RAKSHAK FOUNDATION

Improving Municipal Solid Waste Management Practices

JULY 2013

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Preface

This report is written by Shruti Shukla, MSc Biotechnology student at University of Pune. This program is a part of summer experience in order to gain insight of social and public issues.

Rakshak foundation is a platform to create awareness and work in the field of public policy and social issue. It gives its interns a healthy environment to research, understand and analyse the current problems of importance in our country. A very unique feature of the foundation is the dedication towards its interns and their work.

This report is an analysis of the various reports and articles on Municipal Solid Waste Management and aims to find problems and loopholes in the system and functions. It gives main importance to recommendations and solutions to these problems. This report can be used to understand the current scenario of MSWM in India and concentrate on recommendations to improve the same.

The foundation has provided the chance to work on a very important issue and it's high time that some action is taken in the field. Efforts have been put in to analyse the situation and recommend changes in accordance to the place and its activity.

Acknowledgements

This report is a part of the Rakshak Foundation Internship program and would not have been possible without the support of the organization, the coordinators and the IIT Delhi support staff. These include the founder of the organization Shri Sachin Bansal, and the coordinators Ishika Gupta, Pritesh Mittal, Nikita Anand and Siddarth Das.

Major findings on the waste management practices have been inspired by the field visits and discussions with the officials at the Central Pollution Control Board and Synergy Biomedical Waste Management Ltd. This report wouldn't be possible without their cooperation and help.

I would like to convey my gratitude to the following people for their kind help:

Shri Tapas Saha and Shri Sanjay Kaushik, Synergy Waste Management Ltd. for granting me the permission to visit their facility.

Shri Chandrajeet Raghav for the industrial tour at Synergy Waste Management Ltd. and the discussion following it.

Shri Dr. Sanjeev Agrawal, Senior Scientist, CPCB for the inspiring discussion on the present day practices in Waste management and our government organization.

Shri Tarun Darbari for providing me with the data on the various landfills in Delhi.

Shri Dr. Avinash Akolkar, Senior Scienst, CPCB for discussing the problems, solutions and recommendations on MSWM.

Shri Inder for the various books on Solid waste Management.

Finally all the interns at the Rakshak Foundation who have helped me directly or indirectly in the project.

1. Table of Contents

List of Figures

List of Tables

Executive Summary

This study includes the details on Municipal Solid Waste Management practices followed in India, with a major focus on the laws and acts in the field to regulate and improve the present scenario in Solid waste management. The report also focuses on the problems faced by various organizations like the Central pollution Control Board, the private industries, the households and the labour working in the field. It also explains the various methods used in the general process of MSWM by the authorities and explains the various steps.

This report is the research work of about one month of literature search and a few field trips. The field trips were focussed on finding the major problems in the working of officials and loopholes in the implementation of laws. It also covers the technical aspect of the functioning of a waste management plant along with the different steps such set ups take to work hand in hand with the environment protection rules.

The main objective of this report is to give an idea on the understanding of the project and shape the future structure of the project. It aims at understanding the various aspects related to the topic like the laws, the governmental organization, institutions, steps in storage, collection, segregation and recycling.

All the information and data collected for the report was a result of the various field trips and literature review. The methodology basically comprises of a cycle of collecting information from the databases, websites and research articles then checking their implementation on field via trips and finally analysing the situation. The analysis then gives ideas on further studies for sorting out problems.

The following information was attained during the process -

- To research on existing legislations barring waste littering and dumping in urban areas and their effectiveness.
- Study collection of waste from different sectors like household, industries and markets.
- Collect data on the mix of various types of solid waste e.g. glass, metal, paper, wood, organic matter in the waste.
- Visit one or two waste treatment facilities and observe its working. Find its capacity, average daily waste received and the amount handled daily.
- Discuss the problems encountered in the operation of the facility with the workers, supervisor and manager.
- To visit CPCB to understand the functioning of the main monitoring body and the SPCB.

The final part of the report comprises of the recommendations at various levels of governmental provisions, community level, and private services. They include ideas on improving present day waste management practices, modifying the process in MSW collection, segregation and treatment. It is divided into three levels

- Generation level
- Collection level
- Community or state level

This structure has been provided to the recommendations for it combines all the areas with the major problems in the sector.

The generation level mainly concerns the day to day malpractices of the municipalities and the irresponsibility of the citizens. There is a need for a written set of rules to be followed by households, industries and medical facilities separately. In these the waste management system is again divided into three parts namely *Primary Source*, *Collection*, and *Treatment.* The rules laid down will be supported by penalties in case of non-compliance and are to be followed strictly.

The Collection level targets the local business minds like the NGOs, small scale industries and research institutes for bringing in innovations in the field of handling and processing of waste before it goes for treatment. The collection and transport part can be taken care of by the NGOs and the primary processing by the small scale recycling industries. The later part of research by the educational institutes.

The community level recommendations cover a large scale development for an overall improvement of the waste management practices. It includes setting up Public Private Partnership in the sector, making recycling a compulsory attribute to any industry or facility in the sector, to set up a Reward policy model in the Central Pollution Control Board to regulate the municipalities and promote healthy competition within municipalities. It also includes starting awareness programs and including them in school curriculum to create better informed and responsible citizens.

Key Findings –

- The increasing population, urbanization and the GDP of the country has led to a great increase in the waste generation. The relation of these aspects with the waste generation is directly proportional.
- There is an extensive framework of laws, rules and acts in our constitution to regulate the waste management system.

- The main problem that I have understood in terms of poor management in our country is that of lack of awareness among the people and communities.
- There is no specific rule or law in the Environment protection Act (1986) or the MSW management and handling law (2000) against littering and dumping.
- Every state has its own set of rules and laws to regulate the functioning of the governmental and private bodies.
- The CPCB is the main regulatory body to monitor all the whereabouts of the different state pollution control bodies and various projects undergoing in the country.
- The major problems in the private sector are mostly related to governmental ignorance, lack of expertise in labour, lack of implementation of segregation and transport rules at the site of waste generation.

1. Introduction

1.1 Background Information

India is number two in terms of population which is 1.21 billion. This accounts for nearly 18% of world's population, and we still do not have enough resources or adequate systems in place to treat our solid wastes. India generates an average of around 0.2 to 0.3 million tons of waste on every day. A city like Bangalore generates around 3500-4000 tons of waste while Mumbai and Delhi average almost double of this.[1]

The urban population rate of India grew at a rate of 31.8% during the last decade to 377 million. India is facing problems in increasing available services and resources with the rapid increase in urban population. Solid waste management (SWM) is one of the most important and most neglected services in India, which needs development in the present hour. The current SWM services are inefficient, incur heavy expenditure and are low in quality such that they have started becoming a potential threat to the public health and environmental quality. In a broader sense, municipal solid-waste management is a very complex task, as there is minimum cooperation and awareness between the social, economic and cultural households, communities, enterprises, and municipal authorities. Improper solid waste management deteriorates public health, causes environmental pollution, increases degradation of natural resources, causes climate change and greatly impacts the quality of life of citizens.[2]

The per capita waste generation rate increased from 0.44 kg/day in 2001 to 0.5 kg/day in 2011. Increase in urban population growth rate and per capita waste generation has resulted in a 50% increase in the waste generated by Indian cities within a decade since 2001. There are 53 cities in India with more than a million population, which together generate 86,000 TPD (31.5 million tons per year) of MSW at a per capita waste generation rate of 500 grams/day. The total MSW generated in urban India is estimated to be 68.8 million tons per year (TPY) or 188,500 tons per day (TPD) of MSW.[3]

Big cities collect about 70 - 90% of the total MSW generated, whereas small cities and towns collect less than 50% of waste generated. More than 91% of the MSW collected formally is landfilled on open lands and dumps. It is estimated that about

[1] Delhi urban environment and infrastructure improvement project.
[2] Sustainable Solid Waste Management in India, Asian Productivity Organization Report.
[3] The world Bank Institute development studies Report.

2% of the uncollected wastes is burnt openly on the streets. About 10% of the collected MSW is openly burnt or is caught in landfill fires.[4]

Due to increasing problems in the field of municipal solid waste management, increasing population and increasing waste production with increasing GDP of India, a public interest litigation was filed in the Supreme Court in 1996 against the government of India, state governments, and municipal authorities for their failure to perform their duty of managing MSW adequately. As a result the Supreme Court appointed an expert committee to look into all aspects of SWM and to make recommendations to improve the situation. The result of this 1999's survey included detailed recommendations regarding the actions to be taken by the class 1 cities, the central government and state governments, to solve and address the issues of MSWM. On the basis of the report, the Supreme Court directed the government of India, state governments, and municipal authorities to take the necessary actions. The Ministry of Environment and Forests was directed to formulate rules regarding MSW management and handling. Thus, in September 2000, Municipal Solid Waste (Management and Handling) Rules 2000 under the Environment Protection Act 1986 were published.

Today we have a number of acts and rules in this field to improve the present condition of MSWM. The rules regulating the process and functioning of governmental bodies, private industries and individuals are all under the Environment protection Act, 1986. Presently we have rules on all aspects of solid waste like plastic, hazardous, biomedical but the implementation is very poor. The details of the same have been focused on in the methodology section.

[4] Asian Productivity Organization Report

1.2 Main Problems, their scope and impact on the society

Table 1 Overview of functions of different of governmental organisation[5]

Level	Strength	Weakness	Opportunity	Threats
Central Government	Laws related to SWM are in place	Poor enforcement Inadequate funds No master plan for SWM No awareness for SWM Lack of proactive approach on various recycling industries	Linkage between university and research institute with local bodies Waste-to-energy CDM Project Composting Environment improvement	Noncooperation of the states Lack of political will
State Government	Institutional set-up is in place	Inadequate funds Poor enforcement Lower priority for SWM related projects No database of solid waste Lack of political will for boosting SWM product No control on informal sector recycling No tax holiday for SWM	Wealth from waste Scope of Public Private Participation	No land for disposal Public resistance Inadequate capacity building
Municipal Government	Sufficient manpower Additional state legislation on SWM exists	Fully dependent on state for funds Lack of commitment Lack of capacity building No accountability Lack of database Red tape No community participation	Revenue generation from waste CDM and carbon credits Less health hazardous	Poor environmental concern among citizens Inefficiency Political interference Lowest priority No land available

1.2.1 Major problems in this field are:

- Lack of storage of waste at the source
- Littering of domestic waste on streets
- Littering of trade and constructional waste on streets
- Disposal of Bio-medical waste in municipal waste stream
- Disposal of industrial waste in open areas
- No segregation of waste at source
- Lack of primary collection from the generation site
- Lack of regular street sweeping
- Lack of use of closed vehicles for waste transport
- Waste processing is not wide spread
- Crude dumping
- Insanitary disposal of waste at dumping site
- Lack of waste management planning while setting up new townships
- Lack of proper institutional and designing set up for waste management in urban local bodies.

[5] Asian Productivity Organization Report

- Lack of technically trained manpower
- Lack of involvement of the communities in the awareness and other SWM programs.
- Lack of expertise and exposure in the waste management techniques in the cities.
- Lack of awareness creation mechanism
- Lack of Management Information Systems
- Lack of funds to the working bodies in this field

1.2.2 Scope of the Problems and their impact:

The problems stated above are wide spread in our country. The major reasons for these are the lack of awareness and understanding among the people and the lack of strict monitoring mechanism, implementation of rules, corruption, among the governmental organization.

All this leads to the increase in unhygienic conditions around the industries, households, market areas and especially slums, which are a major dumping ground for the waste materials. The conditions in these areas are unsanitary and have resulted in a great increase in the spread of diseases, promotion of more and more rag pickers and low social status of the slum dwellers in the society.

1.2.3 Impacts on the Society

HEALTH IMPACT

Reading the word itself we realize that Solid Waste has a negative impact on our society. Working for the betterment of the health impact of waste we will have to consider the major problems of insanitary conditions, disposal etc., proposing methods to achieve the target of improving them and innovate new technology to help us in this respect.

ENVIRONMENTAL IMPACT

The impact of waste and its management on the environment is of two types, mainly resource impact and air, land, water impact. To work in this respect of the waste management we would need to consider the points like resource depletion, life cycle material efficiency, source reduction and recyclability, greenhouse gas emissions, water quality degradation and land toxification.

LIVELIHOOD IMPACT

The quality of life of people and communities all around the world is linked directly to the waste generation and management in their countries. To work in this respect of the waste management we need to focus on empowerment of a community to improve the quality of waste management system, to increase the income of the community, to reduce labor intensive methods without hampering the employment of people and without affecting the environment. We should also consider the factors like increase in daily income, increase in task productivity, better educational perspectives and training among the labor to improve their overall living conditions.

COMMUNITY IMPACT

Working on a community level we need to consider the local values, methods and perceptions on the topic. This means learning more on their routines and cultures and then improvising methods for waste management in the community. This includes being a part of the community and participates in community groups, work with local businesses, schools and healthcare facilities.

1.3 Goals and Objectives

Tasks provided by the foundation:

- To research on existing legislations barring waste littering and dumping in urban areas and their effectiveness.
  - This is important to understand the governmental initiatives and will to improve the present conditions.
- Study collection of waste from different sectors like household, industries and markets.
  - It is required to understand the ways of collection and amount of waste generated at these levels to suggest methods to improve the existing processes.
- Meet the Municipal Officer of the city and understand Municipal solid waste management methods in that city.
  - To discuss the problems specific for the city and get suggestions.
- Collect data on the mix of various types of solid waste e.g. glass, metal, paper, wood, organic matter in the waste.
  - To collect data on different kinds of waste and make graphs for better understanding.
- Find out if any part of the waste is segregated and recycled. Does the city uses organic waste for composting?

  - To find if there are provisions for eco-friendly practices in the city, if not then take measures for the same.
- What arrangements exist to segregate and separately handle hazardous and toxic waste such as bio-waste, electronic waste etc.?
  -
- Visit one or two waste treatment facilities and observe its working. Find its capacity, average daily waste received and the amount handled daily.
- Discuss the problems encountered in the operation of the facility with the workers, supervisor and manager.
- Find out the waste handling and treatment practices in advanced countries and compare them with the practices in that city.
  - This is important for comparing and suggesting reforms for the advancement of practices.
- Suggest innovative PPP models to involve the environmentally aware youth of the country to counter urban waste dumping.
- Propagating awareness program in primary schools so as to shape young minds to be environmentally conscious from an early age.
- Mandating community service for offenders. Feasibility of creating a scheme to empower the public to take prompt action against offenders.

Tasks added:

- To visit different waste management facilities in Delhi and get an outlook of the problems in the city.
- To visit Central Pollution Control Board, Delhi to find loopholes in the laws and system.
- To categorize the problems faced in different sector on the basis of its severity.
- To propose solutions to these problems in accordance with feasibility.
- To visit NGOs working in the field of waste management, upliftment of rag pickers and sweepers to understand the ideas behind the initiatives and nurture own ideas in the same.

2. Methodology

2.1 Literature Search

In this section of literature search the details on the different laws regulating waste management, the urban waste management, the institutional framework, problems in the implementation of laws and data from scientific papers, reports and field visits have been included. Overall this section covers major part of the tasks related to literature research.

2.1.1 Laws and Regulatory framework:

The Department of the Environment (DoE) was established in India in 1980 to ensure
healthy environment for the country. It became the Ministry of Environment and Forest (MoEF) in 1985. The Central Pollution Control Board under the Ministry of Environment and Forest was set up soon after this. There are State Pollution Control Boards/Committees (SPCB) in all states under the regulation of CPCB, to meet the challenges relating to environmental issues. The constitutional provisions are supported by a number of laws, acts, rules, and notifications. The Environment (Protection) Act of 1986 (EPA) came into force after the Bhopal gas tragedy and is considered an important regulatory legislation as it filled many gaps in the existing laws. The major regulatory framework of the country is as follows:

• 1986: The Environment (Protection) Act authorizes the central government to protect and improve environmental quality, control and reduce pollution from all sources, and prohibit or restrict the setting and/or operation of any industrial facility on environmental grounds.

• 1986: The Environment (Protection) Rules lay down the procedures for setting standards for the emission or discharge of environmental pollutants.

• 1995: The National Environmental Tribunal Act was created to award compensation for damages to persons, property, and the environment arising from any activity involving hazardous substances. The regulations specific to water, air, forests, and wildlife are as follows-

Water

• 1974: The Water (Prevention and Control of Pollution) Act established an institutional structure for preventing and abating water pollution. It established standards for water quality and effluent. Polluting industries must seek permission

to discharge waste into effluent bodies. The Central Pollution Control Board (CPCB) was constituted under the Water Act.

• 1991: Coastal Regulation Zone Notification put regulations on various activities, including construction in coastal areas, and provided protection regulations for backwaters and estuaries.

Air

• 1981: Air (Prevention and Control of Pollution) Act provided for the control and abatement of air pollution. It entrusted the power of enforcing this act to the Central Pollution Control Boards.

• 1982: Air (Prevention and Control of Pollution) Rules defined the procedures for meetings of the boards and the powers entrusted to them. The regulations related to forest and wildlife were in place before the establishment of the MoEF. The related acts are as follows-

• 1927: The Indian Forest Act and Amendment 1984 was enacted to consolidate the laws related to forests, the transportation of forest produce, and the duty to be levied on timber and other forest produce.

• 1972: Wildlife Protection Act, Rules (1973), and Amendment (1991) provided for the
protection of birds and animals and the matters that affect them—their habitat, waterhole, or the forests that sustain them.

• 1980: The Forest (Conservation) Act and Rules (1981) provided for the protection and conservation of forests.

There are other rules under the Environment Protection Act, 1986 namely-

- The Solid Waste (Management and Handling) Rules, 2000: These rules deal with the scientific management of municipal solid waste by ensuring proper collection, segregation, storage, transportation, processing, and disposal of municipal solid waste.
- The Plastic Waste (Management and Handling) Rules, 2009: This include to ensure safe collection, storage, segregation, transportation, processing and disposal of plastic waste:, no damage to the environment during this process, setting up of the collection centres for plastic waste involving manufacturers, its channelization to recyclers:, to create awareness among

all stakeholders about their responsibilities, and to ensure that open burning of plastic waste is not permitted.

- The E-waste (Management and Handling) Rules, 2011: These rules shall apply to every producer, consumer or bulk consumer, collection centre, dismantler and recycler of e-waste involved in manufacture, sale, purchase and processing of electrical and electronic equipment.
- The Hazardous Waste (Management and Handling) Rules, 1989: These rules deal with controlling the generation, collection, treatment, disposal, import, storage, transport, and handling of hazardous waste.

The Biomedical Waste (Management and Handling) Rules, 1998: These rules are legally binding on healthcare institutions to streamline the process of proper handling (segregation, collection, treatment, and disposal) of hospital waste.[6]

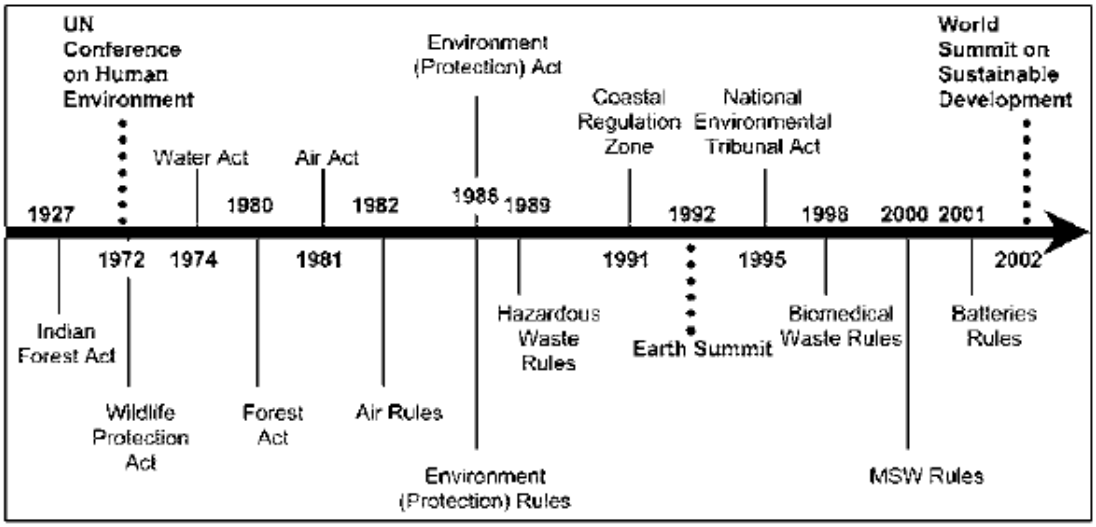


Figure 1 Timeline of Environmental Laws and Regulation in India.[7]

[6] (Asian Productivity Organization Report, http://envfor.nic.in/legis/hsm/hsm1.html)
[7] (Asian Productivity Organization, 2007)

2.1.2 Overview of the MSW (Management and Handling) Rules (2000):

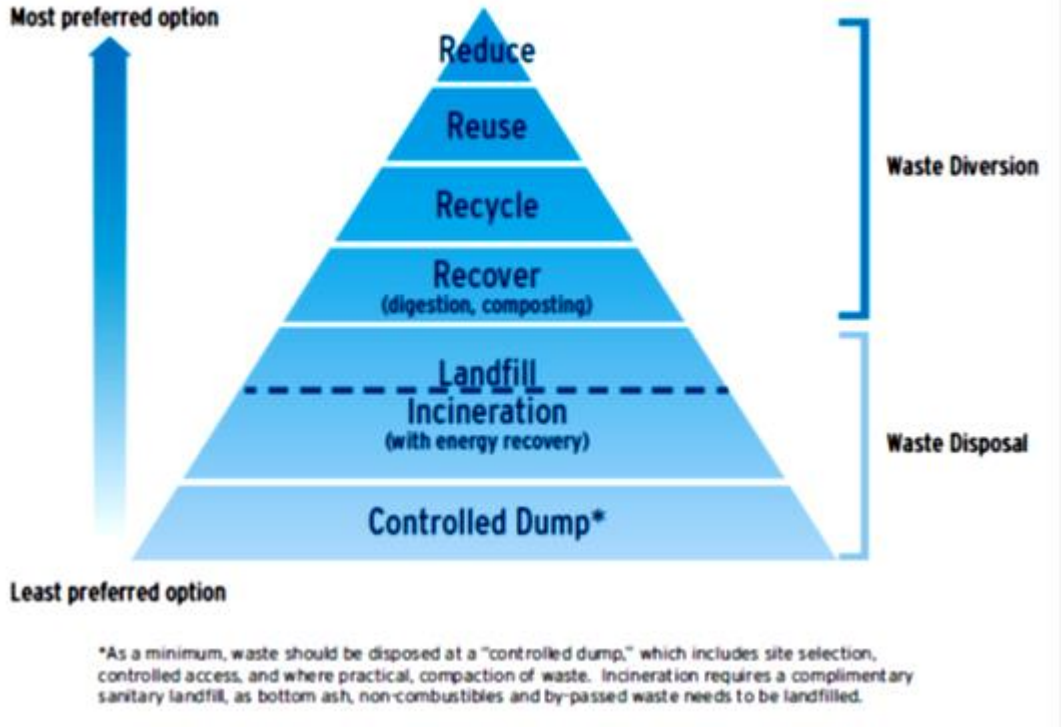


Figure 2 Waste Hierarchy [8]

There is no specific rule or law in the Environment protection Act (1986) or the MSW management and handling law (2000) against littering and dumping.

- Laws talk about sweeping streets, providing garbage containers in various parts of the city for storage of waste, and transporting waste to disposal sites, but they do not clarify how this cleaning shall or can be done.
- The municipal acts do not specify the responsibilities of the citizens.

The rules do not mention specific collection systems, do not state types of waste storage sites, do not stress on covered waste transport, and do not mention aspects of waste treatment or sanitary landfills.

[8] Municipal Solid Waste management, Japan (1005-2014), A Policy Framework for Management of Municipal Solid Waste, Japan }

But there are laws which work on the same lines. Few of the laws under both the acts are listed below.

- Environment protection act 1986 (Act 29)
    - Planning and excecution of laws. [Sec. 3 (2) (b) (ii)]
    - Standards for quality of environment. [Sec. 3 (2) (b) (iii)]
    - Standards for emmision or discharge of pollutants. [Sec. 3 (2) (b) (iv)]
    - Restriction of certain areas for non industrial work. [Sec. 3 (2) (b) (v)]
    - Safeguard against and Prevention of accidents. [Sec. 3 (2) (b) (vi)]
    - Handling of hazardous waste. [Sec. 3 (2) (b) (vii)]
    - Examination of manufacturing processes, materials and substances likely to cause pollution. [Sec. 3 (2) (b) (viii)]
    - Investigation and research on environmental problems. [Sec. 3 (2) (b) (ix)]
    - Inspection of plant, process, equipment etc. [Sec. 3 (2) (b) (x)]
    - Recognition and establishment of environmental laboratories. [Sec. 3 (2) (b) (xi)]
    - Collection and dissemination of information relating to environmental pollution. [Sec. 3 (2) (b) (xii)]
    - Preparation of manuals, codes, guides for prevention, control and abetment of pollution. [Sec. 3 (2) (b) (xiii)]
    - Implementation of the act in all states. [Sec. 3 (2) (b) (xiv)]
    - Procedures to handle the hazardous wastes. [Sec. 6 (2) (c)]
    - Prohibition and restriction of hazardous waste. [Sec. 7]
    - Prohibition and restriction of placement of industries. [Sec. 8]
    - Restriction on the industries for removal of waste above the prescribed level. [Sec. 8]
    - Power of inspection in places, sampling and testing. [Sec. 10]
    - Establishment, functioning, procedures of environment labs. [Sec. 12]
    - The Central govt. has the power to ask for reports time to time or whenever it needs the information, statistics.[Sec. 14]
    - Any rule made under this act shall be laid in front of the parliament house immediately. [Sec. 22]

    - Municipal Solid Waste (Management and Handling) Rules 2000, (Environment Protection Act 1986)

- The municipal authorities must provide the infrastructure and services with regard to collection, storage, segregation, transport, treatment, and disposal of MSW.
- Municipal authorities are to gain authorization from the state pollution control board (SPCB) or committee to set up waste processing and disposal facilities. They are to deliver annual reports of compliance too.
- SPCB are directed to process the application of municipal authorities and authorize the municipalities within 45 days of its submission.
- The CPCB is responsible for coordinating the implementation of the rules among the state boards.
- The municipalities were to implement the rules by December 2003, with punishment for municipal authorities that failed to meet the standards prescribed; nevertheless, most municipalities did not meet the deadline. [9]

o Under Schedule II of the rules, municipal authorities have been further directed to-
  - Set up and implement improved waste management practices and services for waste processing and disposal facilities.
  - Standards for waste processing and disposal facilities are defined in the rules. The municipal authorities are to meet the specifications and standards specified in Schedules III and IV. [10]

Status of Compliance with the 2000 Rules

No consolidated official data is available about the status of compliance of MSW.

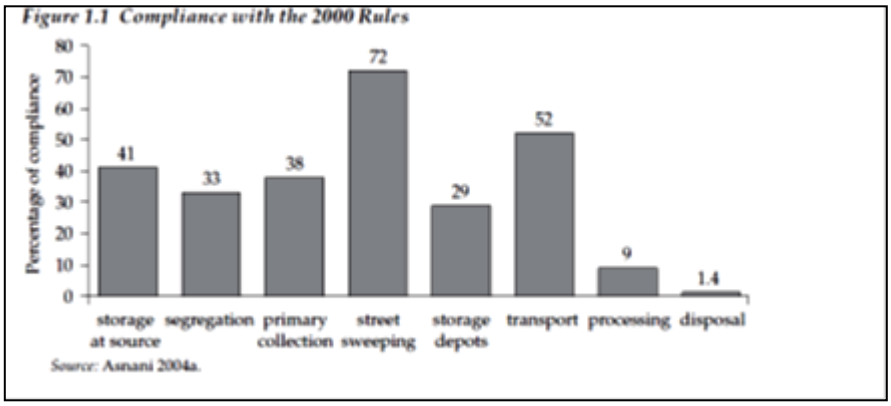


Figure 3 Compliance with 2000 MSWM Rules[11]

[9] (World Bank Report, 2008)
[10] (World Bank Report, 2008)
[11] (World Bank Report, 2008 (Ref 8))

Table 2 Steps of 1st Schedule under Municipal Solid Waste (Management and Handling) Rules 2000.[12]

Table 1.4 The Four Steps of Schedule I of the 2000 Rules

Step	*Completion date*
1. Set up waste processing and disposal facilities.	December 2003 or earlier
2. Monitor the performance of processing and disposal facilities.	Once every 6 months
3. Improve existing landfill sites as per provisions of the rules.	December 2002 or earlier
4. Identify landfill sites for future use and make sites ready for operation.	December 2002 or earlier

Source: Ministry of Environment and Forests 2000.

Punishments

- Any person not rendering help to the governmental officials in case of inspection would be punished under the act.
- Individuals, industries and others not cooperating with the inspection procedures can be imprisoned.
- The samples taken in the inspection can be marked and sealed by the person taking the samples in case the host is not present or is not willing to do the required.
- Penalty for contravention of the provisions of the act and the rules, orders and directions. The punishment may be of 5 years or more imprisonment, with fine of 1 lakh or both.
- If contravention continues the imprisonment increases by 5 years and fine by five thousand everyday till the contravention continues.
- Any company, its head or official will be punished under this act if the laws are violated under their supervision.
- If the offence is performed by a govt. body then its head will be punished according to the offence.

To **prohibit littering** and to facilitate compliance, municipal authorities must take the following steps:

[12] (WB Report, 2008 (Ref 8))

At Collection step –

- Organized collection of MSW at household level by using methods such as door-to-door, house-to-house, or community bin service. Regular collection must be pre-informed.
- Special consideration to devise methods for waste collection in slums and squatter areas, commercial areas and office complexes.
- All recyclable waste, biomedical waste and industrial waste is to be segregated at the source, to prevent the mixing of special waste with ordinary municipal solid waste.
- Collect separately horticultural waste, construction or demolition waste and dispose of it following specific norms. Also the waste generated at dairies should be regulated in accordance with the state laws.
- Prohibit burning of waste.
- Do not permit stray animals at waste storage facilities.

Secondary Storage of Waste

With respect to secondary storage of waste, municipal authorities must do the following:

• Provide sufficient storage facilities in accordance to the quantities of waste generated.
• Provide covered storage facility so that waste is not exposed to open atmosphere.
• Ensure regular cleaning and maintenance of the storage facilities.
• Ensure that storage facilities are easy to handle, transport and use.
• Ensure that manual handling and multiple handling of waste is done with proper safety and care.

Transport of Waste

The following rules apply to transport of waste:

• Vehicles used for transport of waste are covered.
• Waste should not be visible to public or exposed to the open environment. It should not cause scattering of waste.
• Daily clearing of waste from the storage area.
• Empty bins or containers before overflowing.
• Design transport vehicles for multiple handling of waste.

Waste Treatment

Waste treatment rules are as follows:

• Treatment of biodegradable waste by composting, vermicomposting, anaerobic digestion, or appropriate biological process for stabilizing it. Compost or other end product must comply with the standards specified in Schedule IV.
• Ensure recycling of mixed waste containing recoverable materials. Incineration with or without energy recovery can be used.

Waste Disposal

These rules apply to waste disposal:

• Restrict landfilling to non-biodegradable and non-recyclable waste.
• Ensure that landfilling meets the specifications defined in Schedule III.[13]

2.1.3 Municipal Solid Waste Management in India

- Data on the mix of various types of solid waste e.g. glass, metal, paper, wood, organic matter in the waste.

    - India has a population of over 1.21 billion and accounts for 17.5% of the world population.[14]
    - According to the figures of Census of India 2011, 377 million people live in the urban areas of the country. This is 31.16 % of the Country's total population.
    - With increasing urbanization and changing life styles, Indian cities now generate 8 times more MSW than they did in 1947. Presently, about 90 million t of solid waste are generated annually as by products of industrial, mining, municipal, agricultural and other processes. [15]
    - The amount of MSW generated per capita is estimated to increase at a rate of 1–1.33% annually as per 2007 analysis.
    - The total MSW generated by 217 million people living in urban areas was 23.86 million t/yr in 1991, and more than 39 million ton in 2001.[16]

[13] (World Bank Report, 2008)
[14] (Census of India 2011)
[15] (Sharloy et. al, 2008 (Ref 6))
[16] (Kaushal et. al, 2012 (Ref 5))

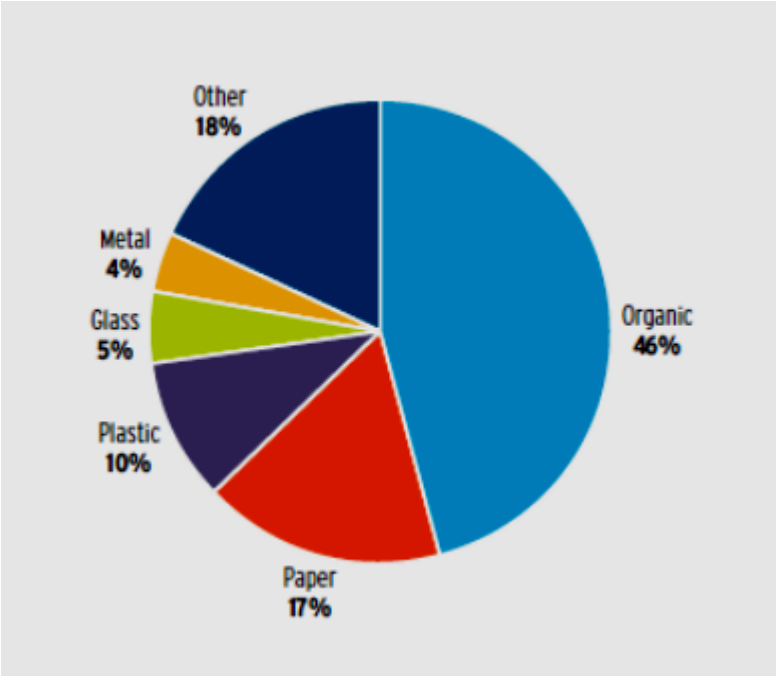


Figure 4 Global Waste Generation (2000)[17]

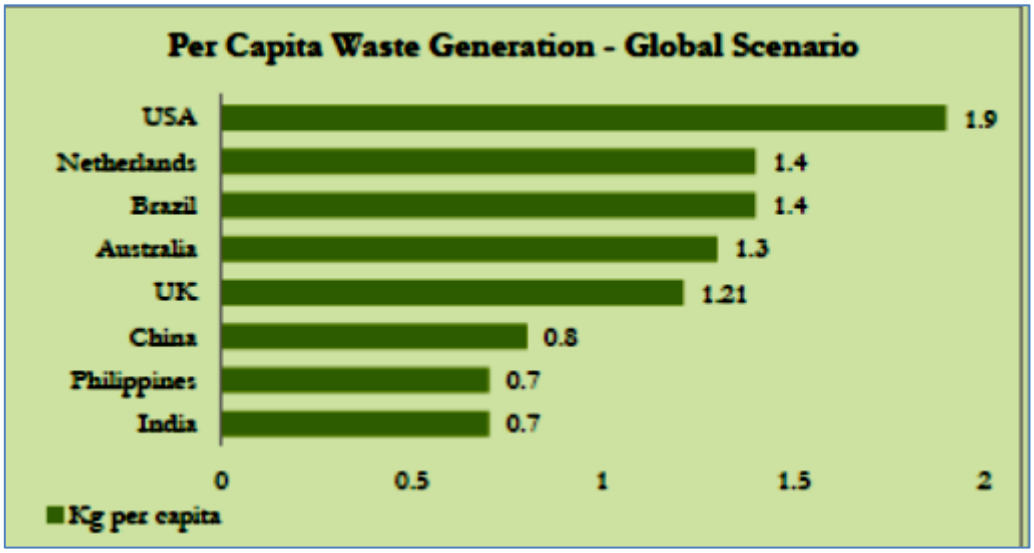


Figure 5 Per Capita Waste Generation (2011): A Few Select Countries [18]

[17] What a waste, 2012 (Ref 9)
[18] World Bank Report (5)

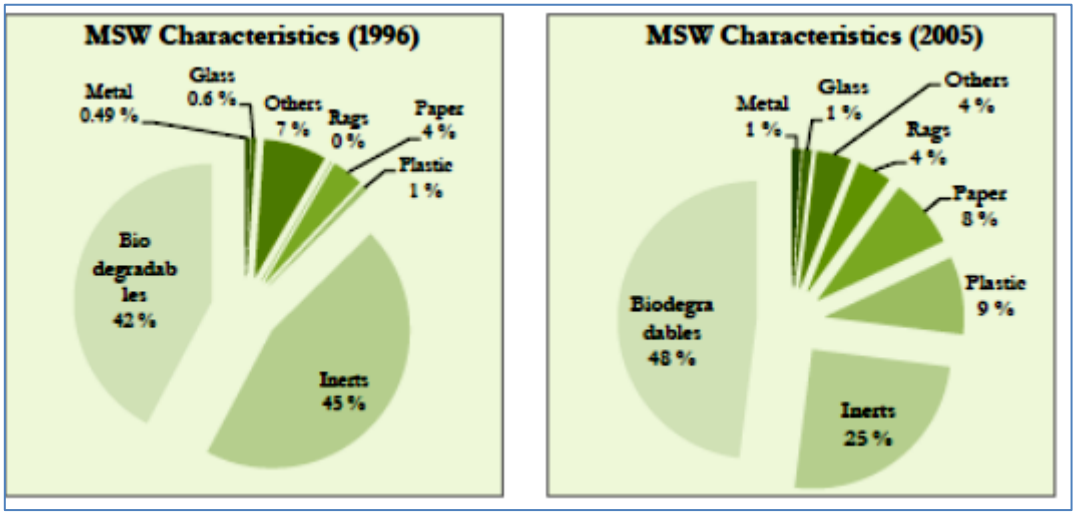


Figure 6 MSW Characteristics (1996 and 2005) of India [19]

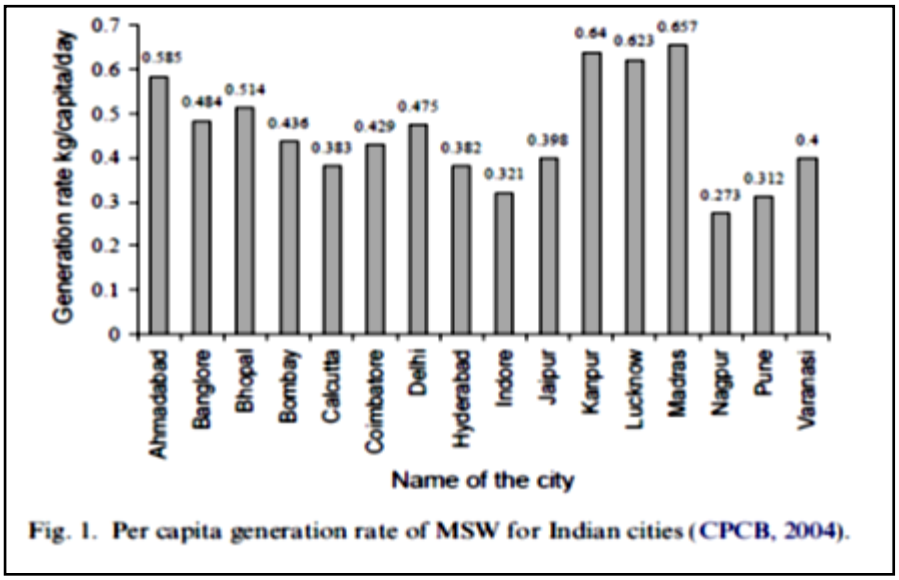


Figure 7 MSW generation rate in different cities [20]

[19] World Bank Report (5)

[20] (Sharloy et. al, 2008 (Ref 6))

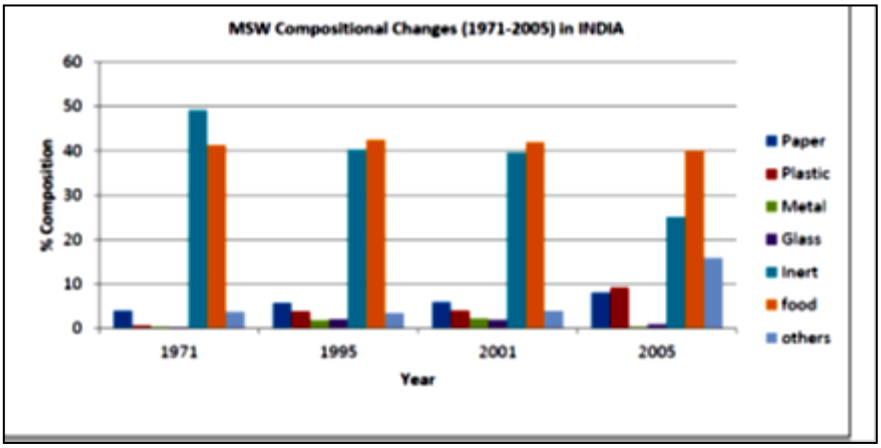


Figure 8 MSW Composition in India[21]

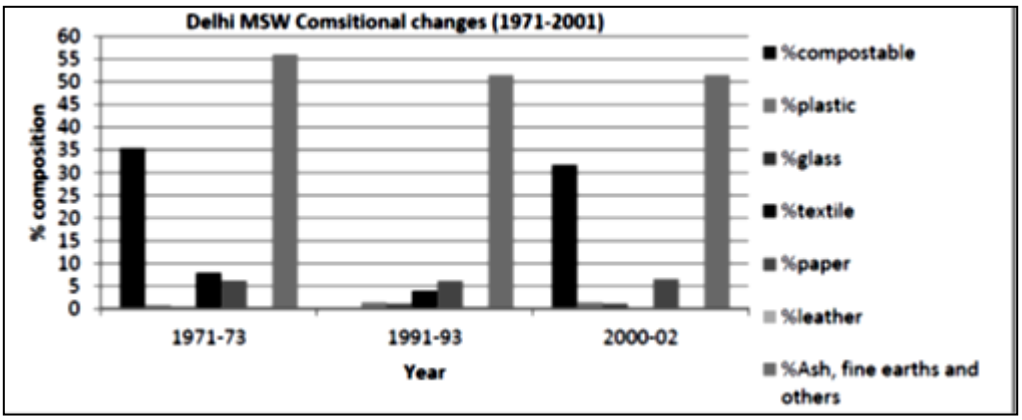


Figure 9 Statistics on MSW in Delhi from 1971-2001 [22]

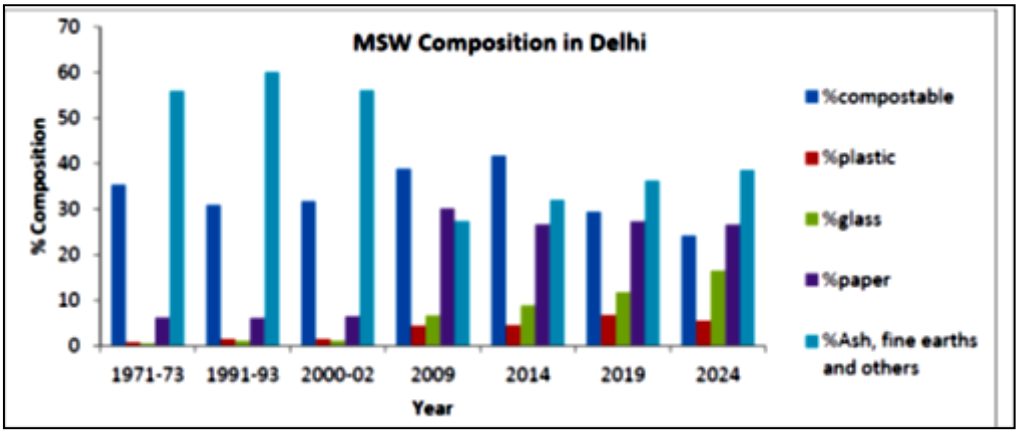


Figure 10 MSW composition in Delhi [23]

[21] (Kaushal et.al, 2012 (Ref 5))
[22] (Kaushal et. al, 2012 (Ref 5))
[23] (Kaushal et.al, 2012 (Ref 5))

2.1.4 Municipal Solid Waste Collection in India

Study collection of waste from different sectors like household, industries and markets.

The term *municipal solid waste* refers to solid waste from houses, streets, public places, shops, offices, hospitals etc.
Management of these types of waste is the responsibility of municipal or other governmental authorities. Although solid waste from industrial processes is generally not considered municipal waste, it nevertheless needs to be taken into account when dealing with solid waste because it often ends up in the MSW stream.

A typical Waste management system in a developing country has the following steps:

- Waste generation and storage
- Segregation, reuse, and recycling at the household level
- Primary waste collection and transport to a transfer station or community bin
- Street sweeping and cleansing of public places
- Management of the transfer station or community bin
- Secondary collection and transport to the waste disposal site
- Waste disposal in landfills
- Collection, transport, and treatment of recyclables at all points on the solid waste pathway.

Other activities include:

- Making policy, enforcing standards and regulations
- Evaluating data on waste generation and characterization for the purposes of planning and adapting system elements.
- Providing training and capacity development to workers and planners.
- Carrying out public information and awareness and education programs
- Identifying and implementing financial mechanisms, economic instruments, and cost-recovery systems.
- Incorporating formal and informal elements of the private sector as well as community-based activities and nongovernmental organizations (NGOs).

Details of the steps:

Household Storage and Segregation of Waste

Storage of waste at the source of its generation is the first essential step toward SWM.

Most households, shops, and establishments throw their waste outside their premises, on streets, in drains, in open spaces, in water bodies, and in other inappropriate places. This type of waste contains high level of biodegradable material, thus attracts rodents and stray animals and contributes to the spread of filth and disease. (8)

There are large community bins for different localities and the people living there are supposed to dispose their waste in it. The use of community bins is not very adequate as its cleaning is not on a regular basis and the bins overflow leading to littering and creating unhygienic conditions. There is a facility of door to door collection too in some places, where the workers walk with a metal cart to collect waste from each house.

The municipal authorities are responsible to collect waste from these bins and clean them regularly.

Partial Segregation of Recyclables

Segregation of recyclable waste at source is not seriously practiced by households, shops, and establishments in India. At least 15 % to 20 % of the country's total waste could be segregated at the source for recycling if the practice of segregation of waste at source was adopted. [24]

Construction and Demolition Waste

Construction and demolition waste is generated because of repair, maintenance, and construction activities comprising of bricks, stones, tiles, cement concrete, wood etc. Such waste is not stored by the waste generator within its premises. Waste is deposited outside the premises on the streets or in open spaces. This causes the hindrance of traffic and adversely affects the aesthetics of city. The disposal of such waste is the responsibility of the contractor working on the project. They are supposed to collect the debris and dump it in landfills or equivalent facility.

[24] Al-Salem et. al , 2009 (Ref 4)

Industrial Waste

Industries produce hazardous and non-hazardous industrial waste, which needs to be disposed off according to the standards laid down under hazardous waste management rules and also directions given by CPCB and by SPCB. In practice, there are very few sites authorized for industrial waste disposal; hence, compliance is weak. Some states do not have even a single facility for disposal of industrial waste. Industrial solid waste is, therefore, disposed of in an unscientific manner, leading to environmental pollution and subsoil contamination.

Waste

Large proportion of BMW is generated by hospitals, nursing homes, and health care establishments are disposed of on the streets or in open spaces around those establishments. BMW contains a variety of infectious and toxic substances and without adequate facilities for the collection, transport, and disposal of BMW, unhealthy. (8)

Types of Collection:

Primary Collection

Primary collection is the most essential component of SWM service and is grossly neglected. Collection system is old and inefficient. Municipal authorities do not provide door-to-door collection of waste, nor do they contract private sector for providing the services.

- The principal reason for this deficiency in service is the mind-set of the municipal authorities. Authorities consider responsibility only for waste collection at street collection points and do not provide doorstep collection service, even though the service is mandated in the rules.
- The second reason is the lack of citizen involvement in the storage of waste at source, which would facilitate primary collection from the doorstep.

Street Sweeping

Without a system of primary collection of waste from the doorstep, street sweeping is the most common method adopted for primary collection of wastes deposited in the streets. However, only important roads and markets are swept daily. Some streets are swept on alternate days or twice a week, and some are

swept occasionally or not at all. No planning is done to ensure that all streets are swept regularly.

Secondary Storage of Waste

Municipal authorities have designated locations in cities and towns for the temporary storage of primary waste and for deposition of the domestic or trade waste. The waste depots are called dustbins, dhallos, waste collection points, etc. Most of those sites are open and are located on the roadside. Waste depot sites are not evenly distributed in cities and towns they are far apart, making it difficult and time consuming for the workers or sweepers to use them. Furthermore, they are often poorly designed and are not synchronized with the primary collection system.

Transport of Waste in Open Vehicles

Waste in the cities and towns is not transported on a daily basis. This service is performed very inefficiently and in unhygienic manner. Open trucks and tractors used to transport waste are loaded manually. This time-consuming activity results in loss of labour productivity and increases the occupational health risk to workers. [25]

Waste Processing and Disposal

The processing technologies in use are composting, biomethanation, and waste to energy, the disposal at landfill is also considered here. Usually the landfill sites are government owned but the operation can be a public private partnership initiative in some cities. Composting technology is used in all cities, followed by waste-to-energy and biomethanation. The operation of a landfill site is either owned by municipal corporations or through public-private partnerships.

Waste minimization happens in two ways. At the household level, newspapers, bottles, plastic, cardboard, etc. are sold directly to Kabariwala. Plastic and other recyclable items are sorted out and segregated by rag pickers from municipal receptacles and landfill sites, and are then sold in the recycling market. [26]

[25] World Bank Report, 2008

[26] Asian Productivity Organization Report, Troschinetz et. al, 2009

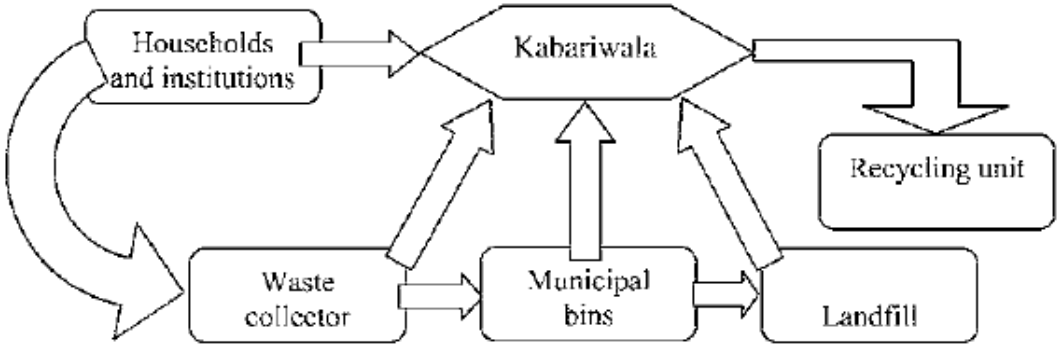


Figure 11 Diagram for recycling waste [27]

[27] Troschinetz et. al, 2009 (Ref7)

2.1.5 Public Private Partnership

Opportunities:

1) Flexibility:

- The private sector can hire qualified staff members
- Salaries and bonuses can be based on staff performance, thus also providing incentives for efficiency and good work.
- Employment is easily terminated when performance is unsatisfactory.
- More effective administration with fewer bureaucratic delays will result.
- Responsibilities will be more clearly defined, with no interdepartmental overlaps and no cross-departmental coordination needs.
- A faster and simpler decision-making process can be implemented.

2) Increased efficiency

- New equipment or spare parts for equipment maintenance can be easily acquired.
- The private sector has ready access to technology and expertise.
- The private sector has easy access to financial resources for new investments.
- Adapting technology to context and situation will be easier, thus increasing equipment performance.
- Full cost accounting and incentives for the lowest possible unit cost can be implemented.

3) Contestability:

- Performance monitoring is necessary.
- The focus should be on customer satisfaction.
- The service provider must be accountable to the beneficiaries for services rendered.
- Incentives for good performance and efficiency can be offered through competition.
- Less political interference will occur with private sector involvement.

Challenges:

1) No competition:

- If not enough private sector companies are interested in providing the service, choice and performance incentives will be minimized.
- Lack of sufficient capacities and skills to ensure satisfactory performance could reduce competition.

- A very strong private sector and weak municipal capacities could result in an unbalanced partnership.
- Long-term contracts with the private sector (creating a monopoly) could lead to loss of control by the municipality, which would eliminate one means of enforcing performance standards.

2) Uncertain safety and social benefits for workers:

- The private sector may not provide workers social security benefits, pensions, sick leave, social insurance etc.
- The private sector may not ensure use of safety and protective equipment.
- The private sector may pay wages for unskilled labor that are minimal or even below minimum wage.

3) No financial mechanism to ensure timely, regular payment for services:

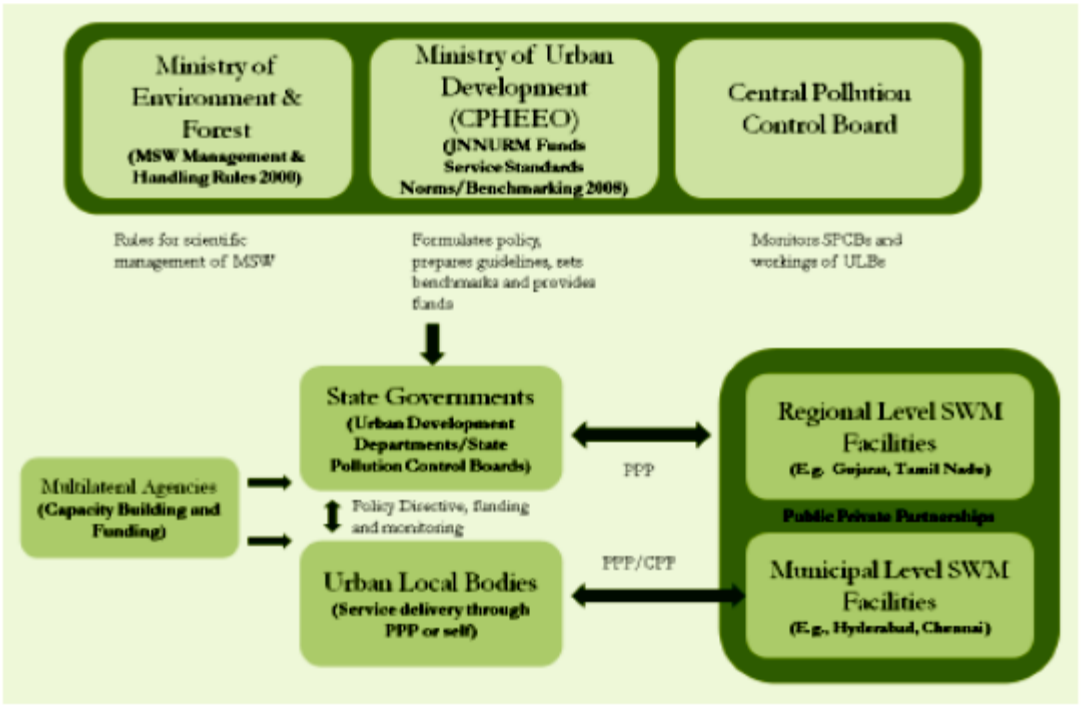
- Municipal financial means may be inadequate to maintain regular payments to the private sector.
- Municipal bureaucratic and administrative deficiencies may severely delay payments to the private sector, thus endangering cash flow and the sustainability of the service.

4) Corruption:

- Suspicion of corruption could discourage enterprises from bidding because they do not believe that the most competitive and competent bid will win the tender.
- Lower standards of operation and service would prevail if monitoring inspectors were bribed.
- Lack of transparency could result in lack of trust between the public (civil society), municipal officials, and the private sector.

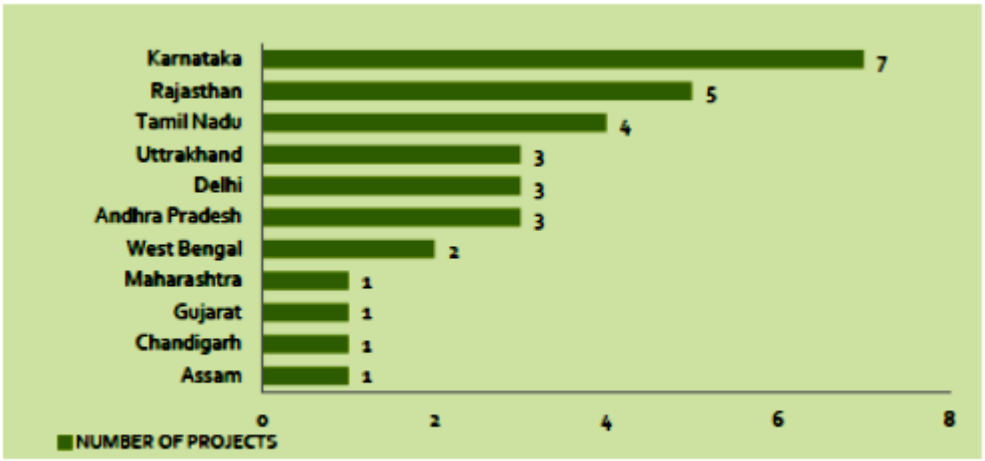
5) Unclear or unstable policy toward private sector participation:

- Fear of reversal of policy and termination of contracts with political change could discourage private sector involvement.
- Many of these risks can be avoided with improved tendering procedures and appropriate contracting and negotiations.



Source: Athena Research

Figure 12 Institutional framework for MSWM with PPP models



Source: Compiled from Status of PPP Projects in India, PPP India Database, DEA, (2011)

Figure 13 SWM Projects at State Level undertaken as Public Private Partnerships

2.1.6 International Scenario

- Japan

The scenario of waste generation in Japan is on the higher end as it is mostly surrounded by water, there is a deficiency of land in Japan due to the same. With this point in mind in 2004, Hong Kong generated about 5.7 million tonnes of waste, out of which 2.3 million tonnes (40%) were recovered and 3.4 million tonnes (60%) were disposed of at landfills. At this rate of waste generation and inadequate waste management practices the landfills in Hong Kong will be filled in six to ten years.[28]

The current MSW management practice in relies on three large landfills in remote parts of the New Territories including a network of refuse transfer stations and collection of waste provided by both private and governmental sector.
The landfills take an area of 270 ha. of land, cost $6 billion to construct, with running costs of about $432 million in 2004. The real statistics of the working of the landfills are not shared with the public. The cost of MSW disposal is paid out of the public revenue. There are no incentives for the public to recycle and reuse waste they are producing. There is no means to reduce the volume of waste generated as the people are not made to pay directly for their waste generation.

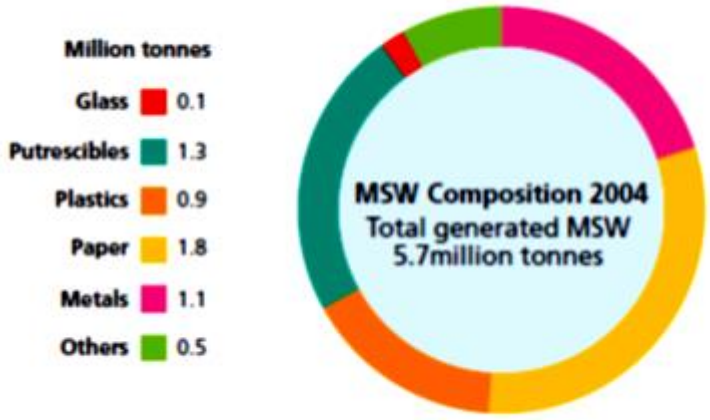


Figure 14 MSW composition of Hong Kong in 2004[29]

[28] A Policy Framework for Management of Municipal Solid Waste (2005-2014) in Japan,
[29] Policy Framework for MSWM in Japan (Ref 10)

Major initiatives to promote MSWM in Japan are:

- Introduction of producer responsibility schemes (PRSs) that hold manufacturers, importers, retailers and consumers responsible for what they produce and consume.

- Appeals, advertising campaigns and reaching out to increase awareness

- For long term role in improving laws in MSWM, its avoidance, reduction, reuse and recycling a sustained, community-wide education and partnership program is proposed.

- Participation of the business community, to demonstrate to the wider public how our policy tools can really work, and instill the concept of sustainable MSW management.

- Government partnership with various parties to expand MSWM program includes property management sector.

- Student activity and awareness is developed to complement the curriculum on MSW management. Some examples of school education activities include the School Environmental Award Scheme cum Student Environmental Protection Ambassador Scheme (SEAS cum SEPAS), is the Hong Kong Green Pre-School and Green School Award (HKGSA).

- Students are trained to be green leaders through the SEAS cum SEPAS, which help to organize green activities on campus.

- Under other scheme, the 'Waste avoidance and reduction', ambassadors from primary and secondary schools are being trained to promote waste avoidance and reduction.

- The Government conducts other education programs on waste reduction and recovery as an on-going effort, including interactive workshops and student visits to waste management facilities such as landfills.

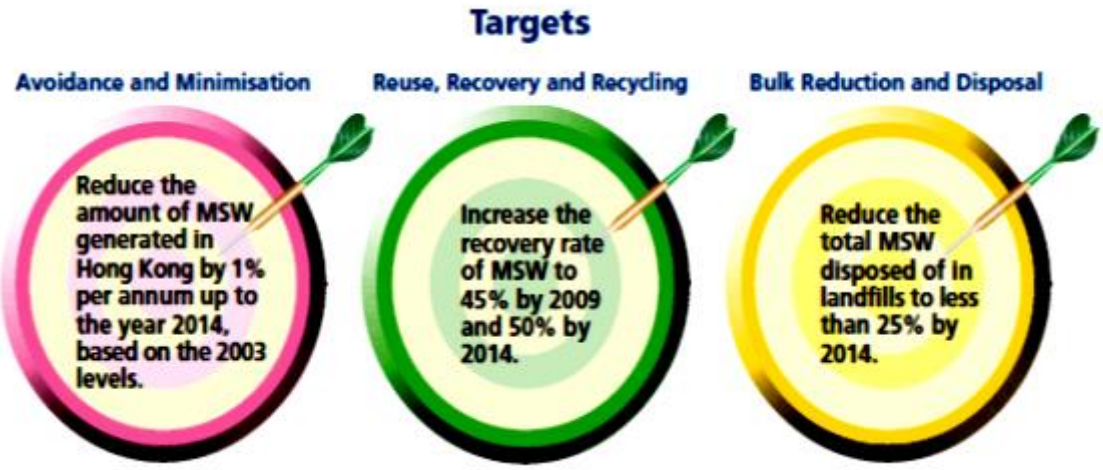


Figure 15 Targets of the Government to reduce Waste in Japan [30]

Figure 16 School awareness programs[31]

Source: Policy Framework for MSWM in Japan

[30] Policy Framework for MSWM in Japan
[31] Policy Framework for MSWM in Japan

(a) environmental education through generations, (b) recycling habits should start when young (c) collection of rechargeable batteries for recycling, and (d) old electrical equipment can be beneficially reused

Figure 17 Awareness Programs in Japan for MSW[32]

Source: Policy Framework for MSWM in Japan

- **Germany**

  The responsibility of MSWM in Germany is shared between the Government, the Federal states and local civic bodies. The National Ministry of Environment is responsible for enactment of laws, planning, information broadcast, public relation and improving waste facilities. Each state has its own waste management act and regulations for disposals. There is no national waste management planning in Germany. Instead, each Federal State develops a waste management plan for its area.[33]

[32] Policy Framework for MSWM in Japan
[33] EEA 2009

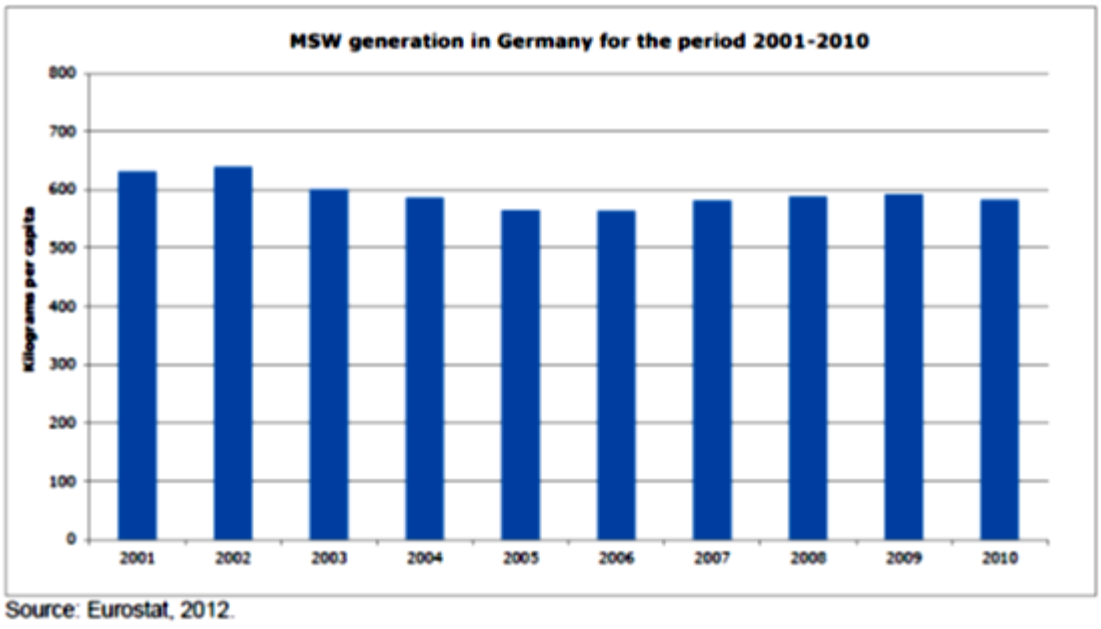


Figure 18 MSW generation per capita in Germany[34]

From the above graph, we can see that there is a decrease in solid waste generation, from 52.1 million tonnes in 2001 to 46.4 million tonnes in 2006. Although there is an increase from 2007 to 2009, the waste generation decreased to 47.7 million tonnes in 2010.

Germany is one of the first European countries to formulate policies to limit landfilling in 1990s. This included collection of packaging waste, biowaste and waste paper separately. Due to this initiative Germany recycled about 48% of municipal waste, landfilled 25% and incinerated 22%. As for 2010 the recycling increased to 62%, landfilling reduced to almost 0% and incineration increased to 37%.[35]

Initiatives:

- Developing waste strategies on the national level, developing waste management plans in the federal states and in the municipalities
- Introduction of producer responsibility for packaging waste
- Ban on landfilling un-pretreated MSW defined as maximum 5 % carbon content or maximum 18 % if the waste has been pre-treated.
- Separate collection and recycling of secondary raw materials (paper and bio-waste), pre-treatment of mixed household waste and dedicated incineration with energy recovery of mixed household waste.

[34] European Environment Agency Report, 2012
[35] European Environment Agency Report, 2012

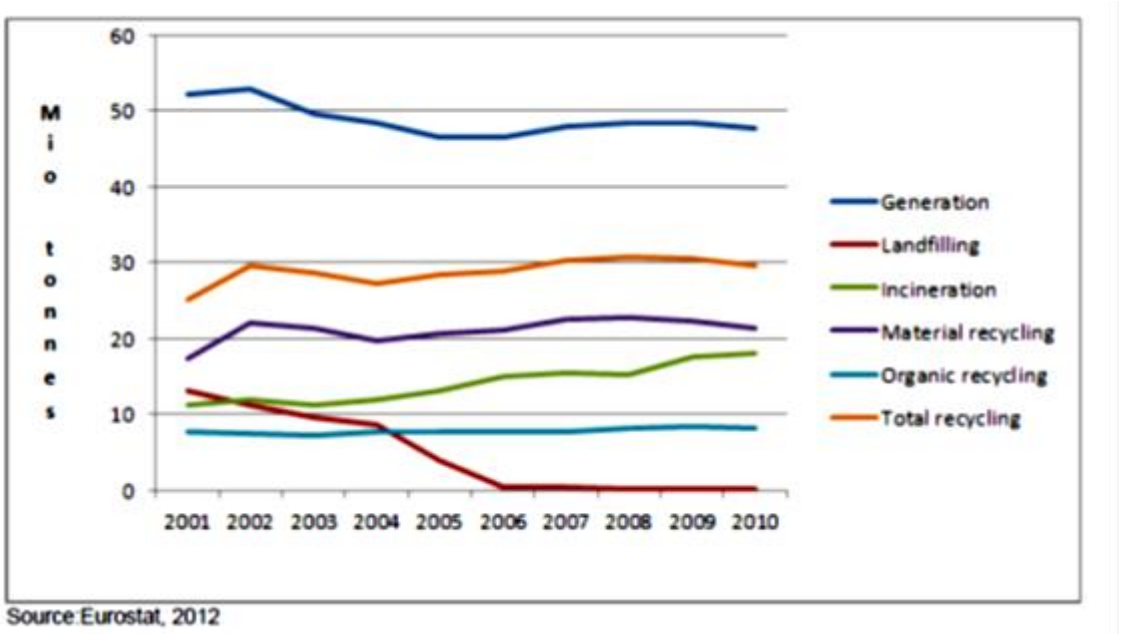


Figure 19 Development of landfilling, incineration and recycling of MSW in Germany (million tonnes).

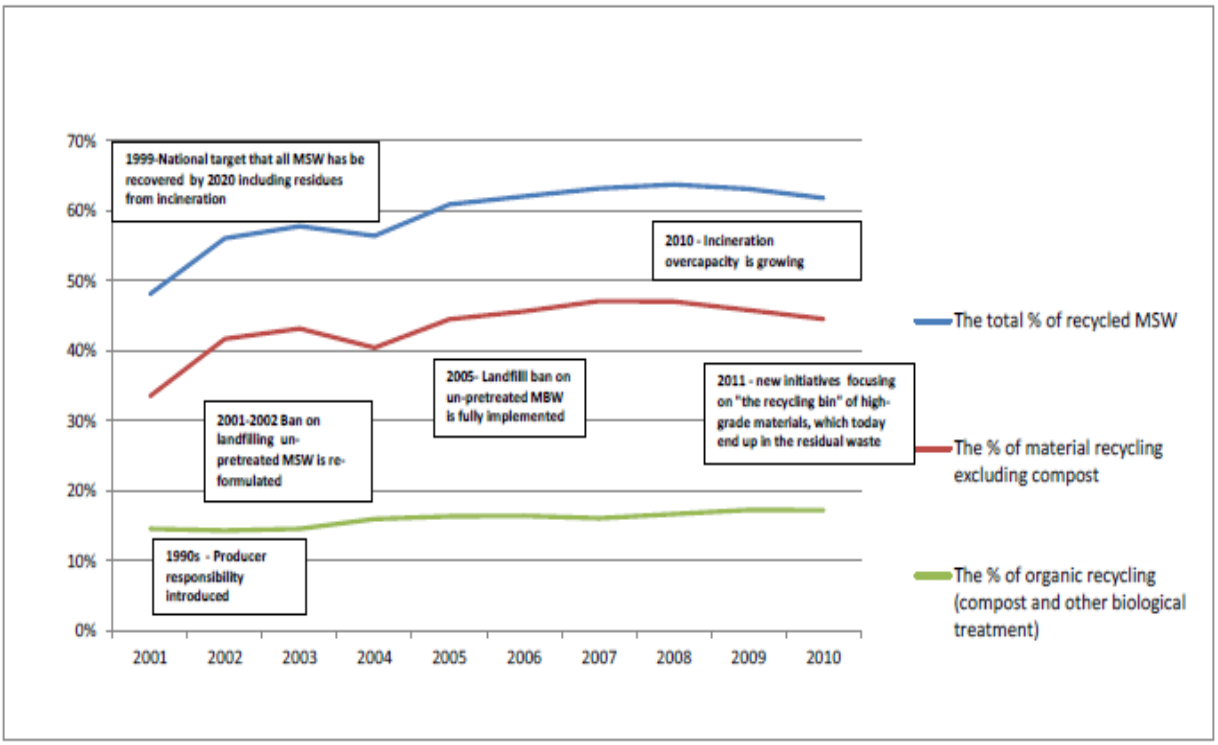


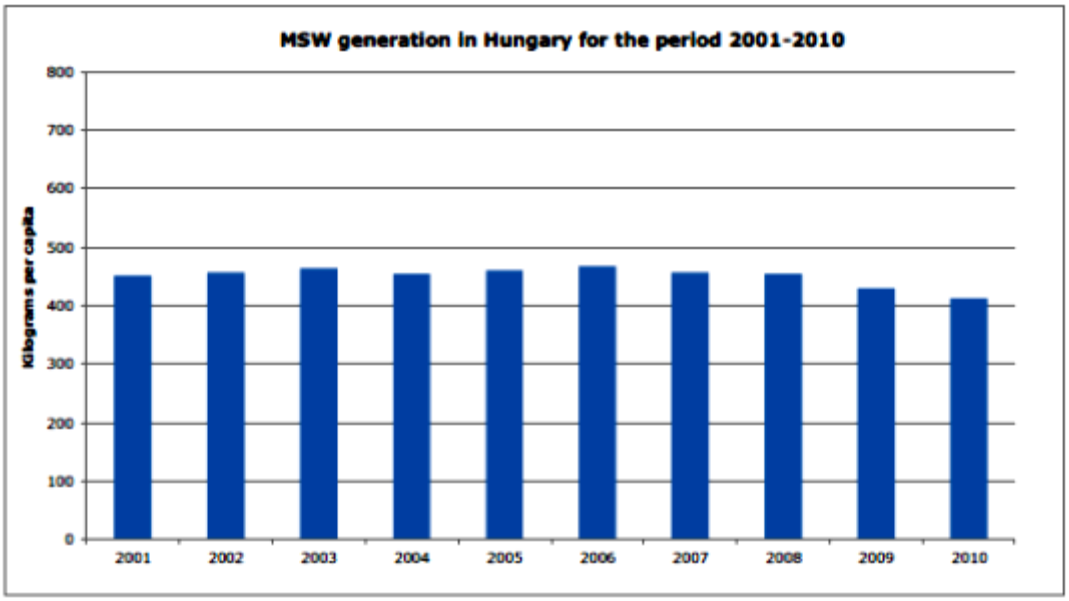
Figure 20 Recycling of MSW in Germany and important policy initiatives

Source: Eurostat, 2012

- **Hungary**

The most dominant facility in MSWM in Hungary has been landfilling. Before 1989 the regulations were focused on hazardous waste and collection of municipal waste from households.

The amount of MSW generated in Hungary has decreased by 13%, from 4.6 million tonnes in 2001 to 4.1 million tonnes in 2010.

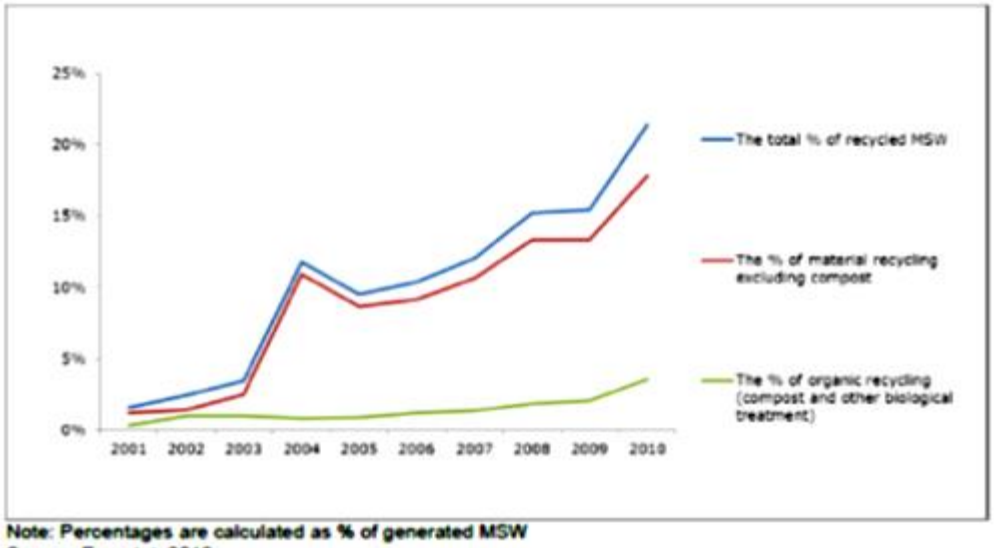


Source: Eurostat, 2012

Figure 21 MSW generations per capita in Hungary

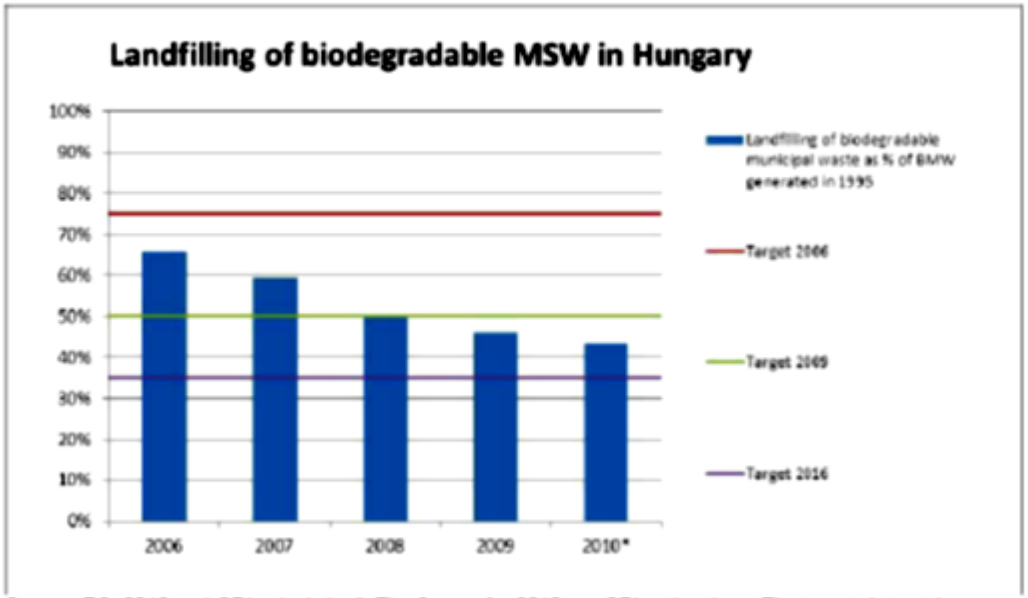
Initiatives

- National Waste Management Agency (OHÜ) established in 2012
- Focusing on building capacity and setting up schemes for separate collection, mainly for packaging waste.
- Reducing BMW going to landfill.
- The national legislation gives frame for the PAYT systems for municipal waste.
- Organization and maintenance of the public municipal waste under local authorities.
- Ban on landfilling of untreated waste.
- National Biowaste Programme (2005-2008) to promote the diversion of BMW from landfills.



Note: Percentages are calculated as % of generated MSW
Source: Eurostat, 2012

Figure 22 Recycling of MSW in Hungary



Source: EC, 2012 and CRI calculation*. The figures for 2010 are CRI estimations. The target dates take account of Hungary's 4 year derogation period.

Figure 23 Landfilling of biodegradable municipal waste in Hungary as % of BMW generated in 1995

2.2 Field Visits

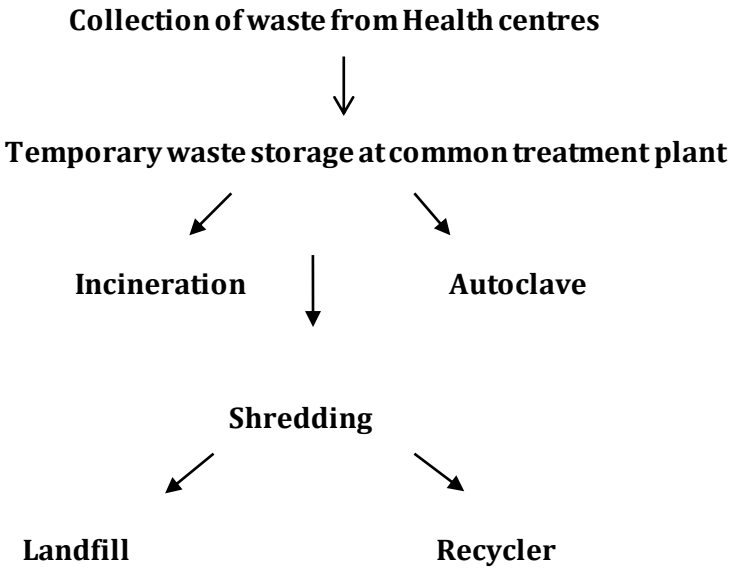
2.2.1: Visit 1

The first visit was at M/s Synergy Waste Management (P) Ltd., Near Composite Plant, Okhla Tank, New Delhi-20 on 28/5/13 around 11:15 am for 2 hours 45 minutes.

Goals of visit:

The main aim of the visit was to understand the private and governmental relations along with problems faced in the industry, to understand the technical details of the plant along with data provisions from the same and to understand the working of a waste treatment plant.

Figure 24 Overview of Waste Treatment



(For details refer Appendix A)

2.2.2 Visit 2:

The second visit was at Central Pollution Control Board, Parivesh Bhavan, East Arjun Nagar, Delhi on 5/6/13 around 11.15am for 1 hour.

The main aim of the visit was to collect data on amount of garbage in landfills in Delhi and to understand the functioning of CPCB.

- The total installed MSW treatment capacity in Delhi has estimated as 5500 MT/day whereas the actual operating capacity is 3389 MT/day (61% capacity utilization).
- CPCB is responsible for the regulation, control and maintenance of the SPCB, the PPPs under the government and other projects assigned to the CPCB.

2.2.3 Visit 3:

The third visit was at Central Pollution Control Board, Parivesh Bhavan, East Arjun Nagar, Delhi on 2/7/13 around 10.45 am for more than an hour.

The main aim of the visit was to check the feasibility of the recommendations, to get insight on the major problems in the non-compliance of the various rules and to discuss the future of MSWM.

- Reasons for Non-compliance of MSWM rules 2000:
  - Lack of awareness and will to improve the situation.
  - Lack of proper initiatives from the basic level to inculcate good MSWM practices.
  - Psychological barrier in different communities.

- Other problems: - Lack of initiatives, innovations, willingness, seriousness from the State and Municipalities. - Lack of implementation of the technical knowledge on the field. - Lack of awareness models to change and improve the psychology of the people to improve MSWM practices.

(For details refer Appendix A)

2.3 Meetings and Interviews

Table 3 Content on the institutions visited.

Date	Name	Designation	Institution	Topic of Discussion
28/5/13	Shri Tapas Saha	CEO	Synergy Waste Management	Details on the problems in Biomedical Waste Management
28/5/13	Shri Chandrajeet Raghav	Operational Manager	Synergy Waste management	The data on Synergy Waste treatment plant.
5/6/13	Dr. Sanjeev Agarwal	Scientist 'C'	CPCB	The role of CPCB in the governmental organization.
2/7/13	Dr Akolkar	Scientist 'F' and Incharge	CPCB	Feasibility of recommendations and discussions on major issues in MSWM in India.

3. Current NGO and Government Efforts

There have been various reforms in the field of waste management in India to improve the condition in the country. The details of the initiatives taken by the government in form of Acts and rules have been covered in the literature review section according to the timeline of their commencements. This section will talk about the different initiatives taken up by the different NGOs in our country at different places.

3.1 Institutional framework in India:

To give a brief recap of the governmental aids, below is a timeline of the laws initiated to help improve the MSWM condition in India

There are various steps taken by the Government to improve the Municipal Solid Waste Management in India. They are as follows-

• *National Waste Management Committee*: Set up in 1990 with the objective of identifying the contents of recyclables in solid waste picked up by rag pickers.

• *Strategy Paper*: The Ministry of Urban Development with the National Environmental Engineering Research Institute (NEERI) formulated strategy papers and was asked to prepare a manual on solid-waste management.

• *Policy Paper*: The Ministry of Urban Development in association with the Central Public Health and Environmental Engineering Institute prepared a policy for the disposal of wastewater, sanitation, solid-waste management, and drainage utilities.

• *Master Plan of Municipal Solid Waste*: The Ministry of Environment and Forest, the
Central Pollution Control Board, and municipal authorities devised a strategy and a master plan for managing solid waste including biomedical waste.

• *High Powered Committee*: A High Powered Committee was constituted in 1995 with the objective of suggesting a long-term strategy for the collection, loading, transportation, composting, treatment, and disposal of solid waste using appropriate technology. [36]

[36] Annepu et. al, 2012 (Ref 2)

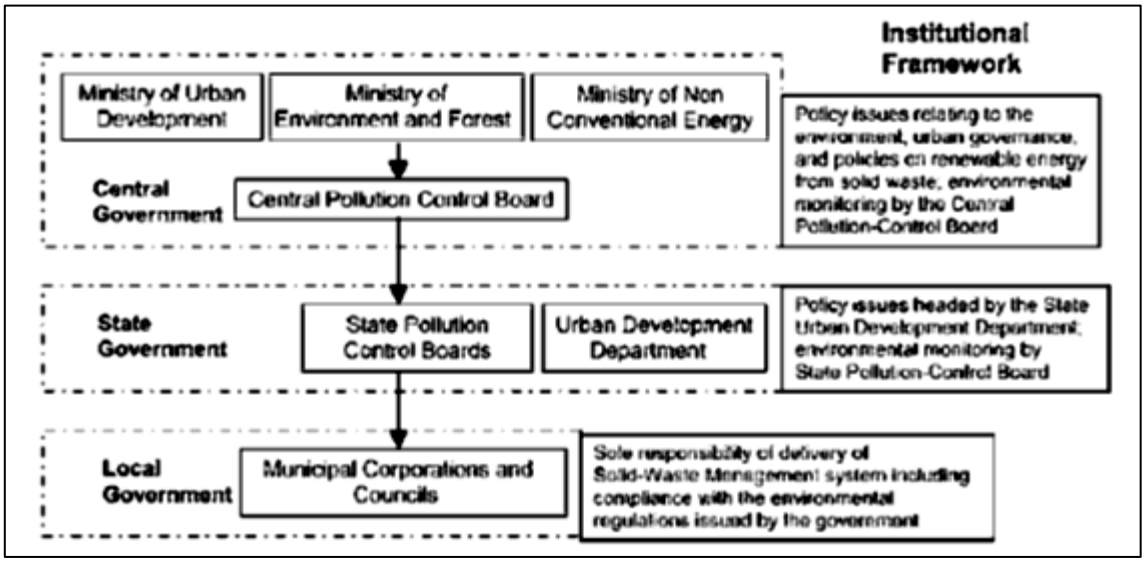


Figure 25 Institutional Framework in India[37]

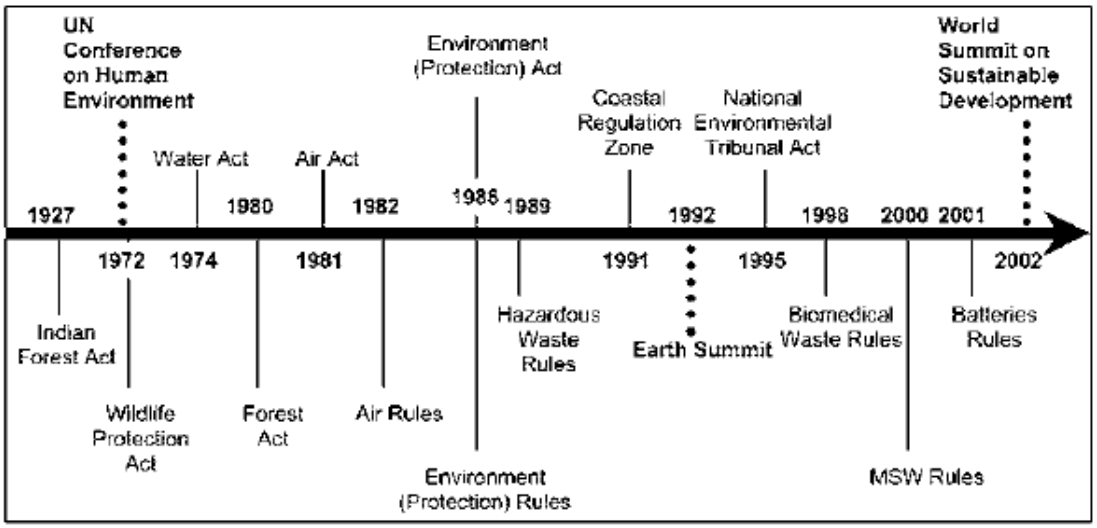


Figure 26 Timeline for laws and rules in India [38]

[37] Asian Productivity Organization Report (Ref 3)

[38] Annepu et. al, 2012 (Ref 2)

3.2 State Initiatives:

- Ahmedabad

  The MSWM in this city is the best in the country in comparison to all other cities. They follow an intensive plan for regulating their waste generation and disposal. The following steps have been taken by the Municipal Cooperation in the city-

1) Mobile Court Initiative for Littering & Nuisance
2) Project for AWARENESS
   Project for IEC (Information, Education, and Communication) Activities and Awareness:
   - To form participatory committees and conduct group meetings.
   - Publicity through Local Cable Network for the generation of awareness towards cleanliness, waste treatment & waste disposal.
3) Capping of dump site; methane gas extraction, processing and supply to nearby industries for generation of electricity.
4) Project for Recovery of Dry Recyclables
5) Decentralized Model for Biodegradable waste: Effective utilization of garden / hotel kitchen waste.
6) Preparation of Ahmedabad SWM Master Plan for 2031
   The following details shall be covered in the Master Plan:
   - Introduction to SWM Master Plan – A Country Overview
   - Profile of Ahmedabad City
   - Existing SWM System in Ahmedabad
   - Solid waste characteristics
   - Current (leading) waste management practices
   - Strategy & Options for SWM in Ahmedabad
   - Planning for 'Zero Waste' management system
   - Institutional strengthening and training
   - Capital Investment Plan
   - Monitoring & Evaluation
7) Preparation of Public Health Bylaws
8) Involving Community for Clean, Green & Beautiful City Rotary Club of Ahmedabad - Adopt a street mechanism.
9) Development of Roadmap for Zero Waste Ahmedabad

- Delhi

Bhagidari Scheme in Delhi:

- The Delhi Government instituted the Bhagidari Scheme for ensuring close cooperation of the Residents Welfare Association (RWAs), civic agencies and the government.
- A step in the right direction was taken by getting a court order for compulsory segregation of waste at the household level from January 1, 2004.
- In December 2003 (Hindustan Times 26.12.2003), the Municipal Commissioner of Delhi announced a system by which segregated garbage from homes would be transported to municipal bins through specially designed handcarts having two compartments.
- He further mentioned that the segregation system would reduce 50 per cent of the garbage going to landfills and thereby result in cost reduction.
- In the initial phase, zones were selected in colonies like Hauz Khas, Gulmohar Park, Vasant Vihar, Green Park, Safdarjung Enclave and Sewa Nagar.
- Due to various reasons, the scheme has not really taken off. Only in some colonies, where RWAs decided to tackle the problem themselves, the scheme is working.

- Maharashtra

Maharashtra Non-Biodegradable Garbage (Control) Act 2006:

- According to this Act, it shall be the duty of the local authority to place or provide a proper & convenient place to public receptacles, depots for temporary deposit or collection of non-biodegradable garbage.

- Providing separate dustbins for temporary deposit non-biodegradable garbage other than those kept & maintained for biodegradable garbage is also a part of the duty.

- System for removal of contents of receptacles, depots shall be established. Arrangement for recycling of the collected non-biodegradable garbage shall be made.

- It shall be the duty of owners and occupiers of every land and building to collect the non-biodegradable garbage & deposit in garbage receptacle,

depots or provide place for temporary deposits or collection of non-biodegradable garbage from their respective land.

3.3 The NGO initiatives:

1) The Municipal Cooperation of Bhopal works for the upliftment of the rag pickers in the city. They arrange for a special program where the rag pickers are involved in collecting waste from door to door and each house pays them a sum of 30 rupees per head per month. They also hold workshops on Integrated Waste Management with local waste collection bodies and private companies. (Bhopal Municipal Information portal)

2) 'No Waste': Waste management initiative started by a responsible citizen Mr Sumit Gupta, a software professional at Bangalore works for awareness and promotion of the adoption of solid waste management at houses and apartments in the city. He is working with two NGOs - Solid Waste Management Round Table Bangalore (SWMRT) and ITC group for the cause. Their main objective is to implement dry waste segregation, collection and recycling in apartments.[39]

3) Janwani a NGO based in Pune jointly with the municipal cooperation, Swach and other organization is creating a model of Zero Garbage Ward and provides solution for solid waste management. It is the first NGO in the country to carry out ISO for waste management with other project partners and pioneers. [40]

4) Waste to Wealth Programs from Exnora a Chennai based environmental NGO focuses on turning the waste generated into wealth options. . The NGO works to promote sustainable human settlements, through the promotion of waste management as an income generating opportunity. [41]

5) PepsiCo Solid Waste Management Program: PepsiCo in collaboration with Exnor works in the field of SWM. It works for the generation of employment opportunities, educating the children, recycling the garbage and arranging door to door awareness campaigns along with street plays.
   They also have various awards in the field of innovation like Golden Peacock Award for Innovation in 2006. [42]

[39] http://www.sumit4all.com/society/no-waste-call-for-action
[40] http://janwani.org/initiatives.php
[41] http://exnora.in/
[42] http://pepsicoindia.co.in/purpose/environmental-sustainability/waste-to-wealth.html

6) International development Initiative has various fellowship programs to invite innovations in the field of waste management, gaining value from waste, including both systems and technologies for improvements and the wellbeing of the waste pickers and their livelihood. [43]

7) Clean Ahmedabad Abhiyan Committee: This organization was formed by concerned citizens, volunteer organization and municipal cooperation of Ahmedabad to find solutions to the health hazards and sanitary problems caused by decomposition of garbage on urban roads. [44]

8) Kagad kach patra kashtakri panchayat: This is a Pune based NGO that works for the upliftment of the rag pickers and sweepers of the city. It was started in 1993, and works for the wellbeing of the rag pickers in the city. It has two initiatives; one is peaceful non-violent protest and resistance and second is development of alternatives, to solve the key issues faced by waste-pickers. They are involved in many other programs like educating the children of waste pickers, employing the women in different self-help groups, setting up cooperatives and aiding loans. [45]

[43] http://web.mit.edu/idi/get_involved.htm
[44] http://www.un.org/esa/earthsummit/abhiyan.htm
[45] http://www.wastepickerscollective.org/

4. Results and Discussions

4.1 Findings from the literature

The literature search was a major tool in performing the major tasks provided in order to understand the project and perform the primary research. Details on the major process, constitutional amendments, statistics on the waste generation was collected through the literature search and has been included in the Literature Search section.

The major findings include the analysis of various laws, their implementation problems and reasons for the poor condition of waste management.

Findings:

Problems with the Environment Protection Act, 1986:

- The deadline for implementing Schedule I of the 2000 rules was in 2005, which has already passed, and compliance is yet not effective.
- There are cities and towns where implementation has not stared.
- Enforcement and sanctioning mechanisms remain weak.
- Some cities and towns have moved somewhat forward, implementing and abiding by the rules, like Kerala and Gujarat, due to the force of their state government, Supreme Court or SPCB.
- There is no comprehensive short and long term plan with municipal authorities to handle MSW in accordance with the MSW Rules, 2000.

Other major problems:

1) There is no compilation of the data related to amount of waste generated in different areas, its collection and amount of waste being recycled.
2) We have a problem of rag pickers and middle men working with them.
3) There is no law abiding the citizens to separate Recyclable, Reusable, Organic, Sharp, and Metals at the primary source generation level.
4) The Municipal solid waste rules under the Environment Protection Act 1986 are not being followed in the cities. Kerala is the only state with reasonably good SWM.
5) Waste management is being looked either for making wealth or generate revenue; or otherwise is allowed to putrefy in cities/towns.

6) Cities and towns, in future, will not get wastelands for further dumping of wastes. In fact, there will be a need to go for 'total' recycling and re-use of waste and aim for negligible or 'Zero Waste' for landfilling.
7) The involvement of local NGOs, small companies and other local bodies in not very sufficient.
8) There is no fee for littering on streets and public places.
9) The public participation and awareness is low.

Figure 27 A public place scene in Bangalore

Source: Google Images

Apart from these there are a number of problems relating to dumping of waste, open drains, inadequate labour, and street cleanliness.
The above mentioned points cover the major drawbacks faced in our system of waste management with a few others that are in consideration for the future studies.

Coming to a world scenario below is a representation of the waste generation in the world on the economic basis. India comes under the Lower Middle Income countries according to the World Bank report, 2010.

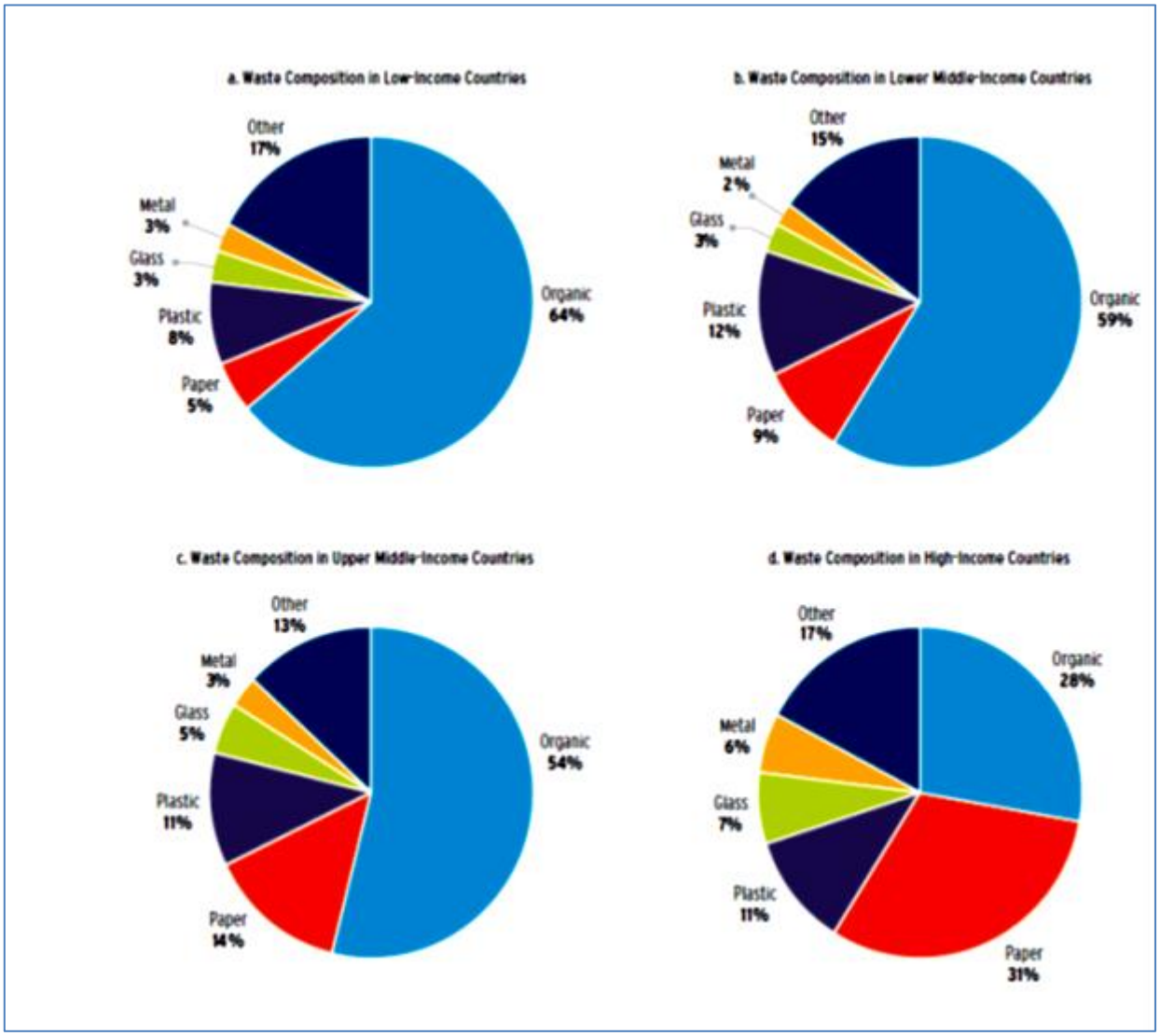


Figure 28 Waste composition of the World[46]

Source: What a Waste

[46] What a Waste (Ref 9)

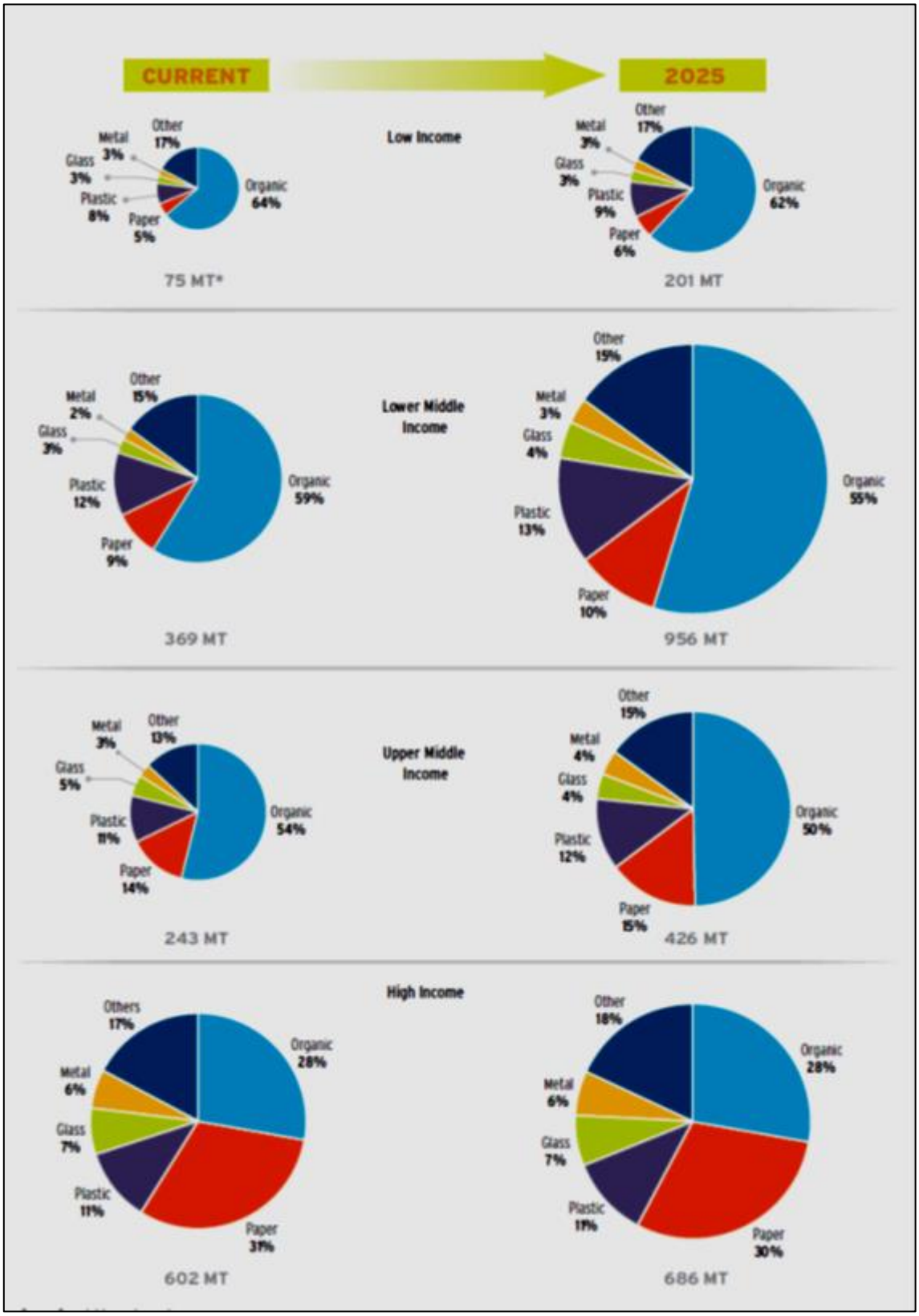


Figure 29 Solid waste composition by Income and Year[47]

[47] What a Waste (Ref 9)

From the above graphs, we can conclude that low income countries have high levels of organic waste being produced. This kind of waste is the most problematic kinds. The treatment of such waste varies from place to place depending on the moisture content, carbon content, biodegradable nature etc. India has a high moisture content waste whereas Europe has dry waste. This waste when landfilled takes up a lot of volume, even though this should not be included in the landfill waste, it is being dumped there in almost all developing countries. This kind of waste is mostly under composting for degradation and biogas production. Composting requires technical expertise to increase efficiency, innovation of new methods for methane production and better models for waste treatment.

4.2 Finding from the fields and impact on the theoretical focus of the project

There have been three field trips in the time span of two month to gain insights on the problem. The field trip form a major part of the problem as they gave a better understanding of the on field crisis and the present conditions that actually exists outside the domains of what reports we read.
The first field visit was performed to understand the basic layout of a waste management plant, the problem they face, the techniques they use and the role of such plants in the hierarchy of the MSWM system.

The impact this visit had on the project was that it gave a better outlook towards the direction to look forward to, for information and gain the right contacts for the right work. It gave the project a pictorial representation to understand what exactly happens on field instead of reading the process on paper. After the visit to Synergy Biomedical Waste treatment plant the understanding of the importance of segregating waste at the source, transport of garbage in accordance to the rules and need to use energy efficient methods in treating waste was established.

The second field visit was performed at the Central Pollution Control Board to understand the role and functioning of the body. As CPCB is the main body regulating and monitoring the implementation of rules and laws under the Ministry of Forest and Environment it was an important point to understand how it works.

The impact of this visit on the project was that I got a better understanding on the different levels of governmental organizations, the role of MoEF, role of CPCB and the functioning of the same. They also provided the data on the different landfills in Delhi which was a major part of the visit. This visit gave me a way into the ways of working of municipal organization and expanded my horizons on the scope of the project.

The third visit was again paid to CPCB to meet a senior scientist in the field of MSWM of India to discuss the reason behind all the problems and issues we face in our country and to check the feasibility of the recommendations.

The impact of this visit was very profound. The project got strong grounds by the approval on feasibility of the recommendation and the charged discussion what we lack in our system. The main point highlighted in this meet was the need to make Municipal Waste Management a topic of national concern. Where the developed and high income countries like Germany are reaching 0% landfilling rate we are still way behind the targeted rates proposed in the MSWM Rules, 2005.

There is no support in the field to come up to a higher level due to negligence in the political agenda of the current government. As the general public lacks the will and awareness to improve the present condition the political parties are blind to the same. Even after all the draw backs, CPCB is trying to put forward the present situation in front of the Supreme Court. They are trying to force the central and state regulatory bodies to work for the improvement of MSWM in lure of funds and perks to the municipalities.

So, all these visits framed a model of problems, lacunas, ground realities and possible solutions for the same. Along with the literature search, data collection and field trips the work with this large information was an important part too. To sum it up the mentor guidance helped through the process of new findings and gave a thrust to shape the project and select a specific target for the project, which is finding solutions to the existing problems in all the sections of waste management.

4.3 Gap analysis

The gaps existing in the project, Municipal Solid Waste Management is due to the ineffectiveness of the governmental bodies and the lack of awareness and will of the people in order to improve the current practices.
The government of India took the first step in the improvement of the MSWM back in 1986 when the Environment Protection Act was notified under the Ministry of Environment and Forest. After that there have been various updates in the act in form of rules and laws to improve the present condition, but all these initiatives are at the level of Central government and MoEF. Even after setting up of institutions like Central Pollution Control Board to regulate the implementation of these laws the State Pollution Control Board are inadequate.

Combination of these gaps leads to the poor waste management practices in our country.

Table 4 Gap analysis

Governmental Gaps	Community Gaps
• Lack of implementation of laws, rules and acts at the state level.	• Lack of primary storage practices at the site of generation as in houses, hospitals, hotels etc. leading to littering and dumping on the roadsides.
• Lack of proper organization in the regulation of the state bodies.	• No segregation of waste leading to inadequate collection methods.
• Lack of surprise visits and checks in the state bodies and private plants.	• Poor condition of the waste bins, dhallos for secondary storage.
• Lack of proper secondary storage, disposal and treatment of waste.	• Lack of awareness in people on the subject of waste management.
• Lack of political pressure.	• Lack of willingness to keep the country clean and hygienic.

Justifications:

- **Governmental Gaps**:

  These gaps are a result of the continuous neglect in the field of MSWM since the beginning. The implementation of MSWM acts were for improving the condition with time and as India develops but the scenario is pretty much the same. The country has developed in terms of GDP, educational quality, foreign relations, and at various other platforms but the development on this platform is negligible. There are submissions of various projects at the central level but their completions and implementation is not being monitored.

  Below are a few tables from the CPCB on the compliance with various rules and the status of implementation of different projects in the country.

Table 5 Status of Authorizations by SPCB

S. No	States/UTs	No. of local bodies	Authorisations granted during 2006-07		Cumulative valid authorization
			No. of applications	Nos Granted	
1	Andaman Nicobar	01	Nil	Nil	01
2	Andhra Pradesh	124	56	27	93 (66+27)
3	Arunachal Pradesh	INR	INR	INR	INR
4	Assam	85	2	1	23
5	Bihar	122	42	Nil	Nil
6	Chandigarh	1	2	2	2
7	Chhatisgarh	110	Nil	01	58
8	Daman Diu	03	Nil	Nil	Nil
9	Delhi	03	03	03	03
10	Goa	13	13	13	13
11	Gujarat	174	6	1	142
12	Haryana	68	Nil	Nil	Nil
13	Himachal Pradesh	56	56 (18+38)	28(11+17)	41
14	Jammu & Kashmir	INR	INR	INR	INR
15	Jharkhand	INR	INR	INR	INR
16	Karnataka	226	226	226	226
17	Kerala	58	09	03	08
18	Lakshadweep	1	Nil	Nil	Nil
19	Madhya Pradesh	339	46	29	85
20	Maharashtra	252	93	79	246
21	Manipur	09	Nil	Nil	Nil
22	Meghalaya	07	Nil	Nil	2
23	Mizoram	01	Nil	Nil	01
24	Nagaland	06	01	01	01
25	Orissa	103	05	Nil	11
26	Puducherry	15	Nil	Nil	3
27	Punjab	103	27	27	27
28	Rajasthan	183	22	06	15
29	Sikkim	01	Nil	Nil	Nil
30	Tamil Nadu	719	17	17	62
31	Tripura	13	13	13	13
32	Uttar Pradesh	INR	INR	INR	INR
33	Uttarakhand	68	35	1	1
34	West Bengal	126	104	49	49

Table 6 Implementation Status of Schedule V

S.No	States	Compost Plants		Vermi compost	
		Commissioned	Planned/ proposed/ UC	Commissi-oned	Planned
1	Andaman Nicobar	Nil	Nil	Nil	Nil
2	Andhra Pradesh	Vijaywada,Suryapet,Kadapa,Mandepet,Ramgun-dam,Adilabad			
3	Arunachal Pradesh	INR	INR	INR	INR
4	Assam	Kamroop	Guwhati, Dibrugarh Silchar Sibsagar	Nil	Nil
5	Bihar	Nil	Nil	Nil	Nil
6	Chandigarh	Nil	Nil	Nil	Nil
7	Chhatisgarh	12	12		
8	Daman Diu	Nil	Nil	Nil	Nil
9	Delhi	Delhi (2)	Nil		
10	Goa	In Vasco, 70 de-centrlaised com-posting plants in Panjim	15 in Panda	Nil	Nil
11	Gujarat	Ahemdabad, Rajkot, Valsod Vadodara	96ULBs+31 New ULBs identified for vermicompost and 34 ULBs for composting	Nil	Nil
12	Haryana	Nil	Nil	Nil	Nil
13	Himachal Pradesh	Shimla, Kullu/ Bunter,Manali, Solan,Kangra/	Dharamsala, Poonta, Palampur		

INR- Information not recieved

		Nagrota, Nahan, Una and Himirpur	Nalagarh Mandi		
14	J & K	INR	INR	INR	INR
15	Jharkhand	INR	INR	INR	INR
16	Karnataka	Mangalore, Bangalore	Nirmal Nagar (8 ULBs)	Nil	Nil
17	Kerala	16	12	7	1
18	Lakshadweep	25 units	Nil	(25 units)	Nil
19	Madhya Pradesh	4	67	8	36
		Commissioned	Planned/ proposed/ UC	Commissi-oned	Planned
20	Maharashtra	12 Akola,Pune, Pimpri-Chincha-wad, Kolhapur, Ambad,Nagpur, Sonpath, Murad-Navapur,Janjira, Mira-Bhayander, Nashik, Ahemdnagar	Baramati Jalana	Ambernath	Shegaon, Pondharpur Bhandara Dahanu Panvel
21	Manipur	Nil	Imphal	Nil	Bishnupur Thousbal, Morch Jin Kakching
22	Meghalaya	Shillong	Tura	Nil	Tura
23	Mizoram	Nil	Nil	Nil	Nil
24	Nagaland	Nil	Kohima	Nil	Nil
25	Orissa	(2) Puri Paradeep	14	Nil	1
26	Puducherry	Puducherry, Outgaret, Karaikal, Nedungadu	1+	1+	Nil
27	Punjab	Nil	5	Nil	Nil
28	Rajasthan	Vijaywada Suryapet Kadapa Mandapet Ramgundram Adilabed	All proposed under 12th FC	Nil	Nil
29	Sikkim				
30	Tamil Nadu	Tiruppur, Namakkal	Udumalpet	Nil	Nil
31	Tirpura	Nil	Agartala	Beleniga Kumarghat	Amapur,Kh owai, Dharmanag ar,Kanalpur Ranibazar Udaipur
32	Uttrakhand	Nil	Pithoragarh, Uttarkashi Nainital	Nil	Nil
33	Uttar Pradesh				
34	West Bengal	Kolkata + 7 ULBs	28	05	Nil

Table 7 Setting up of waste to energy projects

S.No	States/UTs	Waste to Energy Projects	
		Commissioned	Planned
1	Andaman Nicobar	Nil	Nil
2	Andhra Pradesh	Hyderabad(RDF),Vijaywada (RDF), Guntur (RDF), Vijaywada (Bio-methanisation)	45 (7 WTE for 3.9 ULBS)
3	Arunachal Pradesh	INR *	INR
4	Assam	Nil	Nil
5	Bihar	Nil	Nil
6	Chandigarh		One-under construction
7	Chattishgarh	Nil	Nil
8	Daman Diu		
9	Delhi	Nil	Nil
10	Goa	Nil	One planned for Panjim
11	Gujarat		
12	Haryana	Nil	Nil
13	Himachal Pradesh		
14	Jharkhand	INR	INR
15	Jammu & Kashmir	INR	INR
16	Karnataka	Nil	Bangalore
17	Kerala	15 **	3 **
18	Kohima	Nil	Nil
19	Lakshadweep	Nil	Nil
20	Madhya Pradesh	Nil	Nil
21	Maharashtra	Nil	Nil
22	Manipur	Nil	Nil
23	Mizoram	Nil	Nil
24	Meghalaya	Nil	Nil
25	Orissa	Nil	1 (Cuttak + Bhubanesar)
26	Punjab	Nil	Nil
27	Puducherry	Nil	Nil
28	Rajasthan	2	2
29	Sikkim	Nil	Nil
30	Tamil Nadu	Nil	Nil
31	Tripura	Nil	Nil
32	Uttarakhand	Nil	Nil
33	Uttar Pradesh	INR	INR
34	West Bengal	Nil	Nil

Table 8 Setting up of landfill facilities for waste disposal

S. No.	States/UTs	Landfill constructed	Initiatives taken	No. of sites identified
1	Andaman Nicobar	Nil	Port Blair	1
2	Andhra Pradesh	Vizianagaram	Suryapet,Hyderabad, Vijaywada,Vizanagaram	61 (ULBs)
3	Arunachal	INR	INR	INR
	Pradesh			
4	Bihar	Nil	Nil	Nil
5	Chandigarh	Site under construction	-	-
6	Chhatisgarh	Nil	Nil	66
7	Daman Diu	Nil	Daman & DNH	01 (Dadra)
8	Delhi	Nil	Nil	Nil
9	Goa	Nil	Nil	13
10	Gujarat	Surat, Alang	Common site for 12 ULBs of AUDA	142
11	Guwahati	Nil	Nil	1
12	Haryana	Sirsa	Faridabad,Hissar, Ambala, Gurgaon	35
13	Himachal Pradesh	None	Shimla,Chowari, Chamba,Nalagarh, Palampur	52
14	Jharkhand	INR	INR	INR
15	J & K	INR	INR	INR
16	Kerala	Nil	Kozhikode	53
17	Karnataka	Bangalore, Mangalore Karwar,Puttur, Ankola	Sirsi,Dandeli,Bhatkal,Kundapur,Udupi and Chickmngalore	Remaining 213 local bodies have identified the sites.
18	Lakshadweep	Nil	Nil	Nil
19	Madhya Pradesh	22	130	305
20	Maharashtra	Nasik,Sonpeth Ambad	Jalna,Navapur,Pune,Meurd-Janjira, Pimpri Chinchawad	241
21	Manipur	Nil	Imphal,Bishuper,Jin, Thoubal,Kakching, March	One each(6)
22	Mizoram	Nil	Nil	Nil
23	Meghalaya	Nil	Shillong	04
24	Nagaland	Nil	Kohima	01
25	Orissa	Nil	03	51
26	Punjab	Nil	Nil	Nil
27	Puducherry	Nil	Puducherry	1
28	Rajasthan	Jodhpur	Proposed in 14 towns	152
29	Sikkim	Nil	South-West District of Sikkim	1
30	Tamil Nadu	Nil	Namakkal,Tiruppur, Udumalpet	104
31	Tripura	Nil	Agartala	8
32	Uttar Pradesh	INR	INR	INR
33	Uttarakhand	Nil	Nil	Nil
34	West Bengal	Under construction at ND&NB	30	30

Table 9 Summary of Demo projects on implementation of MSWM Rules

S. No	City/Town	Area of City/ Town (sq. km)	Population	Quantity of waste generation (MT/day)	No. of Wards	Project components for Demo-Project	Date of start & Duration	Remarks
1	North Dum Dum & Barrackpore (West Bengal)	26.45 16.89	220000 83000	70 25	30 19	▪ Phase-I: Waste Collection, Segregation, Storage and transportation (Schedule-II) ▪ Phase-II: Waste Processing and Disposal	22.4.03 18 mths --	Completed Phase-II under implementation
2	Chandigarh (UT)	114	9,00,000	300	20 (61 sectors)	▪ Phase-I: Waste collection, segregation, storage and Transportation (Schedule-II) ▪ Phase-II	16.04.03 18 mths --	Under implementation. 70% completed under Phase-I. Phase-II under construction
3	Udumalpet (Tamil Nadu)	7.41	58,893	30	33	Total Project : Waste collection, segregation, storage, transportation, Processing and disposal	10.10.04 24 mths	Waste collection and transportation covered for 80% town. Work relating to Processing and Disposal is in progress
4	Kohima (Nagaland)	30	78,584	35	19	▪ Phase-I : Waste collection, segregation and transportation ▪ Phase-II : DPR to be received on disposal	12.09.05 36 mths	After procurement of tools/equipment, waste collection is spread over the town. Site for landfilling and process-ing is identified.

So, from the above tables it is clear that whatever may be the case, either implementation of the Scheduled laws under the MSWM Rules, 2000 or setting up of new projects for landfills or vermicompost, the government is very negligent towards the situation.

- **Community Gaps:**

  This part of the analysis is greatly dependent on the governmental issues seen above. The way the citizens act is a reflection of the facilities and awareness in them. The community plays a very important role in the whole management system and the working of its structure depends on them to a large extent. The gaps that have been enlisted above are a sheer reflection of the lack of awareness programs and initiatives by the government. It is of course the responsibilities of the community to working accordance with the rule, but if there is no guidance on how to work for it, all the written rules are of no use.

  The main drawback in our system is the lack of incorporation of quality values at the beginning of the moulding the future citizens of the country. We need to teach them the real reasons and positive effects of a good hygienic living. All the gaps can be mended if the community and government work together for building a better management system.

5. Recommendations, Scope and Strategy for Implementation

5.1 Recommendation

Figure 30 General Recommendation Flow chart

1) At the generation level:

i) To formulate a sequenced mechanism to separate, segregate and collect waste on the basis of biodegradable, non-biodegradable, recyclable, reusable and organic compost based waste.

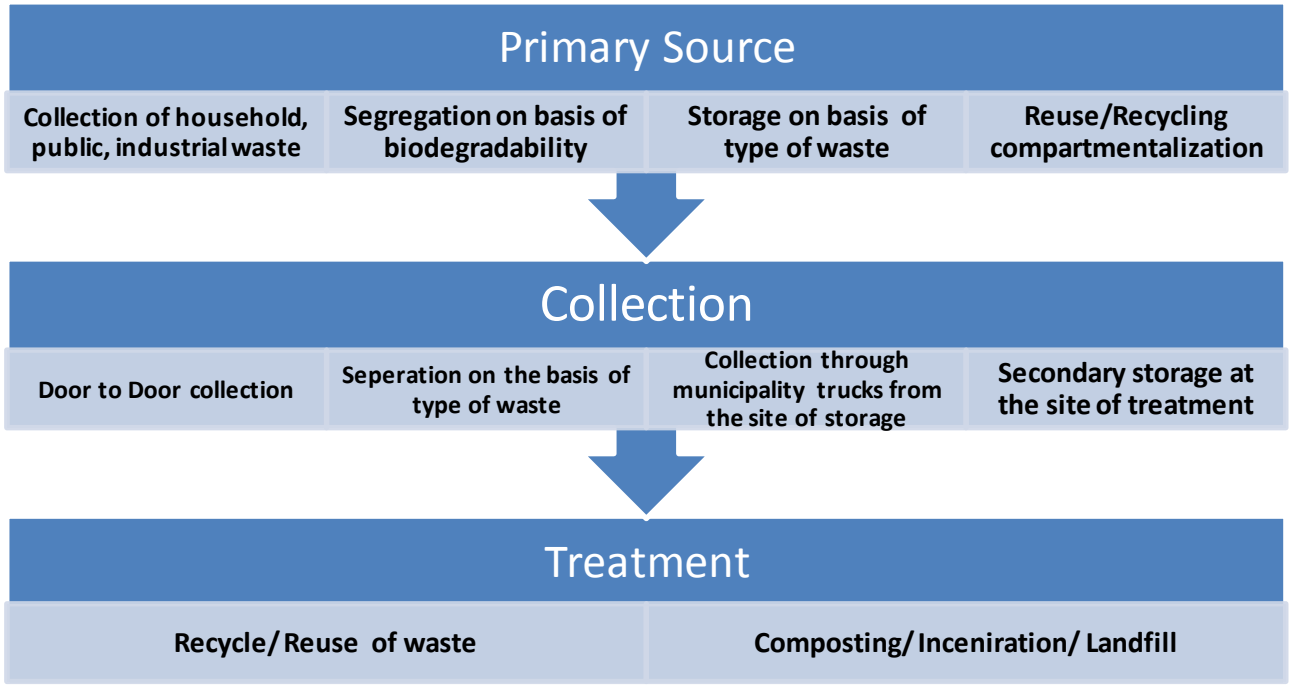


Figure 31 Flow Chart for Collection

This will lead to better treatment of waste, waste reduction and free production of biogas from the waste.

2) At collection and transport level:

i) To involve local NGOs, cooperatives and small private waste management companies to collect waste from the source, transport it to the sorting/treatment facility. This step would lead to employment of rag pickers, sweepers and other personals working in the industry at low or no wages.

ii) Employ trained professionals to maintain a log of the number of organizations working, number of workers employed, amount of waste being transported, compliance with the rules and initiation of new methods for improvement of the present system.

iii) To innovate new ideas to increase the production of useful by product to earn income from these sub-materials.

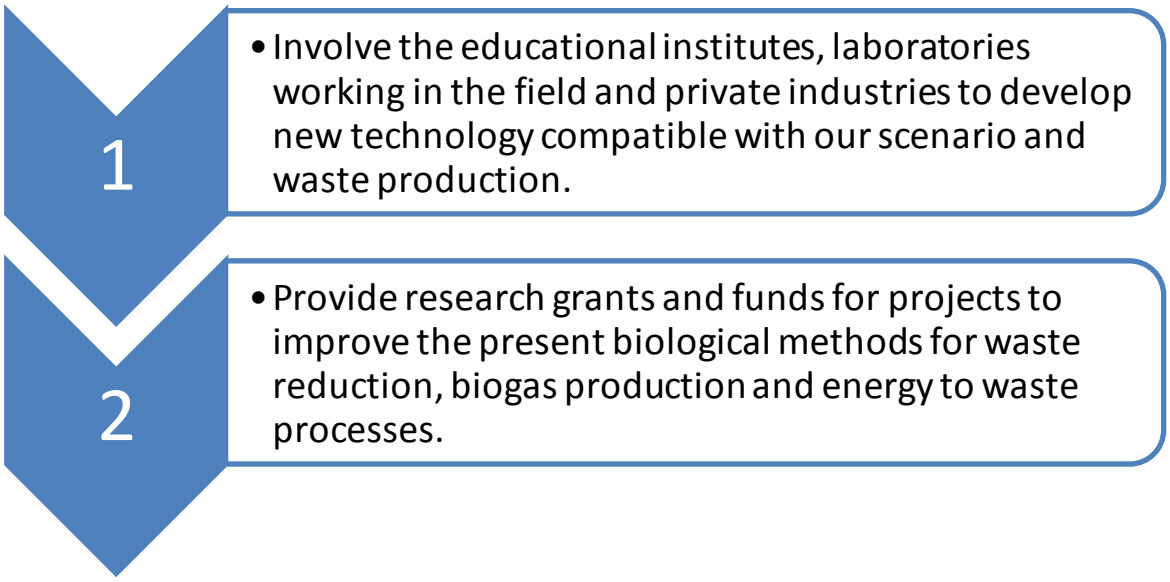


Figure 32 Layout for Initiatives in Waste to Energy field

This would lead to compensation of the transport cost of the waste to treatment site.

3) At a pan City/ State / National level:

i) Initiation of PPPs at the city level to divide the work between the governmental bodies, NGOs and local communities. To work together for the improvement of the local waste management practices.
Requirements for establishing PPPs in MSWM:

- Assessment of the need.
- Evaluation of its feasibility.
- Structure of the model.
- Procurement of resources.

➢ Assessment of the need:

Figure 33 Flow Chart of assessment of need

Explanation:

- The most important point in assessment of the need is to conduct a situational analysis of MSW generated and its quality, followed by assessing the existing municipal solid waste management system (collection, transportation, sweeping, segregation, processing, and disposal) in the cities.
- The assessment also includes nontechnical matters like ICE (information, communication, education), creation of public awareness, manpower and transition arrangements, aesthetic and environmental aspects and compliance with rules & regulations including MSW Rules, and environmental laws.

- Evaluation of its Feasibility

Figure 34 Flow chart of PPP feasibility

Explanation:

- After the initial assessment and need analysis we need to look at the financial viability for the project, which is if the project offers reasonable returns on the investment.
- This will help us in determining, if we need viability gap funding (VGF) (grants/subsidy and/or additional revenue grant/subsidy) or the project is viable of its own to make a good private sector participation.

- Structure of the model

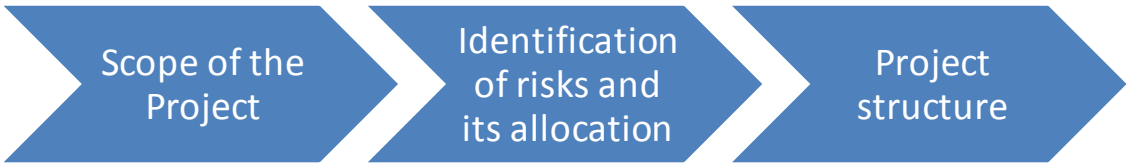


Figure 35 Flowchart of the Model

Explanation:

- The next step is to determine a structure for implementation and monitoring of the project. It involves identification and allocation of key obligations and risks (design/construction risk, operation risk, revenue/demand risk, environmental/regulatory risk)
- Project structure will also look at the service obligations and output requirements along with dealing with non-compliance or default adhering to these obligations.

- Procurement of the resources

Figure 36 Flow Chart for Resource Procurement

Explanation:

- The procurement process being efficient, transparent leads to selection of capable and competitive operator to ensure efficient working and implementation of the project.
- The process includes shortlisting of capable private operators through a combination of technical and financial criteria and conducting a bid.

Below is a flowchart that summarises the ethics we need in the establishment of the PPP project.

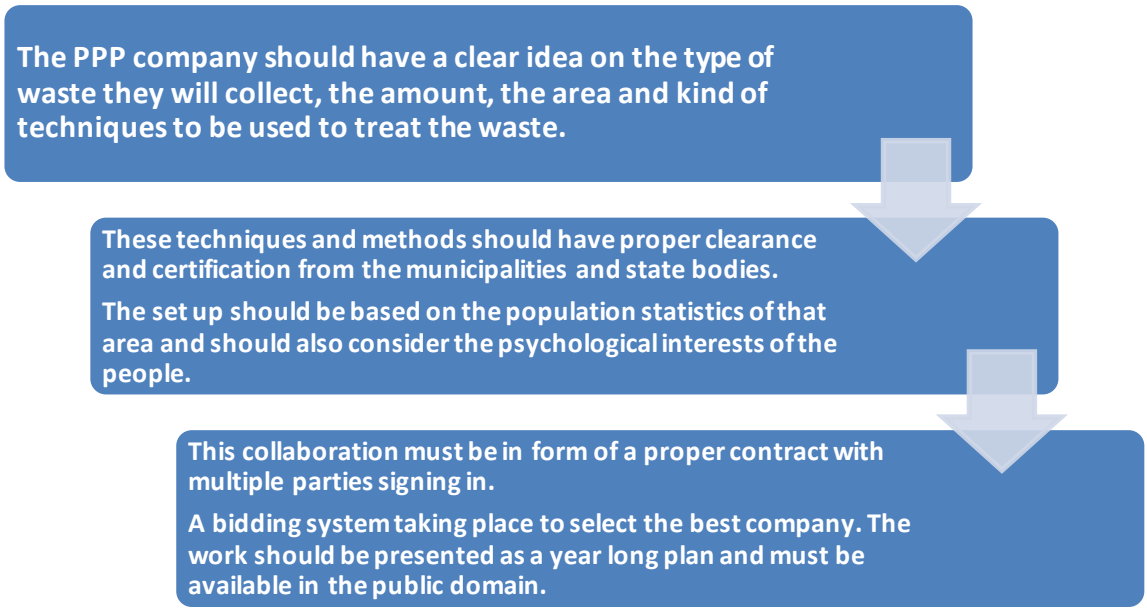


Figure 37 Model for PPP initiative

ii) The recommendation focuses on setting up a mechanism for recycling of waste for every state, incorporated in their annual report, to provide the public with a plan for the whole year on how, what and where will the waste be recycled.

iii) This recommendation deals with the meetings being held at the central bodies like the CPCB for the state pollution control bodies to present their developments, delays and accomplishments through the year. It also includes the status report by the municipalities to CPCB.

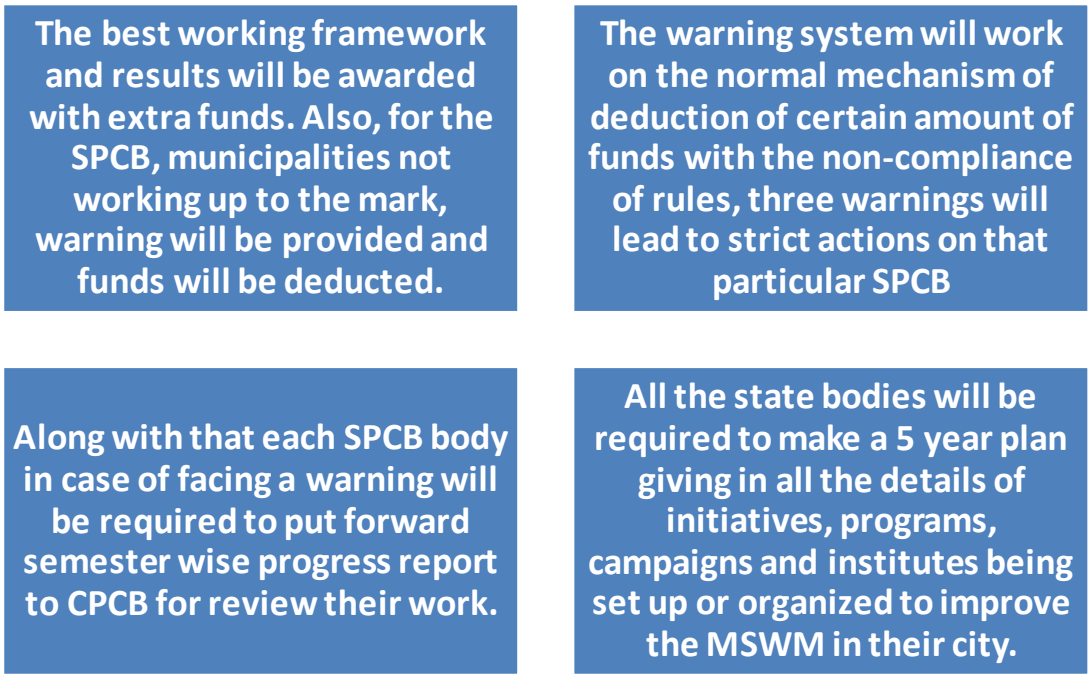


Figure 38 Reward Policy Model

iv) Awareness models should be set up by all the bodies in accordance with their population, resources; inviting private industries, companies to start drives and campaign for the cleanliness of the ward.

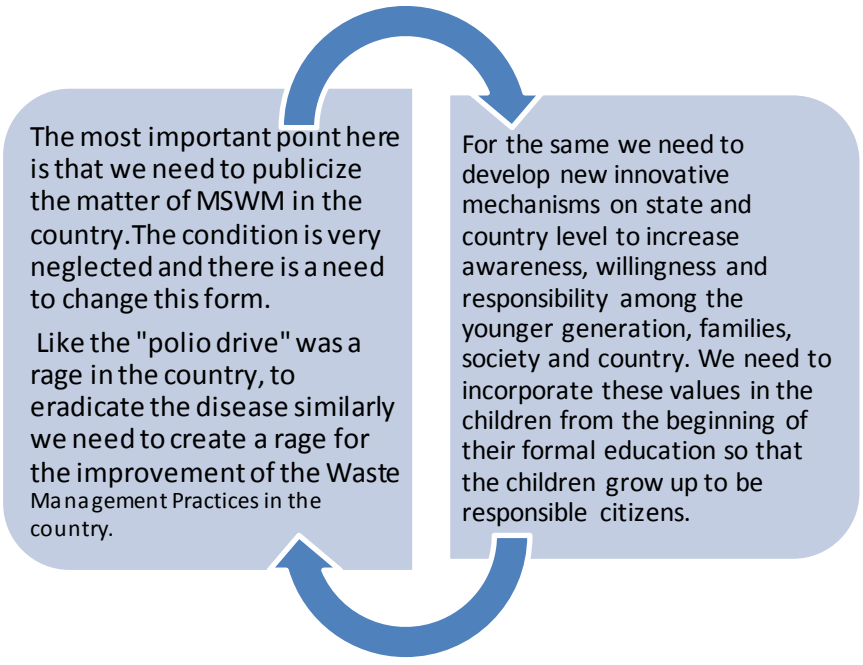


Figure 39 Need for Awareness

5.2 Scope of Recommendations

Justifications:

- The waste collection, segregation, treatment is very poor in India. Observing the waste management practices in Delhi it has come to notice that the facilities in respect of waste management are very low. The collection of waste is lagging behind the generation, leading to overflowing of waste and creation of unhygienic conditions. This is the reason that we need a better mechanism for these practices.

- The amount of organic waste generated in the residential area is enough to set up one compost plant in every society and generate enough bio-gas to run basic electrical functions. This would lead to better recycling, waste reduction and waste to energy conversion. This method can be adopted in India due to the excessive production in organic waste and facilities to set up such plants.

- Private companies and NGO tie up's with municipalities will solve the problem of man power and would create employment too. This is valid in India for the main reason that there is a large population in waste picking who can be officially employed and work for the tie ups.

- Innovations in the field of PPP and awareness are necessary because we need to educate the younger generation in cue of the good waste management practices so that they understand the value and importance of hygienic practices and clean environment. This proposal is inspired from the Japanese code of conduct in the schools, wherein the basic manners includes good waste management right from the beginning of education.

- At present India hardly recycles 5% of the total waste generated in the country which is about 110 thousand tonnes per year.

  The current situation of the major cities isn't very good too. Delhi treats about 25% of the total waste generated, Maharashtra treats 10% of the total waste and West Bengal treats only 4%.
  Looking at these values it is very evident that we are in need of better waste recycling and treatment facilities. It is not the case where we do not have the technical know-how or the expertise but the will and the responsibility to work for the same. So, there is a need to improve the recycling techniques.

- There will be a screening of the work being done by the SPCB, municipalities of each state along with the review of the future plans (the yearly report on the future aspects will be a compulsory aspect in the screening).

6. Conclusion

The major problem faced by the states and cities of our country is the management of solid waste. The solid waste generation has been increasing at a tremendous rate and the municipalities are inadequate in scaling up and upgrading their facilities to improve the present condition. Due to lack of infrastructure and organized system of house to house collection, segregation, treatment etc has led to high littering and disposal practices. By far looking at the statistics none of the states have worked up to the expectations from Municipal Solid Waste Management Rules, 2005 completely.

India with an urban population of 321 623 271 generates about 0.34 kg/capita/day of waste summing up to 109 589 tonnes/day of waste. According to the 2010 World Bank Report, India's expected population will surpass China's population by 2025. This statistics giving India a population of 1 447 499 000, with waste generation of about 0.7 kg/capita/day again summing up to a big number of 376 639 tonnes/day of waste.

This report aims to give an idea on the overall scenario of Municipal Solid Waste Management Practices in India along with the laws regulating them, the acts provided by the government, the authorities in-charge at the various levels and the status of their functioning.

The first section is focused at the literature search which includes all the legislative framework, statistics on waste generation globally, nationally and state wise. It includes other subjects like the different steps in Waste Management, the system followed in developed countries, ways to improve the current practices. The field trips form the next important section to get a hand on the ground experiences and then suggest recommendations for the practices.

The second section includes the initiatives taken up by the government and private bodies to improve and develop the MSWM techniques. Then comes the findings, gap analysis and recommendation sections. These include almost all the possible kinds of programs and steps the government has already taken and the steps that need to be taken. It gives the reader an idea on the various aspects of MSWM in India, its drawbacks and the future of the management field.

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8. Appendix A

Field visits and discussions-

Visit 1

Place: M/s Synergy Waste Management (P) Ltd., Near Composite Plant, Okhla Tank, New Delhi-20

Date: 28/5/13

Time: 11:15 AM

Duration: 2 hours 45 minutes

S.No.	Outcome	Explanation
1)	Got an overview of the system followed by the waste treatment plant. Collection of waste from Health centers ⟶ Temporary waste storage at common treatment plant Incineration Autoclave Shredding Landfill Recycler	This explains the details of waste collection and treatment. The waste is collected and stored at the plant. After that it is sorted out and sections of the waste are treated separately. Hazardous waste is taken for incineration ie burnt in large incinerators; other part is put in autoclave for decontamination. After the waste is decontaminated it is put in the shredder for reducing the mass. Finally this waste is dumped in landfills and the part which is reusable is taken for recycling.

2)	Got an insight into the problems faced by the industries. • Hospitals do not perform primary segregation • Delay in payment • Corruption • No body to solve grievances faced by the companies. • Lack of awareness in people • Unskilled workers • No understanding on the gravity of solving the waste management problem • Carefree attitude of the hospitals • Violations of the rules • Increasing competition due to increase in permissions to open new industries • No market for the byproducts of these industries • Low margin of expansion leading to low profit • Setting up companies with poor infrastructure.	
3)	Understanding the generator body, monitor body and regulatory body in the Waste Management System. Generators: Medial Schools, hospitals, pathology labs, research institutes etc. ↓ Collection of waste from the generators on daily basis by the collectors. ↓ Treatment at the waste treatment plants. ↓ Process monitored and regulated by MoEF -> CPCB -> SPCB -> BWM companies.	

Table 2.2.1.1: Field visit and discussion at a Biomedical Waste treatment Facility.

Visit 2:

Place: Central Pollution Control Board, Parivesh Bhavan, East Arjun Nagar, Delhi

Date: 5/6/13

Time: 11.15am

Duration: 1 hour

The main aim of the visit was to collect data on amount of garbage in landfills in Delhi and to understand the functioning of CPCB.

S.No.	Outcome
1)	The total installed MSW treatment capacity in Delhi has estimated as 5500 MT/day whereas the actual operating capacity is 3389 MT/day (61% capacity utilization)
2)	CPCB is responsible for the regulation, control and maintenance of the SPCB, the PPPs under the government and other projects assigned to the CPCB

Table 2.2.2.1 Field visit and discussion at CPCB

Discussions:

S.No 1)	**Shri Tapas Saha**
	The discussion with Shri Tapas Ji, was related to organization of governmental bodies and their relations with private companies. • The Ministry of Environment and Forest is the main body that regulates the issues, actions and plans relating to the Waste Management and Handling. • MoEF directly controls the Central Pollution Control Board which regulates the State Pollution control board which ensures that the biomedical waste management companies work according to the guidelines and rules laid down. It provides the service providers grants to operate the collection and treatment. • The SPCB holds meeting every month to keep checks on the industries and to discuss the grievances. It talks about the implementation of the rules under the 2000 Act, gets data and information on the progress of each industry. The problem which was highlighted here was that the discussions take place,

	but there is no action on the grievances. • The problems relating to delays and nonpayment by the medical and health institutions are not looked upon by the board. This is a major problem which private industries in this sector face as there is no body to solve the financial problems. • Another problem that was discussed was of corruption. The govt. bodies grants permission and license to companies with poor infrastructure and no guideline relating to the pollution control in their area of establishments. This causes two kinds of problems. 1) The competition for the service increases: To elaborate on this I'll state an example, Supposing there are 4 hospitals in a city and the total net capacity is 40,000 beds. One BMW management industry is capable of treating the waste from 20,000 beds, so that leads to two industrial set up in that region. Now what happens is when a new low quality industry is set up the clientele reduces for the existing two industries, increasing the competition. This also leads to increase in corruption as the low quality industry pays the governmental officers to write appropriate reports even when they do not follow the norms and rules that they should. 2) Quality of services decreases: The BMW is one of the major hazardous waste produced. Treating them is a challenge in itself. When the treatment is not up to the mark it leads to spread of various diseases and other hygiene problems. When the industries do not follow the rules in the end product to be recycled is hazardous too. Cropping up of new industries with bad infrastructure leads to these problems. This is the major overview of the problems that were discussed in today's session.

S.No 2)	**Shri Chandrajeet Raghav**
	The discussion with Shri Chandrajeet Ji, was confined to the details of the plant like • Company started in 2001. • Number of workers = 150 • Capacity = 6 tonnes • Incineration quantity = 3500 kg • Catering 2500 medical and health institutions out of 10,000 in Delhi • Charges = Rs 3/ bed/ day

	• Tie up with govt. bodies like DHS, MCD, Delhi Jal Board • Waste water recycling at the ETP (Effluent treatment Plant) and reuse it at the incineration plant. • The engineering basics of the machines like the incinerators and ETP.

S.No 3)	**Shri Sanjeev Agrawal**
	1) Data on landfill sites: The total installed MSW treatment capacity in Delhi has estimated as 5500 MT/day whereas the actual operating capacity is 3389 MT/day (61% capacity utilization). Presently Delhi has four landfill sites in operation at Ghazipur, Bhalswa, Okhla and Bawana. The estimated percentages of garbage disposal is 36% in Bhalswa, 32% reaches Ghazipur, 14% to Okhla and 18% to Bawana site. The zones bringing in maximum garbage are Shahdara, Rohini, Civil lines and Karol bagh. Three landfill sites namely Bhalswa, Ghazipur and Okhla are operated and maintained by the MCD and Bawana is operated and maintained by Delhi MSW Solution Ltd. (Ramky Group). Amount of Waste: (September-December) Total quantity = 860161 MT Average per day = 7051 MT Malba and inert material amount = 216366 MT Garbage = 643795 Ghazipur Landfill: Garbage from Shahadra, DWM, Sadar Paharganj, Karol Bagh, NDMC and other than MC area reaches Ghazipur. Over the period of the four months 2,22,889 MT of garbage and 53,061 MT of Malba and Slits is disposed off at Ghazipur. Okhla Landfill: Garbage from South Zone, Central Zone, Najafgarh, City zone other than MC area of Delhi and compost plant, reaches Okhla landfill. Over the period of the four months 13423 MT of garbage and 109143 MT of Malba and Silt is disposed off at this site.

	Bhalswa Landfill: Garbage from Civil lines, Rohini zone, Najafgarh zone, Narela zone, West zone, Karol Bagh, S.P zone, KPMC, APMC, Mother Dairy, Garden, Pepsi and other than MC areas of Delhi, reaches this landfill. Bawana Landfill: This is city's first scientific integrated solid waste management facility at Narela-Bawana road with a capacity of handling 1500 MT of waste every day. The sanitary landfill site of this plan will take load of the over saturated landfills. This under construction site will handle garbage from Rohini, Civil Lines and Najafgarh zones. The quantity of garbage per day is 1276 MT/day. 2) Responsibilities of CPCB: - Monitors the action of MCD - Provides guidance to SPCB - Reviews the action plan of the local municipal bodies. - Undertakes inspection, surprise visits and annual reports on the local Municipal bodies and State pollution control bodies. - Presents data in courts and initiates the action plan. Problems faced in CPCB: - Lack of field labor - Lack of office employs - Lack of funds and equipments. - Overburdened with work outside the domains of CPCB - Increase in the number of official complaints, RTIs, inspection projects and other miscellaneous projects to look after. - Time constraint for the different projects, leads to lack of attention to the important issues.

Visit 3:

Place: Central Pollution Control Board, Parivesh Bhavan, East Arjun Nagar, Delhi

Date: 2/7/13

Time: 10.45am

Duration: 1 hour 15 minutes

Goals of the Visit

S.No.	Explain the Goals of the meeting	Goal Met?
1	**Discuss the feasibility of the recommendations**	**Yes**
2	**Discuss the reasons for non-compliance of the various rules**	**Yes**
3	**Discuss the unseen and unnoticed problems in the system**	**Yes**

Outcome of the Field Visit

S.No.	Outcome	Action Planned
1)	**Feasibility of Recommendations:** **Most of the recommendations came out to be feasible along with few additions in the present recommendations.** **Suggestions on research on Planning Commission's Environment Performance study.**	**Study the action plan and recommendations by the Planning Commission.**
2)	**Reasons for Non-compliance of MSWM rules 2000:** - **Lack of awareness and will to improve the situation.** - **Lack of proper initiatives from the basic level to inculcate good MSWM practices.** - **Psychological barrier in different communities.**	**Study report on 'Status of Compliance by CPCB with municipal solid wastes'**
3)	**Other problems:** - **Lack of initiatives, innovations, willingness, seriousness from the State and Municipalities.** - **Lack of implementation of the technical knowledge on the field.** - **Lack of awareness models to change and improve the psychology of the people to improve MSWM practices.**	**Study the model system of places where these problem are being solved.**

Discussion Details

S.No 1)	Dr. Avinash .B. Akolkar

The following are the main points of discussion:

- Zero Waste Concept:
  According to this concept there is 100% collection, segregation, treatment and recycling of waste. But this concept is a far reached goal for India right now. The present condition of the recycling status is very grim and does not seem a possibility for the next 10-15 years.
  The main problem in this scenario is the lack of initiatives, seriousness, willingness, responsibility from the municipalities to improve the present practices.

- Technical Know How:
  India has all the technical knowledge in terms of improving the practices and establishing new infrastructure to treat waste. We lack in the usage and implementation of these techniques.

- Non-compliance of MSWM, 2000 Rules:
  The main reason for non-compliance is the lack of willingness and awareness among the municipalities and the society to improve the system. Another point is the psychology and mind set of the people to clean only their homes and surroundings and no responsibility of the community at all.
  Even with the provisions to punish the municipalities for non-compliance, the result of the situation isn't very fruitful. As the non-compliance is higher than the compliance it is difficult to punish all the municipalities. Also doing this causes unrest in the system as the punishment is against the governmental body. What needs to be done in a situation like this is not punishing the state and municipal organization but to find ways to motivate them for better results. We need to bring the problem of proper MSWM in the eyes of public and political domain so that necessary actions can be taken.

- PPP models and NGO startups:
  There is no system for the collection of data on the waste generated in different wards, cities and states to start a proper plan to work on the lacunae. The PPPs and the NGO work on a profit basis and need a basic support system from the local state authorities and municipalities. There is a need for a proper agreement and contract considering all aspects of waste management to setup a new proposal for waste management practices.

9. Appendix B

Additional Information

1) Municipal Solid Waste Generation in Metro Cities / State Capitals (Source: CPCB datasheet on waste generation in India)

S. 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

S. No.	Name of City	* Municipal Solid Waste (Tonnes per day)		
		1999-2000(a)	2004-2005 (b)	2010-11 (c)
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.	Thiruvanandapuram	-	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

2) Municipal Solid Waste Generation in India (State-wise)

S. No	Name of the State / UT	(a) Municipal solid Waste MT/ day 1999-2000			(b) Municipal solid Waste MT/ day (2009-12)
		Class – I cities	Class – II Towns	Total	
1.	Andaman & Nicobar	-	-	-	50
2.	Andhra Pradesh	3943	433	4376	11500
3.	Arunachal Pradesh	-	-	-	93.802
4.	Assam	196	89	285	1146.28
5.	Bihar	1479	340	1819	1670
6.	Chandigarh	200	-	200	380
7.	Chhattisgarh	-	-	-	1167
8.	Daman Diu & Dadra	-	-	-	41
9.	Delhi	4000	-	4000	7384
10.	Goa	-	-	-	193
11.	Gujarat	-	-	-	7378.775
12.	Haryana	3805	427	4232	536.85
13.	Himachal Pradesh	623	102	725	304.3
14.	Jammu & Kashmir	35	-	35	1792
15.	Jharkhand	-	-	-	1710
16.	Karnataka	3118	160	3278	6500
17.	Kerala	1220	78	1298	8338
18.	Lakshadweep	-	-	-	21
19.	Maharashtra	8589	510	9099	19.204
20.	Manipur	40	-	40	112.9

21.	Meghalaya	35	-	35	284.6
22.	Mizoram	46	-	46	4742
23.	Madhya Pradesh	2286	398	2684	4500
24.	Nagaland	-	-	-	187.6
25.	Orissa	646	9	655	2239.2
26.	Puducherry	60	9	69	380
27.	Punjab	1001	265	1266	2793.5
28.	Rajasthan	1768	198	1966	5037.3
29.	Sikkim	-	-	-	40
30.	Tamil Nadu	5021	382	5403	12504
31.	Tripura	33	-	33	360
32.	Uttar Pradesh	5515	445	5960	11.585
33.	Uttaranchal	-	-	-	752
34.	West Bengal	4475	146	4621	12557
	Total	**48134**	**3991**	**52125**	**127485.107**

3) State wise Municipal Solid Waste Generation:
(Updated as on 31st JULY 2012)

S.No	State	Quantity Generated (TPD)	Collected (TPD)	Treated (TPD)	Reference
1	Andaman & Nicobar	50	43	Nil	Letter dt. 21.4.2011
2	Andhra Pradesh	11500	10655	3656	Letter dt. 1.10.2011
3	Arunachal Pradesh	94	NA	Nil	
4	Assam	1146	807	72.65	Letter dt. 27.12.2011
5	Bihar	1670	1670	Nil	Letter dt. 18.8.2010
6	Chandigarh	380	370	300	Letter dt. 22.12.2011
7	Chhattisgarh	1167	1069	250	Letter dt. 6.6.2012
8	Daman Diu & Dadra	28+13=41	NA	Nil	Letter dt. 18.8.2010
9	Delhi	7384	6796	1927	Letter dt. 3.2.12 & 28.2.12
10	Goa	193	NA	NA	GSPCB Report
11	Gujarat	7379	6744	873	Letter dt. 3.12.2011
12	Haryana	537	NA	Nil	Letter dt. 21.5.10 & 2.6.10
13	Himachal Pradesh	304	275	153.0	Letter dt. 23.12.2011
14	Jammu & Kashmir	1792	1322	320	Letter dt. 21.5.2012
15	Jharkhand	1710	869	50	JSPCB Report
16	Karnataka	6500	2100	2100	Letter dt. 25.6.2010
17	Kerala	8338	1739	1739	Letter dt. 17.6.2010
18	Lakshadweep	21	21	4.2	Proj. Proposal dt. 16.11.06
19	MP	4500	2700	975	Letter dt. 3.1.2012
20	Maharashtra	19,204	19,204	2080	Letter dt. 24.8.2009
21	Manipur	113	93	2.5	MPCB Report 2009
22	Meghalaya	285	238	100	MPCB Report Jan' 2012
23	Mizoram	4742	3122	Nil	Letter dt. 17.10.2011
24	Nagaland	188	140	Nil	NPCB Report 2011
25	Orissa	2239	1837	33	Letter dt. 30.5.12
26	Puducherry	380	NA	Nil	Letter dt. 27.5.2009

27	Punjab	2794	NA	Nil	Letter dt. 3.5.2010
28	Rajasthan	5037	NA	Nil	Letter dt. 29.9.2011
29	Sikkim	40 (capital)	32	32	Letter dt. 11.5.12
30	Tamil Nadu	12504	11626	603	Letter dt. 17.11.2011
31	Tripura	360	246	40	Letter dt. 18.8.2010
32	Uttar Pradesh	11,585	10563	Nil	IIT-K Report:2011& Letter dt. 23.8.2010
33	Uttrakhand	752	NA	Nil	Letter dt. 20.1.2011
34	West Bengal	12557	5054	606.5	JPU Report April 2010 & Letter dt. 17.10.2011
	34 States	**1,27,486**	**89,334**	**15,881**	

4) STATUS OF ANNUAL REPORT RECEIVED FROM SPCBS/PCCB

States	2001-2	2002-3	2003-4	2004-5	2005-6	2006-7	2007-8	2008-9	2009-10	2010-11
Andaman Nicobar				Y	Y					
Andhra Pradesh		Y	Y	Y	Y	Y	Y	Y	Y	Y
Arunachal P.				Y			Y	Y	Y	Y
Assam	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bihar			Y	Y	Y		Y	Y		Y
Chandigarh		Y	Y	Y	Y	Y	Y	Y	Y	
Chhatisgarh	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Daman Diu			Y							
Delhi			Y			Y			Y	Y
Goa						Y	Y	Y	Y	Y
Gujarat		Y	Y	Y	Y		Y	Y	Y	Y
Haryana	Y	Y	Y			Y				
Himachal Pradesh		Y	Y	Y	Y	Y		Y	Y	Y
J & K			Y							Y
Jharkhand			Y							
Karnataka	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Kerala	Y	Y	Y			Y	Y	Y		Y
Lakshadweep							Y			
Madhya Pradesh			Y	Y	Y	Y		Y	Y	Y
Maharashtra	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Manipur			Y				Y			
Meghalaya	Y	Y	Y	Y	Y			Y	Y	Y
Mizoram								Y	Y	Y
Nagaland			Y	Y	Y	Y	Y	Y	Y	Y
Orissa	Y	Y	Y	Y	Y		Y	Y	Y	Y
Puducherry	Y	Y	Y		Y		Y	Y		
Punjab	Y	Y	Y	Y	Y	Y		Y	Y	Y
Rajasthan			Y	Y		Y	Y	Y		
Sikkim			Y				Y			Y
Tamil Nadu			Y	Y		Y	Y	Y	Y	Y
Tripura		Y	Y	Y	Y	Y	Y	Y	Y	Y
Uttar Pradesh	Y			Y	Y		Y	Y		
Uttarakhand		Y	Y					Y	Y	Y
West Bengal		Y	Y	Y	Y	Y	Y	Y	Y	Y
Total	**11**	**17**	**28**	**21**	**19**	**18**	**22**	**25**	**21**	**22**

5) Waste generation in different states. (Source: What a waste)

City	Year	Urban Population	Generation Rate (kg/capita/day)	Total MSW Generated (kg/day)	Total Waste (tons/day)
India (CPCB 2005)					
Agartala	2005	189,998	0.40	75,999	76
Agra	2005	1,275,135	0.51	650,319	650
Ahmedabad	2005	3,520,085	0.37	1,302,431	1,302
Aizwal	2005	228,280	0.25	57,070	57
Allahabad	2005	975,393	0.52	507,204	507
Amritsar	2005	966,862	0.45	435,088	435
Asansol	2005	475,439	0.44	209,193	209
Banglore	2005	4,301,326	0.39	1,677,517	1,678
Bhopal	2005	1,437,354	0.40	574,942	575
Bhubaneswar	2005	648,032	0.36	233,292	233
Chandigarh	2005	808,515	0.40	323,406	323
Chennai	2005	4,343,645	0.62	2,693,060	2,693
Coimbatore	2005	930,882	0.57	530,603	531
Dehradun	2005	426,674	0.31	132,269	132
Delhi	2005	10,306,452	0.57	5,874,678	5,875
Dhanbad	2005	199,258	0.39	77,711	78
Faridabad	2005	1,055,938	0.42	443,494	443
Gandhinagar	2005	195,985	0.22	43,117	43
Greater Mumbai	2005	11,978,450	0.45	5,390,303	5,390
Guwahati	2005	809,895	0.20	161,979	162
Hyderabad	2005	3,843,585	0.57	2,190,843	2,191
Imphal	2005	221,492	0.19	42,083	42
Indore	2005	1,474,968	0.38	560,488	560
Jabalpur	2005	932,484	0.23	214,471	214
Jaipur	2005	2,322,575	0.39	905,804	906
Jammu	2005	369,959	0.58	214,576	215
Jamshedpur	2005	1,104,713	0.31	342,461	342
Kanpur	2005	2,551,337	0.43	1,097,075	1,097
Kochi	2005	595,575	0.67	399,035	399

City	Year	Urban Population	Generation Rate (kg/capita/day)	Total MSW Generated (kg/day)	Total Waste (tons/day)
Kolkata	2005	4,572,876	0.58	2,652,268	2,652
Lucknow	2005	2,185,927	0.22	480,904	481
Ludhiana	2005	1,398,467	0.53	741,188	741
Madurai	2005	928,868	0.30	278,660	279
Meerut	2005	1,068,772	0.46	491,635	492
Nagpur	2005	2,052,066	0.25	513,017	513
Nashik	2005	1,077,236	0.19	204,675	205
Patna	2005	1,366,444	0.37	505,584	506
Pondicherry	2005	220,865	0.59	130,310	130
Pune	2005	2,538,473	0.46	1,167,698	1,168
Raipur	2005	605,747	0.30	181,724	182
Rajkot	2005	967,476	0.21	203,170	203
Ranchi	2005	847,093	0.25	211,773	212
Shillong	2005	132,867	0.34	45,175	45
Simla	2005	142,555	0.27	38,490	38
Srinagar	2005	898,440	0.48	431,251	431
Surat	2005	2,433,835	0.41	997,872	998
Tiruvanantapuram	2005	744,983	0.23	171,346	171
Vadodara	2005	1,306,227	0.27	352,681	353
Varanasi	2005	1,091,918	0.39	425,848	426
Vijaywada	2005	851,282	0.44	374,564	375
Vishakhapatnam	2005	982,904	0.59	579,913	580

"The highest measure of democracy is neither the 'extent of freedom' nor the 'extent of equality' but rather the highest measure of participation."

- A.D. Benoist

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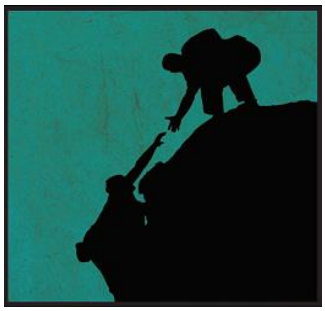

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