

INTEGRATING RECYCLING AND DISPOSAL SYSTEM FOR SOLID WASTE MANAGEMENT IN KARACHI

**By
Dr. Mansoor Ali
Arif Hasan**

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Field work and technical support:
Engr. Mansoor Raza and the Urban Resource Centre, Karachi

**Arif Hasan, Architect and Planning Consultant, 37-D, Mohd. Ali Society,
Karachi – 75350 – Pakistan Tel/Fax: (92.21) 452 2361 E-mail: ahasan@digicom.net.pk**

ACKNOWLEDGEMENTS

This report is the culmination of many years of work on solid waste management by Dr. Mansoor Ali and the Urban Resource Centre (URC). Its background and methodology is explained in the introduction. However, how this work began needs to be explained. In 1992, Dr. Mansoor Ali was doing his Master's thesis at the University of Loughborough on solid waste and its relation to the recycling industry in Karachi. He sought the help of the URC for field investigations. The URC remained in touch with Dr. Mansoor Ali and continued this work around one question: Why does solid waste not reach the landfill site? And the answer invariably was that it was because of the requirements and location of the recycling industry and the scavenging system that served it. This led the URC to lobby for the creation of a "garbage city" where scavenging and recycling could be located. The Sindh Governor's Task Force for Municipal Services accepted this concept for investigation and discussion purposes and after negotiations with interest groups, endorsed it. The logical conclusion of this endorsement was to prepare a pre-feasibility report and hence this study. Meanwhile, Dr. Mansoor over the years had continued to work on solid waste management issues related to Karachi.

A large number of people have assisted me in the preparation of this report. Mansoor Raza has been the main research support person. Field investigations and relevant interviews and their documentation have been carried out by the URC team consisting of Architect Muhammad Younis, Zahid Farooq, Noorjehan and Simon. Khalid Javaid and Muhammad Shakaib of the Karachi Municipal Corporation (KMC), Dr. Aslam Pervaiz (DMC Malir) and M. E. Khwaja (bone recycler) have taken a deep interest in this study and provided valuable information. Architect Sahar Alam and Christophe Polack have prepared the maps and charts which form part of the text and Israr Ahmad Rana has formatted it.

This study draws a great deal upon the previous work of my co-author, Dr. Mansoor Ali, who has been responsible for putting much of it together, and structuring and conducting the workshops related to it. Without his participation and inputs this study could not have been possible.

It is hoped that this study will be useful in guiding future plans for the development of an appropriate solid waste management system for Karachi which does not deprive people of their livelihoods or create new problems for the environment and the city's economy.

ARIF HASAN

Chairman
Urban Resource Centre
Karachi

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EXECUTIVE SUMMARY

It is estimated that the city of Karachi generates 6,000 tonnes of solid waste every day. Of this 600 tonnes of recycleable waste per day is separated at source by housewives, domestic servants, market employees and sold to itinerant waste buyers who then resell this to the recycling industry. The rest of the waste finds its way to neighbourhood collection points or *katchra kundis* as they are called, from where it is supposed to be collected by the five District Municipal Councils (DMCs) of Karachi and transported to the Karachi Municipal Corporation (KMC) landfill site. However, this does not happen. About 1,400 tonnes of waste per day is picked by street pickers from the *katchra kundis*, taken to open spaces or under the bridges within the city, where dealers buy it from the pickers, sort it out and then sell it directly to the recycling industry or to special dealers who then sell it further. Most of this recycling industry is located within the city although some of the recycleable waste is also exported to the Punjab for recycling.

Findings of the Study

A major problem related to solid waste management for Karachi is that the solid waste does not reach the official landfill site. There are a number of reasons for this. These are given below.

- Scavengers pay the DMC staff informally to persuade them not to pick up the waste so that they can scavenge and remove the recycleable material from it. The DMC staff saves money on POL as well in the process, which it pockets.
- There are scavenger's colonies in Karachi which also pay the DMC staff per truck for delivering the waste to them instead of taking it to the official landfill site.
- There is only one landfill site for the whole city and distances to it can be of upto 40 kilometres on bad roads. This is a disincentive to the drivers and DMC staff and private sector operators. Therefore, they take the solid waste to a number of nearby unofficial sites where it is picked by scavengers of recycleable material.
- Both the DMCs and the KMC suffer from poor management of the solid waste system. In addition, the manner of organising, collecting and disposal does not relate in anyway to the scavenging and recycling activities, except informally.
- Waste is also taken to potter's settlements where it is used as fuel in kilns. Here again, the DMC staff are the beneficiaries.
- The recycling industry provides employment to more than 55,000 families and its annual turn over is over Rs 1.2 billion. Its activities have increased by over 65 per cent in the last seven years and it is estimated that there are more than 1,000 recycling units. Almost all of them are in the informal sector. It is estimated that 25 per cent of them are formal units located in the industrial areas of the city and most of these are involved in making board out of waste paper.
- The neighbours to the informal recycling industry are constantly agitating against its presence in their areas since it creates environmental pollution and degradation and social conflict. For this reason, there are also court cases against the industry and as such much of this industry wishes to relocate to a more "friendly" environment.

- Thirty-five studies on solid waste have been conducted on Karachi by various agencies in the last 20 years. None of these studies have tried to integrate the recycling industry and processes with the solid waste management system. As a result of this study, these previous studies have been collected and placed in the Urban Resource Centre in Karachi.

Integrating Recycling with Solid Waste Management in Karachi: Concept

This study is a pre-feasibility for integrating solid waste management with the scavenging and recycling activities in Karachi. The concept was accepted by the Sindh Governor's Task Force for the Improvement of Municipal Services. The Task Force requested the World Bank-Water and Sanitation Programme to support a pre-feasibility and hence this study.

The concept that has been researched consists of developing scavenging and recycling at the landfill sites and preventing scavenging and recycling within the city. It is felt that if scavenging and recycling can be shifted to the landfill site then there will be no impediment to the waste reaching the landfill. For determining how feasible this would be, dialogues and workshops were conducted with DMC and KMC staff, representatives of the recycling industry, scavengers, private sector solid waste management companies, dealers, middlemen and itinerant waste dealers. Summary of the findings of these dialogues is given below.

- The itinerant waste dealers have no problems with the concept. Their business they feel will remain unaffected.
- The scavengers have a problem. If they are to work at the landfill site then they would like to have a space to live which they can call their own, and water and electricity. They would also like to have access to cheap food as they have in the city.
- The informal recycling industry and also the excessively polluting formal industry would like to move away from the city. However, it requires land, road access, electricity, water and preferably living space for its workers. It is willing to pay for these facilities.
- The DMC/KMC staff feels that the system will work provided the DMC/KMC staff is given a financial incentive in managing the collection and transport of solid waste from the *katchra kundis* to the landfill sites.
- The private sector entrepreneurs are supportive of the proposal. They have expressed an interest in developing and managing landfill sites provided they are easily accessible and not too far away from their areas of operation. They are also interested in solid waste collection and disposal to the landfill sites provided this is on a reasonably small scale to make it financially viable for them, given their financial and management constraints.

Recommendations for the Feasibility

The following recommendations have emerged from the study.

- There should be four landfill sites in Karachi each handling about 1,500 tonnes of solid waste per day. They should be so located that refuse trucks do not have to travel more than 15 kilometres to them.
- Jam Chakro, the present official site should be developed as a model to handle 1,500 tonnes of solid waste per day. It should contain 30 sorting yards and 18 recycling factories along with 600 60 M2 plots for scavengers.

- Scavengers and the recycling industry should be provided with land and the infrastructure that they require for performing their activities. This investment could be made by the KMC or by the private sector.
- The investments and revenues from the landfill sites for different options have been worked out and are given in the table below.

Capital and O&M Costs for Proposed Landfill Sites

Sr. No.	Item	Capital Costs (in Rs)	Operational Cost (in Rs)	Revenue per Year (in Rs)	Shortfall (-) Surplus (in Rs)
1.	For 500 tonnes/day module (lower cost option)	57,035,000	6,336,000	6,805,000	+ 469,000
2.	For 500 tonnes/day module (higher cost option)	66,150,000	7,724,000	6,805,000	- 919,000
3.	For one of 4 sites 1,500 tonnes/day (lower cost option) 1x3	171,105,000	11,913,000	20,415,000	+ 1,407,000
4.	For one of 4 sites 1,500 tonnes/day (higher cost option) 2x3	198,450,000	23,172,000	20,415,000	- 2,757,000
5.	For all 4 sites 6,000 tonnes/day (lower cost option) 4x3	684,420,000	47,652,000	81,660,000	+ 5,628,000
6.	For all 4 sites 6,000 tonnes/day (higher cost option) 4x4	793,800,000	92,688,000	81,660,000	- 11,028,000

- Prevention of scavenging at the *katchra kundis* can be stopped if the waste is not exposed and is collected and transported in transferable sealed containers. A number of options for this have been explored which include handing over this work on contract to DMC staff and/or private sector and permitting staff on the solid waste disposal vehicles to negotiate sale of the waste to the scavengers at the landfill sites.
- The new devolution plan of the government offers promising possibilities for improvements in the solid waste management system. The Union Councils (UCs) can be made in-charge of collecting waste to a central pick up point in their jurisdiction. It should be the responsibility of the Town Committees (TCs) or private sector to pick up the waste from the UC and transfer it to a landfill site. The landfill sites should be operated by the KMC or by the private sector.

Missing Issues

There are a number of issues that will need further investigation for a proper physical and financial feasibility. These are:

- Identification of new landfill sites at appropriate locations. At present, only two landfill sites have been identified and both of them are to the north of Karachi. Also, no proper maps for those sites are available with the official agencies.
- The possibilities of taxing the scavengers, dealers and the recycling industry for operating the landfill sites needs to be further investigated. This study has developed a tax proposal based on what the industry owners have proposed.
- The issue of composting the residue organic waste is controversial. Most private sector operators consider it to be a non-profit making venture.
- The present study deals with residential and commercial waste. There is a need to look at hazardous and industrial waste as well.

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Abbreviations and Local Terms

Abbreviations

DMC	District Municipal Committee
DG	District Government
KESC	Karachi Electric Supply Corporation
KMC	Karachi Municipal Corporation
WSP	Water and Sanitation Program
MoU	Memorandum of Understanding
SWM	Solid Waste Management
TFMS	Task Force on Municipal Services in Sindh
TC	Town Council
TOR	Terms of Reference
UC	Union Council
URC	Urban Resource Centre

Local Terms

<i>katchi abadis</i>	squatter settlements
<i>katchra kundi</i>	waste collection point
<i>nullahs</i>	natural drains

Section - 1

1. INTRODUCTION

1.1 Background

The Water and Sanitation Program (WSP) is an international partnership of multilateral and bilateral agencies, with the World Bank as the managing partner. The Programme is decentralised into regional water and sanitation groups, which consist of country programmes reporting to regional headquarters. The goal of the Programme is to improve the access of the poor to safe water and sanitation and its mandate is to inform the sector by generating and managing knowledge, on a country, regional and global axis. The program strategies are designed to have an impact on the poor through improving the policy environment, identification and analysis of key sector issues, learning from lessons on the ground and support to major investments.

The urban portfolio of the program includes a number of projects related to policy development, pilots and documentation and dissemination of sectoral best practices. This has included carrying forward policy dialogue at federal, provincial and operational level. In 1998, the Program organised a round table on the role of the private and non-formal sector in solid waste management in Karachi. The discussion identified the major issues in solid waste management and the role of various actors. WSP has ever since been a part of the policy dialogue and as a part of its ongoing policy work WSP-SA has entered into a Memorandum of Understanding (MoU) with the Task Force on Municipal Services in Sindh (TFMS). This project is a continuation of this dialogue, but not restricted to policy formulation.

The Government of Sindh has established the Task Force on Municipal Services to address both operational and policy constraints to improve delivery of services. The Task Force has been able to address a number of operational constraints through a process of documentation, analysis and coordination; and has been instrumental in designing a number of pilot activities by providing support to relevant government institutions. As a part of its agenda the Task Force has taken up the problem of solid waste management in Karachi and is seeking strategic and workable solutions.

Karachi is a city of over 10 million people that spends approximately Rs 1 billion a year on solid waste management. However, the city looks far from clean. There have been at least 10 major studies on Solid Waste Management (SWM) that could not be implemented. They have all failed to recognise the role of the complex and lucrative recycling industry associated with SWM. These include about 21,000 waste pickers and their contractors. The separated waste is distributed to the bone, metal, paper and glass recycling industry through a well formed network of *kabaris*. The assumption that this informal activity could be stopped or does not exist has not proved to be correct and therefore the solid waste problem stands unresolved.

The Task Force, assisted by the Urban Resource Centre (URC), a Karachi NGO, held a series of discussions with various interest groups involved in SWM for the city. During these discussions a number of issues have been identified by various stakeholders. For example, a workshop was organised in December 1998 to discuss the options on strengthening the linkages between the formal, private and non-formal sectors. In the process the Task Force and the stakeholders managed to reach a consensus on recognising and relocating the recycling industry. One of the key obstacles in relocating the industry is the lack of a suitable site and supporting infrastructure. Such a site must ideally be developed near the disposal sites. A number of informal recycling

activities at present occur at communal bins, collection vehicles and disposal sites. Meanwhile, the small scale recycling industry faces threats of eviction from official agencies and nearby population because of its operations cause environmental pollution.

Keeping in view the above issues, the WSP has agreed to initiate a systematic study on the integration of formal and non-formal systems. A TOR was agreed to and modified during the course of the study. The TOR is as follows:

- **Review of previous studies on Solid Waste Management:** Review the previously conducted studies and assess their strengths and why they have failed to provide workable solutions. Highlight features and lessons that need to be incorporated in the new design.
- **Mapping of the non-formal/private sector in recycling of material from Karachi's solid waste system:** Based on the report on recycling by the task force and data collected by the URC and other research, quantify approximately the no of workers, units and contractors in the SWM activity in Karachi. The analysis would be made at different stages of the process that is collection, separation, distribution and processing in various industries as a link of forward movement of the solid waste according to its divert utility.
- **Sustainability of current landfill sites:** Assess the suitability of the current landfill site and suggest possible alternatives along with size required for future use (10 years minimum), engineering design requirements, environmental protection and the process of establishing a stakeholders/neighbourhood areas consensus.
- **Institutional arrangements, operations and administrative procedures for the site:** Propose and outline the administrative/operation, maintenance and monitoring procedures for the site, clarifying the role of the Government (in the future decentralised open item as per devolution plan), modes of private sector participation and inclusion of the non-formal sector as small scale independent providers of services. The Task Force may wish to continue dialogue with various players to refine details and options.
- **Conceptual plan:** Prepare a conceptual line plan for a landfill site with provision for the relocation of recycling industry. It should consider the various requirements for wastes separation, on-site recycling, distribution of various recycleable material and final sanitary disposal. (Since no maps of existing or proposed landfill sites are available with the Karachi Municipal Corporation (KMC) or other local bodies, TOR have been revised. It has been decided that a modular system would be developed with details for a module of 500 tonnes of solid waste per day.)
- **Pre-feasibility:** Determine the financial and environmental implications of the proposed SWM program for Karachi. Estimate infrastructure cost of the facility including boundaries, roads, weigh-bridges, land area for material recovery, composting and sanitary landfill and recurrent costs for operating the site. Aspects to be considered would include financial management and control, affordability, cost recovery policy/willingness to pay, environmental works and, finally, possible sources of investment funds. (TOR have been revised to develop details for a module of 500 tonnes per day.)

1.2 Methodology

An open ended exploratory methodology was adopted. The study was started in March and continued till June 2001. Most of the work was built on past work, done by the URC, Loughborough University (UK), Shehri and Dawood College, Karachi. The following key activities were undertaken during the methodology.

- a) All the secondary data and information available in the form of grey literature was collected and reviewed. A total of 35 published literature was identified and a summary and reference list was prepared see **Appendix - 1: List of Literature Available on Solid Waste Management.**
- b) The URC conducted a number of interviews with the key stakeholders in recycling and official solid waste management system. Most of these interviews were conducted on the basis of a check list developed by the research team.
- c) News clippings on SWM kept by URC were retrieved, arranged in chronological order and analysed from the year 1992 to date.
- d) Systematic observations were made at communal bins, disposal sites and at the informal recycling industry.
- e) Large scale disposal sites were identified and visited. Most of these sites are unofficial with extensive informal waste picking.
- f) Two workshops were held with the municipal officers and the stakeholders of the recycling industry. A number of meetings were also held with the municipal officers. Findings were presented, discussed and modified to reach a consensus see **Appendix - 2: Proceedings of Workshops and Important Meetings Related to the Study.**
- g) All the primary and secondary information was systematically organised and stored in the URC library for future use.
- h) All the findings were summarised in the form of a draft report.

1.3 Groups of Stakeholders

The stakeholders in the solid waste management and recycling activity can be divided into three broad categories:

- Citizens
- Local authority
- Private sector

Citizens are the waste generators and users of the service provided by the local authority. They expect a reliable and affordable waste collection service. They are also expected to pay regular amount of money against the service. Citizens' groups also like to be involved in the key decision making of solid waste management systems. They also often express their concerns against indiscriminate practices leading to poor urban environmental conditions.

The KMC is responsible for providing waste collection, transport and disposal services. Waste collection and transportation has been the responsibility of district municipal committees while management of landfill sites, large procurements and future planning lies with the Solid Waste Management Department of KMC. As an organisation, KMC is a key stakeholder. However, the staff of the KMC working at different levels can not be neglected in decision making. This is further discussed in the text.

The private and non-formal sector is mainly engaged in waste separation, trade and recycling activity. Up to a lesser extent non-formal actors like sweepers also collect waste against an agreed payment with the household. The key stakeholders within this category are waste pickers (scavengers), waste buyers (paper *batlee wala*), waste traders (*kabaris*) and waste processors

(small and large scale recycling industry). They consider waste as a resource and earn a livelihood from this.

Further discussion and details on the stakeholders will follow in other sections.

1.4 Key Issues

A number of key issues have been identified by different stakeholders. In addition, a number of issues have been mentioned in previous reports. The nature of the issues depend and vary according to individual perspectives. The key issues within the remit of this study are as follows.

- KMC considers solid waste management as a service. As such they have a limited capacity to understand the point of view of the private sector involved in recycling. They also lack instruments of incentives and controls to integrate recycling with the formal waste management systems.
- Most of the recycling activities in Karachi are run by non-formal and large scale private sector. They consider waste as a raw material which should be accessed, separated, traded, processed and sold. A number of these activities have limited integration with the official system.
- Although official landfill sites have been developed, the number of trucks reaching those sites are few. There are number of reasons for this. The landfill sites are far from districts East and South and are considered unsafe and inadequate. Whatever waste reaches the landfill sites is burnt by waste pickers to retrieve metals.
- The reasons of not taking the waste to the landfill sites are also shortage of fuel, theft of fuel, poor control over drivers and a price offered by waste pickers for a truck load of waste to the drivers and staff of the SWM operators. In addition, there is a limited control over drivers and there is no incentive for them in the system to take the waste to the landfill sites.
- The recycling industry in the informal sector faces threats from the local authority and nearby population. They are interested in getting allocated sites to perform their activities without threat or harassment. The smaller units and those industries that pollute the environment are anxious to shift to locations near the landfill sites provided infrastructure for their functioning is available. However, larger scale and established recycling units are not as interested in shifting but they are much fewer in number.
- Similarly, small scale waste dealers may also take an interest in shifting near the landfill sites.
- The cost of formalisation may prove to be a key factor in the shifting of the non-formal recycling industry. If the cost, incentives and controls are not realistic, the new sites developed for the recycling industry may be taken over by the larger scale sector.
- A number of truck loads are diverted to non-formal pottery makers yards. Waste is then slowly burned to bake clay products. Waste from low income areas with lesser quantities of recycleable materials could be formally diverted to these sites. The environmental cost and benefits of such activity need to be assessed in the feasibility report.

1.5 Contribution of This Project

The major contributions of this study are as follows:

- Accessing, storing and reviewing the past literature. Providing a single location for the copies of this literature and making its access easier for every future study/project.

- Up-dating the data and information base on official and informal systems.
- Recognising the informal activities, which are extensive in nature and exploring the possibilities of their integration with formal systems. Past projects considered solid waste management as a service, as a result informal activities were not mainstreamed.
- Working out the financial and social viability of various options of public-private partnership.

1.6 Structure of the Report

This report is divided into 5 Sections. The core of the data and information is given in the Appendices. The structure of the report is as follows:

Section 1	Background, Terms of Reference (TOR)
Section 2	Summary of the literature review. Full literature review is given in Appendix –3: Literature Review
Section 3	A description of the informal system of recycling and it's linkages with the municipal system
Section 4	A description of the municipal system of waste collection, transportation and disposal
Section 5	Pre-feasibility of possible options, integrating formal and non-formal systems

1.7 Karachi's Population and Solid Waste Generation

Reliable solid waste generation figures for Karachi are not available. Previous studies have based these figures on Karachi's population. However, different studies have calculated Karachi's population differently since no census figures were available for the city between 1981 and 2000. This study has used the 1998 census figure of 9.8 million which is disputed by many Karachi NGOs and interest groups as being far too low.

Section - 2

KNOWLEDGE REVIEW

1. PREVIOUS STUDIES

In the past 20 years at least 35 studies have been conducted on solid waste management of Karachi from the municipal perspective. All the reports and studies were available at different places. This study has identified and collected copies of all the past studies and stored them at the URC. A total of 44 studies have been identified. The complete list is attached as **Appendix – 1**. An un-edited version of the knowledge review is attached as **Appendix – 3**.

Most of the past studies have been done around major funded projects, while some are done for academic interest. The studies cover a range of topics. Following is the summary of key issues that emerge from them.

2. SUMMARY OF KEY ISSUES

- Solid waste management has been accorded low priority in the existing planning structure of the KMC.
- The available data on the quantity and quality of the waste stream is outdated and inaccurate. Although, all the studies have used similar data, very few attempted to generate accurate data and information. One can safely say that an accurate data and information base for Karachi's solid waste management is non-existent.
- Solid waste collection and storage facilities are inadequate. Most of the areas lack spaces to provide communal bins. Where bins are provided, they are of low capacity, poorly operated and maintained.
- The role of informal sector is not recognised and hence not incorporated in the planning and operation of solid waste management systems.
- In *katchi abadis* (squatter settlements), solid waste is not collected in trolleys or containers but is disposed onto natural drains (*nullahs*), streets or open plots by households and or sweepers.
- The existing transportation facilities available with KMC are grossly inadequate. Refuse vehicles makes 2 to 3 trips per day to dump sites with sometimes a round trip distance of more than 60 kms.
- The present ancillary facilities such as workshops and laboratories are outdated and inadequate.
- Less than one third of the waste is reaching the officially owned and designated disposal sites. The rest is taken to unofficial disposal sites.
- The KMC personnel involved in solid waste management including engineers, inspectors, supervisors, coolies and sweepers are not properly trained for the function they perform, though they are experienced with the present system.

- The key persons involved in solid waste management are sweepers, coolies (loaders) and drivers. The existing strength of sweepers is 1.06 sweeper for every 1,000 persons which is grossly inadequate if the manual system continues. Other options have not been studied in enough details.
- The inherent technical and managerial incapacity of the KMC/District Municipal Committee (DMC) staff is another inhibitory factor. Low salary and benefit packages make the introduction of qualified staff within these bodies, difficult.
- The budget allocations are grossly inadequate. Further the establishment alone consumes the major portion of the budget. Expenses are partly met by grants which are insufficient and subject to variations. Most of the budget is spent on recurring cost while capital expenditure remains very low.
- Mechanisms for citizens' participation, consultation and dialogue are extremely limited and are mostly restricted to the practice of registration of complaints and their subsequent follow-up. Channels for meaningful communication with civic officials and active citizens' involvement in the affairs of the civic bodies do not exist. Planning, development and management of projects are often devoid of citizens' participation.
- Due to lack of effective co-ordination both inter and intra departmental, the decision-making processes are seldom clearly defined and management lapses occur.
- Legislation and its enforcement is non-existent. Therefore, the role of the regulatory bodies like the Sindh Environmental Protection Agency is extremely limited.
- Effective revenue generating mechanisms do not exist. The conservancy charges cater only to 10 to 20 per cent of the total budgetary requirements of the solid waste management sector. The financing mechanism continues to rely on aid and loan money.
- People generally lack awareness about the impact of poor waste management. They keep their houses clean but do not care for beyond their house boundaries.
- **Controlled disposal of waste is generally not practised. Previous efforts to initiate controlled disposal practices have failed.**

3. KNOWLEDGE GAPS

- Since most of the literature has been developed as a result of infrastructure funding projects, it considers solid waste management as a municipal service to be delivered by the municipal authorities. It does not recognise the role of private sector, both formal and informal. Not much attention has been given to study alternative management options such as Public-Private Partnership.
- The need for reliable data and information is evident from most of the literature. Since the data and information base remained weak the reliability of various proposals is poor.
- The literature generally neglects the role of poor in the provision of the solid waste collection and recycling services.
- The literature does not clearly identify the role of citizens in solid waste management, as waste generators and recipient of the municipal services.
- As a result of poor documentation of past efforts, the literature could not discuss the good practices and lessons learned.

4. CORE LITERATURE

The research team has also identified the core literature, which is given below.

- Ali, S.M. (1997), "Integration of the Official and Private Informal Practices in Solid Waste Management", Karachi
- Ali, S.M., Cotton, A.P. and Westlake, K. (1999), "Down to Earth: Solid Waste Disposal for low income countries", WEDC, Loughborough University, UK (ISBN Paperback 0906055 66 0)
- Anwar, F. (2000), "Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government- Solid Waste Management Sector of Karachi, A Case Study", Karachi
- Globex – City Consult – Sukleen Team (2001), "Solid Waste Management Project", A proposal submitted by Globex – City Consult – to Karachi Metropolitan Corporation, Karachi.
- Hasan A. (1999), "Understanding Karachi-Planning and Reform for the Future", Karachi, City Press Karachi, ISBN (969-8380-28-0)
- National Engineering Consulting Services Pakistan (PVT) Limited (1995), " Solid Waste Management" , Final Report, Karachi
- News clippings on Karachi Solid Waste Management 1992-2001, URC, Karachi
- The Recycle Industry Dialogue initiated by the Sub-Committee on SWM with the stakeholders in the recycle industry.
- SKAA (1998), "Proceedings of the First Discussion on Solid Waste Management", Karachi
- UNCHS Habitat (1992), "Promotion of Waste Recycling and Reuse in Developing Countries", Karachi

Section - 3

THE RECYCLING SECTOR

1. INTRODUCTION

The recycling activities in Karachi are extensive and they have links with all the stages in solid waste systems. They are sustainable and growing with the increase in waste quantities and changes in consumption patterns. All the recycling activities in Karachi are run by the private sector, which are both large scale and small scale and most are informal in nature. While governments in developed countries support and subsidise recycling to reduce the waste quantities and to gain long term environmental benefits, Karachi's recycling sector is not only self financed but also provides employment to more than 55,000 families and reduces weight to 75 per cent of the original wet weight of municipal waste. It operates with an estimated turnover of over 1.2 billion per annum and is able to recycle at least 2,000 tonnes of waste daily. It not only recycles significant quantities of the city's waste but also imports waste from other cities in the country and the region. It also provides raw materials to a number of industries in the country¹.

Understanding and integrating recycling activities with the strategies of solid waste management is important, not only to reduce the quantities of waste but also to gain effective and efficient operations of various stages in the solid waste system. Since waste is an important livelihood source for the poor, integrated approaches to waste management could be used as a practical tool to poverty reduction. Waste is accessed, separated, bought and sold like any other raw material. The attitude of the local recycling sector towards the waste is very different from that of local authorities, as it is seen as a resource by the private informal sector instead of a burden. If not integrated, the recycling could be threatened or threaten future developments in solid waste management. If they cease to operate, the quantities of waste will increase and local authorities will need to spend additional amounts of money to take care of the increased quantities.

This section presents an overview of the recycling sector in Karachi, with a focus on opportunities for integration with waste disposal practices.

2. OVERVIEW

The recycling sector in Karachi can be divided into two broad categories:

- Waste picking in streets, communal bins and disposal sites by Afghan pickers and sweepers. The picked waste then passes through a number of dealers and ultimately reaches the small scale recycling industry. As this stream deals in comparatively poor quality of waste, hence its called the **dirty stream**. Typical materials in this stream are waste paper, plastic bags, broken glass and bottles and bones.
- Waste separation at the source of generation and it's further sell to itinerant waste buyers which passes through a number of dealers and ultimately reaches the large and small scale recycling industry. This stream deals in comparatively better quality of waste, hence its called the **clean stream**. Typical materials in this stream are ferrous cans, metals, newspaper separated at source, bottles and plastics.

¹. Information synthesised from various studies and surveys

In addition to the above two activities waste is also imported from and exported to other cities of the country. Some main dealers and recycling industry also import waste from other countries for re-processing.

There are a number of stakeholders groups involved with recycling in Karachi. Table 3.1 and 3.2 give a brief description of the stakeholders involved in the two streams:

Table 3.1

Stakeholders in Waste Recycling in Karachi (Clean Stream)

Stakeholders	Role
Households	They separate and store the saleable waste components and then sell the separated components to itinerant waste buyers at a known or agreed price
Domestic Servants	In high income areas, they separate and store the saleable waste components. Then sell the separated components to itinerant waste buyers
Itinerant Waste Buyers	They purchase separated waste from the households and other sources and sell it to middle dealers
Middle Dealers	Purchase all the materials from itinerant buyers and sell it to the main dealers. Also clean and process some materials to reduce the transportation cost and add value
Main Dealers	Deal in a single type of waste. They purchase waste from middle dealers and sell it to the recycling industry within and outside the city. Process and sometimes categorise materials for further transportation and add value. For some materials the main dealers for dirty and clean stream could be the same, for example broken glass and ferrous metals
Recycling Industry	Convert waste materials to other saleable products. For example, ferrous metal is re-rolled and glass is mixed with the virgin raw material

Table 3.2

Stakeholders in Waste Recycling in Karachi (Dirty Stream)

Stakeholders	Role
Sweepers	While collecting waste from households, they separate and sell saleable components. The remaining waste is disposed of at communal bins or open plots by them
Street Pickers	A very high number of Afghan immigrants are involved in the separation of paper and cardboard from waste on streets and communal bins. Also pick other components, if they can find them. They bring the waste at common yards and collectively sell them to the dealers and recycling industry

Middle Dealers	Purchase and transport materials from waste pickers yards and sell it to the recycling industry. Also process some materials to reduce the transportation cost and add value, for example paper is baled and compacted
Recycling Industry	Mostly small scale industry involved in the recycling of poor quality paper and cardboard to paper board. There are also few industries which deal in plastics

3. SEPARATION BY HOUSEHOLDS AND SERVANTS

The largest group of people involved in the recycling is the households. They may not be generating the largest quantities of recyclable waste as compared to industries or the commercial sector. Households and servants do not allow the re-saleable waste components into waste and store them for resale. When sizeable quantities of materials accumulate the whole lot is sold to the itinerant waste buyers. The payment is made on the basis of the weight of each individual material. In high income areas domestic servants first access the re-saleable components which they sell, often from their own low income, residential areas. Households regularly separate certain components from waste to earn an extra income. Earlier studies suggest that households separate newspaper, bottles, tin cans, bread, books and magazines. This separation reduces 10 per cent of the waste by weight. Our recent investigations suggest that this practice has expanded. This is evident from the following observations:

- A steady increase in the prices of material since 1994.
- Waste buyers are buying material, which they were not buying previously.
- An increase in the number of buyers and new marketing techniques to buy waste.

The main reason for this expansion is the availability of more recyclable material with the changes in consumer patterns and a resulting increase in the recycling industry. The current and previous prices of various materials are given in Table 3.3.

Table 3.3

Prices Paid to the Households by Itinerant Waste Buyers for Different Materials in Karachi in 1994 and 2001 ²

Waste material (typical sources)	Prices in Rs per Kg (1994)	Prices in Rs per Kg (2001)	Remarks
Urdu Newspaper	2.00	5.00	An increase of 150 per cent in 7 years.
English Newspaper	2.50	8.00	A three times increase.
Ferrous Cans (cooking oil etc.)	5.00	6.00	Number of metal industry in the non-formal sector is marginal.

². 1994 rates taken from Mansoor Ali's Master thesis. 2001 rates acquired by the Research Team for this study from waste buyers.

Ferrous Metals (pipes, fittings etc.)	6.00	7.00	-do-
Bottles (cold drinks, medicine etc.)	1.00	2.00	A 100 per cent increase
Glass (window glass, broken bottles etc.)	0.25	0.50	A 100 per cent increase
Plastics (soft)	6.00	8.00	Plastic quantities are increasing.
Plastics (hard)	8.00	10.00	Plastic quantities are increasing.
Paper, Magazines etc.	1.00	3.00	An increase of 3 times.
Bread (food waste)	1.00	4.00	A four times increase
Aluminium (foil, cold drink cans etc.)	30.00	NA	
Copper (old utensils)	20.00	40.00	

Households sell materials to itinerant waste buyers who move along the streets with a push cart in planned areas and a donkey cart or a bicycle in low income, very scattered or congested areas. Most of the itinerant waste buyers buy such components at a cash value and some of them also barter with new kitchen utensils, sweets, biscuits, sugar and toys. At the end of the day, itinerant waste buyers sell the collected materials to the middle dealers. Our recent estimates suggest that around 40,000 itinerant waste buyers operate in Karachi, a three times increase in the last seven years. The increase in the number of waste buyers and prices of materials is a clear evidence of the increase in the recycling industry. This is a further justification of integrating this activity with the official system of waste management.

The next stage in the trade of cleaner materials is the middle dealer. Middle dealers have permanent plots of land or shops from which they operate their business. Most of the middle dealers get waste components regularly from the itinerant waste buyers. In addition middle dealers also get components directly from the households and shops. Our recent estimates suggest that there are at least 3,000 middle dealers in Karachi. When the waste purchased and stored by middle dealers accumulates to the equivalent of a lorry load it is transported and sold to the respective main dealers.

Main dealers have established businesses, with a large piece of legally hold land and facilities like water, power, telephone and weigh bridge. The main dealers deal in single materials and have established contacts with the industry which use waste material for recycling. The separated waste from the households and waste from commercial and industrial sources ultimately reaches the large and small scale recycling industries.

Purchasing of plastic waste by middle dealer

Purchasing of metal waste by middle dealer

Picking of waste at kutchra kundi

Waste bailed at picker's yards

The purchase prices of some common materials at the middle dealers, main dealers and recycling industry stages are given in Table 3.4.

Table - 3.4

Prices Paid (Rs/kg) for Major Separated Materials at Various Stages in the Recycling Chain of Cleaner Materials ³

Materials	Middle dealers pay to IWBs (Rs/ kg)	Main dealers pay to middle dealers	Main dealers sells at
Urdu Newspapers	5.50	6.0	6.30
English Newspapers	9.00	10.00	11.00
Ferrous Cans (cooking oil etc.)	5.50	6.00	6.30
Ferrous Metals (pipes, fittings etc.)	7.50	8.00	8.30
Bottles (cold drinks, medicine etc.)	-		
Glass (window glass, broken bottles etc.)	1.0	1.50	2.00
Plastics (soft)	10.0	12.0	13.50
Plastics (hard)			
Paper, Magazines etc.	3.50	4.0	5.0
Bread (food waste)	-	5.50	
Aluminium (foil, cold drink cans etc.)	-		
Copper (wire)	65	70	80
Copper (old utensils)	45	50	58

The middle dealers support and extend loans to itinerant waste buyers in return of a regular supply of waste and good prices. The middle dealers are in constant debt to main dealers and main dealers often have to wait for payments from the recycling industry.

It is difficult to estimate the extent of the recycling activity in terms of number of employees, range of investment and the quantities of materials processed. Earlier work done by URC and other research organisations suggests that at least 10 per cent of the waste by weight is reduced by separation in the cleaner stream and it's further trade. This sector provides employment to 55,000 families and an important livelihood asset for the poor.

The separation of cleaner waste by households, commercial sector, industry and institutions operates independent of the municipal system of solid waste management. The main motivation to this activity is additional income to the separator. The markets for the separated material are sustained because of the constant demand of materials from recyclers.

It is important to protect and promote the recycling activities in the cleaner stream of household waste. Household motivation, encouraging industrial demand and reducing health hazards at dealers and recycling units could be the main goals for the recycling programmes. It is important that this activity is given a recognition and supported. Some interesting examples of such

³. Information collected in 2001: Bread is collected directly by dealers from buffalo yards, located outside the city. Ferrous material prices fluctuates and decided daily by Lahore Ferrous market.

initiatives are available in other countries, the most notable one is Linis Ganda programme in Metro Manila.

4. WASTE PICKING BY AFGHANS

A very high number of Afghan immigrants collect paper and cardboard waste from streets and communal bins in Karachi. They work in groups and bring the collected waste at commonly owned yards. The waste is then baled and sometimes compacted at their yards. Dealers and or the recycling industry buy the waste from Afghans for further processing.

Box - 3.1: Pickers Sorting Yard Under the Teen Hattee Bridge

There are altogether 80 waste pickers who bring waste to this sorting yard. All the pickers are Afghans of 10 to 60 years. Most of them have migrated from Qandhar, Afghanistan, fifteen years back, and the younger ones were born here in Pakistan. They travelled together from Afghanistan to Peshawar through Tourkham, without paying bribes, and stayed for sometime in Bannu. The prime reason for migrating from Afghanistan was the devastation caused by war. During their stay in Bannu, the government used to supply them food rations against their ration cards. After getting acquainted with the over all situation of Pakistan, these Afghans came to Karachi and started this work. Those who were better off became dealers and the rest became labourers. Nobody objected to their stay and they are living under the Tin Hatee Bridge, beside the Lyari river, for the last eight years.

They would like to acquire a legal status and to get the Pakistani identity cards. However, the agents who help provide these cards charge at least Rs 2,000 to 3,000 for this service and the Afghani pickers cannot manage to pay this much. On an average, a picker saves at least Rs 1,000 to 1,500 per month. Those who have their families in Afghanistan, send their savings to them regularly. For medical aid, these people mostly go to Usmania Hospital situated nearby, or contact doctors in the neighbourhoods. At the hospital they have to pay Rs. 5 to get the parchi made for obtaining medicines, for which they sometime have to borrow money from others. Usually people here suffer from fever, influenza and cold. If they get bruises or cuts while picking waste, the simple remedy is saniplast, which they buy from any chemist.

These waste pickers work at Lasbela, Guru Mandir, Jail Chowrangji and Liaqatabad from 7 AM to 5 PM to collect waste. They travel on foot to reach these sites. They do not pick all kinds of garbage but only collect bones, glass, paper, plastic, cardboard, shopping bags and iron. They bring the collected waste to their leaders under the bridge. The waste is then sorted, baled and stored. Large dealers and recycling industry send vehicles to collect this waste.

The rates of different items are given as under:

- Glass Rs 70 per maund (40 kg)
- Plastic & Iron Rs 4 per Kilo/ Rs. 160 per maund (40 kg)
- Paper Rs 2 per Kilo/ Rs. 80 per maund (40 kg)

The interviewees told us that the traffic police charge the dealers Rs 30 to 50 for parking the vehicle on the bridge, and if the money is not paid the driver is fined. Rs. 700 per month are given to the P.I.B Thana police as bhatta, against which these Afghans are spared from police harassment. They take water from the nearby mosque and hotel, and for electricity all the dealers have arranged meter whose bill comes to Rs 600 to 700 per month. The bill is shared by all and approximately 10 bulbs are used here for lights. Sometimes these people also use fans or tape recorders due to which the bill increases.

The dealers do not support or trust these people with advanced payments. These waste pickers feel that since they have no other skills or resources, they can only continue or rather prefer to do this work. Even if they get better financial resources, the most they could achieve is become

*dealers themselves and buy a vehicle to collect waste. There are numerous other places in Karachi where similar work is carried out and some are listed in **Appendix – 4.***

Plastic items separated for selling

Glass bottles separated for selling

Figure – 3.1

Reduction in waste quantities is a major benefit of picking activity to solid waste systems. On an average a waste picker collects 40 kg of waste daily and earns a daily income of Rs 50 to Rs 150. The quantities of waste collected by a picker depend upon his age, sex, health, area of operation and mode of transport (such as using a bicycle). Our investigations reveal that pickers work in organised groups and do not compete for the waste. They sort and transport waste collectively. Since the total number of waste pickers in Karachi is not known, so the actual extent of the activities is difficult to determine. Estimates by URC suggest that at least 100,000 Afghan waste pickers operate in Karachi.

Interviews of pickers reveal that on an average 90 per cent by weight of their collected materials is paper and cardboard. Waste pickers start picking very early in the morning to get access to waste left by shops and commercial activities, when they shut in the evenings. Thus, pickers main attraction are generators of commercial waste. Pickers work in groups and bring the waste to their common yards. Their yards are located near the commercial areas but on public land. For example, there are a number of pickers yard in the Lyari river bed and alongside the railway line. Field investigations by URC discovered 50 pickers yards. Those that were interviewed are marked on a listed and marked on a map in **Appendix – 4: List of Informal Waste Collection and Sorting Sites Surveyed by the Research Team** gives location of waste pickers yards visited by the URC’s field research team. At some yards waste paper is compacted and baled, using a manual baler. This reduces the transport cost and make it convenient to transport. The selling prices of various materials from waste pickers are given in below.

The selling price of various items, per Maund (40kg), is as under:

- | | |
|--------------------------|----------------|
| • Glass | Rs 60 to Rs 70 |
| • Paper | Rs 40 to Rs 80 |
| • Cardboard | Rs 60 |
| • Plastic | Rs 160 |
| • Iron | Rs 160 |
| • Bones | Rs 60 |
| • Mixed (unsorted) Waste | Rs 80 |

Box – 3.2: Asil Khan - A Young Picker

Asil Khan’s family lives in Qandhar (Afghanistan) and he came to Pakistan via Quetta. He lives in Gulistan-e-Jauhar with his younger brother who is 12 years old, and the other brother is in Afghanistan who looks after livestock. They visit their homeland every two or three months and take their savings along with them. They eat food from a charity hotel and live in a rented house for Rs. 200 per month. Asil Khan has been working as a waste picker for the last six years, his brother also accompanies him. They have a cycle on which they travel daily from Gulistan-e-Jauhar to Benazir Hotel, located near Super highway. Asil Khan picks paper, plastic, bones, gatta, iron and glass from the kachra kundis and without sorting each item, sells it altogether at Rs 80 per kilo. He goes to sleep at 12 PM and gets up at 8 PM. In a single round trip he earns Rs 40 to 50 and his brother also works with him, therefore it is the labor of two persons.

The integration of waste pickers activities with the solid waste management is possible through recognition of their efforts. The gradual move to house to house collection, reduction of communal bins and development of transfer stations means that waste picking could become centralised. Further incentives could be offered at the disposal sites.

5. WASTE PICKING AT DISPOSAL SITES

The collected waste is transported in refuse trucks to official and un-official disposal sites. The locations of these disposal sites are given in Figure 3.1. The two currently operational official sites

are located at Jam Chamkro and Gond Pas, located approximately 15 kms from the collection areas of district Central and West. In addition, there are at-least 20 other unofficial disposal sites around Karachi. At the time of investigations, we visited 5 large sites, unofficially operational in the South-East of Karachi. Table – 3.5 gives an overview of waste all the disposal sites in Karachi.

Table – 3.5

Overview of Disposal Sites in Karachi

Site Name	Approximate Area (acres)	Waste disposed of (trucks/ day)	Remarks
Jam Chakro (officially operating)	1600	150	250 waste pickers families live near the site, access the waste and burn it to recover metals
Gond Pass (officially operating)	500	200	Waste pickers visit the site and burn it to recover metals
North Karachi, Saba Cinema (officially closed)	26	30	Around 50 pottery makers yards with 500 workers. They burn the waste to bake the clay products
Dhabejee	3000	None	Potential disposal site, if the waste is transported by train.
Korangi 5 (near Rehri Goth road)	12-14 acres	50	Waste pickers visit the site to recover recycleable material and then burn it to recover metals
Lalabad Landhi	25-30 acres	50	Waste pickers visit the site to recover recycleable material and then burn it to recover metals
Korangi 3.5 (Ibrahim Haidry Thana)	40 acres	50	Waste is used to reclaim some land. Waste pickers visit the site to recover recycleable material and then burn it to recover metals
Korangi 1.5 near 100 quarters	25 acres	40	Waste pickers visit the site and burn it to recover metals.

Note: On a normal day, KMC in theory operates around 350 waste trucks, each making 3 trips, generating 1,050 truck loads per day. The above sites receive 570 truck loads per day. The remaining trips, either divert to other smaller sites or are not made at all.

At all the disposal sites, both official and unofficial, the waste trucks are bought by groups of pickers. The price paid to the drivers ranges from Rs 50 to 100 per truck load, depending upon the areas of collection. Waste trucks with higher quantities of recyclable components are expensive. The waste truck is un-loaded to the area identified by pickers. The waste is then left for few days to dry, picked and then burned. This eases the recovery of metals. Magnets on sticks are used to recover ferrous metals. Rubber sleeves are separated from wires to get the copper metal, manually. Pickers claim that they take out metal, worth Rs 100 to 150 from each truck load. At North Karachi old disposal site, the truck loads are bought by pottery makers. The pottery makers burn the waste to bake the pottery items, such as pots, tiles and bricks. The pottery makers also pay Rs 50 to the driver for a truck load of waste. Table – 3.6 gives an estimation of pickers and drivers income at each disposal site.

Table – 3.6

Drivers and Pickers Income at Different Disposal Sites

Site Name	Waste disposed of (trucks-loads/ day)	KMC Drivers Income Rs/ day	Waste Pickers Income Rs/ day
Jam Chakro (officially operating)	150	7,500	7,500
Gond Pass (officially operating)	200	10,000	10000
North Karachi, Saba Cinema (officially closed)	30	1,500	1,500
Dhabejee	None	None	None
Korangi 5 (near Rehri goat road)	50	2,500	2,500
Lalabad Landhi	50	2,500	2,500
Korangi 3.5 (Ibrahim Haidry Thana)	50	2,500	2,500
Korangi 1.5 near 100 quarters	40	2,000	2,000
Total	570	28,500	28,500

Note: The above figures indicate drivers and pickers income from the known disposal sites only. The city-wide estimates must take into consideration the total vehicles operated by KMC, other agencies and the number of trips.

The pickers finally sell their waste to the dealers. In many cases, dealers visit the sites with their trucks to buy the waste.

Incentives to waste pickers and drivers could be used as an important tool to promote effective and safe landfilling of waste. The landfill management and operation could be designed to integrate the informal sector activities with the waste disposal. Burning of waste could be replaced with other livelihoods opportunities. Further details of this proposal are discussed in Section 5 of this report.

6. THE RECYCLING INDUSTRY

A number of recycling industries operate in Karachi, both in the formal and informal sector. They purchase material from main dealers and other industries and re-process them to other saleable

products. There are a number of conversions and re-use of waste materials. Some of the common uses of the materials are given in Table – 3.7.

Table – 3.7

Recycling and Re-use of Some Common Waste Components in Karachi

Waste Material	Common Re-use and Recycling
Broken Glass Bottles Bread Newspapers Ferrous Metal Paper Aluminium Plastics Car Batteries Magazines, Digests, Books Old Furniture	Color separated and converted to glass bottles Washed and sold again Livestock feed, middle dealers sell them directly to cattle yards Various types of packing for shops and vendors Recycled in re-rolling mills, mainly in the Punjab Pulp is made and converted to cardboard and brown paper. Re-melt in moulds for various industries Uses / recycling depends upon type: toys, shoe soles, shopping bags, sandals, etc. Also transported to the Punjab. Broken to extract Lead metals Sold again at reduced prices Sold again at reduced prices

Locations of recycling industries are given in Figure 3.1. The small recycling industry is mainly clustered in Shershah, an area in the South-West of Karachi. Some small clusters of small scale paper industry are also located in Azizabad, North Karachi and Korangi areas. From conversation with stakeholders and observation the contribution of the un-registered informal industry to recycling seems larger as compared to the large scale industry, but it is extremely difficult to discover them. Some of the larger recyclers of waste are given in Table – 3.8.

Table – 3.8

Estimated Quantities of Waste Processed by Large Recycling Industry in Karachi

Raw Material	Product	Quantities Processed/ day	Remarks
Glass	Bottles, marbles and other glass products	50 tonnes/ day	There were 17 registered glass industries in the province of Sindh in 1995-96.

Plastics	Shoes, slippers and other plastic products.	10 tonnes/ day	There are approximately 20 units in Karachi, each processing 0.5 to 1.0 tonne/ day.
Paper	Paper board, cardboard and other products.	10 tonnes/ day	A total of 26 registered industries operated in the province of Sindh in 1995-96..
Poultry waste and other animal waste	Animal Feed	25 tonnes/ day	A total of 16 industries operating. 5 of them process more than 5 tonnes per day.
Bones	Export for gelatine and Fertiliser	50 tonnes/ day	This bone is collected by 20 - 25 contractors from butcher's shops. It is exported for gelatine and fertiliser manufacturing.
Ferrous Metals	Compaction and making bales for further transport to Punjab	An estimated of 50 tonnes/ day.	A total of 41 registered industry operate in the province of Sindh. All of them do not process ferrous metals.
	Total	An estimated 200 tonnes/ day	

In addition to the above large scale recyclers there is an estimated number of 500 small scale informal recycling industry in Karachi, providing employment to 10,000 persons.

All the recycling industry needs various types of infrastructure for their operation. In addition, they like to be as near to the sources and suppliers of the raw material as possible. Some industries face objections from the neighbouring residents and are desirous to operate from formal areas marked for industrial units. In addition to this, there are issues on the poor working conditions and pollution from these industries. The infrastructure requirements and relocation issues of some of the common recycling industry is given in Table – 3.9.

Table – 3.9

Key Infrastructure Requirements for Recycling Industry

Type of Industry	Key Infrastructure Requirements	Key Relocation Considerations
Paper to Cardboard [large scale]	<ul style="list-style-type: none"> • Large quantities of water • Power • Access roads • Wastewater treatment 	Availability of infrastructure and easy access to raw material. Many formal sector large units may not shift
Paper to Cardboard [small scale]	<ul style="list-style-type: none"> • Water • Power • Access roads • Space to dry the paper 	Availability of infrastructure and easy access to raw material. Many formal sector large units may not shift
Glass to bottles	<ul style="list-style-type: none"> • Gas for furnaces • Access roads 	Availability of natural gas may not be possible to arrange. However, bottle gas can serve the purpose
Plastic to granules	<ul style="list-style-type: none"> • Power • Access roads • Ventilation systems • Water 	Availability of infrastructure. Will prefer to be near to source of recyclable material
Bones processing	<ul style="list-style-type: none"> • Water • Access roads • Power • Air cleaning systems • Gas 	Availability of infrastructure. Would prefer to be far away from residential areas
Metals Sorting and Baling	<ul style="list-style-type: none"> • Power • Access Roads 	Except for small units, they would prefer to remain where they are

Recycling industry requires raw material. This material is often separated in the generation, collection and storage stages of waste streams. Availability of raw material may not be a major incentive for the relocation of recycling industry. However, recycling industries play an important role in creating a demand for the recyclable waste. Recognition and appreciation is extremely important for their sustainability. Landfill areas or any other site could provide land and infrastructure for the recycling industry. A number of industry owners have shown keen interest in this idea.

7. LINKS WITH THE OFFICIAL SYSTEM

A number of recycling activities at different stages of the waste streams have been discussed above. Some of them operate independent of municipal systems, some of them have links with the municipal system, and some are entirely dependent on it. Consequently, any changes in solid waste systems could consider what threats and opportunities exist for the private informal activities and actors. Table – 3.10 gives a description of various links of the recycling activity with the official systems.

Recycling of glass bottles

Melting of glass

Crushing of bone

Shoe making from used plastic

Table – 3.10

Recycling Activities, Stakeholders and Their Links with the Official System

Recycling Activity	Stakeholders	Links with the official waste management system
Separation at source and it's further trade (clean stream)	<ul style="list-style-type: none"> • Households • Itinerant waste buyers • Dealers • Recyclers 	None
Picking of waste materials from streets and bins (dirty stream)	<ul style="list-style-type: none"> • Afghan waste pickers • Sweepers • Dealers • Recyclers 	<ul style="list-style-type: none"> • Pickers need an access to communal bins. • They pay money or buy rights informally from municipal staff
Picking and burning of waste at disposal sites	<ul style="list-style-type: none"> • Waste pickers • KMC truck drivers • Dealers • Recyclers 	<ul style="list-style-type: none"> • Pickers need the waste near the sorting area. • They pay money informally to drivers. • Need permission from KMC landfill staff • Pickers do not like heavy rollers for compaction
Small and large scale recycling industry	<ul style="list-style-type: none"> • Recyclers • Dealers 	Informal payments to police and local government staff by small informal units
Recycling industry	Dealers	Informal payments to police and local government staff

It is clear from the above table that waste pickers are more dependent on the official system, as compared to other stakeholders. However, support to any of the above activity could benefit the solid waste management systems through reduction of waste quantities and generation of resources. Further details along these lines are developed in Section 5.

Section - 4

DISPOSAL OF REMAINING WASTE

1. OVERVIEW

As discussed in Section 3, the waste is sorted first by households and servants before it is disposed off from homes. The remaining waste is disposed of and reaches the final destination in the following stages:

Stage	Description	Key Issues
Primary Collection	Waste is taken by municipal sweepers, self employed private sweepers and households to the secondary storage	<ul style="list-style-type: none"> • Municipal sweepers charge an agreed amount from the households • Municipal sweepers do not attend low income areas • Designated places to take the waste are few • In flats and some other residential areas, households have organised collective systems. Such systems have no integration with the official system.
Communal Bins (Secondary Storage)	Waste from a number of households is temporarily stored, before it is collected by trucks. This may be a wall enclosure, a container or an open space. Communal storage is also always an open place.	<ul style="list-style-type: none"> • Finding the space for bins is difficult, particularly in the old city areas. • Low income areas are poorly served by regular collection from secondary storage • Rights to access communal bins are bought and sold by the informal sector • Waste is sometimes burnt in such places • Waste picking (scavenging) is common.
Transportation in Trucks	Waste from secondary storage facilities is transported in trucks to the outside of the city	<ul style="list-style-type: none"> • Only two designated disposal sites area available • The two designated sites are far from the South and East of the city • There is no monitoring system on the number of trips made by each vehicle • There is no monitoring of the disposal places by trucks

		<ul style="list-style-type: none"> The repair and maintenance of vehicles is a major issue, on an average day, 25 per cent of the vehicles are off the road.
Disposal	The trucks un-load the waste to a number of official and unofficial sites, outside the residential areas	<ul style="list-style-type: none"> The waste is often diverted to waste pickers colonies Waste pickers purchase the truck loads to burn it, to recover metals Waste trucks are also diverted by pottery makers

In addition to households waste, Karachi city also generates other waste type from various sources. Estimates of commercial and industrial waste are not available, although a large quantities of such waste is separated at source for recycling. This study estimates the major waste streams as follows:

Table – 4.1

Major Waste Streams in Karachi ¹

Waste Source	Quantities (tonnes/ day)	Comments
Households	4,500	10 per cent by weight is separated for re-sale and not included
Large Markets	50	Mainly organic waste and inert materials
Street Sweepings	200	Mainly paper, plastics and dust
Large Hospitals	8	Often infectious waste mixed with other waste
Cantonments	500	A private contractor collects this
Airport	6	Mainly recyclables
Karachi Port Trust	6	
Buffaloes Yard (Landhi)	500	Mainly organic, not collected at all.
Slaughter House	10	Mainly recyclable organics
Total	Say 5,800 tonnes/ day	

2. PRIMARY COLLECTION

At the primary collection stage the informal system of waste collection by municipal and private sweepers is extensive. From the middle and high income areas and commercial units, sweepers charge an amount of Rs 50 to 150 per month. The low income areas are served by private sweepers, who collect waste in animal or hand carts. They charge an amount of Rs 15 to 50 per month. In flats and certain low and lower middle income areas, often residents associations collectively make arrangements for waste collection and sweeping of common areas. Municipal sweepers regularly make informal payment to their sanitary inspectors to obtain permission for this private work. Many areas are not served by any system and the waste is left un-attended in open areas, storm water drains, water valve chambers and other spaces as they are available.

¹. At the workshop held on 23 May 2000, the KMC and DMC staff participants accepted the above figures as being more realistic than those mentioned in more recent reports.

There are 12,000 male and female sweepers in Karachi. A team of sweeper is assigned to the sanitary inspector of each DMC, who is responsible for street sweepings and waste collection. The sanitary inspector is assisted by 3 to 5 supervisors (*mucaddam*). The sweepers in the area, report to their supervisors and inspectors. The sweepers attendance is marked twice a day by the inspector. Local leaders and councillors try to acquire rights to mark the attendance. In this way they can receive payments from sweepers by marking them present while they are actually employed in working for household and communities. In the present system, sweepers are the only link between the local authorities and citizens. They are not poorest of poor, but a vulnerable group of poor because of their social status.

3. TRANSPORTATION

The city of Karachi is served by 357 waste collection vehicles owned by KMC. These vehicles are allocated to the Engineering Department of DMCs and operated by municipal drivers. The drivers are assigned particular areas, where they report to sanitary inspectors. A log book is kept in the vehicles, which the respective sanitary inspector signs upon cleaning of transfer point. The present distribution of vehicles with five DMCs is given in Table 4.2 below.

Table – 4.2

Waste Collection Vehicles and Their Distribution in Karachi ²

Vehicle Type	DMC Central	DMC East	DMC West	DMC South	DMC Malir	Total	Carrying Capacity/ Vehicle in Tonne s
Refuse Van	29	21	14	38	2	104	10
Open Truck	0	2	0	4	6	12	8
Tractor Trolley	13	5	19	17	7	61	6
Compactor	20	6	0	13	3	42	0
Arm Roll	35	25	15	23	1	99	0
Semi Compactors	0	9	0	0	0	9	0
					Total	367	

With the formation of city councils under the new devolution plan. This distribution of vehicles will probably change. Each vehicle is expected to make 2 to 3 trips per day from the collection area to disposal sites. Keeping in view the weight carrying capacity of vehicles and expected number of trips, the transportation capacity of KMC vehicles is 4,000 tonnes per day with 100 per cent availability of vehicles. On an average a total of 25 per cent of vehicles are out of order, thus making the actual transportation capacity as 3,000 tonnes per day.

². Figures collected by the Research Team from KMC and the DMCs.

4. DISPOSAL

Waste is transported to a number of official and unofficial disposal sites. The number of unofficial sites has reduced in the last three months, because of strict controls by the present administration. The location of major official and unofficial disposal sites is given in Figure 3.1.

Table – 4.3 gives a description of existing official and unofficial disposal sites.

Table - 4. 3

Description of Disposal Sites in Karachi

Site Name	Description	Waste Disposed Off	
		Trucks/Day	Tonnes/Day
Jam Chakro	This is the officially designated site located in the North of Karachi, approximately 10 kms from the centre of District Central. An area measuring 1600 acres is reserved for waste disposal. The site has a weighbridge and site office. The site operation is un-controlled dumping. Pickers access waste, burn the waste to retrieve metals.	150	1,200
Gond Pass	This is the officially designated site located in the North-East of Karachi, approximately 15 kms from the centre of District South. An area measuring 500 acres is reserved for waste disposal. The site operation is un-controlled dumping. Pickers access waste, burn the waste to retrieve metals.	200	1,600
North Karachi, Saba Cinema	This site is officially closed. There are a number of pottery makers on this site. The pottery makers purchase the trucks informally from the drivers and burn it to bake the clay products.	30	200
Dhabejee	This is the officially designated site located in the North of Karachi, approximately 20 kms from the centre of District East. An area is reserved for waste disposal to be transported by train. There is no activity at the site.	None	
Korangi 5	Unofficial disposal site in the South-East of Karachi. Waste picking and burning is common, especially since the waste comes from the affluent areas of the city	50	250
Lalabad Landhi	Unofficial disposal site in the East of Karachi. Waste picking and burning is common.	50	250

Korangi 3.5 (Ibrahim Haidry Police Station)	Unofficial disposal site in the South-East of Karachi. Waste picking and burning is common. Waste comes from the affluent areas of District South	50	250
Korangi 1.5 near 100 quarters	Unofficial disposal site in the South-East of Karachi. Waste picking and burning is common.	40	300
Total		570	4,050

Based on a realistic generation rate of 6,000 tonnes per day, the total weight generated by the city is 2,190,000 tonnes per year. Over a period of 10 years the city will generate 27.5 million tonnes of waste. The landfill requirement of the city is 21 million square meter, equivalent to 5,200 acres. The present sites are equivalent to 2,100 acres and there is a need to develop 3,100 acres of landfill area.

Section - 5

PRE-FEASIBILITY OF INTEGRATED SYSTEMS

1. POSSIBLE OPTIONS

1.1 Overview

Previous sections highlight a number of issues. Addressing all these issues is important to improve the solid waste management system in Karachi. These issues exist at different stages in the solid waste systems and could be explained from the perspectives of different stakeholders. They may also need long, medium and short term strategies in different sectors e.g. finances, administration, law etc. In order to develop holistic solutions, it is important to consider all these issues in an integrated way. An opportunity to initiate the changes already exist as the new local bodies structure will come in effect from August, 2001.

This section is just focused around the terms of reference of this study. Thus, the options related to recycling and the final disposal of waste are discussed in more detail as compared to other issues.

The key objectives of these options are as follows:

- To improve the waste disposal practices through attracting a higher number of waste truck loads at the existing official disposal sites and replace burning of waste with other livelihood opportunities for pickers.
- To restrict waste picking (scavenging) activities in streets and *katchra kundis* and informal sites and to replace them with more centralised activities at transfer stations or disposal sites see **Appendix – 5: List of Unofficial Scavenging Sites in Karachi**.
- To further integrate the waste separation practices at the future proposed disposal sites through planning a modular waste landfilling site with the centralised sorting and selling facilities for pickers.
- To give incentives to the recycling industry to relocate at formally planned areas at or near proposed landfill sites.
- To propose institutional arrangements for the proposed objectives, keeping in mind the new local bodies structures.
- To develop strategies for citizens participation and public consultation in the decision making process of KMC

The above objectives will be addressed through partnership between public and private sector (private sector also means the non-formal sector).

1.2 To Improve Practices at the Existing Official Disposal Sites

As discussed in the previous sections, KMC has acquired two landfill sites in the North and West of the city. The sites have been selected on the basis of some selection criteria, but no detailed technical investigation have been carried out. Some infrastructure has been developed at the two sites and waste truck drivers have been asked to transport the waste to these sites. However, the situation at the two sites is far from satisfactory. The following are the key issues and reasons for them;

Issues	Reasons
A number of waste trucks are not reaching the landfill site.	<ul style="list-style-type: none"> • Disposed of in open places to save fuel • Attracted by waste recyclers • Landfill sites are far • Lack of control and incentive for drivers • Pressure to do a certain number of trips
The waste which is un-loaded at the landfill site is fired by waste pickers to retrieve metals.	<ul style="list-style-type: none"> • Waste is a resource for pickers • Pickers buy a truck load from the drivers • There is no landfill operation • The site is accessible to pickers
Landfill sites are located far from the Southern and Eastern part of the city.	<ul style="list-style-type: none"> • Un-availability of land (real or not) • Other options of waste transfer and disposal not considered
Access road and infrastructure at these sites is considered in-adequate by drivers of vehicles.	A reason given by the drivers
The sites are considered insecure	A reason given by the drivers
The trucks are attracted by waste pickers colonies and clay kilns in North Karachi	<ul style="list-style-type: none"> • Drivers get a price for the truck loads • Landfill sites are far
The administrative control over drivers and field staff is weak. Workers unions are strong.	Solid waste management is a sensitive service
There is no control or incentive for drivers to take more trucks at the designated sites	<ul style="list-style-type: none"> • KMC's control at the operational level are weak • Drivers have strong unions • Drivers salaries are lower than market rates

Feasible Options

Controls	Incentives
The landfill site fuel quota to be linked with the weight of waste brought at the site	Drivers can en-cash extra fuel instead of overtime
Fuel to be only filled at the landfill sites for the catchment area ¹	Drivers will bring more waste loads to the site
Pickers are not allowed to burn waste at the landfill sites	Use pickers in waste spreading and compaction using simple technology such as manual rollers. Enhance other alternatives of waste picking and income generation.
Through an agreement the contractor is responsible for proper site operation and using pickers	Contract-out the landfill site operation to a private contractor, NGO or any other organisation representing pickers
Extend strict controls over drivers over not to divert trucks to un-official sites, except where no landfill is available nearby	Drivers or their co-operatives could be given option to take the contracts of waste transportation (employees buy-outs)
	Drivers can sell their trucks to scavengers at landfill

1.3 To Recognise, Improve and Integrate Waste Picking (Scavenging) at the Official Waste Disposal Sites

There are 250 waste pickers families at the Jam Chakro disposal site. They purchase waste trucks from drivers, let it dry, burn it and retrieve metals for further sale. The following is the list of issues identified.

Issues	Reasons
Pickers divert the trucks to their areas or access waste, wherever it is disposed of.	<ul style="list-style-type: none"> • KMC drivers accept payments for diversion of trucks • Controlled landfill sites are not available and operational in Karachi • Official planning by professionals does not consider informal activities by pickers
Burning of large quantities of waste is extremely hazardous for waste pickers, nearby population and the environment.	<ul style="list-style-type: none"> • KMC could not control the operation at the disposal site • Pickers could not retrieve metals, if the waste is not burned. • The waste is accessible to pickers • Waste is a resource for pickers and their livelihoods depend on it • Pickers do not know and initiate alternative ways of picking materials from waste

¹. At the workshop held on 23 May 2000, DC East mentioned that no oil company is willing to provide a pump at the landfill sites since they did not wish to have a contract with the government.

Pickers resist landfill operation of spreading, compacting and covering the waste	<ul style="list-style-type: none"> • Spreading and compaction make the waste useless for waste pickers • KMC's landfill operation is designed without consulting the landfill pickers
Pickers have low status in the society and are considered as thieves and criminals	Some pickers have legal status but they are in the poverty trap
Waste picking is considered a health hazard	<ul style="list-style-type: none"> • Pickers access all types of waste including hospital waste • Picking is also done by women and children

Controls	Incentives
To control the access to waste through gradual move to house to house collection and transfer stations	Pickers and their groups are offered alternative livelihoods opportunities through NGOs.
To reduce time when waste is actually accessible.	To promote and give incentives for safe picking at transfer stations and or landfill sites
To control access to hospital and other hazardous waste	<ul style="list-style-type: none"> • To educate pickers about the hazards • To recognise and appreciate pickers efforts

1.4 To Replace Waste Picking (Scavenging) Activities in Streets and Communal Bins with Central and Safe Picking

Waste picking is common in streets, communal bins and transfer points. Most of the picking activity is carried out by immigrants from Afghanistan. They do not have official status, but many of them are settled in the country for more than five years and doing waste picking as a survival strategy. Their group leaders have somehow acquired a legal status and it is expected that all the Afghan pickers will have national identity cards in 2 to 3 years time. The existing picking activity could be restricted and replaced by central and safe picking at transfer stations and disposal sites. The following is the list of issues identified with reference to waste picking.

Issues	Reasons
Waste picking is considered as a nuisance from the perspective of senior officers from KMC	<ul style="list-style-type: none"> • KMC officers cannot control their field operations due to informal arrangements arrived at between different stakeholders • The waste is exposed and accessible • Waste is a resource for pickers and their livelihoods depend on it, so pickers access it • In some places, pickers are allowed access to waste by KMC staff in return of money or help
Waste pickers have no legal status and their integration in any official system is impossible.	<ul style="list-style-type: none"> • Pickers have no identity cards • KMC only recognises legitimate

	<p>organisations</p> <ul style="list-style-type: none"> • Pickers have functional organisations but not these are not registered bodies
Pickers have low status in the society and are considered as thieves and criminals	<ul style="list-style-type: none"> • Pickers have no legal status • Society does not appreciate pickers contribution in waste reduction
Waste picking is considered a health hazard	<ul style="list-style-type: none"> • Pickers access all types of waste including hospital waste • Pickers sorting yards are located in extremely hazardous conditions • Picking is also done by children

Controls	Incentives
<ul style="list-style-type: none"> • To control the access to waste through gradual move to house to house collection and official transfer stations • To reduce time when waste is actually accessible. • To control access to hospital and other hazardous waste • To pass a law making it illegal to pick and sort waste except at the landfill sites or other officially allocated areas • Pass a law for bidding, waste picking within the city and enforce it. 	<ul style="list-style-type: none"> • Pickers and their groups are offered alternative livelihoods opportunities through NGOs • To promote safe picking at transfer stations • To educate pickers about the hazards • To recognise and appreciate pickers efforts • Offer residential and working space to scavengers and dealers at the landfill sites • Offer pickers and dealers space at landfill site for their activities

1.5 To Recognise, Improve and Integrate Small Scale Recycling Industry

As discussed earlier, waste is recycled in a number of small recycling industry in the non-formal sector. The actual extent of this industry is un-known, as no data and information is available. Earlier studies and recent studies conducted by URC estimate their number as more than 1,000. Small industry creates a demand for recyclable materials, so it is important to recognise and encourage them without un-necessarily formalising them. Government and non-government organisations could undertake this task.

Issues	Reasons
Waste recycling is seen as a private business. Its indirect contribution to waste reduction is generally not recognised and appreciated.	<ul style="list-style-type: none"> • Industry obtains waste from private sources • Industry has very little dependency on

	<p>KMC's waste management system.</p> <ul style="list-style-type: none"> • Small industry has a profit motive • KMC has very little dealing with the small industries
Small industry is often located in slum areas, so its existence is often considered temporary.	<ul style="list-style-type: none"> • Slum areas are located on the so called illegal land • The industry relies on informal sources of water and power • Small industry does not pay taxes
Pickers have low status in the society and considered as thieves and criminals	
Small industry is considered as those creating pollution. Workers are in poor occupational conditions.	<ul style="list-style-type: none"> • Low capital intensive • Low operational costs • Workers have no legal rights to claim a better working environment

Controls	Incentives
Hazardous industries need to be identified and re-located	<ul style="list-style-type: none"> • Re-location sites and introduction to improved housekeeping. • Provision of infrastructure (such as sewage) to reduce pollution • Supply of raw material at the site • Site and services options may be offered to the industry

1.6 To Encourage and Integrate Medium and Large Scale Recycling Industry

As discussed earlier, large quantities of waste are recycled in registered industry. At least 50 medium to large industry operate in Karachi. They are interested in the larger streams of sorted materials. They create a demand for recyclable materials, so it is important to recognise and encourage them. Industrial Associations, Chamber of Commerce, various interest groups related to the industry could play a vital role in this.

Issues	Reasons
Waste recycling is seen as a private business. It's indirect contribution to waste reduction is generally not recognised and appreciated.	<ul style="list-style-type: none"> • Industry obtains waste from private sources • Industry has very little dependency on KMC's waste management system. • Industry has a profit motive • KMC has very little dealing with the recycling industry

Controls	Incentives
None available	<ul style="list-style-type: none"> • Encouragement of medium and large scale recycling industry through credit facilities

1.7 Integrated Waste Disposal, Sorting and Selling Facilities

This option has been explored in detail in paragraph 2 below and justification for it has been given. Two options for a plan of a modular landfill site to receive 100 truck loads of waste per day have been prepared. The facility will receive 100 truck loads or 500 tonnes per day in year 1, increasing to 800 tonnes per day in year 10.

2. MODULAR LANDFILL SITE DETAILS

2.1 Justification

According to the criteria developed for selection of landfill sites for Karachi (see **Appendix – 6: Selection of Landfill Site for Karachi: Key Criteria**) the city requires four landfill sites. Two landfill sites already exist in the north of the city which can also serve district West. However, no formal sites exist in the east and south of the city. It is necessary to locate these sites. The KMC, DMCs and other government organisations have not identified any new sites and have not adequately explored possibilities of acquiring them. In addition, no maps or plans of the existing formal sites are available with government organisations. The total land required for landfill in Karachi is given in **Appendix – 7: Area Calculation for Landfill Sites**. Given these conditions it is not possible to prepare a conceptual plan for the existing or proposed landfill sites. As such, a conceptual plan of a module receiving 500 tonnes or 100 trucks per day has been prepared and costed and institutional arrangements proposed.

2.2 Two Options

Two options have been considered: a Higher Cost Option and a Lower Cost Option. Basic calculations and assumptions related to the proposed options are given in **Appendix - 8: Basic Calculations and Assumptions for Disposal Site for 500 Tonnes/day**. In both options costs for the following items have not been considered. The reasons for not considering them are also explained below.

- **Electrification:** The Karachi Electric Supply Corporation (KESC) will be interested in extending its network to a landfill site provided it can be assured of recovering its costs and generating revenue through normal connection and consumer charges. Meanwhile the possibility of solar panels at affordable costs can be investigated (see **Appendix – 9: Solar Panels for Electricity Generation**) and their cost can be borne by the users.
- **Gas Connection:** The gas companies would also be willing to extend their systems if their investment can be recovered through normal connection and consumer charges. Meanwhile, most small recyclers feel that their gas requirements can be fulfilled by gas cylinders.
- **Leachate Collection and Treatment:** These along with gas collection have been considered but not costed. Given Karachi's climatic conditions and geological formation, these aspects are not crucial and can be introduced when economic conditions are more favourable.
- **Composting:** At the May 23, 2001 workshop, there was general consensus that composting in the Karachi context was not an economically feasible option. The private sector operators informed the workshop that they had considered and rejected the composting option.
- **Telephone Line:** The telephone line issue is no longer crucial given the availability of mobile phones at approximately the same user and connection charges as normal line phones.

- **Land:** It is assumed that the government will provide land free of cost for a period of 20 years. Landfill required for the disposal of 500 tonnes per day is 3,400 M2. Calculations are given in **Appendix – 10: Landfill Requirements for Disposal of 500 Tonnes/day Solid Waste.**

2.3 Higher Cost Option

2.3.1 Flow of Activities

The flow of activities in this option is given below and a dimensioned plan is provided in Figure – 5.1.

- Access road
- Waste weighing and inspection (optional)
- Waste disposal on a platform (100 M2 and raised by 1.5 metre) through a hopper to a trommel sieve where glass, paper, plastics and textile will be removed.
- Waste spreading and drying
- Metal picking by magnetic extractors
- Composting (optional)
- Waste pushed/carried towards landfill site
- Waste spread and compacted by mechanical means
- Recycleable material transferred to sorting and storage yards and from there to nearby recycling industry

2.3.2 Capital Costs

Capital costs are given in tables 5.1 and 5.2. They work out to a total of Rs 66,150,000.

Figure - 5.1

Figure - 5.2

Table 5.1
Cost of Infrastructure

Sr. No.	Item	Unit	Rate in Rs	Quantity	Cost in Rs
1.	Access road 10 metre wide	Km	15,000,000	2	30,000,000
2.	Water main	Km	3,500,000	2	7,000,000
3.	Surface drain around landfill	Metre	2,500	250	625,000
4.	Platform 10 Mx10Mx1.5M high	M3	1,500	150	225,000
5.	Housing: Site and services 200 numbers of 60M2 each* on the Khuda-ki-Basti Model	M2	50	12,000	600,000
6.	Sorting and selling yards 10 numbers of 200 M2 each*	M2	150	2,000	300,000
7.	Municipal office and related spaces	M2	6,000	500	3,000,000
8.	Factory sites with infrastructure: 6 numbers of 1,000 M2 each	M2	100	6,000	600,000
9.	Electricity**				
10.	Telephone**				
	Total cost				42,350,000
	Recovery of capital cost possible: • Housing at Rs 5,000 per plot: Rs 1,000,000 • Factories at Rs 450 per M2: Rs 2,700,000				3,700,00
	Total investment				38,650,000

* (minus cost of land)

** See in the text: Section 2.2

Table – 5.2
Cost of Equipment

Sr. No.	Item	Unit	Rate in Rs	Quantity	Cost in Rs
1.	Weigh bridge	Each	500,000	1	500,000
2.	Hopper and trommel	Each	250,000	2	500,000
3.	Bulldozer (Chinese)	Each	5,000,000	1	5,000,000
4.	Compactor	Each	9,000,000	1	9,000,000
5.	Wheel loader	Each	10,000,000	1	10,000,000
6.	Small dumper truck	Each	2,500,000	1	2,500,000
	Total				27,500,000

2.3.3 Operational Costs

Table 5.3

Operational Costs

No.	Item	Optional High Cost (in Pak Rs.)
1.	Depreciation of Machinery <ul style="list-style-type: none"> • Cost of machinery (high cost) : Rs 27,500,000 • Depreciation at 8% per year 	2,200,000
2.	POL including Diesel @ 10% of equipment cost per year	2,480,000
3.	Contingencies / utilities	300,000
4.	Maintenance of roads / buildings	200,000
5.	Establishment (see Appendix 13 for details)	2,544,000
	Total	7,724,000

2.3.4 Revenue from Landfill and Shortfall

- Scenario 2 in **Appendix – 12: Incomes from Recycleable Waste Under Different Scenarios** gives the estimated market price of waste material that will be separated at the landfill site if picking, sorting and selling activities are transferred there. This works out to Rs

200,000 per day. Dealers are willing to pay 2.5 per cent of this price as payment for the use of the sorting yards provided they are exempted from income tax. This payment will work out to Rs 1,825,000 per year.

- A tax of one per cent per year of the ex-factory value of the recycled waste can be charged from the recycling units at the landfill. The value of such goods is estimated by recyclers to be about eight times the value of raw material. This works out to Rs 547,500,000 per year. Since 25 per cent of the recycling industry is formal or well established outside the landfill site, it is unlikely that it will move from its present location. As such, we can consider the ex-factory price of the recycle waste at 25 per cent less which works out to Rs 438, 000,000 and one per cent of it is Rs 4,380,000 per year.
- The smaller informal units of the recycling industry are currently paying an average of Rs 7,500 per month as rentals. The 6 units proposed with the module will therefore pay a minimum of Rs 540,000 per year. In addition, they will pay their normal income tax.
- The total revenues from the module work out to Rs 6,805,000 per year against an operational cost of Rs 7,724,000. This leaves us with a shortfall of Rs 919,000.

2.4 Lower Cost Option

2.4.1 Flow of Activities

The flow of activities in this option is given below and a dimensioned plan is provided in Figure – 5.2.

- Access road
- Waste weighing and inspection (optional)
- Waste disposed and spread out on a flat 2,500 M2 platform
- Scavenging teams pick glass, paper, plastics, bones and textile
- Waste drying
- Metal picking by magnetic extractors
- Waste pushed/carried towards landfill site
- Waste spread and compacted by manual rollers
- Recycleable material transferred to sorting and storage yards and from there to nearby recycling industry

2.4.2 Capital Costs

Capital costs are given in tables 5.4 and 5.5. They work out to a total of Rs 57,035,000.

Table 5.4

Cost of Infrastructure

Sr. No.	Item	Unit	Rate in Rs	Quantity	Cost in Rs
1.	Access road 10 metre wide	Km	15,000,000	2	30,000,000
2.	Water main	Km	3,500,000	2	7,000,000
3.	Surface drain around landfill	Metre	2,500	250	625,000
4.	Platform at grade	M2	350	1,600	560,000

5.	Housing: Site and services 200 numbers of 60M2 each* on the Khuda-ki-Basti Model	M2	50	12,000	600,000
6.	Sorting and selling yards 6 numbers of 200 M2 each*	M2	150	200	300,000
7.	Municipal office and related spaces	M2	6,000	500	3,000,000
8.	Factory sites with infrastructure: 6 numbers of 1,000 M2 each	M2	100	6,000	600,000
9.	Electricity**				
10.	Telephone**				
	Total cost				42,685,000
	Recovery of capital cost possible: <ul style="list-style-type: none"> • Housing at Rs 5,000 per plot: Rs 1,000,000 • Factories at Rs 450 per M2: Rs 2,700,000 				3,700,00
	Total investment				38,985,000

* (minus cost of land)

** See in the text: Section 2.2

Figure - 5.3

Waste disposal in squatter settlements

Scavenger's colony at Jam Chakro

Table 5.5
Cost of Equipment

Sr. No.	Item	Unit	Rate in Rs	Quantity	Cost in Rs
1.	Weigh bridge	Each	500,000	1	500,000
2.	Bulldozer (Chinese)	Each	5,500,000	1	5,000,000
3.	Small manual rollers	Each	5,000	10	50,000
4.	Wheel loader	Each	10,000,000	1	10,000,000
5.	Small dumper truck	Each	2,500,000	1	2,500,000
	Total				18,050,000

2.4.3 Operational Costs

Table – 5.6

Operational Costs

No.	Item	Optional Low Cost (in Pak Rs.)
1.	Depreciation of Machinery <ul style="list-style-type: none"> • Cost of machinery : Rs 18,050,000 • Depreciation at 8% per year 	1,444,000
2.	POL including Diesel @ 10% of equipment cost per year	1,800,000
3.	Contingencies / utilities	300,000
4.	Maintenance of roads / buildings	200,000
5.	Establishment (see Appendix 13 for details)	2,592,000
	Total	6,336,000

2.4.4 Revenue from Landfill and Shortfall

- Revenue figures from sorting yards will be the same as for the Higher Cost Option (see Section 2.3.4 above) and work out to Rs 1,825,000 per year.
- Rentals from the recycling industry and a one per cent tax on recycled waste will also be the same as for the Higher Cost Option (see Section 2.3.4 above).

- The total revenues from the module work out to Rs 6,805,000 per year against an operational cost of Rs 6,336,000. This leaves us with a surplus of Rs 469,000 per year.

3. INSTITUTIONAL ARRANGEMENTS

3.1 The Government's Devolution Plan

Under the devolution plan, which will be enacted on August 14, 2001, Karachi will have 18 towns and 178 union councils. Solid waste management is one of their functions. In view of this restructuring recommended responsibilities of each tier of local government for solid waste management are given in the sections below.

3.2 Union Councils (UCs)

Union Council should be responsible for the items mentioned below. They should be able to fulfill these functions because an average Karachi Union Council will have about 9,500 households which is an ideal population for collecting and managing solid waste.

- Collecting and transferring solid waste to a central pick-up point in the jurisdiction of the UC. The following options are available.
 - House to house collection: This is possible in high and middle income areas where collection vehicles can move easily. It can be contracted out to the private sector.
 - Where communities are involved in solid waste collection: In many low income areas CBOs are active in collecting solid waste and transferring it to a *katchra kundi*. Such CBOs can be supported by providing them with sealed containers which can be picked up and replaced by the collecting authority so that the *katchra kundi* and hence picking on it is eliminated.
 - Where sweepers are operative: In many low income areas sweepers have organised themselves to pick solid waste from people's residences and neighbourhood streets. Such sweepers cooperatives should be recognised and they too should be supplied by sealed replaceable containers which can replace the *katchra kundis*.
 - In areas where house to house collection by large vehicle is not possible, the private sector can be inducted to collect waste and transported to a point in the jurisdiction of the UC. The private sector can use smaller vehicles such as specially designed three-wheelers or small Suzuki pick-ups.
 - The UC can also look into the possibility of letting out collection and disposal to drivers and support staff of the present system.
- UCs that do not generate inorganic waste can look into the possibility of selling waste directly to kilns and or potter's colonies. This option can also be opened for private operators. It is estimated by KMC and DMC staff that between 150 to 300 tonnes of waste per day is utilised by the kilns.
- Preventing waste picking in their jurisdiction: This can be done by eliminating *katchra kundis* and introducing the system of replaceable sealed containers and also by enforcing a law to be enacted by the district government preventing scavenging and related activity except at the landfill site.
- Providing information regarding the new system through consultations, meetings, dialogues and video shows: This will be possible since the UCs have small manageable populations.

3.3 Town Councils (TCs)

Town Council will have an average population of about 560,000. They should perform the following functions:

- Collecting and transferring of solid waste to the landfill site. Different town councils should be allocated different sites. (For details see **Appendix – 11: Map of Karachi Showing the Proposed Division of the City into Towns and Their Relationship to the Existing and Proposed Landfill Sites.**
 - From the UC pick-up point.
 - From house to house collection: The TCs will also have the possibility of letting out house to house collection where it is possible and by passing the UCs in this matter.
- Identifying UCs which do not generate waste with sufficient inorganic materials so that these UCs can sell their waste directly to potter's colonies.
- Assisting UCs by providing them with sealed replaceable containers to replace *katchra kundis*. These containers will be used by the private sector, communities, sweeper's cooperatives or others engaged in the solid waste management of the UC and TC.
- Preventing scavenging and related activities within their jurisdiction.
- Providing information regarding the new system to UCs, NGOs, CBOs and educational institutional within their area.

3.4 District Government (DG)

The District Government will perform the following functions.

- It will provide and develop four landfill sites for the city of Karachi in appropriate locations.
- It will manage the landfill sites or it will let them out to the private sector.
- It will collect revenue from landfill and recycling operations or will make this the responsibility of the private contractor/operator of the site.
- It will enact a law forbidding the picking, sorting and storage of solid waste except at the landfill sites.
- It will provide the following at the landfill sites:
 - Picking, sorting and storage facilities to scavengers and dealers.
 - Sites and services for housing on the Khuda-ki-Basti model near the picking and storage spaces on the windward side of the site to prevent air pollution.
 - Land and infrastructure adjacent or at the landfill sites for the relocation and expansion of the recycling industry.

- Develop and disseminate programmes and material for promoting removal and sale of recycleable materials at the household and market level; promoting the concept of shifting scavenging and recycling activities to landfill sites; and training of its staff in these concepts.

3.5 Private Sector

In various meetings and workshops held during this study, the private sector in Karachi is interested in taking on contracts in small units rather than at the city level. Based on feedback its interests include:

- House to house collection where possible of not less than 2,500 houses and transfer to landfill sites.
- Collection of solid waste at the Union Council level in sealed containers and its transfer to a central point in the Union Council area.
- Management of the landfill sites. All potential private sector operators of the landfill sites agree that the management of four smaller sites let out to different contractors is a far more feasible option than the management of one site for Karachi.
- Relocation of small informal sector recycling industry to the landfill sites provided infrastructure is made available. The industry is willing to pay rents/lease charges.
- Relocation of picking, sorting and storage to the landfill sites by scavengers, dealers and agents provided infrastructure is made available. The dealers are willing pay rent/lease charges. The increase in value and quantity of recycleable material under different options is given in **Appendix – 12**.

4. FINANCIAL ASPECTS

4.1 Landfill Sites

Table - 5.7

Capital and O&M Costs for Proposed Landfill Sites

Sr. No.	Item	Capital Costs (in Rs)	Operational Cost (in Rs)	Revenue per Year (in Rs)	Shortfaff (-) Surplus (in Rs)
1.	For 500 tonnes/day module (lower cost option)	57,035,000	6,336,000	6,8055,000	+ 469,000
2.	For 500 tonnes/day module (higher cost option)	66,150,000	7,724,000	6,805,000	- 919,000
3.	For one of 4 sites 1,500 tonnes/day (lower cost option) 1x3	171,105,000	11,913,000	20,415,000	+ 1,407,000
4.	For one of 4 sites	198,450,000	23,172,000	20,415,000	- 2,757,000

	1,500 tonnes/day (higher cost option) 2x3				
5.	For all 4 sites 6,000 tonnes/day (lower cost option) 4x3	684,420,000	47,652,000	81,660,000	+ 5,628,000
6.	For all 4 sites 6,000 tonnes/day (higher cost option) 4x4	793,800,000	92,688,000	81,660,000	- 11,028,000

4.2 Source of Funds

For the development of one landfill site Rs 171,105,000 or US\$ 2.7 million is required. For the development of all four sites Rs 684,420,000 or US\$ 10.7 million is required. These are not large sums and can be acquired from the Government of Pakistan or the District Governments Annual Development Plan (ADP).

5. INFORMATION AND CONSENSUS BUILDING

The success of the programme options developed in the pre-feasibility depends to a large extent on providing information to urban communities and NGOs about the programme and arriving at a consensus among the different interest groups engaged in the solid waste system in Karachi. To make this possible the following will have to be done.

- Explaining the role of the different tiers of government to the people of Karachi and their representatives, through a media campaign and emphasising and highlighting success stories. This will have to be done by the District Government (DG)).
- The DG will have to make videos for the UCs and TCs to promote the concept and good practices among CBOs, NGOs, schools, scavengers, dealers, private sector operators (existing and potential), and government staff. The small size of the UCs can make this exercise possible and productive.
- Initiating a prize for the most successful TC, UC, NGO and or CBO involved in solid waste management (responsibility of the DG).
- The UC will have to negotiate with scavengers and dealers to convince them to move to the developed landfill sites.
- Identifying landfill site locations must be followed by consensus building processes which may lead to some modifications. These consensus building processes will involve scavengers, dealers, recycling industry representatives, settlements in the neighbourhoods, relevant NGOs and CBOs, and government institutions. This consensus building can be done by:
 - Holding structural workshops with the interest groups.
 - Advertising the programme / project and inviting objections and suggestions.
 - Making modifications on the basis of feedback.
 - Setting up monitoring committees at the UC and TC level.

6. RECOMMENDATIONS FOR THE FEASIBILITY

For the preparation of the feasibility the data and options explored by the study can be used to implement the following pilot projects which can be replicated for other landfill sites and TCs and UCs.

- Identification of four landfill sites by the proposed DG.
- Development of Jam Chakro by the DG as a model landfill site for parts of the present district West and Central (**see Figures 5.4 and 5.5 for layout options on pages 55 and 56**). These will include the following towns proposed by the devolution plan: Gadap, New Karachi, Nazimabad, Gulberg, Liaquatabad, (for details see **Appendix – 11**). The management of the site will be let out to the private sector.
- Identify and contract out an area for house to house collection to the private sector where large vehicles can operate (responsibility of the TC).
- Identify a UC where house to house collection is not possible and let out collection to the private sector to transport to a transfer station (responsibility of the TC and UC).
- Identify an area where an NGO or CBO is involved in solid waste management and support it (responsibility of the TC and UC).
- Identify an area where solid waste management can be let out to DG employees engaged in the solid waste management system (responsibility of the TC and UC).
- Identify a UC and or an area comprising more than one UC where solid waste contains little or no inorganic material and develop a system of selling it to potter's colonies for the firing of kilns.

APPENDICES

List of Literature Available on Solid Waste Management

(Sources: 1. Urban Resource Center Karachi, 2. Mr. Arif Hasan and 3. Dr. Mansoor Ali)

1. A report on disposal of solid waste as released by District Municipal Corporation Central HRC No. (SWM-027 – Dated 21 March 2000)
2. Ali, S.M. (1993), “Informal System of Solid Waste Recycling – Preliminary Findings in Karachi”, WEDC, UK
3. Ali, S.M. (1994), “Integration of Formal and Informal Activities in Solid Waste Management – A case study of Informal House to House Collection Systems in F.B. Area, Karachi”, WEDC, UK
4. Ali, S.M. (1994), “Integration of Formal and Informal Activities in Solid Waste Management: A Case Study of Karachi Administration Women Welfare Society (KAWWS), Karachi, WEDC, UK
5. Ali, S.M. (1997), “Integration of the Official and Private Informal Practices in Solid Waste Management”, Karachi
6. Ali, S.M. (1998), “Electronic Conference on Gender and Waste Management 9th to 26th May 1998 – Conference Archives, Compiled by Dr. Mansoor Ali, organized by Global Applied Research Network (Topic Network: Solid Waste Management) and Waste, Netherlands – WEDC, UK
7. Ali, S.M. (2001), “Solid Waste Management”, A Postgraduate Distance Learning Module”, WEDC, Loughborough University, UK
8. Ali, S.M. and Cotton, A.P. (2001), “The Sweeping Business: Developing entrepreneurial skills for the collection of solid waste”, WEDC, Loughborough University, UK. (ISBN paperback 0906055 8 57)
9. Ali, S.M. and Cotton A.P. (1997), “Micro-Enterprise Development for Primary Collection of Solid Waste”, Background paper and electronic feedback from the Conference held from 5 – 19 December 1997, WEDC, UK
10. Ali, S.M. and Cotton, A.P. (2000), “Process of Change in Solid Waste Management: Field Note. WEDC, Loughborough University, UK (ISBN Paperback 096055 6 95)
11. Ali, S.M. and Cotton, A.P. (2001), The Sweeping Business: Developing Entrepreneurial Skill for the Collection of Solid Waste”, WEDC, Loughborough University, UK (ISBN Paperback 096055 8 57)
12. Ali, S.M., Cotton, A.P. and Westlake, K. (1999), “Down to Earth: Solid Waste Disposal for low income countries”, WEDC, Loughborough University, UK (ISBN Paperback 0906055 66 0)
13. Anwar, F. (1998), “Neighborhood Level Solid Waste Management in Karachi – Issues and Solutions”, Karachi

14. Anwar, F. (2000), "Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government- Solid Waste Management Sector of Karachi, A Case Study", Karachi
15. Appleton, J., Ali, S.M. and Cotton, A. (2000), "Successes and Sustainability Indicators: A Tool to Assess Primary Collection Schemes". A case study of Khulna, Bangladesh. WEDC., Loughborough University, UK (ISBN Paperback 090655 733)
16. Coad, A., (1998), "Solid Waste Management", Directory of English Language Publication and Organization for Low and Middle Income Countries. (ISBN 3 908001 82 X)
17. Cempre News (1994), "Private Sector Solid Waste Collection in Porto Alegre, Brazil", Vol. 19, Urban Management and Infrastructure – Participation and Partnership in Urban Infrastructure Management, PP 29, Washington, D.C.
18. Cotton, A., Ali, S.M. and Westlake, K.. (Undated), "Appropriate Land Filling of Solid Waste" : Draft framework for the disposal of municipal solid waste in developing countries". WEDC., Loughborough University, UK
19. Coentreau Levine, S. (1994-95), "Private Sector Participation in Municipal Solid Waste Water Services in Developing Countries", Vol. 1, The Formal Sector (ISBN 1020 0215), USA
20. Coentreau Levine, S. and Coad, A. (2000), "Guidance Pack – Private Sector Participation in Municipal Solid Waste management", UK (ISBN 3 908001 90 0)
21. DFID (1998), "Guidance Manual on Located Supply and Sanitation Programmes". DFID, UK (ISBN 090655 58 x)
22. Globex – City Consult – Sukleen Team (2001), "Solid Waste Management Project", A proposal submitted by Globex – City Consult – to Karachi Metropolitan Corporation, Karachi.
23. Government of Pakistan, Environmental and Urban Affair Division, Islamabad (1996), "Data Collection for Preparation of National Study on Privatization of Solid Waste management in Eight Selected Cities of Pakistan", Islamabad
24. Hasan A. et al (1999), "Understanding Karachi-Planning and Reform for the Future", Karachi, City Press Karachi, ISBN (969-8380-28-0)
25. Hoq, M. and Leehner H. (1994), "Aspects of Solid Waste management – Bangladesh Context", Dhaka
26. JMPEP International Environmental Technology Centre (1996), "International Source Book on Environmentally Sound Technologies for Municipal Solid Waste Management", Osaka/Shige
27. Javaid, K. (1997), "Presentation on Garbage Transfer Station", Karachi
28. June 1998, "Interim Report of the Committee, Constituted by the Hon. Supreme Court of India on Solid Waste Management in Class 1 Cities in India
29. Karachi Metropolitan Corporation (1995), "Compost Plant for Karachi", PC-I, Karachi.
30. Karachi Urban Development Project (1996), " Final Report on Solid Waste Management Karachi", Karachi
31. Klundert, A.V.D.K (1996), "Report on Repair and Maintenance of Vehicles and Equipment", written for Karachi Urban Development Project, KMC, Karachi

32. Klundert, A.V.D.K (1996), "SWM ADVISOR-Second Duration Report", Karachi.
33. KMC (2001), "Presentation by Solid Waste Management Department on Integrated Solid Waste Management of Karachi", Karachi
34. KMC (Undated), "A Report on *Nallah* Development and Solid Waste management", Karachi
35. National Engineering Consulting Services Pakistan (PVT) Limited (1993), "Consulting Services For Community Education For Solid Waste Management", Final Project Report, Karachi
36. National Engineering Consulting Services Pakistan (PVT) Limited (1995), " Solid Waste Management" , Final Report, Karachi
37. National Management Consultants (PVT.) Limited (1993), "Final Report on Private Sector Involvement in Solid Waste Management in Karachi", Karachi
38. News clippings in Urdu", Karachi Waste Management (Mid-Week Feature, Daily Jang, Karachi.
39. News clippings on Karachi Solid Waste Management 1992-2001, URC, Karachi
40. Report and profiles of various members belonging to recycle industry.
41. Rivire D. (1996), "Private Sector Participation in the Water Supply and Waste Water Sector:" Lessons from Six Developing Countries", The World Bank, Washington, D.C.
42. Rouse, J. R. and Ali, S.M. (2001), "Waste Pickers in Dhaka: Using the sustainable livelihoods approach – key findings and field notes". WEDC, Loughborough University, UK. (ISBN paperback 0906055 84 9)
43. Rushbrook, P. (2000), "Guidelines on Minimum Standard for Solid Disposal to Land". Part 1 Improvements to Existing Municipal Waste Dump Sites (unknown)
44. Sidat Hyder Morshed Associates (PVT) Limited (1995), "On Financial Accounting System Under ADB Loan No. 793-PAK(SF)", Karachi
45. Sidat Hyder Morshed Associates (PVT) Limited (1995), " Pre-Final Report on Design of Costing System and Monitoring OF Costs Under ADB Loan No. 793-PAK(SF), Karachi
46. Sidat Hyder Morshed Associates (PVT) Limited (1995), "Draft Report on Assessment of Assets and Facilities Under ADB Loan No. 793-PAK(SF), Karachi
47. Swedish Environmental Protection Agency (1999), "Waste Management: The Swedish Experience", Sweden
48. Syed, M.H. (Undated), "Management Contract in Solid Waste – Experience of DMCC", Initial discussion forum on Solid Waste Management Public Private Participation.
49. UNCHS (Habitat) 1992), "Promotion of Waste Recycling and Reuse in Developing Countries", Karachi
50. (Undated), "The Recycle Industry: Dialogue initiated by the Sub-Committee on SWM with the stakeholders in the recycle industry"

51. URC (1991), "Informal Sector in Solid Waste Management Karachi Pakistan – As part of City Net Study on "The Urban Environment" Undertaken from UNESCAP, URC, Karachi
52. WEIRC and KAWWS (2000), "Capacity Building for Primary Collection in Solid Waste – Citizens Guide for Karachi", March 2000 – H.K.
53. SKAA (1998), "Proceedings of the First Discussion on Solid Waste Management", Karachi

Appendix - 2

Proceedings of Workshops and Important Meetings Related to the Study

Meeting I:

Date: March 13, 2001
Time: 9:30 a.m.
Venue: Office of Arif Hasan and Associates
Participants: Mr. Arif Hasan (AH), Dr. S. Mansoor Ali (MA) and Mr. Mansoor Raza (MR)

This was a kickoff meeting and was arranged to discuss responsibilities vis-à-vis the WSP-SA, Solid Waste Management (SWM) Project. It was suggested that MR will review the existing literature on solid waste and URC will find out the locations of the recycling industry. MA, MR and URC will make a visit to recycling industry. The costing of the proposed landfill(s) will be accomplished by AH.

MA was of the opinion that spread of the city demands more than one landfill sites and at various locations. KMC will be required to furnish the site ownership plan due to future requirements. It was also proposed that KMC personals could be involved by identifying training opportunities for them. If recycling industry is to be shifted to the landfill sites then the life of landfill(s) should at least be 50 years. It was also taken into consideration that formal sector (recycling) will not go to the landfill(s), whereas informal, after the provision of incentives, will shift.

MA opined that if house to house collection of material were made effective then the material would reach the landfill(s). Though Manila incident, raised concerns about MRFs at landfill sites, but recycle industry has a perpetual interest in having MRFs at landfills. It was also mentioned that landfill(s) should be able to repay the investment on them. So costing and repayment strategy will require attention to minute details. It was also discussed that for the sale of recyclable and reusable the landfill could be contracted out and MNCs will be interested in that venture.

Further meetings with URC and Khalid Jawed of KMC were lined up at the end of this meeting.

Meeting II:

Date: March 13, 2001
Time: 12:00 p.m.
Venue: Urban Resource Center
Participants: Mr. Arif Hasan (AH), Dr. S. Mansoor Ali (MA) Mr. Zahid Farooq (ZF), Mr. Mohd. Younus (MY) and Mr. Mansoor Raza (MR)

It was informed to the participants that MA is available till March 22, 2001. It was also brought into light that interviews of various actors of recycling industry are available at URC. MA asked that if URC could make a list of those. MY informed that issues and conflicting interests of stakeholders are also documented by URC.

The meeting embarked on the discussion about the reasons of failure of Al-Khalid. According to ZF, MQM extorted Rs. 15,00,000(?) per month from Al-Khalid. MA pointed out that Al-Khalid could not pull out KMC sweepers from the area. It was suggested that a meeting should be arranged with Al-Khalid. According to ZF, debris picking and de-silting of *Nallah* were the problems that were not envisaged by Al-Khalid.

MA opined that Afghan model is most successful from efficiency point of view. He also expressed that sustainable livelihood approach calls for supporting Afghans. MA suggested a workshop on sustainable livelihood approach on Monday, March 19, 2001.

It was mentioned that bones originated from two sources and those are Municipal Waste and slaughterhouses. Paper has also two major sources. Besides municipal waste, large quantity of paper waste originates from press. The need was highlighted to show the clusters of recycling industry on map. AH suggested obtaining the list of recycling industry, from census of manufacturing industry so that recycling industry in the formal sector can be figured out.

AH said that the proposed Integrated Solid Waste Management (ISWM) should be workable, sustainable and supported by the government.

Meeting III:

Date: March 14, 2001
Time: 10:05 a.m.
Venue: Office of Arif Hasan and Associates
Participants: Mr. Arif Hasan (AH), Dr. S. Mansoor Ali (MA) and Mr. Mansoor Raza (MR)

MA started with his following observations on Comprehensive Solid Waste Management Plan from Globex Team. The study was earlier obtained from KMC, as a part of an effort of literature review:

1. Consultants are experienced in USA and Abu Dhabi context. Peru is the only developing country they have an experience of.
2. Most of team members are freelancers and are not full time members of the organization
3. The report is more biased towards the disposal and treatment of hazardous waste than any other waste
4. Report was developed on broad TOR, without any specificity

MA also mentioned that report revolves around the following main points:

1. Landfill site design and operation
2. Incineration
3. Development of recycling drop off points
4. Transfer Stations
5. Compost Plants
6. Blue Bag operation

He also expressed that consultants proposed a capital-intensive plan for KMC. The report also failed to mention relevant Institutional Laws for SWM. He opined that there should be selective involvement of consultants in the SWM. Landfill design and incineration are the two areas of better utilization, while recycling program and community education should not be part of their service. He also suggested that KMC should focus on strategic planning and people oriented development.

MA further said that public consultation should be the part of the project and AH suggested that this demand of MA should be included in the guidelines for the study.

Meeting IV:

Date: March 14, 2001
Time: 2: 45 a.m.
Venue: Office of Sindh *Katchi Abadi* Authority (SKAA)
Participants: Mr. Tasneem Siddiqui (TS): Director SKAA
Mr. Fawad Khan (FK): ID Specialist World Bank
Mr. Khalid Jawed (KJ): Director Solid Waste KMC
Brig. A. Haq (AQ): Administrator KMC
Mr. Arif Hasan (AH), Chairman URC
Dr. S. Mansoor Ali (MA), Professor at WEDC Lough borough
Mr. Zahid Farooq (ZF): Coordinator URC
Mr. Mansoor Raza (MR)

The meeting started with the briefing of Mr. Tasneem Siddiqui about the achievements of earlier formed Task Force, which are as follows:

1. Promulgation of Urban Land Disposal Ordinance
2. Completion of study on sewerage treatment and disposal with the help of OPP
3. Formulation of Bylaws for Graveyards.
4. Formation of ordinance on ticketing system for vehicles
5. Making of policy for uniform signage and outdoor advertisement policy.
6. Completion of manual on incremental development housing scheme.
7. Formulation of policy for Katchi Abadis
8. Design and construction of public lavatories

He mentioned that consultants, government officials, Independent professional and all other stakeholders were involved in accomplishing the above-mentioned. He also emphasised the need and importance of Task Force for institutionalising the above mentioned initiatives.

After wards AH gave a briefing on the existing solid wastes management system and also referred to MA's work. He said that one of the findings is that without integration of informal recycling sector to exiting SWM, the system is not going to work and the waste will reach to the landfill. When URC contacted *Kabaris*, it reached to the same conclusion. He also mentioned that problem of recycling industries was also identified by URC, and the Centre recommended incentives for the same. The earlier held six studies conducted by KMC, ignored the role of this informal sector. At this point in time he shared a schematic of the landfill with the audience. He opined that system would work only if house to house collection could be performed effectively.

FK said that solid waste is a regional problem and its success in Karachi will be a good example for other countries of the region. WB contacted Dr. Mansoor Ali because he is well aware of the context. He mentioned that WB would be interested in the income generation aspect from the proposed plan.

MA briefed the participants about his experience and gave a presentation to them. He gave the gist of the past six studies, discussed the findings of the Globex Team Report, emphasised the selective involvement of consultants and suggested the role of KMC vis-à-vis community role and education.

KJ said that every study mentioned the development of GTSS. According to him 10 to 12 GTSS are required for the disposal of waste. He was also of the opinion that in Karachi land is not available for the landfills

AQ appreciated the role of MA and opined that technical issues of landfill are a back seat item in Pakistan. He said that involvement of KMC with Globex is preliminary. Since DMCs are not functioning properly he is under extreme pressure from the citizens of Karachi. Charges for waste collection are not mentioned in Globex Team Report. The report does not take care about the disposal of cow dunk. He also opined that since there is no place to hide waste in District Central,

so garbage is visible there. He suggested locating the diesel filling stations at the landfill sites to avoid stealth of it. He said that BOR could easily transfer the land for the landfill sites to KMC.

TS said that organisation of landfill will facilitate and regulate the transportation of waste to landfills. Also, KMC should move BOR for the transfer of land for the landfills.

AH identified five outputs of this study on SWM, which are as follows:

1. Identification of problems associated with transportation of solid waste to landfills and how they could be tackled?
2. Ways to make transportation of waste to landfill happen
3. The organisation of landfill
4. Essential institutional arrangements for its support
5. Revenue generation source(s)

AH identified following support for the above mentioned output:

1. Analysis of previous studies to explore the existing knowledge base
2. Identification of problems and issues of recycling industry and mapping of its locations
3. Analysis of KMC's privatisation attempts and lessons learned from the existing practices.

Meeting V:

Date: March 15, 2001
Time: 10:30 a.m.
Venue: Office of the Director, Solid Waste Management; KMC
Participants: Mr. Khalid Jawed (KJ), Mr. Arif Hasan (AH), Dr. S. Mansoor Ali (MA) and Mr. Mansoor Raza (MR)

Khalid Jawed while describing the difficulties of the solid waste department mentioned that the DMCs only implements the decision as taken by KMC. The former is usually not involved in decision making process. He also mentioned that KMC is less interested in the functions of DMCs and that's why it doesn't put much effort to improve the functions of the later. AH analysed that it is an institutional issue and situation arises due to the unclear policies. On the query of AH, KJ mentioned that KMC is only responsible for the maintenance of landfill sites and for the procurement of and maintenance of incinerators. He further mentioned that very little co-ordination exists between KMC and DMCs

Then much time was spent on GTS. KJ expressed that GT project would be operable only if would be backed by GTs. He mentioned that Farooq Sattar unconditionally and Fahim Zaman was in conditional agreement with the concept of GTS. KJ proposed two GTs, one in Mewashah Lyari and other at Treatment Plant Manzoor Colony. On the contrary Director Land of KMC proposed it alongside Lyari riverbed. He said that 4 acres of land is required for each GTS. The GTS will include weigh bridge, platforms, chutes. The functions performed at GTS will be waste monitoring, separation, compaction, and secondary transportation. He mentioned that secondary transportation will be contracted out to private parties ad they probably will charge Rs. 100 per ton to transfer the waste to landfill site. He mentioned that DMC (S) was in agreement with the proposal, because it has to cover more distance for the transportation of waste to the landfill, then other DMCs. The carrying capacity for waste is approximately 1.5 tonnes/ trip/vehicle. AH opined that if GTs could be connected to Circular Railway, so that waste could reach to Dhabeji landfill. He also added that GTS could be build for the efficient movement of the vehicles and sorting could be performed at landfill sites. KJ said that government should construct and equip GTs while these should be operated by the private sector. He also said that GTs should be under the control of city government and not under town governments. AH extended the discussion by asking that if GTS could be converted to scavenging and sorting places? Other option mentioned by AH is to convert existing informal sorting places to formal sorting and selling points and to

integrate them in solid waste plan. AH opined that due to the spread of city there should be at least three official landfill sites. KJ mentioned that unofficial dumping is going on, on *Rehri Village Road* and it should be given an official status. KJ re-emphasised that no SWM plan could work without GTSS.

In response to a question that how sorting of waste could be stopped at *Katchra Kundis*, KJ suggested the following:

1. By imposing section 144 on the *Katchra Kundis*
2. By privatising GTS, so the private parties for their benefit will themselves stop the sorting of material on *Katchra Kundis*.

According to KJ, the number of vehicles reaching the landfill sites is as follows:

1. Jam Chakro 60 to 70 vehicles per day
2. Gond Pass 100 vehicles per day

He also mentioned that compaction is not performed on the landfill sites, also waste is left without daily cover.

AH told the participants that there are 0.4 million cows in the city producing 4000 tonnes of wet dunk per day, which on drying yields 2000 tons of dry dunk, which may be used as fertiliser. This quantity requires 3 to 6 acres are required for sun drying. Mechanical means could be devised for drying, market could be prospected and supply of fertiliser for KMC utility can be explored. Findings can be integrated in the SWM plan.

Meeting VI:

Date: March 21, 2001
Time: 10:30 a.m.
Venue: SKAA Office
Participants: Zahid Farooq URC,
Khalid Sheikh Al-Khalid Agencies,
Zahid Ali DMC East,
Semoil Barkat DMC West,
Dr. Jawaid A.Khan DMC East,
Dr. Aslam Pervez DMC Malir,
Khalid Jawaid KMC,
Dr. Mir Nusrat DMC West,
Dr. A.D. Sanjnani DMC South,
Sohail Ahmed KMC,
Dr. Mansoor Ali Lough Borough University (UK),
Arif Hasan URC,
Noor Jahan URC

The meeting started with introduction of the participants.

Mr. Arif Hasan, chairman of Urban Resource Center gave the background of the study of Solid Waste Management. He said that Municipal Task Force took up this project in its plan and identified the actors and factors of this project. Through the study it was found that informal sector has a big role in SWM sector. For this study URC was the part of Municipal Task Force. A report was also presented on this study, though it was not a scientific report.

On the basis of the findings of the studies conducted by URC and the Municipal Task Force, Dr. Mansoor will do further research on SWM to consolidate both of the studies.

Dr. Mansoor explained the objectives of the workshop as,

“To identify and verify the problems related to solid waste management for this find the answers of the 4 questions related to the Solid Waste disposal and recycling”.

Question 1: What are the reasons that the vehicles are not reaching to Surjani town and Gond pass?

Responses:

- Insufficient facilities at the land fill site.
- Landfill sites are dangerous zones and there is lack of security.
- There are many places (open plots) in the way of landfill sites and we don't find any hindrance during the process of dumping. So it is not needed to take the burden of dumping garbage on specific sites.
- Dumping of the garbage on open plots is purposeful, i.e “recycling”.
- Pickers create problem, they delay picking of garbage from the site (Mr. Sohail Ahmed from KMC can identify the recycling sites in the city).
- Insufficient trips are taken by vehicles to dump the garbage due to the vested interest of the drivers and no action is taken against them.
- Lack of administration control.
- Inspectors do not appoint sufficient number of Kulis due to their vested interests and unwillingness of the driver to pick garbage is seen.
- Vested interest of the driver in not completing the trips is also there, that is to save money and fuel. Important thing is that for doing so the inspectors protect driver.
- Lack of planning about the number of the vehicles. As a result 40% of the garbage is picked up while 60% is left un-picked.
- Present vehicles are 20 years old. Absence of authority to purchase more vehicles.
- Drivers do not follow the instructions of the DMC's so orders remain unimplemented due to the absence of authority with the DMC's.
- Insecurity on the roads, there is no lighting of the road. (Complained by the drivers of dumping vehicles).
- 1½ - 2 hours are required to complete a trip by the vehicle to dump the garbage of the land fill site, so in insecure condition drivers are reluctant to go there.
- Lack of implementation of law for dumping garbage.
- Lack of contacts among the personnel's hierarchy.
- Lack of allocation of proper funds for the Solid Waste Management project.

Participants suggested the following:

- Directions of both land fill site is same. We suggest for another land-fill site.
- Big and sufficient vehicles are required to pick the garbage.
- Priority must be given to the Solid Waste Management project in the budget.
- The need is to maintain a place in the center of the city to dump garbage.
- Legislation for the recyclers should be done.

Question.2: What specific initiatives/actions can be taken to make sure that the vehicle can reach to the disposal sites?

Responses:

- A proper monitoring system should be developed to ensure that the vehicles could reach on the disposal sites.
- A logbook can be maintained with arrival and departure signature of the inspector/ steaker system can established.
- Proper timings should be fixed for the drivers to dispose off the garbage and they should be warned to strictly follow the timings.
- Fuel for the vehicles should be given to the drives on the basis of tonnage.
- Diesel can be provided to the drivers by the end of trip at the land fill site.
- Efficiency related indicators could be identified on which basis incentives should be given to the drivers.
- Presently there are strong unfair relationship b/w drivers and inspectors. A system should be developed to monitor their activities.
- Power of DHO's should be enhanced to get the work done from the staff.
- Transfer stations can be established in the city which help garbage to be shifted finally to the land fill site.
- Logbook system should be enforced.

Question.3: How to promote recycling at the landfill site?

Responses:

- Picker are of two kinds,
- at the land fill site
- within the city which are uncontrolled.

The need is to integrate these middlemen and a piece of land should be provided to carry on their activities.

Question.4: How to promote recycling within the city?

Responses:

- Transfer station should be established within the city.
- Need to change the behavior of consumers. Thorough educating people, sorted material can be collected from the city by fixing different coloured bins for different disposable items.
- Need is to ban plastic bags, they can not be picked up.
- By promoting awareness among the women to sort out material at the kitchen level.

Mr. Arif Hasan winded up the workshop by saying that we are collecting the studies on this topic to come to any specific conclusion. Dr. Mansoor has collected 35 studies on this topic, to get a consolidated form. Selling and sorting of the garbage is very important, the need is to consolidate them with all the system.

It seems that Municipal Task Force will implement what we suggest on the basis of research by the end of May.

Requests from the participants:

- Proceeding of the workshop should be provided to them.
- Through this research a productive solution of the problem of SWM should come out.

Meeting VII:

March 21, 2001 (Meeting with recycling units)

Introduction

Although various domains from the RI had been invited, only those from the bone industry turned up.

Objective

After the initial round of introductions, Dr Mansoor Ali, also the facilitator of the meeting, briefed all present that the study had been initiated to find the best solution for the garbage disposal, to mutually come to an agreement regarding a systematic solution to solid waste management.

Issue

The issues raised were:

- The problems faced by the RI, an essential ingredient to any study conducted on SWM
- Whether the municipality and the RI can work in harmony.
- To organize the RI. And to achieve that it was necessary to look into its working
 - a) Where did they procure their raw material?
 - b) Could that supply be improved?
 - c) Would they be willing to move to the landfill site?

The way the bone industry works

The bone RI's association informed that 20 per cent of their raw material, i.e. bones are procured from butchers in big cities through a contract system, some from hotels and the rest from homes when the garbage is separated by the Afghans.

The bones from butchers come in containers and transported to the dealers' factories. This practice is done overnight. The butcher gets Re1/kg which the contractor pays. There are about 20-25 contractors in the city. While five years ago, around 40-45 tonnes of bones per year was collected, the industry has jumped to 70,000 tonnes/year.

The bones thus procured is cleaned, crushed, sieved and made into gelatin and fertilizer and exported to Europe and Japan. The methods used are traditional and modernity has not really crept in, nor have new units come about. The by-products are grease from which cheap soap is made. Any kind of machinery used is locally fabricated. It is labour-intensive and creates job for about 2000 people from Peshawar to Karachi and around 50,000 collectors all over the country.

How can the supply be improved?

Most members thought that the way things were going was the best. If they were to be resettled to the landfill site, then sorting of bones would not be possible as the raw material would be burnt by the scavengers. Even door-to-door collection, as suggested by someone, was termed a costly venture although it was possible to have the bones collected from slaughterhouses, butcher shops and hotels.

Their apprehensions

Since they got their raw material directly from the slaughter-houses and the butcher shops and very little from the scavengers, taking the bones to land-fill sites and then getting them back to the mills would not be feasible.

Setting up a unit

Setting up a unit, one would require a minimum investment of Rs 1,000,00 to a maximum of Rs 10,000,000.

The option of taking the industry to the landfill site itself, was possible only if the present practice of garbage collection was changed. The stakeholders were not too happy with the idea of shifting and said that when people spoke of their industry polluting the atmosphere, it was unfair.

Their biggest problem was the smell emitting from the treatment of bones. But they said that they had set up their industry (Ebrahim Hyderi, Shershah, Haroonabad and SITE) much before the *katchi abadis* started expanding. It was also pointed out that *katchi abadis* should not be encouraged to crop up near industrial sites.

They even pointed out that they had got evaluations done to find out if the fumes and waste was being discharged from their factories was actually polluting the surroundings and had uncovered that it was not so.

The bone industry admitted that the problem of foul smell was there but that could not be helped. Mr Mahboob even pointed out that one of his factories was closed down for two months but he had not acquiesced. They denied paying *bhatta* as their paperwork was in order. They said that they never got any incentives from the government, and if the government could not make the export policy in their favor, they should at least be allowed to work without hurdles.

Setting up a recycling bone factory at the land-fill site, one would broadly require land, electricity, sweet water, telephone, sewerage line and proper road for transfer back and forth of the raw material.

Contact of some recycling units:

Name	Organisation	Contact No.
Tahir Rehman	Rehman Crusher	2567192
M.E. Khawaja	Bone Group	2426125
Sh. Naseem Ahmed	M. Mullan Bone Mills	7781824
Rehan Jawed	Shan Paper & Board Mills	5057641
M. Iqbal	Kanch Bottle Marchant Association	2572337
A. Ghaffar	Kanch Bottle Marchant Association	0320-249318
A. Sattar	Kanch Bottle Marchant Association	
Khurshid Ahmed	Kanch Bottle Marchant Association	

Workshop - 23rd May, 2001

To discuss the pre-feasibility of integrated recycling and disposal system for solid waste management.

The Workshop Programme

Introduction to the Workshop Programme (Mansoor Ali)
 Background of the Research Project (Arif Hasan)
 Role of Water and Sanitation Programme (Raja Rehan Arshad)
 Research Scope and Methodology (Mansoor Ali)
 Literature Review (Mansoor Raza)
 Basic Data, Information and Issues (Mansoor Ali)
 Structured Discussion on Key Findings (All)
 Concluding Remarks

Scope and Methodology

Scope

Literature Review
 Mapping of the non-formal activities
 Landfill Site Alternatives
 Institutional Arrangements
 Landfill with material separation and selling facility
 Cost estimates, areas etc. for the above

Methodology

Accessing, reviewing and storing literature
 Interviews and discussions with the stakeholders (URC forums and in field)
 Observations at the official and un-official sites
 Analysis of news clippings (last 7 years)

Basic Data and Information Waste Quantities - Major Streams

Waste Source	Quantities (tonnes/ day)	Comments
Households 10 million @ 0.45	4500	10% by weight is separated for re-sale
Large Markets	50	Mainly organic waste and inert materials
Street Sweepings	200	Mainly paper, plastics and dust
Large Hospitals	8	Often infectious waste mixed with other waste
Cantonments	500	A private contractor collects this
Airport	6	Mainly recyclables
Karachi Port Trust	6	
Buffaloes Yard (Landhi)	500	Mainly organic, not collected at all.
Slaughter House	20	Mainly recyclable organics
TOTAL	5800 tonnes/ day	

Waste Separation at Various Stages

Separation before disposal by households - paper batlee wala
 Separation by Afghan pickers

Picking at disposal sites and use by pottery makers

Quantities of recyclables

Separation by Households - 500 to 1000 tonnes/ day

Separation by Afghan Pickers - 600 tonnes/ day

Separation at Disposal Sites - 200 tonnes/ day

Fuel for Pottery Kilns - 350 tonnes/ day

Waste Transportation Vehicles

Vehicle Type	DMC Central	DMC East	DMC West	DMC South	DMC Malir	Total
Refuse Van	29	21	14	38	2	104
Open Truck	0	2	0	4	6	12
Tractor Trolley	13	5	19	17	7	61
Compactor	20	6	0	13	3	42
Arm Roll	35	25	15	23	1	99
Semi Compactors	0	9	0	0	0	9
					TOTAL	367

Theoretical carrying capacity is 4000 tonnes/ day.

Landfill Area Requirements for Karachi

Based on 6000 tonnes/ day at present

For the next 10 years = 5800 acres

Based on 8000 tonnes/ day at present

For the next 10 years = 6500 acres

Present:

Jam Chakro = 1600 acres

Gond Pass = 500 acres

Dhabejee = 2000 acres

Total = 4100 acres

Required: 2000 acres (approx.)

Key Issues within the scope of this project:

1. Waste trucks must reach the official disposal sites
2. Improve disposal practices at the official sites
3. Restricting picking in streets and dust bins and centralise it at transfer stations or landfill sites
4. Incentives to pickers, dealers and recycling industry to shift
5. Arrangements in new institutional structure (town councils) to move waste efficiently to disposal sites

Key Proposals - Controls and Incentives

To improve the practices at the existing official disposal sites

To restrict picking activities in streets and dust bins to promote centralise and safe picking

To recognise, improve and integrate small scale recycling industry

To encourage and integrate medium and large scale recycling industry

To propose an integrated waste disposal, sorting and selling facility for 100 truck loads/ day

To develop procedures for consensus building and dialogue between communities, KMC and Union Councils on key decisions, for example selection of landfill sites

To further promote separation activities of households by giving them incentives against collection fees

Example:

To improve the practices at the existing official disposal sites

Controls	Incentives
<ul style="list-style-type: none"> • The landfill site fuel quota to be linked with the weight of waste brought at the site • Fuel to be only filled at the landfill sites for the catchment area • Pickers are not allowed to burn waste at the landfill sites • Through an agreement the contractor is responsible for proper site operation and using pickers • Extend strict controls over drivers over not to divert trucks to unofficial sites, except where no landfill is available nearby 	<ul style="list-style-type: none"> • Drivers can en-cash extra fuel instead of overtime • Drivers will bring more waste loads to the site • Use pickers in waste spreading and compaction using simple technology e.g. manual rollers. Enhance other alternatives of waste picking and income generation. • Contract-out the landfill site operation to a private contractor, NGO or any other organisation willing to work with pickers • Drivers or their co-operatives could be given option to take the contracts of waste transportation (employees buy-outs)

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Glossary of Words

Acronyms

ADB	Asian Development Bank
DMC	District Municipal Corporation
DMG	District Management Group
EPMC	Engineering Planning and Management Consultants
GoS	Government of Sindh
HH	House Hold
HHW	Household Waste
KDA	Karachi Development Authority
Km	Kilometres
KMC	Karachi Metropolitan Corporation
LITE	Landhi Industrial Trade Estate
MSW	Municipal Solid Waste
NGOs	Non-Governmental Organisations
OPP	Orangi Pilot Project
PH&S	Public Health and Sanitation
SITE	Sindh Industrial Trade Estate
SLGO	Sindh Local Government Ordinance
SWM	Solid Waste Management
URC	Urban Resource Centre

Local Terms

<i>Nallas</i>	Open Sewage Drains
<i>Chowki</i>	Post
<i>Kabaris</i>	Vendors dealing in used articles
<i>Katchi Abadi</i>	Un-leased Settlement
<i>Katchra Kundi</i>	Filth Storage Depot.
Khilafat	
Madressah	Religious School

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1.0 Overview

Karachi being a mega-city is no exception to the problem of solid waste management. Earlier it was estimated that the city with an estimated population of 13 million generates solid waste at the rate of 6600 tonnes/day. However, the most recent study shows that it is generating waste at the rate of 9000 tonnes/day. The estimated growth rate (per annum) of waste is 3.0 percent. Estimation of per capita generation varies from 0.224 kg/day in 1992 to 0.4 kg/day in 1997. The city generates 10 to 14 percent of the Pakistan's estimated total solid waste (47920 tonnes in 1997, The Dawn, 29/7/97)

It is observed from the known and available history of Karachi that the city has observed a phenomenal increase of population in the span of about 200 years. Between 1872 and 1901, the population of Karachi was doubled. Population increased by 133.4 percent between 1911 and 1941. After partition some 0.6 million people were added to the city. Reasons may be diverse, but all these changes had a profound impact on the consumption quantum and pattern, resulting in more waste generation and hence demand for its better management.

Out of the total waste generated of 8960 tonnes/day, the Municipal Waste in the respective 5 District Municipal Corporations (DMCs) and KMC is 8176 tonnes/day, which is 91 percent of the generated waste (Globex Team, 2001). Another 9 percent (approximately) is generated in the administrative jurisdictions of Cantonments and of Karachi Port Trust (KPT). District South contributes 25% to the waste stream, Central 22.5 percent, East 18.75 percent, West 15 percent and Malir 10 percent by weight. Excluding military, agricultural, special, industrial, hazardous and white goods waste the total waste to be generated in the year 2001 is 8608 tonnes/day. The Household waste (HHW) is more than 50.0 percent of the waste stream and commercial waste is approximately 7.0 percent of the total waste stream by weight.

In 1986, [biodegradable waste \(including green waste\)](#) made 31 percent of total waste, while in 1988 it constitutes 40 percent of the same. Similarly paper and cardboard made 6.5 percent and now it makes 16 percent of the waste. The glass (coloured and clear) also observed phenomenal growth i.e. it was 0.74 percent in 1986 and now it constitutes 3.5 percent of the waste stream. (Globex Team, 2001)

Type of Waste	Percentage (of Total Waste Quantity) PCSIR 1986	Percentage (of Total Waste Quantity) NESPAK 1991	Percentage (of Total Waste Quantity) Globex Team
Bio waste (including Green Waste)	31 percent	38.7 percent	40 percent
Paper and Cardboard	6.5 percent	10 percent	16 percent
Plastics	7 percent	6.63 percent	12 percent
Textile	6.6 percent	8.4 percent	6 percent
Metal	0.36 percent	0.7 percent	4 percent
Glass (Coloured and Clear)	0.74 percent	1.5 percent	3.5 percent
Others/Misc.	47.8 percent	37.07 percent	18.5 percent
Total	100 percent	100 percent	100 percent

It is evident from the available literature that 17 percent of the waste is retained at source, for reuse, sold to kabaris, and constitutes the stream of reuse/recycling. The primary collection is done by households or by street sweepers.

The secondary storage is performed either at formal places like concrete/steel bins (Katchra kundis) provided by KMC or at informal places like empty plots, roadsides and storm sewers. From secondary storage the waste is either sorted out by waste pickers, mostly

young Afghanis, or/and collected and transported by KMC/DMC. Literature argues that collection capacity of KMC is 40 percent but the disposal capacity is even lesser (these figures vary from 33 percent to 51 percent). Open burning at secondary storage and scavenging by animals is common. The waste lifted by KMC though intended to carry to the formal and allocated disposal sites, but often dumping on unauthorised/officially closed, water bodies and on land takes place. This is not an officially accepted practise but very common because of fuel theft, sell o f waste bt drivers and saving of labour

KMC is always short of development budgets, which effects all it's operations. For example, a common practise is to repair vehicles rather to routinely maintain them. It is mentioned that roughly 30 percent of the vehicles are off the road on any working day. The non-existence of first line repair facilities results in severe damages and higher costs of vehicles and equipment.

Literature generally express serious concerns about the environmental hazards due to burning of waste at secondary storage and at the disposal sites, but no scientific data and exact details are available about the quantum of the pollution, these practises generates. Literature also suggests that during collection and transportation, this waste undergo a number of physical and chemical changes

The literature mentions that there are over 435 recycling factories in Karachi and the vast majority of them are informal. The recycling industry plays a very important role in waste reduction and so in the overall economy of Karachi. It provides employment to over 55,000 families and its annual turn over is over Rs. 1.2 billion. In addition, its total production of recyclable material is 1,230,800 tonnes per year. Also, it is gradually expanding and becoming more systematic to deal with the increasing quantities. It has strong links with industrial cities in the Punjab such as Gujranwala where most of Karachi's plastic is recycled. There are evidences that it also import and recycle material from other countries. Literature emphasise that on financial interests, a de facto financial and organisational inter-dependence exists between the various actors in the solid waste management of Karachi and the recycling industry. There is a need to recognise this inter-dependence and institutionalise it so that the SWM system can function effectively. Recycling can be used as a tool to divert larger quantities of waste toward the landfill site.

The administrative efficiency of KMC for the collection of solid waste is limited due to the paucity of funds and the dual management system. The administrator of KMC and the administrators of the respective DMCs report directly to the Commissioner and Deputy commissioner respectively. These two parallel tiers of governance (municipal bodies/ Federal DMG service) often work at cross purposes and represent different interest groups.

The Garbage Train Project for one reason or another has been shelved and the effort to privatise the venture is still far away from appreciation due to its low efficiency. The participation of citizens in decision making is almost totally missing; a phenomenon which is peculiar to civic bodies.

The official disposal sites for ultimate disposals are North Karachi, Mehran town, Jam Chakro and Gond Pass, though there are more than --- unofficial disposal sites around the city. The first two are officially closed, though dumping and waste burning activities could be observed at North Karachi site for pottery making. These disposal sites do not fulfil the requirements of a sanitary landfill, as garbage is randomly dumped, left and occasionally compacted. The literature pointed out that these are merely dumping and burning grounds. It has also been argued that, except Dhabeji, these landfills are located on the growth corridors of the city. The proposal of shifting of recycling industry to the land fill site is only feasible when the landfill is organised and the industry be given proper incentives.

Summary

After going through the available literature, the following are the findings in brief:

- Solid Waste Management has been accorded low priority in the existing planning structure of KMC.

- The available data on the quantity and quality of waste stream is outdated and inaccurate.
- Solid waste collection & storage facilities are inadequate. The dustbins are generally broken and solid waste is thrown outside these dustbins.
- The role of informal sector is not recognised and hence not incorporated in the planning for MSW.
- In katchi abadis, solid waste is not collected in trolleys or containers rather it is thrown by children onto streets or open plots.
- The existing transportation facilities available with KMC are grossly inadequate. Refuse vehicles makes 2-3 trips per day to dump sites with a round trip distance of more then sixty (60) Kms.
- The present ancillary facilities such as workshops, laboratories are outdated and inadequate.
- Less than one third of waste is reaching the landfill sites
- The KMC personnel involved in solid waste including engineers, inspectors, supervisors, coolies and sweepers are not properly trained for the function they perform, though they are experienced with the present system.
- The key persons involved in solid waste management are sweepers, coolies and drivers...the existing strength of sweepers is 1.06 sweeper for every 1000 persons which is grossly inadequate.
- The inherent technical and managerial incapacity of the KMC/DMC staff is another inhibitory factor. Low salary and benefit packages make the introduction of qualified staff within these bodies, difficult.
- The budget allocations are grossly inadequate. Further the establishment alone consumes the major portion of the budget. Expenses are partly met by grants which are insufficient and subject to variations
- Most of the budget is spent on recurring cost while capital expenditure remains very low.
- [The dual control and management system exists. This issue further hinders the process of efficient management within the overall systems of administration.](#)
- Mechanisms for “citizens’ participation” are extremely limited and are mostly restricted to the practice of registration of complaints and their subsequent follow-up.
- Channels for meaningful communication with civic officials and active citizens’ involvement in the affairs of the civic bodies do not exist. Planning, development and management of projects, more often then not, are devoid of citizens’ participation. Transparency in operation thus cannot be safeguarded and ensured.
- Due to lack of effective co-ordination both within a department and at the interdepartmental levels, decision-making processes are seldom clearly defined and management lapses occur.
- No proper performance standards exist. Therefore, the role of the regulatory bodies like the Sindh Environmental Protection Agency (SEPA) is severely curtailed.
- Effective revenue generating mechanisms do not exist. The conservancy charges cater only 10-20 per cent of the total budgetary requirements of the solid waste management sector.
- People generally lack awareness about the impact of poor waste management. They keep their houses clean but do not care for beyond their house boundaries.
- [Environmentally safe disposal methods have yet to see light of the day.](#)

1. Karachi

1.1 History

After silting up of Karack Bunder in 1728, situated forty kilometres (Km) west of Karachi bay on the estuary of Hub river, the merchants of Karack Bunder decided to relocate their activities to

present day Karachi. Afterwards the Kolachi village, as it was called at that time, turned into a major trading port. A fortification wall was constructed around the village with two entrances. Kaharadar (brackish water gate) was the name of the entrance facing the sea on the west and the Mithadar (sweet water gate) facing Lyari river in the east. Between 1729 and 1783, Karachi, due to its strategic importance, saw a struggle for its control between *Khan of Kalat* and the rulers of Sindh. The chronology of important events is as under: (Hasan, 1998)

Table1: Chronology of Important Events of Pre-partition Karachi

S. No.	Year	Event
1.	1783	City fell to Talpur Mirs
2.	1838	British obsessed with the fear of Czarist expansion to the Arabian sea occupied Karachi
3.	1843	British annexed Sindh and shifted capital from Hyderabad to Karachi
4.	1856	Increase in population to 57,000 primarily due to increase in trade
5.	1865	The General Library became the part of the Frere Hall Library
6.	1843	The first Church was built
7.	1857	The Native troops rebelled against the British troops
8.	1861	Development of Singh railway took place, which linked Karachi to the cotton and wheat producing areas.
9.	1868	Karachi became the largest exporter of wheat and cotton in India
10.	1885	The tramway was introduced in Karachi Construction of Sindh Madressah
11.	1887	D.J. Science College was established
12.	1889	Empress Market was built
13.	1892	The steam locomotive tramway was replaced by horse-drawn carriages due to the objection of Karachiites over the noise the former made
14.	1904	Karachi's trade expanded to over Rs. 300 million
15.	1906	Khaliqdina Hall was built and the Native General Library was absorbed in Khaliqdina Hall
16.	1914-1918	Karachi became a military base during the First World War
17.	1915	Karachi Port Trust was built
18.	1921	Trial of Leaders of Khilafat Movement in Khaliqdina Hall
19.	1923	Bank of India was established in Karachi
20.	1924	The first airport in British India was constructed in Karachi
21.	1925	Hindu Gymkhana as established
22.	1929	The High Court Building was added to the city
23.	1931	The Karachi Municipal Corporation Building was constructed
24.	1935	Sindh was separated from Bombay, made province with Karachi its capital
25.	1935-1949	Karachi became the military base and port for supplies in the Second World War
26.	1940	Old Sindh Assembly building was added
27.	1911-1941	Karachi's Population was increased by 133.4 percent

Source: *Understanding Karachi Planning and Reforms for the future: Arif Hasan et al 1998*

Between 1872 and 1901, the population of Karachi more than doubled. The reason for this was the completion of railways, which linked Karachi to the Punjab, northern India and Sindh and their wheat and cotton production started flowing through Karachi.

(Also) between 1911 and 1941 its (Karachi's) population increased by 133.4 percent. It is estimated that 90 percent of Karachi's growth between 1921 and 1941 was the result of migration (Hasan 1998). After partition some 0.6 million people were added to the city, giving birth to population boom in the coming years, which has profound effect on the demand of the civic facilities and to which solid waste management is no exception.

1.2 Topography

Karachi---The provincial capital of Sindh is located at the Arabian Sea Coast about 160 Km North West of Indus Delta. Its geology is characterised with lime stone topography & most of parts of Karachi Division have saline underground water. The wide intervening plains, dry river bed and water channels have some shallow sweet water belts which are seldom perennial in there contents. The main rivers are Hub, Lyari and Malir. The soil conditions are generally sandy with poor water retention capacity. The soil conditions are generally sandy with poor water retention capacity.

Karachi, despite humidity in the air is moderate in climate, favourable for growth of large variety of flora. The low rainfall 5∇ to 7∇ mainly in July to August, in a lime stone topography has scarce residual moisture to sustain greenery and vegetation.

Table 2: Basic Facts about Karachi

S. No.	Parameter	Measure
1.	Longitude	67 East
2.	Latitude	25 North
3.	Area OF Karachi Division	3365 Sq. Km (?)
4.	Urban Area	1821 Sq. Km (?)
5.	Two Agriculture Areas	Malir Basin (east) Hub Basin (west)
6.	Climate	Moderate
7.	Temperature (Annual Mean)	27°C
8.	Elevation	22 meters above sea level

Source: Various

1.3 Demography

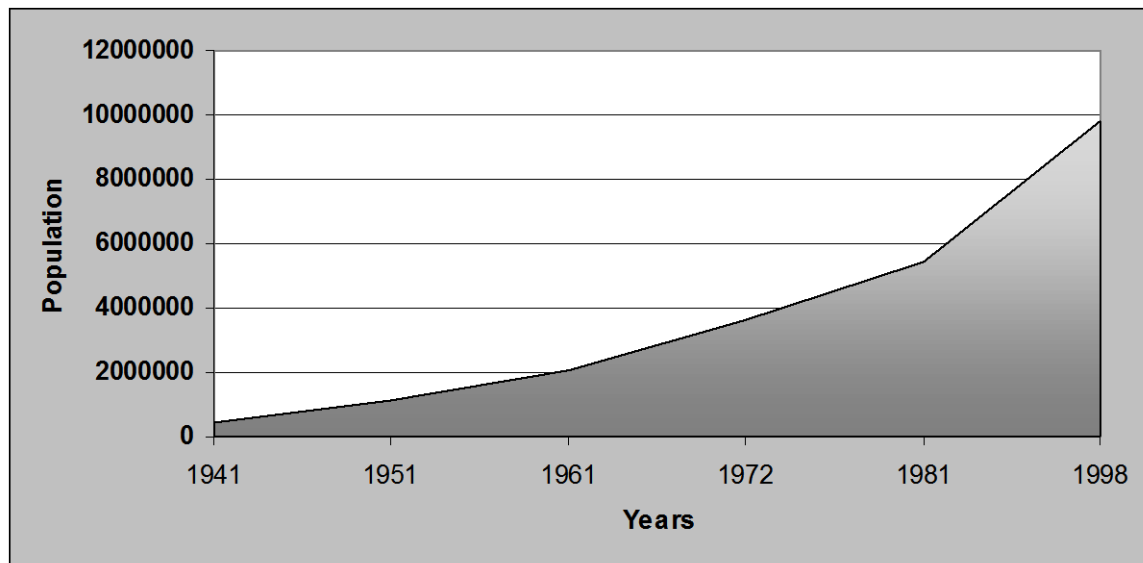
Karachi, the provincial capital of Sindh, is the hub of National Activities, it accounts for more than 6 percent of the National population, 25 percent of the population of Sindh Province, 22 percent of Pakistan's Urban population, 47 percent of Pakistan's Industrial Establishment and 42 percent of Pakistan's Industrial Workers (Jawaid, 1997). Karachi with the span of time has undergone a rapid process of population change and urbanization with a present population of 9.8 million (official) and 1.3 million (unofficial) residents. According to Government statistics, the average annual growth rate of Karachi is 3.5 percent. (Census, 1998)

Table 3: Population Figures of Karachi

Year	Population	Increase/Decrease Over last Census	No. of Years Between	Percent Increase/Decrease	Average Annual Growth Rate
1941	435887	1315108	10	4490	3.7
1951	1137667	701780	10	161.00%	10.07%
1961	2044044	906377	10	79.67%	6.03%
1972	3606746	1562702	11	76.45%	5.30%
1981	5437984	1831238	9	50.77%	4.67%
1998	9802134	4364150	17	80.25%	3.53%

Source: *Understanding Karachi Planning and Reforms for the future: Arif Hasan et al 1998*

Graph 1¹: Pictorial Representation of Karachi's Population over the years



On the eve of partition...the population of Karachi ...was 450,000 of which 61.2 percent was Sindhi speaking. 6.3 per cent was Urdu/Hindi-speaking; 51 per cent was Hindu and 42 per cent was Muslim. By 1951 all this had changed and Karachi population had increased to 1.137 million, because of the influx of 600,000 refugees from India. In 1951 the Sindhi speaking population was 8.6 percent, the Urdu speaking population was 50 percent: the Muslim population was 96 percent and the Hindu population was 2 percent. These changes had the major effect on every aspect of life of the city, be it environment or politics. For an understanding of the present situation in the city and the province and understanding of the repercussions of these demographic changes is essential. (Hasan, 1998).

¹ All the graphs in this text are constructed from the available data for this study

Table 4: Important Demographic Changes between 1981 and 1998

S. No.	Indicator	1981	1998
1	Population	5437984	9856320
2.	Literacy		
	Number	2139090	4978241
	Percentage	55.04%	67.42%
3.	Married Population		
	Number	1975895	3461586
	Percentage	62.08%	56.29%
4.	Divorce Population		
	Number	5347	21693
	Percentage	0.17%	0.35%
5.	Employment		
	Number	1299230	2036301
	Percentage	33.43%	27.58%
6.	Migrant Population		
	Number	1728213	2155321
	Percentage	31.78%	21.87%

This Study

Administratively, it is divided into 5 districts, namely, District Malir, District East, District Central, District West and District South. There are four industrial areas in Karachi namely West Wharf/Kemari Area, Sindh Industrial Trading Estate (SITE), Landhi Industrial Trading Estate (LITE) and Korangi Industrial Area. These areas are characterised by beverage industries, food processing and packaging industries, textile, pharmaceutical and chemical industries.

The System

The flow of waste collection and transportation system in Karachi is given in below.

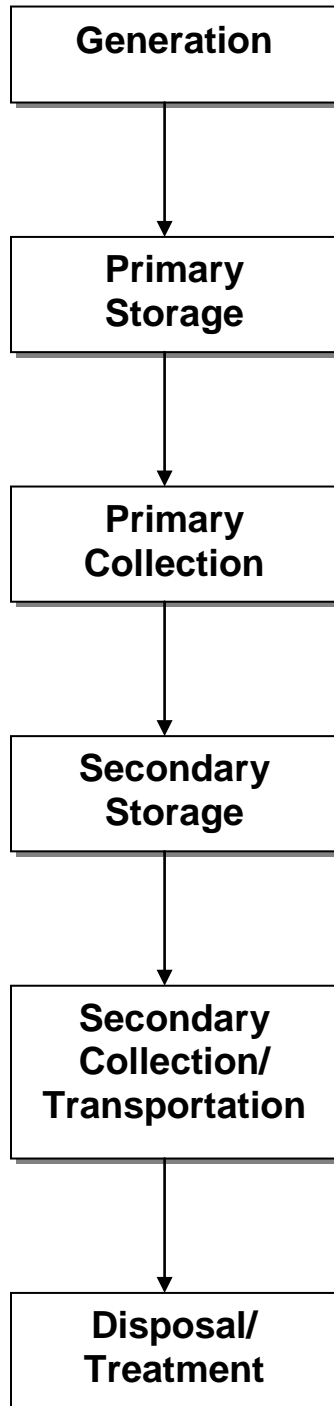
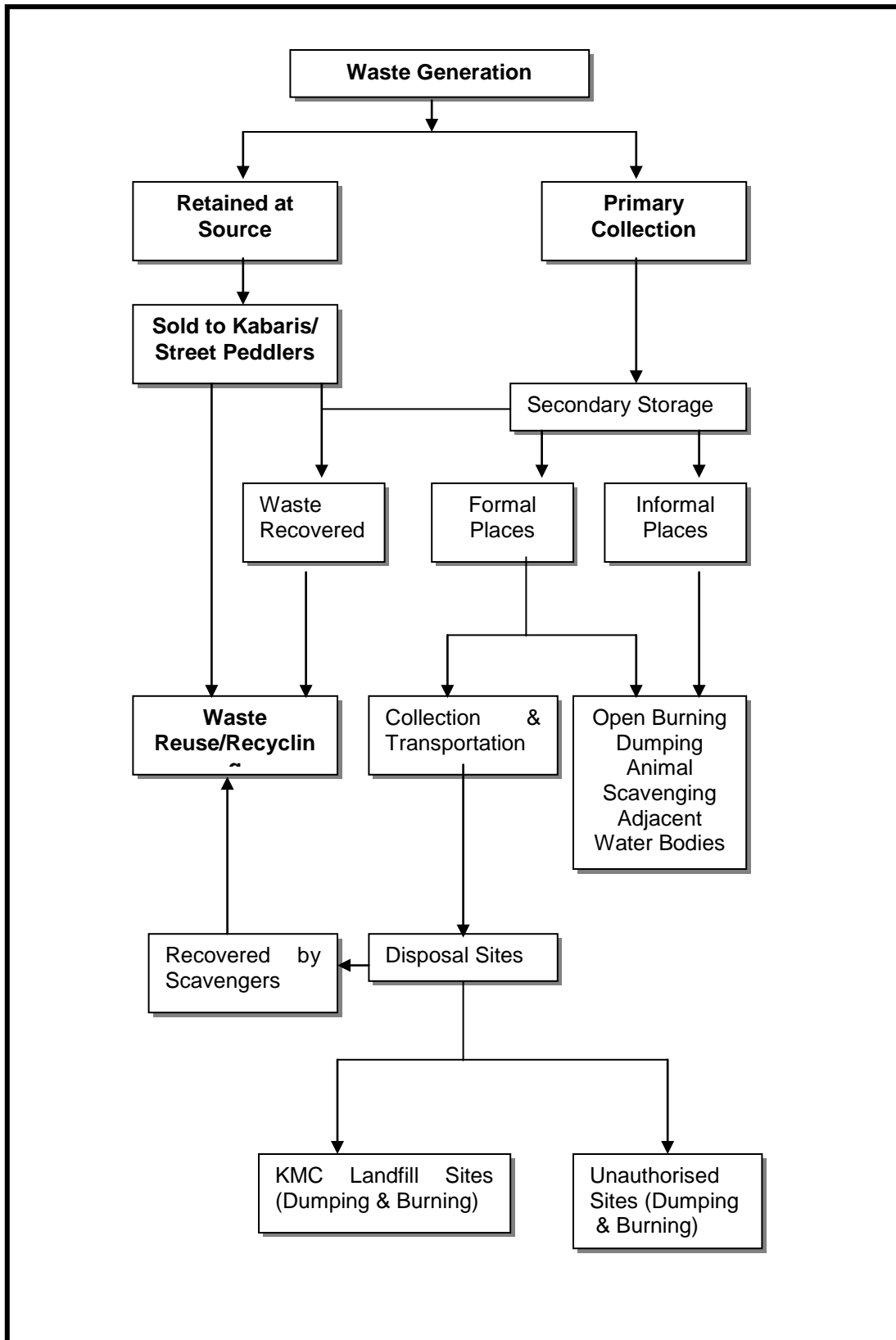


Figure 2: The Waste Management System



2.1 Description

The main sources of generation are households, commercial and industrial areas. Most of the waste generators store the waste at source before it is collected. For primary storage, the household waste is stored in bins, which are often in empty bucket or crate. In low income settlements resident may not have any bins for the primary storage

In primary collection household waste collectors dispose of the waste of household. The waste is taken to official transfer points or unofficial open spaces.

Waste collectors and households carry the waste to the secondary storage points. The secondary storage could be a metallic container, a concrete enclosure or an open space.

Collection vehicles for further transportation collect the waste from the secondary storage points. KMC has got 514 number of vehicles, which operate with DMCs. The frequency of collection varies from one point to another. There are some areas from where waste is not transported at all.

Lastly, the waste is transported away from residential area to a number of disposal sites. KMC is developing two landfill sites for future use. The waste is just unloaded from vehicles and left with further processing.

KMC with the help of respective DMCs has the capacity to collect only 40% of the generated waste. Disposal capacity is even lesser. 15 to 20 percent is collected by informal sector, which includes waste pickers also, for recycling purposes.

3. The Waste

3.1 Type of Waste

The waste generated in Karachi may be divide in to several different categories, which are as follows:

Household Municipal Waste
Institutional Waste
Industrial Waste
Street Sweepings
Agricultural Waste
Radioactive Waste
Hazardous Waste
Fish Market Waste
Sewage Sludge
Contaminated Soil
Automobiles
Other Special Waste

Commercial Waste
Restaurant Waste
Construction And Demolition Debris (C&D)
Landscaping Waste
Medical Waste
Animal Slaughterhouse Waste
Military Waste
Vegetable Market Waste
Asbestos
White Goods
Tyres

3.2 Generation

The quantity of waste estimated to be generated in Karachi, by the year- end 2001, is approximately 8,600 tonnes/day. This quantity excludes industrial and hazardous waste, white goods, agriculture wastes, military wastes and other special wastes. (Globex Team, 2001).

Table 5: Type and Quantities of waste on Daily Basis

S.NO.	Type of Waste ²	Quantity of Waste
1.	Household Waste	4,773.8 tonnes/day
2.	Commercial Waste	606.4 tonnes/day
3.	Institutional Waste	298.6 tonnes/day
4.	Restaurant Waste	180.9 tonnes/day
5.	Industrial/Hazardous Waste	0.0 tonnes/day
6.	C&D/Asbestos/Contaminated Soil Waste	2000.0 tonnes/day
7.	Street Cleaning Waste	165.0 tonnes/day
8.	Street Sweeping Waste	75.0 tonnes/day
9.	Landscape Waste	250.0 tonnes/day
10.	Agricultural Waste	0.0 tonnes/day
11.	Medical and Radioactive Waste	18.0 tonnes/day
12.	Animal Slaughterhouse Waste	68.1 tonnes/day
13.	Household Hazardous Waste	4.0 tonnes/day
14.	Fish Market Waste	72.3 tonnes/day
15.	Vegetable Market Waste	49.7 tonnes/day
16.	Dried Sewage Waste	45.0 tonnes/day
17.	White Goods	0.0 tonnes/day
18.	Military Waste	Unknown

Source: Comprehensive Solid Waste Management Plan: Globex Team 2001

Quantities of the waste generated from each DMC as estimated by Globex Team are shown in the following Table. It is evident that District South is generating most of the waste with Malir having minimum share in the pie.

Table 6: District-wise Generation of Waste

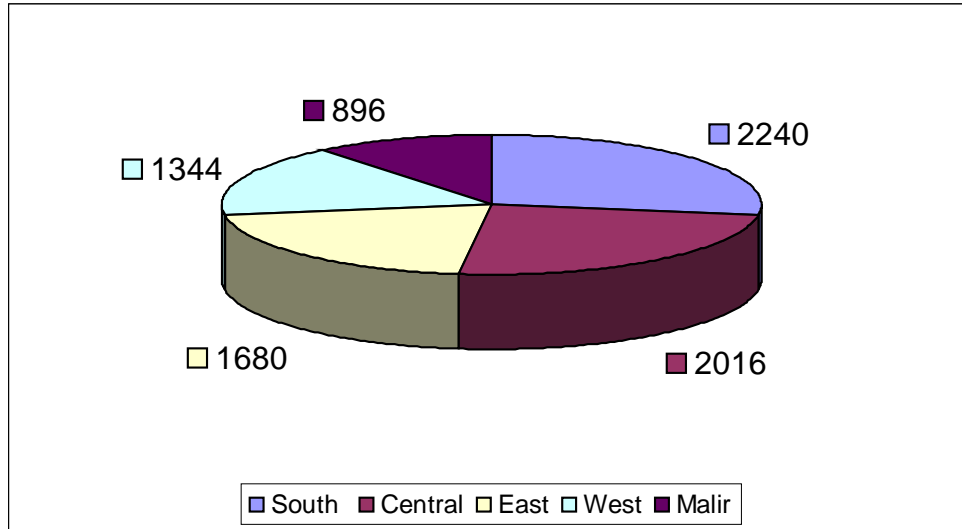
S. No.	Item	Quantity (tonnes/day)
1.	Total quantity of waste generated	8960
a.	MSW in DMC and KMC areas	8176
b.	Cantonment and Karachi Port Trust	784
2.	District-wise Generation	
a.	South	2240
b.	Central	2016
c.	East	1680
d.	West	1344
e.	Malir	896

Source: Comprehensive Solid Waste Management Plan: Globex Team 2001

In the decade of 90's the estimation of waste on generated waste is summarised in the following paragraph form Down to Earth (Ali et a, 1999)

² For the definition of various types see annexure

Graph 2: District-wise Generation of Waste



“Waste composition and quantity in Karachi varies by income group and with the season. Accurate data is difficult to obtain as most recent studies used insufficient number of samples (i.e. less than 500 houses), but the consensus is that city generates about 6000 tonnes of house hold waste daily. The per capita generation varies from 0.224 to 0.371Kg/capita/day (NESPAK, 1992)”.

The KMC documents revealed that per capita solid waste (Jawaid, 1997) generated 0.4 Kg/capita/day. It appears that this calculation is made on the total waste generated and not on the waste from households only.

3.3 Composition

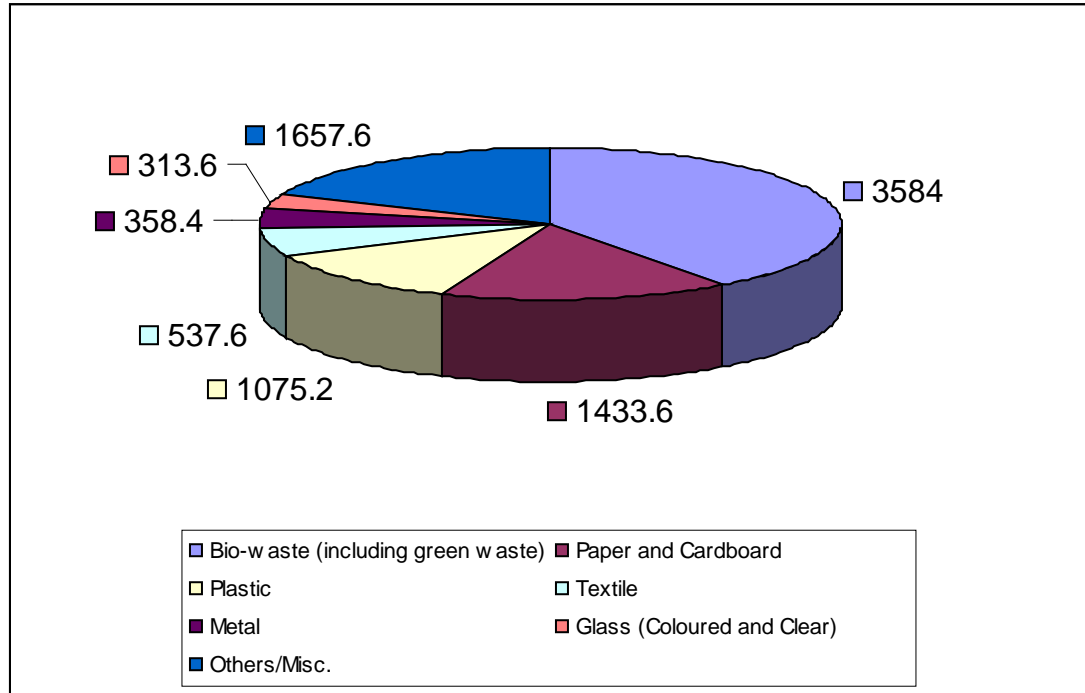
Information on the composition of solid wastes is important in evaluating equipment needs, systems and management programs and plans.

Based on the result of the studies and the investigations performed by Globex team, the following quantities of recyclable material materials are generated on a daily basis in Karachi.

Table 7: Composition of waste in Karachi

S.NO.	Material	Weight tonnes/day	%tage of Total Waste PCSIR 1986	%tage of Total Waste NESPAK 1981	%tage of Total Waste Globex 2001
1.	Bio-waste (including green waste)	3584	31	38.7	40
2.	Paper and Cardboard	1433.6	6.5	10	16
3.	Plastic	1075.2	7	6.63	12
4.	Textile	537.6	6.6	8.4	6
5.	Metal	358.4	0.36	0.7	4
6.	Glass (Coloured and Clear)	313.6	0.74	1.5	3.5
7.	Others/Misc.	1657.6	47.8	37.07	18.5
8.	Total	8960.0	100	100	100

Graph 3: Pictorial Representation of Composition of Solid Waste



During collection and transportation, this waste undergoes a number of physical and chemical changes (Ali et al, 1999), including:

- The removal of a large amount of saleable components such as paper, glass bottles, plastics
- The addition of street sweepings to the waste stream, which increases the quantity of inert materials such as dust, silt, clay
- Biodegradation and the loss of moisture due to the hot climate and an unreliable collection system which leaves waste in the open air for long periods.

The following table compares the result of a waste composition analysis at a Karachi disposal site with waste composition at source. It also indicates that waste reaching the disposal sites contains a very high proportion of non-separable components such as dust and clay

Table 8: Waste Composition as percentage of wet weight at source and disposal sites

S. No.	Waste Component	At Source	At disposal site	Comments
1.	Plastics	6.37%	6.9%	No picking of plastics(including plastic bags, helps in waste burning by pickers

2.	Paper and cardboard	13.84%	2.0%	Waste picking removes much of this material
3.	Textiles	7.98%	6.9%	No picking
4.	Garden Waste	18.995	Negligible	Animal Scavenging at transfer and disposal sites
5.	Wood	0.25%	1.4%	
6.	Ceramics, Clay, Stones	10.55%	8.3%	
7.	Rubber and Leather	1.58%	1.4%	
8.	Food Waste	22.93%	11.0%	Reduction in moisture and through animal scavenging
9.	Metals	2.68%	Negligible	
10.	Glass	2.62%	Negligible	
11.	No-Separable	12.21%	62.1%	Biodegradation and addition of street sweeping

Source: Down to Earth: Ali et al 1999

4. Waste Collection and Storage

4.1 Waste Collection (Primary) and Street Sweeping

The Karachi Metropolitan Corporation has deployed 12413 sweepers for street cleaning. The workers collect the solid waste from small heaps and dustbins with the help of brooms, wheelbarrows etc and store at filth depots and carry out sweeping of streets and roads. A Working day is 8 hours, six days a week ([Data collection for Preparation of National Study on Privatisation of Solid Waste Management in Eight Selected Cities of Pakistan; 1996](#)).

Street sweepers employed with the municipal agencies or hired by residents, provide door to door garbage collection service. A trolley (which is actually a “wheelbarrow”, used in construction activities) serves mostly as the mode of collection and subsequent transport to a garbage collection point. The service is not provided by the city district municipal agencies themselves, rather the sweepers, who are entrusted with the job of cleaning/sweeping the streets, put in extra time to perform the door to door collection service and charge the individual household for the service. Also, of late, some private entrepreneurs, mostly of Afghan origin, (better described as the informal sector) have entered into this field of work. ([Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government: Solid waste Management Sector of Karachi A Case Study by Farhan Anwar; 2000](#))

Residents need a service for the waste collection. Individually, they hire a sweepers. As collective groups, there are two common approaches adopted to establish a system for the primary collection of solid waste (Ali et al: 1999):

1. To act as a pressure group and procure additional staff from the municipal co-operation
2. To introduce private or municipal sweepers to the area for an agreed monthly payment to the municipal staff.

In practise both approaches result in some form of additional payment to sustain the sweepers.

4.2 Secondary Storage

From the households the waste is taken to neighbourhood collection points (concrete/steel bins) stationed at roadsides, on pathways in parks, playgrounds. The garbage may also be dumped openly in storm drains, parks, playgrounds, back-lanes. In such places the garbage is either burnt or is collected by the municipal agencies refuse vans and transported to disposal sites (where garbage is dumped and openly burnt) located on the outskirts of the city.

In the absence of any officially provided strategy for the recycle and reuse of solid waste the informal sector has filled this gap to a great extent. The informal sector comprises of an organised chain of actors, starting from the ragpickers on the streets to recycling factory owners. It is a flourishing business, which at a conservative estimate recycles 15-20 percent by weight of the total generated waste of the city. (Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government: Solid waste Management Sector of Karachi A Case Study by Farhan Anwar; 2000)

4.3 The Agencies

In Karachi there are many agencies responsible for solid waste collection and transportation in their respective areas, but the major one is Karachi Metropolitan Corporation (KMC). The Corporation carries the services of drain cleaning, street sweeping waste collection, transportation and disposal without any treatment except removal of certain items by the scavengers. (Data collection for Preparation of National Study on Privatisation of Solid Waste Management in Eight Selected Cities of Pakistan: 1996).

The following table summarises the names of the agencies involved for collection and transportation of waste in Karachi

Table 8: Agencies in Karachi for SWM

S. No.	Agency	Number
1.	KMC through its five DMCs	6
2.	Karachi Development Authority (KDA)	1
3.	Cantonment Boards	7
4.	Sea Port (Karachi Port Trust and Bin Qasim)	2
5.	Airports (Civil Aviation)	1
6.	Sindh Industrial and Trading Estate (SITE), Steel Mill/Steel Town/ New Karachi Industrial Area	3
7.	Pakistan Railways	1
8.	PWD	1
	Total	22

Source: Comprehensive Solid Waste Management Plan: Globex Team 2001

5.0 Transportation

5.1 The Context

The Karachi Metropolitan Corporation is supposed to collect and dispose about 80 per cent of the solid waste generated in the city (out of 6,600 tonnes/day, official figure). However, the collection capacity of KMC is only about 40 per cent and the disposal capacity even lesser. (Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government: Solid waste Management Sector of Karachi A Case Study by Farhan Anwar; 2000). The KMC is further divided into five District Municipal Corporation (DMCs), corresponding to the five divisions of Karachi (District South, Central, West, East, Malir). The DMCs in various capacities work almost independent of KMC control.

The vehicles are assigned their respective areas from the workshop, early in the morning. Depending upon the type of vehicles, either they pickup the filled containers or fill the vehicles manually from various secondary collection points. Collection crew collect the MSW from the dumping point into the refuse vehicle with the help of hand shovels and baskets. The ultimate effect is two fold: increase in the cost of transportation and littering of refuse on roadside aggravating the vector situation and contributing to unpleasant sights. The literature mentions that MSW is transported both by government departments and by the private sector without any cover on the trucks. This cause littering of garbage throughout the collection route from full rather over loaded vehicles.

Literature also mentions that there exists a symbiotic relationship between the crew for refuse vehicles and the intermediaries of the informal scavenging, for not lifting up of garbage from the *Katchra Kundis*. Whatever transportation of waste is carried out, is in daytime, from 7: a.m. to 6: p.m.

Table 10: District-Wise Waste Generation and Number of Refuse Vehicles

S. No.	Item	Quantity	Number of refuse vehicles
1.	District-wise---	Generation	Collection
a.	South	2240 tonnes/day	123
b.	Central	2016 tonnes/day	112
c.	East	1680 tonnes/day	118
d.	West	1344 tonnes/day	162
e.	Malir	896 tonnes/day	?
	Total	8176 tonnes/day	515

Source: Globex Team, 2001

Literature suggests that there are 19 refuse vehicles in the use of the authorities of District Malir and on an average they carry refuse of 200 to 225 tons per day.

5.2 Routing

Drivers and supervisors determine vehicle routes. They do not depend upon the most cost-effective routing for the collection of MSW in Karachi based on systematic analysis. Karachi has an overloaded and a congested transportation system. Therefore, analysis of a cost effective and an efficient route for refuse vehicles is all the more important.

5.3 Vehicles

There exists no regular maintenance program for the refuse vehicles. Only after any complaint from the driver of a particular, refuse vehicle, maintenance is undertaken. The consumption of diesel is 1,300 litres per day of all the refuse vehicles operating under the DMCs equivalent to Rs..... The departments that is responsible for the maintenance of all the refuse vehicles in a particular DMC is called Engineering Department and is headed by an Executive Engineer. The refuse vehicles, in most of the cases are not parked at the maintenance garages. Usually the drivers of the refuse vehicles park vehicles in places close to their residence. In addition to the above the maintenance garages do not maintain accurate records on the maintenance of each vehicle.

Table 11: Existing Workshops of Municipal Corporation

S. No.	Existing Workshops	Purview
--------	--------------------	---------

1.	Mehmoodabad Workshop 1	KMC
2.	Nishtar Road Workshop	DMC South
3.	Mehmoodabad Workshop 2	DMC East
4.	Landhi Workshop	DMC East
5.	Mewashah Workshop	DMC West
6.	Sewerage Farm Workshop	DMC West
7.	Sohrab Goth Workshop	DMC Central
8.	Located in Malir (Under Construction)	DMC Malir

Source: Globex Team, 2001

6. Disposal

6.1 The Context

Final disposal destination for household/commercial waste is a number of un-official dumping sites on the outskirts of the city where the waste is dumped and burnt without any control. Irregular collection service in temperatures above 20° C leads to a decomposition of organic waste and loss of moisture. There is no method employed by KMC to collect the industrial, commercial, hospital and residential waste separately and hence it reaches the dumping site mixed causing hazardous situation for the environment and human population. The frequent burning and separation of waste at *Katchra Kundis* results in an increased proportion of inert elements and reduction of calorific value of the waste factor important from composting point of view.

Table 12: Projected landfill area requirement of Karachi Division

Year	Population (000's)	Generation		Collection			Landfill site Required (m ³)
		Kg/c/d	Tonnes/ day	Rate	Tonnes/d ay	Tonnes/y ear	
1986	10522	0.613	6450	60%	3870	1161000	1161000
1987	11027	0.616	6792.6	70%	4754.8	1426440	1426440
1988	11556	0.619	7153.3	70%	5007.2	1502160	1502160
1989	12111	0.622	7533	70%	5273.1	1581930	1581930
2000	12692	0.625	7932.5	70%	5552.8	1665840	1665840
2001	13302	0.628	8353.6	70%	5847.5	1754250	1754250
2002	13940	0.631	87961.1	70%	6157.3	1847190	1847190
2003	14609	0.634	9262.1	70%	6483.5	1945050	1945050
2004	15310	0.637	9752.5	70%	6826.8	2048040	2048040
2005	16045	0.64	10268.8	70%	7188.2	2156460	2156460

Source: EPMC Estimates 1996

The waste picking and sorting practices at the secondary storage points have significant importance (Ali et al, 1999) when considering potential treatment or disposal options because:

- They (waste pickers) reduce the quantity of waste reaching the disposal site
- By removing certain components, they alter the composition of waste at the disposal site. This reduces its suitability for certain treatment options such as incineration or composting, and effects the ultimate pollution potential upon landfill.
- Waste picking activity at disposal sites could be extensive in future if the waste cannot be accessed by pickers in the streets or at transfer points.

The consensus from the available literature is that KMC is disposing off the collected waste into low-lying areas without any precautionary measures. There is no provision for separate collection, transportation and disposal of the hazardous waste arising from hospitals and industries. Mixed waste is disposed off in quite an in-hygienic fashion. No system exists for separate disposal of infectious/hazardous waste from hospitals and industries. It is probably due to the absence of strict solid waste rules and regulations and their enforcement. The situation is of great concern and can cause irreparable damage to human life and the environment.

6.2 Landfill Sites

The five landfills/dumping grounds operating (officially and unofficially both) in Karachi are:

Table 13: Landfill Sites of Karachi

Landfill Sites	Status	Area
A. North Karachi	Officially Closed	26 Acres
B. Mehran Town	Officially Closed	100
C. Jam Chakro (Surjani) Town	Dumping has started	1600
D. Gond Pass (Hub)	Dumping has started	500
F. Dhabeji (outside the city)	?	?

Institutional Assessment & Evaluation of Public Facilities Management Practices in Local Government: Solid waste Management Sector of Karachi A Case Study by Farhan Anwar; 2000)

Based on the information available in the literature, the brief description of the landfills are as follows:

A. North Karachi:

The land fill site is officially closed, but activities of dumping and burning of waste can be observed there. Out of 26 acres of the total area, 18 acres are allocated to Farooq Compost Plant. No infrastructure facilities are provided to the dumping site. Despite in-sanitary and unhygienic conditions, sorting and scavenging activities can be observed there. [Due to its proximity with Lyari river, the former is playing its due role to pollute the later.](#)

B. GondPass Landfill:

Situated Northwest of Karachi, at about 40 Km from downtown Karachi comes under DMC West jurisdiction. GondPass landfill receives 720 tones/day of solid waste in average 180 trips of refuse vehicles. [Its proximity to Hub river is a threat to river ecosystem.](#)

C. JamChakro:

Only landfill in Karachi which has weighing scale is situated [30 Km North west of Karachi](#) and comes under the jurisdiction of DMC West. Landfill receives approximately 540 tonnes/day of solid waste in average 135 trips of refuse vehicles. [The proximity to Lyari river is a cause of concern.](#)

D. Rehri Landfill:

Situated at the South of Karachi City, at a distance of approximately 40 Km from downtown it receives 200 tonnes/day of solid waste in an average of 50 trips of refuse vehicles. Its proximity to Korangi creek is a significant threat to marine life. The waste from District Malir and East is transported to this unapproved site.

E. Dhabeji Landfill:

This is the fifth proposed landfill site located at Dhabeji and is located in the Southeastern corner of the city at approximately 60-Km from the downtown. At present, this landfill is not operational and would be operational only if refuse is transported from city to the landfill through operation of a railway transport system.

It is evident from the literature that the onus of KMC is on dumping of the waste then on safe disposal, therefore the word sanitary landfill as used in the literature is a misnomer.

Regarding monitoring of waste (Globex Team 1999) arriving at landfill, there are two basic criteria (i) record keeping of the type of waste by the authorities and (ii) weighing of waste to assess the quantities of the waste. Adequate equipment and personnel to monitor and measure the are non-existent at all the landfills, except for the weighing scales at Jam Chakro, which are non-operational. Furthermore, there is no regular spreading and compaction of waste and little is known about the protection of environment through a barrier system like liner. To make matter worse, burning of waste at the landfills is a common practise and continues unabated. Its easy to imagine the extent of the pollution and damage this practise causes to human life and environment because of the nature of waste accepted at these landfills and the proximity of these landfills to the populated areas.

Most of the literature mentioned two sites for waste disposal. One is at Korangi and the other is at Jam Chakro (these are briefly described above). These sites are acquired through a loan provided by the Asian Development Bank. The primary consideration in choosing the sites was ownership and availability. The literature also suggests that (Ali et al 1999) that though the ownership and availability have been the major criteria in choosing the disposal sites in Karachi, however, given rapid city growth and the volume of traffic in the city centre, it would be advisable to develop disposal sites at three or four different locations outside the city limits.

Based on the studies conducted on Jam Chakro landfill, Gond Pass Landfill, and Rehri landfill and on 3 percent growth rate of waste Globex Team formulated Comprehensive Solid Waste Management Plan, which has laid down the standards for the design of landfill sites. The design criteria revolves around the protection of human health and environment. The design life of the landfill is 25 years and it is estimated that 5711.9 tonnes/day of waste equivalent, to 1,998.891 cu m/year of space, will be landfilled in the year 2001

Typical landfill includes bulldozers, JCBs, excavators, backhoe, and weighbridges. KMC have recently acquired 7 bulldozers, 2 sheep foot rollers and 2 backhoes for landfill operations (Javed, 1997). The KMC's workshop is capable of maintaining refuse trucks but previous reports (Klundert 1996 and NESPAK 1992) have identified the lack of preventive maintenance as a major problem. Procedure for obtaining spare parts is time consuming, apparently to reduce pilferage and corruption and this exacerbates lack of maintenance. One study recommended gradual privatisation of repair and maintenance facilities. Clearly landfill plant and equipment could only be used efficiently if operation and maintenance system are improved. Past performances also

indicates that KMC would not be in a good position to adopt a treatment option employing complex technology, such as incineration.

There is no system for the treatment of various types of waste except of medical waste The present quantity of medical waste generated in Karachi from government and private hospitals and clinics is approximately 18 tonnes/day. KMC has provided 2 incinerators for safe disposal and treatment of medical and other hazardous wastes and offer this service on payment of service charges. Each Incineration Plant has a capacity of treating 11.20 tonnes/day of Medical Waste.

It is clear from the literature available that radioactive, hazardous material, asbestos, fish processing waste, restaurant waste and street sweeping waste goes to landfill sites without any treatment.

The literature suggests three methods of waste disposal for Karachi, which are as follows:

1. Disposal to properly constructed and fully equipped landfill sites

In this regard various suggestion are in the text for the disposal of hazardous, radioactive, fish processing disposal waste, These are primarily for purchase of special equipment but no details of the equipment is given.

2. Incineration

As described earlier this method is suggested primarily for the medical waste. The respective capacities of the two recently installed incinerators are narrated above.

3. Composting

For green waste and restaurant waste, composting is suggested. The details of the PC-1 as conducted by KMC for compost plant is as follows:

A. Justification for the Compost Plant

Karachi, despite humidity in the air is moderate in climate, favourable for growth of large variety of flora. The low rainfall 5∇ to 7∇ mainly in July to August, in a lime stone topography has scarce residual moisture to sustain greenery and vegetation.

The increased dozes of organic material humus, physical, chemical, and biological changes are constantly needed to improve the fertility and water holding capacity during dry seasons. What is needed is a cheap organic fertiliser dressing which may help in removing the alkalinity and aid in achieving the crumb structure of the soil.

In an urban area like Karachi, green manuring or cow-dung, which are indigenous sources to improve fertility, is not readily available. Bulk of cow-dung available in the cattle market is sold as hot cake and is purchased by Banana growers of adjacent districts and is thus not a cheap source as fertilisers for landscaping purpose...

B. Capacity of the Proposed Plant

The proposed compost plant is estimated to produce 120 tonnes a day or on a rough estimate to 3600 tonnes annually.

C. Finances

Local Cost	Rs. 27.19 Million
Foreign Exchange Component	<u>Rs. 71.435 Million</u>

Total Cost	<u>Rs. 98.625 Million</u>
Annual Recurring Expenditure	Rs. 10.375 Million
Cost of Production per ton	Rs. 280 per ton

The proposed site of the plant is *Gutter Bagicha* and the estimation is done on the KMC requirement of Manure of 7000 tonnes annually. According to the report following is the configuration of the availability (annually: in 1995) of the organic manure

Treatment Plant	2000 Tonnes
Sewerage Farm (<i>Gutter Bagicha</i>)	400 Tonnes
Leaf Manure	<u>100</u>
Total	<u>2500</u> Tonnes
Requirement of KMC	<u>7000</u> Tonnes
Deficiency	<u>4500</u> Tonnes

D. Other Aspects of the Feasibility

The process of composting is described in detail. The necessary detail of the equipment is also mentioned. Need of infrastructure is also highlighted and stock taking of already existing infrastructure is also performed.

No suggestions are cited in the literature for slaughterhouse waste and cow dung waste from cattle colony. It was also mentioned that a major portion of municipal waste is disposed off in the water bodies including Malir and Lyari rivers.

Literature suggests that for the option of landfilling the major cost component is the price of the land. In case KMC opts for the transfer of state owned land, which is considerable at the outskirts of the city, the cost of transfer will be negligible. **At the rate of generation of 6000 tonnes/day, and with a compacted density of 500 Kg/cu-m the cost of required land (for one year) will be of Rs. 7500 million. The cost of operation of sanitary landfill will be of Rs. 650 million per year.** Keeping in view the high cost of disposal options and minimum resources available with KMC, it may be concluded that KMC should gradually develop and plan the landfill sites.

7. Recycling of the Waste

7.1 The Context

In the last 25 years, six major internationally funded studies have been conducted for Solid Waste Management for Karachi. The recommendations of these studies have never been implemented fully. Even if they had been, they would not have solved Karachi's solid waste management problem because none of them fully recognised and integrated the crucial role of the recycling industry, most of which is in the informal sector, in the disposal of solid waste in Karachi.

In the absence of any officially provided service in the recycling and reuse of solid waste the informal sector has filled this gap to a great extent. The informal sector comprises of an organised chain of actors, starting from the waste pickers on the streets to recycling factory owners. It is a flourishing business which at a conservative estimate, accounts for 15-20% of the total generated waste of the city. In another estimate by Globex Team (2001), **the quantity of potential recyclables has gone up from 22 percent in 1986 to approximately 41.5 percent in 2001.**

These practices are significant when considering potential treatment or disposal options because:

- They reduce the quantity of waste reaching disposal site

- By removing certain components, they alter the composition of waste at the disposal site. This reduces its suitability for certain treatment options, such as incineration and composting and effects the ultimate pollution potential at the landfill.
- Waste picking activity at the disposal site can be extensive in future if the waste cannot be accessed by pickers in the streets or at transfer points (Ali et al, 1999)

Literature suggests that reusable and recyclable material are usually separated at four levels:

- At source (before disposal)
- At source (after disposal but before reaching community bins)
- At community bins
- At dumping sites

Separated items are either reused by the purchaser or sold through middle dealers and main dealers for ultimate recycling. Main actors in the chain of separation are housewives, domestic servants, sweepers, scavengers, refuse vehicle crew, street peddlers, middle dealers/kabaris (who deals in all materials) and main dealers/wholesalers (who deals in specific materials). The price of the separated materials increase as the waste is sold from one person to another person in the separation stream. The Afghanis, who usually sort the waste from secondary storage bins, sell the raw material to the dealers at the following rates:

- Bones Rs. 90 per Maund
- Paper Rs. 80 per Maund
- Steel Iron Rs. 150 per Maund
- Glass Rs. 80 per Maund (Figures are from the study conducted by URC, in 1999-2000)

Separation and picking activities at dumping sites are of different nature as compared to scavenging in residential areas. The loaded trucks reaching at disposal sites are purchased at different prices by the various groups of pickers. The pickers residing nears the dumping site first incinerate the garbage for separation of metals. These live there with families, all of them participating in picking.

Though informal, the practice of recycling provides employment to many people and the motivation comes from the thriving market of recyclables. The burning practise to recover metals results in environmental pollution. It also produces ash, which is inert and has little potential to pollute as compared with unburned waste. Literature reveals that most of the waste pickers operate and live in sub human conditions.

It has also been revealed that suggestions were put forward to government officials for the integration of scavenging activities to the landfill operations by shifting recycle industry to the landfills. The land requirement for various recycling factories per unit is as follows:

Table 14: Requirement per unit of Major Recycling Industries

Type of Mill	Land Requirement	Facilities Required
Paper	3000 –5000 sq. yards	Gas, Power and Road
Bone Mills	8,000 sq. yards	Gas, Power and Water
Glass	200-600 sq. yards	Gas, Power, Water and Telephone

Source: Urban Resource Centre

According to the available literature the integration of the informal but organised recycling activities with the official waste collection and disposal operations depends on the following:

- Provision of incentives to recycle industry for shifting to the landfill site
- It is not conducive to start the process of shifting until the landfill site is organised.
- If the recycle industries/factories shift, Afghanis will automatically shift.
- Unless sorting is stopped at the collection points, nobody will buy the waste from the landfills.

Another option mentioned in the literature is to organise transfer stations or Material Recovery Facilities (MRFs) and suggest that sorting under the auspices of KMC take place there. That is a different suggestion, since it recommends taking over of informal sorting and scavenging by KMC itself and not the facilitation of already existing informal collection system.

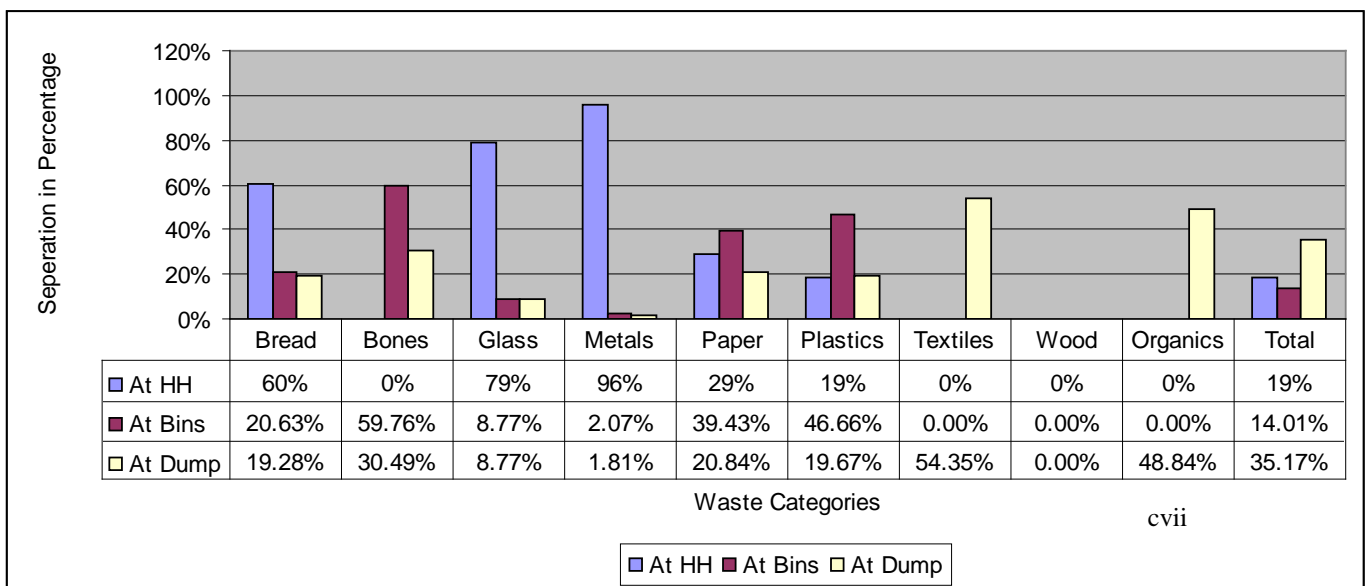
Table 15: Total Annual Volumes of Recyclables Separated from Source to Dump in Tonnes

S. No.	Components	Production	Separation at House	At Bin	At Dump	Total Separation		
1.	Bread	2.7%	111,500	67000	23000	21500	111500	100%
2.	Bones	2.5%	41,000	0	24500	12500	37000	90.2%
3.	Glass	1.2%	93500	74000	8200	8200	90400	96.7%
4.	Metals	0.2%	77,300	74000	1600	1400	77000	99.6%
5.	Paper	14.9%	333500	96000	131500	69500	297000	86.8%
6.	Plastics	7.1%	140800	26500	65700	27700	119900	85.2%
7.	Textiles	1.4%	23000	0	0	12500	12500	54.3%
8.	Wood	0.2%	1650	0	0	0	0	-
9.	Organics	59.3%	994000	0	0	485500	485500	48.8%
	Total		1816250	337500	254500	638800	1230800	

Estimates based on solid waste generation @4500 tonnes/day and 16452 tonnes/year

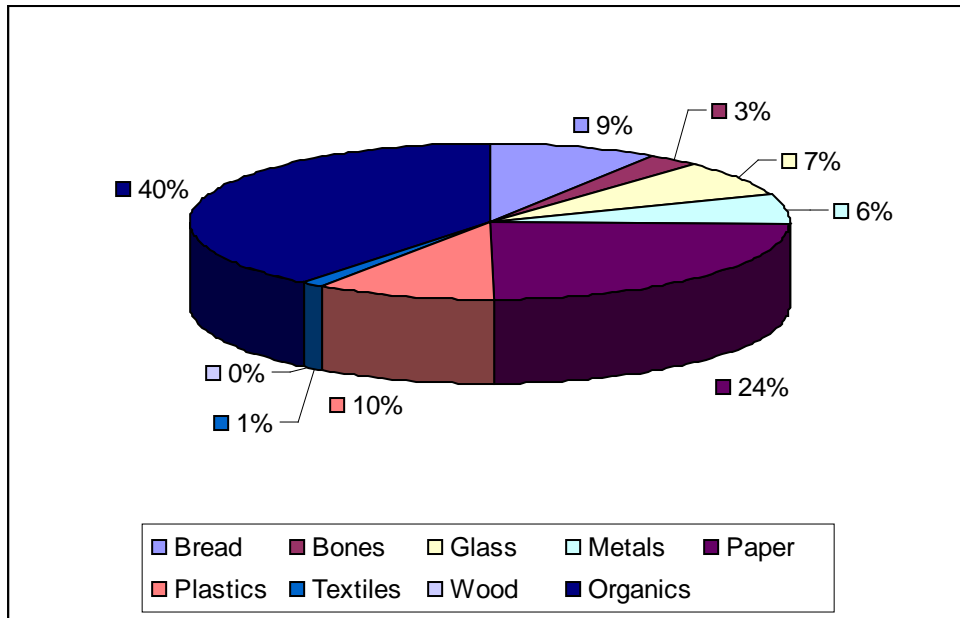
Source: Promotion of waste Recycling and Reuse in Developing Countries, NTCS-1992

Graph 4: Graphical Presentation of Total Annual Volumes of recyclables from Source to Dump

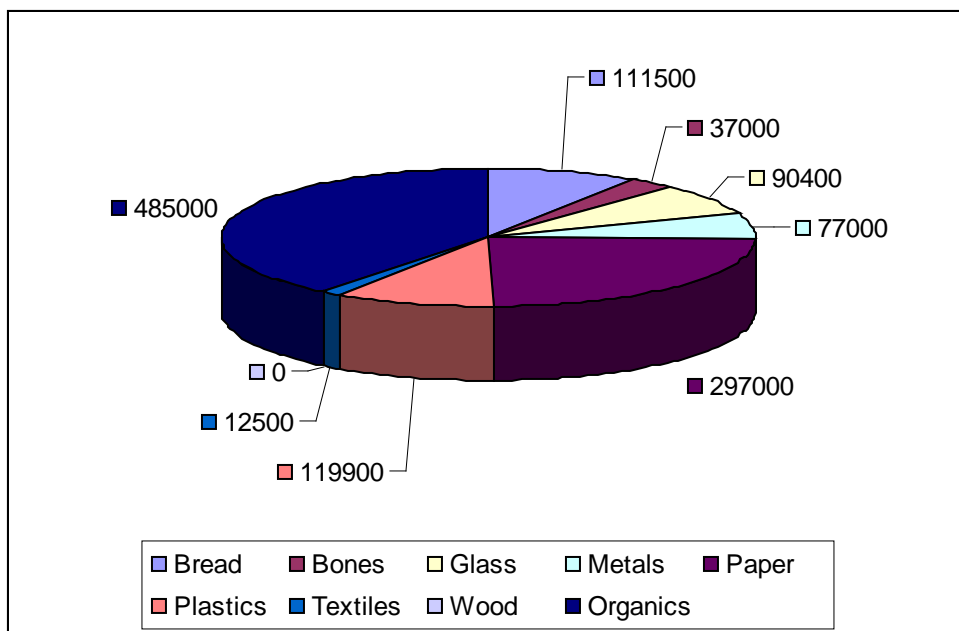


Estimates based on solid waste generation @4500 tonnes/day and 16452 tonnes/year
 Source: Promotion of waste Recycling and Reuse in Developing Countries, NTCS-1992

Graph 5: Share of each element within Recyclables



Graph 6: Total Annual Volumes of Recyclables Separated from Source to Dump in Tonnes (In 1992)



7.2 Process

As far as the process is concerned the literature on the basis of generation of 6600 tonnes per day suggests that eight hundred tonnes (12.12%) of this is removed at source by housewives and sold to about 15,000 *kabaris* who pick up the waste from people's homes. This solid waste consists of glass, plastic, metal and paper. In addition, another 700 (10.6%) tonnes of solid waste is collected from *katchra kundis* and from the streets and markets by waste pickers. This waste consists of paper, rags, plastic, metal objects, glass and bones. Contractors employ these waste pickers and there is an understanding between them and the KMC staff that is of benefit to both of them. Because of this understanding, solid waste is not lifted from the *katchra kundis* and does not find its way to the land fill sites but to the yards of waste dealers and to recycling factories. This activity is carried out by about 21,000 waste pickers, most of whom are young Afghan boys and who work in groups of 5 to 20. Each group is linked to a "contractor".

For their convenience, the waste pickers scatter the waste on to the public spaces around the *katchra kundis*, creating large-scale environmental pollution. The pickers collect paper, plastic, rags, bone and metal. They put these in big plastic bags and carry them to sorting places. If the sorting point is near the cutter kundi, the pickers carry it there physically or on bicycles. If it is far, a donkey cart or a Suzuki pick-up is hired for this purpose. Most of the sorting places are located near the *nallas*, under bridges, in open spaces meant for parks and playgrounds, in abandoned public latrines and even at bus stop sheds. The contractor pays *bhatta* for the use of these spaces to functionaries of government departments who own the space or to neighbourhood toughs and to the police. KMC garbage collection crews and drivers do not lift garbage from the *katchra kundis* regularly to help the pickers in their work. In return, the contractor pays the KMC drivers and crew between Rs 50 to 150 per day. In addition, the cost of the diesel saved by not making the journey from the *katchra kundis* to the distant land fill sites, is also pocketed by the KMC staff.

The sorting point is operated by a contractor who hires 4 to 6 persons to separate different items and to pack them in separate containers. From the sorting point the packed waste is taken to Sher Shah factories for primary recycling or to dealers who are also located in Sher Shah, for refined sorting. Alternatively, in a few cases, it is taken directly to factories in Korangi, New Karachi, Orangi and in Sher Shah itself for recycling or sent to recycling factories in the Punjab industrial cities. The journey from the sorting place to Sher Shah or other locations is by pick-ups and sometime by trucks. Since these vehicles are overloaded, they pay Rs 150 to 200 per trip as *bhatta* to the traffic police. In addition, Rs 10 to 15 are paid at every police chowki (post).

Paper and bone are the two main items that are collected from the dumps. Others such as plastic, glass and metal are removed at home by housewives and sold to the *kabaris*. Paper is turned into cardboard and bones are boiled to remove grease from them. The grease is used for washing soap factories and also for soap making. The bones are ground and mixed with poultry feed. The grease-removing process is very polluting and since these Sher Shah factories are in dense residential areas, there is constant conflict between the residents and the factory owners.

In addition to picking from dumps, pickers invade all the city markets, even in high income areas, after they close at around 7:30 p.m. Here the contractors, and sometimes the pickers as well, pay the market administrators, caretakers and or shopkeepers for the waste they collect.

Waste is not only recycled: KMC staff operating the garbage pick-up vans is paid up to Rs 50 per van to deposit the waste at locations where informal developers are reclaiming land. About 350 (5.3%) tonnes of solid waste and building material debris per day is used for this purpose. Another 400 (6.06%) tonnes of organic waste is used by pottery kilns as fuel or is burnt to extract metal from it. The kiln owners and metal extractors pay the KMC staff for this waste as well. In some cases the kiln operators have located their kilns near the land fill sites.

Waste from high-income localities, where waste pickers are not allowed to operate, contains considerable recyclable material. This is not taken by the KMC van operators to the land fill sites but to scavengers' colonies where the inorganic waste is removed and sent to the recycling factories. The KMC staff receives payment for performing this service as well.

The *kabaris* and the middlemen, who organise waste collection through pickers, sell it to middle dealers of which there are an estimated 800. There are also 1,000 main dealers who also perform secondary reprocessing through manual or mechanical means. These dealers then further sell to the recycling industry. Increasingly the middlemen are employing heroin addicts for waste picking purposes. These addicts have invaded a number of localities in a big way.

The recycling industry transforms paper into paper board; glass into bottles and sheets; plastic into toys, utensils and electrical conduits; bones into ornaments and poultry feed; and all types of metals into various utensils, mild steel bars and machinery items. In addition, rags are turned into fluff for upholstery. There are over 435 recycling factories in Karachi and the vast majority of them are informal. They are located in densely inhabited inner city areas, Sher Shah, along the Lyari Corridor and in a number of Katchi Abadi. The residents of the areas consider them to be a nuisance. Many of the recycling factory owners also consider these locations inappropriate and have bad relations with the people of the neighbourhoods in which they are located.

The recycling industry plays a very important role in garbage collection and disposal and in the economy of Karachi. It provides employment to over 55,000 families and its annual turn over is over Rs 1.2 billion. In addition, its total production of recyclable material is 1,230,800 tonnes per year. Also, it is expanding every day and becoming more sophisticated. It has strong links with industrial cities in the Punjab such as Gujranwala where most of Karachi's plastic is recycled. Based on a study of 7000 tonnes/day (generated waste), it was quoted (The News, 26/7/1999) that 17 percent is paper i.e. more than 1000 tonnes. The waste paper sells at Rs 4,000 per ton and that comes out to be 40,00000 (4 Million) in a single day. Similarly, plastic is 7 percent of the total waste and its value is in between Rs. 6,000 to 16.000 per ton. The news item indicated that the waste paper, plastic, glass and metal altogether add up to about Rs. 10 million per day.

7.3 Conclusion

From the above facts, it is obvious that a de facto financial and organisational inter-dependence exists between the various actors in the solid waste management of Karachi and the recycling industry. There is a need to recognise this inter-dependence and institutionalise it so that the system can function.

8. Institutional Aspects

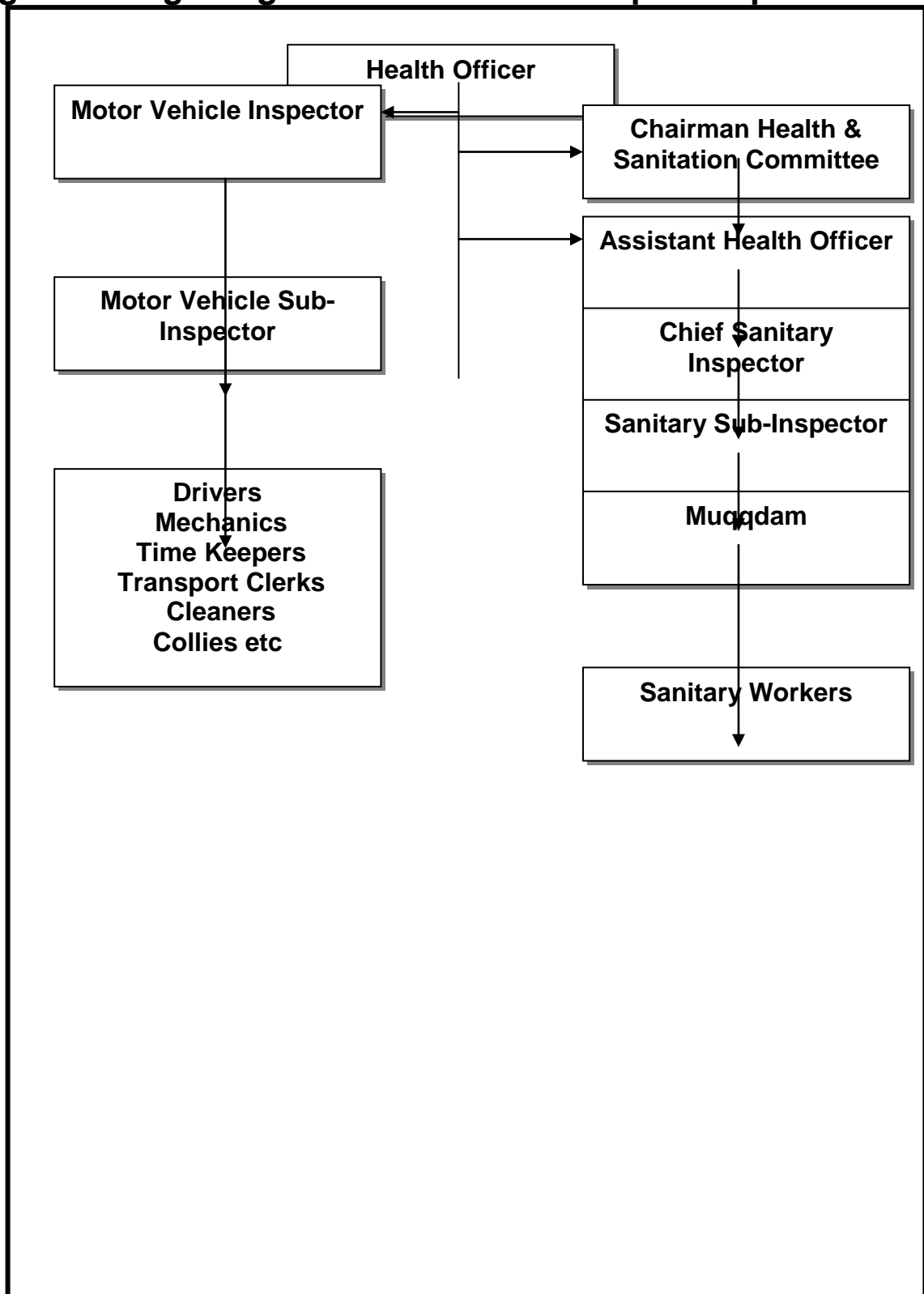
8.1 Structure

Municipal affairs are a provincial subject under the Department of Local Government of the Government of Sindh (GoS). The Karachi Metropolitan Corporation and the five District Municipal Corporation functions under the Sindh Local Government Ordinance (SLGO) of 1979.

KMC has a separate department of Solid Waste Management, under a [director general](#). The department has been established to facilitate planning and monitoring of activities under the Asian Development Bank (ADB) loan [facility and the procurement of equipment and facilities](#). The Corporation is also responsible for the major administrative matters, financial allocations, the drafting, and the approval of local legislation. In the past KMC was directly responsible for waste collection, transportation and disposal, but following the division of the city into five operational zones, these tasks now come under the health departments of five district Management Offices, each headed by Health Officer. Management of general refuse is one of the prime responsibilities of the five DMCs, Development and maintenance of landfill sites for city refuse is with KMC. Each DMC has an independent Health and Sanitation Department (H&S) with a medical doctor as its head. A chief sanitary inspector leads the field staff of the department. Staff includes local sanitary inspectors and *Muqqadms* who supervise the sanitary workers.

KMC has a separate department of Solid Waste Management, under a director general. The department has been established to facilitate planning and monitoring of activities under the Asian Development Bank (ADB). Loan facility and the procurement of equipment and facilities. [The team of the director general includes a chief engineer of electrical and mechanical systems, a director, deputy director and three assistant directors.](#)

Figure 3: Organo-gram of District Municipal Corporation



The administrative heads of KMC and DMCs are either elected representatives or un-elected appointees of the government. Since 1992, there is no direct public representation in KMCs and DMCs. Government of Sindh appoints members of the District Management Group of the civil services of Pakistan as administrators.

There is no regulatory pressure on municipalities to provide an effective Solid Waste Management service. The municipalities have no control over the disposal practises of public. Whatever legislation exists is weak and outdated and KMC lacks the institutional capacity to enforce it.

Table 13: Legislation related to Solid Waste Management in Pakistan

S. No.	Legislation	Offence	Penalty
1	Pakistan Penal Code, 1860, on water pollution	Fouling a public spring or reservoir	Minimum imprisonment of 3 months or fine of Rs. 500
2	Factories act 1934 on water pollution	Disposing untreated industrial waste in water bodies	Fine of Rs. 500
3.	Pakistan Penal Code, 1860, on toxic or hazardous waste	Negligent conduct with respect to poisonous substances	
4.	The Ports Act, 1908 on marine pollution	Discharge of ballast or rubbish into a port	

Source: *Down to Earth (Ali et al, 1999)*

Consequently, there is very little pressure on industry, businesses, institutions or the public to deposit waste at designated sites or in a designated manner.

8.2 Finances

The total revenue expenditure increased by 52% between 1980-1981 and 1984-85. Single major expenditure was incurred on public health... Corporation allocated an amount of Rs. 688.2 million in the 1995-96 budget. Out of it, about 80% was to be consumed by establishment and remaining 18% by fuel maintenance and other contingencies. *As per analysis, KMC spends Rs. 65/capita/year on the average. Further, the ratio of cost to waste collected is Rs. 551/ton. (Data collection for Preparation of National Study on Privatisation of Solid Waste Management in Eight Selected Cities of Pakistan; 1996).*

KMC spend money according to an annually published budget and set procedures. In 1996-97, expenditure on solid waste management operation and maintenance was in the order of Rs. 500 Million and increasing by 20 percent per annum and most of it is spent from the public health department budget. The largest proportion of public health expenditure is on staff cost: this accounted for 84% of the budget between 1991-94. Within this amount, the greatest expenditure is on the field staff, including sanitary inspectors, supervisors and sweepers. Sweepers make up nearly 80 percent of this staff. Thus, most of the budget is spent on recurring cost while capital expenditure remains very low. The little investment that has occurred in recent years was made possible by large grants from aid organisations or loans from international agencies.

Revenue generated by the solid waste management sector originates from two sources. The revenues from the sales of recyclable waste which are recovered at any stage. These revenues are captured by the informal recycling sector in which KMC takes no part. The second source of revenue stems from the combined conservancy/sewerage charges collected by Karachi Water &

Sewerage Board, based on property values assessed about 25 years ago. Cost recovery for these charges is very poor; in 1995, Rs. 141 million was billed out only half of it collected.

At present, the 5 DMCs under the administrative control of the deputy commissioner are financially dependent on KMC. KMC distributes about 67% of the income amongst the five DMCs according to an agreed formula: Central 16.93%, East 16.15%, Malir 5.9%, South 14.98% and West 12.98%.

On an average, the 5 DMCs spend about 25% of the annual budget on (PH&S). A major portion of this spent on solid waste management (SEM) which is a prime function under public health and sanitation.

The DMCs are financially dependent on the distribution of the funds made by KMC, which are then administered by the area deputy commissioners through the government appointed administrators of the DMCs. [This indicated dual control of civic agencies.](#)

Various consultants with the objective of improvement recommend recommendations of privatisation of various segments of waste management system in efficiency. Tenders were floated and Al Khalid Agencies for Waste Management on September 26, 1998 were awarded the contract for waste collection. The service area included 12 councillor's wards in F.B. Area, comprising of 25000 households and 4 councillor's wards in North Karachi, District Central, comprising of 47,000 households. The estimated quantities were 1350 tonnes/day. The total value of the contract was Rs. 43,500,000 and the contract duration was one year, with the provision for further renewal on the successful completion of the first stage. The project has managed to introduce a new concept of solid waste management, which resulted in the capacity building of the private contractor and the DMC staff. However, it failed to invoke public participation and further there was no provision of recycling in the contract.

Apart from the involvement of private sector, a lot of fragmented but innovative work has been done by NGOs but it was mostly limited to primary collection and awareness raising.

Appendix - 4

List of Informal Waste Collection and Sorting Sites Surveyed by the URC

1. Tender Tin Hatti Bridge near Liaquatabad

One contractor is operating here, 12 workers are engaged to sort and pack waste and then Suzuki pick-ups take the sorted waste to Shershah Kabari Market Lyari Nadi. The contractor purchases the waste from street pickers. The materials include paper, plastic, bone, metal etc.

2. Orangi Station Bara Maidan, Nazimabad

Four contractors are operating here, over 40 workers are engaged for sorting and packing of waste. They also sell the waste in Shershah. The contractors purchase the waste from street pickers. The materials include paper, plastic, bone, metal etc.

3. Nullah near Qalinderi Chowk opposite Nusrat Bhutto Colony, North Nazimabad

One contractor has 4 workers for sorting and packing. Sell sorted waste in Shershah. The contractor purchases the waste from street pickers and sweepers.

4. Jahangirabad Nullah

Three contractors are operating here. Obtained land separately on rent basis. The sorting and packing activity found here.

5. Gujar Nullah, Liaquatabad No. 4

Two contractors are operating here, pay rent for the space. After sorting and packing, sell waste in Shershah.

6. Near Saima Garden, Saifi College, North Nazimabad

One contractor operates here, after sorting and packing, sell waste in Shershah.

7. Under Dhobi Ghat Bridge, Lyari Nadi

Ten to 14 groups are operating here, after sorting and packing sell the waste in Shershah, over 60 people are working here for sorting and packing of the waste.

8. Street 1, Azam Town near Manzoor Colony Nullah

One contractor is operating here, he has 4 workers for sorting the waste. After sorting sell the waste in Shershah. Pays a rent of Rs 1,500 per month of the space.

9. Nullah near Musrat Cinema under Bridge of Ibne Sena Road, Nazimabad No. 2

Occupies a big space of land in the nullah. Mainly buys garbage (paper, glass, metal and plastic) from street pickers. After sorting, exports paper to Hyderabad and other materials to Shershah. Pays rent of land as well as bhatta to police.

10. Chanesar Halt near Railway Crossing

After sorting and packing, send materials to Shershah.

11. Behind Cantt. Post Office near Hotel Plaza, Cantt. Station

It is a collection point, where street pickers bring their wastes daily basis and a Suzuki takes them to a nearby sorting point. Such location commonly can be seen anywhere in the city.

12.A Madina Colony, Block 22, Sohrab Goth

Buys wastes from street pickers and after sorting, send paper to a nearby paper factory (Star Paper Factory). Plastic to Azizabad and metal/bone to Shershah.

B. Near W-18 Stop, Madina Colony, Sohrab Goth

Similar activities of sorting and packing found here.

13.A Near Baloch Hotel under Lyari Nadi Bridge Suleman Shah Road, Gulshan-e-Iqbal

The sorting activity was found here, send plastic material to Momenabad, Orangi and rest of things to Shershah.

B. Near Essanagri under Lyari Nadi Bridge

Similar activity was found here.

14. Behind Central Jail, Sabzi Mandi

It is a collection point, where a group of 5 to 7 Afghani street waste pickers bring the wastes and then takes them to Tin Hatti for selling.

15. Near Spancer Eye Hospital, Lea Market

It is a collection point, where a group of 15 to 20 Afghani street waste pickers bring their waste and then Suzuki pickups or donkey carts take the waste to Machar Colony for sorting and packing.

16. Under Kalapul

17. Under Baloch Colony bridge

18. Drigh Colony

19. Mauripur Road

Appendix - 5

List of Unofficial Scavenging Sites in Karachi

District West:

Orangi Town:

1. Asghar Ali Plastic Godown, Plot No. 225, Mujahid Colony, Orangi Town, KP-129
2. Hakim Khan Plastic Godown, Plot No. ----- KESC Survey No. 1776, Sector 4/F, Khyber Colony, Orangi Town, KP-129
3. Mohammad Muslim Al-Wajid Town near Mominabad Market, KP-129
4. Dust bin site Malik Chowk, Mominabad Market, KP- 129.
5. Dust bin site behind Mominabad Market, Metroville Road, KP-129.
6. Dust bin site Hiriyana Colony, Main Faqir Colony Road, Orangi Town, KP-125.
7. Plastic collecting godown, Hiriyana Colony, KP-126.
8. Shakhban plastic godown, KESC Survey No. 377, Noorani Mohallah, Faqir Colony, Sector 10, KP-126.
9. Mohammad Din plastic godown, KESC Survey No. 899, Noorani Mohallah, Faqir Colony, Sector 10, KP-126.
10. Nisar Plastic Godown near Metro Cinemt, KP-128.
11. Mir Ahmed Plastic Godown behind Metro Cinema.
12. Dust bin site, Iqbal Market, KP-119
13. Dust bin site, Gulshan-e-Behar Market, KP-131
14. Dust bin site, Bangla Bazar Market, KP-121
15. Dust bin site Aligarh Market, KP-131
16. Dust bin site Triangular site park, Bacha Khan Chowk, Benaras
17. Dust bin site near Allahwala College, KP-122
18. Dust bin site besides Qatar Hospital, KP-130

Pak Colony:

19. Dust bin site KMC Dispensary, KP-190
20. Dust bin site near Khulfa-e-Rasheedeen Masjid
21. Dust bin site besides Chaman Cinemt, KP-185
22. Dust bin site Old Police Station, KP-107
23. Dust bin site near Marriage Hall, KP-186
24. Dust bin site near Ranger's Headquarter, KP-185

Baldia Town:

25. Dust bin site Lassi Para, Sector 5-E, KP-116
26. Dust bin site, Memon Hospital near Gujrat Atta Mill, KP-117
27. Dust bin site Sector 13-D Road, KP-117
28. Dust bin site, Shahrah-e-Waqas, KP-112
29. Dust bin site, Rasheedabad Road, Baldia Town
30. Dust bin site, Saeedabad No. 7

Shershah:

31. Dust bin site main Shershah Road
32. Dust bin site, M.T. Tyre Company Road
33. Dust bin site Industrial Area, Shershah
34. Dust bin site Jinnah Road, Shershah, KP-192

35. Gali No. 73, KP-192

Keamari:

36. Dust bin site, Jacksons Bazar
37. Dust bin site, Railway crossing, Keamari
38. Dust bin site, Railway crossing
39. Near PIDC Bridge

District Central:

1. Liaquatabad Maternity Home
2. Gharibabad signal
3. Behind Taleemi Bagh, Block 14, F.B. Area
4. Coconut Park, Block 14, F.B. Area
5. Mujahid Colony, Nazimabad
6. Donisl Restaurant, North Nazimabad
7. Saifee Polytechnic Institute, Allama Rasheed Turabi Road
8. Behind DC Central office, Sector 15-A/I
9. Power House Plaza, North Karachi
10. Power House Chowrangi, Sector 5-C behind Grid Station
11. Madras Bakers, Shahrah-e-Khali Khan, North Nazimabad
12. Mr. Burger, Block D, North Nazimabad
13. Water Pump House, Orangabad, Nazimabad
14. Bara Maidan, Nazimabad near Railway Station
15. Allied Bank Kundi Shadman, Sector 14-A
16. Near Agha Juice Centre, Nazimabad – 1
17. Yasinabad behind Comprehensive School, Azizabad
18. H.E.F. Ground, Block H, Hussainabad, F.B. Area

District Malir:

1. Lady's Park, Statium Road
2. Silani Chowk, Ghazi Salahuddin Road near Dhoraji Colony
3. Medi Care Hospitel behind
4. TV Station, Shahzad Khalil Avenue Road
5. Kohkan Ground Hyder Ali Road
6. Alamgir Roads (New Alamgir Masjid Lucky Hotel)
7. Sharfabad School, Alamgir Road
8. Sheheed-e-Millat Service Road near Hussain Society
9. Youth Park, Bahadurabad
10. C.C. Area, Commercial Market
11. Jheel Park, PECHS
12. Rabin Centre, Tariq Road
13. Karachi Memon Society
14. Opposite Sindh Laboratory, Tariq Road
15. Faiz-e-Aam Hospital, Shaheed-e-Millat Road
16. Ruhailkhund Society
17. Shahrah-e-Quaideen near Allied Bank
18. JHassa Singh Park (Guru Mandir)
19. Ahbab Welfare, Hyderabad Colony
20. Shah Najab Imam Bargah
21. Central Jail Wall, University Road
22. Nishtar Park, Soldier Bazar
23. Nishtar Road near Pipe Factory

24. Preedy Street, Lines Area
25. Behind Taj Complex, Lines Area
26. S.O.R. II, Block A
27. Karsaz Road near Water Board office
28. Mudhrat Road, Soldier Bazar
29. Soldier Bazar market
30. Behind Soldier Bazar Thana
31. Darban Bazar, Lasbella Road
32. Opposite Saint Lawrence School, Soldier Bazar
33. Essa Jaffar Road
34. Opposite Brigade Thana, Lines Area
35. Government Schook, PECHS, Block 6
36. Sirajuddola Park, Shaheed-e-Millat Road
37. Tipu Sultan Road
38. Nawab Ismail Khan Road, Guru Mandir
39. Open plot near KESC sub-station, Tipu Sultan Road

District South:

Khori Garden Zone:

1. Near Qismat Cinema, marvie Road
2. Adjacent Kakri Ground, Kharadar
3. Opposite Spencer Eye Hospital, Siddique Wahab Road
4. Jaffery Chowk, Kharadar
5. Behind Civil Hospital, Chand Bibi Road
6. Opposite CMS School, Nishtar Road
7. Tanga stand, Boulton Market
8. Lakri Wali dust bin near Safia School, S.R.
9. Near Allah Rakha Park, Kharadar
10. Adjacent Eidgah Maternity Hospital
11. Dust bin at Hoti Market

Saddar/Clifton Zone:

12. Lilly Bridge dust bin
13. Nallah on Beaumont Road, opposite Karachi Club
14. Dust bin near PIDC Bridge
15. Behind YMCA
16. Traffic post, Pakistan Chowk
17. Behind Tughlaque House
18. Behind Empress Market
19. Magzine Line, Saddar
20. Green Street, Saddar
21. Opposite Gul Centre
22. Near F.J. School, Nishtar Road
23. Opposite Police Hospital, Misham Lea Road

Lyari Zone:

24. Dhobi Ghat, Mirza Adam Khan Road
25. Moughal Godown, Shah Waliullah Road
26. Khada Market, Shah Waliullah Road
27. Niazi Chowk, Shah Waliullah Road
28. Near Ali Bagh Graveyard, Faqir Mohd. Dura Khan Road
29. Tanga stand, Lea Market

30. Near Zonal office, Chakiwara Road
31. Picture Road, Moosa Lane
32. Near Gabol Park, Issa Khan Mehrab Khan Road

Mehmoodabad Zone:

33. Near 11-C stop, Azam Basti
34. Near Norwegian School, Azam Basti
35. Ghalib Road, Manzoor Colony

Selection of Landfill Site for Karachi: Key Criteria

1. Haul Distance

The site must be located at a distance so the collection vehicles could make at least three trips (or whatever is expected) from the centre of the collection area to the disposal site. Keeping in mind the existing size and collection system in Karachi, the haul distance (one way) should not be more than 15 miles.

2. Roads and Other Infrastructure

The landfill site operation need paved roads up to the disposal point, power supply and water. The trunk sewers/drains must also be available. If waste to energy is a possible option then electricity grid is also required etc.

3. Size and Life

Please see the calculations attached. To disposed of 8,000 tonnes of waste in a sanitary landfill, an area of 28,160,000 sq.m is required. This assumes an increase of 5 per cent per annum in waste quantities and useful life of 10 years. This area must ideally be available in at least three directions of the city i.e. North, West, South-East, North-East.

4. Topography

Sites should not have extraordinary slopes and huge depressions. It should be away from flood plains and sea shores.

5. Hydro-geology

The site should be away from underground and surface water resources.

6. Other Features

The site should be away from residential areas and airports. The wind direction must be outwards from residential areas. The cover material should also be available nearby.

7. The Sub-Soil

The ideal sub-soil is clay or soils of low permeability. This is required to retain the leachate within the site.

8. After Use

The filled sites usually have un-predictable settlement. The finished sites are covered with a 2m layer of soil. The leachate and gases are monitored for another 10 years. The finished sites are used as parks, playgrounds or light weight housing.

Framework for Selection of Waste Disposal Options

Desirable Feature	Issues and Questions to Address
<p>1. Technical</p> <p>Efficient and effective operation of the technology used</p>	
Composition of waste	Waste composition and quantity
Existing practices	<ul style="list-style-type: none"> • Current collection and transportation system • Local recycling practices
Siting	<ul style="list-style-type: none"> • Locations for potential treatment/disposal sites • Availability of engineering materials (e.g. soils)
Technology	<ul style="list-style-type: none"> • Secondary data on local climate, water resources and geology/hydrogeology • Nature of plant and equipment required • Operation and maintenance requirements of plant and equipment • Local, regional and national experience with different technologies and systems • Potential to scale up and replicate disposal options which have been run as local pilot projects • Supporting infrastructure for waste collection, transfer and haulage • Availability of technical support (locally or nationally) • Technical assessment of potential options
Other	Anticipated by-products and requirements for their disposal or treatment
<p>2. Institutional</p> <p>Ability and willingness of responsible agencies to operate and manage the system</p>	
Structures, roles and responsibilities	<ul style="list-style-type: none"> • Current institutional framework for waste management, including roles, activities and responsibilities • Existing plans for improving solid waste systems
Operational capacity	<ul style="list-style-type: none"> • Municipal capacity for regulation and monitoring of operations • Local experience in managing different technologies • Scope for providing the necessary staff

¹. Taken from “Down to Earth” by Andrew Cotton, Mansoor Ali and Ken Westake, WEDC, 1999

	training
Incentives	<ul style="list-style-type: none"> • Incentives to improve management and practices of waste disposal • Local support for better waste management
Innovations and partnerships	<ul style="list-style-type: none"> • Scope for different contracting options including private sector involvement • Opportunities for partnerships with other agencies, departments or organisations for service delivery
3. Financial Ability to finance the implementation, operation and maintenance of the system	
Financing and cost recovery	<ul style="list-style-type: none"> • Capital and recurrent costs of the options • Current revenue and expenditure on waste management • Likely need for external finance for capital costs • Willingness to raise finance for improved waste management • Access to loan or grant assistance • Ability to service capital loans • Mechanisms for financing recurrent costs
4. Social No adverse social impact	
Waste picking	<ul style="list-style-type: none"> • Extent of waste picking at the existing dump sites • Potential impact on livelihood of waste pickers • Arrangements for waste picking in the proposed system • Options for maintaining access for waste pickers at disposal site
Other	<ul style="list-style-type: none"> • Health and income implications for the poor • Public opinion on the existing and proposed system • Public pressure to develop improved disposal facilities • Potential for creating more livelihood opportunities through developing new disposal options
5. Environmental Positive environmental impact	
Initial environmental risks	<ul style="list-style-type: none"> • An assessment of adverse impact of existing disposal option • Anticipated impact of proposed disposal

	option(s) <ul style="list-style-type: none">• Associated hazards and risks to nearby population, resources and workers
Long term environmental risks	<ul style="list-style-type: none">• Long term implications (future generations)• Options to close down disposal options at the end of their useful life• After care upon closing down

Area Calculation for Landfill Sites

Quantities of waste per day : 6,000 tonnes
 Quantities of waste per year : 2,190,000 tonnes

Assume Design life = 10 years

Percentage increase = 5 %

Year 1	2,190,000 tonnes/year
Year 2	2,299,500
Year 3	2,414,475
Year 4	2,535,199
Year 5	2,661,959
Year 6	2,795,057
Year 7	2,934,809
Year 8	3,081,550
Year 9	2,325,627
Year 10	3,397,409

 27,545,585 tonnes

Compacted density = 750 kg/cu-m

Volume required = 36,727,446 cu-m

Add 15% for cover etc = 42,236,563

Assuming 2 m depth = 21,118,281.6 sq.m
 21.1182816 sq.km

Basic Calculations and Assumptions for Disposal Site for 500 Tonnes / Day

Assumptions:

- 100 truck load per day
- Equivalent to 500 tonnes/day (present)
- Design Life = 10 years
- Integrated disposal facility: Landfill, sorting, selling, recycling
- Option for composting is available
- Waste quantities increasing by 5 per cent per annum
- Closed landfill could be developed or sold at the market price
- Only household waste is transported
- Last trip of refuse truck could take the material (optional)
- Material prices stay the same in the next 10 years
- All the sorted materials contain 20 per cent impurities

Facilities:

- Access road
- Power
- Sewerage
- Water
- Source water drainage
- Leachate collection (optional) considered no costed
- Leachate treatment (optional) considered not costed
- Gas collection (optional) considered not costed
- Waste inspection and weigh bridge facility
- Guard room
- Municipal office
- Contractors office
- Telephone line
- Waste sorting area
- Waste sieving facility
- Waste spreading, compaction and covering equipment
- Workers (pickers) site and services area
- Dealers selling yards
- Recycling industry - Picker's colony

Flow Diagram:

- Access road
- Waste weighing and inspection (optional)
- Waste disposal on a platform
- Waste picking: glass, paper, plastic, textile Dealers selling/sorting/transport
- Waste drying:
- Waste sieving:
- Metal picking:
- Composting (optional) Dealers taking compost
- Waste pushed/carried towards the landfill site

- Waste spread and compacted

Data/Information:

Waste Projections for 10 years

Year 1	500 tonnes
Year 2	525
Year 3	551
Year 4	579
Year 5	608
Year 6	638
Year 7	670
Year 8	704
Year 9	739
Year 10	776
Facility to process 800 tonnes/day	

Solar Panels for Electricity Generation

From: Ahmed Shibli [ahmed@shibli.demon.co.uk]
Sent: Thursday, January 04, 2001 12:21 AM
To: Tasneem Siddiqui
Subject: Solar Energy

Dear Dr Siddiqui

It was nice to hear from you today. I have been trying to introduce solar energy to Pakistan for some time but have had little success. This was so perhaps because I did not have the right contacts, the prices of the solar products were higher in the past, and also because I have been trying to do it on a voluntary basis which usually means that people involved in the voluntary group may not be able to give much time and continuous effort that success may require. However, now Dr Arif Hassan and you are showing interest and it will be nice to introduce this to Pakistan on business basis.

I have been discussing this venture in the UK with the relevant companies and the situation is as follows:

a) We can provide a pv solar system for two economy type direct current (DC) light bulbs of 9 Watts each (equivalent to 60 Watts ordinary light bulbs), or three light bulbs of 6 Watts each. The panel and the battery will have enough power to light these bulbs for 5 hours each per day/night. This can be provided for the price of Rs.10,000 (ten thousand rupees) that you mentioned. The price will include two economy light bulbs, wiring, battery, battery charge controller, and two small photo voltaic (pv) panels. The pv panels will be of high quality poly crystalline type. They will be about 2.5 ft. x 1.5 ft. each and can be mounted on roof top or in an open place where the house owner can turn them towards the sun during the day time (if he so wishes) for maximum benefit. They will have a 25 year guarantee by their manufacturer (Kyocera in Japan). The 25 year guarantee means that at the 25th year they will still give 80% of their rated output. They will be supplied permanently sealed against weather wind, rain, dirt etc. The battery used will be the ordinary 30 Amp-hours car battery from Pakistan which I guess should last for 5 years, although I am trying to get more information on this from Pakistan.

b) We can provide a pv solar system for two 9 Watts (or three 6 Watts) economy light bulbs (as above) and two DC desk fans (of 15 Watts each) for a price of Rs. 20,000 (twenty thousand rupees). The desk fans can be replaced with a small (30 Watts) ceiling fan. Again the system supplied will give enough power for 5 hours each for the bulbs and the fans. This price does not include supply of wiring, light bulbs, fans or the battery (which in this case will be a large 80 Amp-hours truck battery) which can all be bought from Pakistan.

With regards to the mechanism of doing the above, we can send a technician from here to Pakistan for one week who can install some of the systems and, in the process, train a Pakistani technician to install the remaining to finish off the work. We will bear the cost of both the technicians, but as we will be working on a shoestring budget basis we will appreciate if your organisation can bear the local hospitality i.e. provide transport etc. The other point is that the above prices will only be possible if you are installing the system in a large number of houses (2000 as you mentioned), as the initial cost of travels from the UK to Pakistan and panel transportation will be high.

I suppose that from your point of view you will like to see a system working before you can order them in a large number. This can therefore mean two trips to Pakistan thus increasing costs. Do you see any way round it.

The above costs and specifications are only approximate figures, as we have to find out the export duty etc. to Pakistan. I will now try to find out this information. Please let me know your views on this.

With best regards.

Ahmed Shibli

European Technology Development Ltd.
2 Warwick
Gardens, Ashted, Surrey, KT21 2HR, UK .

Tel: +44 (0)1372.802.555

Fax: +44 (0)1372.817.606

E-mail: ahmed@shibli.demon.co.uk

<http://www.shibli.demon.co.uk/etd.html>

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Landfill Requirements for Disposal of 500 Tonnes/Day Solid Waste**Infrastructure and Other Requirements for Integrated Landfill and Recycling:**

Design life = 10 years
 Waste quantity to receive = 800 tonnes/day

Area requirement for landfilling

	Tonnes/Day -----	Tonnes/Year -----
Year 1	500	182500
Year 2		191625
Year 3		201206
Year 4		211267
Year 5		221830
Year 6		232921
Year 7		244567
Year 8		256796
Year 9		269636
Year 10		283117
	Total	2295465 tonnes

Compacted density = 750 kg/cu-m

Volume required = 3061 cu-m

Add 10% for cover and liners = 3367 cu-m

Assuming a depth of fill as 1 meter:

Area required = 3367 sq-m
 Say 3400 sq-m

Other Infrastructure Requirements:

Access road = 2 km
 Water main = 2 km
 Surface water drain around the landfill = 500 meters
 Site and services housing = 200 pickers families
 Sorting and selling yards 20m x 10m at least 10 in number
 Municipal office = 1,000 sq-m
 Factories sites (optional)
 Small factories sites - 6 units of 1,000 M2

Appendix - 12

Incomes from Recycleable Wastes Under Different Scenarios

Scenario 1: Existing system of waste collection continues

Waste Composition:

Material	%tage	Net Quantity (Tonnes)/ Day	Unit Price (Rs)/ Ton	Market Price (Rs)
Paper	1	4.0	2,000	8,000
Plastics	4	16.0	4,000	64,000
All metals	0.5	2.0	4,000	8,000
Glass	1	4.0	1,000	4,000
Valueless	93.5	374.0	0	0
Total income				84,000 Say Rs 84,000/day in year 1

Scenario 2:

House to house collection
No picking on streets and bins

Waste Composition:

Material	%tage	Net Quantity (Tonnes)/ Day	Unit Price (Rs)/ Ton	Market Price (Rs)
Paper	6	30	2,000	60,000
Plastics	6	30	4,000	120,000
All metals	1	5	4,000	20,000
Glass	1	5	1,000	5,000
Valueless	86	430	0	0
Total income				205,000 Say Rs 200,000/day in year 1

Scenario 3

House to house collection
No picking on streets and bins

Waste Composition:

Material	%tage	Net Quantity (Tonnes)/ Day	Unit Price (Rs)/ Ton	Market Price (Rs)
Paper	8	40	2,000	80,000
Plastics	8	40	4,000	160,000
All metals	4	20	4,000	80,000
Glass	2	10	1,000	10,000
Valueless	86	430	0	0
Total income				330,000 Say Rs 330,000/day in year 1

Appendix - 13

Waste Management at Landfill Site

a) Establishment Costs for 500 Tonnes/Day Waste

Post	Salary Per Month in Rupees	Salary Per Year in Rupees	High Cost		Low Cost	
			NGOs	Cost in Rs	NGOs	Cost in Rs
Machine Operators	7,000	84,000	8	672,000	5	420,000
Coolies	5,000	60,000	10	600,000	15	900,000
Clerks	5,000	60,000	3	180,000	3	180,000
Timekeeper	5,000	60,000	3	180,000	3	180,000
Security Guards	6,000	72,000	10	720,000	10	720,000
Supervisors	6,000	72,000	1	72,000	1	72,000
Assistant Director	10,000	120,000	1	120,000	1	120,000
Total	44,000	120,408	36	2,544,000	38	2,592,000

b) Operation and Maintenance Cost for 4,000 Tonnes/Day: For Comparison Purposes Only

-	Maintenance of machinery	Rs	1,600,000
-	POL including diesel	Rs	2,000,000
-	Depreciation of machinery	Rs	6,500,000 (@ 10% p.a.)
-	Land cost		Nil
-	Establishment	Rs	4,272,000 (60 staff)
-	Contingencies / Utilities	Rs	500,000 (lump sum)
-	Maintenance / Improvement of Road/Buildings	Rs	2,500,000 (lump sum)

	Total:	Rs	1,7372,000
-	Estimated waste disposal from all sources		4,000 tonnes per day = 1,200,00 tonnes per year (300 days)
-	Expenditure per ton basis		Rs 14.47 per ton = Rs 15 per ton
-	Expenditure per truck basis		Rs 30 per refuse vans (carrying capacity upto 3 tonnes)
			Rs 75 per refuse van (carrying capacity more than 3 tonnes)