

CE 213

WATER QUALITY & POLLUTION

L20-21 - Module E. Solid Waste Management
Need, Objectives, Process Involved, Treatment of MSW, Case Study India

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Schedule : LEC: Tu Th 5:00-6:30;

Content

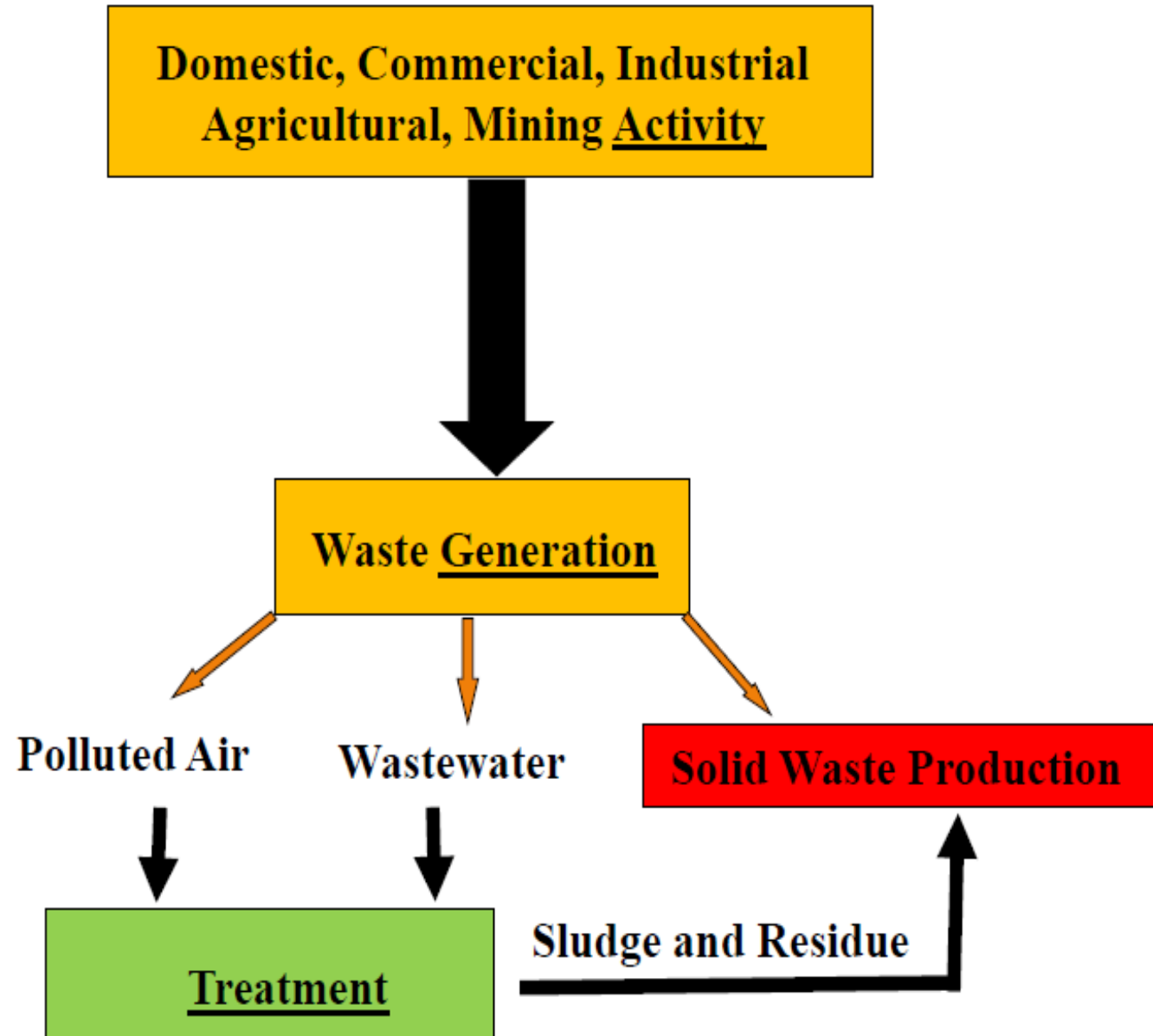
- What is solid waste
 - Origin, Exclusion, Types – Hazardous, MSW
 - Characterization of MSW
- Need for Waste Management
 - MSW 'Life Cycle';
 - Stats on generation ; Reasons for concern
 - Basic principles of Solid Waste Management
- Municipal Solid Waste Management (MSWM)
 - Strategies, Objectives
 - Process of MSWM
 - Waste transformation and Disposal
- Waste Management in India
 - Some stats Solid Waste in India
 - Generation, Growth rate, collection
 - Status of MSWM in India - A Review (Handout 11)
 - Initiatives in India, *Govt. NGO, Private*



What is Solid Waste ?

- Any **garbage, refuse or other discarded material**, including solid, semi-solid, or contained liquid and gaseous material resulting from industrial, commercial, mining, agricultural operation, and from domestic activities, including sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility.

Origin of Solid Waste

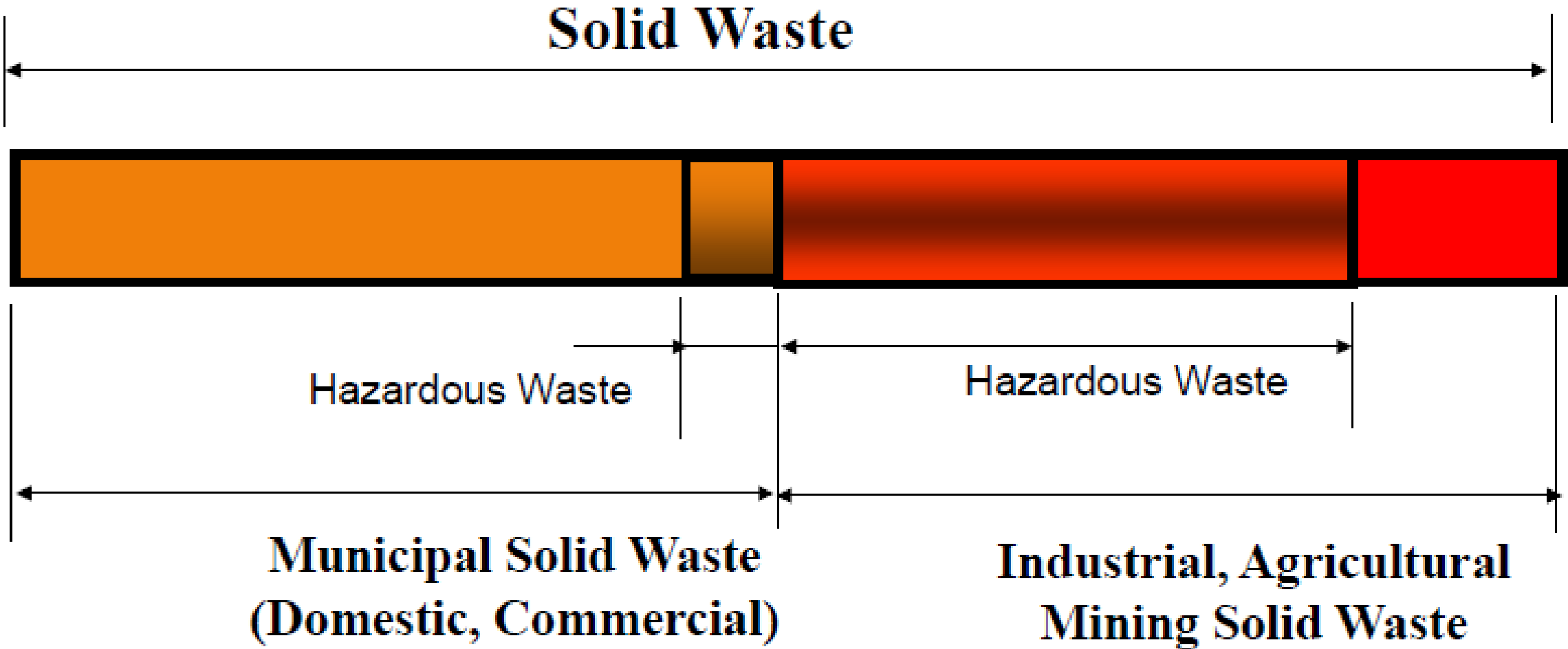


Solid Waste:

Exceptions:

- Solid or dissolved material in **domestic sewage**, or solid or dissolved materials in **irrigation return flows or industrial discharges**.
 - Covered by Water Pollution Laws
- Solid Material suspended in polluted air.
 - Covered by Air Pollution Laws
- In most countries, radio-active wastes are not considered to be solid wastes.
 - Covered by Atomic Energy Regulation Laws

Types of Solid Waste



What is Hazardous Waste ?

- Any solid waste which because of its **quantity, concentration or physical, chemical or infectious characteristics**:
 1. cause, or significantly contribute to, an **increase in mortality** or an increase in serious irreversible or incapacitating reversible illness,
 2. pose a substantial present or **potential hazard** to human health or the environment when **improperly treated, stored, transported or disposed off**.

Four Characteristics are Essentially Hazardous in any Solid Waste:

1. Ignitability, e.g., inflammable
2. Corrosivity, e.g., very acidic or alkaline
3. Reactivity, e.g., explosive
4. EP Toxicity, EP stands for “Extraction Procedure”.

It is designed to identify wastes likely to leach hazardous concentrations of particular toxic constituents into groundwater as a result of improper management.

What is Municipal Solid Waste (MSW)

- Includes commercial and domestic wastes generated in municipal areas in either **solid or semi-solid form or as contained liquid or gases, excluding industrial, agricultural and mining wastes** but including non-hazardous bio-medical wastes and hazardous bio-medical wastes made non-hazardous after treatment.
- It is mostly non-hazardous, but may contain some **hazardous substances** used in domestic and commercial activities,

Examples:

- Oil-based paint, partially empty oil cans, pesticides, waste oil, cleaners, acids/bases, batteries

Characterization of MSW

- MSW (Commercial + Domestic) is **heterogeneous** in nature.
- MSW can further be sub-divided into the following categories: (% of total MSW)
 - **Standard MSW:** Residential and commercial wastes excluding special items, hazardous wastes and some others (~65 percent by weight)
 - **Bulky items** (Furniture, mattress, consumer electronics, white goods, yard waste collected separately, and tires) (~ 5 percent by weight)
 - **Hazardous wastes** (Oil-based paint, solvents, pesticides, cleaners, acids/bases, petroleum products, oils, batteries) (~0.1 percent by weight)
 - **Construction and demolition wastes** (~14 percent by weight)
 - **Municipal services waste**(street sweeping, tree and landscaping, etc.) (~10 percent by weight)
 - **Water/wastewater treatment plant sludge** (~6 percent by weight)

Typical Distribution of Standard MSW Components:
 (Excluding waste which is recycled: by percent weight)

	Low Income	Medium Income	High Income
Organic			
Food Wastes	<u>40-85</u>	<u>20-65</u>	6-30
Paper			<u>20-45</u>
Cardboard	1-10	<u>8-30</u>	5-15
Plastics	1-5	2-6	2-8
Textiles	1-5	2-10	2-6
Rubber			0-2
Leather	1-5	1-4	0-2
Yard wastes			<u>10-20</u>
Wood	1-5	1-10	1-4
Inorganic			
Glass	1-10	1-10	4-12
Tin cans			2-8
Aluminum	1-5	1-5	0-1
Other metal			1-4
Dirt, Ash etc.	1-40	1-30	0-10

Solid Waste in India

Rate of Generation

- It is estimated that about 62 million tonnes of waste is generated annually in the country, out of which 5.6 million is plastic waste, 0.17 million is biomedical waste. In addition, hazardous waste generation is 7.90 million TPA and 15 lakh tonne is e-waste.
- The per capita waste generation in Indian cities range from 200 grams to 600 grams per day (2011). 43 million TPA is collected, 11.9 million is treated and 31 million is dumped in landfill sites.

STATE-WISE MUNICIPAL SOLID WASTE GENERATION DATA

Source: CPCB

(Updated as on 31st JULY 2012)

S.No	State	Quantity Generated (TPD)	Collected (TPD)	Treated (TPD)	S.No	State	Quantity Generated (TPD)	Collected (TPD)	Treated (TPD)
1	Andaman & Nicobar	50	43	Nil	19	MP	4500	2700	975
2	Andhra Pradesh	11500	10655	3656	20	Maharashtra	19,204	19,204	2080
3	Arunachal Pradesh	94	NA	Nil	21	Manipur	113	93	2.5
4	Assam	1146	807	72.65	22	Meghalaya	285	238	100
5	Bihar	1670	1670	Nil	23	Mizoram	4742	3122	Nil
6	Chandigarh	380	370	300	24	Nagaland	188	140	Nil
7	Chhattisgarh	1167	1069	250	25	Orissa	2239	1837	33
8	Daman Diu & Dadra	28+13=41	NA	Nil	26	Puducherry	380	NA	Nil
9	Delhi	7384	6796	1927	27	Punjab	2794	NA	Nil
10	Goa	193	NA	NA	28	Rajasthan	5037	NA	Nil
11	Gujarat	7379	6744	873	29	Sikkim	40 (capital)	32	32
12	Haryana	537	NA	Nil	30	Tamil Nadu	12504	11626	603
13	Himachal Pradesh	304	275	153.0	31	Tripura	360	246	40
14	Jammu & Kashmir	1792	1322	320	32	Uttar Pradesh	11,585	10563	Nil
15	Jharkhand	1710	869	50	33	Uttrakhand	752	NA	Nil
16	Karnataka	6500	2100	2100	34	West Bengal	12557	5054	606.5
17	Kerala	8338	1739	1739					
18	Lakshadweep	21	21	4.2		34 States	1,27,486	89,334	15,881

Municipal Solid Waste Generation in Metro Cities / State Capitals

. No.	Name of City	* Municipal Solid Waste (Tonnes per day)		
		1999-2000(a)	2004-2005 (b)	2010-11 (c)
1	Agartala	-	77	102
2	Agra	-	654	520
3	Ahmedabad	1683	1302	2300
4	Aizwal	-	57	107
5	Allahabad	-	509	350
6	Amritsar	-	438	550
7	Asansol	-	207	210
8	Bangalore	2000	1669	3700
9	Bhopal	546	574	350
10	Bhubaneswar	-	234	400
11	Chandigar	-	326	264
12	Cheennai	3124	3036	4500
13	Coimbatore	350	530	700
14	Daman	-	15	25
15	Dehradun	-	131	220
16	Delhi	4000	5922	6800
17	Dhanbad	-	77	150
18	Faridabad	-	448	700
19	Gandhinagar	-	44	97
20	Gangtok	-	13	26
21	Guwahati	-	166	204
22	Hyderabad	1566	2187	4200
23	Imphal	-	43	120
24	Indore	350	557	720
25	Itanagar	-	12	102
26	Jabalpur	-	216	400
27	Jaipur	580	904	310
28	Jammu	-	215	300

29	Jamshedpur	-	338	28
30	Kanpur	1200	1100	1600
31	Kavaratti	-	3	2
32	Kochi	347	400	150
33	Kohima	-	13	45
34	Kolkata	3692	2653	3670
35	Lucknow	1010	475	1200
36	Ludhiana	400	735	850
37	Madurai	370	275	450
38	Meerut	-	490	52
39	Mumbai	5355	5320	6500
40	Nagpur	443	504	650
41	Nashik	-	200	350
42	Panjim	-	32	25
43	Patna	330	511	220
44	Pondicherry	-	130	250
45	Port Blair	-	76	45
46	Pune	700	1175	1300
47	Raipur	-	184	224
48	Rajkot	-	207	230
49	Ranchi	-	208	140
50	Shillong	-	45	97
51	Shimla	-	39	50
52	Silvassa	-	16	35
53	Srinagar	-	428	550
54	Surat	900	1000	1200
55	Thiruvananthapuram	-	171	250
56	Vadodara	400	357	600
57	Varanasi	412	425	450
58	Vijayawada	-	374	600
59	Vishakhapatnam	300	584	334
	Total MSW	30058	39031	50592

- <http://terienvs.nic.in/index3.aspx?sslid=4111&subsublinkid=1347&langid=1&mid=1>

Data source: ENVIS Centre on Renewable Energy and Environment

- Hosted by [The Energy and Resources Institute, Delhi](#)
- Sponsored by [Ministry of Environment, Forests & Climate Change, Govt of India](#)
- The Environmental Information System (ENVIS) network was established as a plan programme under the Ministry of Environment, Forest and Climate change (MoEFCC), Government of India, in December 1982. A large number of nodes, coined as ENVIS Centres, have been established in the network to cover the broad subject area of the environment with a focal point in the MoEF.
- <http://terienvis.nic.in/index1.aspx?lid=37&mid=-&langid=1&linkid=20>

TERI Projections on Municipal Solid Waste Generation In India

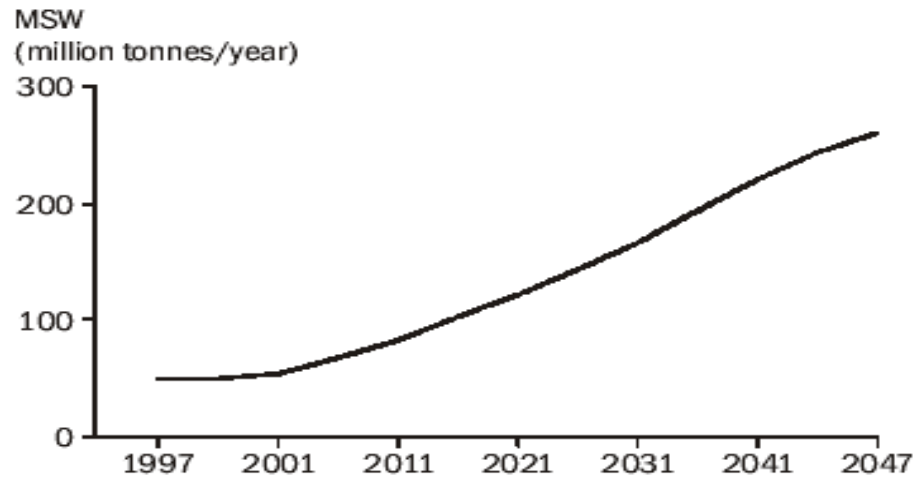


Figure 1 Projected trends in the generation of municipal solid waste (million tonnes/year) according to BAU scenario

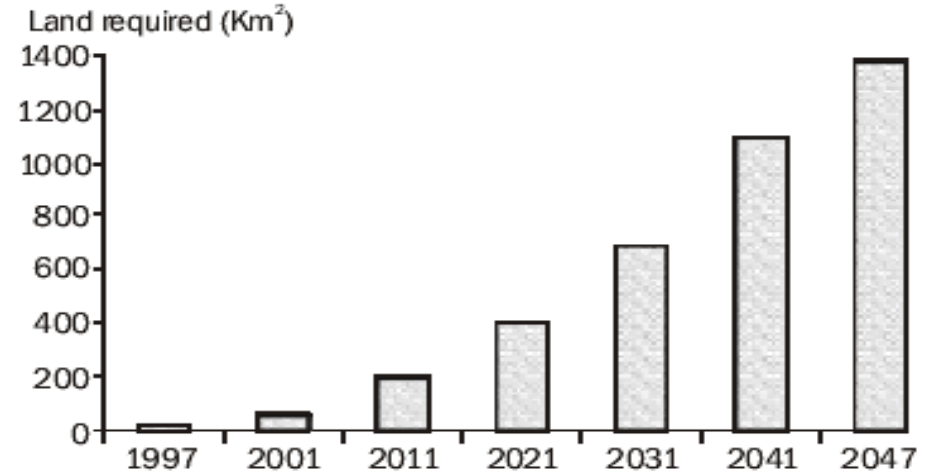


Figure 2 Cumulative land requirement for disposal of municipal solid waste (Km²)

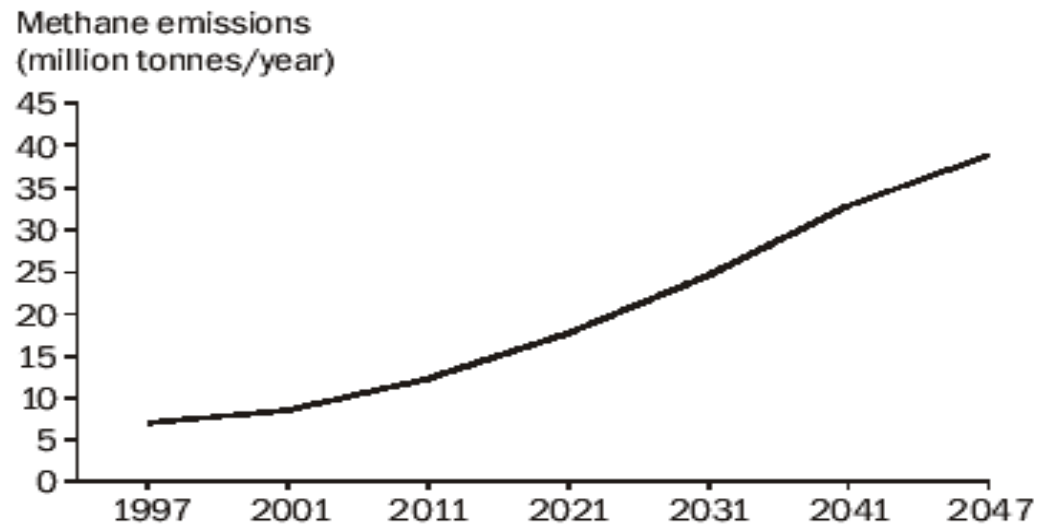


Figure 3 Emission of methane from landfills

Growth of Solid Waste In India

- Waste is growing by leaps & bounds.
- In 1981-91, population of Mumbai increased from 8.2 million to 12.3 million.
- During the same period, municipal solid waste has grown from 3200 tonnes to 5355 tonnes, an increase of 67%.
- Waste collection is very low for all Indian cities.
- City like Bangalore produces 2000 tonnes of waste per annum, the ever increasing waste has put pressure on hygienic condition of the city.

Source: The Energy & Resources Institute TERI, New Delhi

Solid waste MISMANAGEMENT

Certain cases in recent years and resulting impacts

- Cloudburst in Mumbai (2005) clogged the sewage line due to large no. of plastic bags
- Blast in the Bhusan Steel factory at Noida, caused due to imported scrap from Iran
- Reduction in the number of migratory birds due to consumption of contaminated foods
- Stray animals dying on streets and farmland due to consumption of plastic bags, which blocks the food movement in their stomach

More than 45 million tonnes, or 3 million trucks worth, of garbage is untreated and disposed of by municipal authorities everyday in an unhygienic manner leading to health issues and environmental degradation.
(December 2014)

www.indiaspend.com/cover-story/3-million-truckloads-daily-indias-real-trash-problem-68539

- Handout 14

3 Million truckloads daily_India's real trash problem_Dec 2014

Waste Management Process

- Steps in the process:
 - Collection and Transport (CT)
 - Treatment/transformation and Disposal (TD)

After its collection and transportation the waste is sometimes processed by composting, anaerobic digestion or by other methods. The resulting material, after treatment, is then sent for disposal

Reasons highlighting need for Waste Management

- Sharp increase in waste generation
- Collection, treatment, and proper disposal of only a limited amount of waste generated
- Increase in land area requirement for disposal
- Dumping waste in open generates health impacts

According to World Health Organization **22 types of diseases can be prevented or controlled** by improving solid waste management in India.

Only about 75- 80% of the municipal waste gets collected and out of this only 22-28 % is processed and treated and remaining is disposed of indiscriminately at dump yards. It is projected that by the year 2031 the MSW generation shall increase to 165 million tonnes and to 436 million tons by 2050. If cities continue to dump the waste at present rate without treatment, it will need 1240 hectares of land per year and with projected generation of 165 million tons of waste by 2031, the requirement of setting up of land fill for 20 years of 10 meters height will require 66,000 hectares of land.

<http://pib.nic.in/newsite/PrintRelease.aspx?relid=138591>

Proper solid waste management

- Scientific disposal of solid waste through segregation, collection and treatment and disposal in an environmentally sound manner minimizes the adverse impact on the environment.
- Waste-to-energy conversion: As per information available for 2013-14, compiled by CPCB, municipal authorities have so far only set up 553 compost & vermi-compost plants, 56 bio-methanation plants, 22 RDF plants and 13 Waste to Energy (W to E) plants in the country.

The amount of waste that is generated, if collected and treated well, can be effectively used to generate energy.

Globally, there are 2,200 waste-to-energy plants, of which European Union has 445, China has 150 and USA has 86 compared to just 8 in India.

Solid Waste Management

- History of Waste
- Basic Principles of SWM (Mantra)
- SWM Process description

History of Waste

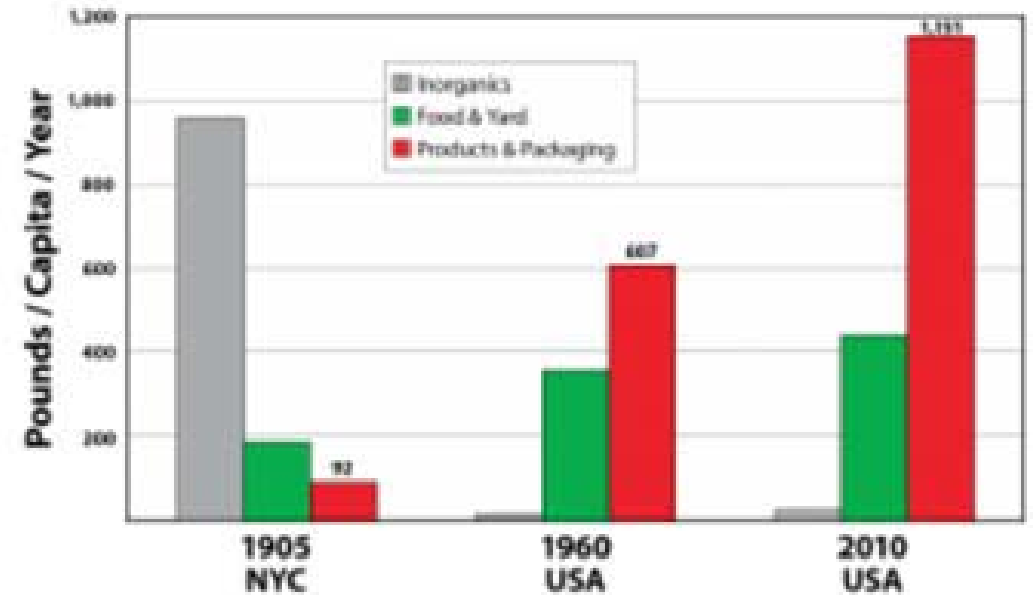
- A century ago urban squalor and disease led citizen reformers to demand cities take action. They did. Cities became responsible for disposing of waste. But urban refuse was different then. It was mostly coal ash and food scraps, with a small proportion (7%) of simple manufactured products like paper and glass.
- Today, products and packaging comprise 71% of our waste, much of it designed to be thrown away after a single use or containing toxic components. Garbage has changed, but our waste management system has not changed at the same rate.

History of Waste contd.

Handout 17: History of Waste

Summary:

- The Beginning: Urbanization & Public Health
- Citizen Groups Demand Collection Services
- Composition of garbage changes
- New products create 'crisis'
- Public Collection for Recycling Emerges
- Enabling the Throw-away Society



Change in nature of waste generated in USA

Today's scenario

Basic Principles of Solid Waste Management

Basic Principles/ 4 Rs

- Refuse: Do not buy anything which we do not really need.
- Reduce - Reduce the amount of garbage generated. Alter our lifestyle so that minimum garbage is generated.
- Reuse - Reuse everything to its maximum after properly cleaning it.

Make secondary use of different articles.

- Recycle – Keep things which can be recycled to be given to rag pickers or waste pickers (Kabadiwallahs). Convert the recyclable garbage into manures or other useful products.

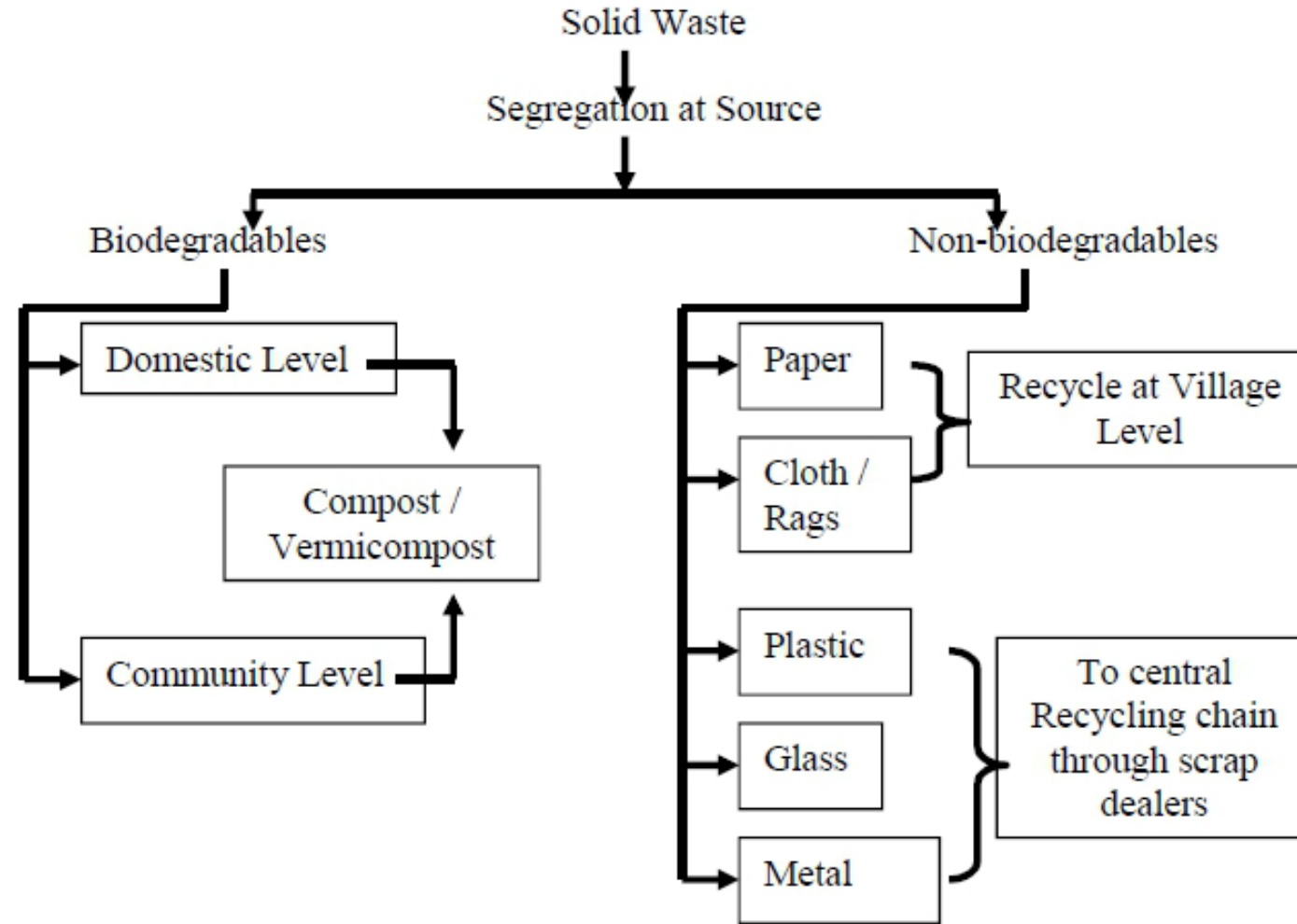
Shift in Waste Management Strategy

Solid Waste Management MANTRA (4R's):

1. Reduce
2. Reuse
3. Recycle and
4. Recover

Advantage: fully capable of managing solid wastes in an **environmentally sound manner.**

Ideal SWM at a glance



*Handout 14: Waste Management Initiative in India for human well being. Agrawal et. Al 2015
European Scientific Journal June 2015 /SPECIAL/ edition ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431*

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MSW Collection, Transport and Treatment