

A Citizens Guide to **SOLID WASTE MANAGEMENT**



SHEHRI-Citizens for a Better Environment

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SOLID WASTE MANAGEMENT

Editor
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The preparation and compilation of this document has been made possible by funds made available by the Friedrich Naumann Foundation.

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All photographs used in this study are of Karachi City, courtesy, Shehri-CBE and N.E.D. Engineering University, Karachi.

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P R E F A C E

As mankind prepares to enter into the 21st century, it is faced with many challenges. Armed conflicts, natural disasters, famine, hunger, poverty and the disparities in technological advancement between the developed and developing nations are issues that cast dark shadows on mankind's march towards global prosperity and happiness. One issue that poses an equally strong, if not a more potent and grave challenge, and is now fast becoming an integral part of most nations policy frameworks, is the issue of environmental degradation. As the fight against environmental degradation continues worldwide, it is being realized by all concerned that much benefits can be achieved by mobilizing the general public, whose role is now considered of vital importance. However, only an aware and educated populous can play its due role in environmental preservation programmes and initiatives.

Unfortunately, in our country, few steps have been initiated to raise such awareness among all sections of the society. This document is an effort to raise public awareness on the important issue of solid waste management. It is an issue, which if not properly addressed, adversely affects the quality of living, health and mental well being of each and every section of a society. Citizens can do much to improve the far from satisfactory situation prevailing in our country regarding this important issue. It is hoped that this document will help a citizen better understand the issue and its implications.

This document is the result of an initiative taken by Shehri - Citizens for a Better Environment, and made possible through the financial support extended by the Friedrich Naumann Foundation. I am thankful to Mr. Qazi Faez Isa, Chairman, and Ms. Amber Alibhai, General Secretary, Shehri-CBE for having provided me with the opportunity of assisting in the preparation of this document. I am greatly indebted to Prof. Saeed Ahmed Khan and Prof. Muhammad Nauman of N.E.D. University of Engineering & Technology, Karachi and all the members of Shehri-CBE for the help and guidance they provided me during the formulation and compilation of this document. I am also grateful to Mr. Badar-uz-Zaman and Mr. Muhammad Arshad, who did the typing and layout work of this document.

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October, 1997.

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INTRODUCTION

People living in the urban and semi-urban centers of the world avail of many services and facilities which make their lives easier. At the same time they face many problems and challenges. Foremost among their worries has now become the issue of pollution and environmental degradation, which poses a direct threat to their health and mental well being.

One major cause of environmental degradation is the practice of improperly disposing the solid waste generated by a city or town. Solid wastes are all the wastes arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. More the population, more will be the volume of solid waste generated. So, solid waste more serious issue in urban areas. In the large urban centers of the world, having larger population load than the rural areas, proper management of solid waste is a civic issue which poses a big challenge and receives great importance. (Of the nearly 48000 tonnes of solid waste generated each day in Pakistan, 19,170 tonnes comes from cities). Proper management of solid waste is needed in order to prevent the degradation of the natural environment and protect public health from the harmful effects of improperly disposed solid waste.

The most important mechanism through which we can effectively tackle this problem is through the formulation and implementation of proper legislation and environmental quality standards. In this document, the issue of legislation is therefore touched first before discussing the various technical and administrative waste management alternatives that are available. The aim of this document is to raise awareness among the general public about the issue of solid waste management to help them become better participants in the efforts to effectively manage our wastes.

LEGISLATION AND STANDARDS FOR SOLID WASTE MANAGEMENT

In our country such standards exist mainly at two levels in the urban and semi-urban areas.

- Municipal Legislation / Regulation
- National Environmental Quality Standards.
- An outdated Factories Act also exists, which deals with the issue of industrial waste.

Municipal Legislation / Regulation

If we take the case of Sindh, then according to the Sindh Local Bodies Ordinance, 1979 (SLGO, 79), "A corporation, municipal committee or town committee shall make adequate arrangements for the removal of refuse from all the public streets, public latrines, urinals, drains and all buildings and lands vested in the council concerned and the collection and proper disposal of such refuse".

The council's responsibilities include the placing of dustbins or other suitable receptacles to be provided at suitable places, including streets or other places conveniently accessible to the public.

However, it is the responsibility of the individual citizens to remove the refuse from his or her house / building and deposit it in the dustbin or receptacles provided by the council.

A municipal law exists regarding the disposal of carcasses.

Whenever an animal in the charge of a per-

son dies otherwise, than by being slaughtered for sale for consumption, for some religious or other purpose, such person shall either:-

- a) Convey the carcass within twenty-four hours to a place, if any, fixed by the corporation, municipal committee or town committee for the disposal of the dead bodies of animals, or to a place at least one mile beyond the limits of the local area.
- b) Give notice of the death to the council concerned, whereupon the council shall cause the carcass to be disposed of and charge such fees from the person concerned as the bye-laws may provide.

Explanation – In this paragraph "*animals*" shall be deemed to mean all horned cattle, elephants, camels, horses, ponies, asses, mules, deer, sheep, goats, swine, dogs, cats and other large animals."

It is usually the responsibility of the municipal public health department and their health officers to look after the solid waste management system of their areas. A health officer may require a developer to provide dustbin and refuse bin centres, along with a provision of maintaining chutes in buildings. There is a prohibition on the sale of night soil, and on its use as manure. Depositing refuse or building material in any public place is also prohibited. The health officer is also authorised to enter any building or land to conduct surveys, inspect or execute any work authorised by the ordinance.

National Environmental Quality Standards

In the developed countries the safe management and disposal activities of solid wastes are controlled and monitored through standards and regulations. There are many criteria's that need to be fulfilled while designing and operating waste management facilities. Similarly, legislation and regulation exist for the proper collection of waste. Air, water and land pollution / contamination which can be caused through the improper disposal of solid



In the absence of any legislation, industrial waste is often burnt openly, in hazardous circumstances.

waste is thus controlled. In our country, although the National Environmental Quality Standards (NEQS) have been formulated and employed (1996) the pollution threat from solid wastes has not been addressed, as the NEQS so far have not been extended to cover solid waste. Since municipal waste is the largest polluter of water in the country (of which solid waste constitutes a major portion) we need to extend the scope of our NEQS to address the issue of solid waste.

Factories Act 1934

The Factories Act deals with the control of pollution through industrial waste. Chapter

3 of the act covers health, safety and cleanliness, disposal of wastes and effluents, ventilation and temperature, dust and fume, artificial humidification, lighting, drinking water, etc. The relevant section under disposal of waste and effluents states:-

1. Effective arrangements shall be made in every factory for the disposal of wastes and effluents due to the manufacturing process carried out therein.
2. The provincial government may make rules prescribing the arrangements to be made under subsection (i) or requiring that the arrangements made in accordance with that sub-section shall be subject to the approval of such authority as may be prescribed.

The Factories Act of 1934 is outdated and grossly inadequate for present day requirements. It was framed at a time when environmental pollution was an unknown subject. There is an immediate need to implement comprehensive legislation to protect and preserve the environment.

The new Pakistan Environmental Protection Ordinance has been passed by the State Assembly (1997). It covers, in general all aspects of the country's environment. Its laws are governed by the provisions of the NEQS.

CLASSIFICATION OF SOLID WASTE

The type and composition of solid waste depends on the nature of activity from which the waste originates.

Two general categories are usually considered.

- i) Municipal Wastes
- ii) Hazardous Wastes / Special Wastes.

Industries and factories also generate solid waste which can possess the characteristics of both municipal and hazardous wastes.

Municipal Solid Waste

Such type of waste is generated mostly as a result of residential / commercial activities.

Residential / Household Solid Waste

Residential waste generally consists of:

- Food wastes such as animal, fruit or vegetable residues (also called garbage) which result from the handling, preparation, cooking and eating of foods. This kind of waste is biodegradable.
- Non-biodegradable but combustible solid waste resulting from residential activities, consists mainly of paper, cardboard, plastics and garden trimmings.
- Non bio-degradable and non-combustible household waste, which is usually made up of items such as glass, tin / aluminum cans and occasionally construction wastes.

- Waste consisting of materials remaining from the burning of wood, coal, coke and other combustible waste, which is mostly generated from household activities in the rural areas.

Commercial Solid Waste

Commercial activities generate certain wastes which are common in nature and composition, though not necessarily in volume to the residential / household waste. Wastes common to both residential and commercial activities include items such as:

- Food wastes and other rubbish items like paper, glass, plastics etc. Commercial sources of solid waste consist chiefly of stores, restaurants, markets, hotels, service shops and office buildings.

However, despite this relative similarity in solid waste composition between residential and commercial sources, there are some differences also:

- Commercial activities occasionally generate extremely hazardous waste such as in the case of medical facilities and research institutions.

On a much smaller scale, (in the urban areas) are generated, treatment plant wastes from water / waste water treatment processes which are principally composed of residual sludges. In Pakistan for e.g. the city of Karachi is presently served by four large municipal waste water treatment plants (TP-1 in S.I.T.E., TP-2 in Mehmoodabad, TP-3 in North Karachi and

TP-4 in Mauripur) which generate such waste. (Excluding TP-3, which is not functioning)

The composition of municipal solid waste, on a global level, differs from region to region, depending on the level of industrialization, development and economic health of a country. In developed and financially stable regions of the world with advanced levels of consumerism, the percentage of non biological (inorganic) waste component, including items such as paper, cardboard, plastics etc., is much more as compared to lesser developed regions of the world with low levels of consumerism. For e.g. in an under developed country like Pakistan, the solid waste generated in its principal economic center i.e. Karachi, is 40% organic in nature, consisting mostly of food wastes as compared, to 25% of such waste in USA.

Hazardous Waste / Special Waste

Wastes that pose a substantial danger immediately or over a period of time to human, plant or animal life are classified as hazardous waste.

Certain components of hospital waste such as those originating from the pathological / chemical labs, wards, can be termed as hazardous and the standard method of their safe disposal is incineration (discussed later).

Waste from certain process industries can be toxic in nature. Aquatic and soil environments are most at risk from industrial wastes which contain heavy metals and synthetic chemical compounds. Agricultural waste which consists of unused pesticides / herbicides poses a great danger to human health if not properly disposed.

The industries identified as generating toxic and hazardous wastes are:

- Pesticides.
- Dyes and Pigments. (eg. Textile Industry)
- Pharmaceuticals.
- Organic Chemicals, including Petrochemicals. (Refineries)
- Fertilizers.
- Steel.
- Non ferrous metals, such as lead, copper and zinc.
- Caustic soda. (eg. manufacture of soaps)

HOW WE MANAGE OUR SOLID WASTE

In Pakistan the civic infrastructure of most of the large and small urban centers, is in desperate need of rehabilitation and development. If we consider the solid waste management system of Karachi as a case study illustrating many of the problems also faced by other cities of Pakistan, it is felt that the need for a long term and properly engineered solid waste management system for the city is long over-due.

MUNICIPAL SOLID WASTE

The city of Karachi generates 6000-8000 tons / day of municipal solid waste. Both the formal and informal sectors are involved in the collection, processing and disposal of solid waste at different levels.

Formal Sector

Karachi city is divided into 10 collection districts : 7 are served by the Karachi Metropolitan Corporation (KMC), the remaining by the airport authority, cantonments and Karachi Development Authority (KDA). KMC spends 40% of the municipal budgetary allocation on solid waste disposal. Only 30% of the solid waste is collected and disposed off by KMC. the remaining is dumped in storm drains, nallahs, nearby rivers and empty plots. Of the solid waste that is collected, much is taken to unauthorized sites all over the city and burnt, dumped into the rivers or seas and used to fill depressed land. KMC does not undertake the recovery of reusable and recyclable material and there is no

separation of waste. The KMC, which utilizes the conservancy / sewerage charges collected from residential, commercial and industrial units for solid waste management says the tax is inadequate to cover the expenses incurred. it has to subsidise 75-100% of solid waste management expenditure from other budgets.

Recently KMC started work on a "Garbage Train Project" aimed at solving the long standing solid waste collection and disposal crisis in the city. This plan proposed the integration of the existing truck collection service with the existing circular railway network, for the transportation of solid waste to a centralized, and final disposal site. It was planned that the trucks were to collect the garbage from neighborhood bins, take it to the nearest of several transfer stations, that were to be built along the railway line, from where the garbage was to be transferred to a centralized waste disposal site (Dhabeji) located at a safe distance away from human settlements. This project seemed to offer a viable solution to the solid waste management crises of the city. Unfortunately not much progress was



Solid waste mismanagement

made and recently the project, itself was abandoned. Causes of failure of this project mainly relate to lack of management and co-ordination between the various organizations involved in the project and a general lack of political will.

Informal Sector

The inactivity of the formal sector, particularly in the recycling / reuse service has meant that the informal sector has been laden with the unenviable task of providing recycling and reuse services to this teeming megapolis.

A thriving recycling industry has taken roots at the non-formal level, which is responsible for collecting and then recy-

cling about 15% - 20% of Karachi's solid waste. An invaluable contribution is being made by this informal sector in the overall solid waste management system of Karachi. However, the practice of exploitation of young illiterate boys (mostly of Afghani origin), who are forced to collect the recyclable components of the city garbage while exposing themselves to extreme health hazards is a highly objectionable component of this business and needs to be addressed. Another concern is that the formal and informal sectors presently function in isolation. A coordinated effort could yield better results. Several NGO's / CBO's are also carrying out solid waste management programs at the neighborhood level.

HOW WE RECYCLE

Much is made of recycling in the West and many citizens especially in Europe are proud of their country's commitment to recycling. Pakistan recycles too, and in all probability does so more extensively and more efficiently than many European countries. The difference is that in European countries, it is a heightened awareness of civic responsibility that prompts a citizen to ensure that their waste is recycled. In Pakistan, we leave the recycling to an informal network of garbage collectors, sorters and re-users who have no support from any official authority and whose incentives are derived from simple economics. No one is decrying the value of economic incentives but the point is that unless official or civic commitment backs this form of waste management, its sustainability and potential is limited. Below are some examples of how we recycle today:

- Small home enterprises in the informal sector make plastic materials such as combs, toys, etc. from waste plastic.
- Broken glass is recycled in formal sector enterprises. Unbroken bottles and such items are washed and brought back into the market by informal enterprises.
- Newspapers and magazines are recycled into quality paper by formal sector enterprises. Informal sector enterprises also recycle newspaper and magazines into low quality paper. Mostly, informal enterprises make cheap quality products from these such as paper bags, wrapping papers, etc.
- Paper boxes, cardboard and such items are recycled into packaging materials by both the formal and informal sector. The mechanical process of recycling is done by the formal sector only.
- Bones are recycled by the informal sector into cheap products such as combs, toys, etc. Certain metals as iron or steel are recycled into billets.
- Naan is recycled in the informal sector to form cow feed.

(Source: Urban Resource Centre)

INDUSTRIAL SOLID WASTE

No comprehensive data exists, on the composition and generation rates of industrial solid waste. As the industrial waste is being handled by each industry separately, detailed studies are needed to find out the characteristics and composition of waste coming out from various industries.

Presently, disposal of industrial waste is undertaken by several private and public sector organizations. The agencies which generate industrial waste, also make arrangements for its disposal. However, smaller units, disposing industrial refuse, are not in a position to process and neutralize their waste, either technologically or resource wise in order to remove its harmful contents.

Most of the industrial waste gets disposed in drains or in the sea. The coastal environment and the aquaculture is thus exposed to severe pollution. The absence of any strict regulations and enforcement mechanisms are major impediments.

Tannery Waste

One of the most hazardous of all industrial wastes is tannery waste. The tanneries not only generate large volumes of liquid, they also generate different types of solid wastes, many of which create serious pollution problems.

Solid wastes are generated from a number of different operations in the tanning process i.e salt dust, wet lime sludges, hair and green fleshings, shavings and trimmings of chrome tanned leather etc.

The tanneries in Korangi, Karachi (Sector 7-A) on an average generate about 280 m³/day of solid waste. These solids are either thrown out of the tanneries, on the roads, or passed on to contractors for the

manufacture of by-products e.g. extraction of fats and glues, soap manufacture and production of animal feeds. About 50% is taken by contractors and 50% thrown outside the tanneries. The disposal of the solid waste in extremely unhygienic conditions is identified as a major problem facing the tannery industry of Karachi.

Presently, a project is underway which proposes to organise a functioning solid waste disposal system with active participation of the tanneries and the municipal authorities. The project aims to cover the issues of transport and means of disposal of solids in a proper manner.

HOSPITAL SOLID WASTE

The potential of hospital waste as a health hazard is much greater than that of general municipal waste and special care needs to be taken while disposing of its harmful components. Typical hospital generated waste consists of medical related wastes such as syringes, cotton bandages/dressings, blood / urine bags, gauzes, surgical gloves, stomach tubes, lab waste (chemicals), and also glucose bottles, packaging and normal kitchen waste. Items such as used syringes, dressings and waste originating from the laboratories and operating theatres are the most threatening to the health and well being of all those who come in contact with them.

In Karachi, hospital waste management practices vary from hospital to hospital. But the managements at most of the hospitals exhibit a careless and at times almost criminal disregard for the hazardous consequences of their improper waste disposal mechanisms. In effect, hospital waste is treated like any other waste when it comes to its disposal, and no account taken of its special nature.

Apart from a few hospitals of the city, most dump their waste inside the hospital com-

pound or in some ill-constructed *kutchra kundi* (dustbin) located in close proximity to the hospital. Some recyclable waste may be sold, to local dealers connected with the garbage trade. A survey by the "Business Recorder" showed alarmingly that more than 30 traders operating in New Karachi, Botal Gali, Afrasiab Colony and Lighthouse, purchase used disposable syringes from waste merchants and repack them for reuse. The remaining waste is disposed by the KMC with the rest of the city's garbage. All these practices put a huge number of people at risk at various stages of the disposal process, both directly and indirectly.

Incinerators in Karachi

Due to the absence of any coherent policy

initiative taken in the past, only a few private and government hospitals have installed waste incineration plants. Major city hospitals such as the Aga Khan University Hospital, the Civil Hospital, the Jinnah Hospital and the Kidney Centre are at present availing of this service. The Karachi Metropolitan Corporation has recently acquired two waste incinerators. They are presently being installed and it is planned they will cater to the hospital waste being generated in the city. In keeping with the general trend, the private concerns are showing better levels of operation/ maintenance and safety as compared to their government counterparts. Most of the management staff at these hospitals agree that the introduction of this technology has been a step in the right direction.

WASTE MANAGEMENT PRACTICES AT THE AGA KHAN UNIVERSITY HOSPITAL

The Aga Khan University Hospital (AKUH), Karachi, employs by far the best management system of hospital waste collection/disposal among all the city hospitals. A hospital waste incinerator with a capacity of 250 kg per hour was installed by a British firm in 1985, at a cost of Rs. 700,000. This gas-fired incinerator with a design life of 15-20 years is presently in operation and forms the centerpiece of AKUH's waste management mechanism. Running cost of the plant has been calculated at Rs. 400-500 per hour of running period. The administration at AKUH has also enforced a waste segregation system. To manage this process a 'Coloured Bag Scheme' has been adopted. The waste is divided at source into three different categories. All the infectious waste (120 bags/day, each bag weighing approximately 10 kg) is packed and sealed in red plastic bags and incinerated. After collection and prior to incineration they are placed in a refrigeration room, adjacent to the incineration plant room in order to avoid any decay. The bags are counted and a check is kept on how many are sent and received for incineration, to ensure the numbers match. The dry recyclable waste such as paper, cartons etc., (70 bags/day, each bag weighing 10-12 kg) is packed and sealed in green plastic bags and stored in a *kutchra kundi* located nearby. These bags along with wet recyclable waste i.e. kitchen waste, are sold to a local garbage recycling concern. The plant avails of the services of a full-time operator. He is provided with a mask and high boots and is required to wear a protective gown while cleaning the plant. According to the senior engineer in charge of maintenance, regular plant maintenance is carried out. A maximum burning temperature of 900°C is maintained. The plant is not fitted with any filters and does not conform to any specific air quality standards, as none exist.

— Farhan Anwar



A view of Nehre-Khayam, Clifton. Open Nullah's are freely used for dumping garbage.



Death on the streets.



The ugly face of Karachi's recycling industry

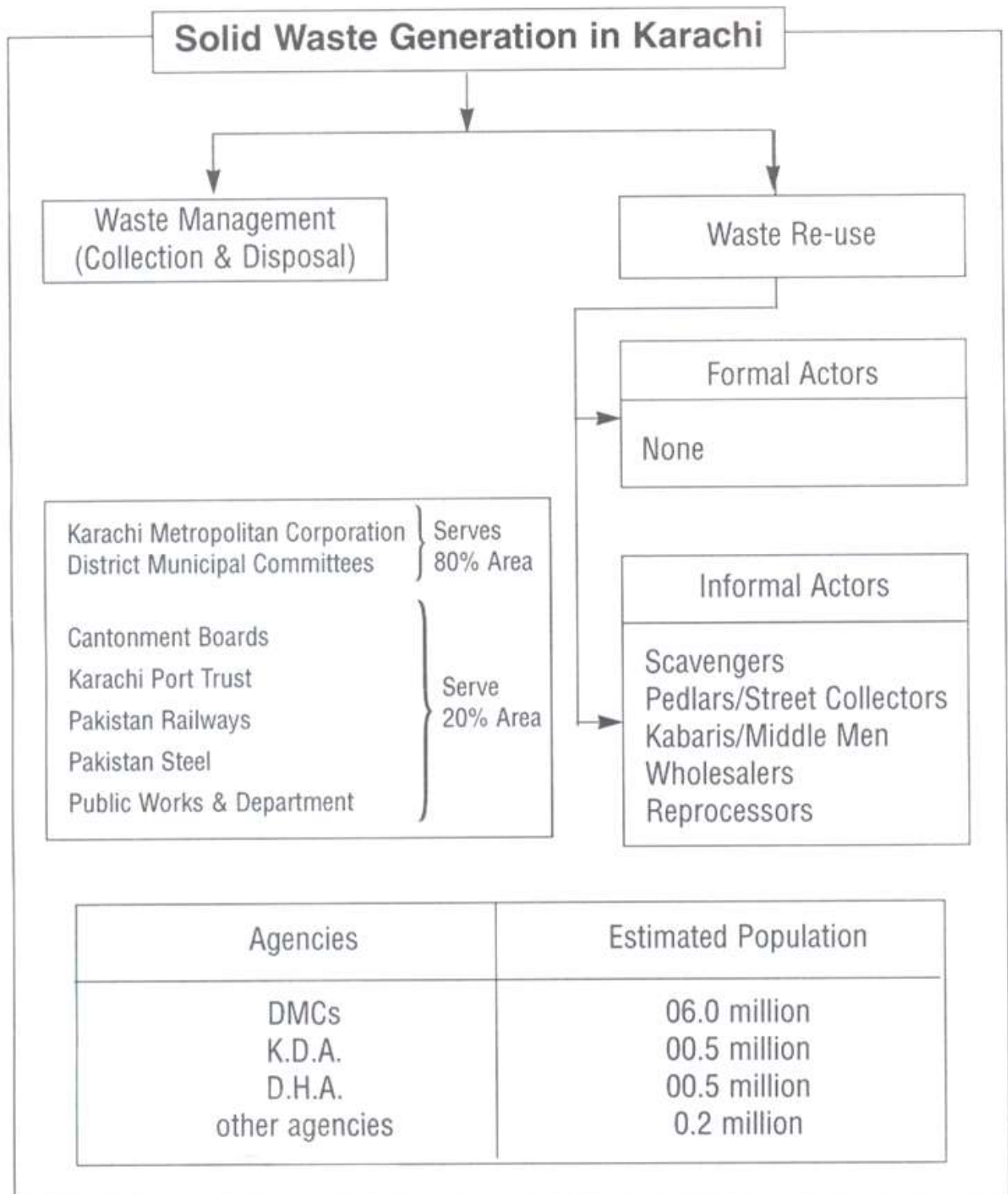


Plastic bags dumped in sewers and drains often cause blockages and resultant overflow.



Improperly located and badly constructed garbage collection points.

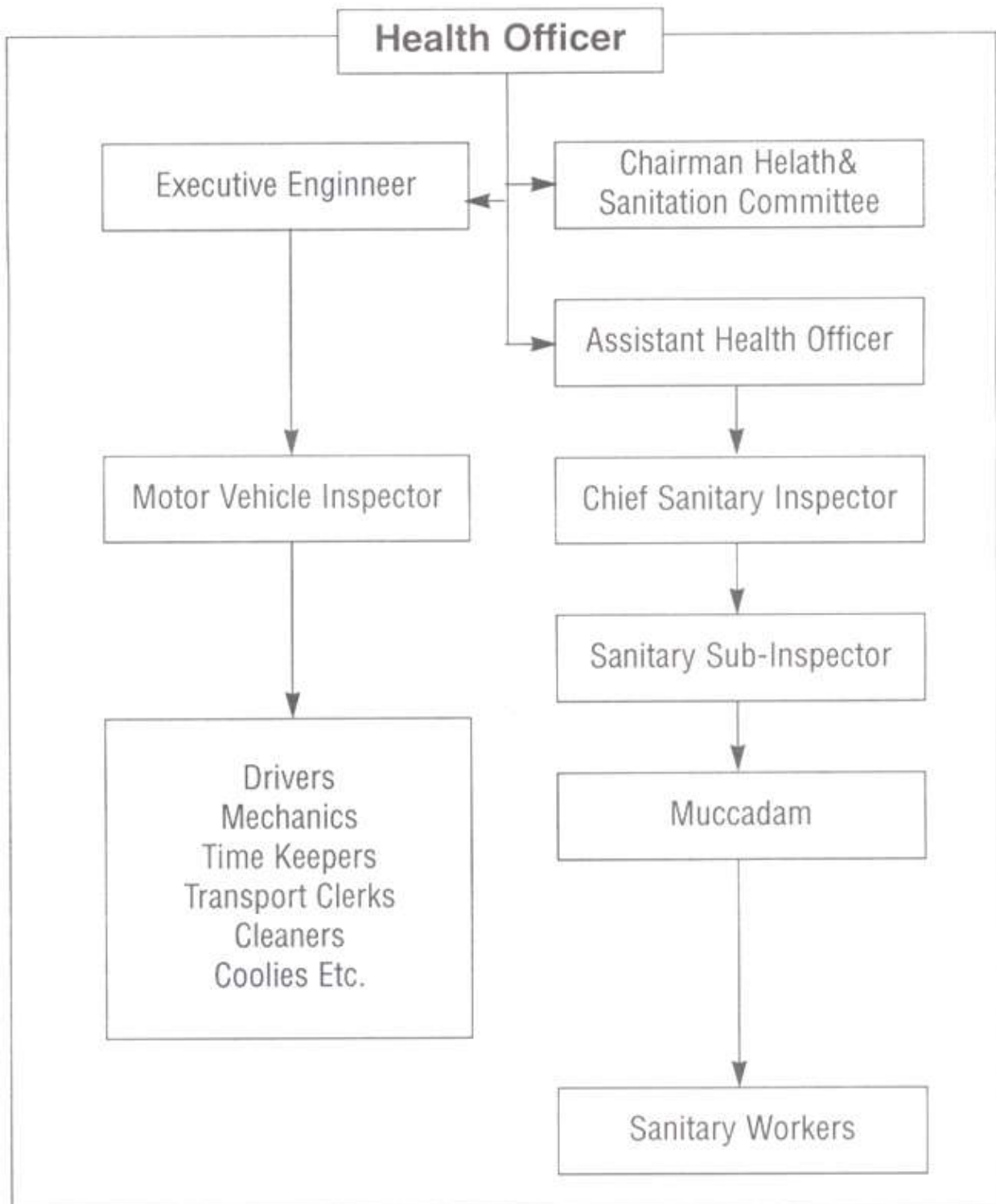
SOLID WASTE GENERATION



Source: National Testing & Consultancy Services, Karachi-Pakistan.

(1991 figures)

ORGANIZATIONAL CHART OF DISTRICT MUNICIPAL COMMITTEE (DMC)



Source: National Testing & Consultancy Services, Karachi-Pakistan.

(1991 figures)

STAFF STRENGTH OF DMC'S FOR SOLID WASTE MANAGEMENT IN KARACHI

POSITION	GRADE	MONTHLY SALARY IN (US\$)	STONE, DERRIS & CLASS ETC.			
			EAST	WEST	SOUTH	CENTRAL
Health Officer	19&18	200	1	1	1	1
Executive Engineer (M&F)	18&17	165	1	1	1	1
Assistant Health Officer	17	165	0	0	1	0
Chief Sanitary Inspectors	16	150	3	2	3	3
Motor Vehicle Inspectors	11	115	0	0	1	1
Sanitary Inspectors	09	100	10	9	22	11
Sanitary Sub-Inspectors	07	88	35	34	37	38
Mechanics	07	88	1	0	0	1
Drivers	07&05	80	78	55	123	70
Time Keepers	05	80	3	1	1	1
Time Clerk/Mushi	04	75	0	0	30	2
Muccadam	03	60	74	34	92	42
Coolies	01	48	220	170	773	415
Sweepers	01	48	2965	1552	2613	2297
Total			3392	1859	3698	2883

Source: National Testing & Consultancy Services, Karachi-Pakistan.

(1991 figures)

DETAILS OF SOLID WASTE COLLECTION VEHICLES IN KARACHI

Name of Agency	STONE, DEBRIS & GLASS ETC.					
	Population	Arm Roll	Com pactors	Tractors Trolley	Tractors Trolley	Vehicles
District Municipal Committee (Central)	2,034	05	10	41	12	68
District Municipal Committee (South)	1,894	03	05	69	18	95
District Municipal Committee (West)	1,396	03	—	24	29	46
District Municipal Committee (East)	2,825	04	06	49	05	64
Total	8,149	15	21	183	54	273
Private Contractors	600	—	14	—	—	14
Cantonment Board	—	—	—	44	—	44
Grand Total	8,749	15	35	227	54	331
Capacity per vehicle/trip	—	3 tons	5 tons	3 tons	2 tons	—
Numbers of trip/vehicle/day	—	3	2	3	3	—

Source: National Testing & Consultancy Services, Karachi-Pakistan.

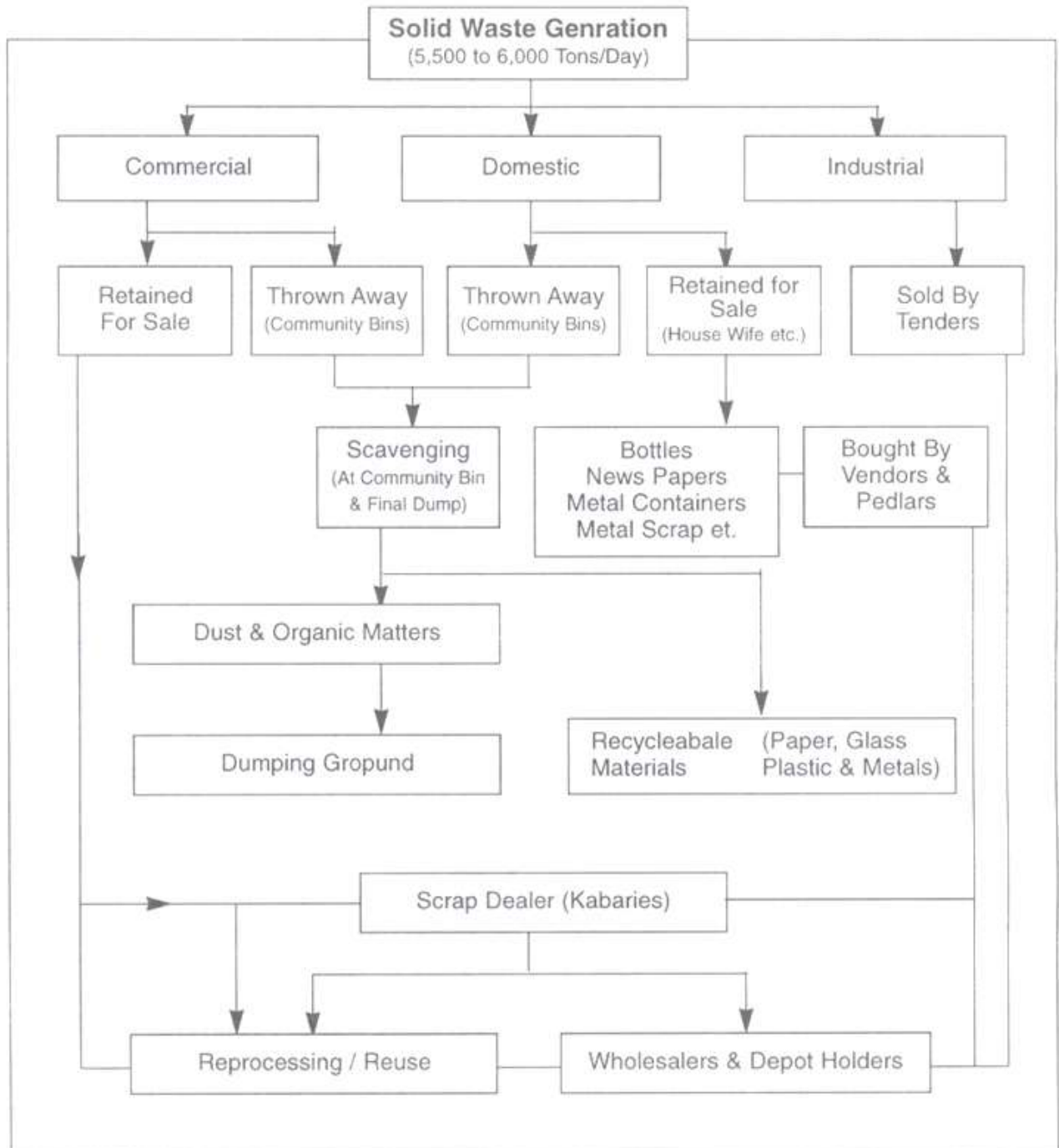
(1991 figures)

SOLID WASTE CHARACTERISTICS IN 7 DISTRICTS ADMINISTERED BY KMC

Name of Agency	organic Matter	Swept Dust & Ashes	Stone, Debris & Glass etc.	Paper, Tin, Plastic & Synthetis
Old City and Kemari	35%	28%	18%	19%
Clifton, Saddar & Ramsawami	50%	10%	18%	22%
Liaquatabad, Nazimabad, Federal B. Area	37%	17%	30%	16%
Lyari	28%	35%	27%	10%
Societies	48%	18%	14%	20%
Landhi-Korangi	28%	30%	30%	12%
North Karachi	24%	30%	33%	13%

Source: National Engineering Services (Pakistan) Limited (NESPAK)

SOLID WASTE GENERATION, SCAVENGING, SORTING OF RECYCLABLE ITEMS, REPROCESSING & DISPOSAL PRACTICES IN KARACHI



Source: National Testing & Consultancy Services, Karachi-Pakistan.

(1991 figures)

ALTERNATIVES FOR SOLID WASTE MANAGEMENT

There are various alternatives available for managing solid waste, which can be used both independently and collectively in the form of comprehensive solid waste management program.

The Need for Proper and Safe Management of Municipal Solid Waste

Municipal solid waste needs proper handling and management because:

- Municipal solid waste, if not properly managed can result in the spread of various diseases as piles of garbage are the ideal breeding grounds for rodents, insects etc. which are the carriers of disease causing germs, and can result in the spread of epidemics.
- There is the overall degradation of the environment and in the quality of human living.
- In localities housing low income groups, children are often seen playing with the garbage and thus coming in direct contact with decomposing food, sharp objects etc. This is a serious health hazard.
- Solid waste often gets dumped in open manholes and drains. Such disposal of solid waste can lead to breakdowns in public utility systems such as sewer system, as things like plastic bags can block sewer lines causing blockage and sewage overflow.
- Then there is also the economic side of this issue. The composition of municipi-

pal solid waste is such that many of the waste components such as paper, plastic, tin, glass, aluminum etc., can be reused or recycled. Energy can also be produced from waste. There is good money to be made from solid waste, provided it is properly handled.

Management of Municipal Solid Waste

Various different methods have evolved over the years to manage and dispose solid wastes in manners that are not harmful to human health and the environment. Economic benefits are also being derived. The issue of solid waste management is now forming an integral part of the overall environmental drive of achieving sustainable development mechanisms, as the world is now becoming increasingly aware of the extent of the serious crises of an ever shrinking global natural resource base.

Some important and widely used methods of municipal solid waste management are listed below. Mostly a combination of some of these methods is employed in managing the municipal solid waste of any area and this usually is the best approach.

1. Reduction / Reuse / Recycle – Composting.
2. Sanitary Land Filling.
3. Incineration.

Reduction / Reuse / Recycle

This method helps in the conservation of natural resources and results in substantial savings in the financial resources of a country.

Reduction

Reduction basically means promoting efforts aimed at reducing the amount of generated solid waste. This aspect of the solid waste issue is indirectly linked to the overall management of solid waste. It follows the simple philosophy that lesser the waste generated, the more easier it will be to manage it. Another main reason underlying this thinking is the grave situation of the world's natural resources. Forests, for e.g. which provide us with lumber, paper and fuel are shrinking by more than 17 million hectares per year. One way of protecting forests could be a much greater efficiency in our use of wood. For example in the United States, which is the world's largest wood consumer, it was found that by simply availing methods of reducing waste, increasing efficiency and boosting recycling of paper and other wood products, U.S. wood consumption could be cut by half. We can also help in reducing our waste volume by adopting such simple measures as using cloth alternatives for things like paper towels, paper napkins, tissues, and carrier bags. Cloth, as we all know is re-usable as against paper which is disposable. Another major potential source of waste reduction is the possibility of simplifying the packaging process. Much paper is needlessly wasted in this process. Efforts should be made to ensure lesser use of packaging.

Reuse

Reuse simply means directly reusing a product, for example, refilling a glass beverage container. This is also a method of reducing waste and is economically beneficial. For example, replacing a throwaway



"Kabari's", an integral part of the local recycling industry.

beverage bottle with a refillable glass bottle (used an average of 10 times) can cut energy use per container by 90%.

Recycling

Recycling means to recycle the material of a used product to form a new product. Most materials in use today are discarded after one use. About two thirds of all aluminum, three fourths of all steel and paper, and an even greater percentage of plastic is discarded after one use. However, now, at least in the developed regions of the world, this throwaway economy is being replaced by one that recycles.

Some advantages of recycling which also reduce environmental degradation are

- Steel produced entirely from scrap requires only one third as much energy as that produced from iron ore.
- Steel produced from scrap reduces air pollution by 85%, cuts water-pollution by 76% and eliminates mining wastes altogether.
- Newsprint, from recycled paper takes 25-60 percent less energy to make them than that from virgin wood pulp.

- Recycling glass saves up to a third of the energy used in the making of the original product.
- Making paper from recycled material reduces pollutants entering the air by 74% and the water by 35%.



The stationary container system of garbage transfer

Composting

Composting is a form of solid waste recycling. If the organic materials, excluding plastics, rubber, and leather are separated from municipal solid wastes and are subjected to bacterial decomposition, the end product remaining after bacterial activities is called compost, or humus. This compost can then be used as a fertilizer in gardens. The entire process involving both the separation and bacterial conversion of the organic solid wastes is known as composting.

Most composting operations involve three basic steps.

- Preparation of the solid wastes.
- Decomposition of the solid wastes.
- Product preparation and marketing.

Composting is a process which unlike other solid waste management processes, can be employed on a very small scale also. Household composting is encouraged in many countries of the world, as composting can not only reduce garbage flow right at the source i.e. the household but it also provides a rich source of humus for gardening, lessening the need to buy chemical fertilizers to maintain lawn and garden facilities.

Sanitary Landfills

All over the world, activities like reuse and

recycling, supplement much larger solid waste management programs. Such programs involve essentially the collection, transport and disposal of the solid waste. The most commonly used disposal method of municipal solid waste is the "Sanitary Landfill Method".

Collection and Transport of Municipal Solid Waste

The collection of waste from neighborhood waste storage points to the processing, transfer or disposal site is usually, done either through.

- **Hauled Container System**, in which the containers used for storage of wastes are hauled by motor vehicle transport to the processing, transfer or disposal site, emptied, and returned to either their original location or some other location.
- **Stationary Container System**, in which the containers used for the storage of wastes remain at the point of waste generation.

Sometimes compactors are used with the collection vehicles, which reduce the volume of the collected waste so as to make



Transfer of garbage to the landfill site through the Garbage Train

- The landfill site should be so located that the wind does not blow from the landfill site to residential areas.
- The water source for agriculture and city supply should be isolated from the landfill site.
- The surface water hydrology patterns have an impact on drainage requirements.

the waste more manageable. If the waste processing or disposal site is at an extended distance from the waste generation area, than means of transport other than motor vehicle transport are also used. These transport modes include *Railroad Transport* which is availed when the processing / disposal site is located in some remote area away from city limits and railroad lines also exist (The Garbage Train Project of Karachi city is one example) *Water Transport* has also been used. Barges and special boats have been used to transport solid wastes to processing locations and to sea side and ocean disposal sites.

Disposal of Solid Waste

Landfilling involves the controlled disposal of solid wastes on or in the upper layer of the earth's mantle. Site selection is an important aspect of the whole process and important factors influencing the site selection for a sanitary landfill include.

- Availability of sufficient land area capable of sustaining the volume of generated waste.

Then there are the natural environmental conditions that need to be considered.

- The topography of the selected site also plays an important role in the final design of the landfill site.
- Soil cover should be available at site.

Landfill Methods and Operations

The principal methods used for landfilling dry areas may be classified as:

- a. Area Method
- b. Trench Method
- c. Depression Method

a) Area Method

This method is used when the terrain is unsuitable for excavation of trenches in which to place the solid wastes.

b) Trench Method

This method is suitable to areas where an adequate depth of cover material is available at the site and where the water table is well below surface.

c) Depression Method

This method is applicable at locations where natural or artificial depressions exist. In such cases it is often possible to use them effectively for landfilling operations. Canyons, and quarries have all been used for this purpose.

The major problems related with the design and management of sanitary landfills, include the control of gas and leachate movement in soils. The evolution of these gases and liquids are caused by the biological decay of organic materials presents in the solid wastes. Various engineered systems are used for the effective control of gases and leachate movements in sanitary landfills. If the designing and operation of sanitary landfills is not properly controlled, gases such as methane can even cause an explosion in the landfill site, while uncontrolled leachate movement can result in underground contamination. The design and operation of sanitary landfills is a highly specialised and engineered process and a variety of activities need to be properly managed and coordinated in order to ensure the smooth working of the landfill site. The effective life of a landfill site depends on the size of the available area which in turn is usually determined by the volume of the waste that is to be disposed. For a mega city like Karachi, a land fill site should ideally have a running life of at least 50 years.

Landfilling with Energy Production

The methane gas produced in sanitary landfills can also be recovered in larger size landfills, and used to produce energy.

Incineration

Incineration can be described as rapid oxidation or burning. Incinerators are devices in which the solid waste are burnt in thermally controlled and closed environment. Incinerators are used in many parts of the world, to safely dispose solid waste of both municipal and industrial kind (waste must contain organic matter). The disposal of

hazardous components of hospital waste through incineration process is a common practice world wide. In Karachi city major hospitals like the Aga Khan Hospital, Civil Hospital and Kidney Center avail of this technology.

- In the process of incineration, the solid waste acts as a fuel.
- In the process of incineration. oxygen must be supplied to support combustion.
- Sufficient temperature must be maintained to sustain the burning process.
- Turbulence to mix the air and fuel thoroughly is needed, if all parts of the wastes are to be burned.
- The combustibles must remain under these favorable conditions of temperature and turbulence for a sufficient time for oxidation to be completed.

These are the main guidelines that are followed while designing a solid waste incinerator. In this process, the amount of waste that is fed in the incinerator is reduced to a non-putrescible residue, without creating a nuisance by the emission of smoke, fly ash, char and odors in excessive amounts.

Incineration with Energy Production

Heat contained in the gas produced from the incineration of solid waste can be recovered by conversion to steam. This steam can then either be used to run boilers or can also be used for power generation.

Management of Hazardous / Special Waste

The safe disposal of hazardous / special wastes poses a lot of problems. Such waste is usually disposed through, *Perpetual Storage Method*.

In this method, toxic waste is dumped in secured land fills lined by synthetic liners or thick impermeable clay liners. However this method is not risk free. In the USA it was found that the toxic waste so dumped in secured landfills over a period of time resulted in underground contamination. Nowadays the cleanup of toxic waste landfill sites is very high on the environmental agenda of the USA. To lower the risk the toxic waste can be placed in arid regions, neither over aquifer nor near major water supplies. Special drains can be installed to catch any liquids that leak out of specially designed containers. However there are doubts wheather risk factor can be totally eliminated. The disposal of toxic waste can even become a political issue crossing national boundaries when such toxic waste is dumped in the oceans by one country, in the sea boundaries of some other countries.

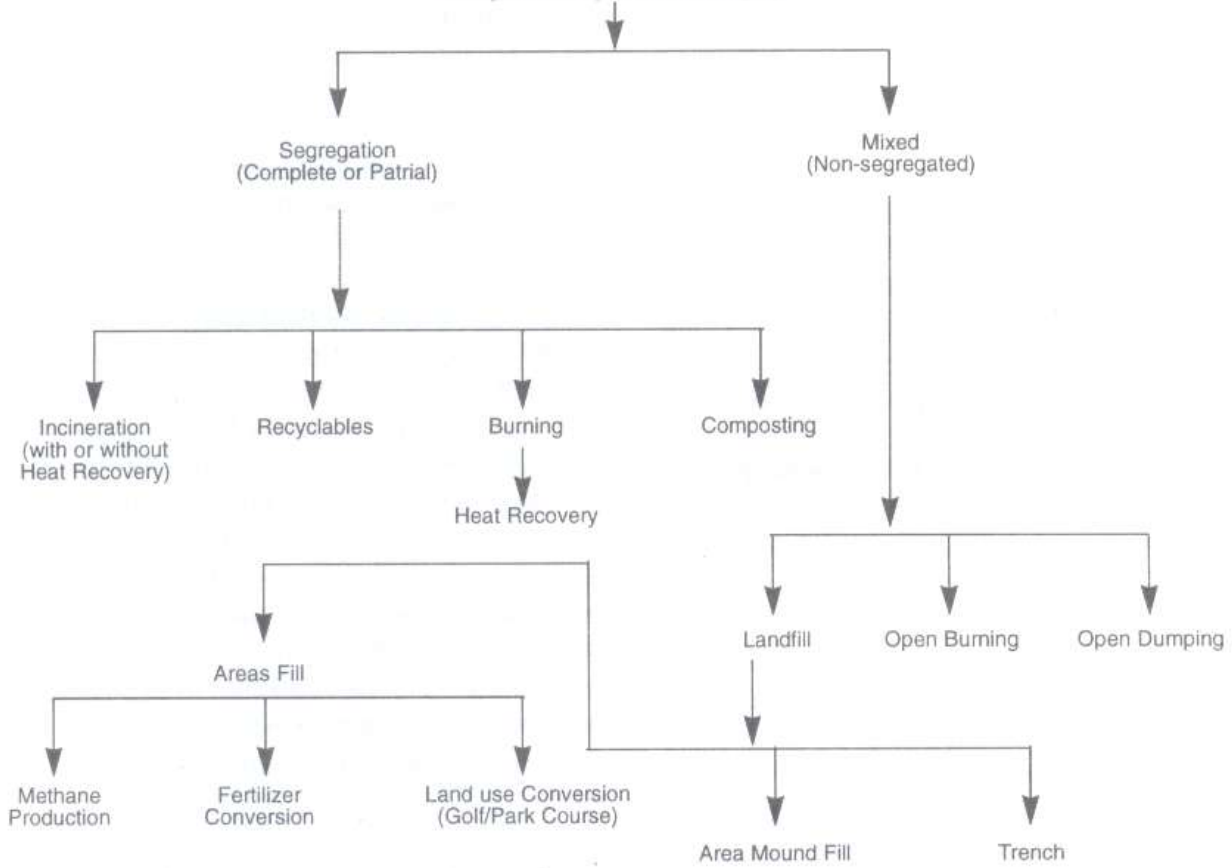
Disposal of Agricultural Waste

In a agricultural country like Pakistan, the

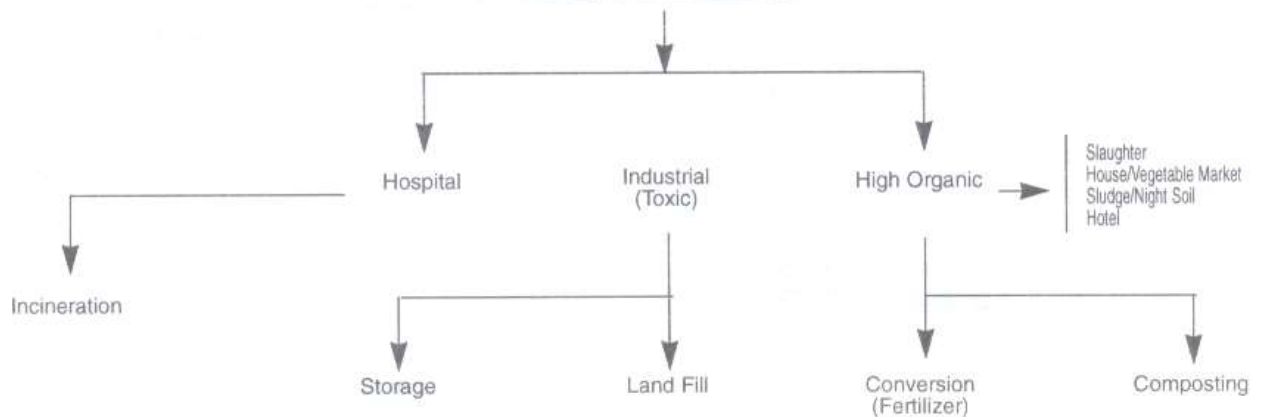
disposal of unused pesticides / herbicides is a serious challenge. It is estimated that about 5000 tonnes of expired and obsolete chemical pesticides, decayed and decomposed are leaking into the environment from rotting drums, rusty cans and withered bags (some of them put into storage more then 20-25 years ago) in 1900 sites located all over the Punjab and in the Karachi, Area. In Karachi the Malir area which is a densely populated, possesses such a toxic dump site. Our major cities have no contingency plan to deal with any emergency related to improperly stored toxic waste. This fact was amply illustrated when highly toxic chemicals were dumped in the Lyari river of Karachi by the local administration in 1993. This unfortunate incident remembered as the '*Sher Shah Toxic Waste Episode*' claimed two lives and dozens of people fell seriously fell. The toxic chemicals were later recovered from the Lyari River and properly disposed through the combined efforts of Sindh Environmental Protection Agency (SEPA) International Union for Conservation of Nature (IUCN) District Administration, Fire Brigade and some local Research and Development (R&D) Institutions. Therefore it is needed to prepare proper plans so that such toxic waste can be stored safely in carefully selected sites and in specially designed containers.

SOLID WASTE MANAGEMENT ALTERNATIVES

A. (Municipal Garbage)



B. Special Wastes



Source: N.E.D. Engineering University, Karachi.

ROLE OF CITIZENS IN THE SOLID WASTE MANAGEMENT SYSTEM

Although the collection, transport and disposal / processing of urban solid waste is the responsibility of metropolitan agencies, individual citizens can contribute a lot by helping out in many areas of solid waste management system.

- A citizen can contribute by minimizing the volume of waste, that is generated. Use of reusable items instead of disposable ones reduces the volume of waste.
- Citizens can separate waste at the household ie. separation of the recyclable components of the waste (paper, cardboard, plastic, aluminum, steel etc.) and give them to the local recyclers (Kabari's or rag pickers). The result would be a reduction in the volume of generated waste.
- Citizens can initiate compost practices at their homes. Such a practice would also reduce the volume of generated waste, and provide them with fertilizer for their lawns and gardens.
- Proper disposal of household garbage at the neighborhood level helps in the safe collection and transport of waste to the ultimate disposal processing

site.

Citizens can also contribute at a slightly enhanced level by becoming part of NGO's / CBO's to run complete neighborhood level garbage collection and sometimes even garbage transport programs. The role of citizen's, NGO's and CBO's is enhanced

in cities where the official solid waste management system does not effectively cater to the needs of the city.

In Karachi, where solid waste management is a major issue, many local NGO's / CBO's are lending a helping

hand. Organizations like Gul Bahao, Karachi Administration Women Welfare Society (KAWWS), Shehri-CBE and Neighborhood Care are running their own solid waste collection programmes (mostly at the neighborhood level). Such programs help in raising a awareness on the issue among the general public and present the metropolitan agencies with models, which could be adopted at the official level.

A brief description of a few community level solid waste management programmes, being run by some local non-governmental organizations is given below:-



Active involvement of citizens in civic affairs can help solve many problems

Gul Bahao

Nargis Latif of Gul Bahao has involved commercial incentives in solid waste management. Her slogan is: "Garbage is Gold!" She buys dry waste and sells it onwards to a junk dealer at a profit. Ms. Latif buys rubbish that is not taken by many of the informal sector junk collectors or Kabari wallah, who buy waste direct from households, such as plastic bags, polyethylene mineral water bottles and other such material. This programme is very effective in raising awareness among the general public on the virtues of garbage recycling and gives the people a cash incentive not to litter the streets.

Karachi Administration Women Welfare Society (KAWWS)

This is non-governmental organization operating in the Karachi Administration Employees Cooperative housing Society. Initially they started, their solid waste management programme by collecting money from the residents, for the purchase of large bins for each of the lanes, where households and sweepers could dump their rubbish. They then worked to persuade people to use these bins and to contribute to extra payments for the sweepers and KMC staff. Starting initially from two blocks in the area, the KAWWS programme now covers 1,881 homes, operating over an area 195 acres. They are also, now looking into the



Citizens can always make a difference

possibility of a door to door garbage collection system.

Neighborhood Care

Neighborhood Care was formed when the residents of Block 6, PECHS approached Mr. Jamil Yusuf and the Citizen-Police Liason Committee for help with a number of problems ranging from security to rubbish collection. He and Sami Mustafa assisted by planning a model collective neighborhood management and security system which involves around 250 houses. The scheme covers 15 lanes in Block 6. The residents pay (even here, not all the residents pay) according to the area their house covers. The occupant of a house on a 1,000 sq yds plot pay Rs. 1,500 per month, and those on a plot of 2,000 sq yds pay Rs. 3,000 per month for all the facilities which include security services, payment to sanitary staff, sewerage and lighting. Plastic bags (30 to each house) are provided to the residents, even to those who have not paid,

for the disposal of their garbage.

Initially a three-wheeler was contracted to collect the garbage. But when it could not handle the work load, a pick-up was commissioned instead.

The van owner is paid Rs. 9,000 per month and the garbage is collected and deposited in the KMC container. The KMC collect the garbage containers daily, leaving empty ones in their place. The driver of the KMC truck collecting the container is paid Rs. 50 a

day. In between garbage collection, the pick-up (the crew includes a driver and two sweeper boys) collects garden trimmings, debris and construction waste from the streets and, on request, from the houses free-of-charge. Sunday is the only day off and on that day people are asked not to put their garbage out.

Shehri-CBE

KMC invited Shehri, an environmental NGO specialising in urban issues, to take over a solid waste management project. The mandate included raising awareness and motivating people to take part in waste management in New Karachi Cooperative Housing Society and Maniya Society, both situated near Tariq Road. The programme was funded by UNICEF, the Friedrich Naumann Foundation and KMC and began in October 1994.

Shehri started with a door-to-door survey to try and gauge the potential of community participation in monitoring the disposal of solid waste. A sweeper was found who swept the streets and collected garbage from each house, depositing it in the community bin. He was paid Rs. 2,000 per month from donor funds. Three community sanitary inspectors employed by the KMC were also hired to monitor the system, to identify the polluters i.e. domestic servants, rag pickers or any one else, and to monitor the sweepers. The residents were reluctant to contribute in spite of having been given, effectively, a free demonstration of the benefits of a cleaner environment. The learning from this is that the residents of an area have to be willing to see garbage disposal as a problem and as their problem.



Our children need to be made aware of the importance of a clean and healthy environment.

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Shehri-CBE

“Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it’s the only thing that ever has”.

– Margaret Mead

Shehri is an NGO, involved in various projects related with protection and conservation of the natural and built environment of our country. Over the years, Shehri has built for itself a sound reputation in the field of environmental advocacy and the development and management of participatory approaches for solving regional issues. Whether they be issues of land use and zoning, solid waste management, nature conservation or policy debates, we can proudly claim to have made a significant contribution. We are also engaged in research work and preparation of environmental impact studies on several issues of environmental concern. Shehri also specializes in managing dialogues and interaction between local people and government agencies on issues and concerns which require joint action and participation.



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