the SWM service delivery. A comprehensive list of these guidelines is given below.

Table 2: Important policy landmarks and initiatives by the Government of India on SWM (MoHUA, 2012)

Year	Rules/Acts/Policies/Schemes/Plans	Effectiveness
1989	The Hazardous Waste (Management and Handling) Rules	Partially
1994–95	Strategy Paper on MSW Management by NEERI	Effective
1998	Biomedical Waste (Management and Handling) Rules	Effective
2000	MSW (Management and 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 and Plastic Waste Rules, 2011	Needed revisions
2013	Draft MSW Rules-2013	Moderate
2014	Draft Manual on Municipal SWM and Handling	Partially
2014	Swachh Bharat Mission (CIM-Clean India Mission)	Partially
2015	Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	Currently running
2016	Waste Management Rules, 2016 comprising of SWM Rules, Plastic Waste Management Rules, Bio-Medical Waste Management Rules, E-Waste Management Rules, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and Construction and Demolition Waste Management Rules, 2016.	Revised and Currently running

Until 2000, there were no specific rules on solid waste. Some existing rules like Biomedical Waste (Management and Handling) Rules, 1998, and The Hazardous Waste (Management and Handling) Rules, 1989 dealt with SWM aspects tangentially. A writ petition *Almitra H. Patel v. Union of India* was filed before the Supreme Court and the Hon'ble Court asked each state to file an affidavit regarding compliance with the prevailing rules. When the Hon'ble Court saw the non-compliance at large, a committee was formed to look into the matter precisely under the supervision of the Ministry of Housing and Urban Affairs. Simultaneously, the Central Pollution Control Board (CPCB) after the consultation with the committee swung into action and notified MSW (Management and Handling) Rules, 2000 under Section 5 of the Environment Protection Act, 1986. This rule ultimately provided a uniform framework for the local authorities around the country on SWM. The Hon'ble Court in its verdict also reprimanded the responsible authorities for their inaction and directed them to prohibit the accumulation of trash/garbage, cleaning of public places, ensure proper and scientific disposal of waste, levy charges for littering, *etc.*

Before the ruling in the above case, there were already some verdicts about this matter. In *B.L. Wadhera v. Union of India and Ors.,* it was observed by the Hon'ble Supreme Court that "The capital of India is one of the most polluted cities in the world. The authorities, responsible for pollution control and environment protection, have not been able to provide a clean and healthy environment to the residents of Delhi."

Despite having various waste management rules/policies (Table 2), I shall mainly focus on the comparative study of MSW (Management and Handling) Rules, 2000, and Solid Waste Management Rules, 2016 (SWMR). The latter supersedes the MSW (Management and Handling) Rules, 2000 that have been in place for the last 16 years and expand the ambit of its application.

SWMR was notified on 8th April, 2016 to put down a strong blueprint for systematic waste management across urban agglomerations. This rule has various unique characteristics. However, it is difficult to determine if any lessons from the past have been incorporated into the new rules.

Materials and Methods

Based on recent research and other legislative frameworks available in the country dealing with solid waste management, this comparative analysis aims to provide a quick overview of the efficacy of the existing SWMR over MSW (Management and Handling) Rules, 2000.

Table 3: Comparative analysis of MSW (Management and Handling) Rules, 2000 and SWMR, 2016 and likely implications

Municipal Solid Wastes (Management and Handling) Rules, 2000	Solid Waste Management Rules, 2016	Reasons and likely implications
Title		
Municipal Solid Wastes (Management and Handling) Rules, 2000.	Solid Waste Management Rules, 2016.	In the SWMR, the command area has been extended beyond the Municipal boundary. Therefore, the word 'Municipal' has been omitted.
Application		
Applied to every municipal body.	The SWMR is now applicable beyond the municipal areas and will extend to urban agglomerations, special economic zones, areas under the control of Indian Railways, airports, airbases, *etc.*	The changes were most likely brought to ensure the efficient execution of the Rules and to achieve the objectives of the Swachh Bharat.
Duties of the waste generator		
...Nil...	In this rule, the responsibility of waste generators has been introduced to segregate waste into three categories- Wet, Dry, and Domestic Hazardous Waste in the respective bins and hand over it to the authorized rag-pickers or waste collectors. Event organizers of more than 100 persons shall inform the local authority at least three working days in advance, such person or the organizer of such event shall ensure segregation of waste at source and hand over the same to waste collector or agencies registered by the local competent authority.	The SWMR emphasizes the source segregation of waste, a basic need for channeling the concept of waste out of wealth by recovery, reuse, and recycling. In line with the above, the event organizers, Housing Societies and Market Associations, Gated communities, institutions, and SEZ have been assigned responsibility. This will certainly improve waste segregation and utilization, with less waste or only inert to landfills.

	All Housing Societies and Market Associations, Gated communities, and institutions have an area of more than 5,000 sq. Meters along with all hotels and restaurants shall, within one year from the date of notification of these rules and in conjunction with the competent authority by the producers as given in these rules, make sure of segregation of waste at source, facilitate collection of segregated waste in separate categories, handover recyclable material either to the authorized rag-pickers or the certified recycling firm. The wet waste shall be processed, treated, and disposed of through composting or bio-methanation within the premises as far as possible. The remaining waste shall be handed over to the waste collectors or agency as directed by the local authority. The developers of Special Economic Zones, industrial parks, and industrial estates are to earmark a minimum of 5% of the total area of the plot or a minimum of 5 plots/sheds for recovery and recycling purposes.	
Collection and disposal of sanitary waste like diapers, sanitary pads, and other disposal items		
...Nil...	The maker or product owners of diapers and sanitary pads shall make available a wrapper or small pouch for disposal of each diaper or napkin along with the packet of their sanitary products. All such marketing companies, makers, or product owners shall educate the masses on the proper wrapping and disposal of their products.	The issue of collection and disposal of sanitary waste like diapers, sanitary pads, and other disposal items has been addressed. This will improve the other waste utilization and management namely wet waste for composting, high calorific waste

	All the used sanitary waste like diapers, sanitary pads, *etc.* shall be wrapped properly by users in the pouches provided by the manufacturers or brand owners of these products or in an appropriate packaging material and shall be placed in the bin assigned for the dry waste/non-biodegradable waste. The makers or product owners of disposable products such as tin, plastic packaging, glass, *etc.*, or brand product owners who introduce such products in the market and sell or market their products in such packaging material shall provide necessary financial support to local authorities for the establishment of the waste management infrastructure.	for energy recovery, *etc.*
	Duties of the Ministry of Housing and Urban Affairs (MoHUA)	
...Nil...	The ministry shall prepare the National Policy and Strategy on SWM together with the policy on Waste to Energy in consultation with stakeholders within six months from the date of notification of these Rules: Review of the measures taken by the States and local bodies, Undertake training and capacity building of local bodies and other stakeholders, Providing project finance and technical guidelines to States, UTs, and local bodies on SWM to facilitate meeting timelines and standards.	Being the nodal ministry on SWM, more responsibilities have been given to MoHUA. The national policy on SWM will be a guiding tool for the States/local authorities in SWM. The technical and financial support provided by MoHUA will improve the SWM scenario in the States/UTs.

Promotion of marketing and utilization of compost		
...Nil...	The Department of Fertilizers, Ministry of Chemicals and Fertilizers shall be instrumental in providing market development assistance on city compost and ensure the promotion of co-marketing of the same with chemical fertilizers in the ratio of 3-4 bags: 6-7 bags by the fertilizer companies up to the extent that the compost is made available for marketing to them. The Ministry of Agriculture (MoA) shall provide pliability in the Fertilizer Control Order for the production and sale of the compost, propagate utilization of compost on cropland, set up laboratories to test the quality of compost produced by local authorities or their authorized agencies and issue appropriate guidelines to maintain the compost quality and the ratio of use of compost vis-a-vis chemical fertilizers while applying compost to the cropland.	This effort of producing compost will make the compost plants economically viable and improve the gainful utilization of waste.
Promotion of Waste to Energy plant		
...Nil...	The Ministry of Power shall be responsible for fixing the charges or tariff for the electricity produced from the Waste to Energy plants based on solid waste and ensure the compulsory purchase of electricity produced from such plants by DISCOMs. The Ministry of New and Renewable Energy shall be instrumental in facilitating the infrastructure support for Waste to Energy plants and give appropriate concessions or incentives for such pants.	This effort will make the Waste to Energy plants economically practicable and improve the gainful utilization of waste. The compulsory provision of utilizing 5% of RDF by the nearby industries will support these plants, and minimize the dependency on fossil fuels.

	Industries situated within the periphery of 100 km from a solid waste-based RDF plant and using fuel have to make arrangements within 6 months from the date of notification of SWMR to replace a minimum of 5% of their fuel requisite by RDF. The non-recyclable waste that has a calorific value of more than or equal to 1,500 K/cal/kg shall not be dumped in landfills. It should only be utilized to generate energy either through RDF or by giving away the feedstock for preparing RDF.	
Duties of Secretary, State Housing and Urban Affairs Department, the Commissioner of Municipal Administration, Director of Local Bodies, local authorities, and village Panchayats		
It is the overall responsibility of the Secretary-in-charge of the Department of Housing and Urban Affairs of the respective State or the UT, as the case may be, to enforce the provisions of the SWMR in the metro cities. The Deputy Commissioner or the District Magistrate of the respective district is overall responsible for enforcing the provisions of the SWMR within the boundary of their jurisdiction.	In SWMR, the detailed duties and responsibilities have been given to the Secretary-in-charge, State Housing, and Urban Affairs Department, Commissioner of the Municipal Administration, Director of local bodies, local authorities, and village Panchayats of census towns and urban agglomerations: These authorities are accountable for the preparation of state policy and SWM strategy in consultation with stakeholders including self-help groups, the representative of rag-pickers, and similar groups working in the field of waste management. The user fee for SWM, and spot fine for littering/have been introduced which shall be as specified in the bylaws of the local bodies.	Integration of self-help groups/the representative of rag-pickers in SWM will improve the collection, segregation, and recovery of reusable, *etc.* The imposition of “user fees” and “spot fines” will improve waste collection and management and also strengthen the financial position of local authorities.

Criteria and standards for the waste treatment facility and pollution control		
...Nil...	SWMR provides exhaustive guidelines for establishing the facility for solid waste processing and treatment, SWM in the hilly areas, for site selection, setting-up of sanitary landfills, and development of the amenities, for waste to energy process, specifications for landfilling operations, and closure on completion of landfilling, pollution prevention, closure and rehabilitation of old dumps, *etc.* In the areas where more than 5 tonnes of solid waste is being generated, it is mandatory to notify and provide the buffer zone for the processing of solid waste and the disposal facilities in consultation with the State Pollution Control Board. The landfill site shall be 100 m away from the river, 200 m from a pond, highways, habitations, water supply wells, and public parks, and 20 km away from the Airport or military aircraft base. The emission standards are amended completely and it also adds parameters like dioxins and furans. The limit for particulate matter has been reduced from 150 to 100 and now 50 mg/Nm^3. Compost standards have also been modified to align with the Fertilizer Control Order.	The criteria and buffer zone requirements for waste treatment and landfilling facilities along with other stringent standards laid down in SWMR will facilitate the smooth functioning of the facility without any pollution issue.

Conclusion

SWM is a major concern for almost all the urban areas in India. Due to rapid urbanization, economic growth, industrialization, and population explosion, the solid waste generation rate has increased during the last few decades. This rapid increase in the population generates much more solid waste than expected. Despite significant development in all sectors, the SWM system has remained relatively unchanged. High garbage pressure needs an alternate management option which is hardly practiced in the country.

To efficiently tackle the issue of SWM, the Ministry of Environment, Forest and Climate Change (MoEFCC) has notified the SWMR, 2016 which replaced the existing MSW (Management and Handling) Rules, 2000. The new rule expanded the scope of application to every urban local body (ULB), which was not incorporated in the previous one. Although the SWMR addresses most of the major issues and loopholes of the SWM system in India, some major obstacles have come out in the effective implementation. Firstly, these rules have failed to impose strict penalties for poor execution of these rules, thus instances of deliberate disregard for these rules have been observed now and then since their implementation.

Secondly, these rules mostly encourage a centralized SWM system instead of a decentralized one. And because the centralized SWM mechanism operating in India is not sufficiently equipped to deal with the increasing heaps of trash, there is no wonder that we find instances of complete failure of the system and hyper-saturation of the landfills and garbage dumps.

Therefore, there is a need for a broad and foolproof SWM framework. The framework should not only have an efficient and decentralized waste disposal mechanism but should also have a strict checking system for the appropriate execution of SWMR. The officials engaged in the execution should have the authority to impose strict penalties upon those who would defer from the rules. Community participation should also be encouraged in the proper segregation of waste at the source and its disposal. As far as disposal of the waste is concerned, we need to consider two dimensions before coming out with a disposal policy, one is “financial sustainability” and another is “environmental sustainability”.

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