MUNICIPAL SOLID WASTE MANGEMENT IN CITY MOTIHARI

KUSUM KUMARI
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ABSTRACT: Waste is a continually growing problem at global and regional as well as at local levels. Solid wastes arise from human and animal activities that are normally discarded as useless or unwanted. In other words, solid wastes may be defined as the organic and inorganic waste materials produced by various activities of the society and which have lost their value to the first user. As the result of rapid increase in production and consumption, urban society rejects and generates solid material regularly which leads to considerable increase in the volume of waste generated from several sources such as, domestic wastes, commercial wastes, institutional wastes and industrial wastes of most diverse categories. Management of solid waste may be defined as that discipline associated with the control of generation, storage, collection, transfer and transport, processing, and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations. In its scope, solid waste management includes all administrative, financial, legal, planning, and engineering functions involved in the whole spectrum of solutions to problems of solid wastes thrust upon the community by its inhabitants. Solid wastes have the potential to pollute all the vital components of living environment (i.e., air, land and water) at local and at global levels. The problem is compounded by trends in consumption and production patterns and by continuing urbanization of the world. The problem is more acute in developing nations than in developed nations as the economic growth as well as urbanization is more rapid.

INTRODUCTION:

Municipal solid waste management is a part of public health and sanitation and is entrusted to the municipal government for execution. Municipal Solid Waste Management has become acute problem in India due to rapid urbanization and uncontrolled growth rate of population. Municipal Solid Waste Management involves the application of principle of Integrated Solid Waste Management (ISWM) to municipal waste. ISWM is the application of suitable techniques, technologies and management programs covering all types of solid wastes from all sources to achieve the twin objectives of (a) waste reduction and (b) effective management of waste still produced after waste reduction.

Municipal Solid Waste (MSW), commonly called "trash" or "garbage," includes wastes such as durable goods (e.g., tires, furniture), nondurable goods (e.g., newspapers, plastic plates/cups), containers and packaging (e.g., milk cartons, plastic wrap), and other wastes (e.g., yard waste, food). This category of waste generally refers to common household waste, as well as office and retail wastes, but excludes industrial, hazardous, and construction wastes.

Municipal solid waste includes commercial and domestic wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated bio-medical wastes.

As per the Municipal Solid Waste (Management and Handling) Rules, 2000, waste disposal methods prescribed includes composting, vermin composting, anaerobic digestion and incineration

Municipal solid waste management comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment and final disposal. Therefore MSWM refers to a systematic process that of solid waste. However, solid waste management is an old service provided by the urban local bodies, efficient municipal solid waste management benefits in maintaining hygienic conditions leading to lesser health issues, better living environment, and improved economic prosperity in the area, cleaner water supply sources and safer neighborhoods. Therefore, the importance of solid waste management cannot be undermined. The failure of SWM can result in serious health problems and environmental degradation; municipalities have overall responsibility for SWM in cities.

TYPES OF MUNICIPAL SOLID WASTE:--

Source	Examples
Residential	Single family homes, duplexes, town houses, apartments
Commercial	Office buildings, shopping malls, warehouses, hotels, airports, restaurants
Institutional	Schools, medical facilities, prisons
Industrial	Packaging of components, office wastes, lunchroom and restroom wastes

Municipal Solid Waste Management:--

Municipal Solid waste management involves the application of principle of Integrated Solid Waste Management (ISWM) to municipal waste. ISWM is the application of suitable techniques, technologies and management programs covering all types of solid wastes from all sources to achieve the twin objectives of (a) waste reduction and (b) effective management of waste still produced after waste reduction.

In the Municipal Solid Waste Management the major issues to be considered are:

- Increasing waste quantities
- Wastes not reported in the national MSW totals
- Lack of clear definition for solid waste management terms and functions
- Lack of quality data
- Need for clear roles in state and local government
- Need for even and predictable enforcement regulations and standards

Environmental and Health risk scenarios:-

Potential hazards of solid wastes are numerous to the living community when it is improperly managed. Solid wastes have the potential to pollute all the vital components of living environment (i.e., air, land and water). Some of the hazards caused by solid wastes are listed below;

- Uncollected wastes often end up in drains, causing blockages that result in flooding and unsanitary conditions.
- Open and overflowing bins attract stray dogs, which has been a major cause of the spread of rabies.
- Open waste bins also attract stray and domestic cattle. Cattle in the city causes nuisance by blocking the traffic on the roads. Cattle that graze on the waste from bins end up eating the plastic along with the vegetable matter, which proves to be fatal for them. The milk obtained from the cattle that feed on waste can be contaminated and can prove to be unsafe for human health.
- Flies breed in some constituents of solid wastes, and flies are very effective vectors that spread disease.
- Mosquitoes breed in blocked drains and in rainwater that is retained in discarded cans, tire and other objects. Mosquitoes spread disease, including malaria and dengue.
- Rats find shelter and food in waste dumps. Rats consume and spoil food, spread disease, damage electrical cables and other materials and inflict unpleasant bites.
- The open burning of waste causes air pollution; the products of combustion include dioxins that are particularly hazardous.
- Aerosols and dusts can spread fungi and pathogens from uncollected and decomposing wastes.
- Uncollected waste degrades the urban environment, discouraging efforts to keep streets and open spaces in a clean and hygienic condition. Plastic bags are in particular an aesthetic nuisance.
- Waste collection workers face particular occupational hazards, including strains from lifting, injuries from sharp objects and contact with pathogens when manually handling the waste.
- Dangerous items (such as broken glass, razor blades, hypodermic needles and other healthcare wastes, aerosol cans and potentially explosive containers and chemicals from industries) may pose risks of injury or poisoning, particularly to children and people who sort through the waste.
- Heavy refuse collection trucks can cause significant damage to the surfaces of roads that were not designed for such weights.
- Waste items that are reused without being cleaned effectively or sterilized can transmit infection to later users. (Examples are bottles and medical supplies.)
- Polluted water flowing from waste dumps and disposal sites can cause serious pollution of water supplies, ponds and lakes. Chemical wastes (especially persistent organics) may be fatal or have serious effects if ingested, inhaled or touched and can cause widespread pollution of water supplies.
- Waste that is treated or disposed of in unsatisfactory ways can cause a severe aesthetic nuisance in terms of smell and appearance.
- Liquids and fumes, escaping from deposits of wastes (perhaps formed as a result of chemical reactions between components in the wastes), can have fatal or other serious effects.
- Methane (one of the main components of landfill gas) is much more effective than carbondioxide as a greenhouse gas, leading to climate change.
- Fires on disposal sites can cause major air pollution, causing illness and reducing visibility, making disposal sites dangerously unstable, causing explosions of cans, and possibly spreading to adjacent property.
- Former disposal sites provide very poor foundation support for large buildings, so buildings constructed on former sites are prone to collapse.

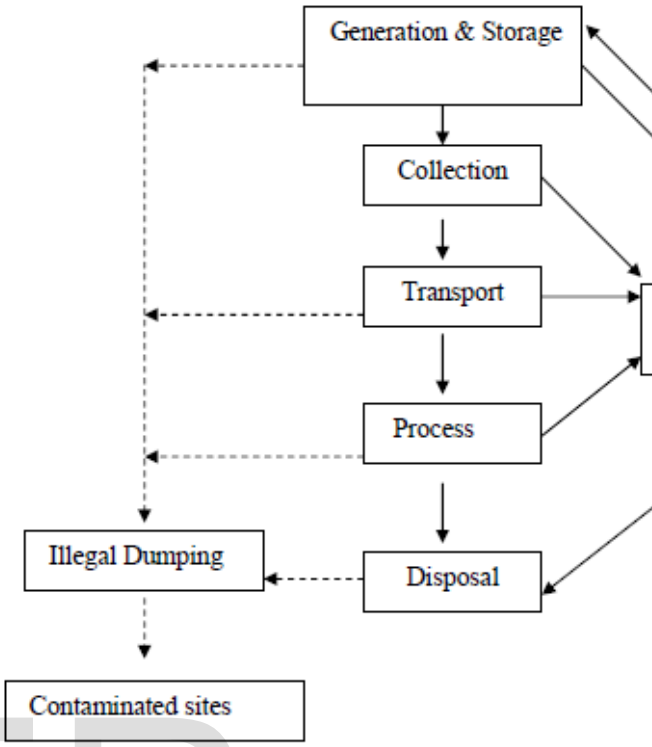
Legal Framework applicable to Municipal Solid Waste Management :

Legislation concerning waste is usually differentiated according to the type of waste. Motihari city covers household,medical/nursing clinical or agricultural waste, from an environmental angle the following environmental rules, regulations and acts would be the most relevant for MSWM:

- Municipal Solid Waste (Management & Handling) Rules 2000, notified by the ministry of Environment and Forests, Government of India vide notification No. S.O.908 (E) dated 25th September 2000. The guidelines given in this law covers all the functional elements of municipal solid waste management.
- The Water (Prevention and Control of Pollution) Act, 1974. Two aspects have to be kept in mind of this law in regard to MSWM. Firstly, a consent from the state pollution control board for establishment of a sanitary landfill site and compost plant is essential and secondly, no water pollution should be caused by the leachate that is emitted by the sanitary landfill site or a compost plant.
- The Water (Prevention and Control of Pollution) Cess Act, 1977 and amendments thereon. The only aspect that should be considered in this law in regard to MSWM is provision for levying and collection of cess on water consumed for the sanitary landfilling, composting and anaerobic digesters.
- The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereon. The aspects to be considered in this law with respect to MSWM is the need for obtaining consent from the State Pollution Control Board for establishment of the processing plants and disposal site and from an environmental aspect would be the pollution caused by incineration plants, compost plants and landfill sites.
- The Environmental (Protection) Act, 1986 and its subsequent notifications. The aspect in regard to MSWM would be the EIA notification, 1944, which states that for any project to be authorized an EIA report should be submitted first.

Functional Elements of Municipal Solid Waste Management

To implement proper waste management, various aspects have to be considered such as Waste generation (source reduction), Waste handling and sorting, storage and processing at the source (onsite storage), Collection, Sorting, processing and transformation, transfer and transport, and Disposal (The Expert Committee, 2000). Figure shows the interrelationship between the functional elements in solid waste management.



A. **Waste Generation:** Waste generation either encompasses activities in which materials are identified as no longer being of value (in their present form) and are thrown away or gathered for disposal. Waste generation is, at present, an activity that is not very controllable. In the future, however, more control is likely to be exercised over the generation of wastes. Reduction of waste at source, although not controlled by solid waste managers, is now included in system evaluations as a method of limiting the quantity of waste generated.

B. **Waste Handling, Sorting, Storage, and Processing at the Source:** The second of the six functional elements in the solid waste management system is waste handling, sorting, storage, and processing at the source. Waste handling and sorting involves the activities associated with management of wastes until they are placed in storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Sorting of waste components is an important step in the handling and storage of solid waste at the source. For example, the best place to separate

waste materials for reuse and recycling is at the source of generation. Households are becoming more aware of the importance of separating newspaper and cardboard, bottles/glass, kitchen wastes and ferrous and non-ferrous materials. On-site storage is of primary importance because of public health concerns and aesthetic consideration. Unsightly makeshift containers and even open ground storage, both of which are undesirable, are often seen at many residential and commercial sites. The cost of providing storage for solid wastes at the source is normally borne by the household in the case of individuals, or by the management of commercial and industrial properties. Processing at the source involves activities such as backyard waste composting.

C. **Transfer and Transport:** The functional element of transfer and transport involves two steps: (i) the transfer of wastes from the smaller collection vehicle to the larger transport equipment and (ii) the subsequent transport of the wastes, usually over long distances, to a processing or disposal site. The transfer usually takes place at a transfer station.

D. **Disposal:** The final functional element in the solid waste management system is disposal. Today the disposal of wastes by land filling or uncontrolled dumping is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from Materials Recovery Facilities (MRFs), residue from the combustion of solid waste, rejects of composting, or other substances from various solid waste-processing facilities. A municipal solid waste landfill plant is an engineered facility used for disposing of solid wastes on land or within the earth's mantle without creating nuisance or hazard to public health or safety, such as breeding of rodents and insects and contamination of groundwater.

MOTIHARI : Profile of city

Motihari is around 165 km northwest from Patna, the capital of Bihar, 45 km from Bettiah, and 72 km from Muzaffarpur. The city is close to Nepal. Birgunj, the second largest town of Nepal, is 55 km away. Motihari is located in the northwestern part of Bihar. The municipality of Motihari was established in 1879 and now it is the district head quarter of East Champaran. The Moti Jheel is the pride and main attaraction of this town. The jheel is located in the centre with the town spread on either bank. The town has development towards the northwest side and southwest along the National Highway 24-A and State Highway 54 towards Raxaul. The present and the future growth directions are towards the western and southern side and along the National and State highways. Low lying areas in the northwestern direction and the presence of Kareri Lake in southeast are barriers to growth in these directions. Motihari has sugar mills, oil seeds and trade in agro base products. However, sugar mills are few in number and mostly old and dilapidated or totally closed. Recently the government has taken several initiatives to rejuvenate the old sugar mills in the Motihari region and proposed to develop it as an agro based market town mainly because, the region is the largest producer of sugar cane, fisheries,potatoes and other vegetables. It is located between latitude NORTH 26^0 - 16′ to 27^0 -1 and longitude EAST 84^0 – 30 to 85^0 16.

Climate and Topography:

EAST CHAMPARAN is located at 26°16′N-27°1′N LATITUDE & 84°30′E-85°16′E LONGITUDE. EAST CHAMPARAN is surrounded by NEPAL in the north, Muzaffarpur & Gopalganj in the south , Sitamarhi & Sheohar district in the east and Gopalganj & West Champaran in the west.

- It is situated in the Plains of River Gandak,Burhi Gandak & Baghmati.
- East Champaran district occupies an area of 3968 sq. km. or 1532 sq. miles.
- The primary occupation of the people of the district is agriculture.

The total areas of land for cultivation are 303923 hectare. Irrigation facilities to 176115 hectare of land are available in the district while area under non irrigation is 127808 hectare The district receives a normal rainfall of 1241.6 mm. The economy of the district mainly depends upon agriculture. It has seen several ups and downs perpetuated by Baghmati in the form of flood, famine and drought. Flood and drought have remained the regular feature of the area.

Population:

The population growth has seen a fluctuating trend. The highest growth was recorded in the 1971-81 decade at 56%. Thereafter, the growth rate declined but highs of 34% in 1991 and 30% in 2001 were recorded. The projected population for the town in 2030 is about 206547.

Existing Land Use

AREA	391401 Hectare

CULTIVABLE LAND	303923 Hectare
NON CULTIVABLE LAND	87478 Hectare
IRRIGATED LAND	176115 Hectare
NON IRRIGATED LAND	127808 Hectare

DETAILS OF EXISTING MICRO & SMALL ENTERPRISES AND ARTISAN UNITS IN THE DISTRICT:

NIC CODE NO.	TYPE OF INDUSTRY	NUMBER OF UNITS	INVESTMENT (Lakh Rs.)	EMPLOYMENT
20	Agro based	512	3984	3120
22	Soda water	4	80	26
23	Cotton textile	12	102	84
24.	Woolen, silk & artificial Thread based clothes.	4	22	24
25.	Jute & jute based	5	46	40
26.	Ready-made garments & embroidery	28	52	42
27.	Wood/wooden based furniture	158	725	452
28.	Paper & Paper products	4	16	31
29.	Leather based	36	24	72
31.	Chemical/Chemical based	42	389	150
30.	Rubber, Plastic & petro based	42	100	126
32.	Mineral based (NON METALIC)	5	25	26
33.	Metal based (Steel Fab.)	102	820	302
35.	Engineering units	68	860	232
36.	Electrical machinery and transport equipment	86	325	254
97.	Repairing & servicing	233	186	332
01.	Others	136	312	200
	Total	1477	8068	5513

Source: DIC EAST CHAMPARAN

CITY MAP:

Silent features of existing Solid Waste Mangement in Motihari:

It is estimated that the tow generates about 30 tons of waste per day. The collection system is basic with high dependence on street sweeping. There is no designated site for disposal. There is lack of industries in Motihari due to which mainly biodegradable waste are produced by households, domestic, hotels commercial establishment, agricultural market, medical/ nursing clinic waste, building construction/demolition waste. Motihari has sugar mills, oil seeds and trade in agro base products. However, sugar mills are few in number and mostly old and dilapidated or totally closed. Recently the government has taken several initiatives to rejuvenate the old sugar mills in the Motihari region and proposed to develop it as an agro based market town mainly because, the region is the largest producer of sugar cane, fisheries, potatoes and other vegetables. Most of the wastes are biodegradable. Due to very less constructions sites it has also less nonbiodegradable wastes still but as the population is growing rapidly these days it may face a situation where solid wastes will be a headache for the government cause here there is no proper solid waste management system or garbage dump places. Since here most of population depends on agriculture wastes cannot be dumped to the fields. Here also there is proper drainage system due to which the pride of Motihari i.e. MotiJheel is going to be die since the wastes are dumped into it by the human beings.

There are many categories of MSW such as food waste, rubbish, commercial waste, Institutional waste, Street Sweeping, Sanitation waste medical/nursing waste present in Motihari. Construction and demolition waste is generated whenever any construction/demolition activity takes place, such as, building roads, bridges; fly over, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc. A part of this waste comes to the municipal stream. These wastes are heavy, having high density, often bulky and occupy considerable storage space either on the road or communal waste bin/container.

The study report stresses the importance of recycling construction waste, creating awareness about the problem of waste management and the availability of technologies for recycling.

The study recommends establishment of quality standards for recycled aggregate materials and recycled aggregate concrete. This would help in setting up a target product quality for producers and assure the user of a minimum quality requirement, thus encouraging him to use it.

Due to the increase in the economic growth after development and redevelopment projects in the country and subsequent increase in the urbanization in

the cities has made construction sector to increase drastically, but also environmental impacts from construction and demolition (C & D) waste are increasingly becoming a major issue in urban solid waste management.

The primary method is adopted in waste handling is carried through by interviewing professionals like project managers, architects, civil engineers, contractors and government officials like city engineers, solid waste management officials. Secondary information is gathered by compiled data from secondary source like various research papers, various international journals, various international reports on construction and demolition waste management.

THE PROBLEMS: Assessment of industrial solid waste management problem greatly varies depending on the nature of the industry, their location and mode of disposal of waste. Further, for arriving at an appropriate solution for better management of industrial solid waste, assessment of nature of waste generated is also essential. Industries are required to collect and dispose of their waste at **specific disposal sites** and such collection, treatment and disposal is required to be monitored by the concerned State Pollution Control Board (SPCB) or Pollution Control Committee (PCC) in Union Territory or energy recovery process can be enhanced using these biodegradable wastes. The following problems are generally encountered in cities and towns while dealing with industrial solid waste

- There are no specific disposal sites where industries can dispose their waste;
- Mostly, industries generating solid waste in city and town limits are of small scale nature and even do not seek consents of SPCBs/PCCs ;
- Industries are located in non-conforming areas and as a result they cause water and air pollution problems besides disposing solid waste.
- Industrial estates located in city limits do not have adequate facilities so that industries can organize their collection, treatment and disposal of liquid and solid waste;
- There is no regular interaction between urban local bodies and SPCBs/PCCs to deal such issues relating to treatment and disposal of waste and issuance of licenses in non-conforming areas.

NEED FOR A MANUAL ON SOLID WASTE MANAGEMENT:

Preparation of the Manual on Municipal Solid Waste Management is mainly to assist the personnel involved in managing the solid waste generated in the cities/towns of the country.

The purpose of the Manual is to create:

- An understanding that municipal solid waste management is part of a broader urbanization problem
- An awareness of need for competent management of municipal solid waste in urban areas;
- An understanding of various systems available for collection, transportation, recycling, resource recovery and disposals
- An approach to preparing municipal solid waste management plans in the light of the potential problems and issues which may become apparent during project development; and
- To provide operational guidelines for the efficient municipal solid waste management systems.

Proposal for Waste to Energy Plant :

This MSW processing plant proposal is based on the technology developed on pilot scale by the Department of Science and Technology, Government of India. The fuel fluff/pellets made of segregated Indian waste has proven to have a calorific value of 3000- 3500 Kcal/kg with a moisture content of 10% at the final stage.

Biomethanation / anaerobic digestion:

Biomethanation of MSW in India is gaining importance at a considerable amount, but only a few local government bodies could initiate this technology, as the capital investment is very high for the Biomethanation plant. Biomethanation is the process of conversion of organic matter in the waste (liquid or solid) to biomethane (sometimes referred to as "biogas") and manure by microbial action in the absence of air, known as "anaerobic digestion".

Production of Methane from MSW by this process involves three basic steps:

- First step involves preparation of organic fraction of MSW, which includes receiving, sorting, separation and size reduction.
- Second step involves addition of moisture & nutrients (*e.g.*, sewage sludge), blending, pH adjustment to about 6.7, heating of the slurry to between 55 to 60oC, and anaerobic digestion in a reactor with continuous flow, in which the contents are well mixed for a period of time varying from 5 to 10 days.
- Third step involves capture, storage and if necessary, separation of gas components
- evolved during digestion process.

Pyrolysis and Gasification:

Pyrolysis: Pyrolysis is a thermal process where organic materials present in the waste are broken down under pressure and at temperatures greater than 925°F in the absence of oxygen to become gas comprising smaller molecules (Syngas). Along with syngas, char and oil are also produced. The gases produced comprise carbon monoxide (25%), hydrogen and hydrocarbons (15%) and carbon dioxide and nitrogen (60%). Then, syngas is cleaned and burned in internal combustion (IC) engine generator sets or turbines to produce electricity.

Gasification:

Gasification is the partial combustion of organic matter in the presence of restricted quantity of oxygen or air at high temperatures (than Pyrolysis). The gas so produced is producer gas. The producer gas is cleaned and burned in internal combustion (IC) engine generator sets or turbines to produce electricity

CONCLUSION

Municipal Solid Waste Management the major issues to be considered are:

- Increasing waste quantities
- Wastes not reported in the national MSW totals
- Lack of clear definition for solid waste management terms and functions
- Lack of quality data
- Need for clear roles in state and local government
- Need for even and predictable enforcement regulations and standards

Therefore government of Bihar should come forward and make rules such that most of biodegradable wastes should be utilized generating energy and also we have aware the people to save our environment to save their lives to enhance their standards and be safe.

- The waste disposal needs immediate attention and strict monitoring.
- The setting up sanitary landfill sites has to speed up and this needs to be given top priority.
- The number of treatment process plants has to be increased to manage total quantity of waste generated. Many new techniques have been implemented for storage, collection, transfer and transportation. These techniques have brought about many positive changes and have increased the efficiency of the MSWM system.
- Proper training and education needs to be provided to the workers and public awareness programs should be conducted regularly.
- The occupational and health and safety measures taken by the authorities are not sufficient. Health and safety programs has to be conducted regularly to check the health condition of the workers in the various areas of MSWM and they should be educated on the health hazards related to their work and the importance of wearing the safety gear.

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