Waste Management

We humans have an amazing potential to convert everything useful into waste
-Anonymous

WASTE MANAGEMENT

Current Status

Causes

Impacts

Prioritisation

Action Plan

CURRENT STATUS

Rapid urbanisation and industrial diversification has led to generation of considerable quantities of municipal, plastic, hazardous and biomedical waste. Improper disposal of waste often results in spread of diseases and contamination of water bodies and soils. The impacts of these wastes on the economy cannot be ignored and managing them has become a major problem. Under the provisions of the Environment Protection Act, 1986, the Government of India has brought into force the Hazardous Waste Management Rules, 1989, the Biomedical Waste (Handling and Management) Rules, 1998, the Recycled Plastics (Manufacture & Usage Rules), 1999, the Municipal Waste (Handling & Management) Rules, 2000, and the Batteries (Handling & Management) Rules, 2001, for proper management of these wastes. In Karnataka, amongst the 3 types of waste generated in 2003, the largest amount generated is municipal solid waste at 21,43,280 metric tons followed by hazardous waste at 86,137 metric tons and biomedical waste at 27,095 metric tons.

MUNICIPAL SOLID WASTE

As regards municipal waste, on an average 40 to 50 percent of the total municipal waste is generated in the six municipal corporations of Karnataka and more than 70 percent of municipal waste is generated by the residential and market areas. The domestic waste generated by households comprises mainly of organic, plastic and paper waste and small quantities of other wastes. Plastic and glass are segregated at the household level or by rag pickers and sold. The remaining waste is disposed in community bins, which, also contains household hazardous wastes such as batteries, bulbs, discarded ointments and medicines. In addition, about 1 to 2 percent of biomedical waste also gets mixed with municipal solid waste in the community bins.

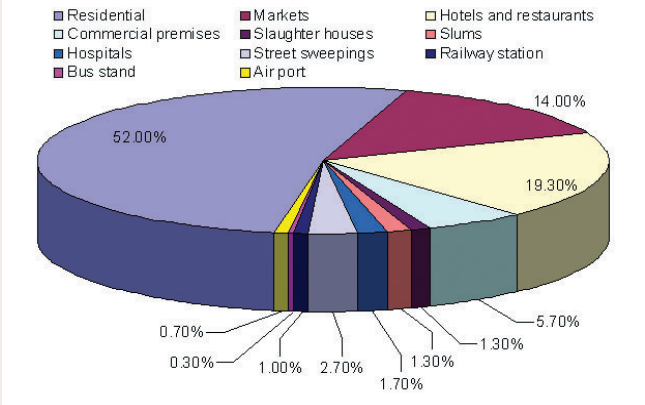
Though, door-to-door collection has been introduced in a few wards of Bangalore and Mysore, the bulk of the municipal solid waste is still collected in community bins and the waste that reaches disposal sites is usually mixed, containing plastic, glass, metals, etc. Many times segregated waste gets mixed up while transporting. Of the total waste generated, each day about 500-600 tons of municipal waste generated from residential, city market

Municipal Solid Waste generation per day in 6 City Corporations of Karnataka for 2002

City Corporations	Population (2002)	Waste generated (tons / day)	Waste Collected (tons /day)	Per capita waste* generated (grams/day)
Bangalore	5,882,162	2,500	1,400	425
Mangalore	551,701	250	200	453
Hubli / Dharwad	801,442	250	200	311
Mysore	794,677	230	183	289
Belgaum	516,155	120	100	232
Gulbarga	452,944	120	100	264
Total	8,999,081	3,470	2,183	386

* Per Capita Waste generated = Waste generated /Population
Source: Respective city corporations

Municipal Solid waste generation by source in Bangalore - 2001



Source wise physical composition of municipal waste in Bangalore in the year 2001

Waste Type	Composition % by weight						
	Residential	Commercial	Hotels & Restaurants	Markets	Slums	Street Sweeping	All Sources
Putrescible	71.5	15.6	76	90	29.9	90	72
Paper	8.4	54.6	17	3	2.5	2	11.6
Plastics	6.9	16.6	2	7	1.7	3	6.2
Glass	2.3	0.7	0.2	-	8.4	-	1.4
Metals	0.3	0.4	0.3	-	0.2	-	0.2
Dust & Ash	8.1	8.2	4	-	56.7	5	6.7
Clothes, Rags	1.3	4	0.4	-	0.5	-	1
Hazardous	1.2	-	-	-	-	-	0.9

and other commercial areas of Bangalore city is collected and transported to the sites maintained by Karnataka Compost Development Corporation, for composting through mechanical and vermi-composting techniques.

The Karnataka Municipalities Act, 1964, and Karnataka Municipal Corporation Act, 1976, have emphasized the need to collect and dispose 'rubbish and filth' in a 'defined' manner, so as to keep public places clean. However, there is no reference to scientific collection and disposal of the waste. Waste collection and disposal was viewed only as a duty concerning maintenance of health and sanitation. With the Municipal Solid Waste (Management & Handling) Rules, 2000, in place, lacunae regarding collection, segregation and disposal practices have been addressed. An amendment to the Karnataka Municipal Corporation Act, 1976, made during 2000 enables corporations to levy a solid waste management cess. Consequently, it is expected that the municipal corporations should be able to handle municipal solid waste more efficiently.

The Municipal Solid Waste (Handling & Management) Rules, 2000 provide for collection, segregation, storage, transportation, processing and safe disposal of municipal solid waste excluding hazardous waste generated from industries and untreated biomedical waste generated from health care establishments. It is applicable to every municipality involved in management of municipal solid waste right from collection to final disposal. These rules lay emphasis on environmentally sound management of municipal solid waste.

In Bangalore, Belgaum, Gulbarga, Hubli-Dharwad, Mangalore and Mysore cities solid waste is being dumped on open sites outside the cities since many years and till now no city or town in the state has an engineered landfill with total waste recycling system to dispose the non-recyclable municipal wastes. Thus, most of the collected waste is disposed on private lands or municipal corporation land situated in the outskirts of the city. For the disposal of municipal solid wastes, as of November 2003, out of 226 urban local bodies in Karnataka, 220 have identified landfill sites and applied for authorization, 6 local bodies are yet to apply for authorization. 192 local bodies have received the authorization from the Karnataka State Pollution Control Board for establishment of landfill facilities while 8 sites were rejected.

The workforce employed for management of solid waste and the budget allocation made for this purpose vary from one city municipal corporation to other. The ratio between the health workers and the population varies between cities. In Bangalore, for every 301 persons there is one health worker whereas in Gulbarga, for a population of 631 persons one worker is available. In Mysore, Mangalore, Belgaum and Hubli-Dharwad, one worker is available for a population of 373,383,430 and 496 persons respectively. The work force is deployed without any scientific analysis of the quantum of work involved. There are no guidelines stipulating the worker to population ratio. Various factors like amount of waste generated, collection mode, availability of collection bins and trucks, common treatment and disposal facilities, decentralized waste processing plants and landfills should determine the adequate number of workers required in any city corporation.

Slaughter house waste

Karnataka produced 81,057 metric tons of meat in 2001 with Bangalore contributing to 18 percent of the production (14,227 metric tons). The meat processing operation consists of slitting and bleeding, deskinning, evisceration, cleaning and carcass washing which are all water consuming. The waste generated consists of dung, blood, hair, condemned parts, skin pieces, fat, paunch manure and wastewater. Though the wastes from slaughter houses come under the purview of Municipal Waste (Handling and Management) Rules, 2000; it is important to note that the waste is similar to bio-medical wastes in terms of its infectious and bio-hazard nature.

The wastes and wastewater is highly infectious and safe treatment is necessary. In Bangalore stipulated environmental requirements are not adhered to by the slaughter houses. The stipulated effluent treatment plant is either not installed or does not operate efficiently. The effluents contain blood, dropping, fat, intestinal contents, and pieces of inedible materials which put a high load on the effluent treatment plant and are therefore many times let into the underground drains. The Government is considering the modernization of the slaughterhouse at Tannery Road or the possibility of relocating it. The Karnataka Meat and Poultry Marketing Corporation is also proposing to establish 6 rural slaughterhouses within a radius of about 50 kilometres around Bangalore city to reduce the transport of animals into the city. The Karnataka Meat and Poultry Marketing Corporation is also proposing to modernize the slaughterhouses at Belgaum, Gulbarga, Hubli-Dharwad, Mangalore and Mysore or to relocate them to the city outskirts.

Current status municipal solid waste disposal in 6 city corporations

City Corporation	No of dumpsites	Area of dumpsites	Distance from city	Period of usage	Existing composting plant	Existing landfill site	Identified landfill site
Bangalore	2	10 acres	12 kms	27 yrs	Yes	No	Yes
Belgaum	1	8 acres	2 kms	40 yrs	No	No	Yes
Gulbarga	1	15 acres	4 kms	4 yrs	No	No	Yes
Hubli Dharwad	2	38 acres	3 kms	30 yrs	No	No	Yes
Mangalore	1	70 acres	15 kms	50 yrs	Yes	Yes	Yes
Mysore	1	4 acres	5 kms	1 year	Yes	No	Yes

Source: Respective city corporations, Karnataka State Pollution Control Board, 2003

Important acts for solid waste management and suggested amendments

The Karnataka Municipalities Act, 1964

The Act is applicable to all municipalities in the State and various obligatory functions of the municipal council are listed under Section 87 of the Act. The provisions relating to soild waste provide for *"cleaning of public streets, places, sewers and all spaces not being private property, removing noxious vegetation, etc."* The same provision further provides for providing respectacles for collecting 'rubbish'. Section 224 of the Act prohibits disposal of 'rubbish and filth' in public places, streets, drains, water courses, etc. Section 226 of the Act provides for imposing fine for violating these legal provisions. However, it is very relevant to mention that the amount of fine is as low as Rs 5 and highest is Rs 25.

Karnataka Municipal Corporations Act, 1976

The obligatory functions of the municipal corporations are covered under the provisions of this Act. The Corporation Commisioner is responsible for proper arrangement of storage and final disposal of 'rubbish and filth' as per Section 225 of the Act. Further, Sections 256 and 257 empower the Corporation Commisioner to direct either the owner or occupier of the private premises to remove rubbish or filth. This Act also provides for imposing very nominal penalty for violating the provisions mentioned above.

Solid waste management cess: Section 103A of the Karnataka Municipal Corporations Act, 1976 has been amended in 2000 by introducing a new provision that enables municipal corporations to levy solid waste management cess not exceeding 1000 rupees per month.

Legislative action for waste management: The schedule 12 of the Constitution of India enjoins the local bodies to maintain the environment of the area under their jurisdiction and includes public health, sanitation, conservancy and solid waste management.

Amendments suggested

- Section 87 of the Karnataka Municipalities Act and Section 58 of the Karnataka Municipal Corporations Act address the obligatory functions concerning waste management with respect to only sanitary and health issues. These provisions do not fully provide for most critical environmental issues like sewage maintenance, prevention of air pollution, environmental planning, prevention of pollution, management of waste and they are not linked to powers, action plans and accountability. Municipal corporations need to be further strengthened by amending suitable provisions which enable municipal solid waste management in a more environment friendly manner. Amendments should be in confirmity with the stipulations envisaged in the Municipal Solid Waste (Management and Handling) Rules.

- The above mentioned acts provide for penalties for violating certain legal provisions pertaining to health and sanitation. However, the penalties envisaged are very meager and ineffective. Amendments to these provisions to enhance penalties are needed to deal with violation of waste management rules.

- Similar amendment needs to be made to the Panchayat Raj Act,1999, to make it obligatory on part of the village panchayats to manage and dispose waste generated in villages.

Source: Review of Local Bodies Acts and Rules of Karnataka on environmental issues, EMPRI, 2003

Problems of municipal solid waste

The key problems of municipal solid waste include

- mixing of waste
- collection and storage of waste
- transportation of waste
- indiscriminate burning of waste
- illegal disposal of waste

Mixing of waste

With only a small percentage of households going in for segregation, the municipal solid waste generated is generally mixed, thereby resulting in disposal sites receiving highly heterogeneous composition of waste. In industrial areas too, the problem of mixed wastes exists as the domestic waste from industries is disposed along with industrial solid hazardous waste such as sludge, metallic scraps, etc., to the community bins located in the industrial area or given away to private contractors. The mixed waste finds its way for disposal into the municipal or private lands as the case may be. This is more prevalent in private industrial areas where there are many small and tiny industries and no space is available to store or dispose the waste.

Collection and storage of waste

Waste collection and disposal lies at the core of municipal solid waste management. Waste management happens to be the single largest category of expenditure in many municipal budgets. Failure or inadequacy of collection, often result in problems of overflowing bins which is a common scenario and major threat to public health. Given its high visibility and importance, collection should receive high degree of scrutiny and analysis. But, in reality, the opposite is quite often true. Workers are often not motivated, untrained, undercompensated, and unnoticed. Further, obstacles to efficiency are obsolete or nonfunctional equipment and inadequate transport facilities which have not kept pace with urban growth. The poorer sections of the society often do not get proper waste collection services or are completely unserved.

Transportation of waste

Transportation is another key component in determining the economies of waste management. Often there is a mismatch between the quantum of waste generated in the city and the vehicles available for transport. Also, the type of vehicle used for transporting municipal solid waste is often not properly designed. The vehicles with closed mechanical loading system should be preferred to prevent garbage spilling during transportation. However, most of the time it is the open trucks which are used to collect the waste. Further, the vehicles do not have segregated compartments for collecting different type of wastes. Many a time though waste is segregated at source and collected in different bins, at the time of transportation when the trucks are loaded the waste is dumped together, thereby defeating the whole purpose of segregation. Transportation of waste over long distances is another problem which is often encountered as there are no relay centres. Use of slow moving waste collection system, manual loading, inefficient use of collection trucks and improper placing of dustbins results in loss of man hours and inefficient waste collection.

Anaerobic Digestion / Biomethanation Treatment of Wastes

Organic components of the wastes is segregated and fed to biogas digester where, in the presence of methanogenic bacteria and under anaerobic conditions, it undergoes bio-degradation producing methane rich biogas and effluent. Biogas mainly consists of methane (about 60-75%), carbon dioxide (about 25-40%) besides small quantities of ammonia and hydrogen sulphide and has a calorific value of about 5000 kcal /m^3. Depending upon the waste composition, the biogas production ranges from 50-150m^3/ton of wastes. The biogas can be utilised either for cooking / heating applications or for generating motive power or electricity through dual fuel, gas engines, low pressure gas turbines or steam turbines. The sludge from anaerobic digestion, after stabilisation, can be used as a soil conditioner or as manure.

Indiscriminate burning of waste

In Karnataka, no engineered landfill with a total waste recycling system exists to dispose municipal wastes. Most of the collected waste is disposed on private lands or municipal land located in the outskirts of the city. It is burnt either as roadside heaps or at dump sites to reduce waste volume and /or to recover recyclable materials. Indiscriminate open burning of waste significantly contributes to urban air pollution as the mixed waste contains tyres, aluminium foils, metallic scrap and domestic hazardous waste that emit highly toxic fumes.

Directions of the Government for transport of municipal solid waste

The Department of Environment and Ecology has recently issued an order in January 2004, directing the Commissioners of the city corporations and the Commissioners / Chief officers of the city municipal councils/Town municipal councils to take all necessary steps to effectively comply with the directions specified in the order for transportation of municipal solid wastes. Non compliance of the directions shall attract Section 15 and 17 of the Environment (Protection) Act, 1986. The directions include

1. The municipal solid wastes shall be transported hygienically through specially designed transport system so as to prevent foul odour, littering, unsightly conditions and accessibility to vectors. There shall not be any leaking of liquid wastes or ingress of rainwater.
2. The vehicle shall carry adequate polythene sheets to collect the scattered solid waste in the event of an accident.
3. The transportation vehicles shall be so designed that multiple handling of wastes, prior to final disposal, is avoided.
4. The transportation vehicle shall possess valid "Fitness Certificate and Pollution Under Control Certificate" and certified transport vehicle under the Motor Vehicle Act.
5. The storage facilities set up by municipal authorities for temporary containment of municipal solid wastes shall be cleared before they start overflowing.
6. Workers handling municipal solid waste for loading and unloading shall wear hand gloves and gum boots compulsorily. The workers shall be made aware of personal hygiene.
7. The vehicle shall have a first-aid kit to treat the workers in case of accidents or injuries while handling wastes.
8. Smoking and carrying inflamable material inside the vehicle shall be strictly prohibited.
9. If an accident occurs during transportation of municipal solid waste, the municipal authority shall forthwith report the accident in the prescribed form to the Secretary, Urban Development Department in case of metropolitan cities, and to the Deputy Commissioner in all other cases.
10. Hazardous wastes, toxic wastes, industrial wastes, untreated bio-medical wastes shall not be transported along with municipal solid wastes.
11. Bio degradable waste as well as construction or demolition wastes or debris shall be transported separately so as to make use of such wastes.
12. In case of vehicles which are owned by the city corporation/ city municipal councils/town municipal councils, such vehicles shall be converted/replaced in compliance with the above mentioned criteria within a period of 3 months.
13. The commissioners of the said city corporations and the commissioners/chief officers of the city municipal councils/ Town municipal councils are required to furnish monthly action taken report to the Secretary, Environment and Ecology Department .

The waste handlers and rag pickers present at the site to recover material are the most affected.

Illegal disposal of waste

Illegal disposal of wastes is a serious problem having several long-term ecological impacts. Unscientific disposal of wastes at dump sites for prolonged duration results in land degradation and ground water pollution through leachate percolation. A study in Bangalore reveals that daily an estimated 600 tons of municipal solid waste is dumped illegally in residential areas and outskirts of the city. In Belgaum, waste is disposed in low-lying areas on city outskirts and the dump site is located just 2 kilometers from city. During monsoon the stagnant water could cause soil contamination and spread of communicable diseases.

Very often budgetary allocation for waste management is not adequate and even when funds are available they are not properly used to address the issues of accountability, efficiency and proper planning. With most of the funds allocated spent on payment of salary and uniforms to sanitary staff, very little funds are made available for developmental work like engineered landfills and transportation.

One of the adverse factors in managing municipal solid waste is the mindset of the general public with respect to segregation of waste and also asserting their rights for a clean and safe neighborhood. Added to this is the lack of knowledge on waste minimisation and the benefits of recycling . To ensure waste minimization and recycling, systematic guidelines need to be in place, which is at present lacking in city corporations and urban local bodies. Though, some recycling takes place through the rag pickers, the chain of the recycling process is not complete and often results in illegal burning or dumping.

Trends and projections for municipal solid waste

Considering the present annual growth rate of 5 percent in waste generation in the State, the projected municipal solid waste generation by 2011 will be about 7424.8 metric ton/day. As all urban local bodies are directed to set up waste processing and disposal facilities, it is assumed that existing practice of illegal waste disposal will be reduced.

At present only about 9 percent of the recyclable material (plastic and paper) is recovered due to non-segregation of waste. By practicing segregation, the extent of recyclable material can be increased to 15 percent. It is also estimated that by 2010 the quantity of recyclable wastes in municipal solid waste is expected to increase by 10 percent, the construction and demolition wastes would increase by 35 percent and the wastes that can be disposed off in landfills would increase by 20 percent.

Government initiatives on ban of plastic articles

Directions have been given to the Tourism Department, Horticulture Department, Jungle Lodges & Resorts, and the Forest Department under the provisions of Environment Protection Act, 1986 to take all necessary steps to ban usage of plastic articles such as carry bags (irrespective of thickness and size), plates, cups/tumbler, spoons, forks, straws by any person inside the eco-tourism areas and zoos. The Government further directed that biodegradable alternatives made of paper, wood, pressed leaf, jute and cotton are to be encouraged in place of plastic articles as this would be eco-friendly and also generate local employment.

■ PLASTIC WASTE

Plastic has been a wonder chemical put to several uses and has become indispensable in day-to-day use. However, unscientific disposal of plastic wastes can lead to many environmental problems. Used plastic often gets mixed with municipal solid waste or gets into the drains. Plastic when mixed with municipal solid waste reduces the composting efficiency by decreasing water permeability as well as air circulation. Plastics pose unique problem in municipal solid waste management due to the considerable amount of time required for degradation. It also causes soil pollution and storm water drains are often clogged due to plastic waste.

The Recycled Plastics (Manufacture and Usage) Rules, 1999, relate to prohibition of usage of carry bags or containers made of both virgin and recycled plastics. The amendment of the rules in 2003 have further restricted the use of carry bags and containers made of recycled plastics for storing, carrying, dispensing or packaging of food stuffs. The rules specify that no person shall manufacture, stock, distribute or sell carry bags made of virgin or recycled plastic bags which are less than 8 X 12 inches (20 X 30 cms.) in size and which do not confirm to the minimum thickness of 20 microns.

In Karnataka, there are about 2996 plastic industries producing about 600 metric tons of produce per day and generating plastic wastes of 28 metric tons/day. Bangalore district alone has about 1,199 plastic industries which generate about 11 metric tons/day of plastic wastes. The plastic waste generated in household sector is estimated to be around 470 metric tons/day. Plastic waste in Bangalore forms nearly 176 metric tons of the total 2,500 metric tons/day of waste generated. In Bangalore around 300 plastic reprocessing units are functioning with a daily turnover of more than Rs. 28 lakhs while on an average 35 tons of non recyclable plastic is being disposed indiscriminately everyday in and around Bangalore.

Considerable amount of non-recyclable plastic materials is disposed off in open lands and drains that can drastically affect soil permeability, water infiltration rate and recharge potential and routinely clog drains. To address the problem of used plastic in municipal solid waste it is advisable to segregate it at source and recycle it to produce some useful items. Plastic recyclable wastes have a market value ranging from one rupee to fifty rupees per kilogram depending upon the type and source of plastic. However, it must be noted that the recycling process is also a polluting one and hence the best way to solve the problem of plastic is to avoid the use of plastic.

Market value of plastic recyclable waste

Recyclable material	Market value (Rs/Kg)
Plastic wires (PVC Based)	10-50
Plastic bags and packaging material made out of virgin material	8-10
Buckets, drums, cans, disposable cups, bottles, rigid pipes, agricultural pipes, plastic crates, cassettes, pens, box straps, bobbins, shampoo bottles, woven sacs, etc.	2-16
Milk pouches	8-10
Electronic items like computer components, calculators, television housing	1-6
Car bumpers	1-6
Industrial wastes like weaving wastes, cutting wastes, damaged items	5-8
Mixed colour polythene bags	2-3

Impact of plastic recycling on the environment

India is rated as one of the highest recycling countries in the world. However, in the recycling process of plastic, the larger proportion is invariably converted to 'down-cycled' inferior product. In the recycling process, extensive sorting, cleaning and removal of additives is necessary and all of which affect the environment and public health.

Grinding of plastic scrap is a noisy operation with noise levels reaching upto 95 decibels. Small scale units are often designed neither for environmentally sound technologies nor for the better processing cum pollution control system. Absence of adequate ventilation systems, lack of space, unhygienic conditions and old equipment often used routinely expose the workers to toxic colours and other pollutants during processing.

The major pollutants of grinding process are suspended and respirable particulate matter. Besides, workers are also exposed to vapours and dusts containing chemical intermediates, polymers and additives during mixing, pelletising and maintenance operations. Plastic grinding generates polymer dust, resulting in inhalation and combustion hazard. The flakes or chips of plastic waste are soaked in caustic soda and detergent for 1 to 3 days and then rinsed with hand exposing the workers to alkaline solution for 6 to 8 hours.

Chemical nature of Plastics and its impacts on Human health

Types of Plastics	Chemicals Present	Impacts
Poly Vinyl Chloride	Organo chlorides like Dioxins, Phthalates	Dioxin is a human carcinogen (causes Angisarcoma). Causes birth defects, foetal death, spontaneous abortions, disrupts hormone system, suppresses immune system, damages to the liver, kidneys and reproductive systems
Poly Urethanes	Isocynates, Polycyclic Aromatic, Hydrocarbons (PAMS), Dioxins	Causes Asthma
Polystyrene	Styrene, 1-3 Butadiene	Human carcinogenic substances
Acrylo Butadiene Styrene	Butadiene, Styrene Acylonitrile	Acylonitrile is a highly toxic substance readily absorbed by inhalation and directly through skin, Causes severe eye irritation, headache and nausea.
Poly Carbonates	Methylene, Chloride Chloroform, Chlorobenzene	Disrupts the hormone system
Polyethylene Teraphthalate	UV stabilizers, Pigments	Irritation of eyes and respiratory tract.

Source: Study on plastic industries in Karnataka-2001, KCPC

Use of plastic waste in pavement modification

Attempts have been made to use disposed polycups for pavement modification. The addition of this poly-cup material imparts more stiffness to the conventional bitumen which has application in areas where breaks are frequently applied like intersections, round about, crossing, merging of roads etc. This also imparts more resistance to permanent deformation leading to longer economic life.

■ HAZARDOUS WASTE

Hazardous waste consists of both solid and liquid residues of different industrial processes, effluent treatment plants and expired products. Although many industries have been in existence for the past 15-20 years, records of hazardous wastes are available only for past few years. The Karnataka State Pollution Control Board in 2002- 2003 has identified 1107 working industries generating hazardous waste. Of these, 937 industries have applied for authorisation for storage of hazardous wastes and 928 industries have been granted authorisation considering the infrastructure available. Chemicals, textiles and automobile industries are the three largest contributors of hazardous waste. Of the total 86111 metric tons of hazardous wastes generated in 2002- 2003, 28366 metric tons is reprocessable, 4568 metric tons is incinerable and 53177 metric tons is disposable in landfills. Of the total hazardous waste generated in the State, 33 percent is recyclable and the remaining 5 percent is incinerable while the rest 62 percent needs to be disposed into a landfill. The Karnataka State Pollution Control Board has authorized 56 reprocessors to reprocess waste oil , printed circuit board waste, lead, zinc, aluminium, spent solvents and spent catalyst / activated carbon. For the safe disposal of hazardous waste Government of Karnataka has taken the initiative in identifying two potential sites for

establishment of treatment, storage, and disposal facility in Siddlaghatta taluk in Kolar district and Thimmanayakanahalli near Dobbaspet industrial area in Bangalore Rural district.

Problems of hazardous waste

The main issues of hazardous waste are

- illegal disposal of hazardous waste,
- mixing of municipal solid waste with hazardous waste,
- improper management and handling of waste,
- absence of disposal sites for hazardous waste
- generation of hazardous waste by the unorganised sector.

Illegal disposal of hazardous waste

Due to the absence of engineered landfill sites, the disposal of the major portion of hazardous waste is the biggest problem. Most registered units are practicing onsite storage whereas the unregistered units are disposing the wastes illegally on highways, lakes, agricultural lands etc., through private contractors.

Household hazardous waste

While hazardous waste generated by industries is known and regulated, the hazardous waste contributed from the household goes unchecked. Common household products like old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries and shoe polish contain constituents which are hazardous.

Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminum foils, plastics, and other such non biodegradable items that cause incalculable harm to the environment. The problem is compounded by the fact that there is very little awareness among the masses regarding proper handling and disposal of household hazardous wastes.

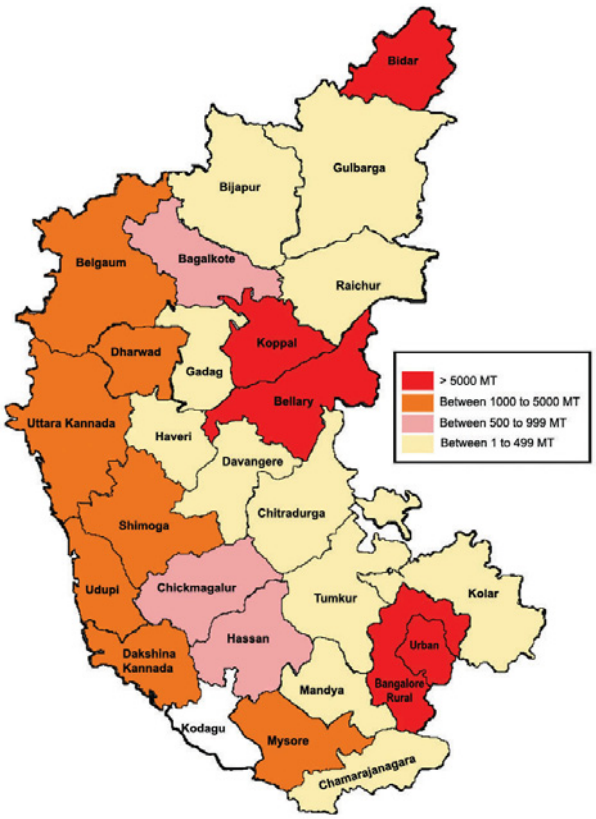
Household hazardous wastes are sometimes disposed of improperly by individuals pouring wastes down the drain, on the ground or into storm water drains. The dangers of such disposal methods may not be immediately noticed or visible, but certain types of household hazardous wastes have the potential to contaminate waterbodies and some also seep through soil and contaminate groundwater. They may be hazardous to children and pets if left around the house. If let into the sewer lines, they may end up in the sewage treatment plant where they affect the treatment process. In household septic tanks, they can kill bacteria which carry out the biological treatment process.

Number of authorised reporcessors along with item and quantity reprocessed

Items reporcessed	No of Units authorised	Total amount reprocessed	
Printed Circuit Boards	11	3,583	MT/yr
Lead Acid Batteries	11	512	MT/yr
Spent activated carbon	2	6	MT/yr
Zinc waste	2	3,720	MT/yr
Discarded containers	1	21,600	Nos
Spent solvents	6	1,032	KL/yr
Aluminium waste	3	609	MT/yr
Waste oil	20	51,924	KL/yr

An added issue of illegal disposal of liquid hazardous waste is on the municipal sewage treatment plants, which are designed to treat only the domestic sewage and are based on biological treatment methods. Toxic liquid hazardous waste getting illegally discharged into the under ground drains/sewers inhibit and destroy the bacterial culture responsible for treating the effluent and thus reduce the treatment efficiency.

Distribution of Hazardous waste generation in Karnataka during 2002-03



Constituents of hazardous waste from various sources, their composition and impacts

Sources of hazardous waste	Constituents	Composition of waste	Impacts
Engineering units	Waste oil and oil emulsions	Paraffin, cycloparaffin, aromatics and organic compounds	Formation of thick layer on the water body affects the food productivity of aquatic animals, oil spilling causes lethal toxicity on fish and aquatic flora
Chemical industry	Tarry waste/heavy metals	Toxic compounds, phenols, organic acids	Organic acids, alkalies make the water corrosive.
Paper and Pulp	Sludge/slurry waste	Organic compounds, acetone, inorganic dyes, phenols	Toxic discharges may inhibit the natural purification of the water bodies
Pesticide industry	Pesticide waste	Monocrotophos, dieldrin, Inorganic pesticides having copper, cadmium, ferrous, manganese, zinc compounds	Chronic water pollutants, Inorganic chemicals disrupt the aquatic organisms
Dye industries	Waste from dyes	Phenolic compounds, tartaric acids	Causes deleterious effects on living organisms

Salient features of Hazardous Wastes (Management and Handling) Amendment Rules 1989, 2000, 2003

In accordance with the powers conferred by Environment Protection Act, 1986, the Ministry of Environment and Forests notified the Rules in 1989. This rule was to cover hazardous wastes excluding those covered under the Air Act, 1981 and Water Act, 1974 and excludes radioactive wastes, and wastes from ships operating beyond 5 kms from the shore

The salient features of these rules are :

- Provide for proper collection, storage, treatment and disposal of hazardous waste either by the occupier or by the operator of a facility.
- Empowers the state regulatory body to grant authorization to an operator or occupier for any of the above activities and to either suspend or cancel an authorization if the authorized person has failed to comply with any of the conditions of the authorization.
- Ensure proper packaging, labeling and transportation of hazardous waste by the operator in accordance with the provisions of the Rules issued by the Central Government under the Motor Vehicles Act, 1988.
- Emphasis is given on environmentally sound management of hazardous waste to ensure the protection of human health and environment against the adverse effects that could be result from such wastes.
- Protection of the waste handlers from accidents. Duty of the occupier of hazardous waste and the operator of a facility to train the waste handlers.
- Mandatory to obtain permission for import or export of hazardous waste in compliance with Basel convention.

In cases, when these liquid hazardous wastes are discharged into storm water drains they get directly discharged without treatment into natural valleys impacting the receiving water bodies. Unscientific storage of hazardous waste could contaminate the ground water in the long run.

Mixing of municipal solid wastes with hazardous wastes

Non segregation of wastes generated in households and industries leads to mixing of municipal solid waste and hazardous waste. This often results in disposal sites recieving mixed hazardous waste.

Improper management and handling of wastes

Lack of technical knowledge and bad management practices lead to unscientific handling of hazardous waste. Onsite storage practices of industrial hazardous waste pose a serious problem to the environment and health and safety of workers.

Absence of disposal sites for hazardous wastes

Due to absence of disposal sites, the excessive or uncontrolled onsite storage of hazardous waste for a prolonged duration makes any industry to face considerable waste management risks and challenges. In major cities like Bangalore and Mysore about 14,000 metric tons of hazardous waste is stored onsite at individual industrial premises.

Market value of certain recyclable wastes

Recyclable material	Market value (Rs/Kg)
Aluminium dross	25-40
Zinc	50
Lead dross	23-25
Waste oil	14-18/L
Spent solvents	11-15/L
Activated carbon	8-10/Kg

Generation of hazardous waste by the unorganised sector

The large number of unregistered, small and tiny units in the state generate hazardous waste in small quantity which goes unaccounted. Most of these industries are situated in residential localities and dispose thehazardous waste into municipal bins. These wastes not only pose immediate health and safety problems to the residents but also pose problems in disposal.

The Basel Convention

The Basel Convention, to which India is a signatory, sets up obligations for countries to reduce transboundary movement of wastes with the main objectives of:

- minimization of hazardous waste generation in terms of quantity and hazardousness.
- disposal as close to the source of generation as possible.
- reduction in the movement of hazardous wastes.

It provides for a comprehensive regime for liability and adequate and prompt compensation for damage resulting from the transboundary movement of hazardous wastes and other wastes and their disposal including illegal traffic. The convention covers damage due to any incident occurring during a transboundary movement of hazardous wastes and other wastes and their disposal, including illegal traffic, from the point where the wastes are transported. The import of hazardous waste into India is prohibited by a 1997 Supreme Court directive.

The Batteries (Management & Handling) Rules, 2001

These rules apply to every manufacturer, importer, re-conditioner, assembler, dealer, recycler, resmelter, auctioneer and consumers. The term 'Battery' used in the rules means lead acid battery, which is a source of electrical energy and contains lead metal and 'used batteries' means used, damaged and old lead acid batteries and parts thereof. The Karnataka State Pollution Control Board has identified 1079 battery handling units in the state in the year 2002-2003.

Action taken by Board in the year 2002-2003 under Batteries (Management & Handling) Rules, 2001

Number of units identified	1079
Number of notice/show cause notices issued	1079
Number of closure orders issued	3
Number of closure seizure issued	2
Number of proposed directions issued	2

■ ELECTRONIC AND ELECTRICAL WASTE

The negative environmental effects of growing consumption of electronic hardware are visible in the end-of-life stage of the electronic equipment. With the increase in usage of electrical and electronic goods like refrigerators, televisions, computers, fax machines, photo copiers, telephones, etc., the problem of disposal of such waste is a major one. At present, there exists no information regarding the generation of electronic waste in state.

E-waste, as it is generally called, represents a deadly cocktail of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes; mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires. It is difficult to recycle these materials in an environmentally sound manner and requires sophisticated technology and processes.

Material recycled and discarded in e-waste

Type of item	Materials recycled	Materials discarded
Printed Circuit Board (PCB)	Copper, plastic bases	Phenols, Epoxy, Glass
Connectors	Copper, MS fittings, Springs	Lead, PVC/ABS body
Capacitors	Copper, Aluminium	PVC, Mylar, petroleum jelly
Transformers	Copper core lamination	PVC bobbin, insulators
Resistors	NIL	Discarded whole
Transistors	NIL	Discarded whole
Integrated Circuits	NIL	Discarded whole
Gas tubes, gas displays	NIL	Gas, Glass, Phosphor Coatings

Innovative reuse of wastes demonstrated under Indo Norwegian Environment Programme

The Indo-Norwegian Environment Programme launched in the year 1997 in Karnataka has been working towards utilization of waste products to produce wealth.

Products from Iron ore tailings

Substantial iron ore waste is accumulated in Karnataka every year from the mining industry. By using the iron ore waste as a substitute for clay in preparing building materials like bricks and tiles, a breakthrough has been made in addressing two environmental issues: topsoil depletion and iron ore waste disposal. This was achieved under Indo-Norwegian Environment Programme by the establishment of a Technology Development and Demonstration Cell, at Surathkal to produce bricks and tiles from iron ore tailings.

Products made from iron ore talings

Fly ash utilization for building material

Centre for Ash Utilisation Technology and Environment Conservation has been set up for use of coal ash as a raw material for manufacture of building products on a semi commercial scale. Raichur Thermal Power Station uses about 18,000 metric tons of coal per day generating about 70,000 metric tons/year of fly ash. Entrepreneurs from the four northern districts of Karnataka, namely Raichur, Bellary, Gulbarga and Bidar were trained in the use of fly ash to create building material. Value addition to fly ash has been achieved through the development of construction material. The products include clay bricks, stone power cement bricks, hollow concrete blocks, soil cement blocks, acid resistant bricks/tiles, glazed floor and wall tiles, pre-stressed concrete poles. Apart from this, fly ash is also an important constituent of portland cement.

Bricks made from fly ash

Stored Bio gas from coffee effluents

Bioreactors to treat coffee effluents

The coffee growing areas of Karnataka are mainly located in the western ghats and processing of coffee has posed a threat to fresh water streams of the western ghats. An initiative taken up by ASTRA of Indian Institute of Science is to adopt bioreactors for treating coffee effluents and use the sludge from the reactor as manure. The gas generated in the bio reactor plant is used for cooking and lighting purpose. Under this project four pilot plants are built and working in three coffee growing districts of Karnataka.

Problems of electronic and electrical waste

The problems of electronic and electrical waste include

- mixing of e-wastes with municipal solid waste
- indiscriminate burning of e-waste

Mixing of e-wastes with municipal solid waste

At present there is no system of separately addressing the waste treatment and disposal problem. A lot of waste generated from consumer goods from households generally get mixed with municipal waste posing environmental hazards. Though some recycling is carried out at the local rag picker level a lot of rejects still enter the municipal solid waste.

Indiscriminate burning of e-waste

Most of the printed circuit boards are burnt to destroy the plastic bases to retreive precious metals. In fact, the plastic casings of personal computers made of either polyvinyl chloride or acrylonitrile-butadiene styrene land up at kilns as a source of energy due to high percentage of silicate. These are often carried out in backyards which affects the health of the worker and causes air pollution. The effects are potent mostly to the soil and water bodies, as

Collection of e-wastes

most of the constituents are hazardous in nature. The impacts of electronic waste arise due to the very high leaching potential of materials like printed circuit board containing copper, phenols, epoxy or connectors, capacitors, transformer, resistors, transistors containing copper, aluminium, iron, lead, polyvinyl chloride, etc. These wastes if discarded improperly leach into the soil and in turn contaminate the ground water.

The recycling and reuse of post-consumer electronics is either technically problematic or is economically not feasible or simply lacks an appropriate physical infrastructure which will require huge investments to build. The disposal and recycling of e-waste in the country has become a serious problem as the methods of disposal are very rudimentary and pose grave environmental and health hazards. In addition , India also has to manage the waste being dumped by other countries.

BIOMEDICAL WASTE

Biomedical waste is the waste generated during diagnosis, treatment, immunisation and research activities involving human beings and animals. Biomedical waste comprises of a maximum of 20 percent infectious, 3 percent hazardous and 77 percent noninfectious waste. Wastes originating from blood banks and laboratories, veterinary institutions and clinics, artificial insemination centres also come under the purview of the Biomedical waste Rules. The segregation of biomedical waste is being practiced in most of the major hospitals by ensuring adequate and proper placement of colour coded waste containers with plastic liners. A small proportion of health care establishments (254 hospitals under Karnataka Health Systems Development Project) have introduced sharp waste management practices like puncture proof containers, sharp treatment chemicals and needle pits for sharps disposal, while most of the health care establishments in the State lack facilities for sharp waste management. The Karnataka State Pollution Control Board has identified 5954 health care establishments. During 2002-03 the board received 2440 authorisation applications for health care establishments and provisional authorisation has been granted to 2357 health care establishments after inspection by field officers.

In Karnataka, 131 licensed blood banks (government and private) are operating, which generate about 200 kgs per day of biomedical waste. Till June 2003, 69 blood banks (government and private) were authorized for biomedical waste handling. The expired blood samples in the banks and laboratories are pretreated with 1 to 2 percent hypochloride solution for the required retention time and then drained off in the sewerage channels.

Veterinary clinical wastes include waste from veterinary hospitals, dispensaries, primary veterinary centres, artificial insemination centre, mobile veterinary clinics and have to be treated as per the biomedical wastes rules. Veterinary wastes include waste from clinical laboratories, animal wastes, sharp wastes, chemotherapeutic wastes, pharmaceutical wastes. Very few institutions like National Centre for Biological Sciences, Bangalore; Department of Clinical Veterinary Medicine, Bangalore and Veterinary Hospital, Belgaum treat the biomedical wastes using incinerators. At present, in Karnataka about 3774 veterinary health care establishments including mobile veterinary clinics and artificial insemination centers are available to attend to the state's livestock population. The Karnataka State Pollution Control Board has identified 3203 veterinary health care establishments (excluding

Estimation of Bio-medical waste generation in Karnataka

Type of Health Care Establishments	Health care establishments	Bed Strength	Unit waste generation	Total waste Generation (kg/day)
Private and Govt. health care establishments	5,954	80,000	1.0 (Kg/bed)	80,000.00
Health care service Centres				
Blood banks	131	--	1 .5 (Kg/day)	196.50
Diagnostic labs, eye banks etc	300 (Approx.)	--	1 .0 (Kg/day)	300.00
Small clinics (general practitioners)	40,000 (Approx)	--	0.2 (Kg/day)	8000.00
Veterinary clinics	3203	--	0.25 (Kg/day)	800.75
Total biomedical waste generation (Kg/day)				**89297.25**
Annual biomedical waste generation (MT/annum)				**32593.50**

artificial insemination centres and mobile veterinary clinics) of which, as on March 2003, 126 have applied for authorization under the Bio-medical Waste (Handling and Management) Rules. Most of the veterinary clinics are disposing the wastes into municipal bins and partially through onsite landfills.

There are two common bio-medical waste treatment and disposal facilities in Bangalore, while there is one each in Belgaum and Mysore which are functional in the state as on date. Two facilities one each in Hubli-Dharwad and Gulbarga are under construction.

Problems of bio medical waste

The main problems relating to biomedical wastes include

- mixing of biomedical waste with municipal solid waste
- improper management and handling of wastes
- improper management of sharp wastes
- dumping of waste from private health care establishments.

Mixing of biomedical waste with municipal solid waste

Lack of infrastructure in most of the clinics results in mixing of infectious, noninfectious and hazardous wastes which are then disposed into the community bins. Even though hazardous and infectious waste constitute only 1 to 2 percent of the total waste, when mixed the entire waste becomes hazardous/infectious which drastically increases the chances of affecting the health of waste workers and rag pickers. This also affects the normal management practices of municipal solid waste like composting and waste recovery/recycling.

Categories of Bio-medical waste stream, their impacts and recycling mode

Biomedical waste category	Impacts	Recycling Category
Infectious Waste		
Anatomical wastes (tissues, organs and body parts)	Infects waste handlers and dependents through direct contacts, vectors	Non-recyclable
Human blood, body fluids, bandages and cotton wastes and other medical washes	Infect through direct contacts or by vectors and spreads diseases like typhoid, tuberculosis, hepatitis, AIDS etc.,	Non-recyclable
Microbial cultures and stocks (lab cultures, stocks or specimens of micro-organisms live or vaccines)	Causes health disorders like headache, cough, skin burn, eye burn, etc., when in contact. If not autoclaved causes serious infections	Non-recyclable
Waste Sharps		
Needles & Syringes	Spreading of infectious diseases like Tetanus, Hepatitis, AIDS and Septicemia	Illegally recycled
Scalpels, blades & broken glass materials	Causes cuts on skin and body portion	Recyclable
IV fluid, blood & urine - bags	Releases Dioxin and Furan, Suspended Particulate Matter gases on incineration, oxides of sulphur, nitrogen and carbon	Illegally recycled
Catheters & plastic tubing, PVC surgical gloves	Dissolution of DHEP chemical from PVC material may serve as human carcinogens and may disturb normal hormonal functions	Illegally recycled
Non-infectious Waste		
Cytotoxic chemical wastes (anticancer drugs, radioactive materials, phenyl, strong acids and alkalies)	Causes cytotoxicity and injury to cells in the form of cancer, ulcers, anemia, skin diseases, poisoning, Foetal abnormalities	Acids & alkalis may be reusable after pre-treatment
Chemical wastes (Used in the production of biologicals & disinfections process)	Causes health disorders like headache, cough etc. Some disinfections chemicals like pesticides and insecticides disturb the normal function of hormones and act as carcinogens	Reusable after pre-treatment
Solid wastes		
Food & canteen wastes, plastics, paper boxes and other wastes	No serious impacts	Recyclable after composting / pre treatment
Incineration ash	Partially incinerated ash may spread diseases	Non-recyclable

Improper management and handling of wastes

In urban centres and municipal towns of less than 5 lakh population, the disposal of biomedical wastes is done through superficial burial or non-engineered landfills within the hospital premises. In the cities of Bangalore and Mysore, though the common treatment facilities and biomedical waste network collection systems have been established by private entrepreneurs many of the health care establishments resort to illegal disposal through community bins to avoid costs. Non-segregation/isolation, improper bagging, transportation and washing of blood soiled linen/clothes can be the means of spreading micro organisms throughout the hospital and possibilities of contaminating the washer/extractor units or dobhighatts.

Improper management of sharp wastes

Amongst all categories of biomedical waste, the sharps (which include syringe, needle, canula, broken glass, ampoules, etc.) have the highest disease transmission potential through the direct prick/stab type injuries.

Dumping of waste from private health care establishments.

Unorganised sectors like illegal slaughter houses, small commercial establishment, roadside vendors, tiny industries, small clinics and private practitioners are major contributors to illegal disposal of waste.

Trends in bio medical waste

Health care establishments (both private and government) in the State have registered a 15 to 20 per cent growth in the last decade. Same trend is likely to continue for another decade. In view of the above, in Karnataka, the amount of biomedical waste generated for the next decade is estimated to be around 80 to 85 metric tons/day.

■ CAUSES

The main causes include

- changing life-styles,
- inadequate planning,
- inadequate finance and infrastructure in waste management
- insufficient training of various stakeholders.

Changing life-styles

The drastic shift in consumption pattern like increasing use of disposables, increasing purchase of consumer durables and nondurables, and fast food culture have resulted in higher generation of waste. However, adequate facilities and plans to meet the requirements for proper waste management have not come up. Much of the existing infrastructure facilities for the waste collection, treatment and disposal have not kept pace with the population growth and economic development. Since the Biomedical and Municipal Solid Waste Rules have come into force very recently (1998 and 2000, respectively) lack of adequate, appropriate and frequent monitoring due to manpower and infrastructure constraints is one of the reasons for a poor waste management system.

Inadequate planning

Inadequate long-term planning for comprehensive waste management (waste minimization/reduction possibilities) has resulted in improper waste handling practices. Most of the red and orange category industries and health care establishments do not have a well-defined waste management system which has affected the environmental quality. Many small scale industries and small clinics do not treat their waste mainly due to lack of common treatment facilities. Also, most of the industrial premises are too small for storing waste or for establishing an individual treatment plant. Various other factors like non-availability of sufficient collection bins and trucks, common treatment and disposal facilities, decentralized waste processing plants and landfills are the causes for improper waste management in the state.

Inadequate finance and infrastructure in waste management

The cost of treatment and disposal of hazardous waste and biomedical waste is high which cannot be afforded by small scale industries and the smaller health care establishments. In the case of urban local bodies which have resource constraints, the costs of collection, transportation and disposal of wastes is unaffordable resulting in neglect of waste management. Inappropriate design of treatment and disposal system, inadequately trained operators also are some of the causes of aggravation of waste problem.

The cost of treatment and disposal of unsegregated waste are more expensive compared to segregated waste. According to the Karnataka Compost Development Corporation composting of unsegregated waste needs 30 percent extra cost than the segregated waste. Given the fact that all urban local bodies have to start treatment and disposal facilities for municipal solid waste the problem of mixed waste can result in higher investments for the urban local bodies. Only 54 authorised waste reprocessing units exists at present in the state and considering the value of recyclable wastes there is a huge economic loss.

Insufficient training of various stakeholders

Lack of awareness among the generators, untrained workers in industries, health care establishments, munipal corporations and urban local bodies have been the main hurdle in the waste management system.

IMPACTS

The mixing of various types of waste results in a consortium of both biodegradables and non biodegradables. This results in more transport related costs and disposal sites receiving highly heterogeneous composition of waste thereby needing more disposal area. It also impairs the biological treatment of wastes as nonbiodegradables hinder the process due to their toxic nature. Such a mixed waste if composted cannot be used due to the toxic residues in it.

Impacts of overflowing bins due to failure or inadequacy of collection systems results in major odour nuisance and could potentially spread diseases. Improper management in terms of collection, storage and transport due to obsolete or nonfunctional equipment and inadequate transport facilities impact the service quality. Further, the workers are often not motivated, untrained, under-compensated, and unnoticed which also impacts the service quality and in turn affects the environment. Most of the times it is the poorer sections of the society which have to bear the brunt.

When vehicle used for transporting waste are not properly designed, (such as no mechanical loading and compacting or no compartments for transporting segregated waste) it results in more transportation and segregation time and costs which eventually again results in low service quality.

Burning of municipal solid waste at roadsides and dump sites is a normal practice in most of the urban areas of Karnataka. Burning of wastes either as roadside heaps or at dumpsites significantly impacts the air quality as most often these wastes are mixed waste containing tyres, aluminium foils, metallic scrap and domestic hazardous waste. Such waste emit highly toxic fumes containing organo-chlorides, suspended and respirable particulate matter, dioxin, sulphur, etc., and affects the health of the individuals in near vicinity and causes respiratory disorders and angiosarcoma for the adjacent residents and waste handlers. Also, the purpose of recovering recyclable materials is often not served as the material retrived is not of good quality.

Mixed wastes when disposed in landfill often leads to chemical reactions between the various constituents resulting in leachates. These leachates which are mostly acidic in nature react with other ingredients of waste, water and soil leading to mobilization of heavy metals and organics. The long terms implications include contamination of ground water and land which involve very high remediation costs.

Hazardous wastes have constituents which make them highly corrosive, flammable, reactive, irritable, or toxic in nature and any illegal and unscientific disposal can result in severe accidents. Improper disposal of wastes also have health impacts which could range from simple allergies, reduced immunity, spread of communicable diseases to genetic changes depending on the type and quantity of waste and the surrounding environment receiving it.

The unscientific recycling process commonly used for plastic waste results in large portion of ‘down-cycled’ inferior product. In the recycling process as extensive sorting, cleaning and removal of additives is carried out chemicals such as dioxins, acylonitrile, styrenes, poly vinyl chloride get released into the air which are carcinogenic and cause severe eye irritation, headache, nausea, hormone system changes, etc. Non-recyclable plastic

materials are often disposed off in open lands and drains which impacts the soil permeability, water infiltration rate and recharge potential.

E-waste, when disposed unscientifically in landfills often results in release of a cocktail of toxic substances such as lead, cadmium, mercury, polychlorinated biphenyls, brominated flame retardants, polyvinyl chloride. These in turn contaminate the water and soil due to their high leachability potential. When the wastes are burnt to retrieve metals, especially copper from the wires, they release dioxins and furans. Dioxin and furans are carcinogenic and also cause birth defects, foetal death, spontaneous abortions, disruption of hormone system, suppression of immune system, damage to liver, kidneys and reproductive system. In the case of biomedical waste, improper operation and uncontrolled incineration (of materials containing chlorine) can generate dioxins and furan emissions, which persist for a longer duration in the environment and is a potent human carcinogen.

The economic impacts include increased costs for treatment and disposal in terms of the technology used and area needed for landfilling. Added to this, is the equally important loss of resources from the waste which can be recycled and reused.

The existing land fill practices for infectious biomedical waste can result in contamination of ground water and surrounding surface water when subjected to improper pretreatment. Further, the effectiveness of autoclaving to disinfect the wastes, and the extent of pathogen destruction depends on the addition of water, volume and the density of waste material which when not adhered to and could cause spread of various infectious diseases. Mixed waste can be extremely hazardous for the health of waste handlers and rag pickers without any protective gears/devices exposing to health risks such as AIDS and Hepatitis B. Equally affected by unsegregated wastes are animals which are likely to ingest materials like plastics, needles, small metallic pieces that can cause serious health problems. Uncontrolled discharges of blood and other liquid wastes from hospitals carry infectious pathogens that pollute the sewage and spread communicable diseases particularly in communities living in the vicinity of sewage channels. Improper handling of soiled linen and contaminated linen are expected to transmit the infectious diseases to the waste handlers and washers.

■ PRIORITISATION

The problems relating to municipal, hazardous and biomedical waste across the state have been evaluated

Prioritisation Matrix

Problems	Socio-Economic/Ecological Impacts							
	Impact on Public Health	Loss of Biodiversity	Impact on Vulnerable groups	Productivity loss	Impact on critical Ecosystem	Irriversibility/ reversibility	Urgency of the problem	Total
Illegal disposal of MSW, hazardous waste, BMW	5	3	3	5	3	5	5	29
Mixing of BMW with MSW	3	1	5	5	3	3	5	25
Improper management and handling of wastes	5	3	3	3	3	5	5	27
Absence of disposal sites for hazardous wastes	5	5	3	3	5	5	3	29
Unorganised sector generating hazardous wastes	5	3	5	3	3	5	5	29
Dumping of waste from private HCEs	5	1	5	3	3	3	5	25
Improper management of sharp wastes	5	1	5	3	1	5	5	25
Total	**33**	**17**	**29**	**25**	**21**	**31**	**33**	**189**

Scale: 1= low, 3 = medium, 5= high

and analysed. Depending upon the severity of the problem and its socio-economic and eclogical impacts, the problems have been classified as low, moderate and high with a value of 1, 3 and 5 respectively.

■ ACTION PLAN

- There is a need to integrate resource recovery component into the current practice of waste management. Wastes should be considered as resource and the waste management policy should be focused on conversion of waste into resource rather than mere safe disposal. Emphasis should be laid on implementing clean production and waste reducing technologies.
- In order to promote recycling, there is a need to create a market for repurchase of waste products at a price based on market conditions. This can be achieved by adopting the Buy back system. Under this certain waste producing products can be made to carry a 'label of guarantee of a prefixed refund' on the left over of the product. It is important to note that this practise already exists as an informal sector all over India.
- Segregation of waste at source into biodegradable, recyclable and hazardous is a primary imperative. To avoid the problem of overflowing bin, it is necessary to have bins that can accommodate 20 percent more than the waste generated.
- Transportation vehicles should have segregated spaces in them so that the segregated waste are not combined while transporting. Also, vehicles should have compacting mechanism especially for biodegradable waste.
- To avoid huge transportation costs it is desirable to have decentralized locations for waste management. Door to door collection of household waste, now in practice in Bangalore and Mysore should be extended to all cities and towns in the state.
- Concerted efforts, using the latest technology should be made to convert the maximum quantity of waste into compost and recycled resources.
- Small clinics/general practitioners generating small quantity of biomedical waste should be brought under the regulatory authority or Registration Authority so that they are registered as a separate category. This will enable better enforcement and monitoring of biomedical waste management rules.
- A group of general practitioners in a locality could be encouraged to have common waste collection arrangement so that the collected waste could be sent to the nearest waste treatment system.
- Private organizations/cooperatives/self-help groups to participate should be encouraged to participate in waste management .
- Government should consider incentives to industries using clean production technology.
- Comprehensive training programs and massive campaigns for raising awareness among the civic-body administrators, health-staff, municipal staff should be taken up.
- E-waste mostly consisting of computers, monitors, scanners, other electronic equipment, gadgets need to have separate regulations for its disposal.
- Product charge: Waste disposal charges should be collected as an add-on proportion of property taxes, differentiating private residential properties paying lower rates than industrial properties.
- Buy back schemes to be considered for consumer goods like food and beverage packets and containers. Paper, bottles, tyres, batteries, televisions, washing machines, water heaters, electrical gadgets, furniture, paper etc., can come under this category.
- Several waste products such as leather, plastics, paper, bottles, tins etc., can be brought under one roof for recycling. Recycled products should display a label announcing the same (e.g., recycled paper).

Solidwaste dumping in coastal area

Untreated sewage entering into the sea