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Review Paper

A Critical Overview of Legal Profile on Solid Waste Management in India

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Abstract: *The problem of solid waste management in India, in combination with rapid urbanization, population growth and unplanned development is worsening day by day. The more serious situation in future may arise due to the toxicity and unavailability of dumping grounds for such wastes. Present paper discusses the legal profile and policies available on solid waste management in India, responsibilities of the concerned departments and future need to enhance legal regime for better management of Indian environment. It is seen that the current laws are unable to ensure environmentally sound and sustainable ways of dealing with waste generation to disposal practices. The laws are not well understood and efficaciously implemented. Improved legal regime and strict implementation of the laws may prove to see a changed picture in Indian society in coming years.*

Keywords: biomedical wastes, legal profile, management policy, rules, solid waste.

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Introduction

The problem of solid waste management (SWM) in India, in combination with rapid urbanization, population growth and unplanned development is worsening day by day. Municipal solid waste (MSW) includes degradable (paper, textiles, food waste, straw and yard waste), partially degradable (wood, disposable napkins and sludge, sanitary residues) and non-degradable materials (leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, dust and electronic waste)^[1,2]. According to United Nations Development Programme survey of 151 mayors of cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal^[3]. Solid waste pollution occurs when the ecosystem functioning is hampered by an overload in carrying capacity of the natural environment due to sheer bulk and complexity of waste^[4]. Pollution of whether air, water or land results in long-term reduction of productivity leading to deterioration of economic condition of country. Therefore, control on pollution, reduce risk of poor health, protect natural environment and thereby contribute to high quality of life is a key component of sustainable development^[5]. Generally, solid waste is

disposed off in low-lying areas without taking any precautions or operational controls. Solid waste management is one of the major environmental problems of Indian megacities^[6]. The SWM in India seems to be of long-standing problems of poor waste disposal systems, inadequate regulation and unauthorized dumping. The social task of waste management has always been to get rid of it^[7].

The growing volume of solid waste generated by communities is a concern for public health officials. Solid waste results from various sources including animal wastes, hazardous wastes, industrial, medical wastes, food wastes, mineral wastes etc. Urban solid waste includes household garbage and rubbish, street sweeping, construction and demolition debris, sanitation residues, trade and industrial refuse and biomedical solid waste^[8]. The wastes may degrade the resource quality and damage the aesthetic quality, groundwater contamination, an increase in disease spreading vectors and other issues regarding sanitation. The government's consciousness in India has mostly been the response after UN declarations, conferences, agreements and ideal protocols by some developed countries. Detection of toxic chemicals in drinking water supplies, polar ice caps, groundwater sources of

various regions and deadly episodes mainly experienced in Minamata, Chernobyl, London smog, Bhopal Gas Tragedy and Love Canal Tragedy have focused the attention of public worldwide on the risks posed by environmental pollutants including hazardous wastes. India is a signatory to various multinational agreements carried out since 1960 and has shown much interest to conserve a global environment. The strong and internationally acceptable points put in Stockholm conference, Rio conference and World Summit on Sustainable Development indicates the India's commitment to protect environment. India has experienced a disastrous condition in Bhopal on 2/3 December 1984. Unscientific disposal of wastes causes an adverse impact on all components of the environment and human health^[9]. One of the major environmental concerns is release of methane gas, 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^[10].

Landfilling of municipal solid waste (MSW) is a common waste management practice and one of the cheapest methods for organized waste management in many parts of the world^[11]. It is found that landfills causes serious health and environmental risks in the form of externalities like formation of leachate and landfill gas leading to water and air pollution along with disamenity effects like increased population of pests, flies, vermin and visual impacts^[8]. The alkaline nature of the solid waste is responsible for increase in soil pH^[12]. The municipal solid waste generation is expected to increase significantly in near future as the country strives to attain an industrialized nation status by the year 2020^[13]. There has been significant increase in generation of solid wastes in India over last few decades and reason is largely associated with population growth^[14]. The solid waste generated in Indian cities has increased from 6 million tons in 1947 to 48 million tons in 1997 and is expected to increase to 300 million tons per annum by 2047^[8]. The present system of solid waste management is not evenly implemented throughout the country and there is no proper storage of wastes. The street sweepings are not carried out regularly and transportation of the wastes is not satisfactory. The main problem also lies in unscientific management of the wastes. Although typical urban growth rate has been determined at around 2.5 percent annually^[15], waste generation is out pacing the urban population growth in Indian cities^[16]. According to the Central Pollution Control Board, average collection coverage ranges from 50 to 90 percent. Urban local bodies (ULBs) spend about \$10-

30 (INR 500-1,500) per ton on SWM. About 60-70% of this amount is spent on collection, 20-30% on transportation. No financial resources are allotted for scientific disposal of waste^[17,18]. Furthermore, of all collected waste, 91 percent is disposed of in an unacceptable manner without any consideration of state-of-the-art engineering principles. The present review article discusses the salient features of the important provisions of the laws and rules enacted in Indian context (MoEF is base for information) and concludes with important suggestions, present situation seen throughout the country in relation with solid waste management.

Indian Constitution and Waste Management

India is the first country that has made constitutional provisions for protection and improvement of the environment. The Indian constitution provides a broad framework of powers and functions in relation with maintenance of safe and healthy environment for people and other living ones. Article 243 (W) of the constitution specifies the powers, authority and responsibility of the municipalities to carry out functions that are relevant to solid waste management, public health, sanitation conservancy and protection of environment, safeguarding interests of weaker sections and urban poverty alleviation. Article 38 urges the state to secure a social order for the promotion of welfare of people. Article 47 imposes a duty on the state to improve the standard of living and public health. The constitution also imposes certain duties on citizens of the country and courts have expanded the understanding of certain provisions in keeping with changing times. In this connection, Article 21 of constitution says 'No person shall be deprived of his life or personal liberty except according to procedure established by law' while Article 48-A is 'The state shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country'. In addition, Article 51-A (g) is also an important provision related with protection of the environment as 'It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures'. These provisions have formed the basis for the outcome of current environmental governance for the protection of environment in India.

Ministries Related with Task of Waste Disposal In India

Ministry of Environment and Forest (MoEF) is the nodal agency to deal with all environmental matters in India. MoEF is required to examine awareness, research and development initiatives, sustainable development initiatives, location of industrial sites and secured landfills for hazardous wastes, use of environmentally sound technologies

along with many other activities and implantation of programmes. It also deals with enforcement and implementation of plastic waste management rules and batteries rules. All state pollution control boards (SPCBs) and pollution control committees (PCCs) are directed to produce a comprehensive report on illegal waste dumpsites in their jurisdiction. The central pollution control board has to issue guidelines to be followed by all concerned including SPCBs, PCCs and the operators of disposal sites for proper functioning. They are also entitled to form authenticated National Inventory on Hazardous Waste dumpsite. Ministry of Law has assigned the task of formation of legal measures in connection with state government for successful implementation. Ministry of Water Resources plays a significant part to control water pollution. Ministry of Health deals with toxicological aspects of wastes like heavy metals, hormone disrupting chemicals and such other issues. Ministry of Science and Technology is assigned the task of conducting major research with the help of Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Department of Biotechnology (DBT). In addition, Ministry of Petroleum and Natural Gas is involved in matters with respect to oil sector while Ministry of Railways, Defense and Surface Transport has to deal with matters relating to large scale use of battery systems, their disposal and other issues aroused due to waste generation with their activities.

Criminal Laws and the Waste Management

There are two major criminal laws dealing with solid waste management, the Indian Penal Code, 1860 and the Criminal Procedure Code, 1973. The Indian Penal Code, 1860 has dealt with solid waste management under Chapter XIV 'of offences affecting the public health, safety, convenience, decency and morals'. Solid waste is equated with 'public nuisance' under this code, enacted during the British times. Since, solid waste gives rise to various types of diseases and is dangerous to public health, it has been treated as 'public nuisance' and made punishable. Provisions under the Criminal Procedure Code, 1973, Section 133 of the Criminal Procedure Code, 1973 deals with 'removal of nuisance' and empowers the Sub-Divisional Magistrate or any executive Magistrate, on receiving information to order the removal of the public nuisance and desist from carrying any trade, business that is causing public nuisance.

Constitution of the High Power Committee

High Power Committee (HPC) appointed by Hon'ble Supreme Court with Prof. MGK Menon as its Chairman was constituted in 1997 to examine all matters relating to hazardous wastes. The committee concluded that the hazardous wastes situation in India is fairly grim. The industry driven economy of India

has resulted in hazardous waste problems, which are difficult to manage in an environment friendly manner. The non-enforcement of 'Polluter Pays' principle, continuation of import of hazardous wastes, absence of proper infrastructure for treatment, lack of technical and financial resources have led to the unscientific disposal of hazardous wastes posing serious threat to human, animal and plant life. On the basis of the recommendations of HPC, Supreme Court had passed an order on October 14, 2003. The order was based on principles of sustainable development, environmental protection in support of Article 21. It states the right to information and public participation is very important in developmental process and confers the duty of government departments to motivate. These also serve as a guide on how to comply with the MSW rules^[30]. Court also held that the precautionary principle and polluter pays principle should be ensured in decision-making.

Waste Management Governance

The central government has enacted various laws to regulate various kinds of waste generated in the country. The wide range of wastes include household, municipal waste, biomedical waste, e-waste, electronic and electrical equipment, construction and demolition waste, mining waste, power plant waste, hazardous waste, agriculture, forestry waste etc. The Environment Protection Act (EPA), 1986 is the umbrella act that pertains to management of wastes in the country. Ministry of Environment and Forests (MoEF) has enacted rules under EPA that govern the management of all kinds of waste in India.

Recycled Plastics Manufacture, Sale and Usage Rules, 1999 as Amended in 2003

Plastics are essentially non-degradable and their volume eventually consumes a disproportionate amount of landfill space. The Recycled Plastics Manufacture and Usages (amendment) Rules [95], 1999 as amended 2003 are applicable to every manufacturer, stockiest, distributor or seller of carry bags containers made of virgin or recycled plastic. These rules have been framed to regulate the manufacture, sale and usage of virgin or recycled plastic bags/containers. District collector/deputy commissioner of the concerned district has been designated as authority for the enforcement of provisions. As per provisions, carry bags and containers made of virgin plastic shall be in natural shade or white. Carry bags and containers made of recycled plastic and used for purposes other than storing and packaging foodstuffs shall be manufactured using pigments colorants as per IS:9833:1981^[95]. No vendor is allowed to use containers made of recycled plastics for storing, carrying, dispensing or packaging of foodstuffs. Recycling is allowed strictly in accordance with the Bureau of Indian Standards (BIS)

specifications and the manufacturers have to print on each packet of carry bags as to whether these are made of 'recycled' or of 'virgin material'^[95].

Plastic Waste Management Rules, 2011

As per the estimate by central pollution control board (CPCB) the plastic consumption in India, is 8 million tons per annum and about 5.7 million tons of plastics are converted into waste annually. The waste plastic finds its way into drains, open lands, rivers, railway tracks and coasts^[19]. The informal recycling sector responsible for the recycling of around 70% of plastic waste^[20] and up to 56% of all recyclable waste generated in India. Plastics (Manufacture, Usage and Waste Management) Rules, 2009 gives the definition of the terms biodegradable plastic, carry bags, commodities, compostable plastic, container, disintegration, post-consumer plastic waste, waste management and the guidelines in relation with manufacture and usage. The Plastic Waste Management Rules, 2011 gives more emphasis on the management of plastic wastes^[92].

These rules mainly specify the minimum thickness of plastic bags as to be of 40 microns as opposed to the previous 20 microns specified by Plastics Rules, 1999. Carry bags can be made from compostable plastics conforming IS/ISO,17088,2008 and requires a label 'recycled' while those made from compostable material bear a label 'compostable'. Sachets using plastic material can not be used for storing, packaging or selling of tobacco and gutkha. These rules do not allow the carry bags for consumers, co-retailers at free of cost. State level advisory (SLA) body is to be created by each state government for the effective implantation of these rules. As per these rules, use of recycled or compostable plastics for storing, carrying or packing foodstuffs is prohibited. Municipal authorities are assigned the task to engage responsible and expert agencies for implementation of these rules^[92]. They can also ask the manufacturers to establish plastic waste collection centers, in line with the principle of 'Extended producer's responsibility' (EPR). As per generation of plastic waste scenario, there is urgent need for coordinated work among manufacturers and government departments to ensure environmentally safe management^[92]. In addition to this, the responsible and careful move by the consumers will also help in conservation of the environment.

Hazardous Wastes Management

The adverse effects of hazardous wastes as well as the significant potential risks posed by them to the life and its supporting systems are increasingly recognized^[21]. Hazardous wastes, which may be in solid, liquid or gaseous form, may cause danger to health or environment, either alone or when in contact

with other wastes^[22]. It is presumed that about 10 to 15 percent of wastes produced by industry are hazardous and the generation of hazardous wastes is increasing at the rate of 2 to 5 percent per year^[23].

Hazardous wastes can be identified by the characteristics that they exhibit viz., ignitability, corrosively, reactivity, or toxicity [24]. While observing data from various sources, the rate of generation of hazardous wastes in India could be above 6.7 MT/year^[25]. Hazardous wastes (HWs) are generated by various industrial and anthropogenic activities mainly from mining, tailings from pesticide based agricultural practices, industrial processes of textile, pesticides, tannery, petrochemicals, pharmaceuticals, paints, oil refineries and petroleum processing, fertilizers, asbestos, caustic soda and in production of many chemicals. Toxic materials present in solid waste are determinants for respiratory and dermatological problems, eye infections and low life expectancy^[26]. In India, unauthorized dumping of HWs is however continuing and in most of the places, HW is being utilized to fill low-lying areas^[27]. Twelve states of the country (Maharashtra, Gujarat, Tamil Nadu, Orissa, Madhya Pradesh, Assam, Uttar Pradesh, West Bengal, Kerala, Andhra Pradesh, Karnataka and Rajasthan) account for 97% of total hazardous waste generation. The top four waste generating states are Maharashtra, Gujarat, Andhra Pradesh and Tamil Nadu. Very few industrial units in India own proper treatment and disposal facilities to such highly toxic and dangerous wastes.

A common waste treatment and disposal facility such as treatment, storage and disposal facility (TSDF) for management of such wastes is one of the useful options under such conditions. Hazardous Waste (Management and Handling) Rules in 1989 through the MoEF under Environment Act, 1986 and amended in 2000, 2003 to deal with hazardous wastes and to curb related environmental problems. Under the HW (M & H) Rules, the hazardous wastes are divided into 18 categories [93]. Moreover, the role and responsibilities of waste generator, state/central pollution controls boards and state government are clearly defined^[28]. MoEF has started a separate Hazardous Substances Management Division (HSMD) apart from MoEF, CPCB and SPCB's have been delegated certain powers for control and regulation of hazardous wastes. The MoEF has elaborately identified various treatment and disposal options of different hazardous waste streams that include physical, chemical treatment, landfill, biological treatment, incineration, recycle and recovery and solidification etc. Hazardous wastes landfill refers to a waste disposal unit, which is designed and constructed with the objective of minimum impact to environment^[29].

Basel Convention

Basel Convention deals with transboundary movement and disposal of hazardous wastes as well as other chemical wastes. India is a signatory to Basel Convention and ratified the convention in 1992. The basic objectives of Basel Convention are for the regulation, control and reduction of transboundary movements of hazardous, prevention and minimization of generation, environmentally sound management and promotion of cleaner technologies. After ratification of this convention, India will be unable to source hazardous wastes for treatment from Organization for Economic Co-operation and Development (OECD) countries because of the ban. The convention requires specialized treatment facilities in order to ensure an environmentally sound recovery or disposal. Therefore, transboundary shipment of hazardous waste is regulated by the convention. Import of hazardous waste is legally prohibited in India but the import may be allowed for the purpose of recycling, recovery or reuse^[84]. However, the convention is unable to prevent inflow of hazardous wastes into India from countries that have not ratified the agreement (USA and other northern developed countries). Industrialized countries want to dump their wastes in developing countries such as India due to strict regulations of disposal and management of such wastes in their own country^[84]. Restrictions imposed by the convention aim at encouraging signatory countries to reduce generation and disposal in safe manner.

National Hazardous Waste Management Strategy

The hazardous waste management strategy incorporates the essence of National Environmental Policy 2006, relevant multilateral environmental agreements like Basel Convention and the national regulations. It deals with effective management of hazardous wastes to avoid environmental pollution call for appropriate strategy for regulatory bodies, generators, recyclers and operators. The strategy also facilitates implementation of action plan as per National Environment Policy 2006 and obligations under the Basel Convention. Application of 'polluter pays principle', inventory of hazardous waste generation, cement kilns for incineration, common treatment, storage and disposal facilities, interstate transportation, safe disposal, illegal dump sites, remediation and strengthening of the infrastructure of regulatory bodies are some core areas of immediate attention in this field.

Hazardous Waste (Management and Handling) amended Rules, 2003

The Ministry of Environment and Forests (MoEF) has promulgated Hazardous Wastes (Management and Handling) Rules, 1989 and amended the same in 2000 and 2003 for effective management and handling of hazardous wastes. These rules define

hazardous waste as 'any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger, or is likely to cause danger, to health or environment, whether alone or when on contact with other wastes or substances^[94]. There are 36 types of industrial processes listed in schedule-I of these rules. Wastes containing Hg, As, waste Asbestos (dust or fibers), waste oil etc., are in the list of banned wastes for import and export. The 2003 amendment rules have excluded biomedical wastes, MSW wastes and wastes related with lead batteries from the list of hazardous wastes as these are covered under special rules. These rules have also listed the hazardous wastes mainly mercury, its compounds, clinical and related wastes which are prohibited for import and export^[94].

The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008

The rules establish responsibility for safe and environmentally sound handling of wastes by any 'occupier' of hazardous waste. 'Recycling' is defined as 'reclamation or reprocessing of hazardous waste in an environmentally sound manner for the original purpose or other purposes'. The occupier and operator of a facility shall be responsible for proper collection, reception, treatment, storage and disposal of hazardous wastes^[85]. It is also the duty of occupier and operator to prevent accidents and limit their consequences, provide information, training and equipment to persons working on-site to ensure safety. A person engaged in all types of handling of such wastes must obtain an authorization from concerned SPCB. The occupier or handler may store hazardous wastes for a period up to 90 days. He has to keep the records of sale, transfer, storage, recycling and reprocessing of such wastes and shall make it available for inspection. Any occupier may only sell or transfer it to a recycler having a valid registration from the CPCB. In order to use hazardous wastes for energy generation, the occupier has to obtain approval from CPCB. Any persons who wish to operate a 'facility', for the management of hazardous wastes must have treatment, storage and disposal facility (TSDF) in compliance with the technical guidelines issued by the CPCB. The state government, occupier or any association shall identify possible sites for disposal facility but only after preliminary impact assessment studies. In case of interstate transport of hazardous wastes for final disposal, 'No Objection Certificate' is must condition from SPCB's of both states. The occupier, transporter and operator of a facility shall be liable for damages caused to the environment resulting due to improper handling and disposal of hazardous waste^[85].

In addition to these rules, the government has moved to enact into legislation, additional incentives for industries to comply with environmental provisions.

In this vein, the Public Liability Insurance Act, 1991 was adopted to require industries dealing with hazards and to ensure against accidents or damages caused by pollutants. The National Environmental Tribunal Act, 1995 provides provisions for expeditious remedies to parties injured by environmental crimes. Legislation on a Community Right to Know, 1996 has also been adopted to provide more access to information regarding potential hazards from industrial operations.

Biomedical Waste (Management and Handling) Rules, 1998 amended 2011

Management of biomedical wastes (BMW) is governed by the Biomedical Waste (Management and Handling) Rules, 1998 and are published under EPA, 1986^[96]. Prior to 1998, the management of healthcare waste in India was the responsibility of municipal or governmental authorities. Hospitals generate various kinds of wastes from wards, operation theatres and outpatient areas. These wastes include bandages, cotton, soiled linen, body parts, sharps (needle, syringes etc), medicines (discarded or expired), laboratory wastes etc. Other wastes generated in healthcare settings include radioactive wastes, mercury containing instruments and polyvinyl chloride (PVC) plastics. These are among the most environmentally sensitive by-products of healthcare^[31]. Tuberculosis, pneumonia, diarrhoeal diseases, tetanus, whooping cough etc., are other common diseases spread due to improper waste management^[32]. The government hospitals and major private hospitals have their own arrangement for treatment of biomedical waste^[33]. Lakshmi^[34] argues that the management of health care waste in India is 'bleak'. It is common scene in India that biomedical waste generated from health care facilities in most of the places are collected without segregation and are disposed in municipal bins located either inside or outside the facility premises. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose, or handle biomedical waste in any form^[96].

The occupier of an institution generating biomedical waste has to get authorization of handling from the concerned SPCB. Under the BMW rules 2011, every occupier generating BMW require authorisation which was only mandatory for the occupier having 1000 beds as per 1998 rules [96]. It shall be the duty of every occupier of an institution generating biomedical wastes to take all necessary steps and ensure safe handling. The wastes also include a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank etc. The biomedical wastes are not allowed to mix with other wastes and require segregation at the point of generation, which is required to be done in accordance with standard procedures prior to storage, transportation, treatment and disposal. The containers

shall be labeled appropriately. The biomedical waste shall be transported only through authorized vehicle. Biomedical wastes are also not allowed to store beyond a period of 48 hours. The treatment and disposal shall be in accordance with standard procedures. These rules also demands for treatment facilities like incinerator, autoclave, microwave system and requisite treatment at common facility. When any accident occurs, authorized person has to report to prescribed authority. In addition, every occupier/operator has to submit annual report related with maintenance of record, collection, reception, storage, treatment and disposal^[96]. Despite the introduction of the Biomedical Rules, Lakshmi^[34] states that waste generated by government hospitals is still largely being dumped in open area, waiting to be collected along with general waste.

The Batteries (Management and Handling) Rules, 2001 Amendment 2010

The Batteries (Management and Handling) Rules, 2001 amended in 2010 apply to every manufacturer, importer, re-conditioner, assembler, dealer, recycler, auctioneer, consumer and bulk consumer involved in manufacture, processing, sale, purchase and use of batteries^[87]. They also ensure that used batteries are collected back for the purpose of recycle or proper disposal. These rules also required to file a half-yearly return of their sales and buy-back to the concerned state board, set up collection centers and ensure that used batteries are sent only to the registered recyclers without any damage to the environment. It is also the duty of producers and others to raise public awareness, publications, posters or by other means against the hazards of lead. It is the responsibility of consumers to return their used batteries only to the dealers at designated collection centers to avoid environmental damage. The importer shall get himself registered with MoEF^[87]. Only one export-import (EXIM) code exists for both old and new computers, preventing targeted compliance monitoring^[35]. Furthermore, imports are often falsely declared to be for charity, going instead to informal recyclers or becoming e-waste within two or three years^[36]. Lacking an effective enforcement mechanism and awareness throughout the country, the legislation remains fruitless, as the success at selected urban areas cannot form the basis of ideal output as expected.

Fly Ash Utilization Notification 1999

It is reported that fly ash production in India will exceed 140 million tons by 2020^[37]. Some areas of fly ash utilization, wherein technology demonstration projects have been completed or are under way, include mine filling, road construction, embankments, hydraulic structures, manufacture of building components, like bricks, blocks and tiles, etc.^[38]. In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated

in recent decades now require that it can be captured prior to release. Internationally, fly ash has been used in many applications^[39] for several years. The draft notification containing certain directions is published under Environment (Protection) Rules, 1986^[88]. Under this notification, it is made compulsory for the manufacturers within 50 km of radius from coal or lignite based power plants to use at least 25 percent of ash for manufacture of bricks, tiles, blocks with soil. Every thermal power plant shall make available ash without any payment, for at least ten years from the date of publication of this notification for manufacturing ash-based products including cement, concrete blocks, bricks, panels, construction of roads, embankments, dams, dykes etc. and construction activities. The central and state government agencies including state electricity boards, national thermal power corporation and management of thermal power plants have to make available land, electricity and water for all mentioned activities. It is also their duty to provide access to ash lifting area for promoting and setting up of ash-based production units^[88].

E-Waste (Management and Handling) Rules 2010 Amended 2011

In India, e-waste generation is growing at about 15% and is expected to cross 800,000 tons per year in 2012. As per Central Pollution Control Board report, 65 cities in India generate more than 60-70% of total e-waste. These wastes which come from 10 states, namely Maharashtra, Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab^[40]. E-waste from developed countries find an easy way into developing countries in the name of free trade^[25] which is further complicating the problems associated with waste management. The electronic devices reach at the end of their useful life, they become e-waste or waste electrical and electronics equipments (WEEE)^[41]. The fraction including iron, copper, aluminium, gold and other metals in e-waste is over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70%^[42], India is experiencing the environmental problems of E-waste^[43]. The quantity of WEEE generation in different States in India is shown in Table 1^[44].

The issue of EEE disposal, import and recycling has become the subject of serious discussion and debate among the government organizations, environmentalist groups and the private sector manufacturers of computers and consumer electronic equipment's^[44]. The Central Pollution Control Board, India had released guidelines in 2008 for environmentally sound management of e-waste, which apply to all those who handle the e-waste^[45]. The guidelines have been formulated with the objective of providing broad guidance for identification of various sources of e-

waste and the approach and methodology for handling and disposal of e-waste^[44].

Table 1: E-waste generation in top ten cities in India

S. No.	City	WEEE, Tons per year
1	Mumbai	11017.1
2	Delhi	9790.3
3	Bangalore	4648.4
4	Chennai	4132.2
5	Kolkata	4025.3
6	Ahmedabad	3287.5
7	Hyderabad	2833.5
8	Pune	2584.2
9	Surat	1836.5
10	Nagpur	1768.9

E-waste contains more than 1,000 different substances and chemicals, many of which are toxic and are likely to create serious problems to the environment and human health if not handled properly. Around 40% of unused and obsolete electronic products remain at homes, godowns and warehouses, as one does not know what to do with such wastes.

However, classification of e-waste as hazardous or otherwise, depends on the amount of hazardous constituents present in it. E-waste contains many toxics such as heavy metals, including lead, cadmium, mercury, gases, biologically active materials, acids and plastic additives including polychlorinated biphenyls (PCBs), polyvinyl chloride (PVC) etc. Additionally E-waste is also a collective terminology for the entire stream of electronic equipment such as TVs, refrigerators, telephones, air conditioners, computers, laptop, notepad, printers, calculators, telephones, mobile phones etc. that has reached its end of life (EOL) for its current user. These rules applies to every producer, consumer or bulk consumer involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components, collection centre, dismantler and recycler of e-waste. The rules gives the definition of terms mainly authorization, bulk consumer, historical e-waste, environmentally sound management, e-waste, electrical and electronic equipment, recycler etc. As per these rules personal computer manufacturers, mobile handset makers and white goods makers will be required to come up with e-waste collection centers or have to introduce 'take back' systems^[89]. It is the duty of producer to carry out recycling or disposal, collection of e-waste generated from 'end of life' of their products in line with the principle of 'Extended Producer Responsibility'. It is also the duty of producers to aware consumers about

hazardous components of the product. The written instructions are required on the product with the do's and don't's about handling. They also have to give information booklets to prevent e-waste from being dropped in garbage bins. Bulk consumers such as enterprises and government will be responsible for recycling of e-wastes generated by them. The bulk users have to ensure that e-waste generated by them is channelized to authorized collection centers or is taken back by the producers. Collection centers have to obtain an authorization from the concerned SPCB. Dismantlers ensure that no damage is caused to the environment and processes are in accordance with the prescribed standards. 'No Objection Certificate' is required for the interstate movement of e-wastes from concerned authorities. Continued and concerted efforts on behalf of government, producers and environmental groups are necessary to ensure proper management E-waste in India. Reusing and recycling the raw materials from obsolete E-products help in conserving natural resources and reducing pollution^[89].

Municipal Solid Waste (Management and Handling) Rules, 2000

The Municipal Solid Wastes (Management and Handling) Rules 2000 are not the only policy documents targeting the issue. In addition, as part of the National Environment Policy 2006, the action plan for soil pollution comprises strengthening the capacities of ULBs for segregation, recycle, reuse of municipal solid wastes and setting up of sanitary landfills, in particular through competitive outsourcing of SWM services^[46]. Nearly 55 per cent of urban household waste generated, consists of organic waste that can be composted and another 15 per cent, can be retrieved as recyclables. The residual 30 per cent would require scientific land filling^[46]. The MSW amount is expected to increase significantly in near future as the country strives to attain an industrialized nation status by the year 2020^[47]. Municipal administrations often lack financial and technical abilities to provide proper SWM services and introduction of community-based schemes involving communities in collecting, sorting and recycling activities has proved a viable alternative^[48]. With rapid urbanization, situation is becoming critical [49]. The per capita solid waste generation varies from 300 g in Bangalore to 500-550 g in Mumbai and Delhi^[49]. It would not be easy for the Municipal Corporation to handle them efficiently until they design comprehensive policies to overcome present problems^[50]. The inadequate collection of revenue and meager sources of revenue is another reason for pitiable finances^[51]. Indian municipalities have overall responsibility for solid waste management in their cities. The difficulties in providing the desired level of public service in the urban centers are often attributed

to poor financial status of managing municipal corporations^[52, 53].

In low-income countries, composting is rarely done whereas in developed countries it is a popular tool at backyard and large facilities^[54]. Under aerobic process, organic portion of the waste is decomposed and compost having high N, P, K values and C/N ratio is produced^[6]. Nearly 55 per cent of urban household waste generated, consists of organic waste that can be composted, and another 15 percent, which can be retrieved as recyclables. The residual 30 per cent would require scientific land filling^[4]. Majority of MSW disposal sites in developing countries especially in Asia and Africa are open dumping ground where insufficient or no cover soil is provided^[55]. In India, 70-90 % of landfilling is open dumping^[56] and several of Class II and Class III cities have only option of illegal dumping in absence of facility. Such dumping grounds have poor or no foundation, liners, leveling, cover soil, leachate management, leak detection, gas collection, treatment facility and designated lifetime of dumping ground^[57]. Waste disposal methods, incineration or landfilling have advantages and disadvantages from waste management perspective, but the choice of management methods have important implication on public, environment and climate^[55]. Due to lack of data and infrastructural, financial and human resources urban local bodies (ULBs) could not achieve the Supreme Court mandate of complete compliance to the rules by 2003. This ideal goal remains to be a distant dream. Although some cities have achieved some progress in SWM, many cities and towns have not even initiated measures^[18].

The failure of municipal solid waste management (MSWM) can result in serious health problems and environmental degradation. SWM is part of public health and sanitation and according to the Indian constitution, it falls under state list. The 74th constitutional amendment gives constitutional recognition for local self-government institutions specifying the powers and responsibilities. To prevent future problems, India must take immediate steps on waste generation, recycling, recovery, reuse and sustainable disposal. At the national policy level, the MoEF has legislated Municipal Solid Waste (Management and Handling) Rules, 2000^[90]. The objective of these rules is to make every municipal authority responsible for implementation of various provisions of the rules within its territorial area and to develop an effective infrastructure for collection, storage, segregation, transportation, processing and disposal. Municipal authorities are has to obtain authorization from concerned SPCB to set up waste processing and disposal facilities. Initial efforts related with solid waste management in India goes back to 'Solid Waste Management in Class I Cities in India',

committee constituted by Honorable Supreme Court of India in 1999, 'National Plastic waste Management Task Force' committee constituted by MoEF, 1997 and 'Waste to Energy Policy' as promoted by the Ministry of Non-Conventional Energy sources (MNES), 1995. Under these rules some of the major functions of civic body include, prohibition of littering, house-to-house waste collection, conducting awareness programs, provision for storage facilities, use of color code bins, promotion of segregation, transport and processing for composting, anaerobic digestion, pelletisation and disposal of inert wastes in sanitary landfills etc. A PIL was filed by Almitra Patel and others in the Supreme Court of India in 1996 alleging that GOI, state governments, and urban local bodies (ULBs) have failed to discharge their obligatory duty to manage MSW appropriately^[91]. Later, Supreme Court set up an expert committee in March 1999. The principal recommendations of the committee have been incorporated in the Municipal Solid Waste (Management and Handling) Rules, 2000 notified by Ministry of Environment and Forests^[90].

These rules defines the scientific terms mainly anaerobic digestion, authorization, biodegradable substance, biomethanation, collection, composting, demolition and construction waste, disposal, generator of wastes, landfilling, leachate, municipal solid waste, operator, pelletisation, processing, recycling, vermicomposting etc. The compost has certain humic characteristics and is beneficial to plant growth thus making the compost of MSW is a key issue for sustainable agriculture and resource management^[58]. Contamination of MSW compost by heavy metals can cause harm to public health and environment and is the major concern leading to its restricted agricultural use^[59]. In relation to soil biological properties, numerous researchers have reported different effects of MSW compost on soil microbial biomass and activity^[60-62]. Indian cities are still struggling to achieve the collection of all MSW generated. Metros and other big cities in India collect between 70- 90% of MSW. Smaller cities and towns collect less than 50%^[17].

Waste generation rate in Indian cities ranges between 200-870 g/day, depending upon the region's lifestyle and the size of the city. The per capita waste generation is increasing by about 1.3% per year in India. Therefore, increase in MSW will have significant impacts in terms of land required for disposing the waste, as it gets more difficult to site landfills^[18]. Under these rules, every municipal authority is responsible for implementation of the provisions and development of infrastructure for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes. The SPCB has to monitor compliance of the standards regarding ground water, ambient air, leachate quality

and compost quality including incineration standards. Due to the reducing property of leachate, during percolation through soil strata, it reacts with iron (Fe) and manganese (Mn) species underground and reduces them into more soluble species, thus increasing their concentrations in groundwater^[63]. In case of any accident related with MSW at the time of collection, segregation, storage, processing, treatment and disposal facility or landfill site or during the transportation of such wastes, the municipal authority has to report to the secretary in-charge of the urban development department in metropolitan cities or to the District Collector or Deputy Commissioner.

At the level of policy, more recently, the National Environment Policy, 2006 attempts to integrate the waste pickers into the waste collection system where it states, 'Give legal recognition to and strengthen the informal sector systems of collection and recycling of various materials. In particular, enhance their access to institutional finance and relevant technologies'. Increased presence of informal sector in large cities explains the huge difference in recyclables composition between large and small cities^[64]. Informal rag picking is prominent and is not only limited to rag pickers but also at source by lowest grade municipal workers for extra income^[65]. Waste management in households is a woman's job in many developing and poor countries. Many waste management Community based organizations (CBOs) are organized by women (examples in Karachi, Chennai, Dacca, Hanoi). A majority of waste pickers are women and children (example of Bangalore, India). Source reduction begins with reducing the amount of waste generated and reusing materials to prevent them from entering the waste stream^[64]. The Karnataka and Rajasthan Government have prepared policy statements on SWM and have also prepared technical manuals on design, operations of the SWM and landfill disposal while Gujarat Government has passed a resolution to allot land to municipal corporations and local bodies on a token lease rent. In addition, there are municipal corporation acts by different states mainly Delhi Municipal Corporation Act 1959, Uttar Pradesh Municipal Corporation Act 1959 and Karnataka Municipal Corporation Act 1976. The Delhi Plastic Bag (Manufacture, Sales and Usage) and non-biodegradable garbage (control) Act, 2000, was enacted to prevent contamination of foodstuff carried in recycled plastic bags, reduce use of plastic bags, throwing or depositing non-biodegradable garbage in public drains, roads and places open to public access.

Due to number of problems, they have not been very effective as far as SWM services are concerned^[53] and unfortunately, there is a large gap between policy and actual implementation.

Case Studies

Apart from the municipal authorities, the pollution control boards also have a basic duty under EPA, 1986 to assist in proper disposal of the wastes. In *Virendar Gaur v. State of Haryana*, the Supreme Court declared that right to life under Article 21 encompasses right to live with human dignity, quality of life and decent environment. Thus, pollution free environment and proper sanitary condition in cities and towns is considered to be integral part of right to life. In the famous case of *Municipal Corporation, Ratlam v. Shri Vardhichand Justice Krishna Iyer* declared that '...the guns of section 133 go into action wherever there is a public nuisance'. The court also pointed out that Article 47 of the Indian constitution makes it imperative that 'steps taken for the improvement of public health as amongst the primary duties of the municipalities.' The landmark case that drew attention to and changed the manner in which waste is handled in major cities is ruling in *Almitra Patel* case. A writ petition was filed by Almitra Patel regarding the management of solid waste disposal in four metropolitan cities namely, Mumbai, Chennai, Calcutta and Delhi. The Court by an order in January 1996 appointed a committee to look into the aspects of 'municipal solid waste management'. Later the pronouncement made by the Supreme Court compelled the central government and the MoEF to notify the Municipal Solid Waste (Management and Handling) Rules, 2000. In addition to this, environmental laws is, perhaps par excellence, an area where national lawmakers, policy makers and authorities can learn from each other's mistakes and successes^[66].

In this context, specific criteria for evaluating environmental policies are efficiency, fairness, incentive for improvement and enforceability^[67]. Judicial interpretation has strengthened this constitutional mandate. In the case of *Tarun Bharat Sangh Alwar v Union of India*^[68], the Supreme Court had ruled that 'the issues of environment must and shall receive the highest attention from this court'. In the same case, the Supreme Court said, 'This litigation concerns environment'. There is need to select technologies that produce no or low quantities of wastes and recycle or reuse waste products^[69].

Privatization

The tremendous pressure on budgetary resources of States/ULBs due to increasing quantities of MSW and lack of infrastructure has helped them involve private sector in urban development^[18]. Government of India has also invested significantly in SWM projects under the 12th Finance Commission and Jawaharlal Nehru National Urban Renewal Mission (JNNURM). The financial assistance provided by GOI to states and ULBs amounted to USD 510 million (INR 2,500 crores)^[18]. Private sector participation in

SWM has been actively encouraged since last decade in several urban local bodies. The scope of the participation however, is restricted largely to awarding contracts for door-to-door collection of waste, street sweeping, composting of waste, transportation of waste and storage in depots/dust bins. In certain cities, for instance Surat, contracts are awarded for night cleaning of major roads. Rate per square metre is fixed for making the roads litter and dust free. Hyderabad city has introduced a contractual system of street cleaning as well as transportation of waste. The contractors are paid fixed monthly amount for the area allotted to them. Several cities (Mumbai, Bhopal, Bangalore, Thane, Ahmedabad, Pune, Kolhapur and Nasik) have entered into a contractual arrangement with private sector for setting up compost plants. The land is given to the private sector on a nominal lease rent for a long term of 15-30 years. In general, institutions refer to conventions, norms and legal rules of a society that provide expectations, stability and meaning essential for coordination that in turn regularize life, support values and protect-produce interests^[70].

The challenges of effective solid waste management are exacerbated with the growing urbanization^[71]. A more environmentally oriented view of urban solid waste management includes reuse, recycling and recovery activities^[72]. The actors involved in capacity development can be categorized into three levels, individuals, organizations and institutions/society (Task Force on Aid Approaches). A typical example is the urban development program that the World Bank promoted from 1976 in 40 cities around the world, including Cairo, Alexandria, Manila, Djakarta and Singapore^[73]. In most cases, overseas development assistance often took the form of providing waste collection machinery or waste disposal facilities^[74]. Privatization is actively pursued under the principle of 'public private partnership (PPP)'. One of the recent characteristics is that such initiatives are taken in many cities of developing countries as well^[75]. Therefore, growth of private companies by free competition, proper planning, work environment, monitoring and control of services are keys to the success of PPP^[76].

Maharashtra State Policy on SWM

The Maharashtra has put in place an action plan for effective implementation of Municipal Solid Wastes (Management and Handling) Rules, 2000. The action plan clearly identifies NGO's and self-help groups (SHGs) as a cheaper alternative for the purposes of contracting out door-to-door collection. The resolution also adopts an inclusive approach to waste pickers and notes 'Instead of keeping them at the end of waste collection chain and obtaining recyclable things only from community bins or from the mixed garbage thrown on land fill sites, rag pickers should be given

multiple contract to collect waste form door to door and take it to processing plants'. Maharashtra Non-Biodegradable Garbage (Control) Act, 2006 has created a separate authority competent for enforcement of the provisions of these rules and mainly functions in use, sell, collection, segregation, transportation and disposal of plastic carry bags/non-biodegradable garbage within their respective jurisdiction. The Maharashtra state has thus adopted many progressive and inclusive policies in creating an enabling environment for informal sector particularly waste recyclers. The rag pickers are allowed to form co-operatives and registration of rag pickers is being started. They are also not allotted the task of collecting bio-medical waste and polluted/toxic waste. This all is done in partnership or association with private sector and with NGO's working at grass root level in the society. Small biomethanation plants have been set up through private sector participation in Vijayawada and eight other towns in Maharashtra.

MSW in Pune

The Bombay Provincial Municipal Corporations Act (BPMC) of 1949 applies to the Pune Municipal Corporation (PMC) and Pimpri Chinchwad Municipal Corporations (PCMC). After MSW Rules 2000, the state of Maharashtra enacted Maharashtra Non-biodegradable Garbage Control Act, 2006. The civic bodies in these cities are mandated by the act to provide for public receptacles for garbage, transport of garbage and its final disposal in such manner that is not detrimental to public health. The municipalities are also required to undertake sweeping of public areas such as roads, markets and other open spaces, cleaning of gutters, drains and the sewage channels and fumigation. Pune model related with MSWM is sustainable and one of the ideal examples in the country. The city has best implemented the primary collection models as per MSW Rules 2000 where social enterprises are allowed and employed for door-to-door collection (DTDC) of wastes. More credit goes to state managers and implementers as it integrates the waste pickers and socially marginalized people along with support from NGO's and peoples of city. Recovery of recyclable materials by informal system is up to 56% in Pune^[77]. Cities such as Bangalore, Chennai, Mumbai and Pune have very active community based and decentralized composting schemes, by which sorted waste is turned into high-quality compost. Composting is a feasible option when degradable and non-degradable wastes are handled separately^[6].

The Environmental Protection Act (EPA) 1986

Enacted in 1986, the Environment Protection Act aims to establish a sufficient protection system for the environment. It gives power to the central government to regulate all forms of waste and to tackle

specific problems in different regions of India. It is the primary legislation and referred as umbrella act. It contains important provisions concerning the environment and encompasses indirectly almost all aspects of the environment directly or indirectly. No person carrying on any industry, operation or process shall discharge or emit any environmental pollutants in excess of such standards as may be prescribed. It also involves the polluter-pays principle and preventive approach to reduce the damage on environment. This concept of continuing punishment for the contraveners is very important provision as it establishes harsh penalties in continuation of environmental degradation. The law holds responsible director, manager or secretary or other officer of the company, in relation with environmental damage as liable for offences.

Key Requirements in SWM

Solid waste management includes all administrative, financial, legal, planning and engineering functions involved in the whole spectrum of solutions to problems of solid wastes^[78]. In India about 40-80% of plastic waste is recycled compared to 10-15% in the developed nations of the world. However, the recovery rate of paper was 14% of the total paper consumption in 1991, while the global recovery rate was higher at 37%^[79]. Sorting and recycling at generation source initiated at various places are encouraging activity^[54, 80]. However, this is mainly done for valuable materials. Most recycling in low-income countries is by informal sectors for livelihood and import of material for recycling. However, in high-income countries, recycling technology is intensive and organized for long-term market interest^[81]. It is scientifically proved and well established that the best practices for waste management can be achieved by well-known '3 Rs' principle. These '3 Rs' are the foundation of most waste minimization strategies. There is urgent need of public awareness and contribution by all the citizens on these aspects. 1) Reduce, The most uncontrollable phase in solid waste management is 'waste generation'. It is always advisable that to reduce the generation of solid waste at source 2) Reuse, Reutilization value of any item should be well known and should be identified well. In this connection NGO's and private sector can play a crucial role 3) Recycle, The process of transforming materials into secondary resources for manufacturing new products is known as recycling and ultimately saves energy a lot.

Better technology selection, trained manpower, public awareness, strengthening institutional mechanism, enforcement of law provision and participation of all stakeholders are the key elements in solid waste management of various types. Waste-to-Energy combustion (WTE) can also be the other option which a process of controlled combustion, using an enclosed device to thermally breakdown

combustible solid waste to an ash residue that contains little or no combustible material and that produces, electricity, steam or other energy as a result^[82]. It is known that as much as 95% of a product's environmental impact occurs before its discarded^[83]. Capacity building is enabling the stakeholders with awareness, skill, education and research to tackle any crisis in the target area^[83].

Conclusion

Overall, it seems that the laws related with solid waste management in India talk about treatment, handling and other scientific techniques but whether implemented successfully or not is questionable and matter of discussion. On the other hand, the picture is also clear that very few laws deal with monitoring mechanisms on performance evaluation of the government authorities and concerned agencies. Entire SWM scenario requires immediate attention of the governments, civic organizations to stop environmental problems as increasingly seen in almost every city of the country. It is seen that the policies lack holistic approach towards waste management and hence need for the participative approaches of all sectors for effective outcome. Integrated solid waste management provides a framework and ideal guidelines for the treatment of wastes where sustainable waste management practices are followed and all states must include ideal aspects of ISWM. There is need to generate sufficient funds at initial stage for the treatment of wastes and by following practice of 'wealth from wastes' in order to reduce economic burden on society. 'Polluter pays principle' for waste generators is one of the best options but should be strictly monitored as may lead to malpractice due to some soft provisions mentioned in the laws. Major drawback of the existing SWM rules 2000 is that they do not mention about the role played by informal sector workers. Direct promotion of incineration seeks to displace and affect the waste pickers at large.

The traditional rights of waste collectors and recyclers needs to be acknowledged and formalized to give better surety of the jobs. Though, the rules recommend recycling they do not say how to follow it or give any direction towards promoting recycling. Landfill sites have not yet been identified by many municipalities and in many, the landfill sites have exhausted. The local bodies do not have resources to acquire new land. In this regard progressive efforts and implementation based on Pune model need to be adopted by other states. There should be clear watch on unscientific disposal of solid wastes and strict fines and punishments against law flouters. The government must impose strict regulations and penalties to the outsiders who dump wastes in the country. To handle the overall matters of solid wastes, respective pollution control boards and the local agencies must come up

with the stringent implementation of the existing laws and the rules therein. Considerable delay in notifying the sites for hazardous wastes and other solid wastes is also a problem in increasing severity of the problems, which requires solutions at the earliest.

Though the HWM Rules came into existence in 1989, it is seen that they are never implemented in a spirit of minimum cause to the environment, many things are ideal and remains on paper. On the other hand environmental impact assessment should be strictly practiced in order to designate the future impact on the environmental components and selection of proper sites for treatment of hazardous wastes. Soft corner should not be given especially for the treatment of hazardous wastes in ecologically fragile areas. Perhaps not accepting the wastes from outsiders and step-by-step implementation of advanced means to treat the hazardous wastes could be best option to save valuable ecosystems of our country. As a final point, there is need to carry out changes in existing laws regarding disposal of e-wastes, hazardous wastes, plastic wastes etc. as per changing conditions of lifestyle patterns of the Indian society.

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