INTEGRATED WASTE MANAGEMENT POLICY AND LEGISLATION FOR AFRICAN NATIONS

2017

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Maps in this report are indicative and not to scale.

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List of abbreviations

AFDB	African Development Bank Group
AFR	Africa region
C&D	Construction and demolition
CSR	Corporate social responsibility
EC	European Commission
EPR	Extended Producer Responsibility
GDP	Gross Domestic Product
GHG	Greenhouse gas
HIC	High income country
ICI	Industrial, commercial, and institutional
IPCC	Intergovernmental Panel on Climate Change
ISWM	Integrated solid waste management
MSW	Municipal Solid Waste
MRF	Materials recovery facility
NEMA	National Environmental Management Agency
OECD	Organization for Economic Cooperation and Development
RDF	Refuse-derived fuel
SWA	Solid Waste Analysis
SWM	Solid waste management
TPD	Tonnes per day
TSDF	Treatment, storage and disposal facilities
WFD	Waste framework directive
WHO	World Health Organization

1. INTRODUCTION

Background

As per the 2012 World Bank report, *What a Waste*, the world generates 1.3 billion tonnes of municipal solid waste (MSW) per year, which is expected to increase to approximately 2.2 billion tonnes per year by 2025. This means there will be a significant increase in per capita waste generation rates, from 1.2 per person per day in 2012 to 1.42 kg per person per day in 2025. However, global averages are broad estimates as rates vary considerably between regions, countries, and cities—even within cities.[1]

More than half of the world's population lives in urban areas. At the present rate of urbanization and growth of the world's population, there will be about 2.5 billion more people living in urban centres by 2050, mainly in Africa and Asia. Urban living is associated with better employment and education opportunities, better health, and greater access to social services, and opportunities for social and cultural activities. Waste generation is inextricably linked to urbanization and economic development. Asia and Africa currently have the highest rates of urbanization.[2] As countries urbanize, their economic wealth increases, which has a direct correlation with the amount of waste generated.

Worldwide, the quantity of waste and per capita generation rates are high in high-income countries in comparison to medium- and low-income countries. This is due to more consumption of materials because of higher living standards and extensive urbanization.

Waste generation in Africa

Africa has had the fastest rate of urbanization for the past two decades at 3.5 per cent a year, according to the African Development Bank Group (AFDB). About 36 per cent people in the continent now live in urban areas, a share that is expected to reach 50 per cent by 2050, as per World Bank estimates.[3] The fallout of this is the generation of enormous amounts of solid waste. What is worse, the bulk of the urban population stays in slums where waste management services are often woefully inadequate, according to a 2014 UN Habitat note, titled *Urbanization Challenges, Waste Management and Development*.[4]

Waste generation data is not adequate for sub-Saharan African countries such as Ghana, Ethiopia, Namibia, Swaziland, Tanzania etc.[5&6] There is no sub-categorization of waste into different streams such as e-waste, biomedical waste and hazardous waste in a majority of African countries. Sub-Saharan Africa generates approximately 62 million tonnes of waste every year. Per capita waste generation is generally low in this region, but spans a wide range, from 0.09–3.0 kg per person per day, with an average of 0.65 kg per capita per day. The countries with the highest per capita rates are islands, likely due to

a high floating population. This is applicable to Zanzibar, whose economy is largely dependent on the tourism industry (80 per cent). The island has limited resources and it has become a challenge to cope with a high influx (about 0.5–0.6 million every year) of tourists.[7]

Waste generation by region

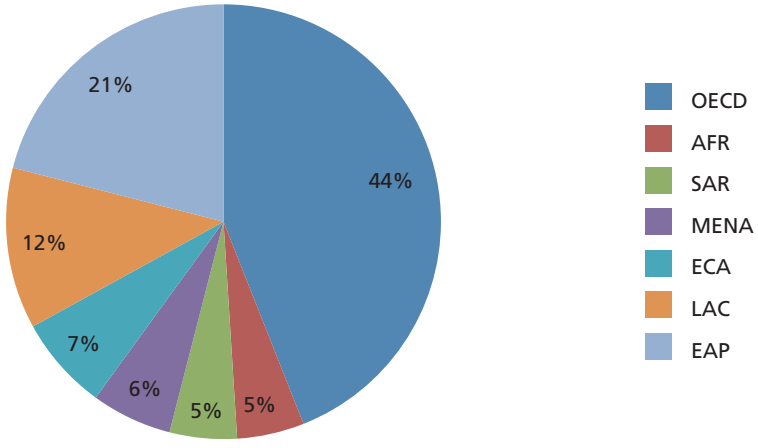
The Organization for Economic Cooperation and Development (OECD) countries generate 572 million tonnes of solid waste per year. Per capita values range from 1.1–3.7 kg per person per day with an average of 2.2 kg per capita per day. *Figure 1.1* illustrates global waste generation in different regions; OECD countries generate almost half of the world's waste, while Africa region (AFR) and South Asia region (SAR) produce the least waste regionally.

It is estimated that a total amount of 236 tonnes per day (TPD) of waste is generated in Swaziland. Approximately 280 TPD of waste is generated in Zanzibar. As per a 2015 paper on MSW characterization and quantification, Ghana generates close to 13,258 TPD of waste.[8] Information furnished by Department of Environmental Affairs of Namibia reveals that the country generates a total amount of 3,000 TPD of solid waste.

A 1994 study on waste management estimated the per capita waste generation rates in Ethiopia to be between 0.221 and 0.252 kg per capita per day. The total waste generated was about 671 TPD. It was calculated based on the per capita generation rate of 0.22 kg per person per day and a population of three million.[9] However, these estimates are still being used two decades later. As per a 2014 study by the Ministry of Urban Development and Housing of Ethiopia, the country generates 2.8 million tonnes of waste every year.

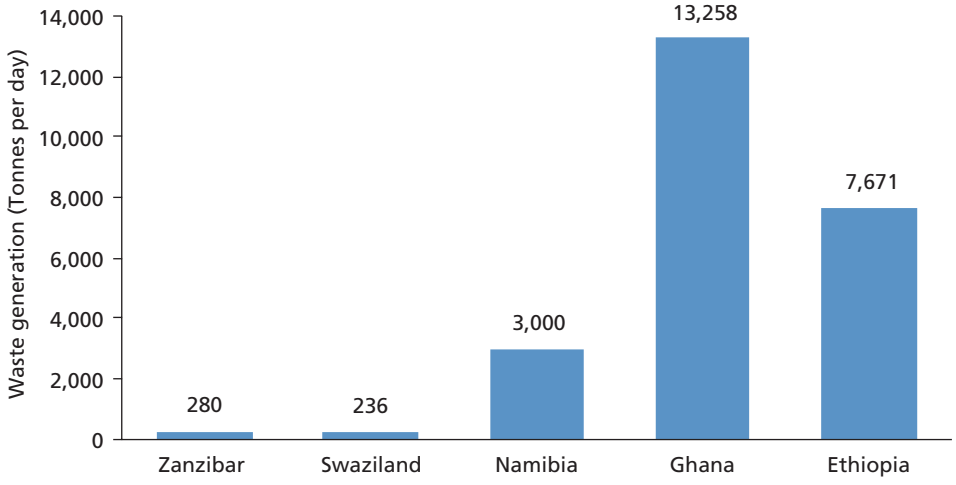
From this data, it is clear that a majority of the countries in sub-Saharan Africa do not have proper inventorization of waste, which is an imperative prerequisite for preparing strategies for waste management. *Figure 1.2* depicts the waste generated per day in sub-Saharan countries.

Figure 1.1: Global waste generation per region



AFR: Africa, SAR: South Asia, MENA: Middle East and North Africa, ECA: Eastern and Central Asia, LAC: Latin America and the Caribbean, and A: East Asia and Pacific
Source: What a Waste, 2012, World Bank

Figure 1.2: Waste generation in sub-Saharan African countries



Source: Figures taken from field assessment report for Zanzibar 22–27 August 2016; CSE report on existing Waste Management Practices in Swaziland, 19–29 October 2016; data furnished by Department of Environmental Affairs, Namibia 2017; data furnished by EPA, Ghana, 2017; and CSE research 2017

Table 1.1 lists expected estimates of waste generation for 2025 according to current trends in population growth in each region. The total urban waste generation of the AFR is expected to increase three times. Per capita generation rate will also increase from 0.65 kg per capita per day to 0.85 kg per capita per day by 2025 in AFR.

Table 1.1: Waste generation estimates for 2025 by region

Region	Available data			Projections of 2025			
	Total urban population (millions)	Urban waste generation		Projected population		Projected urban waste	
		Per capita (kg/capita/day)	Total (tonnes/day)	Total population (million)	Urban population (million)	Per capita (kg/capita/day)	Total (tonnes/day)
AFR	260	0.65	169,119	1,512	518	0.85	441,840
EAP	777	0.95	738,958	2,124	1,229	1.5	1,865,379
ECA	227	1.1	254,389	339	239	1.5	354,810
LCR	399	1.1	437,545	681	466	1.6	728,392
MENA	162	1.1	173,545	379	257	1.43	369,320
OECD	729	2.2	1,566,286	1,031	842	2.1	1,742,417
SAR	426	0.45	192,410	1,938	734	0.77	567,545
Total	2,980	1.2	3,532,252	7,644	4,285	1.4	6,069,703

Source: What a Waste, 2012, World Bank

Waste generation by income level of countries

Ethiopia and Tanzania are regarded as low-income countries, Swaziland and Ghana as lower-middle-income countries, and Namibia as an upper-middle-income country by the World Bank.[10] *Table 1.2* shows the significant variation in the generation of solid waste based on a country's income level.[11]

Table 1.2: Average MSW generation rates by country's income

Income level	Average MSW generation (kg/capita/day)
Low-income	0.6–1.0
Middle-income	0.8–1.5
High-income	1.1–4.5

Source: What a Waste, 2012, World Bank

GDP and waste generation

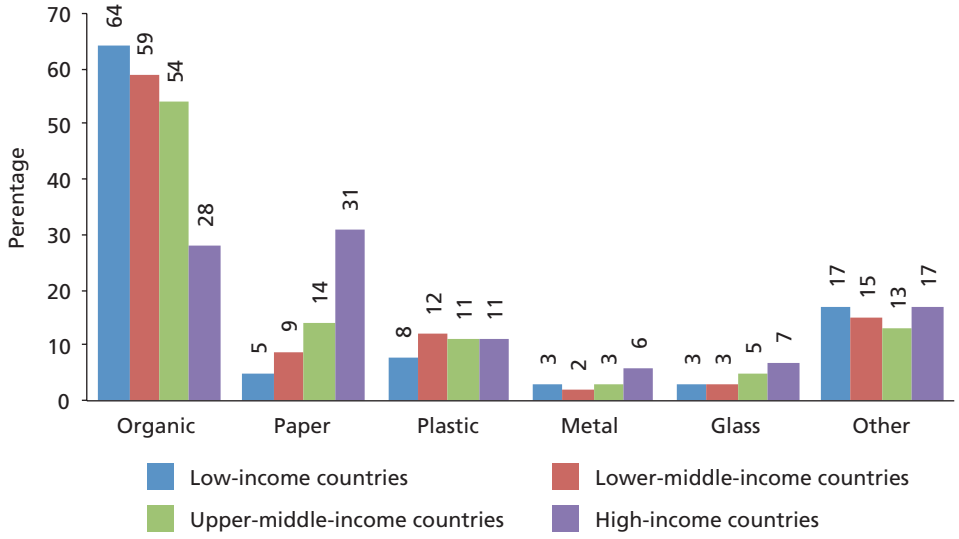
Waste generation and wealth are directly correlated. According to the 2007 Intergovernmental Panel on Climate Change (IPCC) report, there is a direct correlation between solid waste generation and Gross Domestic Product (GDP). Solid waste generation depends on the state of the economy and per capita waste generation increases with increase in income.[12]

A 2013 study by United States Environmental Protection Agency (USEPA) on economic data and indicators analyses the correlation between solid waste generation and GDP. [13&14] The analysis shows a rather strong relationship between how solid waste generation per person increases with increasing per capita real GDP. For every US $5,000 increase in real GDP, solid waste generated per person increases by approximately 0.065 tonnes per year.[15]

Composition of waste in Africa

Waste composition is influenced by many factors, such as level of economic development, cultural norms, geographical location, energy sources and climate. As a country urbanizes and populations become wealthier, consumption of inorganic materials (such as plastics, paper, and aluminium) increases, while the relative organic fraction decreases. Generally, low- and middle-income countries have a high percentage of organic matter in the urban waste stream, ranging from 40 to 85 per cent. Paper, plastic, glass, and metal fractions increase in the waste stream of middle- and high-income countries. *Figure 1.3* illustrates the differences between low-income and high-income countries—organics make up 64 per cent of the solid waste stream for low-income countries and paper only 5 per cent, whereas in high-income countries it is 28 per cent and 31 per cent respectively.[16]

Figure 1.3: Waste composition on the basis of income



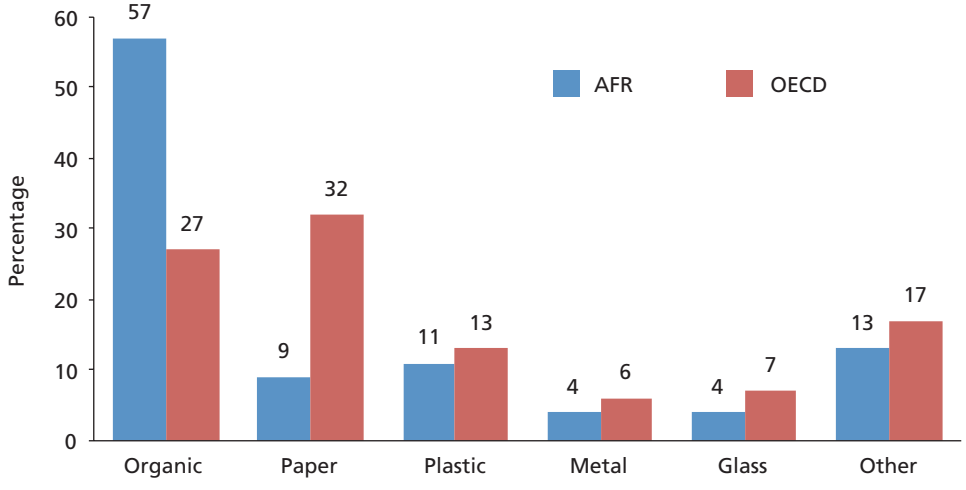
Source: What a Waste, 2012, World Bank

Figure 1.4 depicts solid waste generation by region. AFR has a high fraction of organic waste (57 per cent) as compared to OECD countries, which have the least (27 per cent). The amount of paper, glass, and metals found in the solid waste streams are the highest in OECD countries (32, 7, and 6 per cent respectively) and lowest in AFR (9, 4 and 4 per cent respectively).

Zanzibar has exceptionally high fraction of organic waste in its solid waste composition (86 per cent), whereas Swaziland has an organic fraction in the range of 55–65 per cent. Ethiopia, Ghana and Tanzania have categorized waste into organic, plastic, glass, paper, metal and others. In Swaziland and Zanzibar, waste is categorized into organic, dry recyclable and inert waste.

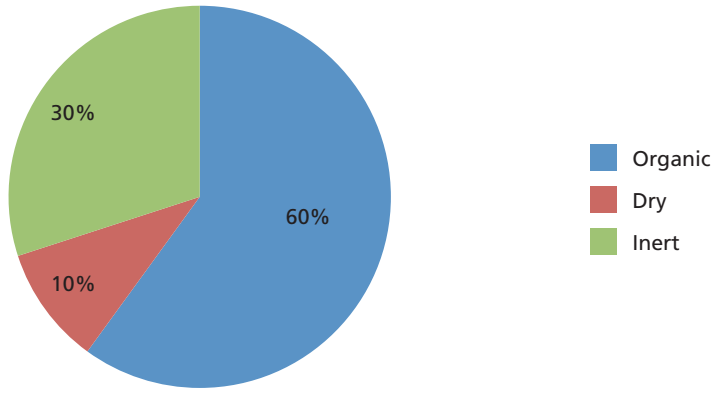
Figure 1.4: Composition of waste in AFR

(a) Comparison of waste composition on the basis of income between AFR and OECD



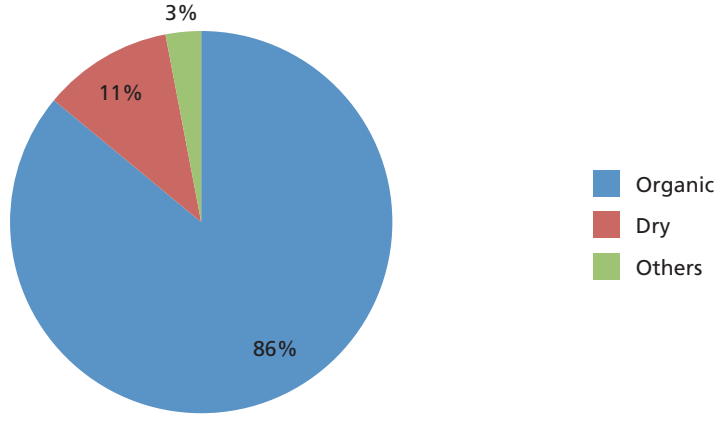
Source: What a Waste, 2012, World Bank

(b) Swaziland



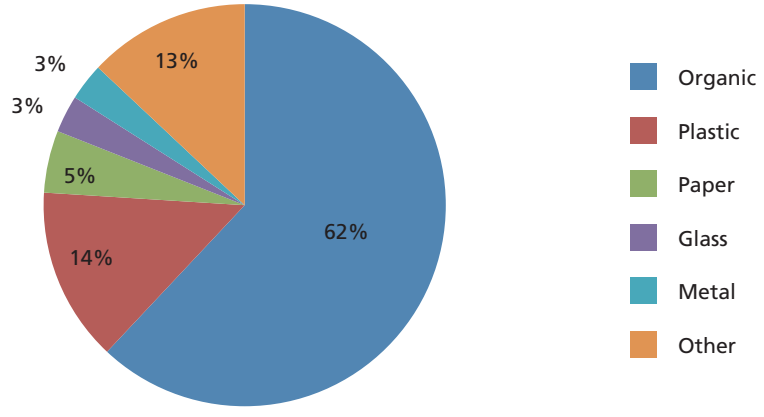
Source: Swaziland Environmental Authority, 2017

(c) Zanzibar



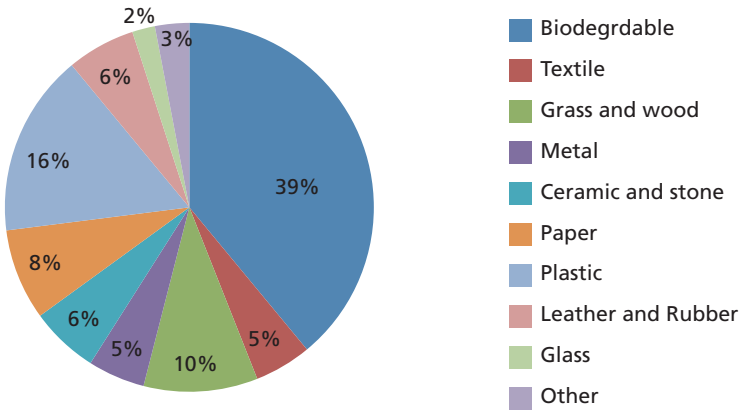
Source: Zanzibar Urban Municipal Council, 2017

(d) Ghana



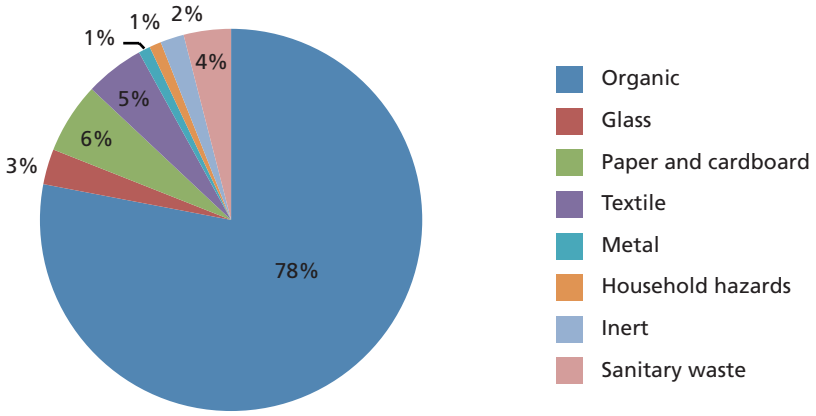
Source: Miezah et.al, Ghana, 2015

(e) Tanzania mainland



Source: National Environment Management Council, Tanzania

(f) Ethiopia (Addis Ababa)

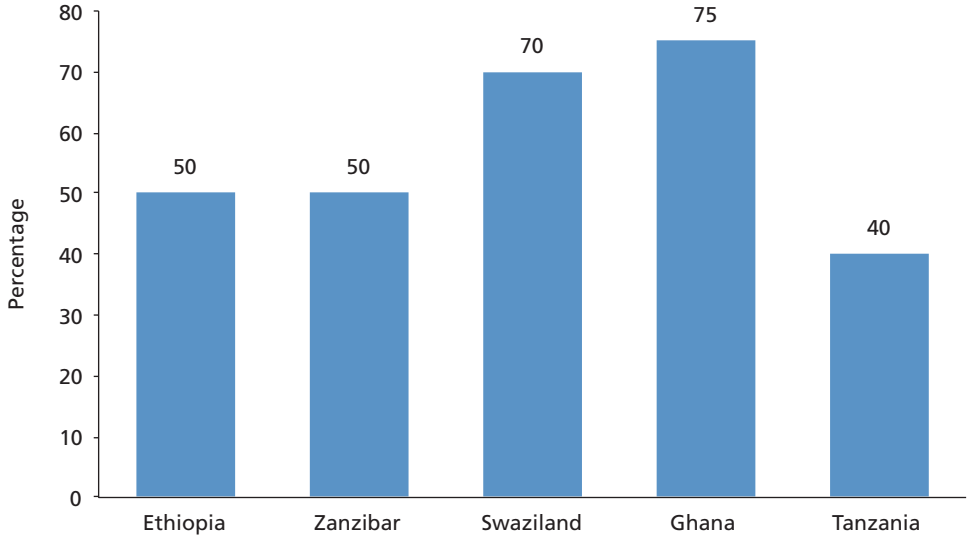


Source: Ministry of Urban Development and Housing, Ethiopia

Waste collection

Waste collection is inadequate in a majority of the sub-Saharan countries due to dearth of infrastructure and manpower. Ghana and Swaziland have put in place good collection systems in all major cities with a collection efficiency of 70 per cent (see *Table 1.3*). However, in Ethiopia and Tanzania, collection of waste is only efficient in certain areas and nearly non-existent in many rural and peri-urban areas. *Figure 1.5* shows the collection efficiency rates in different sub-Saharan countries.

Figure 1.5: Collection efficiency rate in sub-Saharan countries



Source: CSE, 2017.

Table 1.3: Waste collection in African countries

Country	Waste collection mechanism
Tanzania	• Collection rate varies from place to place • Solid waste collection and transportation in urban areas is done by local government agencies or private or community groups on behalf of the councils • Collection is carried out daily or weekly depending on the area
Swaziland	• Door to door (DTD) collection is being done by town councils in a majority of urban areas. Chief dorms are in charge of collection in peri-urban areas • Collection efficiency in urban areas is above 75 per cent • Collection efficiency in rural areas is almost zero
Ethiopia	• For door-to-door collection,there is a wide variation in performance in different municipalities • Primary collection is done by micro- and small-enterprises. For this collection system, residential areas are divided into zones • Collection efficiency varies between cities, Addis Ababa, Mekelle and Bahirdar have a collection rate of 85 per cent. The collection rate of Yirgalem and Logyia-Semera is 10 per cent and 25 per cent respectively
Ghana	• Door-to-door collection in urban areas is a little more than 14 per cent • Overall collection efficiency is more than 75 per cent
Namibia	• Door-to-door collection takes place in all municipalities, town councils, village councils and some settlement areas

Source: Data provided by participating countries during the two-day meeting to finalize Integrated Waste Management Policy and Legislation Outline for African Nations, 6–7 September, 2017, Zanzibar, Tanzania

Waste disposal and processing

Waste disposal data is difficult to collect. Many countries do not collate waste disposal data at the national level, making comparisons across income levels and regions difficult. Furthermore, in cases where data is available, the methodology of how waste disposal is calculated and the definitions used for

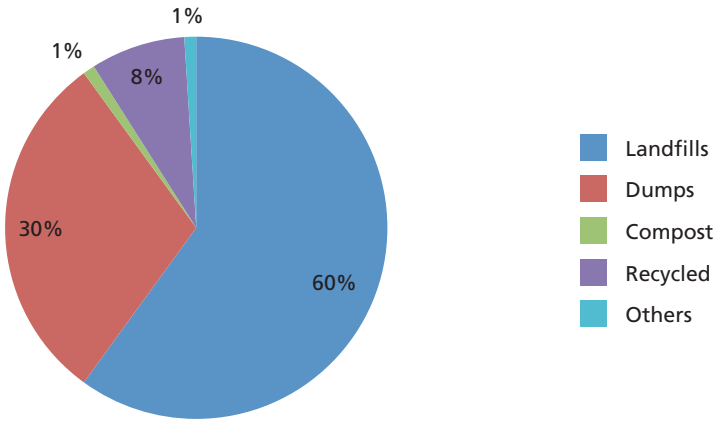
each of the categories is often either not known or not consistent. *Table 1.4* contrasts solid waste processing and disposal of OECD (world's richest) and AFR (world's poorest). The processing capacities in OECD countries are better with composting, recycling and incineration being the most preferred options. In AFR, there are no engineered sanitary landfills and open dumping is widely practiced (see *Figure 1.6*). It is clear that AFR needs to devise systems and a strategy for effective processing and disposal of different waste streams (see *Table 1.5*).

Table 1.4: Solid waste processing and disposal in the richest and poorest regions of the world

AFR		OECD	
Dumps	2.3	Dumps	-
Landfills	2.6	Landfills	242
Compost	0.05	Compost	66
Recycled	0.14	Recycled	125
Incineration	0.05	Incineration	120
Others	0.11	Others	20

In million tonnes per year
Source: What a Waste, Chapter 3, p. 24, 2012, World Bank Paper

Figure 1.6: Total MSW disposed of in Ghana



Source: Industry Knowledge, Ghana Statistical Service, 2010

Table 1.5: Waste processing and disposal mechanisms in different African countries

Tanzania	• Informal sector (waste pickers) collect recyclable waste from commercial areas • Private companies buy segregated recyclable materials (plastic, metals, paper, e-waste) from the informal sector as well as from other agencies • Major cities have industrial corridors with recycling facilities. For instance, Dar es Salaam has 33 factories and 29 collection centers which process, manufacture and exports recyclable raw material • Local government provides micro-loans to women and youth groups to facilitate segregation and sorting centres • Dar es Salaam has put in place a four-year strategy (2016–20) on use of organic waste • Some individuals have started engaging in manure production activities • Mbeya, Tanga, Arusha, Mwanza cities and Dodoma municipality have sanitary landfills while Dar es Salaam is under the process of improving its existing disposal systems
Swaziland	• Processing (recycling and treatment of wet or dry waste): - Recovery of valuable materials glass, PET, cans, paper, cardboard, shrink wrap, metals) done at some disposal sites such as in Matsapha, Mbabane, Piggs Peak, Ngwenya (and by residents in households (mostly urban areas) - Two buy-back centres in Mbabane and one in Matsapha - Five plastic recycling facilities located in Matsapha - One glass recycling facility located at Ngwenya - Small-scale composting done in households and through pilot projects - Disposal facilities a. Approved landfill sites: Four b. Approved formal dumpsites: Two c. Approved communal disposal sites: Five d. Informal or illegal dumpsites: Many
Ethiopia	• Recycling of metal, plastic and paper waste is usually driven by medium- and small-scale cooperatives • Composting is practiced in a few municipalities • More than ten disposal sites constructed in different cities; Sendafa (Addis Ababa), Adegrat, Bishifitu, Kobolicha and Markos have sanitary landfills
Ghana	• Large-scale material recovery facility with composting and plastic recycling in Accra • Medical waste treatment and transfer station by Zoompak Ltd. • Plastic Recycling: More than 20 facilities to treat 250–1,000 kg per day • Paper recycling: Three facilities to treat five–10 tonnes of waste per day • Electronic and hazardous waste: Around 10 facilities with varied capacities • Few engineered landfill sites and dumpsites
Namibia	• Dry waste is sent to different units across the country to be recycled • Engineered landfill sites at Windhoek-Kupferberg and Walvis Bay • Garden refuse and building rubble go to seven sites situated on the outskirts of the city • Country-wide dumping sites pose serious threat to the environment
Zanzibar	• Recently inaugurated its first composting site in Shaurimoyo area in Stone Town • One PET-recycling plant • Over 90 per cent of the collected waste is being dumped in Kibele

Source: Data provided by participating countries during two-day meeting to finalize Integrated Waste Management Policy and Legislation Outline for African Nations, 6–7 September, 2017, Zanzibar, Tanzania

Challenges concerning waste management in Africa

Waste management is a challenge for authorities in Africa, mainly due to the increasing generation of waste, lack of classification and categorization of different waste streams as well as insufficient administrative and financial capacity to handle and manage different material streams. Another major challenge in African countries is lack of regulations and policies to dictate how waste should be managed. Moreover, inadequate technical capacity for long-term planning and management of solid waste is also an issue.

There is a need to have access to financial and technical knowledge. This will go a long way in assisting waste management in municipalities. Furthermore, private players that have the means and are willing to get into waste management have been prevented by certain by-laws from participation, resulting in all waste management responsibilities being allocated to government bodies. Import of sub-standard products, non-operational laws and lack of policy instruments has also contributed to rapid increase in waste generation.[17]

The following are the major challenges concerning waste management in Africa:

i. **Inventorization of waste:** There is no clear estimate on the amount of waste Africa generates, due to lack of inventorization in a majority of the countries. For instance, in Swaziland, the last inventorization was done in 2000 and the same estimates are still being used. Another challenge that the municipal administration faces is increasing quantities of different material streams, which become more and more complex and diverse with demographic and economic growth. The need to confront this problem is not met with sufficient financial, technical, and human resources. Thus, the situation of inadequate waste management is pervasive in many developing or transition economies.[18] In addition, rapid urbanization, population growth and informal settlements are also major challenges.[19]

ii. **Regulations are lax—lack of compliance and enforcement capacities:** In a majority of the countries, environmental policymaking remains largely a function of the Central government, but implementation of policies and legislation is entrusted to the local governments. Existing laws on waste management are not effectively enforced, which may be attributed to inherent weaknesses in the laws themselves, and lack of capacity and manpower to ensure effective compliance and enforcement. Many countries like Swaziland and Zanzibar do not even have a policy in place for waste management.

iii. **Finance and funding:** Waste management is ineffective in Africa because it is not a prioritized activity in all urban councils and municipalities. Funds for the operation of the urban councils are mainly from external sources like the Central government and donors in the form of grants. This also clearly illustrates the solid waste management financing dilemma. Waste business has become increasingly expensive for city authorities to handle on their own.[20]

iv. **No segregation**: Most countries in sub-Saharan Africa have no effective system to support segregation. At present, mixed waste is usually collected and sent to dumpsites. There is an urgent need to devise an effective system of waste segregation at the appropriate stages, i.e., generation, collection, transportation, processing and disposal.

v. **Waste processing and disposal:** The status of processing is extremely grim in the region. In Ghana, there has been a thrust for decentralized treatment. The recycling sector is thriving in Swaziland, Tanzania and Ghana. However, more than 80 per cent waste collected ends up in dumpsites. Most countries do not have sufficient infrastructure to invest in processing or sanitary engineered landfills.

vi. **User fee:** In most AFR countries, there is no system of collection of user fee from waste generators by the municipalities. In countries where it is collected, the collection percentages are low. The problem is compounded by the inability of a large percentage of urban communities to pay for waste collection services due to low income in the East African Community region.[21] In Zanzibar, every household pays approximately US $1 per month as user fee. As of today, 43 per cent of households pay this fee. Commercial shops and hotels pay a monthly fee in the range of US $3–170.

vii. **Public awareness and behaviour change:** There is lack of public awareness with respect to sanitation and appropriate storage of waste. Littering and grey spots are common in informal settlements and peri-urban areas as they do not fall within the jurisdiction of municipalities.

viii. **Optimization of informal sector:** Informal sector is instrumental in waste management in AFR. However, it is not integrated with the municipalities or town councils. Municipalities need to make the informal sector part of their waste management systems to strengthen their existing collection and processing.

ix. **Tourism areas:** Bulk generators such as hotels and restaurants generate garbage and have inadequate systems to segregate, collect and process waste. As a result, generated waste is dumped at numerous illegal spots. This creates an environmental menace which, in the long-term, will impact the tourism industry as well.

2. WASTE CLASSIFICATION AND INVENTORIZATION

Definition of waste

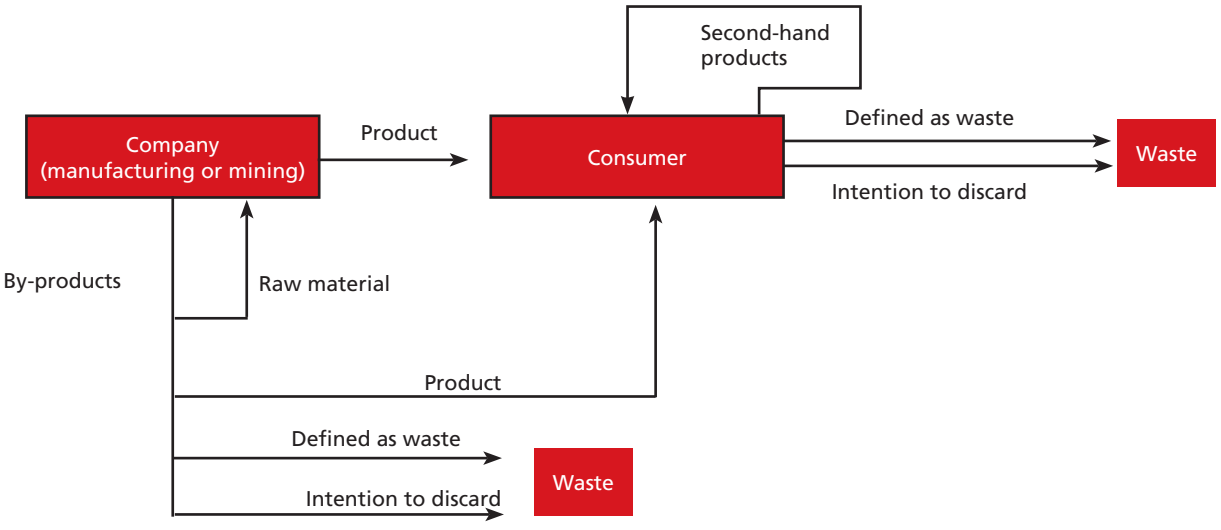
Waste is defined as unwanted or unusable material or any substance which is discarded after primary use, or is worthless, defective and of no use. Examples include municipal solid waste (household trash or refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes—faeces and urine—and surface runoff), and radioactive waste.[22] However, waste has also been defined in the Waste Framework Directive (WFD) of the European Commission (EC) as 'any substance or object which the holder discards or intends to discard or is required to discard'[23] (see *Figure 2.1*). Under Article 2(1) of the Basel Convention, 'wastes' are substances or objects which are disposed of or are intended or required to be disposed of by the provisions of national law.[24]

Classification of waste

Waste can be categorized with respect to its

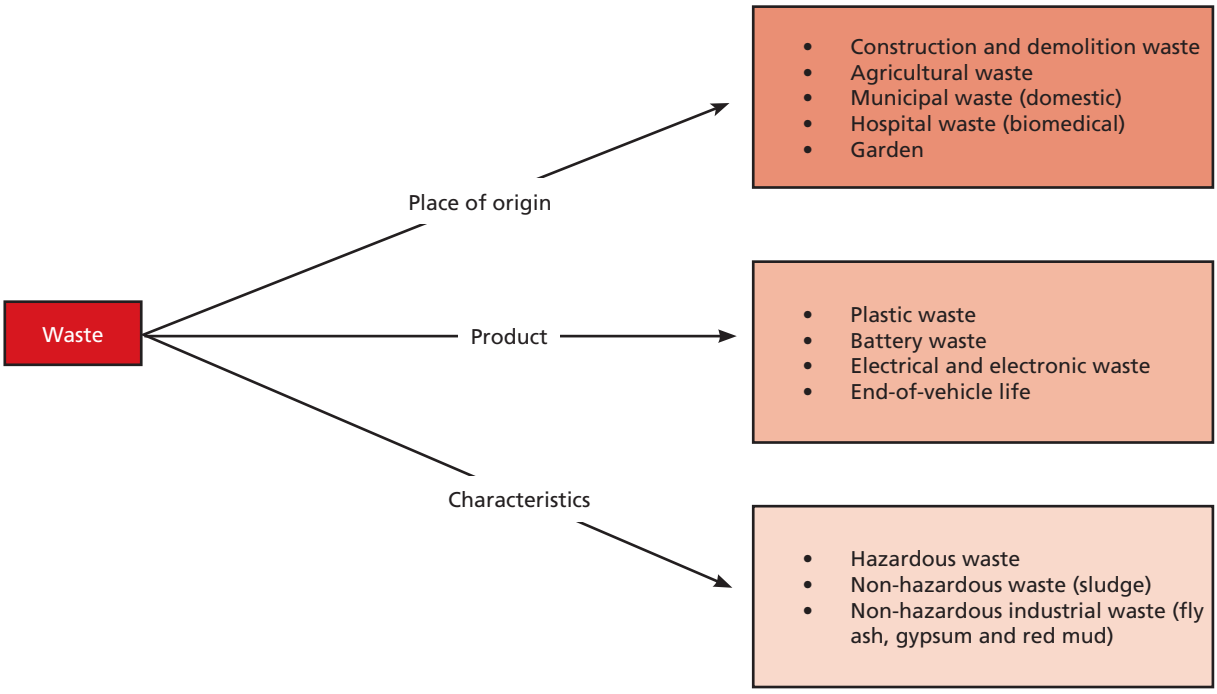
(i) **Origin of generation, product and characteristics** (see *Figure 2.2*)
(ii) **Chemical properties, characterization, utilization and safe disposal**

Figure 2.1: Schematic illustration of the EU legal definition of waste



Source: Preparing a Waste Prevention Programme, 2012, European Commission

Figure 2.2: Classification of waste with respect to origin, product and characterization



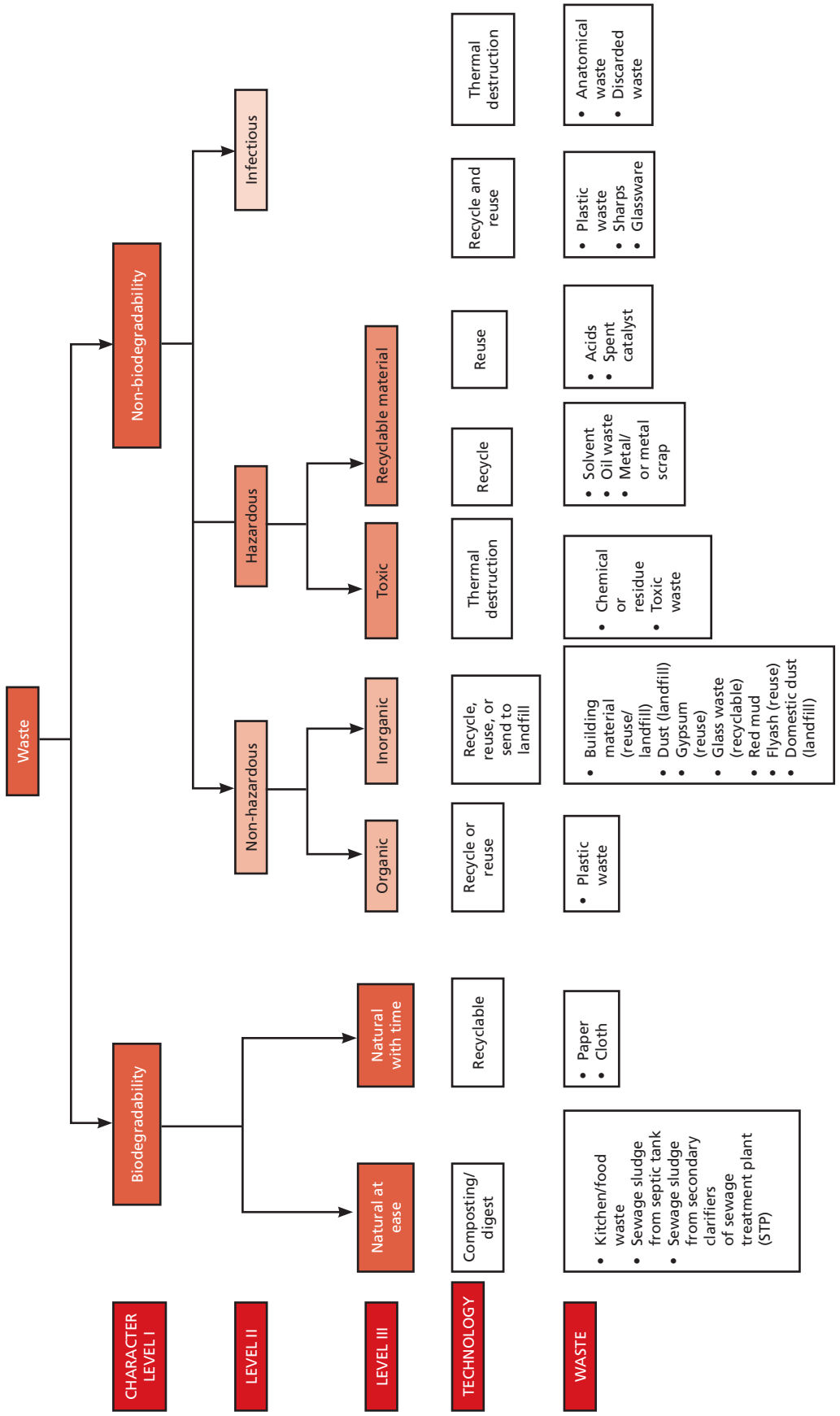
Source: DD Basu/CSE, 2017

Under (i), waste can be further classified on the basis of its origin of generation into construction and demolition (C&D), agricultural, municipal solid, biomedical and horticultural waste. It can be product-based—plastic, battery, electrical, electronic and vehicle scrap waste. Further, on the basis of the characteristics of waste, it can be classified as hazardous, non-hazardous and non-hazardous industrial waste.

Waste can also be characterized on the basis of its chemical properties such as biodegradability, toxic characterization, and infectious or inert nature. Another way of classification of waste is with respect to its utilization and safe disposal. These two ways of classification are summarized in *Figure 2.3*. From the figure, it can be understood that at level I, all waste is classified in terms of its biodegradability or non-biodegradability. At level II, non-biodegradable waste is divided into three subclasses, viz. non-hazardous, hazardous and infectious. Biodegradable waste is classified with respect to scale of time and natural processes. It is clear that a majority of wet waste can be processed by composting, biomethanization etc. Some of the products such as cloth and paper can be easily recycled.

In the case of non-hazardous non-biodegradable waste, there are two distinct groups—organic and inorganic. Plastic waste, being non-hazardous and non-biodegradable, can be recycled to a great extent. There are also some non-hazardous inorganic products such as glass and gypsum, and C&D waste that can be recycled. However, disposal of red mud is still a challenge. Dust from

Figure 2.3: Classification of waste in terms of chemical characterization, utilization and safe disposal



Source: D.D. Basu, 2017, CSE

household or streets can be further disposed of in an engineered landfill. Toxic hazardous waste needs to be thermally destroyed (incineration). However, the capital cost to establish treatment, storage and disposal facilities (TSDF) is extremely high. For most non-industrialized countries, it is not feasible to have TSDF sites for the low quantum of hazardous waste they generate.

Developing a rationale for waste management policy

Generally, three factors govern waste management policy framework, inventorization of waste, effective management practices including choice of technology, and optimal balance of proactive and reactive elements of regulation.

Inventorization and policy framing

Quantity of waste produced depends on the degree of urbanization and industrialization as well as on consumption and behavioural pattern of the society. Nowadays, even less industrialized countries produce complex waste due to import of chemicals, plastics, electronics and electrical items by these countries. The quantity of waste in low-income countries may not be as significant as in an industrialized society, but they can hardly afford sophisticated technologies to process and dispose of waste. Inventorization is an important step in the management of waste. It is difficult, but not impossible, if proper estimates are taken at each step of generation. Therefore, source-specific inventorization is necessary for each category of waste.

Solid waste

MSW inventorization is largely based on sample surveys. Figure 2.4 illustrates a seven step approach to inventorization of MSW.

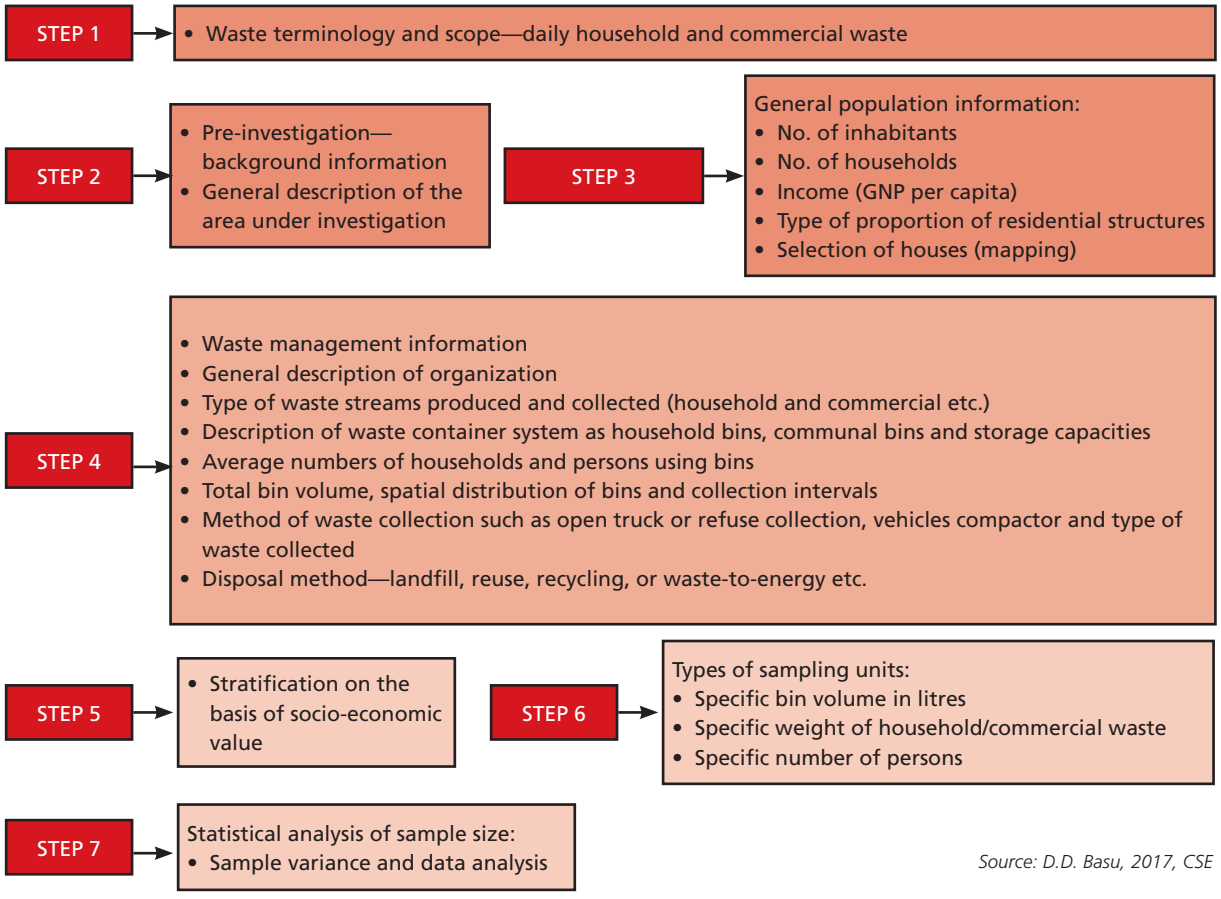
World Bank often groups industrial, commercial, and institutional (ICI) wastes together, representing more than 50 per cent of MSW. C&D waste is often treated separately, if managed well it can be disposed of separately. In most AFR countries, waste generated in hospitals and clinics and agricultural waste are usually considered MSW if the municipality oversees their collection and disposal. *Figure 2.5* enlists the generators of MSW.

A standardized methodology for the analysis of solid waste has been developed by the European Commission as part its *Solid Waste Analysis Tool* (SWA-Tool) project.[25] The SWA-Tool aims to provide a waste analysis methodology for use at a local and regional level. The methodology establishes the minimum standards a waste analysis should meet in terms of sorting procedures and categories, definition of statistical accuracy, and common reporting guidelines.

Plastic waste

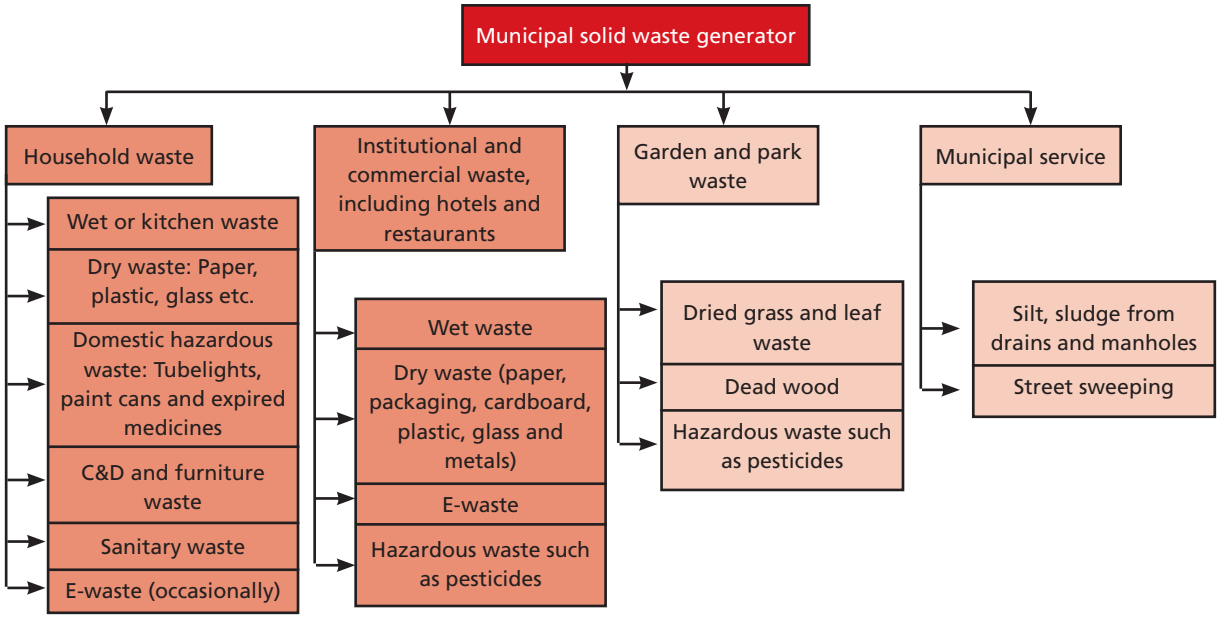
It is imperative for countries manufacturing virgin plastic to track its flow by mapping the stakeholders involved, from the manufacturer to the producer, dealer, retailer, bulk consumer and individuals. If producers and dealers are registered with the municipality, they can give a fairly good idea of consumption of plastic in the country. A retailer will be able to give information about the

Figure 2.4: Steps for municipal solid waste inventorization



Source: D.D. Basu, 2017, CSE

Figure 2.5: Generator of municipal solid waste



Source: D.D. Basu, 2017, CSE

geological distribution of plastic. However, small fractions, like packaged goods (supplies that are directly imported) are difficult to account for.

In case of low-income countries, where virgin plastic is not manufactured, tracking producers, dealers and retailers becomes imperative to understand the consumption and distribution patterns of plastic. *Figures 2.6 (a)* and *(b)* depict two contrasting scenarios to inventorize plastic waste, one where virgin plastic is manufactured and the other where virgin plastic is not produced.

Figure 2.6 (a): Inventorization of plastic waste where virgin plastic is manufactured

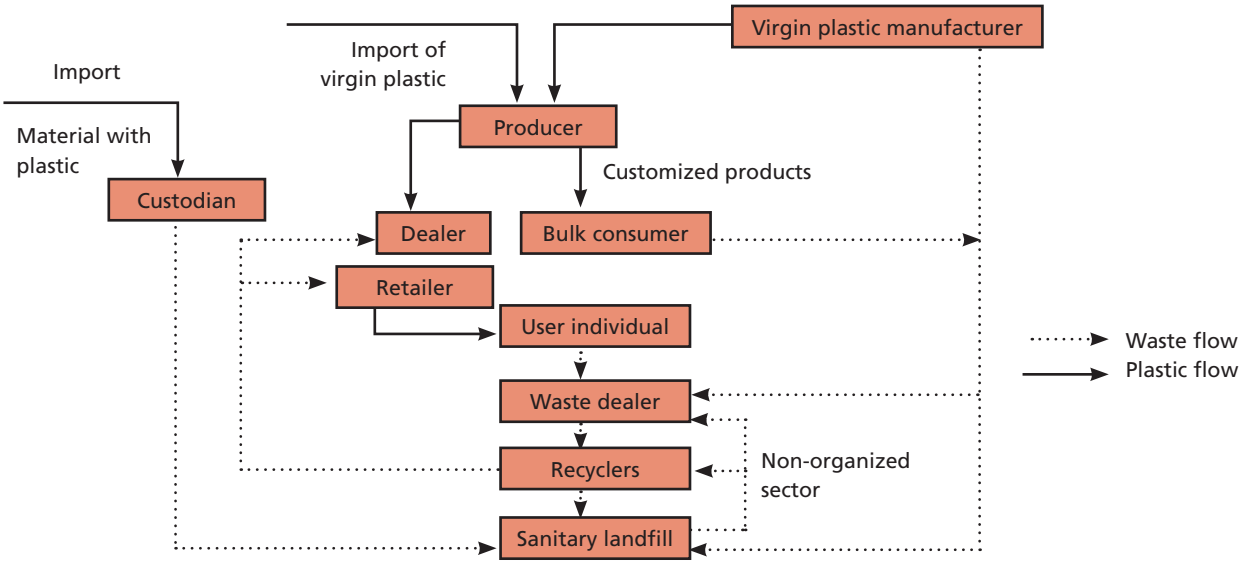
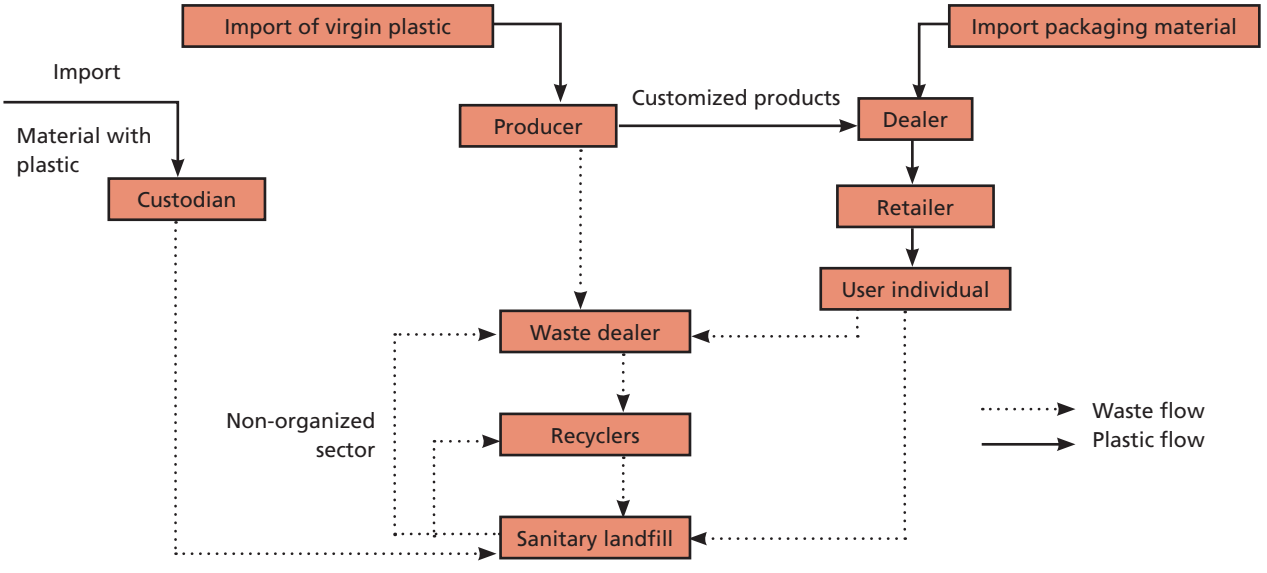
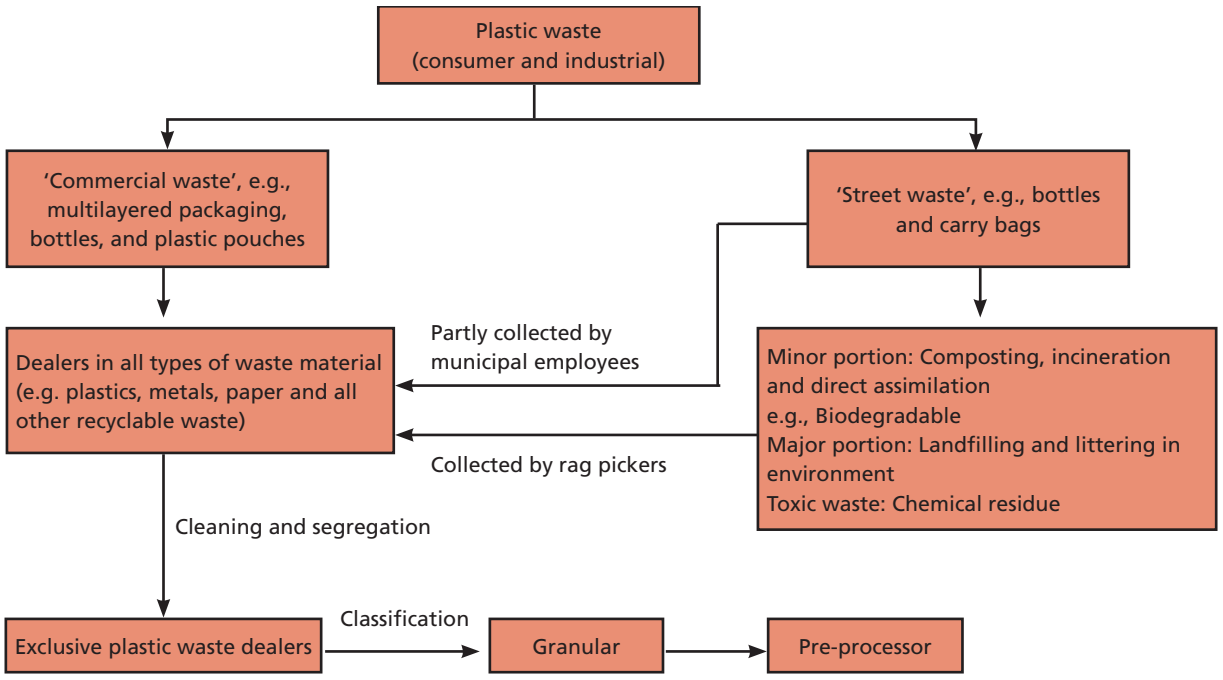


Figure 2.6 (b): Inventorization of plastic waste where virgin plastic is not produced



Source: D.D. Basu, 2017, CSE

Figure 2.7: Flowchart for quantification of plastic waste in MSW



Source: Nitin H. Mutha, Martin Patel, V. Premnath, Plastics materials flow analysis for India, Elsiever,Resources, Conservation and Recycling 47, 2006, p. 222–244

There are two methods to quantify the generation of plastic waste—by determining the percentage of plastic waste in solid waste and by its service life (see *Figure 2.7*). Waste inventorization can establish the percentage of plastic waste in MSW. The service life of plastic material, however, is linked with plastic consumption.

Depending on the area of application, the service life of plastic products, including their reuse period, ranges from one–35 years. For example, the service life of a woven sack used in packaging is less than one year, but it can be used for two more years to protect goods and as roofing material. Thus, the total service life becomes three years. See *Table 2.1* for estimated mean service life of plastic products.

Low-income and developing countries consume plastic products with low service life as compared to developed countries (see *Table 2.2* for a comparison between India and Germany).

Plastic waste can also be estimated by combining the service life and domestic consumption of virgin plastic quantities.

Schemes to push for extended producer responsibility (EPR) need to be developed for sound management of plastic waste. EPR schemes for plastic packaging and commercial recyclable and non-recyclable plastic goods can be further extended to retailers and dealers of such goods. These stakeholders can set up collection systems either collectively or individually. EPR can be

Table 2.1: Estimated mean service life of plastic products

End product	Service life (years)
Films or flexible packaging	1
Injection moulded goods	5–15
Wire and cables	30
Extrusion coating	1
Roto-molded product	10
Woven sacks	3
Blow-moulding product	8
Pipes and conduits	35
Monofilaments	3
Footwear	2
Sheets (thick)	10
Profiles	30
Hoses and tubes	5
Appliances	20
Others	1–3
Mean weighted average	8

Source: Nitin H. Mutha, Martin Patel, V. Premnath, Plastics materials flow analysis for India, Elsiever, Resources, Conservation and Recycling 47, 2006, p. 222–244

Table 2.2: Service life of plastic products in India and Germany

Mean service life (years)	Share of products with different service life (per cent)	
	India	Germany
0 to ≤ 3	61	32
> 3 to ≤ 10	23	39
> 10	16	28

Source: Nitin H. Mutha, Martin Patel, V. Premnath, Plastics materials flow analysis for India, Elsiever,Resources, Conservation and Recycling 47, 2006, p. 222–244

extended to individual users by the provision of incentives such as deposit refund schemes.

EPR is at a less advanced stage in most African countries, with the notable exception of South Africa. EPR initiatives in South Africa have been mostly initiated by the industry itself, with the government intervening occasionally by enacting regulations to ensure enforcement of these initiatives. In 2002, the tyre industry in South Africa formed the South African Tyre Recycling Process Company, which aims to manage the collection and distribution of waste tyres to recycling and re-processors on behalf of the tyre industry.[26]

Hazardous waste

In industrialized countries, factories have provisions to treat and reuse at source the hazardous waste generated and wherever such waste cannot be processed or reused *in situ*, it goes to a TSDF. The hazardous waste generated in non-industrialized countries generally constitutes of expired chemicals such as medicines and pesticides. These can be collected separately under the

provisions of EPR from organized stakeholders such as hospitals, government agricultural departments, dealers and retailers. In order to develop an inventory of the chemicals, a national registration system at the point of entry with details of the origin of the chemical, the company responsible, and a compulsory EPR system is required. All dealers, retailers and bulk consumers need to register the date of expiry of the chemicals. At the retailer level, an incentive scheme to recover the expired product may be initiated. *Figures 2.8 (a)* and *(b)* illustrate the inventorization of hazardous waste generated in two different scenarios.

Figure 2.8 (a): Inventorization of hazardous waste generated by both manufacture and consumption of chemicals in a country

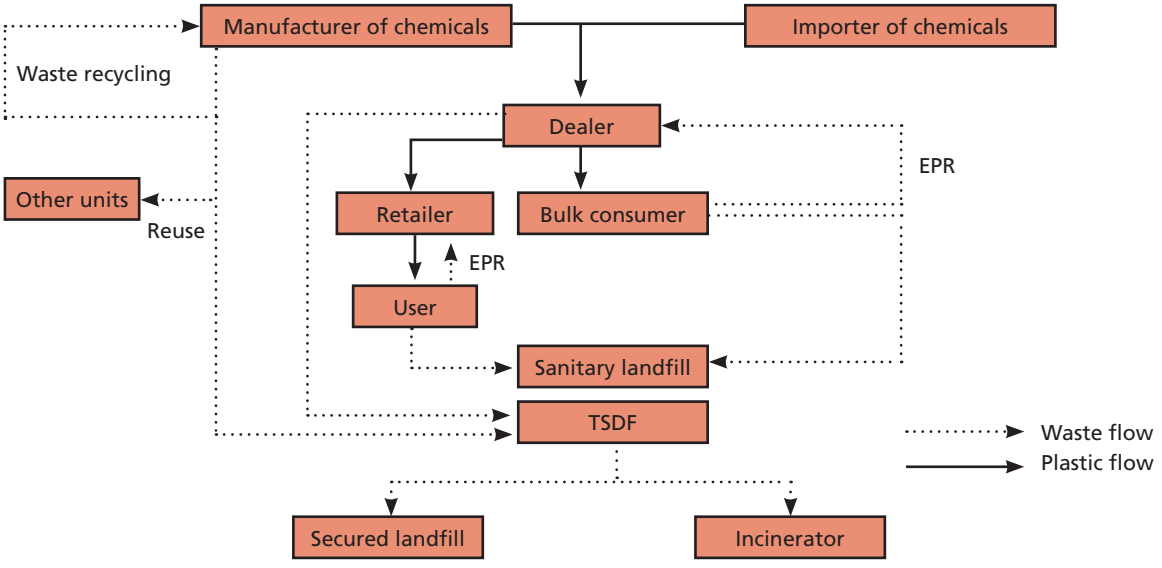
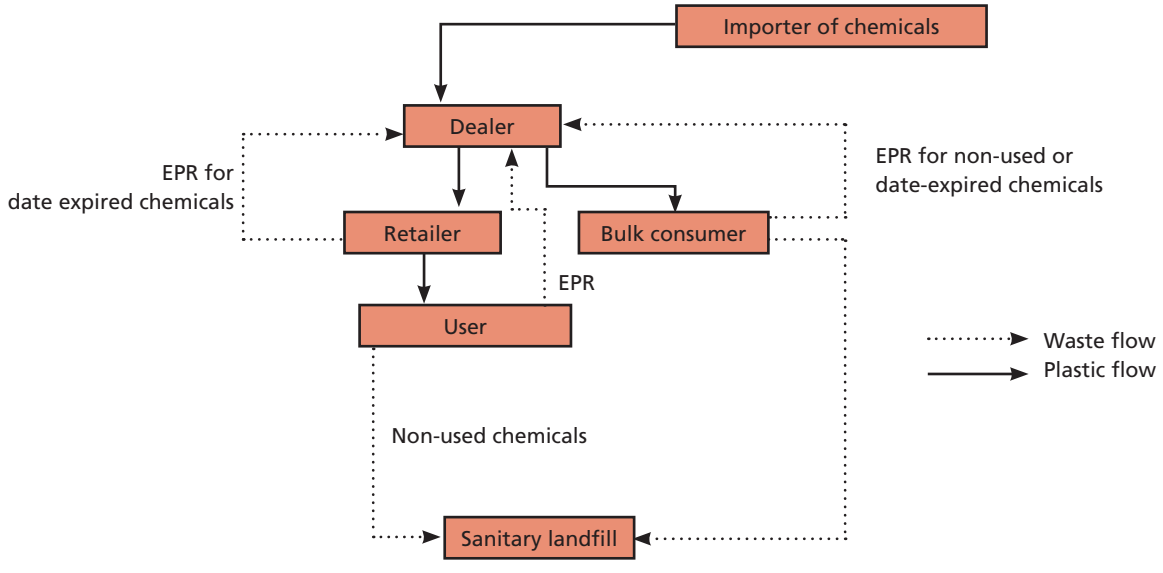


Figure 2.8 (b): Inventorization of hazardous waste generated due to only consumption of chemicals in a country



Source: D.D. Basu, 2017, CSE

Biomedical waste

Inventorization of biomedical waste is generally based on sample surveys. Sample surveys should be based on two factors, one is the categorization of healthcare facilities and the other is the classification of biomedical waste. Categorization of healthcare facilities is based on the number of beds or out-patient department (OPD) services (see *Table 2.3*). Bedded hospitals can be further classified into general and super-specialty hospitals. The data made available by this categorization can further assist in stratified sampling.

Table 2.3: Categorization of healthcare facilities

Categorization (number of beds)	Region- and state-wise number of facilities	
	Number	Region
Primary health facilities		
≤ 50		
> 50 to ≤ 100		
> 100 to ≤ 250		
> 250 to ≤ 500		
> 500		

Source: D.D. Basu, 2017, CSE

The second approach is classification of biomedical waste into different components such as sharps, infectious waste, anatomical waste, and pharmaceutical waste. Classification of waste has become a legislative requirement in various countries and regions including EU and US. World Health Organization (WHO) and Red Cross have also devised general categorizations which are listed in *Table 2.4*. Once such a classification of waste is made, department-wise generation under each category can be estimated.

This kind of inventorization has revealed that, on an average, 0.5 kg per day per bed of hazardous (infectious) biomedical waste is generated in developing countries like India.[27] Low-income countries produce 0.2 kg per day per bed of biomedical waste. However, healthcare waste is often mixed with MSW in these countries, posing a serious risk to environment and skewing the estimates. A proper inventory of biomedical waste should be evolved on the basis of reconnaissance surveys. See *Table 2.5* for an example of a form for quantifying biomedical waste generation.

Table 2.4: Classification of hazardous medical waste

S. no.	Classification of hazardous medical waste	
1	Sharps	Waste entailing risk of injury
2	a. Waste entailing risk of contamination	Waste containing blood, secretions or excreta entailing a risk of contamination
	b. Anatomical waste	Body parts, tissue entailing a risk of contamination.
	c. Infectious waste	Waste containing large quantities of material, substances of cultures entailing the risk of propagating infectious agents (culture of infectious agents), and waste from infected patients placed in isolation wards
3	a. Pharmaceutical waste	Spilled or unused medicines or expired drugs and used medication inceptacles
	b. Cytotoxic waste	Expired or leftover cytotoxic drugs equipment contaminated with cytotoxic waste
	c. Heavy metal	Toxic waste, batteries, and mercury waste (broken thermometers or manometers, and fluorescent or compact fluorescent light tubes)
	d. Chemical waste	Waste containing chemical substance, leftover laboratory solvents, disinfectants, photographic developers and fixers
4	Pressurised containers	Gas cylinders and aerosol cans
5	Radioactive waste	Waste containing radioactive substances; radio nuclides used in laboratories or nuclear medicines, and urine or excreta of patients treated with radioactive substances

Source: Medical waste management, International Committee of Red Cross, 2011

Table 2.5: Form for quantification of biomedical waste generation

S. no.	Type	Quantity (kg/day)							
		Operation theatre	Wards	Public areas	Radiology	Admin	Laundry	Kitchen	Total
-	Household refuse								
-	Plant and kitchen waste								
1	Sharps								
2a	Waste entailing risk of contamination								
2b	Anatomical waste								
2c	Infectious waste								
3a	Pharmaceutical waste								
3b	Waste containing heavy metals								
3c	Chemical waste								
4	Pressurized containers								
Total (kg/day)									
Total (kg/day/patient)									

Source: Medical Waste Management, International Committee of Red Cross (ICRC), 2011.

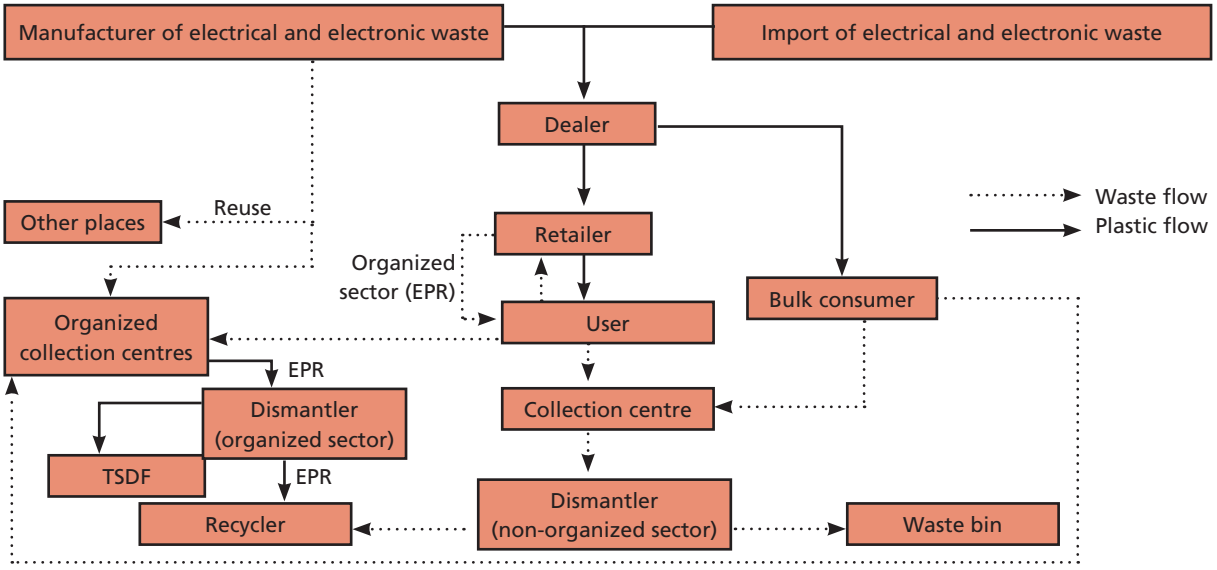
Electronic and electrical waste (e-waste)

Inventorization of e-waste can be achieved by various methods. However, the assessment method with two parameters—input and average life or obsolescence rate of the products—is much simpler and widely used. Input refers to sales and import of the product. The source of the sales data will include government statistics, secondary data available from market research bureau, industry etc.

The average life of a product can be divided into primary and secondary usage life.

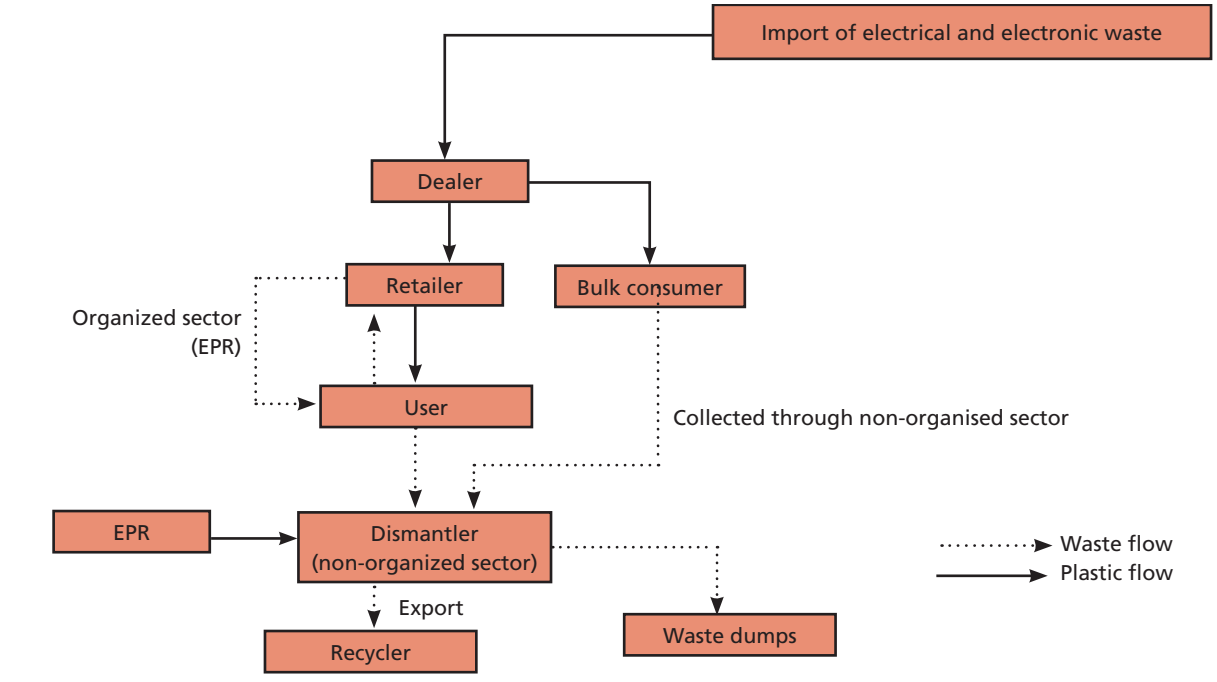
Figures 2.9 (a) and *(b)* summarize the sources of electrical and electronic waste, and their collection, treatment and disposal in industrialized and non-industrialized countries.

Figure 2.9 (a): Inventorization of e-waste generated in industrialized countries



Source: D.D. Basu, 2017, CSE

Figure 2.9 (b): Inventorization of e-waste generated in non-industrialized countries



Source: D.D. Basu, 2017, CSE

EPR IN DEVELOPED COUNTRIES

EUROPEAN UNION

In EU, all member states have implemented schemes on the four waste streams for which EU Directives recommend the use of EPR (packaging, batteries, end-of-life vehicles (ELVs), and electrical and electronic equipment.

Belgium

Waste Electrical and Electronic Equipment (WEEE) legislation has been implemented in Belgium, and companies selling electric and electronic products in the country's market must be able to prove they are meeting their takeback obligations. With the support of Belgian regional governments, the manufacturers and importers of e-waste have established a non-profit organization called Recupel which is responsible for the collection, sorting, processing and recycling of WEEE in Belgium.

Netherlands

The Netherlands enacted EPR legislation requiring manufacturers and importers of large- and small-scale electronic products to establish takeback systems with retailers, local governments and repair shops serving as collection sites.

Sweden

In 2001, Sweden enacted the Ordinance on Producer Responsibility for Electrical and Electronic Products. This law requires manufacturers, importers and retailers to take back a wide range of electronic products free of charge to the consumer. Most manufacturers participate and pay into a collective recycling system operated by a third party non-profit organization. Participation fees are based on the number and type of products put on the market.

SOUTH KOREA

Under the Producer Deposit System of 1992, EPR was first introduced to form a system wherein the product manufacturers take full responsibility for the recycling and disposal of their products. As the system has taken full effect as of 2003, products subject to EPR have further expanded to include personal computers, plastic bags and wrappers, Styrofoam material and cellular phones. Previously, it only included electronic appliances like televisions, refrigerators, washing machines, tires, lubricants, fluorescent lights, and packaging materials such as cans, glass bottles and plastic bottles. A volume-based waste system is in place in Korea and most residents separate recyclable goods from garbage. Local governments also encourage separation of recyclable waste and are encouraged to set up waste storage containers and facilities.

Source: Toxic Links, 2013; http://toxicslink.org/docs/06167_EPR_Sustainable_solution_to_ewaste.pdf

Informal sector plays an important role in management of e-waste, particularly in processes involving collection and dismantling of e-waste. This poses a serious risk to the health of the workers involved in such activities and also contaminates the immediate surroundings.

In non-industrialized countries, there are no formal recyclers. Thus, EPR is imperative. In developing countries, since both formal and informal sectors are involved, it is necessary to underline the role of the informal sector and efforts must be made by the government to formalize it. This can be done with the support of an external agency such as an NGO that can assist in building capacities, obtaining registration and authorization and using environmentally-

sound ways of dismantling. Even after a formal chain is set up, leakage of the collected and dismantled products to a third party at higher prices must be prevented by proper market research and outbidding such third parties, and handholding the informal recycling cycle, stressing the need for environment-friendly disposal. The cost for the formalization and setting up of dismantling and recycling agencies can be borne by corporate social responsibility (CSR) funds of manufacturers of electrical and electronic appliances (see *Box: EPR in developed countries*).

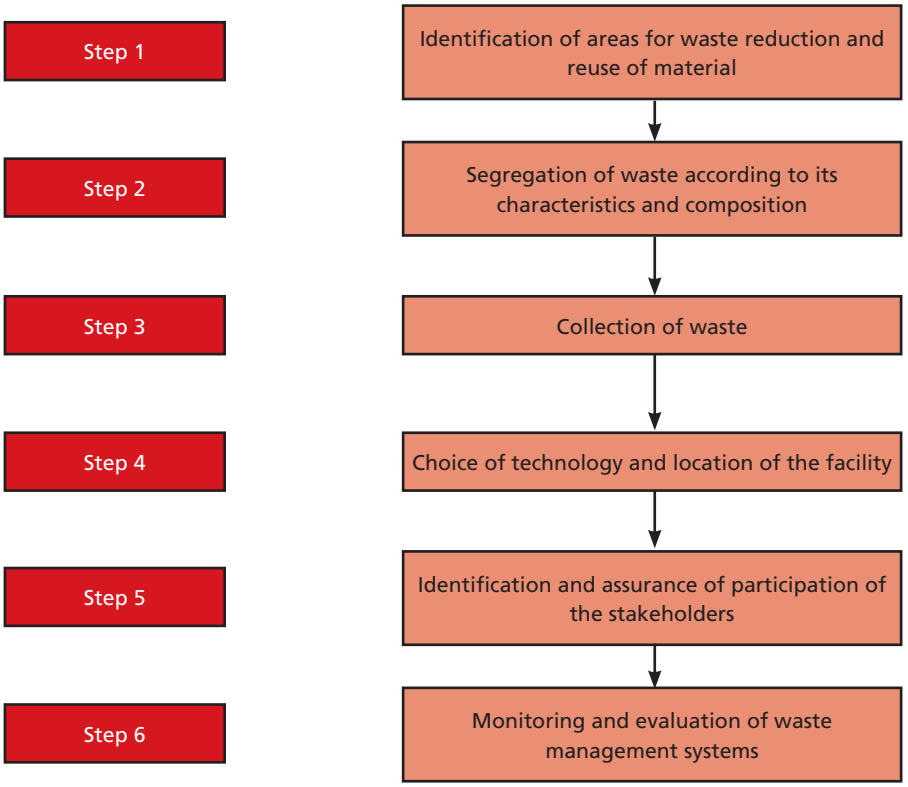
3. STRATEGY, POLICY AND REGULATORY FRAMEWORK FOR WASTE MANAGEMENT

Strategy for waste management practices

The universally accepted paradigm for waste management is based on the '4R concept', i.e. reduce, reuse, renovation and recycle, instead of opting for mere treatment of waste. For non-recyclable toxic waste, the feasible option is thermal destruction. Disposal of waste in landfills should be avoided. It is imperative to minimize generation and the thrust should be on source segregation in order to smoothen processing. Low-income countries should adopt sustainable and affordable technologies.

In order to implement a waste management strategy, the steps given in *Figure 3.1* need to be followed.

Figure 3.1: Steps of waste management strategy



Source: D.D. Basu, 2017, CSE

Waste minimization

Waste minimization can be defined as 'systematically reducing waste at source'.[28] The management of biodegradable waste is challenging due to its perishable nature, its limited storage period, and its harmful impact when leeching out of landfills. However, it is also an area where significant improvements are possible by adoption of decentralized technologies such as composting and biomethanization.

A key area where reduction of waste can be achieved is packaged goods and material. Smaller pouches are more affordable in low-income countries but they create a nuisance because they are difficulty to collect and are non-recyclable.

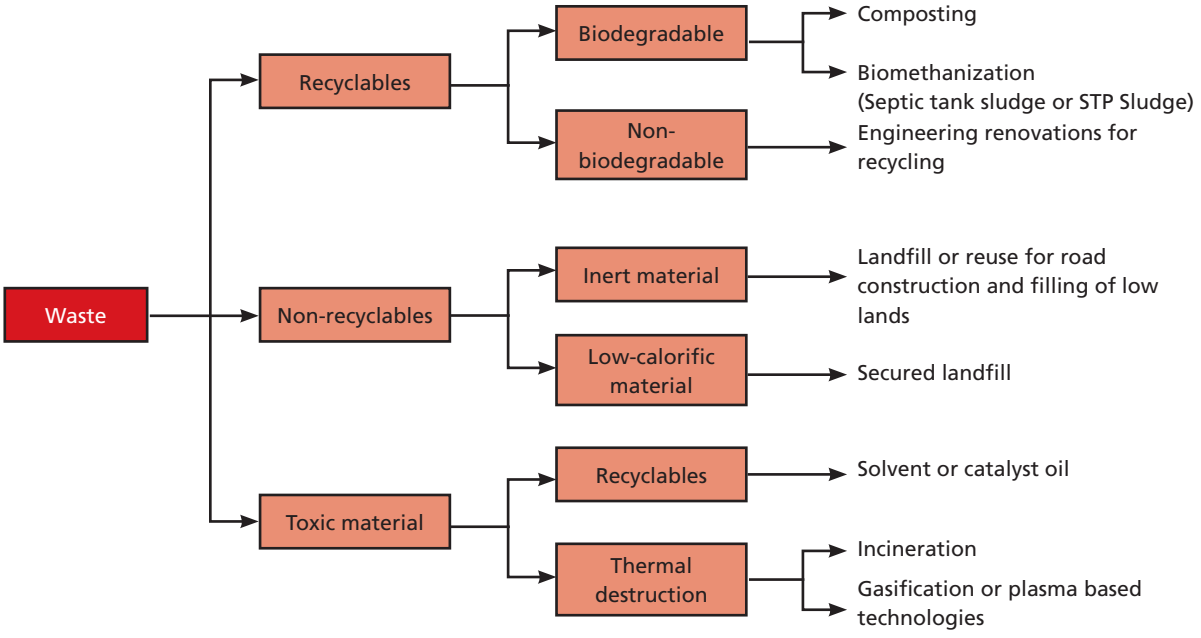
As for e-waste, the life span can be extended by engineering innovations. This is in vogue in India and many other countries, and this practice can be encouraged in African nations as well.

Segregation of waste

Biodegradability, non-biodegradability, toxicity and inert nature are key characteristics in segregation of waste. In addition to waste characterization, purpose of waste utilization and its treatment can also be the guiding factors for segregation. See *Figure 3.2* for segregation of waste on the basis of characterization and end use.

It is important to mention that if the quantity of toxic waste is low, incinerator or plasma technologies should not be considered under the waste management

Figure 3.2: Segregation of waste on the basis of the characterization and end use



Source: D.D. Basu, 2017, CSE

Table 3.1: Suggested frequency of collection

Source of origin	Type of waste				
	Biodegradable waste (kitchen)	Household dust	Recyclable waste (plastic, paper etc.)	Biomedical waste	Other waste (C&D, e-waste etc.)
Household (organized)	Daily	Daily	Once or twice a week	Once a week	--
Household (low-income)	Daily	Daily	Once or twice a week	-	-
Office with canteen or cafeteria	Daily	Daily	Once in a week	-	Once every six months or a year
Hotel	Twice a day	Twice a day	Once every alternative day	-	Once a year
Restaurant	Twice a day	Twice a day	Once every alternative day	-	-
Airport or railway station	Twice a day	Twice a day	Once a day	-	-
Hospital (> 250 beds)	Twice a day	Twice a day	Once a day	Twice a day	Once a day
Market	Twice a day	Once in a day	Once a day	Once a day	Once a day

Source: D.D. Basu, 2017, CSE

policy. It is better to return the waste (expired chemicals) to the country of origin through EPR.

Collection of waste

The established correct procedure of waste collection is as follows:

- Segregated waste is stored in colour-coded bins at the source of origin. One bin and two bags is the ideal option for storing segregated wet, dry and domestic hazardous waste separately
- Type of collection—door-to-door or community bins
- Frequency of collection to be established by the responsible stakeholder
- There must be integration of informal system of collection with the formal system
- There must be a buyback system through retailers or dealers
- Adequate infrastructure for strengthening collection (tricycle, pushcarts, handcarts, tipper etc.) must be provided

Segregated wet waste needs to be collected every day from households. Once the system is set, with requisite infrastructure and manpower in place, dry waste can be collected twice or once a week while domestic hazardous waste can be collected once a week. The mechanism can be adopted for institutions as well. In case of hotels, restaurants, airports, hospitals and other commercial areas, wet waste can be collected twice a day and dry waste once every alternate day. Suggested frequency of collection is summarized in *Table 3.1*.

Choice of technology and location of facility

Appropriate technology should be chosen on the basis of composition and quantity of waste, and affordability. Location of facilities is dependent on the infrastructure needed, and health and safety of the location. Choice of technology and location is discussed with respect to different waste streams as follows.

Municipal solid waste

As already stated, MSW is composed of organic, paper, plastic, glass, metals and inert waste. The percentage of each component varies from country to country, depending on the socio-economic conditions. Organic waste is predominant in lower-, middle- and upper-middle-income countries. In high-income countries, the dry fraction constituting of paper, plastic and packaging material dominates. Other type of waste includes textiles, rags, sanitary napkins, and components of e-waste etc. If MSW is properly segregated, there is an opportunity to process nearly 85 per cent waste. If decentralized methods are adopted, the cost of collection and transportation is lowered significantly.

Figure 3.3 illustrates municipal waste flow along with technologies and locations involved. The figure explains the primary and secondary collection of waste and how it is transported.

Plastic waste

Two types of plastic products are used widely, thermoplastics and thermosetting plastics. Thermoplastic material is recyclable in nature and can be heated and reset into a particular designated shape upon cooling. Most thermoplastic materials have a high molecular weight and melt quickly. On the other hand, a thermosetting plastic, due to its composite chemical structure, cannot be re-moulded or recycled. After use, thermoset plastics are discarded, and accumulate in landfills. *Table 3.2* enlists the most common types of thermoplastics and thermosetting plastics.

Packaging applications and recycling products of thermoplastics is summarized in *Table 3.3*. It is clear that polyethylene, polypropylene, PET and PVC compounds, forming the bulk of plastic waste, can be reutilized easily.

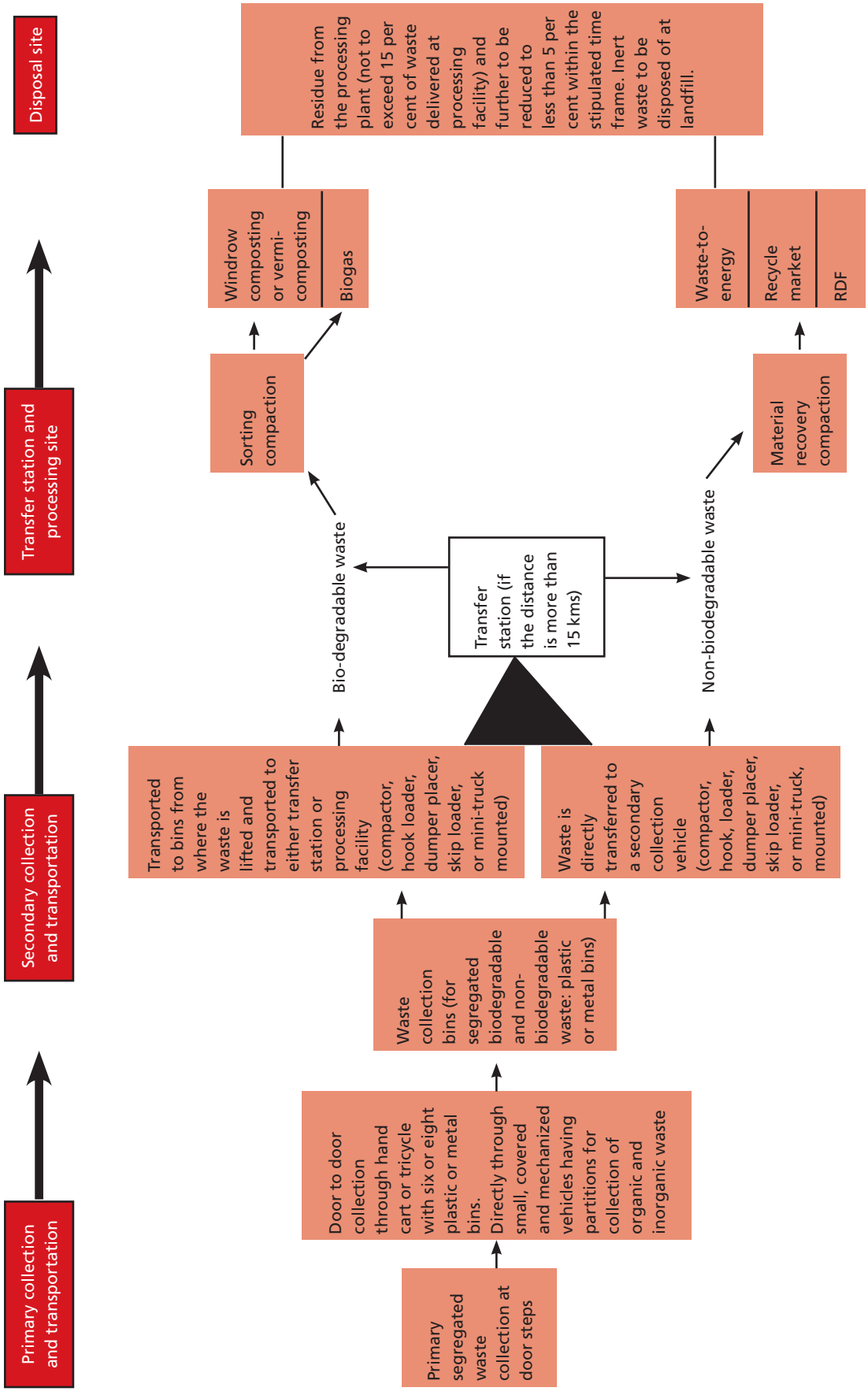
Figure 3.4 illustrates the flow of plastic waste from various point sources such as households, commercial areas, railways, airports etc., its collection, recycling and landfilling. However, in a majority of low-income countries, this waste is not collected and ends up blocking drains, is openly burnt with mixed waste leading to generation of poisonous gases—dioxins and furans—or is dumped in the open.

Table 3.2: Common types of thermoplastic and thermosetting plastic

Thermoplastic	Thermosetting plastic
Polyethylene tetra phthalate (PETE)	Bakelite
Polypropylene (PP)	Epoxy
Polyvinyl acetate (PVA)	Melamine
Polyvinyl chloride (PVC)	Polyester
Polystyrene (PS)	Polyurea theme
Low-density polyethene (LDPE)	Urea—formaldehyde
High-density polyethene (HDPE)	

Source: Central Pollution Control Board, 2016

Figure 3.3: Flowchart for household waste collection, transportation and disposal



Source: Expert Committee for revision of MSWM Manual, 2013–15

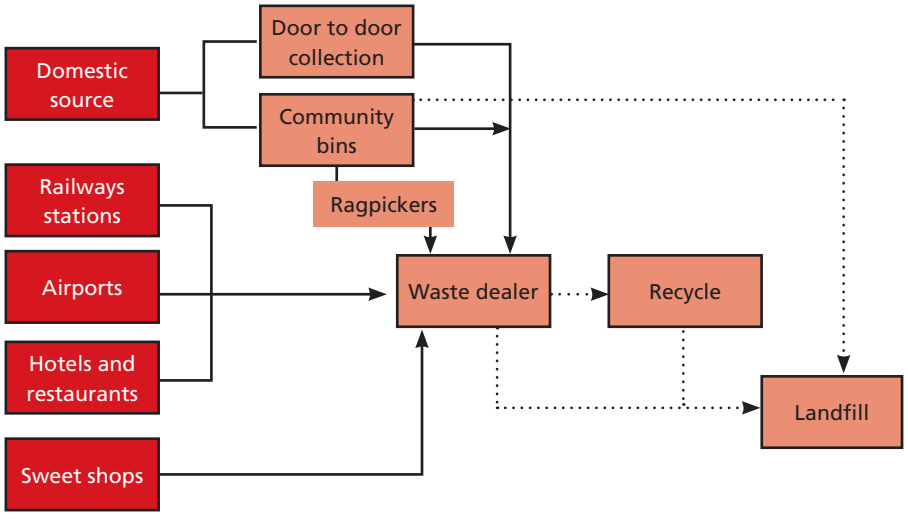
- *The compactor is an appropriate vehicle for collecting biodegradable and recycling component of solid waste*
- *Skip or hook loaders are preferred for collecting inert waste or construction and demolition waste*
- *Waste may be transferred to the transfer station if the processing site is located at least 15 km away from the city*

Table 3.3: Packaging application and recycling products of thermoplastic plastics

Types of plastic	Packaging application	Recycling product
Polyethylene tetra phthalate (PETE)	Potable liquids-holding bottles, microwavable packaging, food jars for butter, jelly and pickles, and plastic films	Fibre fills for sleeping bags, carpet fibres, ropes, pillows, etc.
Polypropylene (PP)	Potable liquids-holding bottles and grocery bags	Plastic lumber, households, grids and luggage
Polyvinyl acetate (PVA)	Food packaging, plastic toys, wire cables, insulation and flexible packaging	Footwear, irrigation and other drainage pipes, mats etc.
Polyvinyl chloride (PVA)	Plastic bags, frozen foods, stretch films and container lid	
Polystyrene (PS)	Food containers, bottle caps, medicine bottles and straws	Plastic lumber, cassette tape, boxes and flower pots
Low-density polyethene (LDPE)	Disposable cups, glasses, plates, spoon, CDs and cassette boxes	Grocery bags, shelter films and household items
High-density polyethene (HDPE)	Custom packaging	Flower pots, trash cans, traffic cones, detergent bottles, soap cases and other household items.

Source: Assessment of plastic waste and its management at airports and railway stations in Delhi, CPCB, Delhi, 2009

Figure 3.4: Flowchart of plastic waste

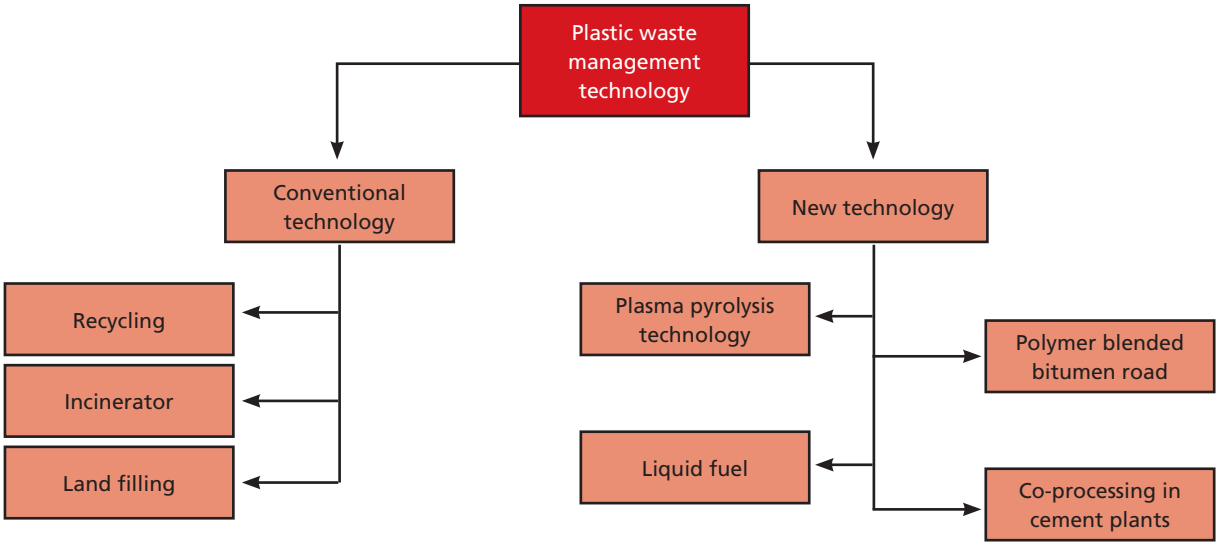


Source: D.D. Basu, 2017, CSE

If there is proper segregation of thermoplastics, above 50–70 per cent of it can be recycled. However, recycling units should be located in a designated industrial area away from habitation.

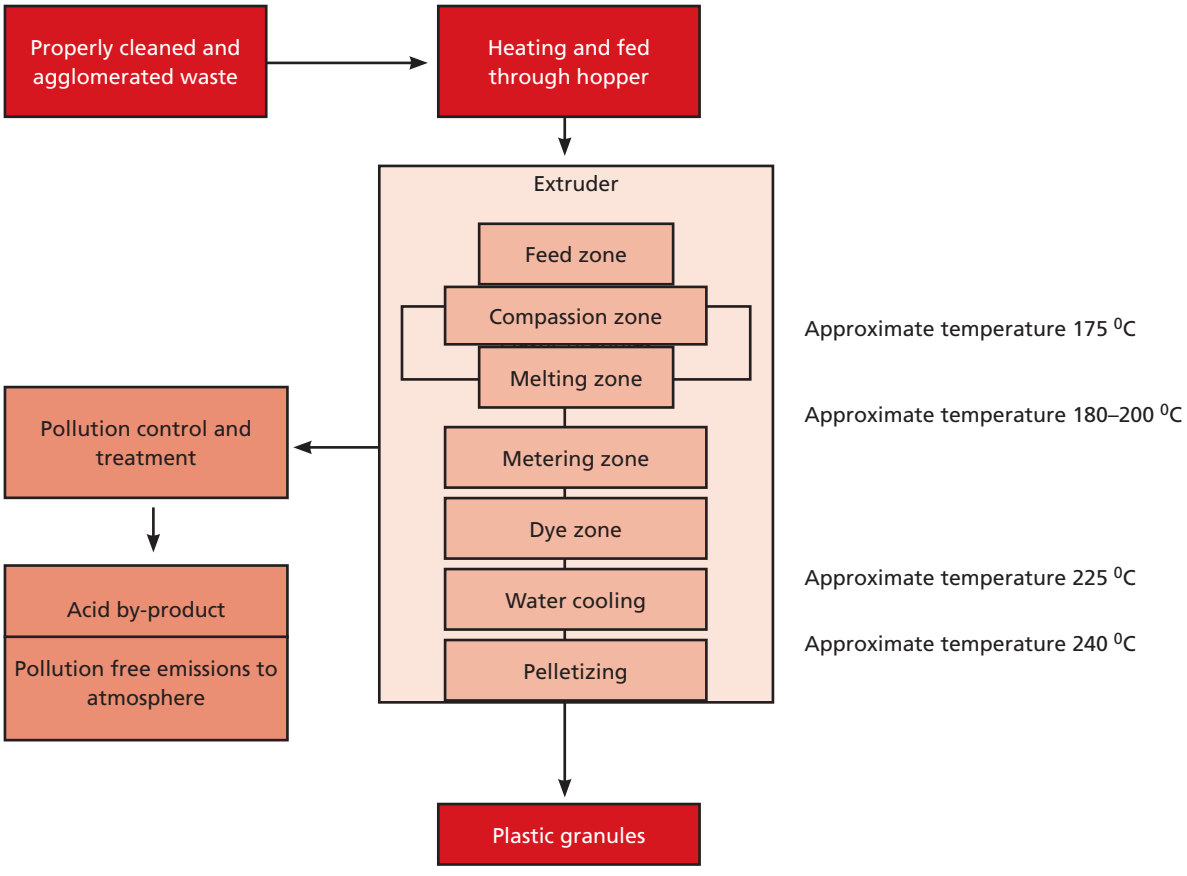
Where collection efficiency is good, various technological options can be adopted for plastic waste management. The most viable option is recycling. Where recycling is not possible, options such as using plastic in road construction or co-processing in cement kilns can also be explored. Incineration and land filling are not environment-friendly solutions for plastic waste management and there should be minimal dependence on these options. *Figure 3.5* illustrates some of the options that can be explored for plastic waste management.

Figure 3.5: Various options for plastic waste management technology



Source: Plastic Waste Management, CPCB. Available at http://www.cpcb.nic.in/wast/plasticwast/Plastic_waste-1.pdf, as accessed on 4 July 2017

Figure 3.6: Green recycling processes for plastic waste



Source: CPCB, 2013. Available at http://www.cpcb.nic.in/divisionsofheadoffice/pcp/management_plasticwaste.pdf, as accessed on 12 August 2017

Table 3.4: Hazardous and non-hazardous biomedical waste

Hazardous	Non-infectious (5 per cent)	15 per cent
	Infectious (10 per cent)	
Non-hazardous		85 per cent

Source: B. Ramesh Babu, A.K. Parande, R. Rajalakshmi, P. Suriyakala, M. Volga, 2009

Figure 3.6 provides a flowchart of the 'green recycling process' for plastic waste. In this process, the properly cleaned and agglomerated plastic waste is further heated and fed through a hopper. It then undergoes various processes—melting, dyeing, and pelletizing, and is converted into plastic granules. These granules can be used for making different products. This technology is affordable and cost-effective and the economies of scale can be achieved since it can be developed in various modular forms.

Biomedical waste

Biomedical waste from hospitals consists of bandages, linen, and other infectious waste (30–35 per cent), plastic (7–10 per cent), disposable syringes (0.3–0.5 per cent), glass (3–5 per cent) and other general wastes including food (40–45 per cent).[29] It can be further categorized into hazardous and non-hazardous waste (see *Table 3.4*).

It is, therefore, imperative to segregate biomedical waste at source and ensure its proper storage, treatment and disposal. *Table 3.5* depicts the type of containment for biomedical waste along with colour codes for different waste streams.

A comparison of technologies that need to be adopted for safe biomedical waste treatment and disposal is summarized in *Table 3.6*.

Table 3.5: Type of container and colour code for different biomedical wastes

Waste class	Type of container	Colour	Disposal system
Human anatomical waste	Plastic	Yellow	Incineration or deep burial
Animal waste	Plastic	Yellow	Data not available
Microbiological and Biotechnological waste	Plastic	Yellow	Auto-cleaning
Sharps	Puncture-proof containers made of HDPE	White	Auto-cleaning followed by metal recovery
Discarded medicines and cytotoxic waste	Plastic	Yellow	Return to point of origin under EPR or incinerator
Solid (glass and metal waste)	Plastic	Blue	Auto-cleaning followed by recycling
Plastic (solid)	Puncture-proof containers made of HDPE	Red	Auto-cleaning, shredding and recycling
Chemical waste (solid)	Puncture-proof containers made of HDPE	Yellow	Incineration or encapsulation in a secured landfill

Source: B. Ramesh Babu, A.K. Parande, R. Rajalakshmi, P. Suriyakala, M. Volga, 2009

Table 3.6: Comparison of treatment technologies for biomedical waste

Treatment systems	Autoclave	Hydroclave	Microwave	Incinerator	Chemical
Description	Steam sterilization (direct heating)	Steam sterilization, (indirect heating) simultaneous shredding and dehydration	Microwave heating of pre-shredded waste	High temperature waste incineration	Mixing pre-ground waste with chemicals, such as chlorine
Sterilization efficacy	Medium	Medium	Medium	High (total destruction of micro-organisms)	Dependent on chlorine strength and dispersal through the waste
Capital cost	Low	Low	High	High	Moderate
Operating cost	Low	Low	High	High	Low
Operator maintenance skills	Low skill level required	Low skill level required	Automated, but highly complex and high level maintenance skill required	High level operator and maintenance skills required	High level required for chemical control and grinder
Air emissions	Odorous but non-toxic	Somewhat odorous but non-toxic	Somewhat odorous but non-toxic	Can be highly toxic	Some chlorine emissions
Water Emissions	Odorous, may contain live micro-organisms	Odorous but sterile	Negligible	None	None
Treated waste characteristics	Wet waste; all material recognizable	Dehydrated and shredded waste; unrecognizable material	Shredded but wet waste	Mostly ash, may contain toxic substances	Shredded wet waste, containing chemicals used as disinfectants

Source: B. Ramesh Babu, A.K. Parande, R. Rajalakshmi, P. Suriyakala, M. Volga, 2009

Identification and assurance of participation of stakeholders

No waste management policy, programme and legislation can be successful without the participation of the stakeholders. It is, therefore, necessary to identify the stakeholders. Stakeholders and their degree of participation is summarized in *Table 3.7*. Dominant stakeholders in MSW, including plastic waste are local authorities, households, commercial and institutional complexes, hotels and restaurants, common facilitators of waste management (landfill and recyclers etc.), plastic packaging dealers (including producers). In developing countries, the informal sector is a major stakeholder.

With respect to biomedical waste, local authorities, biomedical and healthcare facilities, operators of common biomedical waste treatment facilities and federal authorities are the important stakeholders. E-waste handling encompasses household and bulk consumers, dealers and retailers, facilitators, regulators and the informal sector as stakeholders.

Three main actors are involved in the management of hazardous waste—industry, facilitators and regulators. Most hazardous waste is produced by the industrial sector. Battery waste management has limited stakeholders, which includes customers, regulators and waste battery dealers.

Table 3.7: Waste-specific stakeholders and their degree of participation

Waste/Stakeholder		Municipal waste	Plastic waste	Biomedical waste	E-waste	Hazardous waste	Battery waste
Households		+++	++	+	+	-	+
Bulk consumers	Heath facilities	+	++	+++	++	+	+
	Offices and banks	++	++	-	++	-	+
	Institutions	++	++	-	++	-	+
	Commercial establishments	+++	++	-	+	-	+
	Hotels	+++	+++	-	++	-	
	Restaurants and eateries	+++	+++	-	+	-	+
Dealers	Medicine	-	-	++	-	-	-
	Plastic packaging	-	++	-	-	-	-
	EE equipment	-	-	-	++	-	-
	Battery	-	-	-	-	-	++
Retailers	Medicine	-	-	+	-	-	-
	EE equipment	-	-	-	+	-	-
	Battery	-	-	-	-	-	+
Recyclers		++	+++	+	++	+	++
Facilitators		+++	++	+++	+++	+++	-
Industry		+	++	+	+++	+++	++
Regulator	Federal	+	+	++	++	+++	+++
	Local	+++	+++	+++	++	+++	+
Informal sector		+++	+++	+	++	-	+

+++ High participation ++ Medium participation + Low participation - No participation
Source: D.D. Basu, 2017, CSE

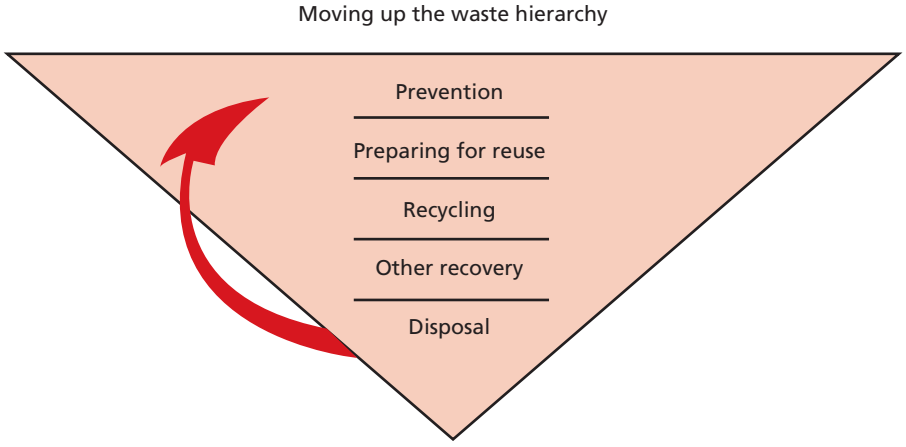
Monitoring and evaluation

Waste management cannot be effective without a proper monitoring system in place. Monitoring protocols can be intensive as well as extensive in nature. Extensive monitoring can be carried out at the local level by the authorities during routine inspections. It must be designed in a way that allows the authorities to create fair statistics answering the following questions:

- How much waste is generated at each level?
- How much waste is segregated and collected?
- How much waste is converted into value added products (recycled)?
- How much waste is sent for dumping and landfilling?
- What are the problem areas?

The federal agency must be engaged on a random basis in cooperation with the local authorities to device an intensive survey to identify the knowledge and infrastructure gaps and awareness levels. This evaluation will help develop future strategies and targets in order to fill the existing gaps in the system. The federal agency can adopt the following outline in order to evaluate the present status of waste management and make future targets:

Figure 3.7: Waste management hierarchy



Source: Waste Management Hierarchy, available at http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf

- Segregation at household, commercial places and source of generation.
- Collection systems
- Collection centre (register)
- Processing (recycling or composting or register)
- Waste dealer (register)
- Health survey of both the formal and informal sector (as part of an intensive survey)

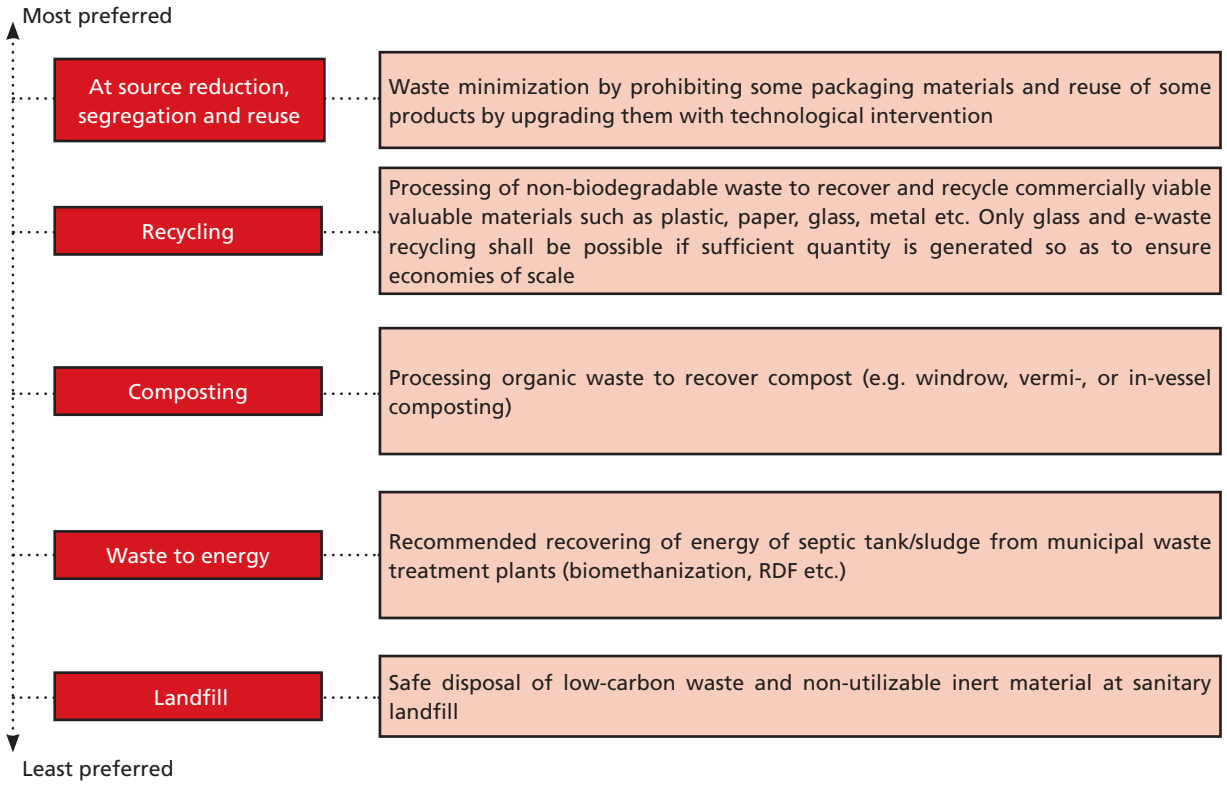
Integrated solid waste management policy framework

Considering the type of waste and operation of technology with minimum scale of operation and least complexity of technology, the most preferred hierarchy of waste management in African countries is described in *Figure 3.7*.

The first objective of waste management hierarchy is to promote waste minimization or reduction. This can be done by prohibiting packaging materials and reuse of some products by upgrading them with technological interventions. The second objective is to promote recycling and recovery of goods. This can be achieved by processing of non-biodegradable waste to recover and recycle commercially viable valuable material such as plastic, paper, glass and metal. The third objective is to adopt composting by processing organic waste to recover compost through processes like box, windrow, vermi-, and in-vessel composting. Waste-to-energy and landfill disposal should be the last option (see *Figure 3.8*).

Promoting waste minimization goes beyond the remit of environmental policy and depends in part on industrial policy and supporting economic instruments. Government and industry must coordinate their actions in a waste minimization programme that knits together the different policy strands and identifies the goods and services to which the provisions can feasibly apply.

Figure 3.8: Waste management hierarchy flowchart



Source: D.D. Basu, 2017, CSE

Proposed policy outlines to strengthen existing waste management systems in African countries

The proposed policy outline is highlighted below:

Waste minimization or source reduction

The following steps can be taken to minimize municipal solid waste generation.

Banning of carry bags

Polythene bags for carrying regular commodities must be banned. These carry bags are very thin and cannot be recycled more than once. They are light and small and create a nuisance on the streets, choking the drains.

Restriction of thin-film packaging

Thin-film multilayer packaging use needs to be restricted since some of them are not recycled. Small plastic pouches for packing also become garbage as they cannot be collected easily. A tax should be imposed with respect to size, composition and recyclability.

Avoid littering

It is the responsibility of the municipality or town council to provide adequate number of litter bins at commercial areas and at all important public places in

PLASTIC BAN IN ZANZIBAR

In Zanzibar, polythene was banned in 2011. The Plastic Bags Banning Regulations of 2011 prohibits the manufacture, import, storage, sale, transport, supply, possession or use of any plastic bag in Zanzibar for any purpose whatsoever. Any breach of these provisions makes the person liable to a fine of two hundred thousand Tanzanian shillings or imprisonment for six months or both. However, proper compliance and better enforcement needs to be encouraged.

Source: CSE assessment paper on Zanzibar, 2016

order to avoid littering in public spaces. Strict penalties must be imposed in cases of violation.

Strengthening collection and transport to support segregation

Generators should segregate at source. Every owner and occupier of premises within the municipal area must abide by and maintain the system of collection, segregation and storage of solid waste apart from having the duty to maintain the cleanliness of the premises. Owners and occupiers of premises within the municipal area must segregate waste under three categories (see *Table: 3.8*):

a. Organic or bio-degradable wastes (called wet waste)
b. Recyclable or non-biodegradable wastes (called dry waste)
c. Domestic hazardous wastes

Inclusion of the informal sector

The informal sector, compromising scrap and junk dealers and waste pickers, plays a significant role in collection and processing of recyclable material. It is reasonable to recognize, identify and integrate informal sector workers into formal waste management processes and initiatives.

Decentralized waste management

Decentralized community-level waste management is preferred over centralized waste management solutions under certain circumstances. It reduces the burden of handling large volumes of MSW at a centralized location, with corresponding reduction in costs of transportation and intermediate storage. In fact, if land is available, community-based composting should be a goal.

The advantages of decentralized waste management include the following:

- Decentralized systems allow for lower level of mechanization than centralized solutions and provide job opportunities for informal sector and small entrepreneurs
- Decentralized options can be tailored for local waste streams, climate, and social and economic conditions
- Decentralized systems reduce the cost incurred in the collection, transportation and disposal of waste

Table 3.8: Role and responsibilities of generators in order of priority

User's category		Responsibility
Individual households and approved colonies		To compulsorily segregate into wet, dry and domestic hazardous waste
Gated communities and flats		To segregate at source, create systems to treat wet waste at source, channelize dry waste to recyclers, only inert and non-recyclable waste to be collected from these areas by the municipality or town council
Star-rated or equivalent hotels		To segregate at source, compulsorily create systems to treat wet waste at source, channelize dry waste to recyclers, only inert and non-recyclable waste to be collected from these areas by the municipality or town council
Eating joints, restaurants, cafes, sweet shop, coffee houses etc. generating more than 20 kg of waste per day		To segregate at source, wherever possible, create systems to treat wet waste at source, channelize dry waste to recyclers, only inert and non-recyclable waste to be collected from these areas by the municipality or town council
Commercial and government offices, banks, insurance offices, coaching classes, and educational institutions per unit		To segregate at source, push for decentralized treatment composting or biomethanization, channelize dry waste to recyclers, only inert and non-recyclable waste to be collected from these areas by the municipality or town council
Restaurants, guesthouses and hostels, etc.		To segregate at source, create systems to treat wet waste at source, channelize dry waste to recyclers, only inert and non-recyclable waste to be collected from these areas by the municipality or town council
Street vendors	a) Without structures (roadside)	To segregate waste into wet and dry and transfer the waste every day to the nearest municipal litter bin or in a collection vehicle designated by the municipality or town council
	b) With structure	
Meat, fish and poultry shops		Slaughter waste from meat, poultry and fish shops should be stored separately in a bin and transferred every day to the nearest municipal litter bin or in a collection vehicle designated by the municipality or town council
Other shops		To segregate waste into wet and dry and transfer the waste every day to the nearest municipal litter bin or in a collection vehicle designated by the municipality or town council

Source: CSE, 2017

Channelization of recyclables

Recycling

At the regional level, some facilities of recycling of plastic and paper can be developed in line with the principles of EPR. Dismantled material can be exported to countries where facilities of recycling are available. Metal and glass waste can be collected and stored. If the quantity is sufficient, it can be sent for recycling, otherwise it may be allowed to be exported for recycling to other countries.

Import and export policy

No waste shall be allowed to enter into the countries for disposal, even in the form of upgraded second-hand material. The import of waste from any country shall be permitted only for recycling or recovery. Export of waste shall be governed by prior informed consent mechanism as a function of EPR.

Impose user-fees and penalties

Every generator needs to pay a user charge for the services provided to them by the local authority. The municipality or town council can keep records of user-fee collection to ensure accountability, transparency and should make every effort to increase awareness among the people on waste management and the user fees.

Disposal of the inert fraction

Waste disposal

As per the hierarchy, the least preferred option is the disposal of waste in engineered landfills. However, only inert rejects from the processing facility, street sweeping etc. can be landfilled. These sanitary landfills shall be constructed as per the stipulated law. Where old dumps are to be closed, possibility of capturing methane gas should be considered. Open dumping must be banned.

Waste to energy

Where material recovery is not possible, energy recovery from waste through production of electricity or fuel should be preferred. Considering all pros and cons, the countries must prefer to avoid this path due to the complexity of technologies, scale of operations required and financial liability in operating the plant. However, biomethanization of sludge from septic tanks and sewages treatment plants is a good option. Incineration of toxic biomedical waste in a controlled fashion can be considered.

Regulations

Within the backdrop of the proposed policy outlines and the existing scenario of waste management as mentioned in *Chapter 1*, the regulations should be a combination of both reactive and proactive approaches.

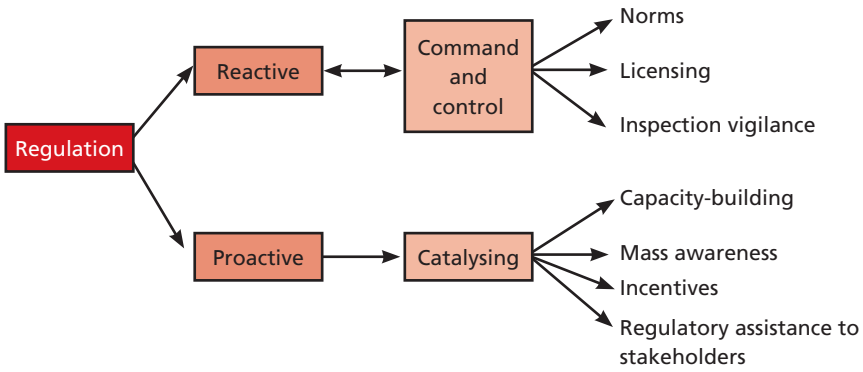
Regulatory framework for waste management

Reactive framework consists of norms, vigilance and inspection. Regulations on waste management cannot be limited to reactive approaches which emphasize on command and control. This is due to the involvement of various levels of stakeholders and sharp variation with respect to their socio-economic status.

On the contrary, a proactive approach emphasizes on building awareness, ensuring effective compliance and capacity-intensive schemes such as training and exposure visits etc.

An effective waste management legislation achieves a balance between reactive and proactive approaches. The regulatory approach to waste management is illustrated in *Figure 3.9*.

Figure 3.9: Regulatory approach to waste management



Source: D.D. Basu, 2017, CSE

Waste-specific or integrated waste management legislation

Once the nature of the regulatory approach is established for waste management, the second question that arises is the type of legislation a country must follow, i.e., waste-specific legislation or integrated waste management legislation. This depends on the level of urbanization and industrialization. The situation is discussed case-by-case as follows:

- **Case 1: When the level of urbanization and industrialization of a country is high:** It is understood that waste generated under all categories in high-income countries is high in volume and complex in nature. Technological capacities of these countries is also high. Such countries, therefore, can adopt waste stream-specific legislations. (see *Table 3.9*).
- **Case 2: When the level of urbanization is moderate and industrialization of a country is low:** Under this scenario, MSW will be higher. Plastic and biomedical waste will also be high but less when compared to *Case 1*. Hazardous and battery waste will not be produced in significant amounts. The waste management potential of the service industry is also not very high. This situation demands integrated waste management laws.
- **Case 3: When the level of urbanization and industrialization of a country is low:** In such cases, integrated waste management legislations help avoid needless entanglements and complexity.

Cases 2 and *3* are specific to non-industrialized societies where urbanization is confined to one or two cities with moderate populations. These countries fall in the low- and lower-middle-income categories. Consumption of consumer goods is low. Under such a scenario, instead of separate legislation for each type of waste, it is better to frame an integrated waste management policy. Integrated waste management is the key to developing sustainable solutions. It provides a strategic approach to sustainable management of different waste streams with emphasis on maximizing resource use efficiency. Therefore, under the prevailing situation, African nations must opt for integrated solid waste management legislations.

Table 3.9: Type of waste and legislation

Type of waste	Legislation
Municipal waste	Municipal solid waste management and handling legislation
Hospital waste or waste from healthcare facilities	Biomedical waste management and handling legislation
Plastic waste	Plastic manufacture, sale and usage legislation
Hazardous waste	Hazardous waste management, handling, and transboundary rules
Batteries waste	Batteries management handling rules
E-waste	Electronic and electrical waste management and handling rules

Source: D.D. Basu, 2017, CSE

Structure of the regulations

While structuring regulations on integrated waste management, the first and foremost step is to identify stakeholders and their classification. In this process, all stakeholders can be classified into three major groups—generators, facilitators and regulators.

Once the stakeholders under the 'generator' category are identified, their duties and responsibilities can be assigned with respect to the type of waste they generate.

The second group of stakeholders are the facilitators—providers of secured landfills, recycling centers, composting centers etc. The regulation must have the provision for public–private partnerships to develop such facilities.

In order to evaluate and monitor the compliance status of generators, regulators must be identified. Three-tier regulation is proposed:

- The first regulator is the environmental management agency at the national level, which is responsible for reviewing the policy, guidelines, capacity building and also acts as an appellate.
- The second (-tier) regulator is the district authority, responsible for inspection and evaluation of waste facilities, transfer of land for common facilities such as composting centers, engineered landfill sites and biomedical waste treatment plants, and assessment of the impact on environment. It should also be empowered to fine for non-compliance.
- The third (-tier) regulator is the local authority which is responsible for collection of municipal waste, management of decentralized facilities, and facilitating recyclers and dismantlers in consultation with the district authority. It should also be empowered to frame its own by-laws.

Besides these regulators, there should be an interdepartmental national advisory council as a parental body to guide all regulators.

The regulations must recognize the informal sector and facilitators as well as should introduce provisions for EPR. Regulations must also address import and export of waste. No legislation can be successful without a consolidated fund for the purpose of carrying out the activities it mandates.

This draft regulation addresses the creation of the funds within the general provisions of the annual budget. In order to strengthen the fund, 'waste cess' is also introduced.

An appellate authority should be created to settle legal issues before proceeding to regular court.

Integrated Waste Management Rules And Resolution (Draft)

PREAMBLE

Whereas every citizen has the constitutional right to a clean and healthy environment for the benefit of present and future generations through adoption of sustainable waste management methodologies.

Whereas, the Environment Management Act provides for the collection, handling, storage, transportation and disposal of municipal solid waste.

Whereas, the Environment Management Act provides for the import in a manner approved by authorities, collection, handling, storage, transportation, disposal of hazardous waste.

Whereas, the Environment Management Act provides for the collection, storage, transportation and disposal in a manner approved by the authority for biomedical waste.

Whereas, the Environment Management Act provides for the collection, storage, dismantling of electronic and electrical waste (hereinafter referred as e-waste).

Whereas, there is a provision under the Environment Management Act that the concerned authority has the power to make rules or resolutions as it deems fit for the proper implementation and enforcement of this Act.

Therefore, in exercise of the power conferred by section --- of the Act, the Central or federal government hereby makes integrated waste management rule and resolution with the following guiding principles:

i. ***No littering***
ii. ***Minimize generation of waste***
iii. Create systems to support segregation
iv. Handover segregated waste to authorized waste collectors, recyclers and waste collection agencies
v. Adopt decentralized technologies and best available practices with respect to techno-economic feasibility
vi. Pay user fees to local bodies or any other person authorized by the local body for sustainability of solid waste management
vii. Fines and penalties for littering and non-compliance

Chapter I
Preliminary

1) Short title, extent and commencement

1. These rules shall be called Integrated Waste Management Rules, (YYYY).
2. These rules shall be applicable and extend to the whole of the territory of (name of the country).
3. Except otherwise provided in these rules, they shall come into force on the MM/DD/YYYY on publication in the Official Gazette.

2) Application

These rules shall apply to:

1. Every generator, including domestic, institutional, commercial and any other waste generator, urban local body, village council, importers, airports, airbases, ports, harbours, defence establishments, special economic zones, and government organizations.
2. Persons who generate, collect, receive, store, transport, treat, dispose of or handle biomedical waste in any form, including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccinations camps, blood donation camps, first-aid rooms of schools, forensic laboratories and research laboratories.
3. Waste resulting from construction, re-modelling, repair and demolition of any civil structure of individual or organization or authority that generates construction and demolition waste such as building materials, debris and rubble.
4. Consumer, bulk consumer, collection center, dealer, e-retailer, refurbisher, dismantler and recycler involved in manufacture, sale, transfer, purchase, collection, storage and processing of e-waste, and electrical and electronic equipment listed in **Schedule I,** including their components, consumables, parts and spares which make the product operational.
5. Faecal sludge and waste from septic tanks.
6. Hazardous and other wastes.

3) Definitions

1. **Animal house** means a place where animals are reared or kept for the purpose of experiments or testing.
2. **Authorization** means the permission given by local or district authority or National Environmental Management Agency (NEMA), as the case maybe, to the operator of a facility or any other agency responsible for processing and disposal of solid waste, plastic and packaging, e-waste, biomedical waste and hazardous waste.
3. **Biodegradable waste** means any organic material that can be degraded by micro-organisms into simpler stable compounds.

4. **Biomedical waste** means any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or research activities pertaining thereto or in the production or testing of biological substances, or in health camps, including the categories mentioned in **Schedule II** appended to these rules.
5. **Biomedical waste treatment and disposal facility** means any facility wherein treatment and disposal of biomedical waste takes place.
6. **Biomethanation** means a process which entails enzymatic decomposition of organic matter by microbial action to produce methane-rich biogas.
7. **Brand owner** (**plastic**) means a person or company that sells any commodity under a registered brand label.
8. **Bulk consumer** means bulk users of electrical and electronic equipment such as government departments, public sector undertakings, banks, educational institutions, multinational organizations, international agencies, partnership and public or private companies that are registered under the various laws and healthcare facilities which have turnover of more than (----) or have more than twenty employees.
9. **Bulk waste generator** (**e-waste**) means and includes buildings occupied by Central government departments or undertakings, local bodies, public sector undertakings or private companies, hospitals, nursing homes, schools, colleges, universities, other educational institutions, hostels, hotels, commercial establishments, markets, places of worship, stadia and sports complexes having an average waste generation rate exceeding 100 kg per day.
10. **Carry bags** (**plastic**) mean bags made from plastic material or compostable plastic material, used for the purpose of carrying or dispensing commodities which have a self-carrying feature but do not include bags that constitute or form an integral part of the packaging in which goods are sealed prior to use.
11. **Channelization** (**e-waste**) means to direct the path for movement of e-waste from collection onwards to authorized dismantlers.
12. **Collection centre** (**e-waste**) means a centre or a collection point or both established by a producer individually or an association jointly to collect e-waste for channelizing the e-waste to dismantlers and play a role as indicated in the authorization for extended producer responsibility granted to the producer and having facilities as per the guidelines of NEMA, including the collection centre established by the dismantler, which should be a part of their authorization issued by the district authority.
13. **Component** (**e-waste**) means one of the parts of a sub-assembly or assembly of which a manufactured product is made up and into which it may be resolved. It includes an accessory or attachment to another component.
14. **Composting** means a controlled process involving microbial decomposition of organic matter.
15. **Construction** means the process of erecting of buildings or built facility or other structures, or building of infrastructure including alteration in these entities.
16. **Construction and demolition waste** (**construction waste**) means the waste comprising of building material, debris and rubble resulting from construction, re-modelling, repair and demolition of any civil structure.

17. **Consumer** means any person using electrical and electronic equipment, excluding bulk consumers.
18. **Contractor** means a person or firm that undertakes a contract to provide materials or labour to perform a service or do a job for a service-providing authority.
19. **Critical care medical equipment** means lifesaving equipment and includes such equipment as specified by the Ministry of Health and Family Welfare from time to time.
20. **Dealer** means any individual or firm that buys or receives electrical and electronic equipment as listed in **Schedule I** of these rules and their components or consumables or parts or spares from producers for sale.
21. **Decentralized processing** means establishment of dispersed facilities for maximizing the processing of biodegradable waste and recovery of recyclables closest to the source of generation so as to minimize transportation of waste for processing or disposal.
22. **Deconstruction** (**construction waste**) means a planned selective demolition in which salvage, re-use and recycling of the demolished structure is maximized.
23. **Demolition** means breaking down or tearing down buildings and other structures either manually or using mechanical force (by various equipment) or by implosion using explosives.
24. **Deposit refund scheme** means a scheme whereby the producer charges an additional amount as a deposit at the time of the sale of product and returns it to the consumer along with interest when the product is returned at the end of its life.
25. **Disintegration** (**plastic**) means the physical breakdown of a material into very small fragments.
26. **Dismantler** means any person or organization engaged in dismantling of used electrical and electronic equipment into their components and having facilities as per the guidelines of NEMA and having authorization from the concerned district authority.
27. **Dismantling** means the process of disconnecting the pieces of used electrical and electronic equipment to destroy the integrity or functioning of such equipment.
28. **Disposal of residue of biomedical, hazardous and e-waste** means any operation which does not lead to reuse, recycling, recovery and utilization, including co-processing, but includes physico-chemical treatment, biological treatment, incineration and disposal in secured landfills.
29. **Disposal of municipal solid waste** means the final and safe disposal of post-processed residual solid waste and inert street sweepings and silt from surface drains on land to prevent contamination of groundwater, surface-water, ambient air and animals or birds to be attracted towards it.
30. **Dry waste** means waste other than biodegradable waste and inert street sweeping. It includes recyclable and non-recyclable waste, combustible waste and sanitary napkins and diapers etc.
31. **Domestic or household hazardous waste** means discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, used needles, syringes and contaminated gauges, insecticides, pesticides, and suchlike, generated at household level.

32. **Door-to-door** means collection of solid waste from the door steps of households, shops, commercial establishments, offices, institutional or any other non-residential premises and includes collection of such waste from the entry gate or a designated location on the ground floor in a housing society, multi-storied building or apartment, large residential, commercial or institutional complex or premises.
33. **Electric or electronic equipment** means equipment which are dependent on electric current or electro-magnetic field in order to become functional.
34. **Environmentally-sound management of hazardous and other waste** means taking all steps required to ensure that hazardous and other wastes are managed in a manner which protects the health of the people and environment against adverse effects of such waste.
35. **Exporter** (**hazardous and other wastes**) means any person or occupier under the jurisdiction of the exporting country who exports hazardous or other wastes, including the country which exports hazardous or other waste.
36. **Extended producer responsibility** means responsibility of any producer of electrical or electronic equipment, packaging products such as plastic, tin, glass and corrugated boxes, tyres, batteries, etc. for environmentally sound management till the end of the life of such waste. Extended producer responsibility may comprise of implementing take-back systems or setting up of collection centers or both and having agreed arrangements with authorized dismantlers or recyclers either individually or collectively through a producer responsibility organization recognized by the producer(s) in their extended producer responsibility authorization.
37. **Extended producer responsibility authorization** means permission given by NEMA to the producer(s) for managing extended producer responsibility with implementation plans and targets outlined in such authorization, including details of the producer responsibility organization and e-waste exchange, if applicable.
38. **EPR plan** means a plan submitted by a producer to NEMA at the time of applying for extended producer responsibility authorization in which a producer shall provide details of e-waste channelization system for targeted collection including details of producer responsibility organization and e-waste exchange, if applicable.
39. **Export**, with its grammatical variations and cognate expressions, means taking out of (the country) to a place outside (the country).
40. **Facility** means any establishment wherein the waste management processes namely segregation, recovery, storage, collection, recycling, processing, treatment or safe disposal are carried out.
41. **Handling** includes all activities relating to sorting, segregation, material recovery, collection, secondary storage, shredding, bailing, crushing, loading, unloading, transportation, processing and disposal of wastes.
42. **Import** with its grammatical variations and cognate expressions, means bringing into (the country) from a place outside (the country).
43. **Importer** means a person who imports or intends to import and holds an importer-exporter code number, unless otherwise specifically exempted.
44. **Incineration** means an engineered process involving burning or combustion of solid waste to thermally degrade waste minerals at high temperature.

45. **Inert** means wastes which are not biodegradable, recyclable or combustible such as street sweeping dust and silt removed from surface drains.
46. **Informal waste collector** includes individuals, associations or waste traders who are involved in sorting, sale and purchase of recyclable material.
47. **Institutional waste generator** means and includes occupier of the institutional buildings such as government departments, public or private sector companies, hospitals, schools, colleges, universities or other places of education organization, academy, hotels, restaurants, malls and shopping complexes.
48. **Local authority or local body** for the purpose of this statuette means and includes municipal corporations, councils, boards, rural village and local town councils, census towns, notified areas and industrial townships, with whatever name they are called in different states and union territories in (the country) (regional or district authority and federal authority).
49. **Management** (**of biomedical waste**) includes all steps required to ensure that biomedical waste is managed in such a manner as to protect the health and environment against any adverse effects due to handling of such waste.
50. **Multi-layered packaging** means material used or to be used for packaging and having at least one layer of plastic as the main ingredients in combination with one or more layers of materials such as paper, paperboard, polymeric materials, materialized layers or aluminium foil, either in the form of a laminate or coextruded structure.
51. **Non-biodegradable waste** means any waste that cannot be degraded by microorganisms into simpler stable compounds.
52. **Occupier** (**in case of biomedical waste**) means a person having administrative control over the institution and the premises generating biomedical waste ,which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank, healthcare facility and clinical establishment, irrespective of their system of medicine and by whatever name they are called.
53. **Operator of a common biomedical waste treatment facility** (**CBMWTF**) means a person who owns or controls a common biomedical waste treatment facility (CBMWTF) for the collection, reception, storage, transport, treatment, disposal or any other form of handling of biomedical waste.
54. **Operator of disposal facility** means a person who owns or operates a facility for collection, reception, treatment, storage and disposal of hazardous and other wastes.
55. **Operator of facility** means a person or entity, who owns or operates a facility for handling waste which includes the local body and any other entity or agency appointed by the local authority.
56. **Plastic** means material which contains an essential ingredient like a high polymer such as polyethylene terephthalate, high density polyethylene, vinyl, low density polyethylene, polypropylene, polystyrene resins, and multi-materials like acrylonitrile butadiene styrene, polyphenylene oxide, polycarbonate, and polybutylene terephthalate.
57. **Plastic sheet** is a sheet made of plastic.
58. **Plastic waste is** any plastic discarded after use or after their intended use is over.

59. **Prescribed authority** means the NEMA at federal, district authority at district level, and authorities at the local level.
60. **Primary collection** means collecting, lifting and removing segregated waste from the source of its generation, including households, shops, offices and any other non-residential premises or from any collection points or any location specified by a local body.
61. **Recovery** means any operation or activity wherein specific materials are recovered.
62. **Recycler** means any person who is engaged in recycling and reprocessing of waste electrical and electronic equipment or assemblies or their components and has facilities as elaborated in the guidelines of NEMA**.**
63. **Refurbishment** means repairing of used electrical and electronic equipment as listed in **Schedule I** for extending its working life for its originally intended use and selling the same in the market or returning to the owner.
64. **Recycling** means the process of transforming segregated non-biodegradable solid waste into new material or products or raw material for producing new products which may or may not be similar to the original products.
65. **Residual solid waste** means and includes the waste and rejects from solid waste processing facilities which are not suitable for recycling or further processing.
66. **Sanitary land filling** means the final and safe disposal of residual waste and inert wastes on land in a facility designed with protective measures against pollution of groundwater, surface-water and fugitive air dust, windblown litter, bad odour, fire hazard, animal and bird menace, pests or rodents, greenhouse gas emissions, persistent organic pollutants, slope instability and erosion.
67. **Sanitary waste** means wastes comprising of used diapers, sanitary towels or napkins, tampons, condoms, incontinence sheets and any other similar waste.
68. **Segregation** means sorting and separate storage of various components of solid waste after collection at secondary waste storage depots or bins for onward transportation of the waste to the processing or disposal facility.
69. **Service provider** means an authority providing public utility services like water, sewerage, electricity, telephone, roads, drainage, etc.
70. **Solid waste** means and includes solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated biomedical waste excluding industrial waste, biomedical waste and e-waste, battery waste, radioactive waste generated in the area under the local authorities and other entities.
71. **Street vendor** means any person engaged in vending of articles, goods, wares, food items or merchandise of everyday use or offering services to the general public, in a street, lane, side walk, footpath, pavement, public park or any other public place or private area, from a temporary built-up structure or by moving from place to place and includes hawkers, peddlers, squatters and all other synonymous terms which may be local or region specific, and the words 'street vending' with their grammatical variations and cognate expressions, shall be construed accordingly.

72. **Tipping fee** (**service fee**) means a fee or support price determined by local authorities or any district authority authorized by NEMA to be paid to the concessionaire or operator of waste processing facility or for disposal of residual solid waste at the landfill.
73. **Transport** means off-site movement of hazardous or other wastes by air, rail, road or water.
74. **Transportation** means conveyance of waste either treated partly or untreated from a location to another location in an environmentally-sound manner through specially-designed and covered transport system so as to prevent foul odour, littering and unsightly conditions.
75. **Transporter** means a person or company or entity engaged in the off-site transportation of e-waste by air, rail, road or water carrying a manifest system issued by the person or company or entity who has handed over the e-waste to the transporter, giving the origin, destination and quantity of the e-waste being transported.
76. **Treatment** means the method, technique or process designed to modify physical, chemical or biological characteristics, or composition of any waste so as to reduce its volume and potential to cause harm.
77. **Used oil** means any oil derived from crude oil or mixtures containing synthetic oil including spent oil, used engine oil, gear oil, hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil and their tank bottom sludge and suitable for reprocessing.
78. **Utilization** means use of hazardous or other waste as a resource.
79. **Vermi-composting** means the process of conversion of bio-degradable waste into compost using earthworms.
80. **Virgin plastic** means plastic material which has not been subjected to use earlier and has also not been blended with scrap or waste.
81. **Waste** means materials that are not products or by-products, for which the generator has no further use for the purposes of production, transformation or consumption.

    Explanation: For the purposes of this clause,
    (i) Waste includes the materials that may be generated during the extraction of raw materials, processing of raw materials into intermediates and final products, consumption of final products, and through other human activities excluding residuals recycled or reused at the place of generation.
    (ii) By-product means a material that is not intended to be produced but gets produced in the production process of intended product and is used as such.
82. **Waste hierarchy** means the priority order in which the solid waste is to and should be managed by giving emphasis to prevention, reduction, reuse, recycle, recovery and disposal, with prevention being the most preferred option and disposal at the landfill being the least.
83. **Waste generator** means and includes every person or group of persons, every residential premise and non-residential establishment including national railways and defence establishments which generate waste.
84. **Waste generator** (**construction waste**) means any person or association of persons or institution, residential and commercial establishments including railways, airports, port and harbour and defence establishments

which undertake construction of or demolition of any civil structure which generates construction and demolition waste.

85. **Waste management** means the collection, storage, transportation, reduction, re-use, recovery, recycling, composting or disposal of plastic waste in an environmentally safe manner.
86. **Waste oil** means any oil which includes spills of crude oil, emulsions, tank bottom sludge and slop oil generated from petroleum refineries, installations or ships and can be used as fuel in furnaces for energy recovery.
87. **Waste picker** means a person or group of persons informally engaged in collection and recovery of usable and recyclable solid waste from the source of waste generation—streets bins, material recovery facilities, and processing and waste disposal facilities for sale to recyclers directly or through intermediaries to earn their livelihood.

Chapter II
Duties and responsibilities of a waste generator

4) Solid waste generator

(1) Every waste generator shall:
   a. Segregate and store the waste generated by them in four separate streams namely, 1. Biodegradable (including horticultural waste), 2. Non-biodegradable with recyclable materials, 3. Sanitary waste or, 4. Household hazardous waste.
   b. Handover wastes mentioned in Rule 4(1)(a) to authorized waste pickers or any authorized agency in the following manner: Biodegradable and non-biodegradable waste shall be collected daily, and household hazardous waste shall be collected on a monthly basis.
   c. Sanitary waste like diapers and sanitary pads shall be wrapped securely in the pouches provided by the manufacturers or brand owners of these products or in a suitable wrapping material as instructed by local authorities and placed in a separate bag that shall be collected by local authorities or agencies daily or once a week, as the case may be.

(2) No waste generator shall throw, burn or bury the waste generated by him or her on streets, open public spaces outside his premises or in the drains or water bodies.
(3) All waste generators shall pay such user fee for solid waste management as specified in the by-laws of the local authority as stated in **Annexure I.**
(4) Biodegradable waste shall be processed, treated and disposed of in a decentralized manner by composting or bio-methanation.
(5) Residual waste shall be given to waste collectors or agency as directed by local authorities.
(6) All gated communities, hotels, institutions, and flats with more than 10,000 sq m built-up area,[30] in partnership with local authorities, shall ensure segregation of waste at source as prescribed in these rules; process, treat biodegradable waste within the premises by composting or any other technology; facilitate collection of segregated recyclable waste

and handover recyclable materials to either authorized waste pickers or authorized recyclers; facilitate collection of hazardous waste and hand it over to authorized waste pickers.

(7) No person shall organize an outdoor event or gathering where food is served without taking permission from local authorities along with payment of user fees as prescribed in the by-laws of the local authority as stated in **Annexure 1**, at least three working days in advance and such person or the organizer of such event shall ensure segregation of waste at source and handing over of segregated waste to waste collector or agency as specified by the local authority.

(8) All waste generators shall pay penalty and fines for violations as specified in the by-laws.

5) Plastic waste generator

(1) The waste generator shall:

a. Take steps to minimize generation of plastic waste and segregate plastic waste at source.

b. Not litter the plastic waste and ensure segregated storage of waste at source and handover segregated waste to local authority or registered waste pickers, registered recyclers or waste collection agencies.

(2) Every person responsible for organizing an event in an open space, which involves service of food stuff in plastic or multilayered packaging or one-time use of disposable plastics shall segregate and manage the waste generated during such events.

6) Biomedical waste generator

(1) It shall be the duty of every occupier of an institution generating biomedical waste, which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, or blood bank by whatever name called,

a. to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment,

b. make provisions within premises for a safe, ventilated and secured location for storage of segregated biomedical waste in coloured bags or containers as specified in **Schedule II,** to ensure that there shall be no secondary handling, pilferage or misappropriation of recyclables or inadvertent scattering or spillage by animals and the biomedical waste from such a place or premises shall be directly transported in the manner as prescribed in these rules to the common biomedical waste treatment facility or for the appropriate treatment and disposal, as the case maybe, in the manner prescribed in **Schedule III, Part A and B**,

c. pre-treat laboratory waste, microbiological waste, blood samples and blood bags through disinfection or sterilization on site in a manner prescribed by the World Health Organization (WHO) or National AIDS Control Organization (NACO) guidelines and then sent to the Common Biomedical Waste Treatment Facility (CBWTF) for final disposal,

d. local authority or its authorized agency shall collect and transport segregated non-biomedical solid waste generated in the health care facilities (HCF), and ensure that biomedical waste should not be mixed with solid waste,
e. use of chlorinated plastic bags, gloves and blood bags shall be phased out as per the targets prescribed by the NEMA or Ministry of Health, as deemed fit,
f. the occupier shall provide training to all healthcare workers and others, involved in handling of biomedical waste at the time of induction and, thereafter, at least once every year, in consultation with the Ministry of Health,
g. an annual report shall be made, which mentions the number of training programmes conducted, number of personnel that received training and also personnel who have not undergone any training,
h. the occupier shall ensure occupational safety of all its healthcare workers and others involved in handling of biomedical waste by providing appropriate and adequate personal protective equipment,
i. the occupier shall conduct a health check up at the time of induction and at least once in a year for its healthcare workers and others involved in handling such waste, and maintain the records for the same,
j. the occupier shall inform the prescribed authority in the incidence of refusal of collection of biomedical waste, either within the intended time or as per the agreed time, whichever is earlier,
k. the occupier shall maintain and update biomedical waste management register daily, according to category and colour coding of such waste as specified in **Schedule II**,
l. the occupier shall make available the annual report on its website or to the concerned department, within two years from the date of the commencement of these rules,
m. the occupier shall report major accidents including accidents caused by fire hazards and blasts during handling of biomedical wastes along with remedial action and relevant steps taken in such occurrences—such a report shall be a part of the Annual Report.

7) Construction and demolition waste generator

(1) Every waste generator shall be responsible for collection and segregation of concrete, soil, steel, wood and plastic, and storage of construction and demolition waste generated as directed or stipulated by local authorities or prescribed agency, as the case may be.
(2) The generator shall ensure that other waste (such as solid waste) does not get mixed with this waste and is stored and disposed of separately.
(3) Every waste generator shall keep the construction and demolition waste within the boundaries of the premises or shall have it collected for being deposited to the collection centre made by the local body or hand it over to the authorized processing facilities of construction and demolition waste.
(4) Every waste generator shall pay relevant charges for collection, transportation, processing and disposal as notified by the concerned authorities.

(5) The rate of the relevant charges shall be fixed by the concerned local authorities or any other authority designated by the state government.

8) E-waste generator

(1) Individual or bulk consumers of electrical and electronic components listed in **Schedule I** shall ensure that e-waste generated by them is collected and deposited in the collection centre or dealt through an authorized collector.
(2) Bulk consumers of electrical and electronic equipment listed in **Schedule I** shall maintain records of e-waste generated by them in the format given in **Annexure II**.
(3) Records mentioned in Rule 7(b) shall be available for scrutiny by the concerned authority.

9) Producer and dealer

(1) The producer of electrical and electronic equipment listed in **Schedule I** shall be responsible for implementing extended producers responsibility through the following framework:
   a. Collection and channelization of e-waste generated from the end-of-life of their products or end-of-life products with same electrical and electronic equipment code and historical waste available on the date from which these rules come into force
   b. The mechanism used for channelization of e-waste from end-of-life products, including those from their service centres to authorized dismantlers shall be in accordance with the extended producer responsibility authorization.
   c. Extended producer responsibility: Authorization should comprise of a general scheme for collection of e-waste through buy-back arrangement, exchange schemes, deposit refund system etc., whether directly or through an authorized agency and channelizing the items so collected to authorized recyclers.
   d. Providing contact details such as physical and email addresses, toll-free telephone or helpline numbers to consumer(s) or bulk consumer(s) through their website and product user documentation so as to facilitate return of end-of-life electrical and electronic equipment.
   e. Creating awareness through media, publications, advertisements, posters, or by any other means of communication.
   f. The producer shall implement extended producer responsibility individually or collectively. In individual producer responsibility, producer may set up his own collection centre or implement take-back system or both to meet extended producer responsibility. In collective systems, producers may tie-up together to set up collection centres or implement take-back system or both.
(2) Primary responsibility for collection of used multi-layered plastic sachet or pouches or packaging or tyres is of the producers, importers and brand owners who introduce the products in the market. They need to establish a system for collecting back such waste generated due to their products. This plan of collection shall be submitted to the concerned department or agency.

(3) In case the dealer has been given the responsibility of collection on behalf of the producer, the dealer shall collect such waste by providing the consumer a box, bin or a demarcated area to deposit such waste, or through a take-back system and send the waste so collected to a collection or dismantling or recycling centre, as designated by the producer.
(4) Collection and channelization of rejected or end of life tyres as well as plastic and packaging material shall be done by the principals stated in Rules 9(1), (2) and (3).

10) Duties and responsibilities of hazardous waste generator

(1) Individual households shall ensure medicines or chemicals that have exceeded their date of expiry be collected and deposited to the retailer or dealer in the vicinity.
(2) Medicines or chemicals mentioned in Rule 10(1) shall be deposited by the retailer or dealer who collects such waste and transferred to the original producer of the product for safe disposal of such waste as per the general principles of extended producer responsibility.
(3) Bulk consumers such as health care facilities of medicine that have exceeded their date of expiry shall maintain a register and make the same available for scrutiny by concerned authorities and ensure that a copy of the record of the aforementioned register is deposited with the office of the common incinerator.
(4) If there is any medicine that has exceeded its date of expiry, it is to be handed over to the original producer under the general principle of extended producer responsibility.
(5) Bulk consumers such as agriculture department that generates chemicals shall maintain a register and make it available for scrutiny of concerned authorities and ensure it is collected and deposited to original producers under the general principle of extended producer responsibility (EPR).
(6) Used and waste oil shall be handed over to the dealer authorized by NEMA.
(7) The authorized dealer shall maintain records of waste or used oil as prescribed by the NEMA from time to time and shall produce it before the authorities when required.
(8) The authorized dealer shall channelize waste or used oil to authorized recycler for refining or re-use of used or waste oil.
(9) Industries generating hazardous waste as identified by NEMA shall follow the following steps:
    a) Prevention
    b) Minimization
    c) Reuse
    d) Recycling
    e) Recovery and utilization, including co-processing
    f) Safe disposal

(10) NEMA shall identify industrial hazardous waste on the basis of source-, waste-, and CRIT (corrosivity, reactivity, ignitivity and toxicity)-specific approach.

(11) Hazardous waste generated in the industry of an occupier shall be sent or sold to an authorized authority or shall be disposed of in an authorized disposal facility.
(12) Staff working in the site shall be provided with appropriate training, personal protective equipment and necessary information to ensure their safety.

Note: Categorization of hazardous waste generated in industry varies from country to country, thus no schedule is made here. The concerned country can make their own schedule according to extent of their industrialization.

Chapter III
Duties and responsibilities of a regulator

11) Local authority

The local authority shall:

a. Prepare a solid waste management plan in consultation with the district authority or provincial government as per policy and guidelines issued by the national authority (Ministry of Environment or environment protection agency or authority) as it may deem fit for the federal government.
b. Arrange for door-to-door collection of segregated solid waste from all households, including slums and informal settlements, commercial, institutional and other non-residential premises, multi–story buildings, large commercial and housing complexes, hotels and restaurants etc. This may be collected from the entry gate or any other designated location in the following manner:
   Collection for biodegradable and non-biodegradable waste shall be done daily, sanitary waste shall be collected on a daily or weekly basis, and household hazardous waste shall be collected on a monthly basis.

c. Establish a system to recognize organization of waste pickers or informal waste collectors and promote and establish a system for integration of these authorized waste pickers and waste collectors to facilitate their participation in solid waste management, including door-to-door collection.
d. Device a mechanism to incentivize waste pickers or informal waste collectors such as promotion of recycling initiatives.
e. Frame by-laws incorporating provisions of these rules (suggested by laws given in **Annexure I**).
f. Prescribe user fee from time to time as deemed appropriate and collect the fee from waste generators on its own or through authorized agency.
g. Direct waste generators not to litter, i.e., throw or dispose of any waste such as paper, water bottles, liquor bottles, soft drink canes, tetra packs, fruit peel, wrapper, or burn or bury waste on streets, open public spaces, drains, waste bodies and to segregate the waste at source as prescribed under these rules and hand over the segregated waste to waste pickers or collectors authorized by the local authority.

h. Impose heavy fines and penalties for littering or burning waste as prescribe in the by-laws.
i. Collect waste from vegetable, fruit, flower, meat, poultry and fish market on a daily basis and promote setting up of decentralized compost plant or biomethanation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions as per the guidelines laid down by NEMA (**Annexure III**).
j. Provide and maintain sufficient number of litter bins of sufficient size on public roads, historical and religious places, commercial areas etc.
k. Separately collect waste from sweeping of streets, lanes and by-lanes daily, or on alternate days depending on the density of population, commercial activities and local situation.
l. Set up facilities for temporary storage of street sweeping and silt removed from surface drains in cases where direct collection of such waste into transport vehicles is not convenient. Waste so collected shall be disposed of at regular intervals as decided by the local body.
m. Transport segregated biodegradable waste to processing facilities like compost plants, biomethanation plants or any such facilities. Preference shall be given to decentralized processing, wherever applicable.
n. Transport non-biodegradable recyclable waste to the respective processing facility or material recovery facility or secondary storage facility.
o. Transport construction and demolition waste as per the provisions of the rules.
p. Ensure proper usage, regular upkeep and maintenance of household, community and public sanitation facilities.
q. Ensure proper disposal and decentralized treatment of sludge, wherever applicable, from on-site installations (septic tanks, pit latrines etc.).
r. Ensure that all human waste is collected safely and confined and disposed of after treatment so as not to cause any hazard to public health or the environment.
s. Involve communities in waste management and promotion of home composting, biomethanation, decentralized processing of waste at community level subject to control of odour and maintenance of hygienic conditions around the facility.
t. Create market linkages for compost in order to push for decentralized processing.
u. In consultation with district or provincial authorities, facilitate the setting up of material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorized waste pickers and waste collectors to separate recyclables from the waste, and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste from the source of generation or from material recovery facilities.
v. Bins or bags for storage of biodegradable waste, non-biodegradable recyclable and household hazardous waste shall be colour-coded.
w. Undertake on their own or through any other agency construction, operation and maintenance of sanitary landfills and associated infrastructure for disposal of residual waste in a manner prescribed under these rules.
x. Create awareness through information, education and communication campaigns and educate waste generators on minimal generation of waste,

not to litter, reusing waste to the extent possible, practicing segregation, appropriate storage of segregated waste at source, and payment of monthly user fees.

y. Local authority shall introduce 'waste cess' in tourist areas. The 'waste cess' thus collected shall be utilized for strengthening waste management in tourism areas.

12) Duties of district or regional authorities

The district or regional authorities shall:

a. Enforce these rules in their district through local bodies in their respective jurisdiction and review implementation of these rules at least twice a year, in close coordination with NEMA.
b. Monitor environmental standards and adherence to conditions as specified by the NEMA.
c. District authority shall assist local authorities on allocation of land for sanitary landfill (as minimal as possible) and land for recycling facilities as per the guidelines laid by the NEMA. Selection criteria for site selection of sanitary landfill is given in **Annexure IV**.
d. Shall grant authorization to local bodies or its authorized agencies for construction, operation of sanitary landfills and recycling facilities.
e. It shall also identify the land for biomedical waste treatment facility and authorize the facilitator for construction and operation of such biomedical waste facilities. Format for application and authorization is given in **Annexure V and VI** respectively.
f. Shall grant authorization to dismantling or recycling facilities of electronic and electrical wastes, plastic and packaging, tyres etc.
g. Shall grant authorization to occupiers of common facilities of hazardous waste.

13) Duties of National Environmental Management Agency (NEMA)

The National Environmental Management Agency shall:

a. Coordinate with the district, regional or local authority for implementation of these rules and adherence to the prescribed standards by the district, regional or local authorities.
b. Lay down the standards of waste water discharge, emissions and leachate with respect to waste processing and disposal facilities.
c. Review environmental standards and norms prescribed for waste processing facilities or treatment technologies and update them as and when required
d. Develop a schedule on industrial hazardous waste with respect to processes generating hazardous waste, waste constituents with concentration limits based on hazardous characteristics in the light of prevailing industries in the concerned country.
e. In consultation with the district, regional or local authorities, at least once in a year review the implementation of prescribed environmental standards for waste processing facilities or treatment technologies and compile the date monitored by them.

f. Review the proposals of the district, regional or local authority for implementation of these rules by local bodies.
g. Prepare an annual report on implementation of these rules on the basis of reports received from district, regional or local authorities and submit it to NEMA—the report shall be put in public domain.
h. Publish guidelines for maintaining buffer zones restricting any residential, commercial or any other construction activity from the outer boundary of the waste processing and disposal facilities for different sizes of facilities handling more than five tonnes of waste per day.
i. Publish guideline from time to time on environmental aspects of processing and disposal of solid waste to enable local bodies to comply with the provisions of these rules.
j. Provide guidance to district and local authorities on inter-district movement of waste.

Chapter IV
Constituting National Advisory Council on Waste Management

14) Constitution of the National Advisory Council headed by the Ministry of Environment

The National Advisory Council shall be headed by the Minister of Environment. The other members shall be:

1. Secretary, Ministry of Urban Development
2. Secretary, Ministry of Health
3. Secretary, Ministry of Local Self Government or Administration
4. Three members from the district or regional authorities (by rotation).
5. Representation from the chamber of commerce
6. Two subject experts, to be nominated by the Minister
7. Secretary, Ministry of Environment, Member Convener

14.1) Duties and responsibilities of National Advisory Council

1. Advice NEMA on national policy
2. Advice to mobilize funds, both national and international, to different agencies
3. Develop periodic benchmarks and review the progress of the district, regional or local authority
4. Assess and support infrastructure, capacities and requirements to strengthen waste management governance
5. Recommend yearly targets for achievement of segregation and EPR

Chapter V
Duties and responsibilities of the facilitator of common facilities of waste management

15) Criteria for duties regarding setting up a waste processing and treatment facility (landfill)

a. District or local authorities, in consultation with land and land revenue department, shall be responsible for providing suitable land as per the guidelines laid down in **Annexure IV** for setting up of solid waste processing and treatment facilitates as per guidelines laid down by NEMA and notify such sites as per the law of the land. In case of proximity to towns, common facilities may be given priority.
b. The operator of the facility shall design and set up the facility as per the technical guidelines issued by the NEMA in this regard from time to time.
c. The operator of the facility shall obtain necessary approval from the relevant authority.
d. The district or local authority shall inspect and monitor the environmental standards of the operation of the waste processing and treatment facilities as stipulated by NEMA, and adherence to approval conditions.
e. The operator of the facility shall be responsible for providing safe environment facilities as per the guidelines issued by NEMA.
f. The operator of waste processing and treatment facility shall submit annual report to the district or local authority. The format for the annual report shall be prescribed by district or local authority in consultation with NEMA.

16) Criteria for setting up of a material recovery facility for recyclable materials

a. A private agency or operator, in cooperation or consultation with local authorities, shall take the initiative to set up material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorized waste pickers and waste collectors to separate recyclable from the waste pickers or recyclable for collection or segregation of recyclable waste such as paper, plastic, metal, glass and textile from the source of generation or from material recovery facilities.
b. District or local authorities, in consultation with land and land revenue department, shall be responsible for providing suitable land for setting up the recycling facilities and notify such sites as per the law of the land.
c. The operator of the facility shall design and set up the facility as per the technical guidelines or manual issued by NEMA in this regard from time to time.
d. The operator of the facility shall apply to the local authority for obtaining authorization in format to be prescribed by NEMA.
e. The district or local authorities, after examining the proposal with due diligence, shall grant authorization for operation of facilities.

f. The district or local authority shall inspect or monitor the environmental standards of the operation of recycling facilities as stipulated by NEMA and adherence to approval condition.
g. The operator of the facility shall be responsible for the safe and environmentally-sound operation of the recycling facilities as per the guideline issued by NEMA.
h. The operator of recycling facility shall submit an annual report to the district or local authority in a prescribed format.

17) Criteria for setting up of a biomedical waste management facility

a. A private agency or operator in cooperation or consultation with district or local authorities shall take the initiative to identify a location to set up a biomedical waste management facility.
b. The district or local authority, after consultation with land and land revenue department, shall notify the land for the said purpose as per law of the land.
c. The operator of the facility shall design and set up the facility as per the technical guidelines or manual issued by the NEMA in this regard, from time to time.
d. The district or local authority, after being assured of the adequacy of the facility directed to all healthcare facilities, preferably within prescribed set back distance of the facility, will allow to dispose of their waste duly segregated as per **Schedule II.**
e. The Ministry of Health shall develop a protocol for healthcare facilities on biomedical waste management and organize capacity building programmes in order to adhere to the protocol. The Ministry of Health shall inspect healthcare facilities and direct the facility to rectify accordingly.
f. The operator of the common biomedical waste treatment facility shall transport the biomedical waste from the premises of an occupier to any off-site biomedical waste treatment facility only in the vehicles having a label as provided in Part 'A' of the **Schedule III** along with necessary information as specified in Part 'B' of the **Schedule III**.
g. The vehicles used for transportation of biomedical waste shall comply with the conditions stipulated in the Motor Vehicles Rules of the Land.
h. The district or local authority shall inspect the biomedical waste management facility from time to time and direct for appropriate action. The inspection shall also be extended to transportation facilities.
i. The operator of the facility shall apply to the district or local authorities for obtaining authorization in the stipulated application form as per notification of NEMA (**Annexure V**). The said authority being satisfied with the adequacy of the facility shall authorize accordingly with a validity period of three years, which is to be renewed six months before the expiration of its validity (**Annexure VI**).
j. The district or local authority has the right to withdraw the authorization, if not found satisfactory at the time of inspection.
k. Medicines that have exceeded their date of expiry shall be sent back by the bulk consumer or retailers to the authorized dealer who shall send it to biomedical waste facilities through local authorities.

18) Criteria for setting up a common hazardous waste management facility

a. The district authority is responsible for providing suitable land for establishment of treatment storage disposal facility (TSDF) as per the guidelines laid down by NEMA and notify such sites as per the law of land.
b. The operator of the facility shall design and set up the facility as per the technical guidelines issued by the NEMA in this regard from time to time.
c. NEMA, on assurance of adequacy of the facility, shall direct all enlisted hazardous waste generating industries to dispose of their waste thereof.
d. Operators of common TSDF facilities shall transport hazardous waste from the premises of an occupier to the facility as per the conditions stipulated in the country's Motor Vehicles Rules and with a notified manifest system.
e. NEMA shall inspect TSDF facility from time to time and direct accordingly. The inspection shall also be extended to the transportation facility.
f. The operator of the facility shall apply to NEMA for obtaining authorization in the stipulated application as per the notification. The said authority being satisfied with the adequacy of the facility shall authorize accordingly with a validity period of three years, which is to be renewed six months before the expiration of the validity.
g. NEMA has the right to withdraw the authorization, if not found satisfactory at the time of inspection.
h. In the absence of common TSDF, the industry generating hazardous waste shall apply to NEMA for transporting the same to the TSDF facility of neighbouring countries. NEMA, after examination with due diligence shall grant authorization with consent from the authorities of the country of TSDF facility with proper manifest system and Motor Vehicles Rules.

19) Extended producer responsibility: Registration and authorization

a. The producers or manufacturers shall register themselves with the district or local authorities.
b. The producer, who is engaged in production and manufacturing and similar business, shall apply for authorization from district or local authorities.
c. The district or local authorities shall examine the proposal with due diligence and grant authorization for implementing the EPR plan.
d. This authorization shall include, among other things, the targeted quantity of e-waste, product code-wise, to be collected during the year. The actual target for collection of e-waste for dismantling or recycling will be fixed on the basis of quantity of electrical and electronic equipment, product code-wise, placed in the market in the previous years and taking into consideration the average life of the equipment. The estimated quantity of e-waste generated during the current year will be indicated by the producer and the quantity expected to be collected with the collection scheme proposed to be implemented by the producer will be indicated in the EPR plan. The NEMA shall fix the targets in accordance with **Schedule IV**.
e. The activities accomplished in the plan shall be submitted by the district or local authority to NEMA in a consolidated annual report.

Chapter VI
Import and export of waste

20) Import and export of waste

a. No import of waste is admissible for the purpose of treatment and disposal as under Basal Convention.
b. Import of waste for the purpose of recycling and dismantling is admissible, as per the provisions of the Basal Convention.
c. Purpose mentioned in Rule 20(b) can be enlisted by NEMA.
d. Export of waste shall only be allowed for the purpose of recycling of dismantled waste, e-waste, plastic and packaging waste, tyres and expired or discarded medicines under extended producer responsibility programme, or utilizing facilities of neighbouring countries with due approval from NEMA.
e. The export of waste shall be duly authorized by the district or local authority.

Chapter VII
Funds and budget for integrated waste management

21) National fund

(1) NEMA shall have its own fund exclusively for waste management. All sums which may from time to time be paid to it by the federal government and all other receipts (by way of gifts, grants, donations, benefactions—fees—or otherwise) of that agency shall be carried to the fund of the agency and all payments by the agency shall be made therefrom.
(2) The expenditure heads shall be confined to capacity building of district or local authorities and healthcare facilities, tipping fees to local authorities for operation and construction of composting or biomethanation plants, landfills, etc.

22) Contribution by federal government

The federal government shall, after due appropriation made by the parliament by law in this behalf, make in each financial year such contributions to the NEMA as it may think necessary for the agency to perform both developing and regulatory functions under the rules.

23) The federal government shall introduce 'environmental cess' on tourists visiting the country. The 'environmental cess' thus collected shall be deposited to the consolidated fund for waste management as referred in Rule 21.

24) Budget for specific purpose on waste management

The NEMA, during each financial year, shall prepare in such form and at such time as may be prescribed, a budget in respect of the next financial year ensuring the estimated receipt and expenditure, and copies thereof shall be forwarded to the federal government.

25) Annual Report

The NEMA shall, during each financial year, prepare in such form as may be prescribed, an annual report giving full accounts of its activities under these Rules including a report of activities during the previous financial year and copies thereof shall be forwarded to the federal government.

Chapter VIII
Legal provisions

26) Power to give direction

Notwithstanding anything contained in any other law, but subject to the provisions of these Rules, and to the directions that the federal government may give in this respect, a district or local authority may, in the exercise of its powers and performance and its functions under these Rules, issue any directions in writing to the operator or occupier of municipal waste landfill, recycler of plastic waste or dismantler of waste, and such operator or occupier shall be bound to comply with such directions.

27) Appeals

1) Any person aggrieved by an order made by the district or local authority under Rule 26 may, within thirty days from the date at which the order is communicated to him, file an appeal to such authority (hereinafter referred to as the Appellate Authority) as the federal government may think fit to constitute or utilizing the service of existing appellate system.
2) An appellate authority shall consist of three persons as the federal government may think fit, to be appointed by the government.
3) The form and manner in which an appeal may be preferred under Rule 26, the fees payable for such appeal and the procedure to be followed by the appellate authority shall be such as may be prescribed by the federal government in a separate notification.

28) Power to make notifications

The federal government may issue notification or prescription of procedure from time to time as is admissible under these rules.

SCHEDULE I

Categories of electrical and electronic equipment including their components, consumables, parts and spares covered under the Rules

S. no.	Categories of electrical and electronic equipment	Electrical and electronic equipment code
i.	**Information technology and telecommunication equipment:**	
	Centralized data processing: Mainframes and minicomputers	
	Personal computing: Personal computers (central processing units with input and output devices)	
	Personal computing: Laptop computers (central processing units with input and output devices)	
	Personal computing: Notebook computers	
	Personal computing: Notepad computers	
	Printers including cartridges	
	Copying equipment	
	User terminals and systems	
	Facsimile	
	Telex	
	Telephones	
	Pay telephones	
	Cordless telephones	
	Cellular telephones	
	Answering systems	
ii.	**Consumer electrical and electronics:**	
	Television sets (including sets based on liquid crystal display and light emitting diode technology)	
	Refrigerators	
	Washing machines	
	Air-conditioners excluding centralized air-conditioning plants	
	Fluorescent and other mercury-containing lamps	

Note: The concerned country may add more items to the list as per requirement.

SCHEDULE II

Biomedical wastes categories and their segregation, collection, treatment, processing and disposal options

Category	Type of waste	Type of bag or container to be used	Treatment and disposal options
(1)	(2)	(3)	(4)
Yellow	**(a) Human anatomical waste** Human tissues, organs, body parts and foetus below the viability period (as per the country's medical termination of pregnancy law).	Yellow coloured non-chlorinated plastic bags	Incineration, plasma pyrolysis or deep burial*
	(b) Animal anatomical waste Experimental animal carcasses, body parts, organs, tissues, including the waste generated from animals used in experiments or testing in veterinary hospitals or colleges or animal houses.		
	(c) Solid waste Items contaminated with blood, body fluids like dressings, plaster casts, cotton swabs and bags containing residual or discarded blood and blood components.		Incineration, plasma pyrolysis or deep burial* In the absence of the above facilities, autoclaving or micro-waving or hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery.
	(d) Expired or discarded medicines Pharmaceutical waste like antibiotics, cytotoxic drugs including all items contaminated with cytotoxic drugs along with glass or plastic ampoules, vials etc.	Yellow coloured non-chlorinated plastic bags or containers	Expired cytotoxic drugs and items contaminated with cytotoxic drugs to be returned back to the manufacturer or supplier for incineration at temperature > 1,200^{0}C or to common biomedical waste treatment facility or hazardous waste treatment, storage and disposal facility for incineration at > 1200 ^{0}C or encapsulation or plasma pyrolysis at > 1200 ^{0}C. All other discarded medicines shall be either sent back to the manufacturer or disposed of by incineration.
	(e) Chemical waste Chemicals used in production of biological and used or discarded disinfectants.	Yellow coloured containers or non-chlorinated plastic bags	Disposed of by incineration or plasma pyrolysis or encapsulation in hazardous waste treatment, storage and disposal facilities.
	(f) Chemical liquid waste Liquid waste generated due to use of chemicals in production of biological and used or discarded disinfectants, silver X-ray film developing liquid, discarded formalin, infected secretions, aspirated body fluids, liquid from laboratories and floor washings, cleaning, housekeeping and disinfecting activities etc.	A separate collection system leading to effluent treatment system	After resource recovery, the chemical liquid waste shall be pre-treated before mixing with other wastewater.
	(g) Discarded linen, mattresses, beddings contaminated with blood or body fluid.	Non-chlorinated yellow plastic bags or suitable packing material	Non-chlorinated chemical disinfection followed by incineration or plasma pyrolysis or for energy recovery. In the absence of above facilities, shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent for energy recovery or incineration or plasma pyrolysis.

Category	Type of waste	Type of bag or container to be used	Treatment and disposal options
(1)	(2)	(3)	(4)
	(h) Microbiology, biotechnology and other clinical laboratory waste Blood bags, laboratory cultures, stocks or specimens of microorganisms, live or attenuated vaccines, human and animal cell cultures used in research, industrial laboratories, production of biological, residual toxins, dishes and devices used for cultures.	Autoclave safe plastic bags or containers	Pre-treat to sterilize with non-chlorinated chemicals on-site as per National AIDS Control Organization or World Health Organization guidelines thereafter for incineration.
Red	**Contaminated waste (recyclable)** (a) Wastes generated from disposable items such as tubing, bottles, intravenous tubes and sets, catheters, urine bags, syringes(without needles and fixed needle syringes) and vacutainers with their needles cut) and gloves.	Red coloured non-chlorinated plastic bags or containers	Autoclaving or micro-waving or hydroclaving followed by shredding or mutilation or combination of sterilization and shredding. Treated waste to be sent to registered or authorized recyclers or for energy recovery or plastics to diesel or fuel oil or for road making, whichever is possible. Plastic waste should not be sent to landfill sites.
White (translucent)	**Waste sharps including metals** Needles, syringes with fixed needles, needles from needle tip cutters or burners, scalpels, blades, or any other contaminated sharp object that may cause puncture and cuts. This includes both used, discarded and contaminated metal sharps.	Puncture, leak, and tamper proof containers	Autoclaving or dry heat sterilization followed by shredding or mutilation or encapsulation in metal container or cement concrete; combination of shredding cum autoclaving; and sent for final disposal to iron foundries (having consent to operate from the state pollution control boards or pollution control committees) or sanitary landfill or designated concrete waste sharp pit.
Blue	**(a) Glassware** Broken or discarded and contaminated glass including medicine vialsand ampoules except those contaminated withcytotoxic wastes.	Cardboard boxes with blue colored marking	Disinfection (by soaking the washed glass waste after cleaning with detergent and sodium hypochlorite treatment) or through autoclaving or microwaving or hydroclaving and then sent for recycling.
	(b) Metallic body implants	Cardboard boxes with blue colored marking	

*Deep burial is permitted only in rural and remote areas without access to common biomedical waste treatment facility with due approval from concerned authorities.

SCHEDULE III

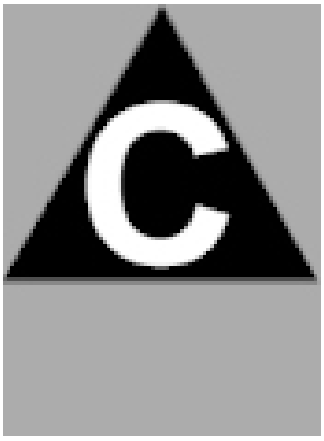
Part A

LABEL FOR BIOMEDICAL WASTE CONTAINERS OR BAGS

BIO-HAZARD

HANDLE WITH CARE

CYCTOXIC



HANDLE WITH CARE

Part B

LABEL FOR TRANSPORTING BIOMEDICAL WASTE BAGS OR CONTAINERS

Day.....Month.....

Year.....

Date of generation.....

Waste category number.....

Waste quantity.....

Sender's name and address:

Phone number.....

Contact person.....

Receiver's name and address:

Phone number.....

Contact person.....

In case of emergency please contact:

Name and address:

Phone number:

Note: Label shall be non-washable and prominently visible.

SCHEDULE IV

Targets for extended producer responsibility—authorization

No.	Year	E-waste collection target (number per weight)
(i)	During the first two years of implementation of the Rules	30 per cent of the quantity of waste generation as in the extended producer responsibility plan
(ii)	During the third and fourth years of implementation of the Rules	40 per cent of the quantity of waste generation as in the extended producer responsibility plan
(iii)	During the fifth and sixth years of implementation of the Rules	50 per cent of the quantity of waste generation as in the extended producer responsibility plan
(iv)	Seventh year onward of implementation of the Rules	70 per cent of the quantity of waste generation as in the extended producer responsibility plan

Annexures

ANNEXURE 1

Draft solid waste management by-laws for the city of (name of the city)

In exercise of the powers conferred by Section (___) of the Municipal Act, (year), and in order to implement the provisions made in the Integrated Waste Management Rules, 2017, the (City) Municipal Corporation, hereby makes the following by-laws for management of solid waste, namely:

1. Short title and commencement
   i. These by-laws may be called the (city) Solid Waste Management By-laws, (year).
   ii. They shall come into force upon approval by the elected board or empowered standing committee of (the city) and with effect from the date of its publication in the official gazette.

2. Every owner and occupier of premises within the municipal area will have to abide by and maintain the system of collection, segregation and storage of solid waste apart from having the duty to have the premises clean. Further, the owners and occupiers of premises within the municipal area shall segregate waste under three categories:
   (a) Organic or biodegradable wastes (called wet waste)
   (b) Recyclable or non-biodegradable wastes (called dry waste)
   (c) Domestic hazardous wastes

3. The (city) municipal corporation shall provide one bin for wet waste and two bins or bags for dry and hazardous waste storage to every owner and occupier of premises within the municipal area.

4. It is provided herein that each and every owner and occupier of a commercial or residential area, apartment owner or societies, co-operatives, institutions, industry etc. shall maintain three types of 'dustbins', i.e. 'green' for storing wet wastes, 'blue' for storing dry waste, and 'red' for storing domestic hazardous waste.

5. Domestic hazardous waste like discarded paint drums, pesticide cans, CFL bulbs, tube lights, expired medicines, broken mercury thermometers, used batteries, used needles and syringes and contaminated gauge etc. generated at the household level shall be stored separately in a 'red' bag and be given to the waste collector. Date expired medicines or chemicals thus collected shall be given to the concerned medicine distributor for safe disposal under the EPR programme.

6. The (city) municipal corporation shall bear the responsibility for the collection and disposal of sanitary and domestic biomedical waste like

expired medicines, broken mercury thermometers, used needles and syringes etc. to the nearest common biomedical waste treatment facility.

7. It will be the responsibility of the (city) municipal corporation to provide adequate number of litter bins at commercial areas and all important public places such as places of worship, parks, bus-stands, and railway stations. At each location, two types of litter bins shall be provided; 'green' for disposing of wet wastes and 'blue' for disposing of dry waste.

8. In commercial areas and important public places, litter bins shall be placed every 200 meters by the (city) municipal corporation. In other areas, they shall be placed every 500 meters.

9. Every street vendor and hawker will buy their own two dustbins for wet and dry waste disposal.

10. It shall be the responsibility of street vendors and hawkers to segregate waste into wet and dry and transfer the waste every day in a collection vehicle designated by the corporation.

11. Slaughter waste from meat, poultry and fish shops shall be stored separately in a bin and collected in a separate collection vehicle designated by the corporation and disposed of appropriately.

12. In every designated commercial area, it shall be the responsibility of the market associations or group of shop owners to ensure that there is no littering and throwing of garbage on the roads, drains and public spaces.

13. Horticultural waste (agricultural waste, garden waste) generated in residential and commercial areas should be segregated and stored separately within the premises. It should be composted within the premises or sent to the nearest compost facility of the corporation.

14. The (city) municipal corporation shall be responsible for collection and composting of horticulture waste from public parks and gardens. Tree leaves on the roads and other public spaces shall also be collected and composted by the corporation.

15. It shall be the responsibility of the owner or occupier of premises to store the construction material and construction and demolition (C&D) waste within the premises.

16. In case the construction material or C&D waste has to be stored on the road and other public spaces due to unavoidable reasons like lack of space or requirements of construction or demolition works, the owner or occupier of the premises shall take permission from the municipal corporation to do so. The municipal corporation shall charge a fee to allow storage of construction material and construction and demolition (C&D) waste on the road and other public spaces.

17. It shall be the responsibility of the owner or occupier of premises to dispose C&D waste at a place designated by the municipal corporation. The C&D waste can be used for filling low-lying areas, provided it is done in an environmentally-safe manner and with the permission and consent of the owner of the land.

18. The (city) municipal corporation shall bear the responsibility of collection and disposal of C&D waste generated from its own activities and activities of other government departments working in the municipal area.

19. The (city) municipal corporation shall earmark a specific area for the disposal of C&D waste and other inert wastes like road sweepings at a notified dumpsite.

20. The (city) municipal corporation shall also ensure that inert waste collected from road sweepings, de-silting of drains, digging of roads and public spaces for various activities etc. is collected and disposed of in a time-bound matter at a specific site as notified. It can also use these wastes, if it deems appropriate, for filling low-lying areas.

21. The (city) municipal corporation shall explore all opportunities for the gainful utilization of the C&D waste.

22. Sales or distribution of plastic carry bags is prohibited in the municipal area, except for use of waste collection bags in bins.

23. Persons or establishments found selling or distributing plastic carry bags below 50 microns thickness shall be fined under these Rules, except the provision under Rule 22.

24. No person shall throw waste or litter at any public place. They shall use dustbins and litter bins so provided for disposing of the waste.

25. The (city) municipal corporation shall develop an effective collection system to collect and transfer segregated waste for processing.

26. The segregated wet waste from each house, shop, commercial area, hotel, restaurant, street bin, educational institute and all other generators of solid waste in the city shall be collected by the corporation on a regular basis.

27. The (city) municipal corporation shall develop and execute a plan by 1 January 2018 to collect segregated wet waste every day; segregated dry waste every alternate day and segregated sanitary waste and domestic hazardous waste once a week.

28. Marriage or event halls shall take permission from the (city) municipal corporation at least seven working days prior to the date of the event or function and shall themselves make the arrangement for segregation and storage of waste at the place of event or function. The segregated waste shall be handed over to waste collectors of the (city) municipal corporation. The (city) municipal corporation can grant permission for days, for weeks,

for months or for one year. It shall charge a fees for holding the function or event. In case of non-compliance, a fine as per Section 40 shall be levied.

29. The (city) municipal corporation shall levy the following user fees for waste management:

S. no.	User category	Monthly user charge
A.	Residential	
1	Residential house (per family, flat or house)	
2	Slums and below-poverty-line residences	
B.	Non-residential	
1.	Street vendors	
	c) Without structure (roadside)	
	d) With structure	
2.	Eating joints, restaurants, cafes, sweet shop, coffee house etc.	
3.	Meat, fish and poultry shops	
4.	Other shops	
5.	Restaurants (Non-AC)	
6.	Restaurants (AC)	
7.	Guest houses	
8.	Malls	
9.	Hostels	
10.	Dharmshalas	
11.	Star or equivalent hotels	
12.	Commercial and government offices and educational institutions per unit	
13.	Banks and insurance offices	
14.	Coaching classes	
C.	Health service institutes (except biomedical waste)	
1.	Clinics per unit	
	Dispensaries and laboratories	
2.	Hospitals (up to 50 beds)	
3.	Hospitals (more than 50 beds)	
D.	Others	
1.	Religious places	Religious centres can willingly contribute to cleanliness in and around their premises
2.	Small-scale industries, cottage units, workshops, petrol pumps (only non-hazardous waste)	
3.	Cold storage, godowns and storage areas where large amount of waste is generated	
5.	Marriage and event halls, exhibitions, and fairs	
6.	Others	
E.	User charges for bulk collection	
1.	C&D waste	---------/ tractor truck
2.	C&D waste	---------/ tipper truck

30. The user fees as listed in Section 29 shall be revised after every two years.

31. The user fee shall start to be collected one month after the passing of the by-laws in the official gazette.

32. The user fee shall be collected on a monthly basis by the corporation and a printed slip will be issued by the corporation for payment of the fee by the user listed in Section 29.

33. The (city) municipal corporation shall make every effort to increase the awareness of people on waste management and the user fees. Proper announcement through advertisement in media, hoardings, public announcements, distribution of leaflets etc. shall be undertaken.

34. The (city) municipal corporation shall constitute a 'city waste management task force' for overseeing the successful implementation of the Municipal Corporation Solid Waste Management By-laws, (Year). The Task Force shall be constituted of the following:
    (a) Mayor
    (b) Deputy mayor
    (c) Municipal commissioner or an official nominated by the commissioner not below the rank of city manager
    (d) Two elected councillors nominated by the mayor

35. The city waste management task force shall meet every two weeks to take stock of the implementation of the by-laws and resolve issues.

36. The (city) municipal corporation shall constitute a 'ward waste management task force' in all wards of the corporation. This task force shall supervise collection, transfer and proper processing of segregated wastes. The task force shall constitute of the following:
    a) Elected members from the ward
    b) Ward supervisor
    c) Two respected local residents (doctors or academics) of the ward nominated by the mayor

37. The 'ward waste management task force' shall have the responsibility to spread awareness for segregation at source in every ward and sensitize people through IEC.

38. The ward waste management task force shall undertake sensitization programmes to inform people about the by-laws and fines or penalty for non-compliance and littering.

39. The ward waste management task force shall monitor the implementation of the (City) Municipal Corporation Solid Waste Management By-laws, (Year) and recommend to the city waste management task force the actions that need to be taken for successful implementation of the by-laws.

40. The (city) municipal corporation shall be empowered to levy fine from households, owners or occupiers of the premises for not abiding with the by-laws and for littering in public areas. The amount of fine shall be as follows:

S. no.	Category	Amount of fine or penalty
(i)	Guest houses, hostel, star or equivalent hotel, commercial offices, government offices, banks, insurance offices, educational institutions, malls, clinics, dispensaries, laboratories, hospitals, cold storage, godowns, marriage and event halls, exhibition and fairs, and storage areas where large amount of waste is generated.	1st offence: Warning 2nd offence – ------- Every subsequent offence – --------
(ii)	Eating joints, restaurants, cafes, sweet shops, coffee houses, meat, fish and poultry shops, coaching classes, petrol pumps, small-scale industries, cottage units, workshops (only non-hazardous waste) etc.	1st offence: Warning 2nd offence – ------- Every subsequent offence – -------
(iii)	Street vendors, with or without a structure	1st offence: Warning 2nd offence – ------ Every subsequent offence – -------
(iv)	Any other commercial establishments other than those mentioned in serial no. (i), (ii) and (iii)	1st offence: Warning 2nd offence – ------- Every subsequent offence – ---------
(v)	Households and individuals	1st offence: Warning 2nd offence – ------- Every subsequent offence – ------
(vi)	Open burning of the waste	1st offence: Warning 2nd offence – ------ Every subsequent offence ----------
(vi)	Penalty for dumping C&D waste	
A	Penalty for dumping of C&D waste on road or on public spaces by individual without prior permission	------/day + amount for sending municipal vehicle to lift and dispose the C&D waste
B	Penalty for dumping of C&D waste by commercial premises, industry or any other bulk generator	------/ tonne/ day + amount for sending municipal vehicle to lift and dispose the C&D waste
(vii)	Mixing of biomedical waste with municipal waste by hospitals, nursing homes, clinic, pathology lab etc.	1st offence: Warning 2nd offence ------ Every subsequent offence -------
(viii)	Non-compliance in approval from corporation for event by marriage halls, event halls, exhibition, and fairs etc.	--------/day

41. Every violation shall be recorded and the corporation shall provide a slip to the violators to deposit the fine within seven days of the violation at an office(s) designated by the (city) municipal corporation for the purpose.

42. If a violator, who is the owner or occupier of a premise, fails to deposit the fine within the stipulated timeframe, then the fine plus 12 per cent annual interest rate shall be added to the property tax and recovered.

43. If the violation continues, the defaulter can be taken to a civil court as per the Environment Management Act.

44. If an individual or street vendor is found littering on the road or other public places, a spot fine can be imposed and recovered.

45. The ward waste management taskforce shall submit a fortnightly report to the city waste management task force about the violation so found and action taken.

46. The (city) municipal corporation shall publish a status report on the number of violations and violators, the amount of fines imposed and recovered etc. on its website every month.

47. The (city) municipal corporation shall carry out information, education and communication (IEC) and awareness raising in residential and commercial areas of the city for spreading the message of segregation at source.

48. The (city) municipal corporation shall circulate information on the by-laws through use of newspapers, radio, hoardings and local TV channels for one month after the date of publication of the by-laws in the Official Gazette. After that, a summary of the by-laws shall be displayed at prominent public places in the form of hoardings.

ANNEXURE II

Format for maintenance of records of e-waste generated

Table: Generated quantity in metric tonnes (MT) per year

1.	Name and address of bulk consumer		
2.	Date of issue of extended producer responsibility		
3.	Type and quantity of e-waste handled or generated	Category	Quantity
4.	Type of e-waste stored	Category	Quantity
5.	Type of e-waste transported	Category	Quantity
6.	Type and quantity of e-waste refurbished (name and address of refurbished material sent)	Category	Quantity

ANNEXURE III

Standards for composting[31]

Waste processing facilities shall include composting as one of the technologies for processing of biodegradable waste. In order to prevent pollution from compost plants, the following shall be complied with:

i. The incoming organic waste at site shall be stored properly prior to further processing. To the extent possible, the waste storage area should be covered. If such storage is done in an open area, it shall be provided with impermeable base with facility for collection of leachate and surface water run-off into lined drains leading to a leachate treatment and disposal facility.
ii. Necessary precaution shall be taken to minimize nuisance of odour, flies, rodents, bird menace, and fire hazards.
iii. In case of breakdown or maintenance of the plant, waste intake shall be stopped and arrangements be worked out for diversion of waste to the temporary processing sites or temporary landfill sites which will be again reprocessed when plant is in order.
iv. Pre-process and post-process rejects shall be removed from the processing facility on a regular basis and shall not be allowed to pile at the site. Recyclables shall be routed through appropriate vendors. The non-recyclable high calorific fractions shall be segregated and sent to waste-to-energy or for RDF production, co-processing in cement plants or to thermal power plants. Only rejects from all processes shall be sent to sanitary landfill site(s).
v. The windrow area shall be provided with an impermeable base. Such a base shall be made of concrete or compacted clay of 50 cm thickness having permeability coefficient less than 7–10 cm/sec. The base shall be provided with 1 to 2 per cent slope and circled by lined drains for collection of leachate or surface run-off.
vi. Ambient air quality monitoring shall be regularly carried out. Odour nuisance in downwind direction on the boundary of processing plant shall also be checked regularly.
vii. Leachate shall be re-circulated in compost plants for moisture maintenance.
viii. The end product compost shall meet the standards prescribed under fertilizer control order notified from time to time.

In order to ensure safe application of compost, the specifications for compost quality should be notified. The table lists some examples of the compost standards from a few countries based on different parameters.

Table: Comparison of compost standards

	Type	India	EU (Most EU countries have statutory and voluntary standards and below are a few statutory guidelines)	Australia	Canada CCME Standards (Canada has three sets of standards)
i.	Moisture content per cent by mass	15–25	> 15	0–3 +/- of standard optimum moisture content (SOMC)	> 40
ii.	Organic matter percent by mass	> 12	> 20	Not defined	> 30 on a dry weight basis
iii.	Pathogens	Nil	Salmonella 0–25gm, E. Coli < 1,000 MPN/g	Salmonella spp absent in 25 g Escherichia Coli (E. Coli) < 100 MPN/g* Faecal coliforms < 1,000 MPN/g	Fecal coliforms 2 < 1,000 No Salmonella sp. with a detection level < 3 MPN/4g total solids
iv.	Conductivity (dsm-1)	> 4	Varies country wise	> 4	Not defined
v.	Nitrogen	< 0.8 Minimum per cent by weight	> 17 (g/m^2)	Not defined	Not defined
vi.	Phosphorous P2O5	< 0.4 Minimum per cent by weight	> 6 (g/m^2)	Not defined	Not defined
vii.	Potassium K2O	< 0.4 Minimum per cent by weight	> 12 (g/m^2)	Not defined	Not defined
viii.	C:N	< 20:1	Varies country wise. Explained in the next table	Between 25:1 and 35:1	< 25:1
ix.	Arsenic (mg/kg)	< 10		< 20	13–75
x.	Zinc (mg/kg)	< 1,000		< 60	700–1,850
xi.	Lead (mg/kg)	< 100		< 150	150–500
xii.	Chromium (mg/kg)	< 50		< 100	210
xiii.	Cadmium (mg/kg)	< 5		< 1	3–20
xiv.	Nickel (mg/kg)	< 50		< 300	62–180
xv.	Copper (mg/kg)	< 300		< 150	400
xvi.	Mercury (mg/kg)	< 0.15		< 1	0.8–5
xvii.	Other impurities	Not defined	Varies country wise	Glass, metal and rigid plastics 0.5, plastics light and flexible or film 0.0	Total foreign matter greater than 3 mm shall not exceed 1 per cent, calculated on a dry weight basis, and plastic cannot exceed 0.5 per cent; and compost shall not contain any foreign matter greater than 25 mm per 500 ml.
xviii.	Testing frequency for compost analysis	No guidelines available	Different countries have different sub-standards	Not defined	Very elaborately defined
xix.	Others	Powdered or granular form, dark brown to black in colour with no foul odour	No odours, no glass, wire, and no unacceptable weed seeds	< 40 mm particle size	< 25 mm particle size

Source: Canada, http://www.ccme.ca/files/Resources/waste/compost_quality/compostgdlns_1340_e.pdf , SWM Rules, 2016 India; http://www.moef.gov.in/sites/default/files/SWM%202016.pdf , EPA, Australia; www.epa.sa.gov.au/files/4771342_compostguideline.pdf , EU, http://ec.europa.eu/environment/waste/compost/pdf/hm_annex2.pdf,

Table 2: Standards for metal content in compost for European countries

	Austria	Belgium	Denmark	France	Germany	Italy	Netherland	Spain	Switzerland	UK
Arsenic mg/kg	Not a criterion	Not a criterion	25	<8	Not a criterion	Not a criterion	Class 1: < 25 Class 2: < 15	Not defined	Not defined	Not defined
Zinc mg/kg	A + < 200 A < 500 B 1,200–1,800	< 1,000–1,500	Not defined	Not defined	< 400	< 500	Class 1: < 900 Class 2: <280	< 4,000	< 500	< 400
Lead mg/kg	A + < 45 A < 120 B < 200	< 600–1,000	< 120	< 800	< 150	<140	Class 1: <200 Class 2: <120	< 1200	< 150	< 200
Chromium	A+ < 70 A < 70 B < 250	< 150– 200	Not defined	Not defined	< 100	< 100	Class 1: < 200 Class 2: < 70	< 750	< 150	< 100
Cadmium mg/kg	A + 0.7 A < 1 B < 3	< 5	< 1	< 8	< 2	< 2	Class 1: <2 Class 2: <1	< 40	< 3	< 1.5
Nickel mg/kg	A + < 25 A < 60 B < 100	< 100	< 45	< 200	< 50	< 50	Class 1: < 50 Class 2: < 20	< 400	< 50	< 50
Copper mg/kg	A + < 70 A < 150 B 400–500	< 500	Not defined	Not defined	< 100	< 300	Class 1: < 300 Class 2: < 90	< 1750	< 150	< 200
Mercury mg/kg	A + < 0.4 A < 0.7 B < 3	< 5	< 1	< 8	< 1	< 2	Class 1: < 2 Class 2: < 0.7	< 25	< 3	< 1
Other impurities, man-made foreign matter, glass, plastic, metal, (as per cent of dry weight)	A must be < 3 per cent of 11 mm size B < 2 per cent of > 2 mm fraction	No visible contaminant, maximum 0.5 per cent > 2 mm	-	Maximum contamination 20 per cent < 6 per cent of > 5 mm fraction	< 0.5 per cent for > 2 mm fraction	< 3 per cent total	< 0.5 per cent for > 2 mm fraction	Free of contamination	Man-made < 0.5 per cent for > 2 mm fraction; maximum 0.1 per cent plastic	< 1 per cent > 2 mm < 0.5 per cent if plastic
Testing frequency for compost analysis	Once every year minimum or once per 2,000m^3	Eight times per year for 4,000-10,000 tonne per year facilities	Once every six months	Once every six months	< 2,000 t/a; quarter > 12000 t 12x 8 times/yr. (t/a = tonnes/ annum)	Unregulated	1 time each 5000 tonnes or min 6x per year	unregulated	1x/year for > 100 tonnes	2x < 5,000 tonnes 3x > 5000 t 4x > 20000 t
Salt content (end-use test)	Not a criterion	Not a criterion	Not a criterion	Not a criterion	< 2.5 g/litre	Not a critirion	Not a criterion	Not a criterion	Not a criterion	Not a criterion

Source: EU; http://ec.europa.eu/environment/waste/compost/pdf/hm_annex2.pdf, Cornell; http://compost.css.cornell.edu/Brinton.pdf

ANNEXURE IV

Specifications for sanitary landfills and criteria for site selection

1) The department allocating land shall provide a suitable site for setting up of solid waste processing and treatment facilities and notify such sites.
2) A sanitary landfill site shall be planned, designed and developed with the proper documentation of the construction plan as well as closure planning in a phased manner. In case a new landfill facility is being established adjoining an existing landfill site, the closure plan of existing landfill should form a part of the new landfill.
3) The landfill sites shall be selected to make use of nearby waste processing facilities. Otherwise, waste processing facility shall be planned as an integral part of the landfill site.
4) Landfill sites shall be set up as per the guidelines of the NEMA.
5) Landfill sites which have been in use for more than five years shall be improved in accordance with the specifications given in this Schedule.
6) Landfill sites shall be large enough to last for at least 20–25 years and shall develop 'landfill cells' in a phased manner to avoid waterlogging and misuse.
7) The landfill site shall be 100 m away from a river, 200 m from a pond, 200 m from a highways, habitation, public park, water park, and well, and 20 km away from an airport or airbase. However, in special cases, a landfill site may be set up within a distance of 10 km and 20 km away from an airport or airbase after obtaining a non-objection certificate from the civil aviation authority or air force, as the case may be. A landfill site shall not be permitted within the flood plains as recorded for the last 100 years, zone of coastal regulation, wetland, critical habitat areas, and sensitive eco-fragile areas.
8) The sites for a landfill processing and disposing of solid waste shall be incorporated in the town planning department's land use plans.
9) A buffer zone of no development shall be maintained around solid waste processing and disposal facilities exceeding five tonnes per day of installed capacity. This shall be maintained within the total area of solid waste processing and disposal facility. The buffer zone shall be prescribed on case by case basis by the local body in consultation with concerned district authority.
10) Temporary storage facilities for solid waste shall be established in each landfill site to accommodate the waste in case of non-operation of waste processing during emergency or natural calamities.

ANNEXURE V

APPLICATION FORM FOR AUTHORIZATION OR RENEWAL OF AUTHORIZATION

(To be submitted by occupier of a healthcare facility or common biomedical waste treatment facility)
To
The Prescribed Authority
(Name of the State or UT Administration)
Address

1. **Particulars of the applicant:**
   i. Name of the applicant: (In block letters and in full)
   ii. Name of the healthcare facility (HCF) or common biomedical waste treatment facility (CBWTF):
   iii. Address for correspondence:
   iv. Telephone and fax no.:
   v. Email:
   vi. Website address:

2. **Activity for which authorization is sought:**

Activity	Please tick
Generation or segregation	
Collection	
Storage	
Packaging	
Reception	
Transportation	
Treatment, processing or conversion	
Recycling, disposal or destruction	
Use	
Offering for sale or transfer	
Any other form of handling	

3. **Application for fresh or renewal of authorization (please tick whatever is applicable):**
   i. Applied for CTO/CTE Yes/No
   ii. In case of renewal previous authorization number and date: ----------
   ----

4. i. Address of the healthcare facility or common biomedical waste treatment facility:
   ii. GPS coordinates of healthcare facility or common biomedical waste treatment facility:

5. **Details of HCF or CBWTF:**
   i. Number of beds of at the HCF:
   ii. Number of patients treated per month by the HCF:
   iii. Number of healthcare facilities covered by the CBMWTF: _____
   iv. Number of beds covered by the CBMWTF: _____

v. Installed treatment and disposal capacity of the CBMWTF:_____ kg per day

vi. Quantity of biomedical waste treated or disposed of by the CBMWTF:_____ Kg/ day

vii. Area or distance covered by the CBMWTF:_____ (please attach a map with a GPS locations of the CBMWTF and area of coverage)

viii. Quantity of biomedical waste handled, treated or disposed:

Category	Type of waste	Quantity generated or collected (kg/ day)	Method of treatment and disposal (refer to Schedule I)
(1)	(2)	(3)	(4)
Yellow	a) Human anatomical waste		
	b) Animal anatomical waste		
	c) Solid waste		
	d) Expired or discarded medicines		
	e) Chemical solid waste		
	f) Chemical liquid waste		
	g) Discarded linen, mattress, and beddings contained with blood or body fluids		
	h) Microbiology, biotechnology and other clinical laboratory waste		
Red	Contaminated waste (recyclables)		
White (translucent)	Waste sharps including metals		
Blue	Glassware		
	Metallic body implants		

6. **Brief description of arrangements for handling of biomedical waste (attach details):**

i. Mode of transportation (if any) of biomedical waste:

ii. Details of treatment equipment (please give details such as the number, type and capacity of each unit)

	No. of units	Capacity of each unit
Incinerators		
Plasma pyrolysis		
Autoclaves		
Microwave		
Hydroclave		
Shredder		
Needle tip cutter or destroyer		
Sharps encapsulation or concrete pit		
Deep burial pits		
Chemical disinfection		
Any other treatment equipment		

7. **Contingency plan of common biomedical waste treatment facility (attach documents):**
8. **Details of the directions or notices or legal actions, if any, during the period of earlier authorization**

9. **Declaration:**
   I do hereby declare that the statements made and information given above are true to the best of my knowledge and belief and that I have not concealed any information. I do also hereby undertake to provide any further information sought by the prescribed authority in relation to these rules and to fulfil any conditions stipulated by the prescribed authority.

Date: Signature of the applicant

Place: Designation of the applicant

ANNEXURE VI

AUTHORIZATION FORM

(Authorization form for operating a facility for generation, collection, reception, treatment, storage, transport and disposal of biomedical waste)

1. File number of authorization and date of issue.....
2. M/s _____ an occupier or operator of the facility located at _____ is hereby granted an authorization for:

Activity	Please tick
Generation or segregation	
Collection	
Storage	
Packaging	
Reception	
Transportation	
Treatment, processing or conversion	
Recycling	
Disposal or destruction	
Use	
Offering for sale or transfer	
Any other form of handling	

3. M/s _____ is hereby authorized for handling of biomedical waste as per the capacity given below;
   i. Number of beds at the HCF:
   ii. Number of healthcare facilities covered by the CBMWTF: _____
   iii. Installed treatment and disposal capacity:_____ kg per day
   iv. Area or distance covered by the CBMWTF:_____
   v. Quantity of biomedical waste handled, treated or disposed of:

Type of waste category	Quantity permitted for handling
Yellow	
Red	
White (translucent)	
Blue	

4. This authorization shall be in force for a period of ..... years from the date of issue.
5. This authorization is subject to the conditions stated below and to any other conditions as may be specified in the Rules for time to time by NEMA.

Date .....
Place: .....

Signature.....
Designation: .....

Terms and conditions of authorization *

1. The authorization shall comply with the provisions of NEMA rules.
2. The authorization or its renewal shall be produced for inspection at the request of an officer authorized by the prescribed authority.

3. The person authorized shall not rent, lend, sell, transfer or otherwise transport the biomedical wastes without obtaining prior permission of the prescribed authority.
4. Any unauthorized change in personnel, equipment or working conditions as mentioned in the application by the person authorized shall constitute a breach of his authorization.
5. It is the duty of the authorized person to take prior permission of the prescribed authority to close down the facility and such other terms and conditions may be stipulated by the prescribed authority.

Endnotes

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In our times, waste, and how to deal with it, has become synonymous with progress and a major policy and logistic headache for governments and citizens across the world. As the nations of the African region rise, the mountains of waste in their territory are also becoming bigger and bigger.

Since the level of industrialization and urbanization is moderate to low in most countries in the region, which means certain kinds of hazardous chemical and metallic wastes are not produced in large quantities in these countries, an integrated approach to waste management will serve them well.

This policy guide underlines the unique features of waste and its management in African countries, drawing parallels with other regions of the world, wherever necessary. It also provides a set of draft regulations on integrated waste management.

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