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HEALTHY

REPORT OF THE TECHNOLOGY ADVISORY GROUP ON SOLID WASTE MANAGEMENT

Constituted by

THE GOVERNMENT OF INDIA
MINISTRY OF URBAN DEVELOPMENT

CENTRAL PUBLIC HEALTH AND
ENVIRONMENTAL ENGINEERING ORGANIZATION
(CPHEEO)
MINISTRY OF URBAN DEVELOPMENT
GOVERNMENT OF INDIA
NEW DELHI

MAY 2005

LET US MANAGE OUR WASTE

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NEW DELHI

MAY 2005

सत्यमेव जयते

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GOVERNMENT OF INDIA
MINISTRY OF URBAN DEVELOPMENT
NIRMAN BHAVAN, NEW DELHI-110011

24th January, 2005

FOREWARD

Solid Waste Management (SWM) is an essential and obligatory function of Urban Local Bodies (ULB). Lack of proper planning and inefficient management of solid waste leads to environmental degradation, ecological imbalance adversely affecting the health of mainly the urban poor. Management of solid waste in a scientific and hygienic manner is, therefore, a major challenge facing urban areas of the country. To manage this service efficiently, ULBs need adequate technical, managerial, administrative, financial and institutional arrangements.

A Technology Advisory Group set up by the Ministry of Urban Development has compiled a report on Solid Waste Management. It is based on information received on various proven technologies for processing and disposal of waste and inputs given by experts and managers working in the field. This report contains information relating to waste processing / treatment technology, waste handling vehicles and equipment, financial resources, sectoral lending by financial institutions and potential for private sector participation in this activity. The report also highlights support that the Central and State Governments could render to ULBs in capacity building, research and development and the role that non-governmental and community based organizations and public as a whole could meaningfully play in the management of urban solid waste.

I am pleased to acknowledge the contribution made by the Technology Advisory Group in preparing this report. I am confident that this report would provide necessary guidance to ULBs in managing solid waste in an effective manner in the urban areas of the country.

(Anil Baijal)
Secretary to Government of India

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ANNEXURES

PREFACE

Solid Waste Management is one of the essential obligatory functions of Urban Local Bodies in India. This service is falling too short of the desired level of efficiency and satisfaction, resulting in the problems of health, sanitation and environmental degradation. Most of the urban areas of the country are placated by acute problems of solid waste. Due to lack of serious efforts by the towns / city authorities, garbage and its management has become a tenacious problem and this notwithstanding the fact that the largest part of the municipal expenditure is allotted to the solid waste management. Barring a few progressive municipal corporations in the country, most local bodies suffer due to non-availability of adequate expertise and experience, resulting in improper handling of municipal solid waste, leading to environmental pollution and health hazards.

Looking at the pathetic situation of solid waste management practices being adopted by Urban Local Bodies in the country due to various reasons and having no action plan to solve the problem in future in spite of outbreak of epidemics in some parts of the country, the Hon'ble Supreme Court of India had been seized with the problem and directed the Ministry of Urban Development & Poverty Alleviation to constitute a National Technology Mission in the Ministry of Urban Development & Poverty Alleviation for improving the solid waste management practices in the country within a period of 5 years.

Pursuant to the recommendation of the Committee on Solid Waste Management for Class-I Cities by the Hon'ble Supreme Court of India regarding constitution of a National Technology Mission in the Ministry of Urban Development & Poverty Alleviation for improving solid waste management practices in the country within a period 5 years and the decisions taken in the Inter-Ministerial Meeting held under the chairmanship of the then Secretary(UD) on 26.6.1999, the Technology Advisory Group (TAG) on Solid Waste Management has been constituted in August 1999 with the objectives of collection information on various proven technologies for processing & disposal of wastes, identifying appropriate and cost effective technologies suitable to Indian conditions, to pilot projects where necessary and provide technical guidance to the State Governments and Urban Local Bodies for adopting and suggesting technologies where feasible. Developing the IEC material for creating awareness among the masses through print media with the cooperation of State Governments and Urban Local Bodies, Promotion of capacity building and human resource development in Urban Local Bodies, Identifying training needs, develop mechanism to meet the training needs and designate institutions in States / Regions as resource center's for providing such training, Channeling and making optimum use of funds earmarked for solid waste management in various Ministries, financial institutions and international donors are also some of the objectives of TAG.

The composition of the present TAG is as under:-

1. Shri V.B. Ramaprasad, **Chairman**
Adviser(PHEE), CPHEEO
Ministry of Urban Development & Poverty Alleviation,
Nirman Bhawan, New Delhi.

2. Shri Joseph Mathew **Official Member**
Director(Finance),
Ministry of Urban Development & Poverty Alleviation,
Nirman Bhawan, New Delhi.

3. Additional Director(Municipal Solid Waste Management) **Official Member**
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Lodhi Road, New Delhi-110003.

4. Dr. M.R. Motsara **Official Member**
Additional Commissioner,
Department of Fertilizers,
Ministry of Agriculture,
Krishi Bhawan, New Delhi.

5. Shri K.P. Katailiha **Official Member**
Deputy Adviser(WS),
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6. Mr. G. Patwardhan, **Official Member**
Additional Secretary(P)
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7. Shri N.P. Singh **Official Member**
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8. Dr. A.B. Akolkar **Official Member**
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Mumbai Municipal Corporation,
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11. Shri P.U. Asnani **Non-Official Member**
Urban Environment Infrastructure Representative India,
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12. Shri Ravi Das **Official Member**
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13. Shri Dharmendra Pratap Yadav **Official Member**
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14. Shri Anjan Das, **Official Member**
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15. Shri D.P. Dixit, **Official Member**
General Manager,
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16. Mr. Basaviah, **Official Member**
Managing Director,
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19. Shri Srinivasa Setty, **Official Member**
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20. Dr. N.B. Mazumdar, **Official Member**
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21. Shri H.S. Bains, **Official Member**
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22. Dr. Manoj Dutta, **Non-Official Member (Local)**
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23. Prof. H.S. Mukunda, **Non-Official Member**
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24. Dr. S. S. Khanna, **Non-Official Member (Local)**
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25. Shri B.B. Uppal, **Member Secretary**
Deputy Adviser(PHE),
Ministry of Urban Development & Poverty Alleviation,
Nirman Bhawan, New Delhi.

The notification for the aforesaid reconstituted TAG is also appended as per Annexure-I.

The Technology Advisory Group was first constituted in August, 1999 under the chairmanship of Dr. S.R. Shukla, the then Adviser(PHEE) with Mr. V.B. Ramaprasad as Member Secretary and 20 other members from various Ministries and concerned organizations. Notification appended at Annexure-II.

The Technology Advisory Group thanks the Ministry of Urban Development & Poverty Alleviation, Government of India for providing all the facilities for holding the TAG meetings in the Conference Hall of the Ministry at Nirman Bhawan, New Delhi. The initiative taken by Dr. S.R. Shukla, the then Adviser(PHEE) in getting the original Technology Advisory Group constituted is gratefully acknowledged.

The Group expresses its appreciation to Shri P.U. Asnani, Chairman of the Core Group on Technology for his untiring efforts in drafting report of the core group on technology and drafting the first Draft Report of TAG. Special mention is made of the services rendered by Shri A.D. Bhide, Chairman of Core Group on IEC, for his contribution in the preparation of IEC material for the Report.

The valuable contribution by Shri Satyanarayana & Ms. Kirti Devi from FIRE Project of USAID in drafting / framing the chapter on 'Financial Management & Private Sector Participation' is gratefully acknowledged.

The TAG expresses its appreciation to Shri B.B. Uppal, Deputy Adviser(PHE) & Member Secretary for his untiring efforts in finalising the First Report of the TAG.

The TAG is also thankful to Shri R. Sethuraman, Dy. Adviser (PHE), Shri M. Sankaranarayanan, Shri M. Dhinadhayalan, Shri N.N. Hotchandani, Shri V.K. Chaurasia, and Shri K.A. Roy, Assistant Adviser (PHE) for their keen interest and cooperation during the TAG meetings and coordinating the core group meetings from time to time.

The Group would like to express its gratitude to Shri S.K. Gulati, Private Secretary, Smt. Shobha Ventakaraman, Shri Rajagopalan, Smt. Padmavathi Ravi, Personal Assistant, Shri B.P. Ganguly, Statistical Assistant, Shri Chandra Singh, Ferro Printer and other staff members of CPHEEO for their untiring efforts in preparing background material for TAG meetings and facilitating presentations by technology providers during the meetings.

Last but not the least, the Group desires to record its appreciation of the services rendered and cooperation extended by different officers and staff members of PHE Division, Accounts and the Store Division of the Ministry.

V.B. RAMAPRASAD
ADVISER (PHEE) &
CHAIRMAN TAG

CHAPTER—1

INTRODUCTION

Pursuant to the recommendations of the Committee on Solid Waste Management for Class-I cities constituted by the Hon'ble Supreme Court of India, The Government of India, Ministry of Urban Affairs and Employment, Department of Urban Development constituted a Technology Advisory Group on SWM vide Government of India order No. Q-11021/21/99/- PHE dated 18th August, 1999 for a period of five years and later reconstituted the technology advisory group on 16-01-2002. The copy of the aforesaid orders are annexed as Annexure-1.

The roles and objectives of the Technology Advisory Group have been determined as under:

(a) To collect information on various proven technologies for processing and disposal of wastes, identify appropriate and cost effective technologies suitable under Indian (local) conditions through pilot projects where necessary and advise State Governments and urban local bodies to adopt such technologies.

(b) To provide technical assistance to urban local bodies for adopting the suggested technologies where feasible.

(c) To channelise and make optimum use of funds earmarked for SWM projects in the various Ministries, such as Ministries of Environment & Forest, Non-conventional Energy Sources, Agriculture, Urban Development, Planning Commission, financial institutions and international donor agencies.

(d) To develop IEC (Information, Education & Communication) material for awareness programmes and disseminate the same through mass and print media with the cooperation of State Governments and urban local bodies.

(e) To promote capacity building & HRD in urban local bodies identify their training needs, develop mechanism to meet the training needs and designate institutions in each State/region as resource centre for providing such training to various categories of personnel involved in SWM.

(f) To establish a bench mark on the performance of various urban local bodies in SWM and circulate the same to urban local bodies and State Governments, for information and improvement where necessary.

(g) To arrange/promote and coordinate inter-city, inter-state meets for SWM personnel to exchange information on various aspects of SWM.

(h) To provide a forum of public interaction and intervention in the field of SWM and strengthen/ support participation by NGOs and citizens.

(i) To take suitable and appropriate measures as may be necessary from time to time to improve the SWM systems.

(j) To keep the nodal Ministry, viz. Ministry of Urban Development informed about the various action points required to be undertaken by the Technology Advisory Group, Ministry of Urban Development, other Ministries and Institutions.

3221 UD&PA/03—3A

Constitution of Core Groups

With a view to give focused attention to various objectives laid down, three Core Groups were constituted by the Ministry of Urban Development, Government of India as under.

1. Appropriate Technologies, Research & Development

2. Financial Resources and Private Sector Participation

3. Capacity Building, Human Resource Development, Information, Education and Communication.

The composition of the Core Groups and their terms of reference have been shown in the Government order dated 18th August 1999 annexed as Annexure 2.

The Core Groups have deliberated on the terms of reference given to them by having series of meetings from time to time and have submitted their reports to the Technology Advisory Group, which has deliberated on the recommendations of the Core Group and have agreed to release the first set of recommendations on some of the items to improve the solid waste management practices in the urban areas in the country and has further decided to release more and more recommendations and information for the benefits of the urban local bodies from time to time in future.

This report principally covers the details of various technologies available within and outside the country for the treatment of municipal solid waste and deriving compost, RDF, power, etc. from the waste, their merits, demerits, their limitations, etc. It also narrates the extent of application of these technologies in India so far. The report also refers to some of the national and international technologies presented before the Technology Advisory Group/Core Group by various technology providers and gives the views of the TAG about the suitability of those technologies under Indian conditions. The report also deals with Government of India's initiatives and schemes supporting the solid waste management services, financial aspects giving details of sectoral lending by financial institutions, the extent of private sector participation attempted, the legal issues related to private sector participation in India and makes recommendations of fiscal incentives for SWM infrastructure financing by the state and central governments as well as makes recommendations for central and state governments as well as urban local bodies. It also gives estimates of the capital investments required to modernize the SWM services in the country between 2000 and 2007. The report also spells out the strategies proposed to be adopted for building community awareness through information, education and communication techniques for ensuring public participation and for human resources development through internal capacity building of the officers and supervisory staff dealing with solid waste management at various levels through training at various levels. The report gives the estimated cost involved in these activities.

The information given in this report would help the urban local bodies in selecting appropriate technologies for processing of municipal solid waste in terms of the Supreme Court Committee recommendations as well as the Municipal Solid Waste (Management & Handling) Rules, 2000, give an insight in finding financial resources and the manner in which they could involve private sector to take over part of their burden of improving SWM services. It will also help them in designing public awareness campaign and internal capacity building programs.

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CHAPTER—2

INITIATIVES BY THE GOVERNMENT OF INDIA

	Initiatives by GOI
1960s	Ministry of Food and Agriculture-offered soft loans to whom local bodies for promoting composting of urban solid waste.
1969-74	Fourth five-year plan provided block grants and loans to state governments for setting up MSW composting facilities.
1974	GOI introduced a modified scheme to revive urban waste composting in cities with a population over 0.3 million.
1975	GOI constituted the first high powered committee for a holistic review of urban waste problems. This committee in its report covered eight areas of waste management and made 76 recommendations.
1994	Bubonic Plague in Surat (Gujarat)
1995	High powered committee under the chairmanship of Prof. J. S. Bajaj (Member, Planning Commission), was constituted.
	Ministry of Health and Family Welfare undertook a national mission on environmental health and sanitation.
	Central Public Health and Environmental Engineering Organization (CPHEEO), under the Ministry of Urban Development, drafted a policy paper.
	More than 35 composting facilities emerged with PSP.
1996	MNES initiated pilot programme to promote waste-to-energy projects.
	Number of PILs filed, greater acceptability and participation of NGOs/CBOs.
1998	Expert Committee formed by the Supreme Court of India under the chairmanship of Mr. Asim Burman (Commissioner, Calcutta Municipal Corporation), to review SWM practices in Class-I cities, and make recommendations to improve SWM systems.
1999	March 1999, expert committee submitted its report to Supreme Court and copy of the report circulated to all class-I cities in India.
	August 1999— Under the Supreme Court directions, the Ministry of Urban Development set up a Technological Advisory Group (TAG), under which the following three core groups have been constituted.
	1. Appropriate technologies, research and development.
	2. Financial resources and private sector participation.
	3. Capacity building human resources development, information collection and communication.
	September 1999, the MOEF issued draft rules for Municipal Waste (Management & Handling)
2000	May 2000 — MOUD brought out Manual on Solid Waste Management prepared by expert committee.
	September 2000 — The MOE & F notified Municipal Solid Waste (Management & Handling) Rules 2000 making it mandatory for urban local bodies to implement the improved systems of waste management in a given time frame ending 31st December 2003.
2002	January 2002—MOUA & E reconstituted the Technology Advisory Group on SWM.

The early initiatives of the Government of India regarding urban waste management focused primarily upon promoting composting of urban Municipal Solid Waste (MSW). In 1960s the Ministry of Food and Agriculture offered soft loans to urban local bodies for the purpose. The fourth five-year plan (1969-74) provided block grants and loans to State government for setting up MSW composting plants. Finally in 1974, GOI introduced a modified scheme to revive urban waste composting particularly in cities with a population over 0.3 million. The above efforts, however, did not meet the envisaged level of success.

In 1975, the GOI for the first time constituted a high-powered committee for a holistic review of problems regarding urban waste. This committee, in its report covered eight areas of waste management and made 76 recommendations.

However it took the outbreak of an epidemic in the city of Surat (Gujarat) in 1994, to throw light on the appalling conditions and realities regarding SWM services. This provided a renewed impetus to the efforts of the government. A high-powered committee, (Bajaj Committee) was constituted in 1995, which made a number of wide ranging recommendations. These included waste segregation at source; primary collection, installation of user charges; use of appropriate equipment and vehicles; focus upon sanitary land filling and composting; and encouraging Private Sector Participation (PSP) on a pilot basis.

In the same year (1995) the Ministry of Health and Family Welfare, GOI, Undertook a national mission on environmental health and sanitation. Further, the Central Public Health and Environmental Engineering Organization (CPHEEO), under the Ministry of Urban Development and Poverty Alleviation (MOUD) prepared a draft policy paper that detailed issues and funding requirements of SWM in India.

Post Surat the country saw the emergence of more than 35 waste treatment projects (during the period 1995-2000) with Private Sector Participation. Most of these projects are for composting facilities

and are concentrated in the states of Tamil nadu, Maharashtra, Andhra Pradesh, West Bengal and Kerala. This period also saw increased awareness and peoples participation in SWM, manifested in the form of PILs. This period also saw an increasing acceptability of the role of NGOs and CBOs in the sector.

In July 1998 a committee was formed by the Supreme Court of India to review the Solid Waste Management condition in Class I cities in India. Constituted under the Chairmanship of Mr. Asim Burman (Commissioner, Calcutta Municipal Corporation) this committee was constituted by members from municipal corporations, CPWD, MOEF, MOUD, and a public representative. This committee tabled its report in March 1999 giving wide-ranging recommendations to improve the system of waste management from storage of waste at source to its final disposal. It also covered institutional, financial, legal and health aspects. One of the key recommendations of the committee was to enable Private Sector Participation. In addition to being a potential source of project funding, the rational for PSP included benefits such as cost savings and improvement in efficiency and effectiveness in service delivery. PSP was also seen as a means to accessing new technologies.

In August 1999—Under the Supreme Court directions, the Ministry of Urban Development set up a Technological Advisory Group (TAG), under which the following three core groups have been constituted.

1. Appropriate technologies, research and development

2. Financial resources and private sector participation.

3. Capacity building, human resources development, information, collection and communication.

In September 1999, the Ministry of Environment and Forest (MOEF), issued draft rules for Municipal Wastes (Management and Handling) (Refer: The Gazette of India, Ministry of Environment and Forests Notification).

In May 2000, the Central Public Health & Environmental Engineering Organization under the MOUD brought out a manual on Municipal Solid Waste Management to provide guidance to ULBs. This manual was prepared by an expert group constituted by members from CPHEEO, CPCB, NEERI, MNES, Municipal Corporations, WHO, Academic Institutes, HUDCO and USAEP.

I. In September 2000 the MOEF notified Municipal Solid Waste (Management & Handling) Rules 2000 making it mandatory for urban local bodies to improve the systems of waste management as envisaged in the rules in a given time frame ending 31st December 2003. These rules lay out procedures for waste collection, segregation, storage, transportation, processing and disposal. Further these mandate that all cities set up suitable waste treatment and disposal facilities by December 31, 2003 or earlier. These rules also specify standards for compost quality, leachate control and management and closure of landfill sites. This has precipitated a lot of interest and activity in the sector.

In January 2002, the Ministry of Urban Affairs & Employment reconstituted and Technology Advisory Group on SWM and inducted some new members to make the committee broad based.

The MOUD is also in the process of preparing a policy for Urban Infrastructure.

Need For Coordinated Concerted Efforts By Various Ministries.

As can be seen from the above, multiple ministries are responsible for different aspects of Solid Waste Management, these are: Ministry of Health and Family Welfare, Ministry of Environment and Forest, Ministry of Urban Development and Poverty Alleviation, Ministry of Agriculture, and Ministry of Non Conventional Energy Sources. It is critical that these ministries make a coordinated concerted effort toward addressing SWM problems.

In addition to assessing the problem at hand the various committees constituted by the government, have served this critical role of coordinating and aligning efforts of the various ministries an research institutes. This linkage and coordination was missing earlier and may be identified as one of the important factor for infusing energy into the recent efforts by the government.

[1] The Ministry of Urban Development and Poverty Alleviation was earlier called the Ministry of Urban Affairs and Employment.

CHAPTER—3

MAGNITUDE OF THE PROBLEM

MAGNITUDE OF THE PROBLEM

The studies conducted by National Environmental Engineering Research Institute (NEERI) have revealed that India produces about 38 million metric tonnes of urban solid waste annually. The per capita waste generation varies between 0.2 kilograms and 0.6 kilograms per day depending on the size and population of the city as shown in the table below. This is estimated to be two to three times more than the waste generated by rural residents.

Quantity of municipal solid waste generated in Indian Urban Centers.

Population range (in millions)	No. of urban centers sampled	Total population in millions	Average per capita waste generation (Kg/capita/day)
< 0.1	328	68.300	0.21
0.1 — 0.5	255	56.914	0.21
0.5 — 1.0	31	21.728	0.25
1.0 — 2.0	14	17.184	0.27
2.0 — 5.0	6	25.597	0.35
>5.0	3	26.306	0.50*

*0.6 kg./capita/day generation of MSW observed in metro cities. Source background material for manual on SWM NEERI 1996.

The per capita waste generated in a typical Indian metropolitan city increases by 1.3 percent per year (TERI, 1998). On the other hand, while the country's overall population growth rate is about 2 precent, the estimated urban population growth rate is much higher, around 3.5 per cent per annum (World Bank, 1998). These two factors have led to a yearly increase of the overall burden on solid waste in Indian cities of almost 5 per cent (CREED, 1999).

The following table illustrates the estimated urban municipal solid waste generation (Kg/capita/day) for the year 2025. When viewed together with the fact that the urban population would be in the range of 45 percent of the total population, this increase becomes extremely significant. Such a dramatic increase will place enormous stress on limited financial resources and inadequate waste management systems[1].

[1] "Indonesia, Philippines and parts of China and India, are the Asian countries facing the greatest waste management challenge, based on projected waste generation rates and relative affluence to deal with the problem 'Source : (May 1999) What a Waste' : Solid Waste Management in Asia May, Urban Development Sector Unit, East Asia and Pacific Region, IBRD. World Bank.

Table—Estimated Urban Municipal SW Generation in India

Year	GNP Per Capita 1995 USD	Current Urban Population Percentage of total	Current Urban MSW generation in 5 million plus cities (kg/capita/day)
2025	620	45.2	0.70

Source : (May 1999) What a Waste: Solid Waste Management in Asia May. Urban Development Sector Unit, East Asia and Pacific Region, IBRD. World Bank.

As reported in manual on MSW management, CPHEEO, MOUD, GOI

In addition to addressing demands of rapid urbanization, another critical issue that India would face over the next twenty-five years is the shift in composition of urban solid waste, especially in metropolitan cities. India is one of the most populous countries in the world and among one of the lowest consumers of paper per capita. As the GNP and urban population grow the paper consumption and retated packaging wastes will also increase[2]. India must, therefore, ensure that development of waste management systems does not lag behind the realities of a changing waste stream.

Summary

- ⇨ Per capita waste generation rates would go up from year to year. This will increase the liability of the urban local bodies to handle the waste scientifically.
- ⇨ The growing consumption of paper, plastic and packaging material would pose serious problems unless RRR (Reduce, Reuse & Recycle) policies are adopted.
- ⇨ Availability of land for the waste disposal would be scare in urban areas. The cities would, therefore, face a serious problem of waste disposal unless they process the waste and reduce the quantities of waste going to landfills.
- ⇨ Adjoining rural areas would not permit urban waste coming in their area for disposal on account of NIMBY (Not In My Back Yard) syndrome. PILs would be on a rise.
- ⇨ Implementation of environmental laws would be stricter and local bodies will have to find funds for treatment and disposal of waste in an environmentally acceptable manner by giving high priority to solid waste management.

In this context it is important that the Government play a more proactive role. A comprehensive policy framework is also needed at the national and state levels. This should link public health, environmental and decentralization policies more closely together so that these are mutually supportive. Focus must be upon providing incentives to ULBs to deliver better services, recover costs from users, and cooperate with neighbouring municipalities.

EXISTING SERVICE LEVELS IN SOLID WASTE MANAGEMENT IN ULBs

The urban local body is the main body responsible for urban SWM systems in India. Although other sub-systems such as private organizations engaged in waste processing and informal recycling system, are actively involved in the waste management process, their activities are dependent on the operation of the municipal body (Sudhir, et.al., 1996).

[1] Waste collected as a percentage of total waste generated.

In most local bodies, staff engaged in SWM constitute as much as 30 to 50 percent of total municipal staff. It is estimated that ULBs spend about Rs. 500 to Rs. 1500 per ton on solid waste for collection, transportation, treatment and disposal. About 60 to 70 percent of this amount is spent on collection, 20 to 30 percent on transportation and less than 5 percent on final waste disposal. Hardly any attention is given to scientific and safe disposal of waste (CPHEEO Manual 2000).

A large number of ULBs, despite spending 20-50 percent of their municipal services budget on SWM are unable to provide satisfactory and reliable services (NIUA, 2000). The quantum of funds remains inadequate given the poor fiscal condition of our ULBs vis-a-vis demands placed by rapid urbanization. Further, service levels are especially poor in slum communities.

Collection

Due to budgetary constraints, inadequate equipment and poor planning, house-to-house collection is very rare in India, particularly in certain low-income areas where waste in not collected at all (Baud and Schenk, 1994). On an average, the collection efficiencies range from 50 to 90 percent of the solid waste generated, leaving the balance unattended. (CPHEEO Manual 2000). Findings of a recently concluded study by CPCB indicate waste collection efficiency[2] in some Indian cities is as low as 25 percent.

Table.— Current Status of Management (1997)

Cities	Class I	Class II
Cities	300*	345
Mode of collection		
- Manually	50%	78%
- Trucks	49%	21%
- Others	1%	1%
Disposal		
- Dumping	94%	93%
- Composting	5%	6%
- Other	1%	1%
Average per capita expenditure on the service per annum	Rs. 114	Rs. 62

Note : * CPCB data reported 299 cities, however the Census of India reports 300 Class I cities and the above table has been corrected accordingly.

Source : (2000), Mgmt of Municipal Solid Waste, Central Pollution Control Board, Delhi, pg. 5, 48. Average per capita expenditure on the service (97-98), based upon a recent survey by NIUA. Further there is a great reliance on manual collection and loading of waste. During manual loading, 6-8 workers are deployed on each truck. Most cities face labour linked issues, such as : health impact on the MSW staff ; recurring labour agitations, especially in cities where labour unions active ; and implications on private sector participation. A recently concluded survey by NIUA identifies that as per 1997-98 figures, in most Class I cities average expenditure on Staff salaries constitutes about 75 per cent of total expenditure on the service. This percentage expenditure rises to 85 per cent for Class II cities.

Meanwhile collection from slums, narrow lanes and high traffic areas continues to remain difficult. In the absence of adequate secondary collection, waste storage depots remain unhygienic with waste often seen lying outside the depots.

Transportation

Transportation of waste from collection centers to final disposal site is another important step in the management of garbage. According to estimates only about 50-90 per cent of generated waste is collected for transportation to the disposal sites. Transportation of garbage is carried out using old outdated trucks, tippers and refuse collectors. Inadequancy of transportation fleet and frequent breakdown of vehicles are the major hardship in proper collection of garbage. In smaller cities waste transportation modes include bullock carts, three wheelers and tractors trucks. In efficient workshop facilities and poor fleet management and maintenance further serve to reduce the life of vehicles. The entire management system is not always synchronized with primary and secondary collection and bulk storage facility. In some cases, front-end loaders are also used, though; the receptacles are not well designed to suit such system. Maintenance of all equipment remains poor.

Disposal

The current level of SWM expenditure on waste treatment and disposal is abysmally low, and is less than 5 per cent. The CPCB study indicates that about 94 per cent of cities resort to indiscriminate dumping of domestic, commercial, industrial and medical wastes in low-lying areas. This leads to contamination of ground and surface water by leachate. Government of India, Ministry of Environments has notified Bio-Medical Waste (Management & Handling) Rules 1998 for the management of bio-medical waste. However, its enforcement is highly inadequate resulting in disposal of bio-medical waste along with the municipal solid waste. The implementation of bio-medical waste (Management & Handling) Rules need to be tightened in all the states. Further, air pollution due to burning of open dumps, and flooding due to clogged drains are some of the other common environmental problems. Sanitary disposal of waste remains the most critical aspect of SWM in the country.

Various forms of resource recovery activities, such as composting waste-to-energy and recycling are beginning to be initiated in India. This is a good trend and must continue to be supported by the government.

Even when waste reduction technologies such as; composting, tapping bio-methane for energy production (waste to energy plants) are practiced, a sanitary landfill is still required. Development and operations of a landfill site necessities the identification of resources. Further as land for treatment facilities and landfills becomes scarce, ULBs will have to purchase/acquire additional land. This will add to the cost burden of the ULBS.

Existing Waste Dumpsites

According to CPCB, studies on landfills have revealed high SPM values at landfill sites. Acrobiological studies demonstrate the presence of actinomycetes/fungi and other microbes in air samples from the vicinity of landfill sites. Further, examination of water environment indicates high TDS in contiguous groundwater sources.

Table.— Characteristics of Land Fill Leachate at Existing Dumpsites

Parameter	Concentration (mg/l)	Standard for disposal of treated leachate (land disposal) MSW Rules 2000 (mg/l)
PH	3.7 - 8.3	5.5 - 9.0
Total dissolved solids	725 - 55000	2100

Table.— Characteristics of Land Fill Leachate at Existing Dumpsites—Contd.

Parameter	Concentration (mg/l)	Standard for disposal of treated leachate (land disposal) MSW Rules 2000 (mg/l)
Chlorides	2 - 11373	600
Total Kj. Nitrogen	2 - 3320	-
Lead	0 - 14.2	-
COD	50 - 99000	-
BOD 5	0 - 19500	100

Source : (2000), Management of Municipal Solid Waste, Central Pollution Control Board, Pg. 6, 42

The closure of existing open dumpsites and the introduction of sanitary landfill is an urgent priority in India as everywhere in the developing world. Closure of existing dumpsites should be carried out in a phased manner, wherein as a first step the critical sites are identified and cleaned. The CPCB is conducting a study on assessment of impact of completed and existing landfill sites in 14 towns, namely, Hyderabad, Ahmedabad, Surat, Bangalore, Mumbai, Pune, Bhopal, Jaipur, Chennai, Kanpur, Lucknow, Agra, Calcutta and Delhi. Under the study, it is proposed to assess the degree of pollution from the completed and existing landfill sites including air and water pollution in detail. As soon as the results of these studies are available, they will be made known to ULBs.

The CPHEEO, in the Ministry of Urban Development has compiled information about the existing level of services in many cities in different states of India which shows a wide variation in the level of services prevalent and also indicates the gap in the level of services in various towns. The details compiled are annexed as Annexure — III.

CHAPTER—4

WASTE PROCESSING/TREATMENT TECHNOLOGIES

1. INDENTIFICATION OF APPROPRIATE TECHNOLOGIES :

The urban local bodies in the country are today exploring various methods for processing, treatment and disposal of municipal solid waste to solve their ever-increasing problem of waste management. In this regard, they are expected to adopt any appropriate technology or combination of technologies to best suit their local situation. However, the waste processing/treatment facilities based on any chosen technology, or combination of technologies, have to meet the criteria/ statutory standards for different end products, emissions and discharges, etc., laid down in the Municipal Solid waste (management & Handling) Rules 2000.

While the aforesaid rules have laid down the minimal requirements for waste processing/treatment facilities, but in the absence of sufficient past experience and technical expertise, several local bodies may end up with facilities, which neither fully meet the statutory requirements nor fully address their local needs and conditions.

The Technology Advisory Group has made a serious attempt to examine the different technological options available world-wide for processing, treatment and disposal of Municipal Solid Waste and to judge their suitability for the Municipal Solid Waste being generated in urban areas in India, which is presented in this Chapter. In this regard the TAG has organized presentations of different processes by interested technology providers to get an up-date and status of various technologies, besides taking into consideration other available information.

2. TECHNOLOGIES FOR PROCESSING, TREATMENT OF MUNICIPAL SOLID WASTE:

The main technological options available for processing and treatment of Municipal Solid Waste for Resource/Energy Recovery/Disposal, are the following:—

1. Composting
2. Vermi-composting
3. Anaerobic Digestion/Biomethanation
4. Incineration
5. Gasification/pyrolysis
6. Plasma Pyrolysis
7. Production of Refuse Derived Fuel (RDF)/Pelletisation
8. Sanitary Landfilling/Landfill Gas Recovery

The first three technologies [S.No.1-3] depend upon biological decomposition of the biodegradable organic fraction of MSW to produce compost/biogas/landfill gas. The technologies listed at S.No. 4-6 depend upon thermal decomposition of the entire organic fraction of MSW (Biodegradable as well as non-biodegradable fraction) to produce heat energy/fuel gas/fuel oil. The technology at S.No. 7 is only a waste processing method for producing RDF Fluff/ Pellets, for subsequent energy recovery through the technologies listed at S.No. 4-6. The last technology at S.No. 8 is the ultimate means of disposal of residual wastes from all sources,

including those from other waste processing/treatment plants. All these technologies are described in detail in the manual on Solid Waste Management published by the MOUD.

Bio-Medical Waste Management

The bio-medical waste which was until recently mixed with municipal solid waste is now required to be handled separately as per the bio-medical Waste (management & handling) Rules 1998 notified by the Ministry of Environment and Forests. The bio-medical waste is now expected to be handled by the waste producers and not allowed to be mixed with municipal solid waste. These rules are annexed as Annexure-9

3. ADVANTAGES/OPPORTUNITIES AND LIMITATIONS/BARRIERS OF DIFFERENT TECHNOLOGIES FOR THEIR APPLICABILITY IN INDIA :

COMPOSTING :

Composting of MSW is currently the most important biological route for recycling matter and nutrients from the organic fraction of MSW. Full scale composting technology for (i) source separated MSW and (ii) mechanically separated MSW (iii) mixed MSW is already commercially available and in use, and its further application is limited only by process economics and the availability for markets for the composted MSW, which include applications like use as manure, soil conditioner for parks, gardens, agricultural lands, landfill cover, etc., depending upon its composition/quality.

Advantages/Opportunities:

- Age Old established concept for recycling of matter/nutrients to Soil.
- Simple and straight forward for adoption, for source separated MSW.
- Does not require large capital investment, compared to other waste treatment options.
- Suitable for organic biodegradable fraction of MSW, yard (or garden)waste/waste containing high proportion of lignocelluloses materials, which do not readily degrade under anaerobic conditions, waste from slaughterhouse and diary waste.
- Can be done from a small scale to a large scale.

Limitations/barriers:

- Suitable for only organic biodegradable fraction of MSW; not very suitable for wastes which may be too wet.
- Problems relating to the complexity of the raw waste, which need to be addressed.
- Around 30-35 kwh energy is consumed per tonne of waste input in full-scale plants during sieving and turning of waste pile for supply of oxygen.
- Emissions of environmental concern from open compost plants if not managed properly.
- Operations get hampered during heavy rains for a few days at the open compost plants.
- Open compost plants if not managed well could emit bad odour and create fly menace.
- Risk of production of contaminated compost from MSW if entry of biomedical waste, Hazardous industrial waste and other toxic material is not restricted at the compost plant site.*
- The requirement of land is relatively more for open compost plants.

- In case of vermi composting source segregation of organic biodegradable waste is essential. Worms are likely to die if any taxic material enters the steam of compostable matter. This also requires more land than microbial composting.

The quality of compost produced from source segregated organic waste is generally better than that of compost produced from mechanically separated MSW, and of that produced from mixed MSW (without any separation). Grinding of MSW should be avoided as it can mask the presence of hazardous material and make it impossible for their removal after the composting is done. In the absence of waste segregation at source, there is possibility of the produced compost being contaminated by heavy metals and toxic/hazardous substances, etc. It is critical that compost so produced be environmentally safe and, if the compost is marketed for agriculture, it is ensured through proper testing and certification that it is free from heavy metals, toxic materials, sharp objects, glass, etc.

The MSW Management & Handling Rules 2000 have laid certain limits for heavy metals content in compost produced from MSW that these standards are adequate/address all parameters for safe agricultural use. It is, therefore, necessary to ensure that the standards laid down are met and a mechanism is put in place to ensure that the same are strictly implemented. Pending the same, agricultural use of compost derived from MSW calls for caution.

APPLICATION IN INDIA

More than a dozen mechanized plants in large cities such as Mumbai, Delhi, Kolkata, Bangalore, Ahmedabad, Bhopal, etc., and several small scale non-mechanized plants in small towns are in operation in India through public and private sector participation.

ADVICE TO URBAN LOCAL BODIES

The Urban local bodies are advised to refer to chapter 14 of the manual on municipal solid waste management prepared and published by the Ministry of Urban Development, Government of India, New Delhi in May 2000 for guidance in regard to the construction of compost plants in their cities if they decide to go for composting for the treatment and disposal of municipal solid waste.

ANAEROBIC DIGESTION/BIOMETHANATION —

Biomethanation is an age old established technology for disinfections, deodorization and stabilization of sewage sludge, farmyard manures/animal slurries and also for industrial sludges. Its application for organic fraction of MSW is, however, more recent and less extensive. As it leads to bio-gas/power generation in addition to production of compost (residual sludge), it provides a value addition to the Aerobic (Composting) process and also offers certain other clear advantages over composting in term of energy production/consumption, compost quality and net environmental gains.

Advantages/Opportunities :

- Suitable for kitchen wastes and other putrescible wastes, which may be too wet and lacking in structure for aerobic composting.
- A net energy-producing process (100-150 Kwh per tonne of waste input).
- Totally enclosed system enables all the gas produced to be collected for use.
- The net environmental gains are positive.
- Modular construction of plant and closed treatment needs less land area.
- Can be done at small scale.

- Free from bad odour, rodent and fly menace, visible pollution and social resistance.
- Potential for improvement of economics with increase in energy price and/or buy-back-power tariff in future.
- Potential for co-disposal with other organic waste streams from industry/agriculture.

Limitations/barriers :

- Suitable for only organic biodegradable fraction of MSW; does not degrade any complex organics or oils, grease, or ligno-cellulosic materials such as yard waste.
- Heat released is less, resulting in lower and less effective destruction of pathogenic organisms than in aerobic composting. (If temperature is increased it will kill microorganism).
- Problems relating to complexity of input waste need to be addressed, as in case of aerobic composting process. Requires waste segregation for improving digestion efficiency (biogas yield) and improving quality of residual sludge.
- While the liquid sludge can be used as rich organic manure, either directly or after drying, its quality needs to be ensured to meet statutory standards. No grinding of waste material should take place.
- Disposal of process waste-water requires treatment to meet statutory standards.
- Biogas leakage, posing environmental and fire hazards.
- Generally more capital intensive than aerobic composting.

APPLICATION IN INDIA

- Biomethanation projects for MSW are in initial stages of development and their commercialization is being demonstrated.

The construction work of 5 MW capacity MSW based power generation project at Lucknow (based BIMA Digester) is in progress and likely to be completed by March 2003 where 300 metric tonnes of municipal solid waste will be utilized for power generation. The result of this plant would be made known to the urban local bodies as soon as the plant gets successfully commissioned.

PRODUCTION OF RDF/PELLETS :

It is basically a processing method for mixed MSW, which can be very effective in preparing an enriched fuel feed for thermal processes like Incineration—Or for use in industrial furnaces.

Advantages/ Opportunities:

- The RDF pellets can be conveniently stored and transported.
- Can effectively take care of imbalances in input waste feed to power plant.
- As it involves significant MSW sorting operations, it provides a greater opportunity to remove environmentally harmful materials from the incoming waste prior to combustion.

Limitations/barriers:

- Energy intensive.
- Not suitable for too wet MSW during rainy season.
- Distinct possibility of contamination of RDF Fluff/Pellets, by toxic/hazardous materials, which can not be removed completely from mixed MSW by sorting; not safe for burning in the open /for domestic use.

- Plant for production of RDF Fluff will be useless until a dedicated power plant with necessary pollution control systems to meet statutory limits for air emissions/other discharges, already exists/is planned to be set up simultaneously, to consume the pellets.

APPLICATION IN INDIA

The Department of Science And Technology of Technology Information, Forecasting and Assessment Council (TIFAC) New Delhi had initially perfected the technology of processing municipal solid waste to separate combustible fraction and densification into fuel pellets to a scale of 2 tons per hour in a demonstration plant at Deonor Dump Yard of Mumbai Municipal Corporation fuel pellets produced in the demo plants were found to have calorific value in excess of 3000 K. Cal. Kg. consistently and the fuel was test marketed around Rs. 1000 per tonne in and around Mumbai. Thereafter, DST transferred the Mumbai Plant to Bombay Municipal Corporation for scale up and commercial operation through private participation. However, the same has not been done so far by the BMC.

The DST technology of processing MSW into fuel pellets has been transferred to M/s. Selco International Limited for scale up and commercial operation. The Technology Development Board of DST and TIFAC is now assisting Selco to set up a 6.6 MW power plant to incinerate MSW derived fuel and generate electricity. TIFAC has also transferred the technology recently to M/s. Sriram Energy Systems Ltd. to set up a similar plant at New Vijayawada.

The results of both the plants would be observed and communicated to the cities for their information once the plants are satisfactorily commissioned.

INCINERATION -This technology is used in developed countries only where there is a shortage of land for waste treatment and disposal and/or the waste has high calorific value on account of large component of paper, plastic, packaging material, etc., as an important method of waste disposal/volume reduction and conversion to innocuous material, with energy recovery. When the waste is dry, it may not need any auxiliary fuel except for start-up but when and the input waste is mixed MSW rich in inerts and moisture content, supplementary fuel may be needed to sustain combustion, adversely affecting net energy recovery.

APPLICATION IN INDIA

An Incineration plant for 3.75 MW power generation from 300 tpd MSW was installed at Timarpur, Delhi in the year 1987 could not operate successfully due to low Net Calorific Value MSW.

Advantages/ Opportunities:

- Most suitable for high Calorific Value waste, pathological wastes, etc.
- Can reduce waste volumes by over 90% and convert waste to innocuous material.
- Units with continuous feed and high throughput can be set up.
- Thermal Energy recovery for direct heating or, power generation.
- Relatively noiseless and odourless.
- Low land area requirement.
- Can be located within city limits, reducing the cost of waste transportation.
- Hygienic.

Limitations/barriers :

- Least suitable for disposal of aqueous/ high moisture content/ low Calorific Value and chlorinated waste.

- Excessive moisture and inert content affects net energy recovery;
- High Capital and O & M costs.
- Skilled personnel required for plant operation and maintenance.
- Concern for emission of particulates, SOx, NOx, chlorinated compounds, ranging from HCl to Dioxins*.
- Concern for toxic metals in particulates that may concentrate in ash; need for care in their removal and disposal.

* This mainly depends on presence of chlorinated hydrocarbons like PVC, in the waste. These can only be achieved by having very high temperature combustion in secondary burning chambers and adequate retention time. By suitable furnace construction and control of the combustion process, to meet strictest statutory standards. It is claimed that maintaining very high temperatures during the combustion process can eliminate virtually all dioxins produced. Also that fabric filtration systems can remove up to 99 per cent of other contaminants in the form of particulates and alkaline scrubbers can remove SOx. Activated carbon injection before the flue gas treatment has also proved to be effective. Activated carbon reactor and catalytic rectors are used for advanced processing. However, Dioxins are most controversial issues, and the mechanism of their production are not yet completely clarified and their removal methods are not yet completely established.

PYROLYSIS/GASIFICATION/PLASMA PYROLYSIS VITRIFICATION (PPV) / PLASMA ARC PROCESS :

Pyrolysis/Gasification processes are already established for homogenous organic matter like wood, pulp etc. while Plasma Pyrolysis is a relatively new technology for disposal of particularly hazardous wastes radioactive wastes, etc. These are now being recognized as an attractive option for disposal of MSW also. In all these processes, besides net energy recovery, proper destruction of the waste is also ensured. These processes, therefore, have an edge over incineration.

Advantages/ Opportunities :

- Production of fuel gas/fuel oil, which replace fossil fuels.
- Compared to incineration, control of atmospheric pollution can be dealt with in a superior way, in techno economic sense.
- NOx and SOx gases emissions do not occur in normal operation due to the lack of oxygen in the system.
- Plasma Pyrolysis Vitrification attractive for disposal of mixed/ hazardous wastes. Toxic materials get encapsulated in vitreous mass, which is relatively much safer to handle than incinerator/Gasifier ash.

Limitations/barriers :

- Capital intensive.
- Net energy recovery may suffer in case of wastes with excessive moisture and inert content.
- High viscosity of pyrolysis oil may be problematic for its transportation & burning.
- Concentration of toxic/hazardous matter in Gasifier ash, which will need care in handling and disposal.

APPLICATION IN INDIA

- No such plants has so far come up in India or elsewhere for the disposal of MSW. It is an Emerging technology for MSW and yet to be successfully demonstrated for large scale application.

SANITARY LANDFILLS/LANDFILL GAS RECOVERY —Sanitary Landfills are the final means of disposal of residual/ unutilized municipal solid waste from waste processing facilities/ other sources and can not be avoided all together in the foreseeable future in our country. The recent Manual on Management of MSW has laid down the guidelines for design/ preparation of sanitary landfills and for their maintenance.

The numerous existing dumping sites across the country offer immense possibilities for recovering the landfill gas (mixture of largely methane and other gases) produced in landfills as a source of energy, with net environmental gains. However, the viability of recovery and utilization of this gas as an energy source is directly dependent upon the quantity and nature of the waste deposited in the landfill and, therefore, not all existing dumps may be techno-economically viable for commercial energy recovery projects. The feasibility has to be determined in each specific case as per the guidelines given in the aforesaid Manual.

A word of caution :

Shallow dumps are the order of the day in India and as per studies conducted by National Productivity Council and as per experiences in EU, the concentration of gas is of the order of 1.6 ppm and the cost of collection of gas and utilization could be very high.

Advantages/ Opportunities :

- Natural resouces are returned to soil and recycled.
- Least cost option for waste disposal.
- Potential for recovery of landfill gas as a source of energy, with net environmental gains. The gas after necessary cleaning, can be utilized for power generation or as domestic fuel for direct thermal applications.
- Highly skilled personnel not necessary.

Limitations/barriers :

- Cost of MSW transportation to far away landfill sites may often be prohibitive.
- **Down gradient surface water can be polluted by surface run-off in absence of proper drainage treatment systems.**
- Soil/Groundwater aequifers may get contaminated by polluted leachate in the absence of proper leachate treatment system.
- Inefficient gas recovery process. Balance gas escapes to the atmosphere (significant source of two major Green House gases, carbon dioxide & methane).
- Large land area requirement.
- Significant transportation costs to far away landfill sites may upset viability.
- Cost of pre-treatment to upgrade the gas quality and leachate treatment may be significant.
- Spontaneous ignition/explosions due to possible build up of methane concentrations in atmosphere within the landfill or surrounding enclosures if proper gas ventilation are not constructed.

Caution. No sanitary landfill should be constructed in low lying marshy lands. The site must not get flooded.

APPLICATION IN INDIA

In india not a single site can be said to be a sanitary landfill site. Most of the sites are crude dumping sites and a few can be said to be controlled dumps. Under the Municipal Solid Waste (Management & Handling) Rules 2000, land filling of compostable matter is not permissible and

only rejects are to be landfilled. It is imperative for all local bodies in the country to design and construct sanitary landfill sites to meet the requirements of law.

4. GUIDELINES FOR ENABLING DECISION MAKING REGARDING CHOICE OF TECHNOLOGY :

The decision to implement any particular technology for processing/ treatment of MSW depends on a number of factors, which are enumerated below :

Site specific circumstances : Costs of waste transportation; scale of treatment; local socio-economic conditions/may over-ride certain solutions which otherwise are techno-economically more viable.

The origin/quality of the waste : This is very important in determining which treatment method is most appropriate; e.g. wastes from vegetable/fruit yards and markets, agricultural and food processing units etc., which contain highconcentration of bio-degradable matter, will be suited for treatment through biological route viz. composting or energy recovery through anaerobic digestion. For waste containing high percentage of combustible fraction (e.g. slowly digestible and indigestible organic matter such as coarser wood, paper, cardboard, plastics and other synthetics) and, low percentage of inerts (stones, sand, glass, metals, etc.) and moisture, the thermal route can be gainfully utilized.

Presence of hazardous/toxic waste : strict enforcement of regulations & control of different waste streams **is necessary to prevent** risk of hazardous/toxic waste getting mixed up with MSW, beyond levels which render the MSW unfit for direct transformation into compost for agriculture, through either aerobic composting or anaerobic digestion route, even waste that is going to be converted in to RDF need to be controlled in order to prevent volatilization of heavy metal during burning of RDF fuels.

Availability of outlets for the energy produced: Effective marketability of end products (thermal energy/ power/ fuel oil/ gas/ pellets) will be a crucial factor technology selection; non-availability consumers of thermal energy/ power in vicinity of proposed plant site or absence of necessary infrastructure for connecting to power grade, may tilt the decision in favour of technologies to convert MSW into transportable resource (composting) or fuel (oil/ pellets).

Market for compost/ Anaerobic Digestion Sludge: Demand for compost/ digestate from Anaerobic Digestion, will ultimately drive the price of the end product, which in turn will dictate the sustainability of such operations. It is important that there exist a market for the product. Factors which can effect the demand for the product include mainly the quality of the copost/ digestate and the cost of its transportation, which may adversely affect the overall economics.

Energy prices/ buyback tariff for energy purchase: High cost of grid power from MSW may render energy intensive processes less viable and attractive.

Cost of alternatives: The capital and recurring costs of defferent alternatives will be an important factor from the investors point of view, in selecting any particular option. High capital cost may preclude selection of an option even though the return on investment may be higher.

Level of capital and labour costs: High costs of capital and manpower with adequate expertise and skill for smooth operation and maintenance of plants based on advanced technologies may be deterrent to their adoption.

Land prices: high land prices will favour selection of technologies with least land area requirement per tonne of waste destroyed/transformed in to resource/energy.

Status of different technologies: The general tendency not to try any technology unless demonstrated elsewhere, may be bottle-neck to adoption of emerging technologies, even though the same may prove to be more beneficial under the given conditions. **However, while selecting any technology which is not proven under the Indian conditions, extreme care should be taken about the suitability of technology under the given condition.**

EPC measures: Any waste handling, treatment and disposal facility, either for energy/resource recovery or only for waste destruction, can be a source of environmental pollution (air/ground/water and land/visual/ noise/odour pollution/ explosion), unless proper Environmental Pollution Control (EPC) measures are incorporated in its design and operation. It is necessary that each facility incorporates necessary safeguards to meet the statutory standards. The technical complexity and high cost of such measures may adversely affect the economics of certain technologies and favour adoption of other less complex technologies, even though the actual gains of waste treatment may be lesser.

Policy e.g. renewable energy and recycling policies: While each technology has its own role, the decision to adopt any technology can be greatly influenced by directly extending subsidies for particular options, as per e.g. encouraging higher purchase tariffs by Government for renewable energy or compost and by increasing the costs of landfilling MSW.

In general, the decision needs to be based on techno-economic viability of any option at the specific site keeping in view the local conditions and the available physical and financial resources. The urban local bodies should follow their own standard procedure of inviting bids and evaluating different options on merits. Due importance needs to be given to options which are techno-economically most viable/ sustainable in long run, environmentally most friendly and are suited to local needs, besides to the capability and experience of the technology provider in the area of solid waste management.

⇒ **RECOMMENDATION OF THE COMMITTEE CONSTITUTED BY HONOURABLE SUPREME COURT OF INDIA**

With the availability of land for processing and disposal of waste becoming scarce and the food and bio-degradable component useful to agriculture going waste, measures for conservation of land and organic waste resource shall be taken and organics shall be returned to the soil.

All organic/bio-degradable wastes collected from households, shops, markets, hotels and other establishments shall first be composted by following suitable methods of composting, encouraging public, NGO/CBO participation with or without power generation as deemed appropriate. Recyclable waste shall be passed on to recycling industry.

Only rejects and domestic hazardous waste shall be carefully landfilled. Bio-medical waste shall be disposed of as per the Bio-Medical Waste (Management and Handling) Rules 1998 (Annexed as Annexure - 9.)

CAUTION AGAINST USING UNPROVEN TECHNOLOGIES

Local bodies are cautioned not to adopt expensive technologies of power generation, fuel pelletization, incineration, etc., until they are proven under Indian condition and Government of India or expert agencies nominated by Government of India advises cities for adopting such technoligies.

MANDATORY PROVISION MADE IN MUNICIPAL SOLID WASTE (MANAGEMENT & HANDLING) RULES, 2000.

* Processing of municipal solid wastes.

Municipal authorities shall adopt suitable technology or combination of such technologies to make use of wastes so as to minimize burden on landfill. Following criteria shall be adopted, namely :—

(i) The biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of wastes. It shall be ensured that compost or any other end product shall comply with standards as specified in Schedule-IV;

(ii) Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can also be used for processing wastes in specific cases. Municipal authority or the operator of a facility wishing to use other state-of-the-art technologies shall approach the Central Pollution Control Board to get the standards laid down before applying for grant of authorization.

* Disposal of municipal solid wastes.

Landfilling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either, for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, landfilling shall be done following proper norms. Landfill sites shall meet the specifications as given in Schedule-III.

5. CONCLUSION & RECOMMENDATIONS

⇒ Composting of MSW is currently the most simple and straightforward technology for treatment of municipal solid waste and can be adopted by the urban local bodies following the guidelines given in the manual on Municipal Solid Waste Management prepared by Government of India in May, 2000. The local bodies must, however, ensure that the compost meets the standards prescibed in Municipal Solid Waste (Management & Handling) Rules 2000.

⇒ Different technologies for recovering energy/resource from Municipal Solid Waste do exist and are being extensively utilized in developed countries for their multiple benefits. However, no waste to energy technologies have been successfully demonstrated in developing countries to handle large quantities of MSW. Some of the technologies are now being attempted in India on a large-scale, some others are under advanced stages of development. Their results are yet to be seen. Cities may look at the results of the waste to energy plants coming up in India and take an appropriate decision after comparing the cost benefits and environmental impacts of such technologies.

⇒ Special efforts are needed on part of the Civic Bodies to promote waste segregation at source to ensure that mismatch between waste and any chosen technology is minimized. The aspect of waste contamination by hazardous/toxic substances is very critical and needs to be duly taken in to account, while finalizing the selection/design of any waste treatment facility for a given location. At places where segregation of waste at source is not practiced, at least central sorting facility should be introduced at the treatment sites to ensure that no contaminated or hazardous or toxic substance gets into MSW and adversely affect the quality of the compost or the end product.

⇒ Each technological option has its own pros and cons and no particular option can be applied universally across the length and breadth of the country with diverse climatic and local conditions including waste characteristics. A careful assessment has to be made in each specific case before deciding upon any particular option, duly taking into account the available waste quanities and characteristics and the local conditions. A relative assessment from environmental angle is also necessary, keeping in view the existing regulatory standards. It needs to be ensured that any proposed facility fully complies with the environmental regulations as laid down in the **Municiplal Solid Waste (Management & Handling) Rules 2000** issued by the Ministry of Environment and Forests and as may be amended from time to time, for preventing environmental degradation and maintenance of high standards for protection of environment.

The State Governments are, therefore, recommended to promote setting up demonstration/pilot plants of various successful technologies for municipal solid waste treatment in the State, which may serve as a model for other cities and towns to follow. Such pilot plants could also be used for research and development and refinement of technologies to be used in the state. Models should be developed for different sizes of cities to facilitate easy replication.

⇒ **TECHNOLOGY PROVIDERS ALONG WITH PROFILE OF THEIR REPORTED CAPABILITIES/PROCESSES :**

All technology providers/companies in the area of waste management, within and outside the country, were invited through press advertisements in leading newspapers in mega cities as well as by writing to various foreign embassies/commercial offices in India, to provide details of the technologies being offered by them and to make presentation of the same before the Core Group. They were also given a common format to furnish details of their technologies, covering their experience in the field, the suitability of the technology under Indian conditions, the requirement of finance, manpower, land, water, power, etc. for setting up waste treatment facility in India etc. A copy of the advertisement given is placed at Annexure-VI. In response to this invitation, several technology providers/which were subsequently organized before the Core Group on 2nd, 3rd, 29th and 30th of August 2000, at New Delhi.

⇒ A list of the technology providers along with profile of their reported capabilities/processes, including the information furnished by them w.r.t. requirement of land, water, power, manpower, finances, etc., is given in the Annexure-IV. This includes a few technology providers who furnished the information but did not turn up for making a presentation as well as the list of some technology providers for landfills such as landfill operators, landfill design consultants, landfill waste characterization and environmental impact assessment consultants.

⇒ **The participation of technology providers in the exercise is very limited and does not cover the entire range of solid waste management services available world-wide. Therefore, it will not be desirable to ignore other options/companies, on which no information is presently available with TAG. As such, decision reg. choice of technology/technology provider, should not be limited only to the listed technology providers, as there may be many vendors/promoters of different technologies. The details/ claims of different technoligies by various companies, which are given in the Annexure-IV, need to be considered as only indicative.**

CHAPTER—5

WASTE HANDLING VEHICLES AND EQUIPMENT

Invitation to manufacturers/suppliers of Vehicle and Equipments

Wide publicity was given in leading newspapers in mega cities of India as well as letters were written to various embassies and commercial offices of foreign countries in India inviting the vehicle manufacturers/ suppliers to furnish details of the vehicles and equipments manufactured and supplied by them for handling municipal solid wastes may be suitable under Indian conditions to facilitate identification of appropriate vehicles and equipments which could be recommended to urban local bodies in India.

Responses to the advertisement/letters

In response to the advertisement given and the letters written to various agencies, 15 vehicles manufacturers and suppliers furnished information about their vehicles and equipments to the Core Group Secretariat and some of them showed willingness to make a presentation.

Presentations before the Core Group

The vehicles manufacturers and suppliers providers who responded to the advertisements given and furnished the information about their vehicles and equipments, were requested to make and short presentation before the Core Group on 3rd, 29th and 30th August, 2000 at New Delhi and those present were heard by the Core Group as under.

Manufacture of vehicles and equipment

3rd August 2000

1. Maniar and Company
2. Urban Waste Management Limited
3. Escorts Construction Equipment Ltd.
4. Industrial Spares India Private Limited
5. Greaves Limited.

29th August 2000

1. Power Tech.
2. Svedale Industries India Pvt. Ltd., Haryana

30th August 2000

1. Swaraj Mazda.
2. Bharat Earth Movers Ltd.

Analysis of the presentations made

Based on the presentations made and the queries put to the presenters by the members of the Core Group, the Core Group has tried to analyze the appropriateness of vehicles and equipments in Indian conditions

and has looked into the capabilities of the vehicle manufacturers and suppliers. At the outset, the Core Group has felt that the participation of manufacturers and suppliers of vehicles and equipments is very limited and does not cover the wide range of vehicles and equipments used for solid waste management services. Therefore, it will not be desirable and prudent to make recommendations of only those vehicles and equipments alone, which have been presented before the Core Group and ignore those who have, for one or other reason, not been able to furnish information to the Core Group. The Core Group felt that it should give importance to the type of vehicles and equipments that are available, and proven, cost effective and sustainable in long run, and can be operated and maintained with the local expertise and not to recommend any specific vehicles and equipments to the urban local bodies. It may be left to the local body to select any vehicles and equipments from among those, which are listed as proven after carefully ascertaining the creditability and experience of the party in the sector of solid waste management. The Core group further makes it clear to urban local bodies that they should follow the procedure of short-listing the vehicle manufacturers and suppliers by inviting bids and evaluating them on merits. The technological details/options furnished in this report may be considered by them as indicative only.

The Technology Advisory Group concurs with the views of the Core Group and keeps the option open for the vehicles and equipments manufacturers and suppliers, who have not been in a position to make presentation before the Core Group in past, to submit the information about their vehicles and equipments to the Technology advisory Group for appropriate consideration to facilitate identification of more manufacturers and suppliers of vehicles and equipments suitable under the Indian conditions.

The Observations of the Core Group about the manufacturers and suppliers of vehicles who have made presentation are as under :

Maniar and Company

This company is a manufacturer of solid waste handling equipment. It has experience of over 50 years in the field. They manufacture small equipment mounted on tractors and trailers or attached to tractors. The hydraulic tipping is also provided for the containers mounted on tractors. They manufacture containers of various sizes. They have also developed power tillers four-wheelers having 12 HP capacity. 1.5 cubic meter containers can unload into a larger container at the transfer station. They have also developed front-end loader on a tractor costing in all Rs. 5.5 lacs. The bucket is of 0.3 cubic metre. 360 degree rotational facilities are available in a loader-cum-excavator developed by them.

The containers manufactured by them are of 10 gauge with channels and 18 inch ground clearance is available when container is carried by the tractor to the disposal site. They have developed auto removal system for primary collection of waste with a siren arragnement having a capacity of 1.2 cubic metre. It costs 1.75 lacs on a Vespa vehicle. They also manufacture dumper placer system on small and big vehicles with containers of 4.5 and 7 cu. metres with hydraulic system for automatic loading/unloading, etc. The partner of the firm Mr. Iqbal Maniar made presentation and explained the details of the products and their efficiency.

Observations

It was observed that these vehicles can be used by the municipal corporations and municipalities and tractor driven equipment could be conveniently utilized by the smaller local bodies. The local bodies should however ensure that the steel plates used by the manufacturer are of appropriate gauge and of good quality. Using ante corrosive coatings.

Urban Waste Management Limited

This company is a manufacturer of solid waste management equipments. They are presently manufacturing and marketing UWM dumper placer system along with 4.5 to 7 cub. metre container. The dumper placer suitable for handling 4.5 cub. meter container is mounted on 6 ton GVW LCV whereas dumper placer for 7 cub. meter container is mounted on 16 ton GVW HCV. They also offer twin containers handling

dumper placer system mounted on 8 ton GVW chasis. Twin container handling dumper placer system facilitates lifting and taking up of the loaded container from the left side of the vehicle. For handling silt removal from the drains they provide 5 cub. meter capacity open container with a facility of covering with tarpaulin. They also manufacture refuse collector having 6 cub. meter capacity suitable for house to house collection. Containers of 0.4 cub. meter capacity are used with these refuse collectors. The company has suggested that if SAICOR type of steel manufactured by Bokaro Plant is used it could give three times more life of the containers with only 30% extra cost and they can guarantee seven years life of the containers. The company has supplied vehicles and equipment to several cities in India. Company also makes UWM covered tipper trucks. These tipper trucks are of 10 cub. meter capacity and are provided with hydraulically operated cover. The body is provided with stainless steel lining. They also market mechanical road sweeper manufactured by M/s. Johnston Engineering Ltd., UK.

The company made a presentation and discussed the advantages of their system and furnished the photograph of the equipment manufactured. The details and technical specifications were given.

Observations

Looking to the technological details furnished, the dumper placer system and the refuse collector developed by the company are suitable for handling municipal solid waste in the urban areas.

Escorts Constructions Equipment Ltd.

This company is a manufacturer of vehicles and equipments. They manufacture front end loaders of 0.5 cub. meter capacity with a articulated boom grains of 2 TM to 80 TM for municipal application. They have 28 years of experience of front end loaders and 5 years of experience of articulated boom end. They supply front end loaders of different models costing 6.2 lacs to 6.95 lacs and the articulated boom grain cost 14 to 22 lacs. This equipment has been supplied to various cities and corporations and industries in the country and they are being used for garbage handling. For loading garbage into the trucks and the cranes can very efficiently be used for removing silt from the nallas. They have furnished the details of the products.

Observations

Looking to their products, they are quite efficient and sturdy but their application for handling municipal solid waste is now getting limited as waste is not required to be collected in open. Therefore, the use of loaders for handling MSW gets restricted and not recommended. However, these loaders can be effectively used for lifting of construction waste, debris, etc. and the boom cranes can be utilized for cleaning of nallas efficiently having a fleet of simple truck attached to one crane for optimum utilization of the cranes. The use of both the above equipments are recommended on the lines indicated above.

Industrial Spares India Limited

This company has come forward as SWM equipment providers. They market mechanized road sweeper machines. Vehicle's mounted capacity to sweep is 6000 sq. meter per hour to 25000 sq. meter per hour. The vehicles are manufactured abroad and utilized in foreign countries and they suggest that model R 1200 and Coro 140 city can efficiently work on the Indian roads. They have given the details of the equipment being marketed by them. The cost of the mechanical road sweeper that was recommended for Indian roads are ranging from 40 lacs and above. They are prohibitively expensive, besides their spares, etc. would always be a problem as the vehicles is not manufactured in India.

Observations

Use of such vehicles, which are imported having very high value and difficulty in getting spare parts are not recommended at this juncture.

Greaves Limited

Greaves Limited company manufactures equipment for handling MSW. They gave details about various models of refuse compactors. They have furnished the details of the equipments provided. They claim that these refuse compactors are very powerful and can bring about a good compaction to the range of 1 to 4.

Observations

The compaction rate suggested does not hold good under Indian conditions as the Indian garbage has very small percentage of packaging and recyclable material. The cost of the equipment mentioned is very high, unaffordable by the urban local bodies in India, besides their repairs and maintenance would also be difficult. Use of these equipments are, therefore not recommended.

Swaraj Mazda

They manufacture light commercial vehicle 3.5 to 8.8 mt capacity 3.3 wheel base.

This company manufactures three categories of vehicles and equipments.

1. Wt48 dumper placer type vehicle of 6 cmt capacity.

2. Dumper placer vehicles having pair of containers of 2.5 to 3.5 cmt capacity each.

3. Compactors having a capacity of 6 cmt capacity. This compactors can lift of 0.6 cmt capacity.

They have a large net work of 150 dealers in the country with workshop facility. Five Zonal Offices and they have supplied more than 500 vehicles in all over the county.

They can take maintenance contract if 15 to 20 vehicles are purchased. They can provide training to the workshop staff for running their vehicles and its maintenance. The cost of one such dumper placer is 5 to 6 lacs. The twin containered dumper placer costs Rs. 6.5 lacs. They suggest use of 3.5 cmt bin with light motor commercial vehicle to avoid any problem on account of filling in silt in the container. They have supplied vehicles to several Local Bodies and have got repeat orders.

Observations

The products appear reliable and can be utilized by the ULBs.

Bharat Earth Movers Ltd.

Bharat Earth Movers Ltd manufactures heavy earth moving equipment. They have three plants in India. They make range of bull dozzers and excavators. It is an ISO 9000 company. They make bull dozzers as well as wheel dozzers of various makes. BD 31 is of 66 horse power and BD 50 is of 90 HP. These are widely used. Wheel dozzers are of 130 HP with no chain. It can move freely from one place to another. The bull dozzers are used for bulk clearance. They also manufacture excavators and loaders of 1cmt loader bucket and 72 HP engine as well as small front end loader of 59 HP, which is very versatile. They manufacture long boom excavators to carry on de-silting from distance of 60 feet with a bucket of 0.45 cmt.

Observations

Bhart Earth Movers Ltd is a renowned company manufacturing standard products and their products are recommended for use at the landfill site as well as for handling municipal solid waste.

Power Tech.

Power Tech, is a tractor trailed road vacuum sweeper manufacturing company. This company has been manufacturing mechanical road sweepers having central brush and the side brush to clean the streets. Its operation was shown on the video and the details were explained. The vehicle design a simple and sturdy can be driven by a tractor. It has an in-built arrangement to pick up garbage earth and small pieces of grit, bricks, stones

from the streets and transfer to 4cmt storage tank. It has a powerful suction nozzle, which can suck loose material lying around. This machine is being utilized in Ludhiana satisfactorily.

Observations

The machine design seems to be suitable for street cleaning provided the roads are properly paved. The use of this machine can replace large number of sweepers from the roads, which are brought under mechanical road sweeping. The use of this vehicle is recommended.

Svedal Industries India Pvt. Ltd., Haryana

This company provides equipments for handling bulky refuse, metal and scraps and provides hammer mills, etc. They provide rotor sears, screening and mixing drums and double screw press. During the presentation literature has been furnished for various equipments.

Observations

The equipments manufactured are not very much in use in India at the moment nor are they recommended at this stage. Mega cities like Mumbai, Delhi, Calcutta and Chennai can separately consider use of such equipments when required.

Bull Machines Pvt. Ltd., Coimbatore

This company provides equipment and machinery for handling door to door and streetwise collection, storage and transportation of Municipal Solid Waste. It provides tractor driven road sweepers, Bio-pulverisers/ Shredders, Loaders with grabbing buckets, self propelled Windrow Turners, Mobile Screeners and other compost handling machineries. Literature has been furnished for all equipments.

Observations

Since most of the equipment and machinery manufactured by the company is tractor based, it is easy to operate and maintain as spare parts for tractors are easily available if required. The company takes operation and maintenance contract also.

RECOMMENDATION OF THE COMMITTEE APPOINTED BY THE HONOURABLE SUPREME COURT ON TRANSPORTATION OF WASTE.

TRANSPORTATION of waste shall be done regularly to ensure that the containers/trolleys and dustbin sites are cleared before they start overflowing. The frequency of transportation shall be arranged accordingly. The system of transportation of waste must synchronize with bulk storage of waste at the temporary waste storage depots. Multiple and manual handling of waste should be avoided.

Mandatory directions contained in Municipal Solid Waste (Management & Handling) Rules 2000 in regard to transportation of municipal solid wastes.

Vehicle used for transportation of wastes shall be covered. Waste should not be visible to public nor exposed to open environment preventing their scattering. The following criteria shall be met, namely:—

(i) The storage facilities set up by municipal authorities shall be daily attended for clearing of wastes. The bins or containers wherever placed shall be cleaned before they start overflowing.

(ii) Transportation vehicles shall be so designed that multiple handling of waste, prior to final disposal is avoided.

Conclusion & Recommendation

⇒ The vehicles and equipments manufactured by Maniar and Company, Swaraj Mazda, Urban Waste Management Limited, Escorts Construction Equipments, Bharat Earth Movers, Power Tech are found suitable for handling MSW.

⇒ The vehicles and equipment supplied by Industrial Spares India Limited, Greaves Limited, Svedale Industries India Private Limited are very expensive and not easily maintainable or desirable to be used in the Indian conditions.

⇒ Mega cities in India can consider using expensive equipment only after making a thorough search of technology providers and after very careful scrutiny of the efficacy of the equipment offered.

⇒ There are variety of vehicles and equipment manufacturers in India; but they have not come forward to make presentation before the Core Group. The urban local bodies should, therefore, carefully evaluate the quality of vehicles and equipment being offered to them by the manufacturers and suppliers of vehicles and equipments and take the decision on merits.

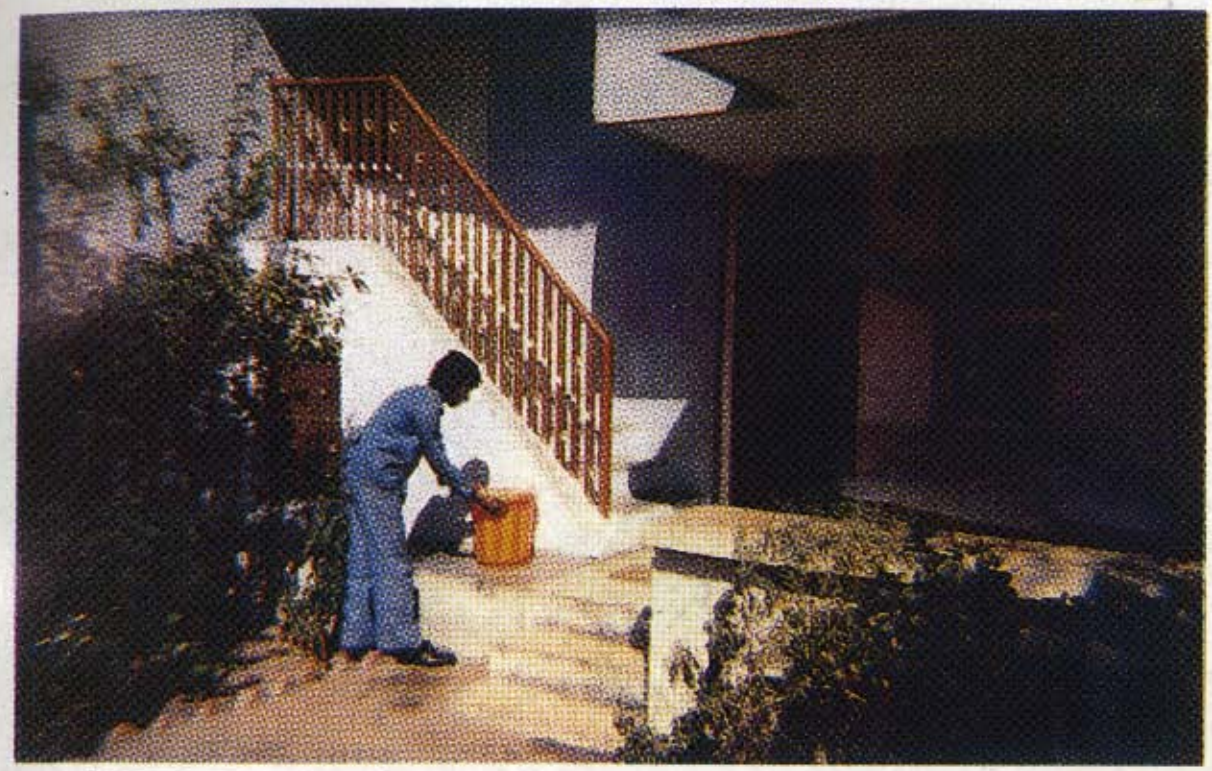
⇒ It would be desirable that smaller local bodies may go for tractor mounted or tractor driven transport system whereas larger cities may consider using sophisticated hydraulic equipment such as dumper placers, roll on roll off vehicles, non-compacting refuse collectors, for transportation of waste.

⇒ ULBs should introduce containerized system as shown below beginning from containerized handcarts for primary collection of waste to large sized containers for secondary storage of waste and use of vehicles as stated above for transportation of waste. They may also use large vehicles for transportation of waste to long distances (exceeding 15 KM) using transfer stations for intermediate transfer of waste.

⇒ Use of front-end loaders for bulk handling of inert waste material, wheel dozzers and bull dozzers for spreading and compactions of waste at the landfill sites are recommended.

⇒ The use of compactor vehicles, highly mechanical, large size road sweepers and very expensive machineries are generally not recommended as their O & M cost will be high, day to day maintenance and availability of spares would be difficult. Mega cities may, however, consider using them only after evaluating their appropriateness in a given situation.

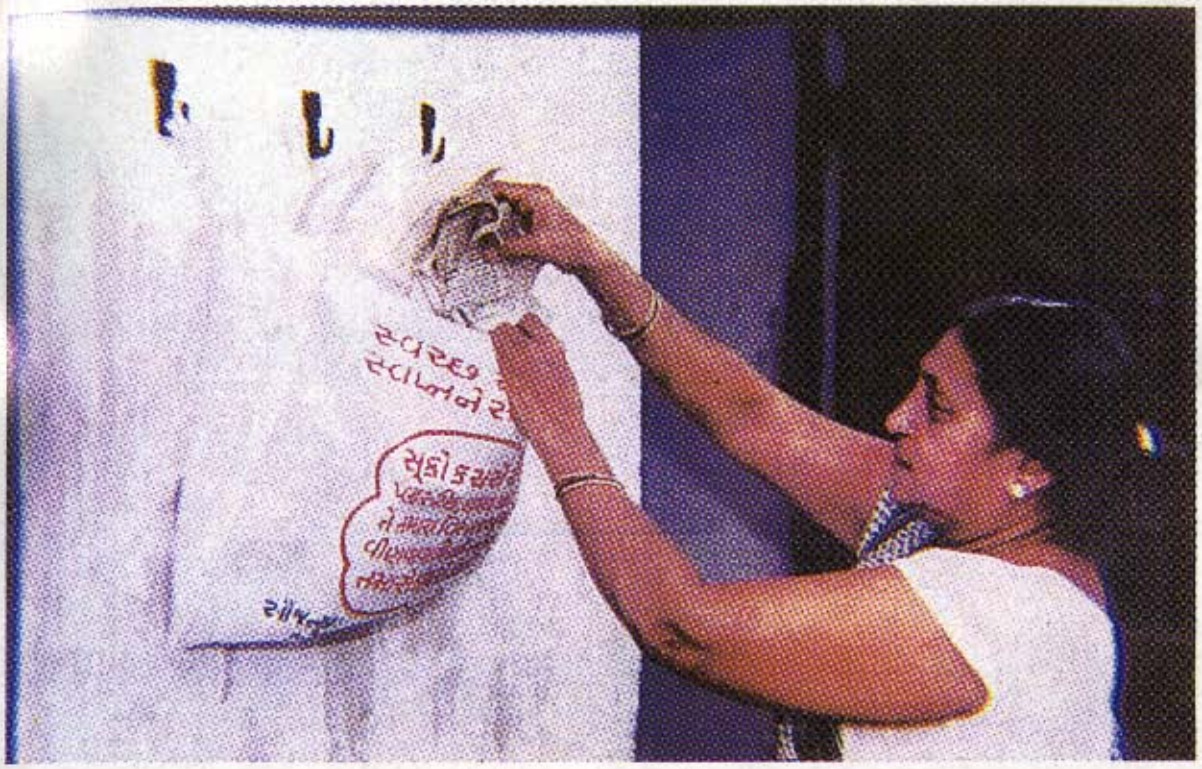
RECOMMENDED CONTAINRIZED SYSTEM FOR WASTE MANAGEMENT



DOMESTIC WASTE STORAGE BIN MAINTAINED AT HOUSEHOLD LEVEL

DOORSTEP COLLECTION OF WASTE IN CONTAINERIZED HANDCARTS

3221 UD&PA/03—7A



RECYCLABLE WASTE BEING STORED SEPARATELY AT HOME

RECYCLABLE WASTE BEING HANDED OVER TO A WASTE PICKER

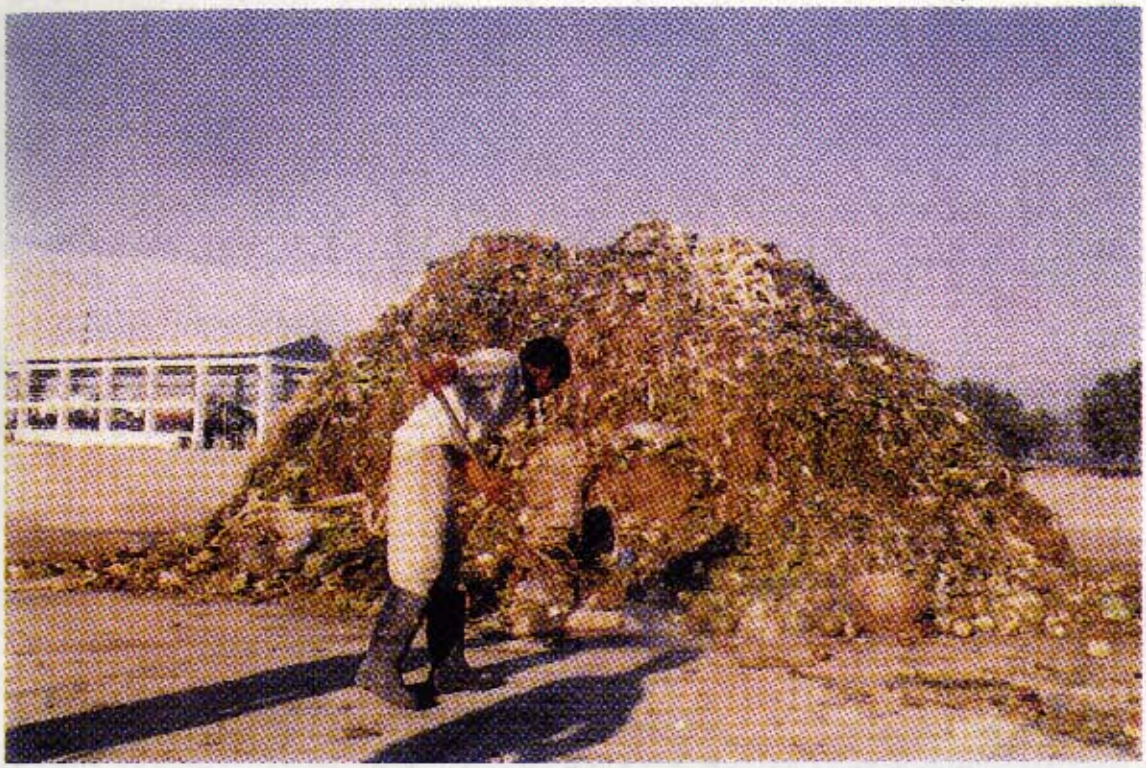
A COMMUNITY BIN BEING USED BY A SLUM DWELLER FOR DEPOSITING WASTE

FILLED COMMUNITY WASTE BIN BEING REPLACED BY SANITATION STAFF

WASTE COLLECTED FROM THE DOORSTEP BEING TAKEN TO WASTE STORAGE DEPOT (CONTAINER)

CLOSED BODY CONTAINER BEING TRANSPORTED TO THE TREATMENT PLANT

CONTRAINER BEING UNLOADED AT THE TREATMENT PLANT FOR COMPOSTING OF WASTE



PROCESSING OF WASTE THROUGH AEROBIC COMPOSTING

SIEVING OF COMPOSTED MATTER AT THE COMPOST PLANT

SANITARY LANDFILL SITE UNDER PREPARATION

CHAPTER—6

FINANCIAL RESOURCES

Most of the urban local bodies in India are financially weak for various reasons and have not been able to discharge their obligatory functions satisfactorily. The subject of solid waste management has received low priority over the period of years with the result of allocation of funds for improving solid waste management practices has by and large remained negligible resulting in deterioration of services from time to time.

Municipal Solid Waste (Management and Handling) Rules, 2000 now make it mandatory for the urban local bodies to provide adequate level of service as prescribed under the rules and meet the standards laid down. This necessitates adequate financial allocation for solid waste management or adoption of innovative methods of public/private partnership and or NGO/private sector participation in the delivery of solid waste management services.

INCOME AND EXPENDITURE HEADS PROFILE FOR SWM IN ULBs

The quantum of money currently available with ULBs is clearly not adequate. As per findings of a recently concluded survey by NIUA, the service either generates no revenue or the revenue generated is not very significant. An analysis of revenue and expenditure of ULBs indicates that the current cost recovery rates are negilible. Most of the local bodies do not levy tax or user charges for solid waste management, though the same is permissible under various state laws.

However, in the states where the income is generated from SWM activities, it is usually deposited in the general revenue account and no separate account is maintained. This raises two problems : one, it becomes difficult to readily assess the income and expenditure levels and to realize the implications thereof; and second, SWM allocations (e.g. for routine maintenance etc.) become a factor of the seasonal variations in the revenue stream of the general budget. Further, since solid waste operating costs often are not broken out from other costs, there is less incentive for efficient operation of the system. If cost savings are instituted, the saving accrue to the general fund rather than the solid waste system. Maharashtra is the only state in India that compulsorily requires all Class I cities to maintain a separate budget for water and sanitation. It would be beneficial for cities to move toward an enterprise fund[1]. Sound financial management of a proposed waste management system requires decision makers to know the operating and capital costs and projected revenues of each waste management alternative. Further this will provide the basis for establishing and collecting charges. ULBs must also be introduced to the concept of Full Cost Accounting[2] so they recognized the importance of making provisions of future financial demands, such as landfill closure costs etc.

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[1] Enterprise Fund may be defined as a fund for a specific purpose that is self-supporting from the revenue it generates. In order to overcome the problem of erratic cash flows throughout the years, local bodies must set up an enterprise fund for SWM, into which all service fees, conservancy tax etc are deposited. This will ensure a consistent cash flow or regular operating expenses such as purchase of parts and repairs. In the long run, this will also help local bodies to indentify service income, expenditure and required element of transfers and subsidies.

[2] Full Cost Accounting (FCA) includes accounting for past (up-front costs such as project development costs) and future outlays (back end costs such as post closure landfill costs). FCA includes provisions for costs rather than outlays (an outlay is an expenditure of cash to acquire or use a resource. A cost is the value of the resource as it is used. For example, an outlay is made when a collection truck is purchased, but the cost of the truck is incurred over its active life (e.g 10 years). The cost of the truck must be allocated over a period of time because every year of its use contributes to the deterioration of the truck's value. Further FCA includes accounting for hidden costs, overhead and indirect costs that may typically be shared with other departments (such as legal service, administrative support, data processing, purchasing etc.).

Typically capital fund allocations for SWM are made on an as and when required basis. Interagency coordination and a city level plan, with related budget estimates are usually absent. This leads to reduced efficiency in capital spending. As a result systems are not always synchronized and there have been instances where money has been ill spend on mismatched equipment.

INCOME

Operating Revenue

For solid waste systems, it is essential that the operating and maintenance costs be carefully assessed for any project. SW collection equipment is relatively short-lived and operating and maintenance costs are substantial. Operations and maintenance costs may be obtained from two sources : current general revenues (dependent upon the resources base of the ULB) and SWM operating revenue (essentially user charges).

— Tax financing

Traditionally funding for solid waste systems comes from the general fund. Most ULBs use a percentage of the property tax to support the solid waste management system. This tax, known as conservancy tax, is easy to administer since no separate billing or collection system is needed. However, the disadvantage is that in most Indian cities assessment and collection of property tax is poor and this poor base provides for very little income. Further, such tax financing is completely divorced from income and expenditure of service and provides no incentive to local bodies to instituted efficiencies. Bangalore proposes to introduce a sanitary tax and has moved a bill to this effect.

— User charges

User charges can be an equitable means of funding SWM services if properly administered. These are an excellent means of placing explicit costs on each households contribution to the waste stream. Further these may be used as an incentive to reduce waste generation and encourage recycling, especially if structured so that those who pollute more pay more. Increased public awareness of solid waste issues and public involvement in decision-making process may provide the opportunity to adjust user charges to reflect real costs of providing solid waste services. User fee can be assessed at a uniform or variable rate, depending on the amount and kind or service provided.

Cities are increasing proposing to introduce user charges, for example Vijayawada (Hyderabad) and Gandhinagar (Gujarat) propose to establish user charges for all category of user. Mumbai has introduced establishment charges for commercial outfits as a first step and though the implementation and collection of the same is weak at this point, the city proposes to improve the same as also extend user charge to other categories.

Primary problems with user charges are billing, difficulties in administration, and the fact that if they truly reflect costs; they may be too high for low income or fixed income persons and may lead to littering/open dumping.

In large cities the NGOs are coming forward to organize ragpickers and introduce through them house-to-house collection of waste by charging a monthly fee ranging from Rs. 10 to Rs. 25. At some places it is given Rs. 40 per month. This information arrangement is working quite satisfactorily at many places and reduces the burden of the urban local body. This system needs to be encouraged and NGOs may be promoted to take up such activities. Resident welfare associations are also being involved in primary collection of waste by giving incentives to them. This has worked very well in the city of Ludhiana where 65% of the city waste is being managed by the resident welfare associations.

— Fines (administration charges)

The SWM income for Mumbai shows income from administration charges. These charges are essentially fines imposed for dumping/littering of waste.

— Revenue from recovery programmes

Waste recycling, composting, waste-to-energy, and methane gas recovery programmes may generate operating revenues. Such programmes provide direct paybacks in terms of tangible financial benefits associated with recovered materials and conserved energy, and additional benefits due to avoided costs of land filling. Further these help increase the life of landfill facility. In India, waste composting facilities are beginning to see much success. Many such facilities have been set up under joint initiatives by local governments and private sector. Waste-to-energy projects are also beginning to draw the attention of local governments.

— Disposal site fees

Typically Indian cities resort to open dumping of waste and sanitary landfills are conspicuous by their absence. It is only in the few years that waste recovery facilities (composting, waste-to-energy) have begun to emerge. However at the end of such treatment there still remains waste has to be disposed in a sanitary landfill. At present no city in India charges a disposal site fee such as tipping fee etc. Typically such fee is charged based upon the quantity of waste dumped for landfill at the disposal site. Such fee must be designed to reflect operating costs, especially the costs of environmental control as, closure, post closure maintenance and liability. Fees calculation may also depend on the type of refuse received.

EXPENDITURE

Operating Expenditure

Solid waste management may constitute upto 20 to 50 percent of municipal budget expenditure. The main expenditure heads under SWM are as follows : salaries and wages, consumables, vehicles repair, contingencies and others.

— Salaries and wages

As much as 30 to 50 percent of municipal staff in a local body may be engaged in SWM activities. Most of this staff is engaged in waste collection and transportation. A recent survey by the National Institute of Urban Affairs shows "salaries and wages" for SWM in Class-I cities, may constitute as much as 75 percent of total SWM expenditure. This is still higher at 85 percent in Class-II cities.

Capital investments

Typically, in Indian cities, capital fund allocations for SWM are made on an as and when required basis. Further, interagency coordination and city level planning with related budget estimates, is usually absent in most local bodies. This leads to reduced efficiency in capital spending. As a result systems are not always synchronized and there have been instances where money has been ill spent on mismatched equipment.

— Current general revenue capital financing

Typically capital costs for SWM in India are met from the current revenue and borrowings, with allocations being made on an as and when required basis. Such use of current revenues for capital financing essentially depends on the local body's resource base. Capital investments may be for : equipment, vehicles, treatment and disposal facilities.

— Borrowing – Municipal bonds, Bank/FI loans, Leasing

Borrowings are another source of capital financing. Cities are increasing beginning to access the capital market by issuing municipal bonds. Though no city has used such borrowing for SWM projects so far, this remains a potential source for capital financing.

Cities borrow from financial institutions such as HUDCO, for financing equipment and vehicles (refer section on Financial Institutions).

The Ahmedabad Municipal Corporation is in an advanced stage of discussion with ICICI for finalizing a lease financing arrangement for equipment and vehicle leasing. This may develop as a potential model for such financing to local bodies (refer section on Financial Institutions).

Private financing (PSP)

Over the recent years the country has seen an increased role of the private sector in financing resource recovery (composting, waste-to-energy) facilities. As many as 35 composting facilities have been set up in the country with Private Sector Participation, over the past five years. Earlier this year work commenced on the first waste-to-energy facility in the country. Private sector funding is a potential source for the sector (refer section on Private Sector Participation)

— Grant Funding

Grant funding has been used in a number of cities for financing procurement of equipment and vehicles for SWM. However such funding has had limited impact, since interagency coordination and city level planning is absent in most local bodies, and in cases such money has been ill spent on mismatched equipment. Grant funding must be linked to development of city plans for SWM to better utilize the same. Further the donor must monitor such expenditures. Further, in addition to equipment compatibility, local bodies must also ensure ease of replacement upon end of useful life of equipment.

— State and Regional Programme Management and Coordination (Regionalisation)

Regionalisation/resource pooling is another potential source for capital financing. Under this arrangement local bodies may come together to : develop/construct common facilities, or to access capital market to raise financing for such projects, or conduct waste characterization studies etc. This helps distribute costs. Resource pooling may also enhance the cost-effectiveness of recycling and recovery efforts. Such arrangements may be applicable in suburbs of cities such as Mumbai etc. where land is at a premium and there is direct advantage in developing common treatment and disposal facilities.

In the year 2000 the Vijayawada Municipal Corporation tied up with an entreprencur for setting up a waste pelletisation project on a BOO basis. The project will also proposes to utilize waste from the nearby city of Guntur. Resource pooling allows greater economies of scale however the same must be carefully evaluated against parameters such as cost of transportation of waste etc., before arriving at the desired approach.

GOI SCHEMES/SUBSIDIES AVAILABLE FOR SWM

A. SUPPORT TO CITIES FOR SWM

Integrated Dvelopment of Small and Medium Towns

The Centrally Sponsored Scheme of Integrated Development of Small and Medium Towns (IDSMT) was initiated during the 6th Five year Plan in 1979-80. The Scheme has continued in the 7th, 8th and 9th Plans. Its key objectives amongst others include : improving infrastructure facilities; and promoting resources generating scheme for ULBs to improve their overall financial position. The scheme is applicable to towns/cities with population up to 5 lakhs where elections to the local bodies have been held. The projects funded under IDSMT have to be of citywide significance and in accordance with City Development Plans. These may include Solid Waste Management projects.

Since the inception of the Scheme till March 31, 1999, as many as 945 towns have been covered under the Scheme from all the States and Union Territories, and Central assistance amounting to approximately

Rs. 3452 million released for these towns. Besides, Rs. 82 million have been released under the Central Urban Infrastructure Support Scheme (CUISS) to about 370 towns for the preparation of project reports/development plans.

This scheme has not been instrumental in providing an impetus to improved Solid Waste Management.

Mega City Scheme

The Centrally-sponsored Scheme of Infrastructure Development in Mega Cities has been in operation from 1993-94. The Scheme is applicable to Mumbai, Calcutta, Chennai, Bangalore and Hyderabad. The primary objective of the scheme is to undertake infrastructure development projects of citywide significance covering components such as water, sewerage, roads, etc. including SWM.

The fund-sharing between Central Govt. and State Govt. is at 25 percent : 25 percent; the balance 50 percent is to be met from institutional finance/market funds. Funds will flow from the Central and State Governments to the nodal agency as a grant. However, the amounts flowing from the nodal agency to the implementing agencies for projects would be a mix of loans and grants such that 75 percent of the Central and State shares are recovered back into a Revolving Fund at the level of the Mega City Scheme nodal agency. The objective is to create and maintain a special fund for the development of infrastructure assets on a sustained basis.

As of 31st December 1999, more than 375 projects have been undertaken under the Mega City Scheme at a total project cost of about Rs. 30897.8 million. Of this Central Assistance provided is about Rs. 5138.5 million, State share mobilised is about Rs. 5769.8 million. None of the projects financed under the Mega City scheme were for Solid Waste Management. Further due to slow progress in designing direct and indirect cost recovery instruments not much success has been achieved regarding the Revolving Fund for sustained investment in infrastructure.

B. SUBSIDIES AVAILABLE TO CITIES AND PRIVATE SECTOR FOR RESOURCE RECOVERY PROGRAMMES

The enormous increase in the quantum and diversity of waste materials generated by human activity has led to an increasing awareness about an urgent need to adopt efficient, scientific and safe methods for the treatment, processing and disposal of waste. In recent years there has been an increasing emphasis by the government on resource recovery, such as reduction of organic fertilizer/soil conditioner, bio-energy, power etc. for value addition as well as saving of precious natural resources. Such resource recovery helps extend the "useful life" of a landfill site. The Ministry of Agriculture and the Ministry of Environment and Forest has been actively promoting waste composting, while the Ministry of Non-Conventional Energy Sources has designed schemes to promote waste-to-energy projects. Further the Ministry of Environment and Forests had also sanctioned a project to the Central Road Research Institute for conducting research for effective utilization of municipal solid waste in road construction.

Waste-to-Compost

PROGRAMMES FOR PROMOTION OF WASTE COMPOSTING PLANTS

During 1975 to 1985 eleven mechanical composting plants, with processing capacities ranging from 150 to 300 tons of municipal solid waste per day, were set up. The technology and institutional arrangements varied from each city. However, today with the exception of Delhi and Bangalore, all of the above-mentioned plants have been closed down. **Even plants in these two cities are operating at a much lower capacity,** less than 30 tons per day, with substantial financial subsidy from their respective state government.

Factors Responsible for the Closure of Mechanized Composting Plants set up during 1975—1985.

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It is felt that instead of giving the reasons for the failure of the plants in a tabular form, the reasons may be listed, since all the plants suffered from some common problems eg.

⇒ Over mechanisation,

⇒ the capital as well as operating costs of the plants were very high.

⇒ The sale price was high and the farmers were not willing to puchase the same at such a high price

⇒ The plant authorities did not make any marketing effort.

⇒ Some of the units such as magnetic separator, mixing drum had no useful role and only led to an increase in the capital as well as operating cost.

⇒ The auger mechanism that was used in a majority of the plants had a very low mixing efficiency.

In addition to the above common problems, some of the plants had their own inherent problems such as

⇒ In Bombay, the capital cost was very high due to the cost of the shed over the windrow yard, as well as the diffused air supply arrangement. Further, the reception hopper as well as the feeding crane were provided for the same work.

⇒ Kanpur plant was located at a site which was prone to flooding

⇒ The land available at the Calcutta plant was inadequate.

Learning from past experiences

As is evident from past experience sustainability of composting operations over long period is a function of proper operation and maintenance of the plant. Composting technology has undergone substantial changes from 1974 to 2000, thereby having a bearing on the commercial viability of the venture. The quality and demand of organic compost has improved substantially. However, because there are hidden costs and benefits, municipal solid waste composting cannot be assessed solely on a commercial basis. The current ex-factory sale price of compost ranges from Rs. 1800 to Rs. 2400 per MT.[5]. However, after loading on trucking and distribution costs the sale price may be high as Rs. 3500 to Rs. 4000 per MT. The current mechanism for setting compost price is arbitrary and is essentially driven by market demand. No tax is levied on compost.

During the period 1995 to 2000, approximately 50 numbers of compost facilities have emerged. Since the ownership of most of these plants rests with the private entrepreneurs or at times by the entrepreneur jointly with FIs or ULBs, the commercial risk is shared between the parties involved. Moreover in most cases long-term agreements have been reached between the ULB and entrepreneur, therby shifting the onus of proper operation and maintenance of the plant onto the entrepreneur.

On-going GOI schemes to promote municipal solid waste composting

The Ministry of Agriculture and the Ministry of Environment and Forest have two separate schemes to promote municipal solid waste composting. Both schemes provide only subsidies and do not follow through implementation and performance monitoring. As a result the impact of these schemes are not known readily at the GOI level.

i. The Ministry of Agriculture (MOA) introduced a centrally sponsored "Balanced and Integrated Use of Fertilizers" in 1992 (Eight five-year plan period 1992—97), under which support is given to local bodies and private sector (included recently) for setting up compost plants for converting MSW into

[5] NOTE : Compost is essentially a bio-organic soil enricher and works extremely well when used with chemical fertilizers.

compost. This grant is available for upto one-third of the project cost subject to a mximum of Rs. 5 million per project. The grant is provided for building, plant and machinery only. The allowable treatment capacity of the plant is 50 to 100 TPD. According to the MOA a total number of 38 projects were taken up under this scheme. The total Central Assistance proposed during the Ninth plan period (1997—2002) procedure for release of central grant through State Governments is Rs. 180 million and the budget provision during the current financial year is Rs. 5 crores.

ii. The Ministry of environment and forest initiated a scheme to provide financial subsidy to the tune of 50% of the capital cost to set up pilot/demonstration project on Municipal Solid Waste composting. The Ministry also extended limited financial assistance for waste characterization and feasibility studies. The scheme was introduced in 1992 and the Ministry sanctions the following three projects.

   i. The municipal solid waste management project Nagar Nigam, Ghaziabad at a cost of 55 lacs.

   ii. Pilot project for solid waste management for Hyderabad City, Municipal Corporation, Hyderabad at a cost of 53.3 lacs.

   iii. Pilot project for solid waste management in Shimla at a total cost of Rs. 25 lacs.

None of the above projects have been established or commissioned.

Other Concessions by State Governments and Urban Local Bodies.

i. **Land :** In many cases the State Government/ULBs make land available to the entrepreneur for siting of composting facility at a nominal lease. This is primarily to improve the commercial viability of the venture in order to promote resource recovery.

ii. **Other :** Some State agricultural Departments are considering subsidizing the price of such compost in order to promote waste composting facilities.

It is imperative that these be strictly implemented. It would also be useful to test the raw material coming to these composting facilities to ensure that it excludes hazardous and medical waste.

Waste segregation at source should be aggressively promoted. Waste quality directly determines the costs of pre-processing of waste to suit the chosen technology. Enforcement of strict measures to avoid mixing of undesirable waste streams will play a major role in making such facilities more viable.

Finally, terms for MSW supply, allotment of land and market for the end product directly affect the net revenue to the facility operator and thus are factors in determining the financial viability of projects. It is necessary that the terms are conducive enough to attract private sector participation in the activity.

PROGRAMME FOR PROMOTION OF WASTE-TO-ENERGY

Past Efforts

One of the initial initiatives of the Government was in supporting the setting up of a refuse incineration-cum-power generation plant at Timarpur, New Delhi in 1987. This was set up as an R&D project using Danish Technology and financial support from Govt. of Denmark. However, it could not operate satisfactorily on continuous basis due to mismatch between the incoming waste fed into the plant and the plant design and the Govt. decided to close down the facility. It was later planned to lease it out to interested entrepreneurs who could make their own investment in making necessary modifications in the plant and operate it on commercial basis, but the exercise was dropped as no offer was considered acceptable. Considering that the plant is based

on over 14 year old incineration technology which has seen much advancements and it will make better sense to set up an altogether new plant based on latest technology, the plant is now being disposed of.

Support from Central Government for Waste to Energy Projects :

In the year 1995-96, the National Programme on Energy Recovery from Urban and Industrial Wastes was launched by the Ministry of Non-Conventional Engergy Sources (MNES), which is being continued over the years. The objective of the program is to create an environment and fiscal regime conducive to improving waste management practices. The program provided various types of fiscal and financial incentives to ULBs and private firms for setting up waste to energy facilities. As a result of this programme, there has been much interest for partnering amongst local bodies and private sector for setting up projects for generating of power from municipal solid waste.

A number of feasibility studies for setting up projects on energy recovery from waste have been supported under the programme in different States : UP (11 studies), Haryana (7), Andhra Pradesh (6), Gujarat (4), Madhya Pradesh (7), Karnataka (1) and Kerala (1).

On-going Efforts

In the Scheme for year 2000-01, incentives were modified to make the program more attractive to the private sector. Current incentives include an interest subsidy, financial assistance, support for TA studies, and service charges to FIs for channeling these subsidies.

- A plant to convert 700 TPD MSW in to 210 TPD of RDF Pellets is being set up by a private enterpreneur on BOO basis in association with the Hyderabad Municipal Corporation. It is based on the Pelletisation technology developed by the Department of Science & Technology (DST). The pellets so produced would be used for industrial fuel initially and for 6 MW power generation ultimately. One line of 105 TPD fuel pellets has already been established, which is under trial operations.

- Two other projects being set up by private enterpreneurs on BOO basis are (i) project in Nagpur city to generate 4 MW power and 150 TPD of compost from 500 TPD of MSW using Biomethanation technology, which is under installation and (ii) project in Lucknow city to generate 5 MW power and 75 TPD compost from a minimum 300 TPD of segregated MSW, also based on Biomethanation technology, which is at advanced stage of finalisation of various tieups and the works are likely to commence in near future.

- The Municipal Corporation of Vijayawada has tied up with an entrepreneur for setting up a project on BOO basis, for producing RDF Pellets from MSW and generating power from these Pellets. The project will utilize waste of nearby Guntur city also. Initially, the Corporation had tied up with another entrepreneur for setting up a Pelletisation project but it could not take off as the promoter backed out due to own financial problems.

- A number of enterpreneurs are in various stages of discussion/tie-ups with Corporations of Chennai, Bhopal, Mumbai, Hyderabad, Delhi, etc. for setting up WTE facilities, based on different technologies.

- The work on preparation of a national master plan for assessing the potential of energy recovery from urban and industrial wastes began in year 1999-2000 and is in progress.

- The work on preparation of a national master plan for assessing the potential of energy recovery from urban and industrial wastes began in year 1999-2000 and is in progress.

The Project financing in all these is arranged using a mix of promoter equity, loans from FIs, suppliers credit and capital/interest subsidy from Government.

Support from State Governments

Some state governments namely Uttar Pradesh, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Maharashtra, Haryana and Karnataka have announced policy measures pertaining to allotment of land, supply of garbage and facilities for evacuation, sale and purchase of power to encourage the setting up of Waste to Energy projects. Land for the facilities is being provided by the ULB at a nominal lease rent. The tariff for power purchase generally agreed to is as per the general guidelines issued by the Ministry of Non-Conventional Energy Sources. However, there are often delays in finalization of the actual terms with the enterpreneurs, specially with regard to power tariff, in the wake of deregulation of the power sector/absence of clear policy directions.

FISCAL INCENTIVES FOR SWM INFRASTRUCTURE FINANCING

FISCAL INCENTIVES CURRENTLY AVAILABLE

(1) Tax Exemption to Certain Bonds by Local Authorities

Section 10 Clause 15 : In recognition of the need for mobilizing resources for urban infrastructure projects, the government has accorded a tax-free status to the interest on bonds issued by local authorities each year. These bonds would be specified by the Central Government through the notification in the Official Gazette.

(2) Tax Holiday to the Project Entity for Solid Waste Management

As announced in the Union Budget 2001-02, deduction under Section 80IA of the Act in respect of profits and gains of undertaking/enterprise engaged in infrastructure facilities, etc. is proposed to be at 100 percent of such profits for 10 consecutive assessment years out of first 15 years, except for the following infrastructure facilities where the deduction would be available for 10 consecutive assessment years out of first 20 years :

- A road including toll road, a bridge or rail system;
- A highway project including housing or other activities being an integral part of the highway project; and
- A water supply project, water treatment system, irrigation project, sanitation and sewerage system or solid waste management system.

To qualify for tax-holiday under this provision the conditions required to be satisfied are :

- A company registered in India, or a consortium of companies registered in India, own the Enterprise carrying on infrastructure business.
- The Enterprise has entered into an agreement for developing, maintenance and operating infrastructure facility.
- The agreement is with one of the following : central government, state government, local authority, any other statutory body, or such other entity/body as may be notified to the central government.
- The infrastructure facility shall be transferred to the government/authority within a period stipulated in the agreement (note : as announced in the Union Budget 2001-02, this requirement is proposed to be removed)
- The Enterprise starts operating and maintaining infrastructure facility on or after April 1, 1995.

Infrastructure facility is defined by clause (ca) of Sub-Section (12) of Section 80IA to mean the following : road, highway, bridge, airport, port, rail system, such other public facility of similar nature as may be notified by

CBDT. In order to attract commercial enterprises, as announce in the Union Budget 2000-01, the definition of infrastructure was broadened to include solid waste management and water treatment plants.

(3) Income of Infrastructure Capital Funds/Companies to be Tax Exempt

Section 10(23G) : This Section provides that any income of an infrastructure capital fund or an infrastructure capital company or a cooperative bank by way of "interest", dividends and long term capital gains from investments made by way of equity or long term finance in an approved enterprise wholly engaged in the business of (i) developing, (ii) maintaining and operating or (iii) developing, maintaining and operating an infrastructure facility shall not be included in computing the total income.

In order to provide impetus for infrastructure development, the scope of the term 'infrastructure facility' as defined in Sub-Section (12) of Section 80IA is now enlarged so as to include solid waste management and water treatment within its scope. As a consequence, income drived by infrastructure capital fund or infrastructure capital company for investments in any enterprise wholly engaged in the development of these infrastructure facilities would be exempt from Tax.

Further the criteria for companies that could avail of benefits under Section 10(23G) of the income tax act has been broadened from those maintaining, operating and developing (that is all activities were to be done by one company) to now those companies that could be doing either : developing, operating and maintaining; developing, maintaining and operating; long term funds, project development support, pushing reform agenda for increased investment inflow.

The clauses (a) and (b) of the explanation 1 to the clause 10(23G) have also been amended to bring the definition of infrastructure capital fund in conformity with the said clauses. The proposed amendments took effect retrospectively from 1st April 2000 and will accordingly apply in relation to assessment year 2000-2001 and subsequent years.

As announced in Union Budget 2001-02, it is proposed to align the meaning of "eligible enterprise" with the meaning given in Section 80IA (4) of the Act. Further, the scope of the term "interest" has been enlarged to include any guarantee fee or commission received by a financial institution for giving any guarantee to or providing credit rating in respect of an enterprise, which has been approved by the Central Government in this regard. Also, this exemption is now being extended to Co-operative banks.

(4) Tax breaks to approval FIs

Section 36(1)(vii) : This Section provides for tax breaks to approved financial corporations engaged in providing long term finance for industrial or agricultural development in India. The Section has been amended with effect from assessment year 1996-97 as follows in relation to its ambit as well a extent :

- The deduction will now be available for development of infrastructure facilities in India : for this purpose the expression infrastructure facility shall have the meaning assigned to it in Section 80IA.
- The said deduction was hitherto allowed to the extent of 40 percent of the entity's total income carried to a special reserve. The deduction was allowed on the "total income" and not with reference to the income from the activities specified in Section 36(1)(viii). The Section is now amended in order to limit the deduction of 40 per cent only to the income derived from providing long-term finance for the activities specified in Section 36(1)(viii) and as computed under the head profit and gains of business or profession. This takes outside the purview of deduction, income arising from other activities or from sources other than business.

The benefit under this Section is currently restricted to financial institutions — such as IDBI and ICICI — that are engaged in providing long-term finance for industrial and agricultural development or development of infrastructure facilities in India.

(5) Included as Eligible Investment of Charitable Funds

Section 11(5)(ix) : This clause provides for inclusion of deposits with or investments in any bonds issued by a public company formed or registered in India, with the main objective of carrying on the business of providing long-term finance for construction of houses in India for residential purposes, as an eligible investment of trusts. As announced in the budget speech of year 2000 a new clause is to be inserted in the sub-section so that investments in public companies formed and registered in India with the main objective of carrying on the business of providing long-term finance for urban infrastructure would also be specified as one of the eligible modes of investment. This enables sponsors of urban infrastructure projects to have access to investable surpluses of charitable trust funds.

(6) Indirect Taxes and State Levies

- There is 16 per cent Central Excise duty levied on SW machinery.
- Customs duty levied on SW machinery is 35 per cent plus. Now that SWM is defined as infrastructure under 80IA of the Income Tax Act, 1961, it is requested that Customs duty on SW machinery for waste treatment projects be brought on par with equipment for pollution control.
- No excise or sales tax is levied on compost (manure).

RESPONSIBILITIES OF STATES

Each state would need to formulate its policy to effectively complete for investments required for developing such infrastructure within the state. Thus at the state level, levies could be rationalized for defined projects. Eligible projects could be defined as those where financing is fully underwritten in a creditable manner or where the state or state government is a partner with a minimum set equity stake.

State governments should carefully consider and provide these incentives in a manner, which reflects their concern and gravity of the situation in their state. For instance the state of Maharashtra generates the maximum quantity of waste and must therefore promote remedial measures.

ADDITIONAL FISCAL INCENTIVES RECOMMENDED FOR SOLID WASTE INFRASTRUCTURE FINANCING

Section 80IA – benefit to project entity

a. Extend to Existing Infrastructure facility

The section specifies that the infrastructure facility should be "new". Accordingly it may not include projects, which involve remaking or expansion. Most infrastructure projects would involve acquisition of existing facility to meet the increased demands. It is necessary to capture revenues from existing facilities to make the expansion viable. Hence it is recommended that the scope of definition be extended to include projects involving expansion or remaking existing facilities.

b. Ownership of Infrastructure Facility

The Section requires the facility to be "owned" by the enterprise. But in many infrastructure projects it may not be feasible to own all the facilities. Some of the equipment may be procured under a leasing or other financing arrangement. It is therefore necessary to clarify that the scope of this Section extends to include cases where part of the facility is procured under a lease or any other financing arrangement.

Add New Section or Amend Section 35AC – benefit to project sponsor

In order to provide equity support from the business community and to provide an incentive for funds to flow into the infrastructure sector, it is recommended that investment in the share capital of SPVs undertaking infrastructure projects be eligible for tax rebate.

This incentive could be provide through an amendment to Section 35 AC of the Income Tax Act, 1961. Under Section 35 AC any expenditure by way of payments of any sum to public sector companies or a local authority or to any association or institution approved by national committee for carrying out any eligible project or scheme for promoting social and economic welfare is allowed as deduction. Expenditure directly incurred on such projects or schemes is allowed as deduction.

It is recommended that similar deduction be provided in respect of expenditure on eligible infrastructure projects. Projects eligible for benefits under Section 35 AC could be defined as those where the financing is fully underwritten in a creditable manner or where the Central or State Government is a partner with a minimum equity stake.

Indirect Taxes and State Levies

Customs levied on SW machinery is 35 per cent plus. Now that SWM is defined as infrastructure under 80IA of the Income Tax Act, 1961, it is required that customs on SW machinery for waste treatment projects be brought on par with equipment for pollution control.

SWM services not to be taxed and state levies need to be rationalised

Solid waste management services have remain neglected for over five decades and therefore, there is a need to give fiscal incentives for SWM infrastructure financing in the form of not taxing the income derived from solid waste management services by the private entrepreneur and rationalisation of indirect taxes and state levies in view of the fact that SWM is defined as infrastructure under Section 80IA of Income Tax Act, 1961.

Recommendations made by the committee appointed by the Supreme Court of India

- ⇨ Local body cannot escape the responsibility of providing solid waste management services on the ground of paucity of funds. It must raise finances to maintain minimum level of services.

Local bodies should

- ⇨ Observe financial discipline by putting a ban on wasteful expenditure and non-essential items of work and find funds for SWM services.
- ⇨ Improve collection efficiency of taxes and charges.
- ⇨ Review the existing rates and charges and introduce the element of cost recovery.
- ⇨ Introduce NGO and private sector participation.

The State Government should

- ⇨ Assess the gap in finances available with the local bodies and funds required for essential services of the local body.
- ⇨ Give fiscal autonomy to local bodies.
- ⇨ Give incentives to recycling industry.
- ⇨ Extend financial support to urban local bodies for a period of three years as per the formula given in the report.

The mandatory provision in the Municipal Solid Waste (Management & Handling) Rule, 2000

Every municipal authority shall be responsible for infrastructure development or collection, storage, segregation, storage, transportation, processing and disposal of municipal solid waste in terms of Municipal Solid Waste (Management & Handling) Rules, 2000 and each local body shall meet the compliance criteria as shown in Schedule – II and meet the specifications and standards specified in Schedule – III & IV.

The local bodies have, therefore, to find funds and create a mechanism to provide services through user charges or private sector participation to meet the mandatory requirements of law.

Conclusions & Recommendations

- ⇨ The ULBs must make adequate allocation of funds for SWM services.
- ⇨ There should be a separate head of account of income and expenditure on solid waste management.
- ⇨ User charges should be introduced to meet the cost of SWM services.
- ⇨ Private sector/NGO should be involved for providing services and cost recovery.
- ⇨ Revenue recovery should be made from composting waste-to-energy and by way of tipping fees for disposal of waste.
- ⇨ Fines should be levied for littering the streets.
- ⇨ Borrowing of funds through access to capital market by issuing tax-free municipal bond may be attempted by large cities.
- ⇨ The Government of India schemes for subsidies may be availed of by the cities by submitting project proposals.
- ⇨ On going schemes of Government of India for promoting composting of waste and waste to energy projects may be availed of by the cities.
- ⇨ Mega cities should avail of the centrally sponsored schemes of infrastructure development for improving SWM services.
- ⇨ The enterpreneurs dealing with solid waste management should avail of benefits of tax holiday under Section 80IA of the Income Tax Act after qualifying.
- ⇨ The Central Government may consider reducing the customs duty on SWM machinery as solid waste is defined as infrastructure under 80IA of the Income Tax Act, 1961 and put on par with pollution control equipment.
- ⇨ A new Section may be added or Section 35 AC may be amended in the Income Tax Act, 1961 to give benefit to project sponsor.
- ⇨ The State Governments may formulate policies to effectively compete for investments required for developing SWM infrastructure within the state.
- ⇨ SWM services may not to be taxed and state levies need to be rationalised.

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CHAPTER —7

SECTORAL LENDING BY FINANCIAL INSTITUTIONS

Housing and Urban Development Corporation (HUDCO)

Under its Urban Infrastructure Financing Program, HUDCO provides financial assistance (as loan) for the waste management sector. Waste Management projects linked to renewable energy are also encouraged, depending upon their viability and sustainability. Financing of renewable energy schemes in the Small Hydro-electric Power and Wind Power have just been started. Technical Assistance in the form of consultancey and support in project formulation is provided in the Waste Management Sector. A Waste Management Cell has been created within its Urban Infrastructure Finance Wing for augmenting these efforts. HUDCO also facilitates project formulation and acts as an arranger of funds if required. Some of the subsidies/soft loans available from GOI is also routed through HUDCO in order to dovetail the grant and debt for facilitating the projects.

Broadly HUDCO's portfolio for lending in the Waste Management sector includes projects for management of Municipal Solid Waste and Bio-medical Waste, Common Facilities for Management of Hazardous Industrial Waste (TSDF), Bagasse (from sugar mills) based Cogeneration and Biomass based Power Projects etc. The project components for municipal solid waste include storage, collection, treatment, recycling/ resource recovery (composting, waste-to- energy) and disposal. These loans may be availed by both the public and private sectors, Joint (Public-Private) and Cooperative sectors as well as registered NGOs.

1. Financial Assistance

The interest rate and extent of financing for HUDCO lending depends on the category of the scheme and of the borrowing agency, the repayment period and the type of security offered. It also varies with the cost of capital for HUDCO. The extent of financing depends on the category of the projects as well as the borrowing agency as shown below :

Extent of Financing	
1. Public Sector Borrowing Agencies with Government Guarantee (with Budgetary Provision) for the scheme	85%*
2. Direct Borrowing by Govt.	100%
3. Private Sector	
. Municipal solid Waste Management	70%
. Common facility for Bio-Medical Waste Management	
. Co-generation scheme (Bagasse/Bio-mass based for Power and steam)	60%#
. Common facility for management of toxic and Hazardous waste	
. Waste to energy scheme	
* Extent of Finance for Bagasse based co-generation Scheme offering Government Guarantee as security (with budgetary provision)	80%
# Extent of Finance for Bagasse based co-generation/ Bio-mass based Power scheme in the Joint Sector	70%

4. Joint Sector

For the Joint sectors having more than 26% Government Equity, conditions for the Public Sector would be applicable. For the others, the conditions for the Private Sector would be applicable.

The security for these projects depends on the category of the project and of the promoter/borrower. Typically the security package includes a combination of the following components :

Prime Security

- Government Guarantee (with budgetary Provision)

or

- Bank Guarantee of a Scheduled Bank (except Co-operative Bank)

or

- Mortgage of Land and Building (Bankable Assets) to the extent of 125-150% of the loan Amount. After commissioning of the project, eligible Project Assets including hypotecation of plant and equipment may be included in the security cover so that an equivalent amount of other mortgage may be released.

Collateral Security
(in case of projects not secured by Government Guarantee)

- Personal guarantee of Promoter Directors backed by mortgage of personal properties
- Corporate guarantee acceptable to HUDCO
- Bank guarantee from a scheduled Bank (except co-operative Bank)
- Cash deposit in a scheduled Bank with lien for HUDCO
- The extent of collateral security would be 25 - 75%, depending upon the strength and type of the project and the promoters.

Other conditions

- Trust and Retention/Escrow Account would be opened as per HUDCO norms with HUDCO's lien on all receivables.
- Assignment of necessary titles/documents, pledge of shares. Deposit of post dated cheques.

2. Procedure for Application and Sanction

With increasing magnitude of business, HUDCO has increasingly decentralized its operations. Regional Offices numbering 20 have been set up across the country. There are 3 Zonal Offices, 10 Development Offices and 2 Field Offices. The Regional Offices are responsible for receiving applications for financial assistance and appraising the schemes for sanction. Certain schemes are sanctioned at the Head Office depending upon the category and loan amount. Release of loan amount is also done from the Regional Offices. The appraisal process involves in-depth technical, financial and legal scrutiny.

3. The Experience of Financing

The schemes for municipal solid waste management are relatively inexpensive except waste to energy projects using imported technology. However, according to 'Municipal Solid Waste (Management and Handling) Rules, 2000, Sanitary Land-filling would become slightly more expensive in terms of initial capital investment as well as recurring expenses for construction of additional cells and strips.

Between 1994 and 2002, HUDCO has sanctioned 22 waste management schemes with a total project cost of Rs. 713.46 crore and loan amount of Rs. 387.48 crore (excluding projects which did not take off and were subsequently closed). The list of sanctioned schemes as of now, is mentioned in the table below. It is seen that out of the total of 22 projects, only 11 (9 municipalities and 2 private) were sanctioned for municipal solid waste management. It has been observed that the municipalities are not much interested in taking loan for solid waste management and are more interested in grants. Lack of confidence and willingness to streamline solid waste management and operate and maintain the same in an appropriate manner possibly due to Institutional debility appears to be one of the main reasons. Non-availability of State Government Guarantee and high rate of interest are commonly sited by the municipalities as reasons. However, they readily come forward for certain other infrastructure projects, which are much more expensive and have the same range of interest rate.

4. Technical Assistance

Under its technical assistance program, HUDCO prepared project formulation reports for solid waste management for various towns including the pilgrim towns of Thrissur and Guruvayur in Kerala, Imphal (Manipur), Shillong (Meghalaya), Pondicherry, Tirurpur (Tamil Nadu), Anantpur (Andhra Pradesh), Alwar (Rajasthan), Aligarh (Uttar Pradesh) and Allahabad (Uttar Pradesh). Most of these ULBs subsequently applied for loan assistance from HUDCO based upon these studies. However, because of the reasons mentioned above, the documentation was not completed by the municipalities and financial closure could not be achieved. HUDCO has also provided technical assistance for designing community garbage storage facilities at Varanasi, vermi-compost plant at Tura and incinerator for biomedical waste at Shillong.

HUDCO has also conducted a major Consultancy assistant for the Ministry of Urban Development regarding mitigation of bird-hit menace for IAF aircraft appropriate waste management within 10-15 km radius of 10 selected Defence airfields, namely: Adampur, Ambala, Bareilly, Dundigal, Gwalior, Hindon, Jodhpur, Pune, Sirsa and Tejpur. Bird hits were posing a potential hazard to safe operation of fighter aircraft and inadequate waste management was identified as a major reason for attracting birds.

5. HUDCO Project Initialization Fund

In 1999-2000, HUDCO constituted a Project initialization Fund (PIF) to facilitate development of viable projects. This fund makes provision for loans toward development of urban infrastructure projects, which included Solid Waste Management Projects also. The lending areas include preparation of feasibility studies, analysis/research leading to project development, preparation of consultancy documents and bidding and documentation process.

The PIF is structured to provide lending for up to 100 percent of project formulation cost. However, to enable a wider spread of fund utilization, the assistance is capped at 3 per cent of total project cost or Rs. 50 million whichever is less. The rate of interest on loans varies between 13 to 14 percent. The loan repayment period is ten years, including time spent on preparatory studies. The fund allows a moratorium on principle repayment, permissible till completion of the project. The loan in secured by either government guarantee or irrevocable bank guarantee or mortgage or negative lien on assets.

In 1999 HUDCO had sanctioned a loan of Rs. 1.5 million (100 percent of estimated study cost) to the Kerala Urban Development Finance Corporation for carrying out a study and project packaging on Solid Waste Management for 13 cities in Kerala.

Industrial Credit and Investment Corporation of India (ICICI)

In 1997-98 ICICI established the Infrastructure Group as a separate Strategic Business Division. ICICI has no standard scheme for lending to SWM projects and such lending is market driven. In principle ICICI would consider lending to projects of size range 50 to 60 million, thereby making smaller projects such as composting facilities eligible candidates. Till date no firm has borrowed from ICICI for a SWM project, however they have been in regular dialogue with Excel (private firm involved in composting).

Interestingly ICICI is keen to lend to financially sound urban local bodies. Recently ICICI has signed a lease lending agreement with Ahmedabad Municipal Corporation (AMC). The arrangement works well for both parties since the corporation is a non-tax paying entity and under the arrangement ICICI would acquire tax advantages of ownership (such as depreciation) and therefore pass on to AMC a better interest rate.

Lease Lending Agreement

ICICI and AMC have entered into a lease lending agreement for leasing of equipment, including dumper placers and trucks worth Rs. 80 million. The lease is secured by corporation receivables, such as income from property tax in selected wards. Under this arrangement ICICI would purchase and hold title of the asset and AMC would pay rent for using it during the lease term. Stipulations have been included in the agreement, allowing AMC to purchase the equipment at "fair market value" at end of the lease. Under the arrangement ICICI would acquire tax advantages of ownership (such as depreciation) and therefore pass on to AMC a better interest rate.

ICICI also leads the Asset Management Company (AMC) recently constituted in Tamil Nadu to deploy the resources of the Tamil Nadu Urban Development Fund (TNUDF) in which it is a partner along with Government of Tamil Nadu, HDFC and IL&FS.

Infrastructure Development Finance Company (IDFC)

IDFC lending for SWM projects is contract based and is linked to project cash flows and terms of agreement. Loan is provided on market terms and conditions including a market driven interest rate. Due to input parameters such as loan processing and monitoring efforts, IDFC prefers that projects have an economic size (approximately in the range of Rs. 100 million). This essentially precludes composting facilities from being eligible for such borrowing. However, this is not a key criteria for project selection and given the positive environmental spin offs of such projects IDFC would consider lending to, or taking an equity stake, in well-structured projects of a smaller size also. Currently IDFC is in an advanced stage of discussion with Asia Bio Energy for funding a Waste-to Energy project structured in association with the Lucknow Nagar Nigam (LNN). The facility would handle a minimum of 300 TPD.

WTE - Lucknow Nagar Nigam

The Lucknow Nagar Nigam (municipal corporation) has partnered with Enkem India Ltd. (project promoter) for executing a bio-methanation WTE project on a BOO basis. The facility is to handle a minimum of 300 TPD and the project cost is estimated at Rs. 760 million.

Enkem India Ltd. has floated an SPV called Asia Bio Energy for the project and is in advanced stages of discussions with partner firms for taking an equity position in the SPV. Enkem has tied up with ENTEC (an Austria based firm) to provide the designated technology. ENTEC will also provide the digester (to produce methane) and a performance guarantee for the same. Jurong engineers (a Singapore based consortium) will execute the EPC contract and M/s CGEA Asia Holding Pte. Ltd (a wholly owned subsidiary of Vivendi) will be responsible for Operations and Maintenance. Currently the financing plan for the project is being concretised. A Power Purchase Agreement has been signed with the UP Electricity Board for power offtake and payment of tariff. Further the Uttar Pradesh government has guaranteed payment should the electricity board fail to pay. The finances have nearly been tied up for the project as follows :

Table – Lucknow Waste-to-Energy Project, Financing Plan

Rs. in Million

	Funding		Amount	Status
1.	Promoter Equity	An SPV called " Asia bio energy" has been floated for the project.	200	Tied
2.	Govt. Subsidy	MNES (30 million for each MWe)	150	Tied (in principle)
3.	Equipment Supplier (gas engine, 6 units of 1 MW each)	The gas engine is being supplied on an operating lease bases with a fixed and a variable lease payment.	110	Tied
4.	Debt	Contract based lending by IDFC	200	Advanced stage of discussion
5.	Credit	Deferred credit being provided by the equipment supplier	100	Being arranged
	Total		760	

Source : Discussions with IDFC

The project size is approximately Rs. 760 million. IDFC is considering providing a debt of Rs. 200 million for the project in addition to a small equity stake. According to IDFC due diligence for WTE projects is extremely tricky and has to be a detailed exercise. Demonstrated technology, waste availability, contractual structure energy, saleability with supporting back-to-back agreements, and risk allocation and mitigation and promoter's profile are the key criteria that determine the lending. Further in case of the Lucknow project the subsidy available to the project from MNES was considered critical for making the project viable and facilitating the lending.

IDFC has also been approached by promoters for funding of composting facilities at Chandigarh, Trichi, Pune, Chennai, Coimbatore and Salem. However, these projects are in preliminary stages and discussions have been general.

IDFC has also been approached for lending for development of a township near Calcutta. This "New Calcutta Town Project" is estimated to cost Rs. 4130 million and includes a SWM component of Rs. 100 million (comprising of transportation equipment and sanitary landfilling costs. Discussions are in preliminary stages, however, IDFC lending would essentially be based upon project cash flows.

Infrastructure Leasing and Financial Services (IL&FS)

IL&FS is a partner (along with Government of Tamil Nadu, HDFC and ICICI) in the recently constituted Asset Management Company in Tamil Nadu to deploy the resources of the Tamil Nadu Urban Development Fund (TNUDF).

NABARD – Refinance

NABARD has access to priority sector funding from the banking sector for agriculture and irrigation. NABARD makes available project based lending for composting/vermin-composting facilities and such schemes are considered as priority lending's. The funding is essentially available as refinancing of loans already made by

FIs or other banks. According to NABARD there is no "funds limitation" imposed by NABARD, however, in order for a project to be eligible for such refinancing it must meet the following criteria :

- Commercially viable (review of project cash flows);
- Technically viability (use of tested technology);
- The private firm must have marketing capacity regarding the end product.

Indian Renewable Energy Development Agency (IREDA)

Waste-to-energy (WTE) projects are eligible for loan from IREDA. For Instance in the Nagpur WTE project that has been designated as a demonstration project by MNES, IREDA gave a loan of Rs. 117.0 million to the Nagpur waste-to-energy project (total estimated project cost is Rs. 472.45 million).

Further the capital subsidy from MNES is also normally routed through HUDCO or IREDA.

Industrial Development Bank of India

IDBI is a potential source for such funding. Further Section 36(1)(vii) that provides for tax breaks to approved financial corporations engaged in providing long term finance for industrial or agricultural development in India is applicable to IDBI.

Industrial Finance Corporation of India Ltd. (IFCI)

IFCI provides lending to industrial projects and may be a potential source for such funding.

Other Sources : Commercial Banks, Suppliers Credit, Private Venture Capital Fund

Commercial banks appear to be the main source of borrowing by project promoters.

Another potential source of funding is supplier credit, for example in the case of the Lucknow WTE project equipment supplier facilitated lending by way of operating lease and deferred credit (refer box on Lucknow financing plan).

The emerging venture capital funds may be another possible source of funding, especially for WTE projects where projects costs are in the range of Rs. 400 to 800 million (economy of scale in terms of processing and monitoring of loan). However promoter profile is one of the key criteria for determining project lending by such funds.

OTHER ACTORS

Bilateral/Multilateral Donors

Even though there is no dedicated SWM program, Technical Assistance for such projects may be availed under programs such as the Indo-US Financial Institution Reform Expansion, US Asia Environmental Partnership, Urban Management Program, Water and Sanitation Program of the World Bank, and under other projects linked with water and sanitation. Further a number of donor agencies are providing support in related areas such as micro finance, poverty, health and energy related programs.

Support Institutions/Mechanisms

The Supreme Court guidelines regarding standards and service levels as well as the MOEF rules have precipitated a lot of interest in the sector and are expected to generate much activity in coming years. In addition

to increased equirement for finances, technical expertise and operation expertise, there will also be an increased demand in related areas such as :

- Advisory/consulting services (engineering, legal, financial and managerial) for support in areas related to technical studies and design, project structuring and development, preparation of procurement documents and support in bidding process and negotiations, and service monitoring.
- Equipment suppliers/manufactures for meeting increased demand and ensuring easy availability.
- Availability of support institutions/mechanisms e.g. such as insurance facilities for such projects and staff, appropriate dispute resolution systems, etc.

Conclusions & Recommendations.

- ⇨ The urban local bodies should avail of the financial assistance (loans) and technical assistance for project formulation from HUDCO, which also facilitates projects by dovetailing HUDCO finance with subsidy/soft loans from GOI through various ministries.
- ⇨ ULBs can avail of lending from ICICI for SWM projects in the range of 50 to 60 million Rupees investment. They have set up an infrastructure group for this purpose.
- ⇨ ULBs can also avail of finances from Infrastructure Development Finance Company (IDFC) where the lending is contract based.
- ⇨ NABARD refinancing scheme could be availed of by the ULBs. NABARD makes available project based lending for composting on priority.
- ⇨ ULBs may avail of finance from Indian Renewable Energy Development Agency (IREDA) for waste to energy project and avail of the capital subsidy from Ministry of Non-Convention Energy Sources routed through HUDCO or IREDA.
- ⇨ ULBs may avail of services from ILFS, IFCI, IDBI for financing the infrastructure and take the assistance of bilateral/multilateral donor's technical assistance for such projects. As per example, USAID, US AEP, Indo-US Financial Institutions Reforms and Expansion Project (FIRE Project), UMP, WSP, etc.

CHAPTER —8

PRIVATE SECTOR PARTICIPATION IN SWM IN INDIA

"One of the proven ways world wide, of obtaining efficiency gains in solid waste management is through the involvement of the private sector—that is, when the key success factors of competition, transparency and accountability are present" (Cointreau-Levine, 1994). In addition to being a potential source of attracting project funding and new technology, the rationale for Private Sector Participation (PSP) includes benefits such as cost savings and improvement in efficiency and effectiveness in service delivery. These are due to greater financial and managerial autonomy and accountability in private sector operations. However the degree, to which these efficiency gains are reflected in bid prices and shared with the local body, depends on the keenness in competition amongst private firms.

In order to facilitate the bidding process, cities must structure the project suitably and pre-define basis for payment. There are obvious advantages to be gained in terms of operational efficiencies where the bidder is allowed flexibility in system-design, and the bids are performance based. Further, project viability often hinges on information regarding waste quantity, quality, flows etc. and must be adequatley determined by the local body/private party.

Initial experience in India suggests that efficiency gains are to be made from PSP in SWM. However in the absence of adequate data and cost information, it is difficult to properly quantify such gains. Further, any cost computations must include in the analysis, costs of : bidding, project design and service monitoring, as also record the level of service delivered.

Potential Cost Savings from PSP in SWM in India—Initial Experiences

New Bombay (1992-93)

— The private firm's cost of service delivery at Rs. 4.3 million per year was much lower than CIDCO's costs of Rs. 9.9 million, thereby indicating an efficiency gain as high as 56 per cent.

Rajkot (1991-92)

— Upon privatization, the Rajkot Municipal Corporation's expenditure on removal of primary waste was reduced from Rs. 1.7 million to Rs. 1.4 million, indicating a saving of 15 per cent.

— Further, the corporation's expenditure (including establishment costs) on secondary waste removal, dropped from Rs. 260 per ton to Rs. 200 per ton, thereby indicating an efficiency gain as high as 23 per cent.

ULBs

— Income from resource recovery projects such as waste composting

Source : Based upon information available in the draft policy paper on urban infrastructure, Ministry of Urban Development.

It must be noted that private sector participation cannot be used as a panacea for all problems. In order to attract private sector in service aspects such as collection and transportation or landfill site management, ULBs will have to put their house in order. It is important to introduce commercial orientation in the outlook of cities,

regarding delivery of SWM services. Improved revenue generation and accounting practices remain critical pre-requisites. Cities must establish/improve income from operating revenues and also improve/strengthen their overall resource base. Transparency in procurement of equipment and services must also be maintained.

The present capacity of municipalities in India to manage the privatization process varies across cities and there is a clear need for developing in-house financial and managerial capacity. Further, monitoring of private sector is important, since the onus of ensuring proper service delivery and standard compliance, remains with the local body.

It is essential that cities choose and develop solutions that respond to their local needs and capacities. Further, these must be constantly reviewed and adapted to best deliver the service. Parivate sector participation must be introduced within the framework of a macro waste management plan for the city. "Hyderabad is probably one of the few cities in India where the approach to contracting for solid waste management has been developed systematically within a citywide perspective" (Mehta, Meera 1999).

Contracts for Solid Waste Management—Municipal Corporation of Hyderabad

Over the last five years, Hyderabad Municipal Corporation (HMC) has been developing and refining approaches to involving private sector in its SWM services. These measures have spanned private sector involvement in primary collection, street sweeping, transportation and disposal of solid waste in the city. There is a clear effort to move towards a simple system that responds to the local private sector and HMC capacity to monitor. This process suggests the need to continually review and adapt the process to local contexts.

Item.	1996-97	1997-98	1998-99
Scope of Contracts	Only for sweeping, collection and transporation of garbage	Separate contracts for areas and main roads with inclusion of transportation	Contracts reforms into "Day Units" for areas and "Night Units" for main roads
Procurement Process	Procured through lowest bid for a monthly rate for given quantity of work in specified areas	Procured through lowest bids for a rate per quantity of garbage delivered	Procured through technical capacity and past experience at a fixed price for a defined unit which represents equal quantity of work
Coverage of the Arrangement	27 areas covering about 40000 population and a distance of 27 km.	For main roads a length covering 153.5 km. in 4 contracts. For other areas, 7 municipal wards with about 30 per cent coverage of city	Planning for the entire city by dividing into day and night units. About 60 per cent of total work is contracted out.
Provision for Penalties	Penalty linked to 'unsatisfactory' work at 2 per cent of the contract amount.	Penalty linked to 15 per cent of the assessed value of 'unsatisfactory' work	Penalties based on performance monitoring system using detailed input and output criteria.
Monitoring Systems	Limited role of communities, weak municipal monitoring	Enhanced role of communities and increased participation of women. Strengthened municipal systems and introduction of computerized weigh bridges.	Role of communities made more extensive with informal committees Computerized monitoring with the Daily Deduction System.

Source : Mehta Meera (1999). "A Review of Public-Private Partnerships in the Water and Environmental Sanitation in India", Water and Environmental Sanitation Group. DFID, India.

TYPES OF PSP ARRANGEMENTS AND ISSUES EMERGING IN SWM IN INDIA

A number of cities in India are experimenting with various forms of arrangements to introduce private sector participation in SWM. Contracting of equipment or of discreet components of service is a popular method of introducing private sector participation. Such contracting is essentially based upon a fee based payment arrangement. Meanwhile long-term concessions (BOOT/BOO) are the popular form of agreement being used for revenue generating components of the service, such as resource recovery projects. Under such arrangements, the private sector finances and owns (for period of time sufficient to depreciate investments and provide a reasonable return to the equity investors) MSW facilities. In return, the local body typically grants and enables access to a specified quantity of MSW. The local body may also provide land for the facility at a nominal lease.

(I) CONTRACTING FOR MAINTENANCE JOBS, EQUIPMENT/VEHICLES

(a) Vehicular Fleet Maintenance and Repair

Most local bodies turn to open competition for minor repairs/fleet maintenance of waste transportation fleet. Quotations are obtained from various garages and the job is given to the lowest bidder.

(b) Vehicles

Contracting to lease equipment/vehicles, rather than to obtain service is one way of obtaining equipment especially when the opportunity to borrow money for a capital investment is limited. Typically in such arrangements the private firm provides the vehicles as well as fuel and maintenance. However it must be recognized that leasing equipment/vehicles may limit the choice of the local body to type available in the market.

Contracting Waste Transportation Vehicles

Brihan-Mumbai Municipal Corporation

At present Mumbai contracts the services of waste transportation vehicles (without labourers) for all 24 wards. A total of 140 tempos are hired daily and are used in narrow lanes and slums. The contract rates for these tempos vary from Rs. 550 to 730 per vehicle per shift of eight hours that includes three trips. Further the service of approximately 800 dumpers (capacities of 8 cu.m to 10 cu.m) is hired, with the assumption of one trip per shift of eight hours and direct unloading of MSW at designated dumping grounds. The contract rates include costs for maintenance. Earlier, the city also contracted a driver and 5 labourers with each vehicle, however, pursuant to problems related to contract labour issues this practice has now been discontinued.

Source : SWM Department, Brihan-Mumbai Municipal Corporation

The city of Mumbai has been contracting vehicles for more than 15 years, for waste transportation from all 24 wards within its jurisdiction. Earlier, the city also contracted a driver and 5 labourers with each vehicle; however, pursuant to problems related to contract labour issues (refer box under section on legal impediments) this practice has now been discontinued. The Ludhiana Municipal Corporation has also appointed private vehicle owners to transport solid waste at night.

(2) SERVICE CONTRACTS FOR DISCREET SERVICE COMPONENTS

(a) Waste Collection and Transportation

"There is great opportunity for privatization of waste collection and transportation service under contract with the local government. One of the reasons for this is the absence of barrier to entry. The service involves low economies of scale, technological simplicity, and moderate investment costs" (Donahue, J.D. 1989). Currently more than 50 urban local bodies in India have entered into various contracting arrangements with private firms

for waste collection and transportation. Typically these contracts are fee based, wherein the local body pays the private firms a monthly fee for provision of services.

Based upon technology and investment requirements, various profiles of private firms engaged in such activity in the country are emerging. Metro cities such as Chennai and Mumbai have gone in for the mechanized approaches requiring larger investments, and have attracted national and international firms. These cities have better financial capacity (budget size, revenue base etc.) as well as managerial capacity (process management, service monitoring etc.) to be able to attract and manage larger firms.

In cases, where cities have gone in for relatively simpler technology solutions requiring moderate investments, local firms with modest financial resources are increasingly entering the business of waste collection and transportation. In the city of Hyderabad there is a clear effort to move towards a simple system that responds to the local private sector and MCH capacity to monitor.

Interestingly cities are also experimenting with community contract systems (with NGOs and CBOs) for primary waste collection and sweeping, as in Hyderabad, Mumbai, Vijayawada and Ludhiana (refer section on NGOs/CBOs).

Modernizing Service Delivery and Management

Privatization of MSW Collection and Trahsportation—Chennai Municipal Corporation

With a view to mechanize and modernize its service delivery, and also modernize service management techniques, the corporation of Chennai has privatized waste collection and transportation in 3 Zones (6, 8 and 10) within the city covering approximately 35 per cent of Corporation area.

As a first step, the Chennai Municipal Corporation had hired consultants KPMG (Klynveld Peatt Marwick Goerdeler) to assist them through the entire process. The Chennai Municipal Corporation and the Tamil Nadu Industrial Development Corporation first called for RFQs. Subsequently, out of 7 firms that responded, 4 were pre-qualified. Of these, 3 firms submitted commercial proposals and only one bid was evaluated as a successful bidder. The selected bidder M/S C.G.E.A. Asia Holdings, Singapore, was selected on October 1999 and the agreement signed on November 1999. Operations began earlier this year on March 2000.

As per terms of agreement the private operator is responsible for sweeping, collection, storing and transportation of waste as also for creating public awareness through IEC. Waste material includes garbage, construction waste and garden waste. The private operator has committed to deploy more than 1800 employees, 31 compacter trucks, 30-35 hook lift trucks, 170 auto rickshaws, 800 modified bicycles, applied sweepers, mechanical sweepers and 5300 mobile garbage bins. In addition they will modernize 2 vehicle/ operational depots in Zone 6 and 10, and 2 transfer station in Zone 8 and 10.

The daily quantity of waste to be removed is in excess of 1000 TPD for a term of 7 years. The rate offered by the private firm for the first year is Rs. 648 per MT to be escalated annually at 5 per cent. This is much lower than the corporations estimated cost of Rs. 1050 per MT for service delivery through its own manpower and machines. The corporation estimates a saving of Rs. 10 to 12 crore a year.

Most existing corporation workers were redeployed to other departments and no worker lost his job. Meanwhile all workers of the private firm have been provided with appropriate uniforms, gloves, caps, shoes and safety gear. Further provision of toilet and washing facilities is planned at each site.

Source : Presentation by the Chennai Municipal Commissioner

Key Impediments in Contracting Waste Collection and Transportation Services

The following key issues currently act as impediments in contracting of waste collection and transportation services. First, in absence of user charges for SWM services in most cities, contract fee is essentially met out of the general revenue of the local body. This requires that local body have a sound revenue base and allocate resources to SWM activities. Further it is also important that cities establish/improve the income from the operating revenue generated from the delivery of the service. The privatization effort currently underway in Gandhinagar would be the first attempt by any city to link user charge billing and collection to payment of the private firm.

The second critical issue is the issue of labour redundancy. In some cities as much as 20 to 50 per cent of total staff of a local body may be engaged in the activity. Most of this staff is engaged in waste transportation and collection. It therefore becomes imperative that an adequate staffing plan is drawn out and the apprehensions of these workers addressed adequately, if PSP efforts have to be successful. Many approaches exist and are being used in various cities. These generally include a judicious combination of labour retrenching, redeployment, retraining and retirement. In some cases around the world, labour groups are allowed to partner with private firms for bidding projects. The labour has a working knowledge of issues related to service delivery and there are obvious benefits to be gained from such arrangements. However it is important that cities involve and consult the labour while drawing up any arrangement. Such active participation is critical to the success of any such plan.

PSP Vs Staffing Issues

Experience of Brihan-Mumbai Municipal Corporation

The BMC has a total of 33000 employees working in SWM. Of these 9000 employees are sweepers, while 8500 are involved in loading vehicles. According to city estimates approximately 50 per cent of these employees will retire over the next five years. The city has decided to not make any new recruitment for the service in lieu of its various privatization plans. Further once these privatization schemes are made operational, the city proposes to redeploy many of the existing staff to additional areas and slums.

However the actualization of any such plan hinges upon active consultation and participation by labour groups. In an initiative in 1994, the city privatized sweeping (manual night sweeping) of 34 km of road length in a demarcated area (Dahisar). As a result, out of a total 130 corporation employees working in the area, 30 were redeployed to slums. Subsequently in August 2000 these employees moved to industrial court against such redeployment. The contention was that these slums were on private land and that the corporation had no policy of providing service to the same. Further they stated that the corporation had not taken them into confidence at the time of decision making. On October 9, 2000 the court made a ruling that the corporation could privatize sweeping and such labour redeployment to slum areas was allowed. The corporation anticipates that the labour will now appeal in the High Court.

Source : SWM Department, Brihan-Mumbai Municipal Corporation

Risk in Privatizing Waste Collection and Transportation

Cities must ensure that such service responsibility is distributed amongst multiple firms or between private firms and ULB staff, for various city zones. In case the responsibility to deliver citywide services was to rest with one firm, there would be the risk of tc entire system breaking down, in case of early termination of agreement. In case of the Rajkot contract for waste collection and treansportation, all service providers in the city had joined hands just before an important national festival and demanded an increased fee from the corporation, who were left ina weak negotiating position. Corporations must ensure that they safeguard themselves against

such scenarios by inserting adequate provisions in the agreements or by retaining a suitable proportion of corporation staff.

Further, it is important that local bodies implement rules and ensure compliance by households. Education and enforcement of punitive measures must be employed to address : non-payment of user charges by households, open dumping/night dumping of waste etc. In case of Gandhinagar SWM privatization, one of the concerns raised by potential bidders related to linking payment structures with collection of user charge, was enforcing of such payment compliance. While the limited experience of NGOs shows as high as 90 per cent collection efficiency, private firms are wary of entirely bearing such risk in the absence of proven enforcement measures.

(b) Development and Maintenance of Landfill Site

Interestingly, the Agra Nagar Nigam (Municipal Corporation) had signed an MOU with a private investor, to develop a sanitary, scientifically managed landfill site. The ultimate objective was to tap methane gas from the facility to generate energy. However this MOU has still not been executed and the project has not moved further. Currently the Chennai Municipal Corporation is actively considering private sector participation in developing and managing a sanitary landfill site.

(3) DBO, BOOT, BOO, CONCESSIONS FOR RESOURCE RECOVERY PROJECTS

(a) Waste Composting Projects

Bacterial decomposition of the organic fraction of solid waste is known as composting. Decomposition of organic solid waste can be accomplished either aerobically (in the presence of oxygen) or anaerobically (in the absence of oxygen). Approximately 35 composting projects have emerged/finalized in the country over the past five years. The designed treatment capacity of these facilities ranges from 80-700 TPD and their combined designed treatment capacity is 2929125 MT per year. Further, as many as 17 additional projects, with a combined designed treatment capacity of 1697250 MT per year, are in the finalization stage.

Most of the existing facilities have emerged in the state of Maharashtra, Tamil Nadu, Andhra Pradesh and Kerala. The largest operating plant is located in Calcutta and has a treatment capacity of 700 TPD, while Thiruvananthapuram recently commissioned the first fully covered plant covering an area of 12000sq.ft.

The capital investment requirement for such projects is typically in the range of 30 to 75 million (100-700 TPD), and project financing has predominantly been driven by promoter equity.

DBO

A number of cities such as Mysore, Calicut, Kochi, Thiruvananthapuram, Shillong and Puri have used the DBO model for privatizing. Under this arrangement the private firm is reponsible for designing and building the facility. The financing responsibility and ownership remains with the local body. The private firm also operates the facilities for a specified period of time.

BOOT/BOO

BOOT is the most popular form of agreement that has emerged in the country, with regard to composting projects. Typically in most such arrangements the private sector finance, build, own and operate the facility for a specified period of time sufficient to depreciate equipment and allow the private firm a reasonable return. As seen in the various cases in India, this period could range from 15 to 30 years. At the end of this period the facility is transferred back to the government, based upon the agreement between the two parties.

The Kolhapur Solid Waste Disposal Project, Maharashtra

A BOOT Solid Waste Composting Project

Determined to upgrade its solid waste management system, the city decided to implement a waste-composting project using private sector participation. The project was first conceptualized toward end of 1996. As a first step the Kolhapur Municipal Corporation enlisted assistance of consultants AIC Watson (now known as Montgomery Watson), to carry out field measurements and base studies, prepare procurement documents and support the bidding process.

The services of the private firm were procured through competitive bidding. In April, 1998, the city invited proposals for project pre-qualification, following which three consortiums were short-listed for the second stage of bidding. The RFP documents were issued in October, 1998. The corporation received two bids in February, 1999. Subsequently in April 1999, following technical and financial evaluation, Zoom Developers (P) Ltd. in association with Larsen Engineers, was selected to implement the project. However, due to time taken in obtaining formal clearances from city and state departments for leasing of land for the project, the Letter of Acceptance was issued in February, 2000. Finally, almost three years since project conceptualization and four city commissioners later, the agreement was signed in September, 2000.

Under terms of contract agreement the KMC and the selected bidder would enter into a 30-year concession agreement for a Build-Own-Operate-Transfer (BOOT) contract. The corporation will provide a long-term lease for the land (4 ha) to the concessionaire, who will design, build, operate and maintain the waste treatment facility (handling capacity-160 TPD initial year going up to 270 TPD final year) for this period, and mobilize the entire finances towards these activities. The corporation has committed to deliver MSW to the treatment site (weekly average of 770 tons), for which the concessionaire will compensate it via a fixed annual payment of Rs. 0.48 million (escalated annually at 8 per cent). The concessionaire has also committed to accept up to 20 per cent excess waste quantity for wheih it will compensate the city at a different rate. However the city would be penalized at this same rate should the waste delivered be less than the guaranteed quantity. The concessionaire will also pay the city a nominal lease amount of Re. 1 per sq.mt. per year for land. The city estimates a total income of Rs. 0.65 million in the first year of commissioning of the facility. The concessionaire will be solely responsible for marketing manure produced from composting of waste.

Source : Kolhapur Municipal Corporation and Indo-US FIRE project

The private firm typically recoups its investments from marketing of compost derived from waste processing. Local bodies see this, as an attractive method for attracting private capital for creating facilities that will eventually be owned by them.

In order to make the project viable and to attract private sector, in most cases local bodies have made available land at a nominal lease amount for such projects. However, there have been cases such as in Tambavaram (Tamil Nadu) wherein following the issuance of an advertisement to invite proposals, the municipality declined to provide land on a long-term lease. The municipality's prime concern in this case was potential misuse by the private firm.

The local body may also guarantee supply of a specified minimum quantity of waste at the project facility. Some cities such as Kolhapur (Maharashtra) preferred to guarantee a weekly average, instead of a daily quantity. Typically the payment arrangement between the private firm and local body may be laid out in the following two manners :

(i) the private firm pay the local body a price for the quantity of raw material (SWM) delivered at the composting facility, as done in Kolhapur, or ;

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(ii) the private firm share profits made from the end product, i.e. from sale of compost produced, as done in Vijayawada.

Vijayawada Solid Waste Disposal Project, Andhra Pradesh

BOO Solid Waste Composting Project

This project represents a contractual arrangement between the Vijayawada Municiapal Corporation and Excel Industries, who provided the technology, financed and operate the facility. The composting facility has a waste handling capacity of 150 TPD (ultimate capacity-300 TPD).

Excel Industreis, based on their earlier experience in Mumbai and Madhya Pradesh, developed the project proposal as well as a final agreement. A final arrangement was arrived at through joint negotiations in 1996. The project was implemented on a fixed term BOO basis, with a provision for negotiation at the end of the period. As per the agreement, Excel Industries has the freedom to either provide the services on its own or through a local entrepreneur.

As part of this arrangement, Vijayawada Municipal Corporation will receive payments from the contractor for the following, which was estimated to add up to Rs. 0.75 million per annum in 1998 :

- Nominal lease rent of Rs. 1 per sq.m. per annum for 3.36 ha of land leased for a 30 year period
- Rent per sq.m. per annum for land in consideration of already existing infrastructure facilities such as road, fencing, windrow, platforms, campus lighting, drainage etc.
- Lumpsum amount of Rs. 0.225 million per annum as compensation in consideration for using the existing buildings, equipments, machinery etc; and
- Royalty of 2.5 percent on net ex-factory sales realization or Rs. 35 per metric ton of organic manure produced, whichever is higher

After signing the agreement with the VMC, Excel Industries completed the construction of the facility in 1997, and it has been operational since. In terms of ongoing operations, VMC has received the payments from Excel Industries on a regular basis. However, there have been some disputes related to the quantity of garbage actually delivered on the site, and with both parties making different claims. VMC planned to overcome these by introducing a computerized weigh bridge at the site.

Source : Mehta Meera (1999). "A Review of Public-Private Partnerships in the Water and Environmental Sanitation in India". Water and Environmental Sanitation Group. DFID India.

In the first arrangement the local body does not bear any marketing risk, while in the second arrangement the risk is shared between the private firm and local body. The second arrangement requires that the local body have the capacity to assess and monitor sales of the end product.

Key Risks in Waste Composting Projects

(a) Compost Quality

One of the key risks associated with compost produced form municipal solid waste is quality of the end product. In the absence of waste segregation at source there is possibility of the end product being contaminated. This is a substantial risk especially since the GOI is actively promoting composting facilities. It is critical that compost so produced be environmentally safe and the farmer be assured of its quality. Standardization of compost quality would also have a bearing on its demand.

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Solid Waste Management rules issued by MOEF try to address this risk and include standards, which such compost must meet. However, it needs to be established that these standards are adequate and address all parameters. Further it is imperative that these be strictly implemented. It would also be useful to test the raw material coming to these composting facilities to ensure that it excludes hazardous and medical waste. Waste segregation at source must also be aggressively promoted. Some European countries limit the use of such compost to public gardens and playgrounds.

(b) Market for Compost

Demamd for compost will ultimately drive the price of the end product, which in trun will dictate the sustainability of such operations. It is important that there exist a market for the product.

Creating a market would require the government to set and maintaining stringent standards regarding the quality of end product, educating users about the benefits of compost and draw up a marketing plan. The following factors can affect the demand for the product :

- The type of agriculture or horticulture in the region: Compost finds favourable application in tea gardens. It may also be used in the development of wasteland.
- Interestingly, Excel reports that approximately 95 per cent to their compost is purchased by farmers for growing sugarcane grapes, bananas, etc, and has resulted in a 25 per cent decrease in chemical fertilizers use among these farmers. Further their compost is receiving good responses from the farmers in Gujarat, Maharashtra and Madhya Pradesh.
- Farmer's preferences : Farmers need to be made aware of the benefits of using compost in conjunction with chemical fertilizers.
- Marketing plan : It is important that a proper marketing plan be drawn up. This should include a broad assessment of the total production capacity and demand for such product.

Today approximately 35 composting facilities are operational in the country. The designed treatment capacity of these facilities is 2929125 MT per year, which would produce approximately 585825 MT of organic manure annually. Further, as many as 17 additional composting projects are being finalized. The total treatment capacity of these would be 1697250 MT per year, resulting in additional annual production of approximately 339450 MT of organic manure.

The distance that compost must be transported has a direct bearing on cost, and potentially demand. Futher compost is bulkier compared to chemical fertilizers and this may sometimes act as a detriment to farmers while considering its use. It is therefore preferential that the compost finds application in local neighbouring areas.

(c) Single firm advantage in the market

One firm has been instrumental in promoting the acceptability of composting projects. This firm is currently involved in 23 out of the 36 operational projects, in capacities ranging from project promoter to technology provider. Futher this firm is also involved in at least 11 of the 17 proposed projects, and in most of these cases this firm is responsible for marketing of compost produces. The firm's core business is agro-chemical manufacturing and it has an excellent distribution and sales network for its agro-chemicals. This essentially provides it marketing and circulating advantage for its compost produce. While the efforts of this firm must be applauded, the government must also create an environment to promote other firms for marketing compost.

(d) Waste-to-Energy (WTE) Projects

Waste-to-Energy projects include the use of technology that employs the process of incineration, pelletisation or bio-methanation. Such projects are still in the initial stage in India, and the viability and sustainability of the technology process and projects, is still being established. The incineration plant at Timarpur (Delhi) set up using Danish technology did not operate because the waste fed into the plant had a low calorific value. Recent attempts by the MNES and the MCD to lease the facility to interested entrepreneurs were aborted when no firm could meet the stipulated requirements, NGOs also resisted the revival of the facility. Considering that the plant is based on over 14 year old incineration technology that has since seen much advancements, the MNES has now decided to dispose off the facility.

In the past cities of Vijayawada, Baroda, Bangalore, Mumbai and Kalyan explored setting up pelletisation facilities, another process employed in WTE projects. However these projects got stalled at varying stages of project development or were eventually shut down. In the current year, the city of Hyderabad has set up, under trial operations, a pelletisation plant to convert 700 TPD MSW to 210 TPD of pellets. The facility will be set up by a private entrepreneur on BOO basis in association with the Hyderabad Municipal Corporation, and is based on technology developed by the Department of Science and Technology (DST). The pellets so produced would be used for industrial fuel initially and for 6 MW power generation ultimately. One line of 105 TPD fuel pellets has already been established, and is under trial operations.

In the recent years, as a result of the commendable efforts of the Ministry of Non-Conventional Energy Sources (MNES) and its programmes, there has been much interest for partnering amongst local bodies and private sector for generating of power through bio-methanation of municipal solid waste. Interestingly the two projects that have reached an advanced stage of development, namely the Nagpur WTE project (works commenced on project facility earlier this year) and the Lucknow WTE project (finances being tied) have both been structured on a BOO basis.

BOO-Bio-methanation

Bio-methanation projects are larger in terms of investment requirement and more complex when compared to composting projects. As seen for the initiatives in the country, typically the minimum waste requirement for such facilities is 300 TPD, with required capital investment in the range of 400 to 800 million.

Project financing is arranged using a mix of promoter equity, loans from financial institutions, suppliers credit and government subsidies.

Private firms are in advanced stages of discussion with corporations such as Nagpur (work commenced) Lucknow, Chennai, Bhopal, Mumbai and Delhi for setting up WTE facilities. These jurisdictions generate required waste quantities to make such project propositions possible. Further, some of the bigger cities have better capacity to handle complex PSP arrangements and documentations.

Earlier this year, work commenced for setting up a plant for generation of approximately 5.4 MW power through bio-methanation of municipal solid waste in Nagpur (Maharashtra). This would be the first such facility in the country. The project is being executed on a BOO basis, wherein the initial agreement is for a period of 30 years extendable by another 30 years.

The Lucknow Nagar Nigam (municipal corporation) has also tied up with a private firm for a bio-methanation WTE project. The facility would handle a minimum of 300 TPD. The project cost is approximately Rs. 760 million (refer box on project financing plan under section on Financial Institutions). The Brihan-Mumbai Municipal Corporation has also entered into agreement with 3 private firms for 3 WTE projects, each having waste handling capacity of 1000 TPD.

WTE

Nagpur Municipal Corporation

In April 1998, the Nagpur Municipal Corporation entered into a concession agreement with CICON and ENBEE Infrastructure Ltd. for setting up of a waste-to-energy (bio-methanation) facility on a BOO basis. The agreement is for a period of 30 years extendable by another 30 years. Under terms of agreement, NMC will provide 10 acres of land on a lease basis and guarantee supply of 520 TPD of raw material to the plant. In case of shortfall of organic content (including paper) below 60 per cent, the NMC will arrange to provide additional MSW up to an extent of 100 TPD. The project promoters have entered into separate Power Purchase Agreements (PPA) with Madhya Pradesh Papers Ltd. and Nav Bharat Papers Ltd. The promoters have also executed a manure purchase agreement with ENBEE fertilizers.

The project uses "Dranco" (Dry Anaerobic Composting) anaerobic digestion technology, which is being successfully utilized in 6 plants in Europe (MNES Report). The facility is expected to generate 4.75 mega watt (MW) (at 87 per cent of installed capacity of 5.4 MW) of electricity and 150 tons (at 88 per cent of installed capacity of 170 tons) per day of organic manure. The total project cost is estimated at Rs. 472.45 million and the financing plan is as follows :

Table—Financing Plan *Rs. in Million*

	Funding		Amount
1	Promoter Equity	Enbee Infrastructure Limited, a Special Purpose Vehicle has been set up under the Indian Companies Act for project implementation.	118.44
2	Government Subsidy	MNES (30 million for each MWe) (To be routed through HUDCO/IREDA)	120.02
3	Loan	HUDCO	117.00
4	Loan	IREDA	117.00
	Total		**472.46**

In December 1999, work commenced on setting up of the project facility.

Source : Mehta Meera (1999). "A Review of Public-Private Partnerships in the Water and Environmental Sanitation in India". Water and Environmental Sanitation Group. DFID, India.

Key Risks in WTE Projects

Waste to energy projects are still in the initial stages of development. Even though the technology has been proven worldwide, its viability and sustainability needs to be demonstrated and established in the country. The main factors that determine the techno-economic viability of WTE projects are discussed below :

- Capital investment : WTE projects generally involve higher capital investment and are more complex when compared to other options of waste disposal, but as pointed by MNES, gains in terms of waste reduction, energy, etc. are also higher. Such plants are financially viable in other/developed countries mainly because of the tipping fees/gate fees charged by the facility for the service of waste disposal, in

additional to its revenue income from power sales. It is thereafter the sole responsibility of the facility operator to treat and dispose of the accepted waste as per statutory requirements. However, at present in India, revenue from power sales is the only source of revenue income for WTE plants.

- Scale of operation : Most cities generate sufficient waste quantities to enable projects of total power generation capacities ranging from 5-50 MW, which corresponds to MSW generation ranging from 500-5000 TPD. Technologically it is feasible to set up even smaller capacity projects of 1-5 MW ranges, corresponding to around 100-500 TPD waste treatment. However, economies of scale generally favour centralized, large-scale projects. Waste from a number of adjoining regions/cities could be treated at a common WTE facility; however, in such cases the costs of waste transportation versus projects benefits must be carefully evaluated.

- Available waste quality : Waste quality directly determines the costs of pre-processing of the waste to suit the chosen technology. Enforcement of strict measures for segregation of waste at source in order to avoid of mixing of undesirable waste streams will play a major role in making the WTE facilities more viable.

- Statutory requirements : The statutory requirements that a WTE facility must comply with, will directly govern the cost of the environmental pollution control measurs to be incorporated in the overall facility. These requirements, however, cannot be compromised with and are only likely to be made more stringent in the future.

- Project risks—terms for MSW supply, allotment of land and sale/purchase of power directly affect the net revenue to the facility operator and are factors in determining the financial viability of projects. It is necessary that the terms are conducive enough to attract private sector participation in the activity. Since FI lending for such facilities is usually project based, it is critical that all project risks be suitably addressed, with back-to-back agreements in place. The energy off take agreements must be in place, to ensure marketability of energy so produced.

- FIs attach great importance to the promoter's profile for such projects.

PRIVATE SECTOR PARTICIPATION ATTEMPTED IN VARIOUS STATES

The information regarding private sector participation in collection and transportation, resource recovery projects, such as waste to compost microbial as well as vermi compost, waste to energy through biomethanation, pelletization, and incineration attempted in various states in the country till date is compiled with whatever information that could be gathered from various cities and kept as Annexure-5 (5.1 to 5.7)

LEGAL ISSUES RELATED TO PSP IN SWM IN INDIA

Labour Issues

(1) Contract Labour (Regulation and Abolition) Act, 1970 (CLA)

The existing Act was passed in 1970 when the Government was concerned about exploitation of workers under the contract labour system. The Act abolished contract labour in various jobs and processes and regulated its employment where it could not be abolished. It essentially lays out the relationship between the principle employer and contract labour.

In accordance with provisions laid out under Section 10(1) of the CLA, State Governments may prohibit employment of contract labour in any process, operation or work in any establishment (defined to include any office or department of a local authority). Any state that chooses to exercise this provision must carefully review implications of such a decision on delivery of SWM service and staff strength and related expenditure of a local body. Further such a ban would preclude introduction of private sector participation. The State of Tamil

Nadu is one state that has banned the use of contract labour in sweeping and scavenging services. As a result when the Chennai Municipal Corporation decided to privatize these services, it had to request the State to grant it special exemption (in accordance with provisions laid out under Section 31 of CLA) from the ban regarding use of such labour.

Ordinance Amending the 1988 GO issued by GOTN that had Abolished Contract Labour in Sweeping/Scavenging in the State of Tamil Nadu.

Exemption to Chennai Municipal Corporation

The Labour and Employment Department, Government of Tamil Nadu (GOTN), in accordance with powers delegated to it under section 10(1) of the Contract Labour Act, had issued a GO dated 19-9-88, abolishing the use of contract labour for sweeping/scavenging in establishments/factories employing 50 or more workmen. Meanwhile in a separate GO dated 4-5-98; the Municipal Administration and Water Supply Department, GOTN, issued guidelines to privatize works related to cleaning and scavenging in local bodies.

In 1999, the Commissioner of Chennai Municipal Corporation made the case that the first order essentially pre-empted private sector participation in SWM in the city, thereby affecting service delivery. Subsequently the GOTN, in accordance with its powers under Section 31 of the Act granted an exemption to the Chennai Municipal Corporation, and the expression "except Chennai Corporation" was added after the expression "employing 50 or more workmen". As a result, the Municipal Corporation of Chennai is now empowered to engage private labour for varius Solid Waste Management activities within its jurisdiction.

Source : Chennai Municipal Corporation

If State Government has not prohibited activities such as street sweeping, garbage collection, etc, contract labour can be employed by a local body to carry out the same until the State Government abolishes such activity. As per directions of the Supreme Court in the Air India case, once an activity is abolished, the existing contract, workers doing such jobs will automatically become regular employees of the establishment. This again has serious implications for both local bodies and private firms engaged in the delivery of SWM services.

It may be noted that in case a local body chooses to employ contract labour, it would be the principal employer and the onus of carrying out duties as prescribed under the CLA would rest with it. In case of delivery of service using private sector participation, the local body as the principal employer must ensure that the private firm meets duties under the CLA. Alternately, the local body must specify/identify the private firm as the principal employer in the project agreement.

Brihan-Mumbai Municipal Corporation

Case Against Use of Contract Labour

For the past 15-20 years, the Brihan-Mumbai Municipal Corporation had been hiring vehicle service for SWM. Each vehicle came with 5 labourers. These workers were paid Rs. 1500 per person per month, as opposed to the corporation wage of Rs. 6000 per employee per month. In 1998 the labour moved to court, asking to be included as permanent employees of the BMC and demanding equal wages. Both demands were made under provisions within the Contract Labour Act (CLA).

Subsequently the High Court identified 800 persons who had been working on the job for the past years and ordered that these be made permanent. The court also issued a directive banning contract labour in SWM.

The decision of the High Court was challenged in the Honourable Supreme Court of India, which has ruled in favour of Mumbai Municipal Corporation. The Honourable Supreme Court of India in SAIL versus National Union Water Front Workers (C.A. No. 6009–6010/2001 dated August 30, 2001) has held on 30th August 2001 that neither section 10 of Contract Labour (Regulation & Abolition) Act 1970 nor any other provision in this Act whether expressly or by necessary implication provides for automatic absorption of Contract Labour on issuing a notification by appropriate government under sub-section (1) of Section 10, prohibiting employment of contract labour, in any process, operation or other work in any establishment. Consequently, the principal employer cannot be required to order absorption of the contract labour working in the concerned establishment.

The Honourable Supreme Court has also overruled its own earlier judgment in Air India case prospectively.

Further, point 5 in annexure of Form VI, prescribing payment of same wages as that employed by the establishment for similar work must be reviewed. This is since corporation wages are essentially negotiated wages between authorities and strong labour unions. Under point 4 in annexure of Form VI, the act already mandates adherence to prescribed rate under the Minimum Wages Act 1948, which should suffice.

Source : SWM Department, Brihan-Mumbai Municipal Corporation

Source : SWM department, BMC

If a private firm takes up the job of collection of Household waste and transporting the same either to the municipal dustbin or up to the designated dumping sites as per an agreement reached with individual household or by the residential associations, the said activities cannot be taken as done at the instance of the local body and such local body cannot be taken as the principal employer.

Another issue that emerges out of the CLA is that regarding wage rates. Point 5 in annexure of Form VI, prescribes payment of same wages to contract labour as that to workers employed by the establishment for similar work. Municipal Corporations argue that since corporation wages are not market wages but are negotiated wages between authorities and strong labour unions, this provision be reviewed.

Amendment of Contract Labour Act—Review by GOI

The Government is all set to enact a new legislation on contract labour with the aim to meet challenges of the emerging competitive environment and to provide flexibility in outsourcing certain types of activities to specialized outfits. A committee of secretaries headed by Cabinet Secretary Prabhat Kumar has, already cleared this draft legislation.

Some of the highlights of the new legislation are reported to be as follows :

- Opening up of contract labour system to new sectors,
- Companies including PSUs, may be allowed to hire contract labour,
- Abolition of automatic absorption by the principal employer once link between the contractor and worker is snapped.
- Penal provisions to be softened,

- Added provisions for safety net for contract labour,
- Women may get to work in industries being run on three shifts,
- The new law to be in accordance with the ongoing economic liberalization.

Currently the Government has initiated a consultative process with labour unions, since it felt that these changes were needed to ensure the objective of efficient and economic provision of services without curtailing labour rights.

As per the announcement made in the union budget 2001-2002, the Contract Labour Act is proposed to be amended, in order to facilitate outsourcing without any restrictions and to provide protection to the contractual labours.

Source : (i) Newspaper articles : June 26, 2000, Times of India, New Delhi, July 3, 2000, Economic Times, New Delhi, September 9,2000, Hindustan Times, New Delhi.

(ii) Union Budget 2000-2001

(2) SC, ST (Prevention of Atrocities) Act, 1989

SWM Supervisors often complain about the misuse of the SC, ST (Prevention of Atrocities) Act against them by the ground staff. This is a situation peculiar to the country, and a suitable party must carefully review each such complaint.

Environmental issues

(1) Siting Facilities

A number of PILs have been filed in recent years regarding the siting of waste treatment facility. Such PILs delay project implementation and have financial implications for the private firm. In November 1994, the Karnataka State Government leased 9 sites, totaling 53.5 acres, to Bangalore Municipal Corporation for sanitary landfill. However there was much local opposition regarding the use of these sites for the above-mentioned function (citing potential health problems as a reason) and a PIL was filed against the same. The issue is now in court. In another case a composting facility in Thane was shut down, following a PIL by local residents. Subsequently the courts dismissed this case. However it is interesting to note the diametrically opposite views taken by two sets of experts on the subject, in this case (refer box below).

Not In My Backyard (NIMBY)

PIL against the siting of composting facility within Thane Municipal Corporation

In May 1998 the Thane Municipal Corporation (TMC) commissioned a 300 TPD capacity composting facility, owned and operated by a private firm (Leaf Biotech with Excel technology). Soon after, neighbouring residents started complaining about foul odour, In response the city commissioner commissioned the National Environment Engineering Research Institute (NEERI) to ascertain the cause for the odour. The NEERI study confirmed the emanation of odour due to plant operations, however it recommended against closure or shifting of the facility.

Subsequently, in April 1999, a local resident filed a PIL in the Mumbai High Court. As a result the TMC stopped providing garbage to the facility site without assigning any reasons to the private firm. The court also appointed a committee of experts to review the mater. This committee found severe fault with NEERIs findings and report. Meanwhile the Maharashtra Pollution Control Board observed no foul smell outside the compost premise.

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In its final report to the High Court, the committee stated that the plant did not warrant closure and that it found no evidence that plant operations were the source of odours or health problems. The committee stated that the measured levels of all gases at the site were far below internationally recognized concentrations at which any health effects show up. The committee also suggested several measures to the corporation for minimizing any public inconvenience from garbage traffic to the site and from its generally unsanitary management of wastes.

Subsequently the High Court in its interim order on July 5,2000 permitted Leaf Biotech to operate its plant. The TMC also accepted the committee's recommendations made to it. Finally on July 29,2000 the case was dismissed.

Source : Newspaper article , July 30,2000. Mumbai edition.

(2) Future potential for Brownfield Development

Proper standards must also be drawn out regarding future potential brown field development at these sites.In cities such as Mumbai where real estate prices are high, and land is at a premium, such usage of these sites is already being seen. Proper safeguard measures must be established to avoid any health impacts from such use.

(3) Implementation of Environmental Standards-Role of Pollution Control Boards

Most plans stumble due to lack of adequate implementation of standards. Since disposal of municipal solid waste poses problems of the pollution and health hazards, the Polloution control boards are expected to take action for persuading the civic authority in proper management of municipal solid wastes. Though, direct responsibility of management of solid wastes is on local municipal authorities, the Pollution Control boards need to have close linkage with local authorities in rendering assistance in terms of carrying out necessary surveys and providing technological back-up.

Miscellaneous

(1) Vesting of right to Create Security against corporation Land/Assets

Often FIs require that the private firm mortgage corporation/state land (leased to it for the project) as a security against the required project loan. In many resource recovery projects, cities had to give rights to project promoters to create securities in favour of lenders.

While this helped facilitate raising financing for the project, it remains unclear as to what the implications of the same would be in case of land mortgage, which is an immovable asset, in the scenario where the private firm defaults on lender repayments. An FI would have limited financial value for such land since this is government land specified for a marked use. The main recourse to the lender in such a case is to replace the defaulting firm with another firm, for continuing the identified project (provision normally included under Lenders Step-In-rights in agreements).

(2) Patents Issues

In the case of patented technology/process, the issue of patent transfer needs to be reviewed. This may become critical for local bodies to be able to successfully operate and maintain such facilities upon transfer.

Recommendations of the committee appointed by the Honourable Supreme Court

There is a need to improve accountability and the level of service through NGO, private sector participation in SWM services to improve the overall performance.

Private sector participation or public/private partnership may be considered by urban local bodies in the areas where municipal corporations or municipalities are not currently providing a service keeping in mind the provisions of the Contract Labour (Regulations & Abolition) Act, 1970 of Government of India. PSP may be considered in newly developed areas, under developed areas and particularly in areas where local bodies have not been providing services. It should be encouraged in the areas of door-to-door collection of domestic waste, commercial waste, hoispital waste, hotel waste, construction waste, yard waste and for setting up and operate and maintain compost plants and other treatment plants as well as common disposal facilities. They could also be engaged for supplying vehicles on rent, lease as well as for repair and maintenance of vehicles. There should be a right mix of private sector and public sector participation to ensure that there is no exploitation of labour as well as of the management. This will check growth in establishment cost, bring economy in expenditure and introduce an element of healthy competition between the private sector and public sector in solid waste management.

CONCLUSIONS AND RECOMMENDATIONS

- ⇒ The local bodies should make an endeavour to involve private sector in SWM services to ensure efficiency, economy in expenditure and accountability in service.
- ⇒ Cities should structure the project well and pre-define the basis of payment.
- ⇒ User charges need to be introduced to make the PSP financially viable and sustainable over a period of time.
- ⇒ While planning for private sector participation, labour redundancy issue need to be addressed properly.
- ⇒ Retrenchment of casual/daily wages labour, redeployment of permanent staff and no recruitment on retirement of existing employees may help in reducing the staff liability.
- ⇒ Labour groups could be encouraged to be partners with private sector in the contract.
- ⇒ Contracts need to be given to multi firms to ensure that no monopoly is created by one firm, which may result in breakdown in service if labour problem arises in the firm. Preferably, part of service be contracted out and part of the service be carried out departmentally so that in case of any failure, ULB can take over.
- ⇒ DBO, BOOT, BOO models can be adopted for contracting out waste processing. The ULBs should consider giving land on a long term lease on a token rent, provide assured quantity of gargage/solid waste at the plant site free of cost and negotiate suitable payment terms with the private sector in terms of royalty, tipping fee, etc.
- ⇒ While contracting out, the provision of Contract Labor (Regulation & Abolition) Act, 1970 should be adhered to.
- ⇒ Various contracting mechanisms have been shown in this Chapter. ULBs may adopt the one that suits them.
- ⇒ The contract papers should be prepared carefully to avoid legal complications in future.

CHAPTER—9

ROLE FOR NON-GOVERNMENTAL ORGANIZATIONS (NGOs) AND COMMUNITY BASED ORGANIZATIONS (CBOs)

The informal sector plays a critical role in waste management and exists as a parallel system to the formal waste management process. The sector is labour intensive and includes rag pickers, Itinerant Waste Buyers (IWBs) and small recycling enterprises. There are varying estimates of quantity of waste recovery taking place within the informal sector. Bhide (1990) estimates that waste pickers recover between 6 to 7 per cent of waste generated, while Souza (1991) puts the figure at around 15 per cent. Research has shown that organizing the informal sector and promoting micro-enterprises has proven to be an effective way of extending affordable services, especially to poor urban communities (Arroyo et al., 1999). Further promotion and developement of recycling groups is also a means of upgrading living and working conditions of rag pickers.

Experience in India is showing, that NGOs can play an important role in urban solid waste management. This support may be in one or more of the following areas:

— Incorporation of micro-enterprises and informal waste recycling groups

— Community level waste collection, segregation, transportation and decentralized treatment

— Community education, forum for public concerns.

The strength of these organizations lies in being able to reach communities, and motivate and organize them toward ensuring better waste management. In some cases NGOs have managed community participation in user-fee-based waste collection and disposal programs. Another innovative approach being tried by cities is the involvement of local business/trade associations in cost sharing and monitoring of these service.

Though the above initiatives are commendable, in most cities NGO/CBO participation is still on a laboratory scale having limited service coverage and impact when compared to overall city operations. In many cases NGOs/CBOs have required Government assistance through provision of grants, equipment and land; and the commercial viability of these scheme in absence of such support is yet to be proven. The potential for expansion of such services to a larger service area, and replicability and sustainbility of operations is still to be explored.

Emerging Role of NGOs in Urban Waste Management Process

Incorporation of micro-enterprises and informal waste recycling groups

NGOs/CBOs are increasingly supporting the incorporation of micro-enterprises and informal waste recycling groups. In Ahmedabad, the Self-Employed Women's Association (SEWA) has played an important role in helping organize women rag pickers. Once organized these groups have improved access to training for waste collection and segregation, and micro-credit. In Chennai, one of the most successful cities in terms of service coverage by informal organizations. NGO's like Exnora, DBAI, AYC, Asha Nivas, Neesakaran and IIT are involved in solid waste collection, whereas Exnora and IIT are involved in the segregation and composting of solid waste.

EXNORA- Chennai

Community Participation for Clear Surroundings

Madras rapid growth resulted water supply contamination, sewage problems and informal garbage dumps. Government-provided garbage containers did not work as residents found it inconvenient to carry garbage to collection points. EXNORA International intervened, beginaing in 1989, and developed "Civic Exnoras", independent resident committees affiliated with the parent organization, each comprising of 75 to 100 families. A 'street beautifier' is paid from neighbourhood funds to collect refuse from households using specially designed tricycles, and to sweep the streets. The Civic Exnoras operate not only in middle and upper-class neighbourhoods, but also in slums, where residents are provided with free tricycles and youth are involved. 900 Civic Exnoras are operating in Madras, encouraging committees to implement other programs such as waste composting.

Source: Internet Site-www.un.org (Hobitat Best Practices)

Community level waste collection, segregation, transportation and decentralized treatment

NGOs such as Exnora, Wastewise, Green Cross Society, SPARC, Muskan Jyoti, CEE, Conserve etc. are involved in community level waste collection, segregation, composting and education, in cities such as Chennai, Bangalore, Pune, Ahmedabad, Rajkot, Lucknow, Tiruppur, Pimpri-Chinchwad, Coorg. Hubli-Dharwad etc.

Muskan Jyoti Samiti-Lucknow

Waste Collection, Segregation, Transportation, Vermi-composting

Since 1994 Muskan Jyoti Samiti, a Non-Governmental Organization, has been providing solid waste management services related to street cleaning, waste collection, sorting, and transportation to about 20000 households, including 22 slums, in peripheral areas of Lucknow city (estimated 2001 population of Lucknow-2.9 million). In March 1999, they also started a vermi-composting unit and a research center on a 65-acre site on city outskirts.

The State government provided the land, capital and equipment for the facility. The State Urban Development Authority gave a grant of Rs. 124000 for preparation of the vermi-composting beds and pits, and also provided 100 cycle trolleys (cost Rs: 3000 per unit). The Lucknow District Urban Development Authority gave 4 tractor trolleys (cost Rs. 236000 per unit) and 200 handcarts (cost Rs. 1000 per unit). However, the NGO works independent of the Lucknow Municipal Corporation.

The NGO recovers its operation and maintenance cost from user charges collected from beneficiary households served. The monthly garbage collection rates are as follows: slum dwellers Rs. 10 economically weaker section Rs. 15, middle income households Rs. 20, and high income households Rs. 25. The annual collection from the households has risen-two fold since MJS started operations, from Rs. 180000 in 1994-95 to Rs 4320000 in 1998-99, Income from the sale of inorganic materials recovered from the collected waste has also been rising rapidly, reaching Rs. 660000 in 1998-99 form Rs. 45000 in 1995-96. There was no income from the sale of inorganic materials in 1994-95. Further, income from the sale of compost started accruing to MJS only in the year 1999. The bulk of the MJS's expenditure in SWM is on salaries paid to the increasing number of workers.

Source: "Profits from Waste; An NGO-led Initiative for solid Waste Management in Lucknow, Uttar Pradesh India". Field Note, Small Private Initiatives (SPI) Series 3.

Provision of such service is generally based upon collection of user charges from beneficiary households, thereby demonstrating the viability of providing a fee-paying SWM service in India's urban areas. In Lucknow

even the poorer households are willing to pay a significant amount as the monthly fee for good solid waste collection service to ensure a better living environment.

Increased NGO participation is being seen in provision of decentralized solutions for waste treatment such as vermi-composting[1], as being tried in Lucknow, valsad, Vyara, Hubli-Dharwad, Davangere etc. The City of Mumbai is promoting Community level vermi-composting with the aim of reducing waste at source.

COMMUNITY EDUCATION

NGOs such as CEE, Conserve etc. are implementing community involvement programs in a number of cities such as Bangalore, Ahmendabad, Pimpri-Chinchwad, Tiruppur, Coorg, Delhi etc., for raising awareness regarding SWM issues through education and communication programs. NGO/CBOs are increasingly acting as forums for voicing public concerns and opinions. For instance, the attempt to revive the incineration plant at Timarpur (Delhi) saw much opposition from local NGOs, who argue that waste incineration has serious environmental impacts.

Cities and Community Contract Systems

Cities providing incentives to community groups

There is an increasing acceptability by cities of the role played by NGOs/CBOs in the urban waste management process. Many cities are experimenting with community contract systems in SWM. Such community schemes operate in a variety of ways, some relying on NGOs or CBOs to provide service while other delegate management oversight and control. Some schemes also incorporate innovative lending to poor groups. Experience has shown that community contracting can provide satisfactory services at lower cost with supervision provided by the community itself.

Cities such as Hyderabad, Vijayawada and Kukatpally in Andhra Pradesh, have introduced innovative schemes that are linked with other government programs. Here the city supports formation of women groups that are then given street sweeping or garbage collection contracts. The city also gives these groups a 50 per cent subsidy for equipment and vehicle, drawn under the SJSRY program of the Central Government. The city further helps in arranging remaining finance for equipement and vehicles. The communities, as also a sanitary inspector, monitor the services on a regular basis.

Involving Community Groups—Vijayawada Municipal Corporation Sanitation by Women's Group

The Vijayawada Municipal Corporation has constituted a scheme called DWCUA (Development of Women and Children in Urban Areas) to promote the participation of poor comunities and women in sanitation. Under the scheme the corporation facilitates the formation of area based community groups comprising women and children. These groups are then allocated the responsibility of sweeping, cleaning, collection and transportation of garbage, and desilting in their area.

[1] *Vermi-composting is a process of using earthworms for conversion of biodegradable wastes into compost. When biodegradable wastes are applied to a soil containing earthworms in the form of a mulch, simple wastes like sugars are consumed directly by the bacteria, nurtured by the earthworms. More complex wastes like cellulose are broken down into simpler compounds by enzymes produced by the earthworm, before being fed to the bacteria. The predominance of the bacteria grown by earthworm ensures maximum energy utilization because they can release almost twenty times more energy per unit of carbon than anemhic bacteria; Vermiculture can either be done in pots, bins or in garden. 100 gms of waste requires 0.1 sq.mt. of area for treatment.*

Under the scheme VMC supports these groups by arranging finance for sanitation vehicles and implements. Each garbage vehicle unit, consisting of a tractor and a trailer (costing approximately Rs. 0.26 million) is financed as follows: corporation subsidy of 50 per cent drawn under the SJSRY program, 45 per cent bank loan, and 5 per cent paid contribution by the group. The VMC acts as an intermediary to facilitate the above bank borrowing. The loan is further secured against guaranteed future income of these groups from the corporation's rental of Rs. 350 per day for each vehicle unit. Of this rental amount the corporation directly deducts Rs. 150 per day as loan repayment amount and repays the bank on behalf of these groups.

Each group member is paid Rs. 55 per day. This includes Rs. 50 per day towards labour charge and Rs. 5 per day towards a group corpus fund. The corpus fund is used for meeting incidental charges such as cost of the uniform (jacket), shoes, implements etc.

As of August 2000, there existed a total of about 12 such groups, including 3 nights sanitation groups. These together covered about 20 per cent of the town area. The scheme has resulted in cost savings for the corporation as well as better service performance because of local community involvement. Interestingly the scheme has helped challenge traditional caste bias regarding sweeping and such activities and women from various communities are increasingly coming forward to participate in the same.

Source : Municipal Commissioner, Vijayawada Municipal Corporation

Mumbai has interduced a Community Based organization participation Scheme for up keeping clean surrounding in slum areas. Under this scheme an NGO called "Suruchi Mahila Mandal" has come forward for provision of service in 9 slum pockets of Ward P, south area, for a period of one year. The Municipal Corporation of Greater Mumbai has committed to provide cash assistance to the NGO in the form of a reducing contribution. M.C.G.M. will also provide the NGO a set of handcart with 2 handbarrows for each group of 4-5 workers.

Another innnovative approach being tried by cities is to promote participation of local residents. Termed as the Advanced Locality Management (ALM) Process in Mumbai, this approach hinges on the concept of self-governance. Under the ALM system the locality forms a locality committee, which is the made responsible for coordinating and monitoring the process of service delivery in the locality. The Ludhiana Municipal Corporation has also successfully promoted the involvement of neighbourhood groups. Under this program, localities first form and register neighbourhood groups with the corporation. These groups are responsible for door-to- door waste collection in the locality. The corporation provides these groups cash assistance to meet 50 per cent of the workers salary expense.

Involving Neighbourhood Group—Ludhiana Municipal Corporation

The Ludhiana Municipal Corporation was able to provide sanitation sevices (solid waste collection and cleaning of drainage) to only40 per cent of the city's area and therefore constituted a scheme to promote community participation in service delivery.

Under this scheme, a Mohalla Sanitation Committee (MSC) consisting of a President, General Secretary and Cashier is elected by local people and registered with LMC. Following this the sanitary inspector of the area inspects the locality and estimates the need for sanitation workers.

The MSC employs the sanitation workers and supervises their work. Each sanitation worker is paid

Rs. 1600 per month, which is shared equally between the corporation and the MSC. The MSC essentially raises this amount from the households served.

About 101 such committees have been formed which have 1950 workers.

Source : Municipal Commissioner, Ludhiana Municipal Corporation

Involvement of senior citizens in garbage collection and disposal, and maintaining clean surroundings is another emerging approach in waste management in urban centers. In Mumbai the Dignity Foundation, an association of senior citizens has brought together 663 dignitaries who take up issues related to the service.

Cities partnering with local business groups

Cities are increasingly involving local trader associations for sharing costs and monitoring service delivery. The Vijayawada Municipal Corporation has jointly with the local traders associaton, introduced a scheme for waste collection and transportation (refer box).

Involving Trader Association —Vijayawada Municipal Corporation

Autonagar Sanitation Scheme

In order to address the sanitation problem in Autonagar area (a densely developed area of 252 acres) the corporation approached the area association for sharing of service costs. Subsequently the association committed to contributing 50 per cent of oveall expenditure and two groups, comprising 30 persons each, were engaged. A garbage vehicle unit (tractors with traillers) was arranged for each of these groups. Labour charges and financing of garage vehicle was done as per the model described above. During 1999-2000 the activity cost approximately Rs. 0.1 million; 50 per cent of which was borne by the association. Further, the association was also responsible for monitoring and supervising service delivery.

Cities, such as Ahmedabad, have used assistance from local business houses in other sector projects such as road designing and building, slum networking. Local businesses in various cities have indicated an interest in partnering with local bodies for maintaining sanitation in selected areas against advertisement rights.

RECOMMENDATIONS OF COMMITTEE APPOINTED BY THE HONOURABLE SUPREME COURT OF INDIA

NGOs may be fully involved in creating public awareness and encouraging public participation in SWM planning and practice. NGOs may also be encouraged to enter into the field of organizing ragpickers in doorstep collection of waste. ULBs may provide financial and logistic support to NGOs for the purpose.

CONCLUSIONS & RECOMMENDATIONS

- ⇨ NGOs/CBOs can play a very important role in solid waste management. They may be encouraged to get involved in primary collection of waste from house to house, shops and establishments. They can charge a small fee in the form of a user charges.
- ⇨ They could be involved in organizing the ragpickers in segregation of recyclable material and reduce the burden of the ULBs.
- ⇨ They may be involved in taking up decentralized treatment of waste at the community level such as microbial or vermi composting, which will reduce the transportation cost of the ULBs.
- ⇨ NGOs may also be involved in educating the community by forming neighbourhood groups and umdertake mass awareness campaign.

CHAPTER—10

RECOMMENDATIONS TO EXTEND CENTRAL AND STATE GOVERNMENT SUPPORTS TO URBAN LOCAL BODIES

Recommendations made under this section have been categorized as recommendations for Center and States, and for ULBs. While delivery of SWM sevices is primarily the responsibility of local governments, the government at the center and state has a critical role to play in indentifying objectives, and designing policies to achieve the same.

It is important that the three tiers of government work intandem to achieve defined objectives. Some initiatives may need to be made jointly, while others may require separate approaches across the government tiers, given their perspective, role and capacity.

RECOMMENDATIONS—CENTER AND STATES GOVERNMENT

(1) Setting Objectives and Policies

Align and Dovetail Efforts to Define Objectives

A number of Ministries are responsible for different aspects of Solid Waste Management, these are : Ministry of Health and Family Welfare, Ministry of Environment and Forests, Ministry of Urban Development, Ministry of Agriculture, and Ministry of Non Conventional Energy Sources. It is critical that various ministries at the center make a coordinated concerted effort toward addressing SWM problems. As can be seen from recent experience, the various committees constituted by the GOI, have served this critical role of coordinating and aligning efforts of the various ministries and research institutes. This linkage and coordination was missing earlier and may be identified as one of the important factors for infusing energy into the recent efforts by the government. Coordination and alignment is also required in efforts of the center and states.

Institute Timely Comprehensive Policies that Respond to Sectoral Trends

It is important that ministries jointly set objectives and prepare timely comprehensive policies that anticipate and respond to sectoral trends (at center and state level). Such policy preparation necessitates that systems be in place for periodic information collection, analysis and recommendations. This would enable policy making, help assess policy impacts, and help anticipate sectoral shifts and trends.

As a first step waste segregation at source must be aggressively promoted. Further the government must move towards an integrated waste management approach and design policies that promote waste diversion, reduction, recovery etc. The government must align the role of various stakeholders such that these policy objectives are met. In order to do this multiple approaches may be used, such as: mandating that a portion of recycled material be used in packaging etc., subsidizing products made from recycled materials, susidizing products obtained from processing waste and so on.

Some of the more urbanized states generate huge quantities of waste. The gravity of the situation will only increase with time and policies in these states must reflect the same. These states must aggressively promote waste reduction at source, waste recycling, and resource recovery. They could introduce fiscal incentives for attracting increased participation in the sector and in delivery of services.

(2) Funding and Technical Assistance to Support Policy Objectives and Safeguard Environment

The Supreme Court guidelines regarding standards and service levels as well as the MOEF rules will have cost implications and must be supported by identifying matching resources (grants/soft loans) and technical expertise from higher levels of governments. These are to be used to induce local governments to provide a socially and environmentally desirable level of solid waste management. Local bodies may choose to provide general fund subsidies in recognition of the public good and equity aspect of solid waste management. Annex 12.1 includes "back of envelope" calculations to illustrate the magnitude of the requirement of finances for SWM till year 2007. This demand will have to be met jointly by central, state and local bodies.

It is recommended that given the context of new stringent environment regulations, a scheme be initiated for central/state support for initiating projects for designing, developing and maintaining treatment facilities and sanitary landfills for municipal solid waste (excluding cost of land).

Futher in order to support efforts of local bodies and to develop capacity to manage and monitor services, there must be a focus on technical assistance for local bodies through technical assistance programs/ support in out sourcing of technical expertise etc.

(3) Partnerships to Promote Policy Objectives

Tap Bilateral/Multilateral Support

Currently such support for SWM is available in form of technical assistance. The government may tap into various bilateral/multilateral programs to dovetails efforts in the area of micro enterprises support, schemes for waste diversion, reduction, recovery etc., and suport for Private Sector Participation.

Attracting PSP and Promiting NGOs/CBOs

Existing legal impediments must be addressed in order to attract Private Sector Participation from local, national and international firms. Incentives to firms to participate in SWM activities and schemes to support micro entrerprises must be promoted.

(4) Capacity Building of ULBs and Benchmarking

The center and states must make a concerted effort toward capacity building of ULBs in areas of imporved accounting systems, commercial orientation in service delivery and Private Sector Participation. Such capacity building could be carried out through ongoing training programs, providing hands on experience in projects, exposure visits and experience sharing with peer groups. It may be beneficial to provide career growth opportunities based upon such learning. States must also move toward benchmarking service delivery between various cities.

RECOMMENDATIONS—URBAN LOCAL BODIES

(1) Improve Resoure Base and Institute Income from SWM Service Delivery

Improve Resource Base and Recovery

The fundamental approach for urban local bodies to improve delivery of SWM services, have better access to improved machinery and technology, attract private sector participation and have an increased borrowing potential (from bonds, FIs etc.) is to improve its resource base and institute/increase income from the delivery of services. Since SWM is funded through general revenues, local bodies will have to improve assessment, billing and collection of existing income sources. This is critical if local bodies are to meet improved service standards and safeguard their environment.

Cities such as Ahmedabad that have worked toward ensuring an improved resource base and recovery have been better positioned to access the market, attract interest from financial institutions and private sector.

Increase/Institute/Implement Operating Revenue

In addition to improving general revenues local bodies must institute/increase and implement collection of operating revenue by means such as: user charges, tipping fee/disposal site fee, landfill tax etc.

As a first step cities may choose to introduce targeted service delivery and user charge collection from bigger waste generators (commercial enterprises such as hotels etc.) as is being introduced in Mumbai and gradually introduce the system of levying solid waste management fees from all households, shops and etablishments in the form of a user charge. All cities should draw up a levy structure for waste collection to meet at least the operating cost of primary collection departmentally or through a contractor/private sector. Simultaneously, the institution of tipping fee at waste treatment sites will make waste treatment and disposal project financially viable and attractive to entrepreneurs.

Such operating revenues also become critical in light of increasingly stringent environment guidelines.

Maintain a Separate Account for Municipal Solid Waste Management

In order to overcome the problem of erratic cash flows throughout the years, local bodies must maintain a separate account for SWM and deposit all service fees, conservancy tax etc into this account. This will ensure a consistent cash flow for regular operating expneses such as purchase of parts and repairs, salaries etc.

In the long run, this will also help local bodies identify service income, expenditure and required element of transfers and subsidies. Ultimately ULBs must move toward making this activity self-supporting from the revenue it generates; and, earmarked transfers and grants.

(2) Commercial Orientation

Commercial Orientation in Service Delivery and City Wide Strategy

City commissioners must introduce their staff to the concept of commercial orientation in service delivery in order to facilitate the understanding of linkages between costs of service, recovery of these costs and the resulting implications on service levels and delivery, and investment.

Local bodies must be encouraged to undertake citywide strategic planning to design and implement integrated solid waste systems that are responsive to dynamic demographic and industrial growth. These must be correlated with required budget allocations. Further they must identify the resource pools from which they propose to meet these allocations.

It is also critical that cities introduce improved accounting and budget principles to promote effciency in capital investment. City staff must be introduced to the concept of enterprise fund and full cost accounting. Cities may also explore the potential for regionalisation/resource pooling both for developing common facilities and/or for raising.

(3) Partnerships

Attract PSP By Addressing Impediments

ULBs must address local impediments to PSP. This would require that cities address labour concerns. ULBs need to invest in ongoing training of its labour, retrain/redeploy labour, or as a potential solution allow labour groups to partner with private sector on bids. Further labour groups must be included while designing and arriving at any such plan. Local bodies must also institute operating revenues.

Attract Other Local Stakeholders

Local bodies can find a helpful ally in the local community to achieve improved service delivery. Education, consumer awareness and spreading of the city's message are critical to achieve this. Cities could even support the endeavors of NGOs/CBOs and design approaches that dovetail with other center/state schemes as is being tried in Vijayawada. Further, local busines houses have a great stake in the community and their assistance may be sought. Such assistance could be toward funding schemes and/or implementation of projects as being tried in Vijayawada, or as tried in Ahmedabad wherein a private company developed a road in lieu of advertisement rights for a period of time. Such involvement of local business houses will also help generate local employment.

RECOMMENDATIONS OF THE COMMITTEE APPOINTED BY THE HONOURABLE SUPREME COURT OF INDIA

- ⇨ Central and state governments to give financial support to local bodies for setting up treatment and disposal facilities.
- ⇨ States to appoint an empowered committee for giving necessary clearance for allotment of government land to local bodies for treatment and disposal of waste.
- ⇨ Government of India to suitably amend the Contract Labour (Regulation & Abolition) Act 1970 to facilitate private sector participation.
- ⇨ Installation of compost plant may be encouraged by central/state in the conuntry through various incentives.
- ⇨ Incentives be given to recycling industry through allotment of land, water, power, tax holiday purchase of recycled goods, etc.

POLICY GUIDELINES GIVEN IN MANUAL ON SOLID WASTE MANAGEMENT, PREPARED BY GOVERNMENT OF INDIA.

Central government may :—

- ⇨ Provide fiscal concession in purchase of special types of vehicles and equipment.
- ⇨ Promote joint ventures in setting up industry for manufacture of SWM equipment and vehicles within the country.
- ⇨ Allow local bodies to raise tax free bonds without any upper ceiling.
- ⇨ Provide financial assistance for setting up compost plants and other waste processing units.
- ⇨ Mobilize financial assistance to ULBs from external sources and bilateral agencies.
- ⇨ Set up pilot projects for waste processing and disposal.

State government may

- ⇨ Promote financial health of ULBs
- ⇨ Extend need based financial assistance to ULBs
- ⇨ Extend facility of long term loans
- ⇨ Grant land for treatment and disposal facility
- ⇨ Promote recycling industry
- ⇨ Provide tax benefits.

CONCLUSION AND RECOMMENDATIONS

- ⇨ The central and state governments may :
- ⇨ Initiate schemes to extend central/state support in project designing, developing and maintaining treatment facilities and sanitary landfill sites.
- ⇨ Provide technical assistance to local bodies by outsourcing technical expertise.
- ⇨ Tap various bilateral and multilateral programs to dovetail efforts in the area of micro enterprise support, schemes for waste diversion, reduction, recovery, etc.
- ⇨ Address legal impediments to facilitate private sector participation in solid waste management.

Urban local bodies may :

- ⇨ Improve resource base and recovery
- ⇨ Increase operating revenue
- ⇨ Maintain separate account for MSW
- ⇨ Introduce commercial orientation in service delivery
- ⇨ Explore the potential of resource pooling for developing common facilities
- ⇨ Address impediments to private sector participation

CHAPTER—11

CAPACITY BUILDING AND RESEARCH & DEVELOPMENT

1.0 Human Resources Development

The problem of waste management is becoming acute in the urban areas with the growth of population and increase in the quantities of waste generating from various sources. The inability of the local governments to effectively deal with the problem is making situation worse. The solution of the problem lies in efficient management by the civic authorities as well as active participation of the people it does not seem possible to keep the cities clean until the municipal administration is made efficient at all levels and the citizens as well as the NGOs/CBOs are involved in a coordinated manner. It is commonly observed that the officers and staff involved in managing various activities of Solid Waste Management have not received appropriate training to equip them in carry out their duties efficiently. It is also observed that there is no program for dissemination of the latest information to the persons engaged in the activities of solid waste management. Their knowledge, therefore, generally outdated and traditional unhygienic systems of waste management continued in the urban areas. It is therefore, necessary that the personnel responsible for Solid Waste Management are given adequate training in various aspects of solid waste management and they are kept updated with the latest advances in the waste management system.

2.0 Training Needs for Staff at Different Levels

Cities can be maintained clean when well-designed equipments are provided along with adequately trained staff at all the levels. To achieve maximum productivity of the solid waste management system, the staff needs to be trained as well as motivated. The staff at different levels can be classified as under :—

Junior level staff (Operating and maintenance staff)	Safai Karmacharis, drivers, cleaners, electricians (Auto), welders etc.
Middle level staff (Supervisory Staff)	Assistant Sanitary Inspectors, Sanitary Inspectors, Foremen (Auto), Assistant Engineers (Auto), etc.
Senior level staff (Management and Planning Cadre Staff)	Sanitary Superintendents, Chief Sanitary Inspectors (in case of small cities) Professional Engineers, i.e. Executive Engineer, Joint Director, Health Officer, Chief Engineer and Director of Conservancy and Solid Waste Management in large cities.

2.1 Training modules for personnel at various levels

For maximizing productivity, the junior level staff should be trained to improve their skills and motivated to give optimum output. The staff at supervisory level should be properly trained in the art of supervision and motivating the staff working under them. They should also be trained in adopting modern methods of solid waste management and appraised of developments in this sector. It is, therefore, desirable to develop specialized training programs differing in scope, duration and specialization, depending upon the level of the concerned staff in the solid waste management system.

Junior Level Staff

There are two main categories of Staff at junior level.

- Conservancy staff/Street sweepers/sanitation workers engaged in street sweeping, primary collection transportation and disposal of waste.

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Vehicle operation and maintenance staff such as drivers, cleaners, welders, electricians, helpers, etc. involved in operation and maintenance of solid waste transportation vehicles.

I. Conservancy Staff

The street sweepers, the sanitation workers engaged in primary collection, transportation and disposal of waste, etc., are generally recruited without any special qualifications and assigned the work without any specific training and hence they follow the method of working adopted by their senior co-workers. Thus, the wrong practices continue in perpetuity. Various activities such as using short-handled brooms, traditional handcarts which necessitates the discharge of waste on the ground or just outside the bin creating in sanitary conditions. The streets are swept half-heartedly picking up part of the waste leaving the dust behind. The waste quite often is burnt on the streets to avoid taking it to the waste storage depot and quite often it is overloaded in the handcart to avoid making of more trips to the storage depot. Waste from such handcarts keeps on falling on the streets. The waste is loaded manually into the trucks and the site is not fully cleared before they move to the next site and the trucks are more often partially loaded and taken to the disposal site resulting into under-utilization of the fleet of vehicles and manpower. Besides they do not take any precautionary measure to protect their health and shy from wearing uniforms given to them. Unscientific methods of working by the sanitation staff adversely affect their health. Studies on health of refuse workers carried out by NEERI in 1970 and later by Ahmedabad Municipal Corporation in early 1990s showed that the present practices of solid waste management pose significant health risk and many workers are found to be affected by respiratory inspections, chaste diseases, etc.

The workforce at the lower level is generally found averse to the change even though it is for their good. They have wrong notions about the use of improved systems of waste management, which needs to be cleared through an appropriate training. The sanitation workers, therefore, need to be explained the benefits of the new tools and equipments and the modern methods of waste management and should be sensitized to the rising expectations of the people and the fresh recruits should be given free service training so that they know their job well before they take up their duties. The sanitation workers should also be exposed through exchanges to different cities and towns to broaden their understanding and knowledge by seeing the best practices in other cities and towns.

These workers should be given one full day training to acquaint them with the recent trends in waste management and specially given training in house to house collection by bell ringing system or similar other systems, community based collection system, proper methods of street sweeping, drain cleaning, etc. and use of containerized handcarts, and improved tools and equipments designed for them. They need to be sensitized about the expectations of the people from them in terms of quality of work and personal behavior with the public and also motivated to take pride in their work.

They should be made aware about the precaution they should take while at work to protect their health and use the uniforms, etc., given to them regularly. They should also be given training biomedical waste and other hazardous waste material if it is found in the domestic waste stream.

Improved performance resulting from the training should be rewarded by cash prizes, awards, increments etc.

Vehicle Operation & Maintenance Staff

The training program of at least 5 days duration needs to be arranged for drivers, cleaners and maintenance staff. A driver is the key element in transportation who uses vehicles with high capital cost. Any breakdown of vehicle, accident, frequent repairs to vehicles due to lack of proper maintenance leads to increased downtime of the vehicle and affects daily work schedule. They should be reminded about their responsibility and the health and safety aspects related to their jobs. Thus routine checking should be carried out by driver and at garage level by the technician. The training should highlight the importance of preventive maintenance work. The technicians should be imparted training for operation and maintenace of new types of vehicles. The importance

of training should be stressed by the use of posters at the work site, publication of accident statistics etc. If new vehicles are purchased, the technicians should be sent to supplier for specialized training (in supplier's workshop) in maintenance of such vehicles. The maintenance staff should be aware of the repair schedule to be followed at garage level. An appropriate incentive scheme should be introduced for drivers and maintenance staff and they should be awarded when their vehicles give a turn out above a specific level as a result of the preventive maintenance carried out by them.

Middle Level Staff

1. Sanitary Inspectors

They have normally passed a sanitary inspector's course. Although the present courses give necessary training in food sanitation, control of epidemics and public health activities, very meager training is imparted in solid waste management. Since these supervisors play a key role, specific training courses of 5 days duration should be conducted. Such courses should involve both theory as well as practice of Solid Waste Management. They need to be trained to manage the workforce under them and the manner in which they should supervise their work. They should also be taught how to motivate the staff and how to initiate punitive actions against the staff not performing their duties properly. They should also be taught the provisions of Municipal Solid Waste (Management & Handling) Rules 2000 and Biomedical Waste (Management & Handling) Rules 1998. The administrative procedures as well as legal processes to be followed to ensure compliance with the rules should be explained to them. They may me given special training on management information system and in furnishing the data to higher authorities from time to time. Their knowledge should be updated from time to time with the advancement in the field of solid waste management. The training should be imparted by faculty having specialized knowledge in the areas of Solid Waste Management as well as in administrative and legal aspect of waste management and disposal.

2. Foremen, Jr. Engineers, Assistant Engineers

The supervisory level technicians and engineers are required to maintain the fleet of vehicles. They should, therefore, be well conversant with the variety of vehicles and the operation of vehicles of different types, the likely problems faced during operation of such vehicles, and should be technically competent to guide the mechanics, fitters and helpers to take corrective measures. They should also be prepared to face the eventualities with adequate spares, tools and equipments required for maintenance of the vehicles. They must be trained in ABCD analysis for inventory control and maintain appropriate records for the vehicles, batteries, tyres, etc.

This staff, though conversant with their routine work, should be well trained in all areas of operation and maintenance of the vehicles in the SWM workshop by conducting training courses through experts. As they form the backbone of solid waste management system they should be acquainted with solid waste characteristics and trained in the area of planning, operation and maintenance of refuse collection vehicles and various machineries used at the processing and disposal sites. They should also be made capable to provide training to their junior level staff.

Senior Level Personnel

These include Chief Sanitary Inspector, Sanitary Superintendents looking after entire solid watse management in small cities and towns and generally primary collection work in big cities and Ex. Engineer, Health Officers, Superintending Engineer (Auto). Directors SWM, Chief Engineer SWM, etc. responsible for either transportation and disposal of municipal solid waste or for entire solid waste management system in the city.

The above personnel should be given extensive training in planning and operation of the solid waste management system. The training should be regarding the characteristics and volume of solid waste generated, and the deficiencies in the systems of collection and transportation and disposal of waste and the manner in

which the deficiencies could be corrected and modern systems of waste management introduced. The training should also cover public health aspects of waste management. These senior personnel are expected to tackle various technical and operational hurdles and find solutions, which would be hygienically safe, technologically sound, economically feasible and socially acceptable. They should be made well conversant with the various processing and disposal methods their design and operation. The training should cover latest advances in the area of solid waste management within and outside the country. The training program should be spread over at least for two weeks for those who are technical personnel responsible for design and operation and it could be for one-week duration for those who are decision-markers. The course content should include at least the following :—

* An overview, concept of solid waste management, types of solid waste, qualitative and quantitative analysis of waste, the existing systems and their deficiencies.

* Storage at source, primary collection, secondary storage and transportation of storage—Requisites of an efficient system of primary collection, community storage and transportation of waste-selection of appropriate type of vehicles and equipments for this purpose.

* Processing technologies—Basics of aerobic composting-microbial and vermicomposting, anaerobic digestion, incineration, biomethanation,power generation, pellatization, etc.

* Landfill technology—Selection of site, liner, spreading, compacting and covering of waste, leachate treatment, biogas generation, control and recovery, final cover and monitoring of landfill.

* Planning of waste management—short term and long-term planning, design and construction of waste treatment and disposal facilities.

* Financial Legal and Institutional Aspects—Estimation of financial requirements possible cost recoveries through user charges, privatization of services, accounting systems, legal provisions of the rules and the laws framed, and the manner in which rules and laws could be effectively enforced expectation from the community, the responsibility of management.

* Human Resources Development, Management Information System, and public & NGO participation, etc.

Note—Due to the low public image of this activity, it is noticed that better qualified personnel shift to other departments at the first available opportunity and pepole with good qualification are not attracted towards this service. A concious effort should hence be made to retain competent officers on these positions for a reasonable time and attractive package should be offered with financial incentives and professional avenues for recruiting qualified and competent people for this service.

2.2 Arrangement for Imparting Training

The junior level staff as well as middle level staff should be given training close to their work place or at least within the city or town by persons having adequate knowledge of the subject as well as tools and equipments. Outside faculty could be involved to share their experiences and add to their enlightenment. Each state should create training facilities by drawing faculty from within the cities and from outside as may be necessary. Both short, medium and long-term courses should be regularly conducted in each state to cover all the staff required to be trained.

Presently, short-term training courses only for engineers involved in this activity are funded by CPHEEO, Ministry of Urban Development. However, due to the short duration these are treated mostly as appreciation courses. Training courses of longer duration and of specialized nature need to be orgnized at the nodal Ministry i.e Ministry of Urban Development to support these activities further. The middle level staff should also be deputed to larger municipal agencies to undergo field training after the basic foundation course.

The senior level staff should be given short-term training within and outside the state through workshops, seminars. etc. and should be given long-term training at professional Colleges/Institutes. It will be desirable to have 3 to 6 months courses tailor made for the requirement of engineers involved in Solid Waste Management Activities.

The creation of these additional facilities at various levels will require active administrative and financial support from State Government as well as from the Central Government. It is suggested that the training courses for the operating staff and the supervisory staff be the responsibility of the State Governments, while the training courses for the managerial staff be funded and organized by the Central Government. Such institutes, which already have expertise in the area, can be provided funds for running such courses. After a few years, when these courses are well established, the management can be transferred to the State Government.

2.3 Financial Aspects

The financial provisions for arranging such training courses are expected to be abour Rs. 75,000/- per lakh polulation as per details given below :

(1) Training for Junior level staff—all staff to be trained every year at work site for one day —Rs.25,000/-

(2) Middle level staff—20% to be trained every year for 15 days—15,000/-

(3) Senior level staff—One week training once every tow years—Rs. 35,000/-

Total cost/year—Rs. 75,000/-

Research & Development

Research and Development has to be a continuous exercise at the state and national level to update the technology for treatement and disposal of waste and for improving the effiency and performance fo the vehicles and equipments. Research and developments are necessary in all aspects of waste management beginning from the design of long handle broom to be used by males and females, design of the containerized handcarts and the tools to be given to the sanitation workers, the design of large size containers to facilitate easy transfer of waste from the handcarts to the containers and its synchronization with transport vehciles. The variety of transport vehicles for solid easte management also needs to be standardized through research and development and the technology for the treatment of municipal waste such as composing biomenthanation, power generation, etc. also needs to be upgraded and improving to bring about higher efficiency in the operation. The quality of compost is required to be improved to meet the demand of farmers and to make it popular among the agriculturists community. The research must show the distinct advantage of use of compost for improving the quality of soils and the agricultural production by using bioorganic fertilizer. The research in the area of processing and disposal of waste may be encouraged at the IITs in India and the vehicles and equipments design improvement may also be taken up at the national level institutions to standardize the use of tools and equipments in solid waste management. These institutions need to be encouraged through funding support for carrying out research and development by the Government of India and the state governments.

RECOMMENTATIONS OF THE EXPERT COMMITTEE APPOINTED BY THE HONOURABLE SUPRME COURT OF INDIA

⇒ Decentralize the administration and delegate adequate powers to induct enviromental or public health engineeers in providing SWM services.

⇒ Give priprity to human resources development.

⇒ Involve education and research instituions.

CONCLUSIONS AND RECOMMENDATIONS

⇒ Improvement in knowledge base of the staff at various levels by exposing them to appropirate training followed by retraining at regular intervals is necessary, Training activities need to be supported initially at central level and these should gradually be transferred to state level. However, training of trainers should continue to be supported under a central program.

⇒ Personnel responsible for SWM at various levels should be given adequate training in various aspects of solid waste management.

⇒ The staff and the officers must be kept updated with the latest advances in SWM.

⇒ Separate training programs should be organized for junior level, middle level, and senior level staff and officers.

⇒ Conservancy staff be given one full day training in recent trend in waste management, house to house collection, proper methods of street sweeping, use of tools and equipment, expectation of people, etc.

⇒ Vehicle operators be given five day training on maintenance and preventive checks of vehicles and equipment.

⇒ Supervisory staff be given training for five days covering theory and practice with special focus on how to manage the workforce and the manner in which they can supervise the staff effectively.

⇒ They should be exposed to MIS, advancement in the SWM field, legal requirements.

⇒ Higher technical staff be trained in all aspects of operation and maintenance of the fleet of various types of vehicles.

⇒ Senior level officials may be exposed to latest development in waste management sector and acquainted with planning processes for work management and various methods of treatment and disposal of waste.

⇒ The frequency of training and the training content may be as suggested in this chapter.

CHAPTER—12

INFORMATION, EDUCATION & COMMUNICATION

Need for IEC

The key to the success of solid waste management system in any city is the cooperation of the citizens. Citizens must be fully involved in the proper storage, collection, and safe disposal of waste and should also be made aware of health risks associated with improper solid waste management. It is also necessary to provide facilities for imparting training to staff at various levels so that they can provide efficient service.

IEC should hence focus on creating awareness, motivating people to change their habits, informing them of actions required to be taken, and maintaining the desired habits by sustatined efforts from both local governments, citizens, community based organizations.

IEC Topics :

Subjects on which awareness needs to be created are :

1. Keeping neighbourhoods an city clean
2. Health risks posed by unclean environment
3. Solid Waste Management (SWM) process—from generation to disposal
4. Collection of wase at source and its segregation in decomposable and non-decomposable components
5. Precautions to be taken regarding collection and disposal of various types of waste such as garden waste, kitchen waste, waste from hotels and restaurants, market, construction waste, waste from commercial establishments, industrial and hospital waste.
6. Reducing, recycling and reusing waste
7. People's active participation in improving solid waste management
8. Fines and penalties for non-compliance with legal provisions
9. Recommendations of Hon'ble Supreme Court of India

Everyone should be made aware of the duty to keep neighourhoods and city clean and a sense of responsibility should be inculcated in every person to ensure the safe disposal of the waste they generate. They should form a habit of throwing only in designated receptacles. Messages are observed to be imbibed quickly when the messages stress on the illeffect that it has on people's personal well-being. making people aware of the health risks associated with unclean environment will have a better impact rather than that obtained by just telling them to keep cities clean to make them look beautiful.

Creation of awareness is the first step towards changing habits. Most people are not aware that it is their duty to throw the waste they generate into municipal receptacles and that the responsibility of the municipal body starts with street sweeping. They also do not know the various ways in which waste can be stored,

transported and disposed and the problems of waste disposal. Therefore, it is necessary to make all the citizens aware of the entire process of solid waste management i.e., from generation to disposal as well as the steps the local governments need to take to improve the service. Waste collection at source must be given special emphasis because that is the point where the common man plays a very important role in the SWM system.

Segregation of waste at source is an important step for improving solid waste collection and disposal and therefore, requires people's cooperation. It is necessary to educate people about the different types of waste gererated at home and how to segregate biodegradable waste from the non-biodegradable. They can also be told as to how to deal with construction and garden waste. Segregation at source is not likely to happen in a short period of time and hence will need a sustained effort till habits change.

Each major waste generator needs to be educated about sanitary methods of waste storage, transportation and disposal. The major waste generators include hotels and restaurants, hospitals, industries, and markets. They can make a significant difference to the health of citizens when they manage their waste in a scientific manner.

Considerable emphasis needs to be placed on reducing, recycling and reusing of waste. Once people are made aware of these three R's some change in their habits is likely to follow. Composting can be considered as the first option when dealing with organic waste, since composting can be done in a decentralized manner even at the neighbourhood level. The citizens should be informmed of the various methods of composting alongwith its demonstration, so as to encourage them to practice composting of organic waste, wherever feasible.

People must be informed about their significant role in keeping cities clean and that without their cooperation even the best efforts of local governments may not yield desired results. They should also be simultaneously informed about fines and penalties for not adopting correct methods of waste disposal. Achieving any significant change in behaviour is not possible without enforcement of the legal provisions of the Acts.

The Hon'ble Supreme Court had to intervene mainly to correct a situation which had been completely neglected, and this aspect must also be conveyed to people.

IEC Medium and Methods :

Public awareness and education campaigns should be launched to drive the message to people and ensure their active participation using a variety of media.

SWM logo, mascot and slogan :

In order to create an identity for proper solid waste management it is necessary to create a logo for it. This logo should always be used whenever messages related to SWM are conveyed. A mascot can aslo be created for this purpose so that everyone is able to identify the mascot with proper SWM. All print and audio-visual medium should appropriately carry the logo/mascot. These could also be carried on related products such as bags and dustbins and local governments should use them on all equipment/litereture related to SWM. A catchy slogan carrying a message of what is correct behaviour with respect to SWM will people understand what needs be done.

Children as target group :

Children are the future citizens and changing their behaviour, when they are still young and impressionable will go a long way in changing our future for the better. One of the major advantages of involving children is that they influence the behaviour of adults. This will bring about a change sooner than expected. There are various ways in which children can be involved in waste related activities to ensure very good results. Various types of competitions will stimulate thinking and lead to improved behaviour. Quiz competitions and debates will motivate children to read and seek information from different sources.

Schools could introduce :

1. SWM topic in school curricula
2. Conduct essay, painting, poster, quiz competitions
3. Arrange debates
4. Introduce wall magazines
5. Develop models
6. Introduce projects, games and role plays

It will be desirable to prepare and propogate 'Model' material for use in schools, colleges, Industrial Training Institutes etc. for the education of children/students at an impressionable age.

Children can be given project work related to SWM such as documenting the habits of their neighbouring residents in respect of waste storage and disposal. Children will take up such projects enthusiastically and in the process will also learn about SWM. Prizes could be awarded for the best project work. Wall magazines in schools will help children to project their views on the topic.

Games (on paper) related to SWM could be created by professionals and played in schools to enhance knowledge about proper methods of managing solids waste. Role-play is an important means to understand the role of various actors in society and their behaviour. This could be developed with various characters seen in public places or even for various members of a household. Professionals could be involved in developing the role play games which make children play different roles related to SWM.

General public as target group :

Advertisements and messages should create public awareness and motivate people to take proper actions. However messages should also highlight the punishments for wrong doing. Advertisements should not only convey messages but should also touch emotions.

A variety of media can be used to convey messages to the public about proper waste related behaviour.

Print Medium :

Print medium is a durable and long lasting medium. SWM messages on pamphlets, booklets, posters, newssletters, stickers, and advertisements can be physically possessed and can be read again and again whenever and wherever one feels like reading them. This has a long lasting effect and many messages on SWM can be conveyed through this medium. Though the print medium is more appropriate for the literate class, it is a good medium for all sections of the society. For the illiterate, messages can be conveyed pictographically in print.

How, when and where to use different print medium will depend on the campaign to be launched for improving SWM. Depending upon the audience to be addressed the best print medium or a mix of print media can be used supplemented by other medium. The messages to be conveyed should be clear and easily comprehensible and preferably be eye-catching to grap reader's attention.

Print medium includes :

1. Stickers
2. Posters
3. Pamphlets

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4. Newsletters

5. Filp Charts

6. Messages on products

7. Advertisements in newspapers, magazines etc.

Messages on how to dispose the product after use could be printed on the product itself and carrying this message should be made mandatory for all products.

Audio-visual medium :

This is a very effective medium and can convey messages which make a large and long lasting impact. When television is used for conveying messages it can reach a vast audience. Hence, a sustained campaign on SWM should use audio-visual medium which could screen :

Short films on SWM showing the problem, issues and solutions—for T. V., film theatres and for general screening

Cartoon films showing the required change in behaviour for T.V.

Social advertising on T.V.

Short skits on T. V.

Use of T.V. as a medium for conveying messages on SWM has to be very well thought out. It must be slotted for a time when people will not surf channels or are feeling disinterested. When people are watching serious programmes such as news or other important/interesting programmes it can be projected. It should also be screened when the viewership is fairly large i.e. at or close to prime time. Cartoon films on SWM could also be shown along with children's programmes. Skits focussing on changing public behaviour can be shown at various times. In order to stay focussed, these should not exceed two minutes.

Other medium :

A number of other media can be used for conveying messages on SWM.

Messages in public places can be on :

1. Hordings
2. Banners
3. Buses
4. Bus stops
5. Markets
6. Other public place
7. Messages in fairs and festivals

Hordings could either contain messages only on SWM or could be a part of a big advertisement in which it occurs at a specified position (either at bottom or at top) which could be made mandatory. Messages on such hordings should be clear and crisp so that one can read it while travelling. Messages on buses could focus

on actions required to change people's waste disposal habits and on health risks associated with improper disposal of solid waste. Messages on hoardings should be changed frequently to keep people's interest alive.

At bus stops, markets and other public places messages on proper waste disposal methods should be displayed in prominent locations. These should be supplemented by placing of dustbins at shorter distances and collecting the waste from them at regular intervals.

In fairs and festivals large quantity of waste is generated and it is necessary to display messages on hoardings or banners on proper waste disposal methods. Printed messages in the form of pamplets can also be distributed in such places.

Active help from religious and spiritual leaders should also be sought as they can influence their disciples about public hygiene and play an active and positive role in keeping public places clean. The doctors in rural and urban areas can also play a very effective role in such dissemintation and their cooperation should be soughit.

Other media for conveying messages to public:

For enhancing the impact of messages being conveyed it is necessary to use other media also, particularly when trying to reach people in different areas of the city.

These could include:

1. Advertisement on radio
2. Street plays
3. Puppertry
4. Folk music
5. Exhibitions, including mobile exhibitions
6. Processions and rallies
7. Slide shows
8. Discussion groups, meetings
9. Seminars, workshop
10. Training programmes
11. Web site

Radio, despite competition from other media remains an important medium of conveying messages due to its larger coverage. Advertisements propagating need for better waste related habits can be aired on radio on popular frequencies such as FM and Vividh Bharati. These could be jingles, simple messages or even lectures and should be aired at regular intervals. There could be a signature tune for SWM related messages similar to the logo and mascot for visual messages.

Street plays are very effective for conveying messages to low and middle income groups. Although street plays have a limited reach and have to be arranged repeatedly for different audience, their impact is immense since it is live. Puppetry is also a very effective method of conveying messages, particularly to children and for low-income groups. Folk music can also be used, either on its own or along with street plays and puppetry, to enhance the impact of the message being conveyed.

Exhibition have a different role to play in conveying messages and eliciting public cooperation. Exhibitions can use a variety of media. They can have photographs, posters, paintings, models films, puppetry, slide shows, and seminars. They can distribute printed material and also display and sell products under one roof. The advantage of exhibitions will be that people visiting the exhibitions can seek additional details. Sponsors can be sought for holding exhibitions and the sponsors can promote their products at the venue. A mobile exhibition can also be arranged which can travel to different locations and even to remote areas. Mobile exhibitions will minimize the cost and effort of making repeated arrangements in different localities.

Resident welfare associations, societies and such other groups in residential areas should be involved in improving local environment. They can help organise any of the above media in their areas and assist in keeping neighborhoods clean. Similarly, in industrial and commercial areas meetings of associations can be organised and the need to keep their areas clean should be conveyed using different types of media.

Seminars and workshops can be held for various groups focusing not only on measures to be taken for keeping cities clean, but also on how to implement the changes. These should be organised in consultation with local governments.

Training programmes could be organised for staff of local government on various aspects of the service and these should be arranged on a regular basis.

Web Site

A web site should be created on solid waste management and given wide publicity. Since internet is universally accessible, it would be very useful to have such as site. The site should, at least, contain the following:

1. Technical and financial information related to SWM
2. IEC materials films on SWM
3. Training materials
4. Addresses and other details of technology providers, NGOs, and private companies dealing with SWM
5. Addresses of local governments—as many as possible
6. Results of research studies on the subject
7. Policies related to SWM
8. Legislations relating to SWM
9. Supreme Court Committee's Report
10. Links to other related national and international sites from which statistical and general information could be obtained.

It should be a centralised site, which would provide all the required information. The site should also have an email address so that queries can be posted and responded to. The management of the web site should be given to a professional body, which would administer the web site and update it at regular intervals.

Selecting the appropriate medium or a mix of medium for the target audience needs to be done by experienced professionals. However, none of the above would be a one time or short time effort. Each of the medium and message will have to be used repeatedly for a considerable length of time, say 2-3 years, before any perceptible change takes place. Once a change is observed then the frequency of use of the medium may be gradually reduced to finally reach a point where periodic messages would be adequate.

Any change in people's habit promoted through IEC campaigns must be accompanied by an equal effort on the part of the local governments to provide adequate and functioning infrastructure so that what is advocated is implemented. If proper infrastructure is not provided and maintained then any amount of effort put in to get people's cooperation would not yield the desired results.

Involvement of NGOs

Various non-government organizations are actively involved in various issues of general interest. Their experience and difficulties faced by them will be useful to other agencies planning to get involved in similar activities. Various agencies involved in such activity were invited to share their experience with the core group. An advertisement (Annexure 6) was accordingly published in prominent newspapers inviting NGOs to participate in such a dialogue and to make a presentation. On the scheduled date seven organzations (out of 14 that were invited) made the presentation :

(1) Stree Mukti Sanghtana, Mumbai.

(2) Asian Centre for Organization, Research and Development (ACORD), New Delhi.

(3) Society for Research, Development and Communication (SRDC), Guwahati.

(4) Tiljala Society for Human & Educational Development (TILJALA SHED), Calcutta.

(5) Centre for Environment Education, Bangalore, CEE Delhi Desk.

(6) Mass Education, Calcutta.

(7) APNALAYA, Mumbai.

It was observed that some of them had been working with women and children, some with waste pickers and some with citizens at various levels. The methodologies and communication tools used by them were more or less similar. The major points of interest and specific aspects of their activities are summarized below :

(i) It is necessary to provide an arrangement for making the rag pickers financially independent from the money lenders operating in the form of middleman. In one case, it is being arranged through saving and credit groups which were initiated by NGOs. In another case, the loan is in the form of revolving loans. In one more case, the loan has to be repaid with a nominal rate of interest of 2%. It was fell that such assistance will be beneficial to the rag pickers who will not be dependent on middlemen for funds and can then sell the reclaimed materials at the market rates.

(ii) It is also necessary to provide adequate space to the rag pickers (commonly provide by NGO's) for carrying out their activities so that the material is properly separated and processed for sale.

(iii) When the NGOs provide night shelter to the rag pickers, faster rehabilitation of the rag pickers is observed.

(iv) Under various schemes such as DRDA, NGOs can provide necessary guidance and help to rag pickers in obtaining loans from the agencies for the purchase of cycle, cycle rickshaw etc. for collection of waste.

(v) All the NGOs felt that if the urban Local Bodies issue a notification requiring source separation of the waste as stipulated in the Supreme Court order, it will be helpful in the working of the rag pickers and they will be able to collect source separated waste from households.

(vi) Some of the NGOs were working mostly with women and children. They indicated that they are conducting literacy classes and community development programmes involving group meetings and person to person contact.

(vii) NGOs have prepared posters regarding the proper methods of storage of waste, propagating the need for cleaner dust bins and their surroundings as well as other posters which inform people about the ill-effects of burning of garbage.

(viii) Street plays of 15 minutes duration were being arranged in schools, slums and markets by another NGO. The puppetry programmes were also arranged at these locations and were found to be effective.

(ix) An half an hour radio programmes on All India Radio entitled "Aao Dilli Sawaren" is being arranged by another NGO on every Sunday aiming to inculcate a sense of pride in citizen of Delhi and mobilising them to adopt environmentally sound and cleaner waste management practices. School children are being involved and interviews with prominent personalities on environmental issues are arranged. The names of the areas, which are kept clean are announced so as to motivate others to observe similar cleanliness. Some popular songs are also played and the question and answer session, where experts participate are also arranged.

(x) To educate the school children, project work on solid waste management is also arranged by one NGO during the vacations.

(xi) Training programmes were arranged by one NGO, where a batch of 25 to 30 sanitary workers of ULBs are trained. They are mostly trained in the use of protective equipment, method of cleaning of the dust bins, drains etc.

(xii) Some NGOs also arranged training programmes and workshops for workers and managers involved in collection of hospital solid waste.

(xiii) It was commonly felt that various NGOs should work in collaboration and exchange the information about their experiences for mutual benefit.

(xiv) One NGO is providing a special vehicle to collect hospital waste from 400 hospitals in Calcutta. They have mostly employed rag pickers and the vehicles are provided on a rent by Calcutta Corporation.

The studies carried out by NGOs as well as various agencies have clearly pointed out the insanitary conditions in which the rag pickers work. They come in contact with infective, corrosive and hazardous material which results in various skin infections, wound, burns etc. They are also prone to infections of the gastrointestinal tract. It is hence desirable that NGO's provide necessary education to them so that they take preventive measures. The NGO's can also make available various health care facilities and assist them in obtaining the benefits of these facilities.

PARTICIPATORY LEARNING TOOLS DEVELOPED BY NGO

An NGO 'ACORD' has developed participatory learning tool on solid waste management giving guidelines for trainers, facilitators, for conducting the training sessions using 46 colour picture cards of various categories, the details of which are given at Annexure—10

5.0 Package of IEC Material

In addition to the IEC material available with and being used by various NGOs, professional agencies were also invited to participate and make presentation on the materials they can help prepare. In response to the

Ahmedabad Municipal Corporation's invitation for providing communication tools for use in Solid Waste Management 14 agencies came forward for making presentation on the subject. The Core Group availed the opportunity to participate in the presentation arranged by Ahmedabad Municipal Corporation (AMC). In addition to stressing on the common communication tools. Some of the innovative ideas suggested by the agencies are:

1. Dance, drama, puppetry and street plays can also be used as a part of long term strategy. These can also be used for making necessary information dissemination in residential colonies of railways etc.

2. Short films can be prepared for the benefit of the citizens as well as the staff of Solid Waste Management (SWM) Department clearly indicating the do's and don'ts. The films produced by CPHEEO, HUDCO, CPCB and Centre for Environment Education (NGO) were also viewed and it is felt that there is a need to prepare targeted short films which will impress on the viewer the need to maintain the city clean.

3. A wall magazine/ poster can be prepared for information and dissemination in schools as well as in offices.

4. Drawing and essay competition of SWM for school students should be arranged with handsome prizes as was done in the past by Shankar's Weekly.

5. Campaigns and programmes should be arranged by involving film personalities and such other celebrities willing to work in this field.

6. Co-operation of spiritual leaders should be sought for propagation of the messages for proper solid waste management.

7. Municipal agencies, while licensing the fairs and festivals etc. should insist on the organizers to provide the banners with SWM messages.

8. All hoardings should carry a prominent line seeking cooperation of the citizens in maintaining the city clean.

9. A logo/ mascot/slogan regarding importance of keeping cities clean should be coined/ framed with the help of expert agencies which should be widely adopted.

10. The literature on best practices should be prepared and distributed to the citizens.

11. Note books for school children printed through Government agencies should carry the message on cleanliness campaigns.

12. Small booklets to serve as ready reckoner on SWM should be prepared.

13. Magic shows/ simple magic program should be popularized which will propagate the ideas.

14. Messages can be widely distributed by printing them on milk pouches, T-shirts etc.

15. On the basis of their presentation and their capabilities, three agencies were short listed.

16. Ahmedabad Municipal Corporation (AMC) will subsequently obtain the financial bids from them and finalise the bids.

17. After assessing their impact in AMC area, their wider adoption can be considered in other urban local bodies, if deemed fit.

The IEC media which can be used to obtain maximum benefits was discussed at length with various expert agencies such as Prasar Bharati, DAVP, All India Radio and Doordarshan. Presentations made by various professional organisations in the private sector were also arranged at Ahmedabad where 14 such organisations participated. Based on the ideas presented by these agencies the following package is suggested. As it is difficult to project the cost estimates for specific cases, general cost estimates are given for the purpose of obtaining a general idea.

5.1 Media for effective dissemination of IEC material

The citizens have to be informed about the need for their active participation in Solid Waste Management in the following manner:—

(1) Awareness about the advantages of the 3 R's i.e Reduce, Reuse and Recyle

(2) Prevention of littering and throwing of the waste in public places.

(3) Separation of dry recyclable waste from the wet decomposible waste at the source

To achieve the above objectives, the three core messages will be;

Message-1: Practice that 3 R's

(i) Practicing 3 R's is environmental friendly

(ii) Disposal of waste in proper manner takes less space, saves time and energy

(iii) Helps conserve available resources making it more economical and sustainable

(iv) Helps future generations

(v) As far as possible, use recyclable material

Message-2 : Do not Litter

(i) Appeal to the citizens that they should ensure that the city does not get submerged in a pile of garbage

(ii) Littering leads to pollution and damages the environment

(iii) Use of bins for collection of waste improves the hygienic conditions

(iv) A clean city gives you a healthy feeling and a good impression to the visitors

Message-3: Separate your waste

(i) Do your bit for the city starting from your home

(ii) The wet waste can be composted which is a useful product

(iii) Separate the dry waste which is recyclable

(iv) Recycling gives a decent source of income to the waste collectors, besides resulting in the conservation of resources

To transmit the above messages, the media strategy includes an initial high profile campaign for two months followed by a lower intensity campaign for the next four months.

The newspaper advertisements should be issued in 5-7 local newspapers on a staggered basis so that the viewers never lose the sight of the campaign. The advertisement should carry the messages in 6-7 different advertisements.

Audio publicity can be in the form of atleast three spotjingles of 30-40 seconds each. These should be broadcast on Vividh Bharati as well as F.M. Channel. On Vividh Bharati, it should be broadcast everyday for the first two months followed by alternate days for the next four months. In the FM channel for the first two months it should be broadcast twice everyday followed by once everyday for the remaining four months.

The outdoor publicity should be used for atleast three months starting from two months after the above mentioned newspaper and audio campaign. This can be in the form of hoardings, bus panels and on Kiosks.

The video publicity should be in the form of three spots of 30-40 seconds, twice a week for the first two months followed by once a week for the next 4 months. These spots would be telecast on Doordarshan as well as the local cable net work. Two films of 10-15 minutes duration each may also be prepared on specific topics that need to be described. The films should be screened on Doordarshan once or twice a week. They can also be screened in Schools, Colleges, Community gatherings, etc.

Printed publicity for distribution in schools, colleges, public offices can be carried out in the first 2 months of the campaign in the form of posters and pamphlets.

5.2 Costs

The cost of using the various media in the above manner for publicity in 10 identified large cities (Delhi, Mumbai, Calcutta, Chennai, Bangalore, Hyderabad, Ahmedabad, Kanpur, Pune and Nagpur) in the country are :

- ⇒ Newspaper advertisements — Rs. 70 lakhs
- ⇒ Audio publicity —Production cost Rs. 2 lakhs. Broadcasting cost — 18 lakhs; Total = Rs. 20.0 lakhs
- ⇒ Out door publicity in the form of 20 hoarding, 2000 bus panel and 3000 kiosks = Rs. 25.0 lakhs
- ⇒ Video publicity — production cost — 15 lakhs + Telecast cost — 50 lakhs, total cost = Rs. 65.0 lakhs
- ⇒ Printed publicity — Printing 2, 40,000 posters and pamphlets each will cost — Rs. 12 lakhs + 3 lakhs for distribution; Total = Rs. 15.0 lakhs.

Support to educational institutions for developing IEC material.

Various educational Institutes imparting training in SWM filed should be encouraged to develop and disseminate IEC material. Some of these Institutes are = NEERI, Anna University, AIIH & PH. National Institute of Urban Affairs, National Institute of Design, Centre for Environmental Education, Bangalore, Amedabad, etc.

RECOMMENDATIONS OF THE EXPERT COMMITTEE APPOINTED BY THE HONOURABLE SUPREME COURT OF INDIA.

- ⇒ NGOs play a vital role in citizens education and their active help should be sought to make the movement more broad based and effective.
- ⇒ Citizens cooperations is vital in keeping garbage off the streets.
- ⇒ Series of measures are required to be taken to bring about a change in public behaviour
- ⇒ Suitable messages should be prepared involving professional communicators.
- ⇒ Use of hoarding, public transport, cable, TV, radio, newspapers and other media be made for mass awareness.
- ⇒ NGOs be involved in creating public awareness.
- ⇒ Use of schools and colleges, wards committees, reisdent associations, NCC. NSS, Scouts & Guides be made for creating public awareness.
- ⇒ Commercial sponsors be encouraged to come forward to sponsor cleanliness drives.

CONCLUSION AND RECOMMENDATIONS

- ⇒ For improvement in solid waste management, besides using appropriate equipment and trained manpower, active public participation is a must, which requires education and motivation of the citizen.
- ⇒ Education and motivation of citizens can be carried out using various communication tools. The logo/mascot/slogan needs to be uniformly used. The results from the initiative of Gujarat Government need to be utilized by Central Government also.
- ⇒ A campaign using various media such as T.V. Radio, plays etc should be mounted. The private sector can also be involved in this activity by giving them appropriate incentive in the form of tax benefits etc.
- ⇒ Educational films need to be prepared by the nodal Ministry and whenever other agencies prepare such useful material they can also be provided appropriate incentives.
- ⇒ Citizens must be fully involved in proper storage of waste at source, segregation of recyclable material, primary collection and safe disposal of waste as shown below.
- ⇒ Citizens should be made aware of the health risks associated with improper solid waste management.
- ⇒ IEC should have focus on creating awareness, motivating people to change their habits.
- ⇒ Citizens should be made aware of their duties to keep the neighbourhood clean.
- ⇒ Emphasis needs to be placed on reducing, reusing, and recycling the waste.
- ⇒ A mascot should also be created for this purpose.

⇒ Children should be made the target group for changing the behaviour of future citizens.

⇒ For public awareness the advertisement should not only convey messages but should also touch emotions.

⇒ Stickers, posters, pamphlets, newsletters, flip charts, messages on products, advertisements in newspapaer and magazines should be used for creating mass awareness.

⇒ Audiovisual media, hoarding, banners, should be widely used to convey the messages.

⇒ Advertisement on radios Street plays, puppetry, pop music, exhibitions, slides shows, a group discusions, meetings, seminars, should be used as media to convey messages to public.

⇒ Web sites should be created on SWM and given a wide publicity.

⇒ NGOs may be actively involved in educating the masses.

⇒ Packages of IEC materials should be prepared and used through NGOs, professional agencies, etc.

⇒ Short films may be prepared for the benefit of citizen and staff of SWM.

⇒ There should be a logo to create an identification of solid waste management program as shown on the next page.

⇒ <u>Three core messages should be delivered</u> —

1. Practice three R's (Reduce Reuse & recycle)
2. Do not litter.
3. Segregate recyclable waste from wet biodegradable waste.

⇒ Local bodies to adopt publicity campagin as advised in this chapter.

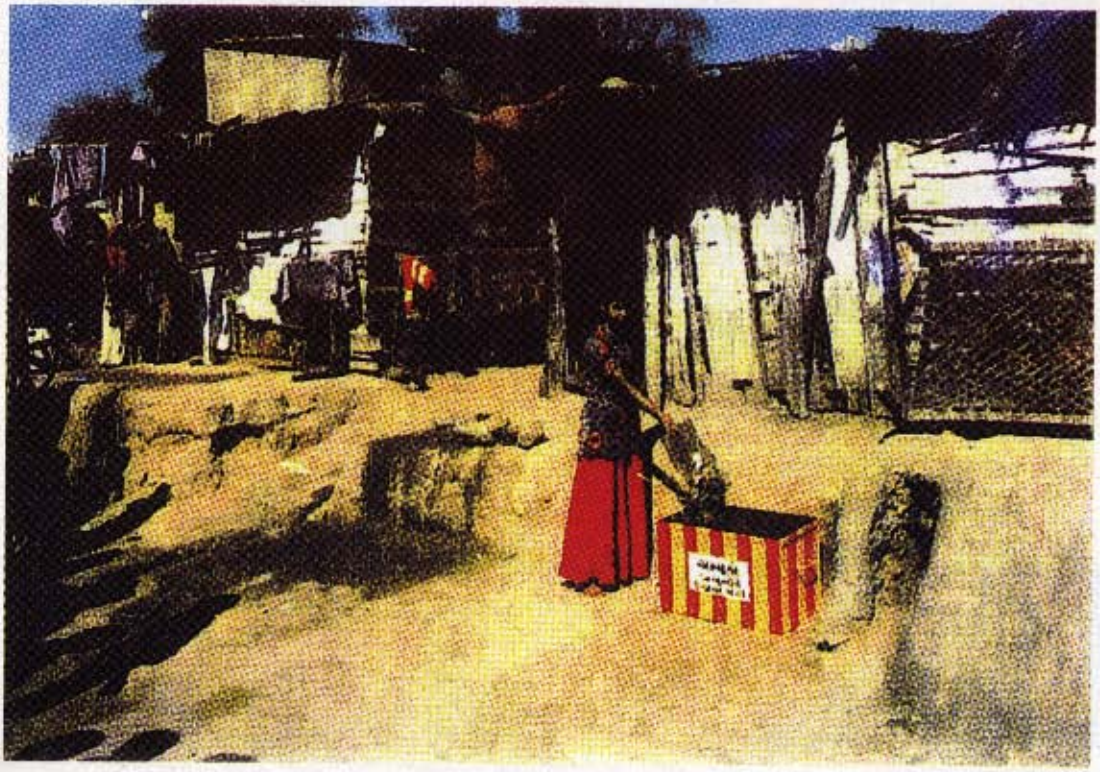
LOGO TO BE USED BY THE ULBS

CLEAN
GREEN
HEALTHY CITY

LET US MANAGE OUR WASTE

ROLE OF CITIZENS TO KEEP THE CITY CLEAN

KEEP FOOD WASTE IN DOMESTIC BIN



3221 UD&PA/03—21A

KEEP RECYCLABLE WASTE IN A SEPARATE BAG/BIN

HANDOVER RECYBLABLE WASTE TO RAGPICKERS

HANDOVER DOMESTIC WASTE TO STREET SWEEPER

USE LITTER BINS WHILE ON THE STREETS

SO SIMPLE TO KEEP THE CITY CLEAN !!!

ANNEXURES

ANNEXURE—1

No. Q-11021/21/99-PHE

GOVERNMENT OF INDIA

Ministry of Urban Affairs & Employment

(Department of Urban Development)

Nirman Bhavan, New Delhi
Dated : 18th August, 1999

ORDER

Subject : Constitution of a Technology Advisory Group on Solid Waste Management.

Pursuant to the recommendations of the Committee on Solid Waste Management for class I cities constituted by the Hon'ble Supreme Court regarding the constitution of a National Technology Mission in the Ministry of Urban Development for improving solid waste management practices in the country within a period fo five years and the decision taken in the Inter-Ministerial meeting held under the chairmanship of Secretary (UD) on 28-6-99, approval of the competent authority is hereby accorded to the constitution of a Technology Advisory Group with the following composition :—

(i)	Adviser (PHEE), CPHEEO, Ministry of Urban Development	. . .Chairman
(ii)	Representative of the Ministry of Environment & Forests	. . . Member (Official)
(iii)	Representative of the Ministry of Non-Conventional Energy Sources	. . . Member (Official)
(iv)	Representative of the Ministry of Agricultural & Cooperation	. . .Member (Official)
(v)	Representative of the Ministry of Health & Family Welfare	. . .Member (Official)
(vi)	Representative of the Ministry of Finance	. . Member (Official)
(vii)	Representative of the Planning Commission	. . .Member (Official)
(viii)	Representative of the Municipal Corporation of Brihan Mumbai	. . .Member (Official)
(ix)	Representative of the Calcutta Municipal Corporation	. . .Member (Official)
(x)	Representative of the Chennai Municipal Corporation	. . .Member (Official
(xi)	Representative of the Municipal Corporation of Delhi	. . .Member (Official)

(xii)	Representative of the Surat Municipal Corporation	. . .Member (Official)
(xiii)	Representative of the Central Pollution Control Board	. . .Member (Official)
(xiv)	Shri P. U. Asanani, Urban Environment Infrastructure Representative of India, USAID	. . .Member (Non-Official)
(xv)	Shri V.B. Rama Prasad, Deputy Advisor, CPHEEO	. . .Member Secretary Official)

The concerned Ministries/Departments, Municipal Corporations and Central Pollution Control Board would be required to nominate a suitable representative not below the rank of deputy Secretary/ Deputy Adviser/ Superintending Engineer to serve in the above Group.

2. The role and objective of the technology Advisory Group (TAG) would be as under :—

(a) To collection information on various proven technologies for processing and disposal of wastes, identify appropiate and cost effective technologies suitable under Indian (local) conditions through pilot projects where necessary and advise State Governments and urban local bodies to adopt such technologies.

(b) To provide technical assistance to urban local bodies for adopting the suggested technologies where feasible.

(c) To channelise and make optimum use of funds earmarked for SWM projects in the various Ministries, such as Ministries of Environment & Forests, Non-Conventional Energy Sources, Agriculture, Urban Development, Planning Commission, financial institutions and international donor agencies.

(d) To develop IEC (Information, Education & Communication) material for awareness programmes and disseminate the same through mass and print media with the cooperation of State Govts. and urban local bodies.

(e) To promote capacity building & HRD in urban local bodies, identify their training needs, develop mechniasm to meet the training needs and designate institutions in each State/region as resources centre for providing such training to various categories of personnel involved in SWM.

(f) To establsih a bench mark on the performance of various urban local bodies in SWM and circulate the same to urban local bodies and State Govts. for information and improvement where necessary.

(g) To arrange/promote and co-ordinate inter-city, inter-State meets for SWM personnel to exchange information on various aspects of SWM.

(h) To provide a forum for public interaction and intervention in the filed of SWM and strengthen/ support participation by NGOs and citizens.

(i) To take suitable and appropriate measures as may be necessary from time to time to improve the SWM systems.

(j) To keep the nodal Ministry, viz. Ministry of Urban Development informed about the various action points required to be undertaken by the Technology Advisory Group, Ministry of Urban Development, other Ministries and Institutions.

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3. The tenure of the Technology Advisory Group will be for a period of five years with effect from the date of issue of this oeder. The Group will meet periodically. TA/DA, etc., including air-travel of non-official members, as admissible to grade 1 officers of the Government of India would be met from the Ministry's budget under PHE Training/Pilot Project for feasibility Study and Evaluation System. TA/DA of official members will be met by their respective Departments. Secretarial assistance for the work of the Technology Advisory Group would be arranged by the Administrative wing of the Ministry.

4. This issues with the concurrence of the Internal Finance Division vide Dy. No. 1417-F dated 17-8-99.

Sd/-

B. S. MINHAS,
Joint Secretary to the Govt. of India

To

The Pay & Accounts Officer (Sectt),
Ministry of Urban Development,
Nirman Bhavan, New Delhi

Copy to :—

1. Principal Director of Audit, Economic & Service Ministeries, AGCR Building, New Delhi-110 002.
2. Principal Accounts Officer, Ministry of Urban Development, Nirman Bhavan, New Delhi.
3. Adviser (PHEE), CPHEEO for follow up action.
4. Ministry of Environment & Forests (Shri V. Rajagopalan, Joint Secretary), Paryavaran Bhavan, C.G.O. Complex, Lodhi Road, New Delhi - 110 003
5. Ministry of Non-Conventional Energy Sources (Shri A.K. Maeyotra, Joint Secretary), Block No. 14, C.G.O. Complex, Lodhi Road, New Delhi-110 003.
6. Ministry of Health & Family Welfare (Ms. K. Sujatha Rao, Joint Secretary), Nirman Bhawan, New Delhi.
7. Ministry of Agricultute (Shri Anil Sinha, Joint Secretary), Department of Agriculture & Cooperation, Krishi Bhawan, New Delhi-110 001.
8. Ministry of Finance, Department of Economic Affairs (Shri Sunil Chaturvedi, Deputy Secretary-Budget), North Block, New Delhi.
9. Planning Commission (Ms. Krishna Singh, Principal Adviser), Yojana Bhawan, New Delhi
10. Commissioner (Shri K. Nalinakshan). Municipal Corpoaration of Brihan Mumbai, Mahapalika Marg Fort, Mumbai-400 032.
11. Commissioner (Shri Asim Barman), Calcutta Municipal Corporation, 5, S.N. Banerjee Road, Calcutta-700 013.
12. Commissioner (Shri P. Kolappan), Chennai Municipal Corpoaration, Chennai-600 003.
13. Commissioner (Shri V.K. Duggal), Municipal Corporation of Delhi, Town Hall, Delhi.
14. Commissioner (Shri G.P. Mahpatra), Municipal Corporation of Surat, Mugli Sarai, Surat-395 003.

15. Chairman (Shri Dilip Biswas), Central Pollution Control Board, CBD-cum-Office Complex, East Arjun Nagar, Shahadara, Delhi-110 092.

16. Shri P.U. Asnani, 4, Garden Enclave, Opposite Law Garden, Ellisbridge, Ahmedabad-380 006.

17. Shri V.B. Rama Prasad, Deputy Adviser, CPHEEO.

18. Deputy Secretary (Admn.), Ministry of Urban Development for necessary action to provide secretarial assistance.

19. Admn-II Section.

20. Admn-IV Section.

21. Finance Division.

22. Senior PPS to Secretary (UD).PS to JS (UEPA)

23. Sanction Folder.

Sd/-

B. S. MINHAS,
Joint Secretary to the Govt. of India

No. Q-11021/21/99-PHE

GOVERNMENT OF INDIA

Ministry of Urban Development

Nirman Bhawan, New Delhi-110 011
Dated : 8-9-99

ORDER

Subject : Technology Advisory Group on Solid Waste Management

In continuation of this Ministry's Order of even No. dated 18-8-99 on the subject mentioned above, approval of the competent authority is hereby accorded to the inclusion of Shri A. D. Bhide. Deputy Director, National Environmental Engineering and Research Institute (NEERI), Nagpur in the Technical Advisory Group on Solid Waste Management as a non-official member.

2. Shri A.D. Bhide will be entitled to draw TA/DA etc., including air-travel as admissible to Grade-I officers of the Government of India for attending the meetings of the Technology Advisory Group and the expenditure will be met from the Ministry's budget under PHE Training/Pilot Project for Feasibility Studies & Evaluation System.

3. This issues with the concurrence of the Internal Finance Division vide Dy. No. 1504-F(AS/F) dated 2-9-99

Sd/-

YOGENDRA TRIPATHI,
Director (WS)
Tel. No 301 6551

To

The Pay & Accounts Officer (Sectt.)
Ministry of Urban Development
Nirman Bhawan, New Delhi.

Copy to —

1. Principal Director of Audit, Economic & Service Ministries. AGCR Building, New Delhi-110 002.
2. Principal Accounts Officer, Ministry of Urban Development. Nirman Bhawan, New Delhi.
3. Director, National Environmental Engineering and Research Institute (NEERI), Nehru Marg, Nagpur-440 020 along with a copy of the previous order dated 18-8-99.
4. Shri A.D. Bhide. Deputy Director & Head, Solid Waste Management Division. National Environmental Engineering and Research Institute (NEERI), Nehru Marg, Nagpur-440 020.
5. Adviser (PHEE), CPHEEO.
6. Admn-II Section.
7. Finance Division.
8. Sanction Folder.

Sd/-

YOGENDRA TRIPATHI,
Director (WS)

No. Q-11021/21/99-PHE

GOVERNMENT OF INDIA

Ministry of Urban Development

Nirman Bhavan, New Delhi-110 011
Dated : 22-9-99

ORDER

Subject : Technology Advisory Group on Solid Waste Management.

Pursuant to the recommendations of the Committee on Solid Waste Management for class I cities constituted by the Hon'ble Supreme Court regarding the constitution of a National Technology Mission in the Ministry of Urban Development for improving solid waste management practies in the country and in continuation of this Ministry's orders of even No. dated 18-8-99 and 8-9-99 on the subject mentioned above, approval of the competent authority is hereby accorded to the inclusion of the following officials from the State Government for a period of two years with effect from the date of issue of this order in the technology Advisory Group (TAG) on Solid Waste management constituted under the chairmanship of the Adviser (PHEE), Central Public Health and Environmental Engineering Organisation (CPHEEO), New Delhi.

i	Secretary-incharge of Solid Waste Management Government of Andhra Pradesh or his representative	Member (Official)
ii.	Secretary in-charge of Solid Waste Management Government of Maharashtra or his representative	Member (Official)
iii.	Secretary in-charge of Solid Waste Management Government of Orissa or his representative	Member (Offical)
iv.	Secretary in-charge of Solid Waste Management Government of Uttar Pradesh or his representative	Member (Official)

2. Expenditure on TA/DA in respect of the above officials for attending the meetings of the technology Advisory Group from time to time will be met by the respective State Governments.

Sd/-

(B. S. MINHAS),
Joint Secretary to the Govt. of India

The Pay & Accounts Officer (Sectt.)
Ministry of Urban Development
Nirman Bhavan, New Delhi.

Copy to —

1. Principal Director of Audit, Economic & Service Ministries, AGCR Building, New Delhi-110 002.
2. Principal Accounts Officer, Ministry of Urban Development, Nirman Bhavan, New Delhi.
3. Principal Secretary, Housing, Municipal Admn. & Urban Development Department, Government of Andhra Pradesh, Andhra Pradesh Secretariat, Hyderabad -500 022 along with a copy each of the previous orders referred to above for necessary action.
4. Secretary, Government of Maharashtra, Water Supply & Sanitation Department, Mantralaya, Mumbai : 400 032 along with a copy each of the previous orders referred to above for necessary action.
5. Secretary-cum-Commissioner, Deptt. of Housing & Urban Development, Govt. of Orissa, Bhubaneshwar : 751 001 along with a copy each of the previous order referred to above for necessary action.

6. Secretary, Urban Development Department, Government of Uttar Pradesh, Vikash Bhavan, Lucknow : 226 003 along with a copy each of the previous orders referred to above for necessary action.

7. Adviser(PHEE), CPHEEO for follow up action.

8. Admn-II Section.

9. Finance Division.

10. Sanction Folder.

Sd/-

(B. S. MINHAS),
Jt. Secy. to the Govt. of India)

No. Q-11021/21/99-PHE

GOVERNMENT OF INDIA

Ministry of Urban Affairs & Employment

(Department of Urban Development)

Nirman Bhavan, New Delhi.
Dated : 16-1-2002

ORDER

Subject : Re-constitution of Technology Advisory Group on Solid Waste Management.

With reference to the CPHEEO's Note No. Q-15014/1/2000-CPHEEO dated 15-11-2001 and in continuation of this Ministry's Office Order of even No. dated 18-8-1999, 8-9-99 & 22-9-99 approval of the competent authority is hereby accorded to revise the composition of the Technology Advisory Group(TAG) on Solid Waste Management. The revised composition of TAG is as under :—

1	Shri V. B. Rama Prasad Adviser (PHEE), CPHEEO M/o Urban Development & Poverty Alleviation (UD & PA), New Delhi.	Chairman
2.	Shri Joseph Mathew Director(Finance) M/o UD & PA, New Delhi.	Official Member
3.	Representative of M/o Environment & Forests, New Delhi.	Official Member
4.	Dr. M. R. Motsara Additional Commissioner (Fert.) Ministry of Agriculture, Department of Agriculture & Co-operation, New Delhi.	Official Member
5.	Shri K. P. Katailiha Deputy Adviser (WS) Planning Commission, New Delhi.	Official Member
6.	Representative M/o Health & Family Welfare, Department of Health New Delhi.	Official Member
7.	Shir N. K. Singh Adviser M/o Non-Conventional Energy Sources, New Delhi	Official Member
8.	Dr. A. B. Akolkar Senior Scientist Central Pollution Control Board, New Delhi.	Official Member

9.	Shri A. D. Bhide Deputy Director & Head Planning & Information Division NEERI, Nagpur	Non-Official Member
10.	Shri A. K. Jain Additional Municipal Commissioner Municipal Corporation of Greater Mumbai, Mumbai.	Official Member
11.	Shri P. U. Asnani Infrastructure Representative of India, USAID, Ahmedabad	Non-Official Member
12.	Director(CSE) I Municipal Corporation of Delhi, Delhi.	Official Member
13.	Deputy Municipal Commissioner (Solid Waste) Corporation of Chennai, Chennai.	Official Member
14.	Shri Anjan Das Director, Andhra Pradesh Technology Development & Promotion Centre, Hyderabad	Official Member
15.	Shri D. P. Dixit General Manager M.P. Agro State Industries Corporation, Bhopal	Official Member
16.	Shri C. Basaviah Managing Director Karnataka Compost Development Corporation, Bangalore	Official Member
17.	Shri V. Satyanarayana Senior Infrastructure Finance Adviser INDO-US AID. FIRE Project, New Delhi.	Official Member
18.	Dr. S. K. Ghoshal Chairman, Orissa Pollution Control Board Bhubaneswar	Official Member
19.	Shri Srinivasa Setty Officer on Special Duty Technology Information Forecasting and Control (TIFAC) New Delhi	Official Member
20.	Dr. N. B. Mazumdar Chief (Waste Management) HUDCO, New Delhi	Official Member
21.	Shri H.S. Bains Chairman, Haryana Pollution Control Board Chandigarh	Official Member

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22. Dr. Manoj Dutta — Non-Official Member (Local)
Professor
Civil Engineering Department
IIT, Delhi.

23. Prof. H.S. Mukunda — Non-Official Member
Indian Institute of Science
Department of Aerospace Engineering
Bangalore

24. Dr. S.S. Khanna — Non-Official Member (Local)
Former Adviser (Agriculture)
Planning Commission
New Delhi

25. Shri B.B. Uppal — Member Secretary
Deputy Adviser(PHE), CPHEEO
M/o UD&PA, New Delhi

2. The terms & conditions of the Technology Advisory Group would remain the same as stipulated in this Ministry's letter of even number dated 18-8-1999. The TAG would be required to finalise the pending draft reports immediately.

3. Expenditure on TA/DA, including air journeys for non-officials as per entitlement of Grade I officers of the Govt. of India, TA only for local non officials, working lunch, tea, stationery etc. for all participants in the meetings of the TAG would be met from the Ministry's Budget under PHE Training or Pilot Project for Feasibility Study & Evaluation System.

4. This issues with the concurrence of the Internal Finance Division vide Dy. No. 2568/DOI/W&E/2001 dated 28-12-2001.

Sd/-

S. BANERJEE, Jt. Secy. to the Govt. of India

To

The Pay & Accounts Officer (Sectt.)
Ministry of Urban Development & Poverty Alleviation,
Nirman Bhawan,
New Delhi.

Copy to :—

1. Principal Director of Audit, Economic & Service Ministries, AGCR Building, New Delhi-110 002.
2. Principal Accounts Officer, Ministry of Urban Development, Nirman Bhawan, New Delhi.
3. Adviser (PHEE), CPHEEO for follow up action.
4. Secretary, Ministry of Environment & Forests, Paryavaran Bhawan, C.G.O. Complex, Lodhi Road, New Delhi-110 003
5. Secretary, Ministry of Non-Conventional Energy Sources Block No. 14, C.G.O. Complex, Lodhi Road, New Delhi 110 003

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6. Secretary, Ministry of Health & Family Welfare, Nirman Bhawan, New Delhi.

7. Secretary, Ministry of Agriculture Department of Agriculture & Cooperation, Krishi Bhawan, New Delhi - 110 001

8. Adviser, Planning Commission Yojana Bhawan, New Delhi.

9. Commissioner, Municipal Corporation of Brihan Mumbai, Mahapalika Marg, Fort, Mumbai-400 032.

10. Commissioner, Chennai Municipal Corporation, Chennai-600 003.

11. Commissioner, Municipal Corporation of Delhi, Town Hall, Delhi.

12. Chairman, Central Pollution Control Board, CBD-cum-Office Complex, East Arjun Nagar, Shahadara, Delhi-110 092.

13. Shri P.U. Asnani, 4, Garden Enclave, Opposite Law Garden, Ellisbridge, Ahmedabad-380 006.

14. Director, NEERI, Nehru Marg, Nagpur-440 020.

15. Director, Andhra Pradesh Tech. Dev. & Promotion Centre, Road No.3, Banjara Hills, Hyderabad-500 034.

16. General Manager, M.P. Agro State Industries Corpn., Bhopal.

17. Managing Director, Karnataka Compost Development Corpn., Haralakunte Singasangasandra Post, Bangalore-560 068.

18. Director, INDO-USAID, FIRE Project, E-3/4, Vasant Vihar, New Delhi -1110057.

19. Chairman, Orissa Pollution Control Board, A-118, Nilkanta Nagar, Unit VIII, Bhubaneswar-751 012.

20. Officer-in-charge, TIFAC, Technology Bhawan, New Mehrauli Road, New Delhi.

21. CMD, HUDCO, India Habitate Centre, Lodhi Road, New Delhi.

22. Chairman, Haryana Pollution Control Board, SCO No.11 A, Sector VII C, Madya Marg, Chandigarh.

23. Director, IIT, Hauz Khas, New Delhi.

24. Director, Indian Instt. of Science, Deptt. of Aero Space Engineering, Bangalore,

25. Shri B.B. Uppal , Deputy Adviser, CPHEEO

26. Admn-II Section

27. Finance Division.

28. Sanction Folder.

Sd/-

S.BANERJEE, Joint Secretary to the Govt. of India.

ANNEXURE—2

No. Q-11021/21/99-PHE
Government of India
Ministry of Urban Development

Nirman Bhawan, New Delhi
Dated : 30th May, 2000

ORDER

Subject : Constitution of Core Groups under the Technology Advisory Group on Solid Waste Management.

I am directed to convey the approval of the competent authority to the constitution of the following three Core Groups under the Technolgy Advisory Group on Solid Waste Management for class I cities constituted earlier vide this Ministry's order dated 18-8-99.

I CORE GROUP ON 'APPROPRIATE TECHNOLOGIES AND RESEARCH & DEVELOPMENT'

Composition :

i.	Shri P.U. Asnani, Urban Environment Infrastructure Representative of India, USAID	Chairman (Non-Official)
ii.	Shri A.D. Bhide, Dy. Director, NEERI. Nagpur	Member (Non-Official)
iii.	Shri A.K. Varshney, Principal Scientific Officer, MNES	Member (Official)
iv.	Shri K.S. Sandhu, Director (CSE), MCD	Member (Official)
v.	Dr. A.B. Akolkar, Senior Scientist, CPCB, New Delhi	Member (Official)
vi.	Shri G.V. Raghava Rao, Deputy Chief Engineer, PHED, Andhra Pradesh	Member (Official)
vii.	Shri R. Ramanathan, Superintending Engineer, Solid Waste Management Division, Municipal Corporation of Chennai	Member (Official)
viii.	Shri P.C. Rath, Superintending Engineer PHED, Orissa	Member (Official)
ix.	Shri M.A. Haque, Additional Director, M/o E&f	Member (Official)
x.	Representative of M/o Law	Member (Official)
xi.	Shri M. Sankaranarayanan, Assistant Adviser, CPHEEO	Member Coordinator

Terms of Reference :

(a) Collect information on various proven technologies for processing and disposal of municipal solid waste.

(b) Identify appropriate and cost effective technologies suitable under local conditions.

(c) Recommend cost effective and sustainable technologies under local conditons to Technology Advisory Group (TAG) for testing the same through pilot plants if necessary in consultation with the local bodies concerned and Central Ministries/Departments.

(d) Assess the infrastructure required such as land, machinery, equipment, manpower, electric power and water supply for setting up of processing/treatment plants of different standard capacities.

(e) Assess the requirement of capital cost to establish processing/treatment plants of various standard sizes/capacities.

(f) Assess the annual operation and maintenance cost of the identified processing/treatment plants of various capacities.

(g) Identify the environmental aspects to be considered while setting up of such plants as well as during their operation and maintenance so as to protect the environment from possible degradation and suggest suitable remedial measures to mitigate possible environmental problems.

(h) Identify and suggest Research and Development inputs which are necessary for various unit operations such as street sweeping, storage of waste, collection and, conveyance/transportation, transfer stations, processing/treatment of waste, final disposal and also to assess the possible impact on the environment and to suggest remedial measures wherever necessary.

(i) Identify and suggest a list of various Research and Development institutions at Centre and State level which are engaged in municipal solid waste management so as to assist the urban local bodies.

(j) Identify and suggest a list of technology providers, consultants and R&D experts in the field of municipal solid waste management.

(k) Identify and list out the technologies being promoted and financed by the various Central and State Ministries/Departments.

(l) Review various technologies being adopted in different parts of the country and list out their merits and demerits/deficiencies from technical, financial, managerial, social and environmental angles.

(m) Any other aspect/issue, the sub-group may like to consider and include.

II CORE GROUP ON 'FINANCIAL RESOURCES AND PRIVATE SECTOR PARTICIPATION'

Composition :

i.	Shri V.P. Raja, Secretary (WS&S), Govt. of Maharashtra	Chairman (Offficial)
ii.	Shri A.K. Jain, Addl. Municipal Commissioner, Mumbai Municipal Corporation	Member (Official)
iii.	Shri K.P. Katailiha, Dy. Adviser (WS), Planning Commission	Member (Official)
iv.	Shri Joseph Mathew, Director (F), Ministry of UD	Member (Official)

v. Dr. N.B. Mazumdar, Deputy Chief, HUDCO — Member (Official)

vi. Shri N.N. Hotchandani, Assistant Advisor, CPHEEO — Member (Coordinator)

Terms of Reference :

(a) Access financial resources of different categories of urban local bodies and their annual budgets for various municipal functions with special reference to solid waste management.

(b) Suggest realistic financial allocation necessary for maintaining solid waste management activities in different categories of towns and cities.

(c) Study the pattern of expenditure incurred on various components of solid waste management during the last 5 years in different towns and cities.

(d) Suggest ways and means of mobilising financial resources by the urban local bodies to meet the requirement of funds for maintaining appropriate level of solid waste management services through sanitation and solid waste management tax, property tax, user charges etc

(e) Collect details of various Central and State Ministries and Departments and other financial institutions which are providing financial assistance for solid waste management activities through various schemes/ programmes.

(f) Enlist private agencies/organisations which are actively involved in different solid waste management activities and their functions in detail.

(g) Examine the scope of private sector participation in solid waste management services keeping in view the existing labour laws as well as Contract Labour (Regulation & Abolition) Act 1970.

(h) Suggest the area of activities where private sector participation may be attempted and the manner in which they can be implemented.

(i) List out and provide details with regard to the areas and activities in which private sector has been providing services along with the terms and conditions, agreements reached between urban local bodies and the private sector.

(j) Suggest model concession agreements and contractual terms and conditions to be imposed by urban local bodies while going for private sector participation.

(k) Suggest the role and extent of participation of NGO/voluntary organizations in SWM services.

(l) Provide details of various concessions and incentives available presently for carrying out solid waste management activities and suggest additional incentives/concessions needed for considerations.

(m) Any other aspect/issue, the sub-group may like to consider and include.

III. CORE GROUP ON 'CAPACITY BUILDING, HUMAN RESOURCE DEVELOPMENT, INFORMATION, EDUCATION & COMMUNICATION'

Composition :

i. Shri A.D. Bhide, Dy. Director, NEERI, Nagpur — Chairman (Non-Official)

ii. Shri P.U. Asnani, Urban Environment Infrastructure Representative of India, USAID — Member (Non-Official)

iii. Representative of the M/o Information & Broadcasting — Member (Official)

iv. Representative of Directorate of Audio Visual Publicity (DAVP) — Member (Official)

v. Smt. Usha Raghupati, Social Scientist, NIUA, New Delhi — Member (Official)

vi. Representative of M/o Health & Family Welfare — Member (Official)

vii. Representative of M/o Social Justice & Empowerment — Member (Official)

viii. Representative of State Government of Uttar Pradesh — Member (Official)

ix. Shri M.M. Datta, WHO India Office — Member (Non-Official)

x. Representative of Safai Kamgar Commission — Member (Official)

xi. Shri M. Dheenadhayalan, Assistant Adviser, CPHEEO — Member (Coordinator)

Terms of Reference :

(a) Identify the IEC needs for efficient solid waste management systems in urban areas.

(b) Collect information/details/suggestions from NGOs/voluntary organisations, expert agencies having social outlook and approach in identifying suitable methodologies and communication tools for effective IEC.

(c) Suggest suitable package of IEC material to be developed for different levels of cities and towns through expert agencies in different local languages with cost estimates.

(d) Identify suitable media for effective dissemination of IEC, material and suggest suitable strategy for implementation.

(e) Identify training needs and the institutions, which can provide training to various levels of personnel in urban local bodies engaged in solid waste management with cost estimates.

(f) Suggest suitable training modules for various levels of SWM personnel.

(g) Identify the deficiencies in the institutional capabilities of the urban local bodies for effective solid waste management activities and suggest suitable measures to strengthen and improve the capabilities with its financial implications.

(h) Any other aspect/issue the sub-group may like to consider and include.

2. The concerned Ministries/Department, NIUA and Safai Kamgar Commission would be required to nominate a suitable representative not below the rank of Deputy Secretary/Deputy Adviser/Superintending Engineer to serve in their respective Core Group.

3. The Core Groups are to submit their draft reports to the Chairman-TAG within 12 weeks from the date of issue of this order. The TAG will review the progress after a period of 6 weeks from the date of issue of this order. The respective Chairman of the Core Groups may co-opt any additional members, if necessary, without causing any additional financial burden on the Ministry. The Core Groups may hold a maximum of 5 meetings within a period of 12 weeks to finalise their respective reports. The non-official Members are entitled to TA & DA including air journey as per entitlement of Grade I officers of the Government of India. TA and DA of the official members for attending the meeting will have to be met by their respective Departments. The Ministry will be kept informed of the progress made from time to time.

4. This issues with the concurrence of the Internal Finance Division vide Dy. No. 922-F dated 17-4-2000.

Sd/-

(Dharmendra)
Deputy Secretary to the Govt. of India
Telefax No. 301 4206

To

The Pay & Accounts Officer (Sectt),
Ministry of Urban Development,
Nirman Bhavan,
New Delhi.

Copy to :—

1. Principal Director of Audit, Economic & Service Ministries, AGCR Building, New Delhi-110 002.
2. Principal Accounts Officer, Minitry of Urban Development, Nirman Bhawan, New Delhi.
3. Adviser (PHEE), CPHEEO for follow up action.
4. Shri P.U. Asnani, Urban Environment Infrastructure Representative of India, USAID.
5. Shri A.D. Bhide, Deputy Director, National Environmental Engineering Research Institute, Nagpur.
6. Shri A.K. Varshney, Principal Scientific Officer, Ministry of Non-Conventional Energy Sources, Block No. 14, CGO Complex, Lodhi Road, New Delhi.
7. Shri K.S. Sandhu, Director (CSE), Municipal Corporation of Delhi.
8. Dr. A.B. Akolkar, Senior Scientist, Central Pollution Control Board, East Arjun Nagar, New Delhi.
9. Shri G.V. Raghava Rao, Deputy Chief Engineer, PHED, Andhra Pradesh, Hyderabad.
10. Shri R. Ramanathan, Superintending Engineer, Solid Waste Management Division, Municipal Corporation of Chennai, Chennai.
11. Shri P.C. Rath, Superintending Engineer, PHED, Orissa, Bhubaneshwar.
12. Shri M.A. Haque, Additional Director, Ministry of Environment & Forests, Paryavaran Bhawan, New Delhi.
13. Representative of M/o Law, Justice & Company Affairs, Shastri Bhawan, New Delhi.
14. Shri M. Sankaranarayanan, Assistant Adviser, CPHEEO, New Delhi.
15. Shri V.P. Raja, Secretary (WS&S), Govt. of Maharashtra, Water Supply & Sanitation Department, Mantralaya, Mumbai.
16. Shri A.K. Jain, Addl. Municipal Commissioner, Mumbai Municipal Corporation, Municipal Head Office, Port, Mumbai.
17. Shri K.P. Katailiha, Dy. Adviser (WS), Planning Commission, Yojana Bhawan, New Delhi.

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18. Shri Joseph Mathew, Director (F), Ministry of Urban Development.

19. Dr. N.B. Mazumdar, Deputy Chief, Housing & Urban Development Corporation, India Habitat Centre, New Delhi.

20. Shri N.N. Hotchandani, Assistant Adviser, CPHEEO, New Delhi.

21. Representative of the M/o Information & Broadcasting, Shastri Bhawan, New Delhi.

22. Representative of Directorate of Audio Visual Publicity (DAVP).

23. Smt. Usha Raghupati, Social Scientist, NIUA, India Habitat Centre, New Delhi.

24. Representative of M/o Health & Family Welfare, Nirman Bhawan, New Delhi.

25. Representative of M/o Social Justice & Empowerment, Shastri Bhawan, New Delhi.

26. Representative of Government of Uttar Pradesh, Lucknow.

27. Shri M.M. Datta, WHO Representative Officer, Nirman Bhawan, New Delhi.

28. Representative of Safai Kamgar Commission.

29. Shri M. Dheenadhayalan, Assistant Adviser, CPHEEO, New Delhi.

30. Admn-II Section.

31. Admn, IV Section.

32. Finance Division.

33. Senior PPS to Secretary (UD)/PS to AS(F).

34. Sanction Folder.

Sd/-

(Dharmendra)
Deputy Secretary to the Govt. of India

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ANNEXURE—3

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999) COLLECTED BY CPHEEO

City Name	General						SW generation and collection			
	Area (sq.km.)	Pop. 1991	Pop. 1998	Slum pop. & urban poor	No. of house-holds	No. of wards/zones	SW genera-tion per capita/ day (g.)	SW generated/day (MT) Total	Domestic	Comm. & Indus.
Andhra Pradesh										
Qutbullapur	46.87	105380	250000	162822	50000	24	280	70	60	10
Ramagundam	93.87	214384	350000	74523	60585	34	800	280	168	112
Eluru	11.88	212000	252000	74849	36125	36	500	142	35	40
Anantapur	15.98	174792	240000	60000	35000	28	120	120	60	60
Tirupati	24	174369	210000	58364	45000	20	0.5	125	70	40
Khammam	18.53	127992	180000	40312	32000	36 Wards, 12 zones	450	81	64.8	16.2
Latur	28	191407	270675	87379	37095	50	0.5	150	50	100
Mahabubnagar	13	115000	180000	89,951	30450	32	30	30	Nil	Nil
Warangal	68.5	467757	650000	250000	100000	50 Wards, 10 zones	20	2.9	850	40
Guntur	47.5	471020	600000	290000	116343	19 Wards, 3 zones	500	280	197	82
Proddatur	7.12	133914	160210	41422	28984	4	200	35	28	7
Assam										
Jorhat	9.2	112000	170000	36000	9000	19	180	20	11	9
Guwahati	216	700000	1000000	75000	100000	60	200	250	175	75
Bihar										
Bhagalpur	84	254995	290700	96445	45767	37	250	72	58	14
Delhi										
Delhi	1484.46	9300000	12000000	600000	n.a.	134	450	6000	2200	n.a.
Gujarat										
Jamnagar	26.1	326241	500000	101824	90000	17	500	300	50	15
Surat	112.27	1490000	220000	850000	480185	Wards 54 Zones 6	517	870	390	480
Veraval-Patan	9.65	115649	Nil	12000	28000	14	500	70	40	25
Navsari	8.55	126089	138856	34700	33088	14	290	40.26	30.26	10
Bharuch	19.9	133102	175000	15000	35000	Ward 14, zones 11	250	100	30	Nil
Rajkot	104.4	560000	850000	110000	165000	24	550	465	465	n.a.
Junagarh	13.47	130432	165000	35000	40000	10	250	145	45	30
Gandhidham	30.93	104585	250000	60000	31270	14 Wards, 6 zones	400	110	100	10
Anand	21.13	110266	121525	38230	37534	14	10	11	4	7
Bhavnagar	54.4	402338	491910	200000	106000	17	300	165	95	60
Vadodara	108	1039346	1400000	4.2	2	Wards 10, zones 4	n.a.	560	560	n.a.

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Details of waste transportation										
	SW collected per day (MT)	Periodicity of SW collection per week	No. of community dustbins	No. of disposal sites (land fill sites)	No. of hand carts/ trolleys available	No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. no. of trips made by each truck/ tractor per day and distance travelled (k.m.)	Avg. quantity of SW carried by each vehicle per trip (M.T.)
Andhra Pradesh											
Qutbullapur	70	4 times	511	1	60	4 lorries under privatisation	Nil	1	Nil	4 trips, 40 km.	3
Ramagundam	150	2 times in a week	350	19	62	Nil	Nil	18	Nil	6 trips, 5 km.	9
Eluru	144	Daily collection	520	2	50	Nil	Nil	13	Nil	5 trips, 50 km.	3
Anantapur	110	Daily collection	540	1	45	6	Nil	3	Nil	6 trips, 10 km.	6
Tirupati	125	Daily collection	350	1	70	1	Nil	13	Nil	4 trips, 12 km.	2.5
Khammam	72.9	510.3	539	1	Nil	Nil	Nil	12	Nil	5 trips, 50 km.	1.2
Latur	200	Daily collection	406	3	100	Nil	10	Nil	Nil	6 trips, 10 km.	2
Mahabubnagar	22	135	375	6	150	Nil	Nil	3	Nil	5 trips	1.5
Warangal	80	20	2000	10	130	Nil	19	Nil	Nil	3trips per day	2.5
Guntur	280	Daily collection	2800	3	400	3	Nil	21	Nil	6 trips, 50 km.	5
Proddatur	30	Daily collection	150	3	16	1	Nil	4	Nil	5 trips, 40 km.	1
Assam											
Jorhat	14	Twice in a week	25	1	5	2	Nil	3	Nil	3 trips, 16 km.	Nil
Guwahati	200	Daily collection	80	1	100	28	8	1	Nil	3-4 trips, 50 km	2.5
Bihar											
Bhagalpur	24	168	108	Nil	45	Nil	Nil	6	1	9 trips, 5 km.	0.75
Delhi											
Delhi	6000	Daily collection	3264	3	12500	570	Nil	Nil	Nil	2 trips per day	4
Gujarat											
Jamnagar	300	2100	950	1	500	Nil	Nil	25	Nil	8 trips, 5 km.	4
Surat	850	Daily collection	700	2	H.Carts 3500	65	85	46	Nil	5 trips, 10 km.	1
Veraval-Patan	60	Twice a day	18	1	70	Nil	Nil	2	Nil	4	2.5
Navsari	291832	Daily collection	84	2	75	1	2	3	Nil	3 trips 45 km.	1.5
Bharuch	75	Daily collection	80	2	Nil	25	3	Nil	Nil	4 trips, 0.125 200 km.	
Gandhidam	70	Twice in a week	200	1	150	2	Nil	5	Nil	6 trips, 25 km.	3
Rajkot	425	Daily collection	650	5	1071	26	2	9	Nil	5trips, 400km.	4
Junagarh	100	700	50	No	190	8	Nil	5	Nil	8trips, 65 km.	2.5
Anand	Nil	Daily collection	30	5	130	1	1	2	Nil	10trips,4 kms.	Nil
Bhavnagar	115	50	200	1	400	20	Nil	15	4	2 truck, 130 tractor 7 mt	Nil
Vadodara	500	Daily collection	480	8	2500	32	20	2	Nil	3 trips for truck, 5 trips per dumper	2

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	%of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Details of waste disposal				Waste Treatment		
				Method of SWM treatment/ disposal	Land fill site			Compositing		
					Area	Distance from transfer station/ city (km.)	No. of years designed	Manual/ mechanical	Is compost sold?	If yes, revenue, generated/year
Andhra Pradesh										
Quthullapur	2	No	Through State Govt. agency	Dumping in open land	10 Acres	8	Nil	Nil	Nil	Nil
Ramagundam	Nil	No	Private workshop	Trenching ground	9 sq.km.	13	5	Nil	Nil	Nil
Eluru	10	Nil	Private workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Anantapur	10	No	Local workshop	Composting	20	10	25	Manual	No	Nil
Tirupati	10	Private	Private workshop	Composting	30 Acres	8	20	Nil	No	Nil
Khamman	5	No	Private workshop	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Latur	Nil	n.a.	Nil	Land filling	8 Acre	7	3	Nil	Nil	Nil
Mahabubnagar	25	No	Private workshop	Dumping in open land	1000	n.a.	2	Manual	No	Nil
Warangal	20	No	Private workshop	Dumping in open land	20 Acres	20	Nil	Nil	Nil	Nil
Guntur	Nil	Yes	n.a.	Dumping in open land	18 Acres	1	Nil	Nil	Nil	Nil
Proddatur	12.5	Nil	Local Mechanics	Dumping in open land	1	1.5	Nil	Nil	No	Nil
Assam										
Jorhat	Nil	No	Private workshop	Nil	0.03	2	20	Nil	Nil	Nil
Guwahati	2	Yes	Private workshop	Nil	20	15	5	Nil	Nil	Nil
Bihar										
Bhagalpur	25	Yes	Nil	No	Nil	Nil	Nil	Nil	Nil	Nil
Delhi										
Delhi	25	Yes	n.a.	Dumping in open land	150 Acre	35	4	Mechanical	Nil	Nil
Gujarat										
Jamnagar	Nil	Yes	n.a.	Dumping in open land	4 Acres	8	2	Nil	Nil	Nil
Surat	20	Yes	n.a.	Dumping in open land	200 Acres	7	20	Nil	Nil	Nil
Veraval-Patan	Nil	Yes	Nil	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Navsari	20	No	Private workshop	Nil	0.5	10	10	Nil	Nil	Nil
Bharuch	25	Yes	Private workshop	Dumping in open land	10	10	5	Nil	Nil	Nil
Gandhidham	Nil	Nil	Private workshop	Dumping in open land	Nil	6	Nil	Nil	Nil	Nil
Rajkot	25	Yes	n.a.	Dumping in open land	Nil	details enclosed	Nil	Nil	Nil	Nil
Junagarh	80	Yes	Nil	No process plan	Nil	Nil	Nil	Nil	Nil	Nil
Anand	25	Yes	Nil	Dumping in open land	2	4	10	Nil	Nil	Nil
Bhavnagar	15	Yes	Nil	Dumping in open land	5	3	25	Nil	Nil	Nil
Vadodara	15	Yes	Nil	Dumping in open land	20Acres	7	5	No	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Gas Production						Institutional arrangements		
	Methane gas								
	Methane gas produced form land fill site (Y/N)	If yes, quantity (cum./ year)	How much is sold to public?	Revenue generated thro' sale of compost, methane gas	Total revenue generated thro' sale of compost, methane gas	Annual expenditure incurred for SWM (Rs Lakhs)	Agency Incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
Andhra Pradesh									
Quthullapur	Nil	Nil	Nil	Nil	Nil	58.71	Municipal Council	1	50
Ramagundam	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	5	91
Eluru	Nil	Nil	Nil	Nil	Nil	1.85	Nil	29	383
Anantapur	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Tirupati	Nil	Nil	Nil	Nil	Nil	200.5	SCHWEP (NGO)	42	322
Khamman	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	Nil	Nil
Latur	Nil	Nil	Nil	Nil	Nil	331.43	Municipal Council	9	488
Mahabubnagar	Nil	Nil	Nil	Nil	Nil	3	Municipal Council	13	180
Warangal	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	57	671
Guntur	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	20	806
Proddatur	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	5	206
Assam									
Jorhat	Nil	Nil	Nil	Nil	Nil	19.98	Municipal Council	6	48
Guwahati	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	119	1161
Bihar									
Bhagalpur	Nil	Nil	Nil	Nil	Nil	99	Municipal Council	11	384
Delhi									
Delhi	Nil	Nil	Nil	Nil	Nil	215557	Municipal Council	1647	38111
Gujarat									
Jamnagar	Nil	Nil	Nil	Nil	Nil	7 crores	Municipal Council	44	1316
Surat	Nil	Nil	Nil	Nil	Nil	156	Dy. Commissioner	20	470
Verabal-Patan	Nil	Nil	Nil	Nil	Nil	Nil	Self	16	331
Navsari	Nil	Nil	Nil	Nil	Nil	120	Sanitary department	14	220
Bharuch	Nil	Nil	Nil	Nil	Nil	255	Sanitary department	22	310
Gandhidham	Nil	Nil	Nil	Nil	Nil	143	Sanitary department	8	211
Rajkot	Nil	Nil	Nil	Nil	Nil	1191.4	Municipal Council	133	588
Junagarh	Nil	Nil	Nil	Nil	Nil	Nil	Nagar Palika	40	410
Anand	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	4
Bhavnagar	Nil	Nil	Nil	Nil	Nil	3476284	Nil	4	316
Vadodara	Nil	Nil	Nil	Nil	No	12 crores	Municipal Council	172	3403

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)		Privatisation			
	Undertaken in the past	To be under taken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, details	If no, any future plan for privatisation	Details of NGO's working SWM
Andhra Pradesh						
Quthullapur	35	79	Yes	details enclosed	Nil	Nil
Ramagundam	Nil	Nil	Nil	Nil	Private contractors	Nil
Eluru	Nil	Nil	2 Areas	6,7 & 18 wards	Nil	Nil
Anantapur	Nil	Nil	Nil	details enclosed	Nil	Nil
Tirupati	Nil	Nil	Nil	details enclosed	Nil	SCHEWP, NGO
Khamman	Nil	Nil	Nil	Nil	Nil	Nil
Latur	85.7	details enclosed	Nil	Nil	Nil	Nil
Mahabubnagar	Nil	Nil	No	Nil	Yes	Nil
Warangal	Nil	Nil	Nil	Nil	Nil	Nil
Guntur	Nil	Nil	Nil	Nil	Nil	Nil
Proddatur	Nil	Nil	Nil	Nil	Nil	Nil
Assam						
Jorhat	17.84	Nil	Nil	Nil	Nil	Nil
Guwahati	60	details enclosed	Yes	details enclosed	Nil	Nil
Bihar						
Bhagalpur	Nil	Nil	Nil	details enclosed	No	Nil
Delhi						
Delhi	180	details enclosed	details enclosed	details enclosed	Nil	Nil
Gujarat						
Jamnagar	130	140	No	Nil	Nil	Nil
Surat	140	200	Yes	details enclosed	Private contractors	Nil
Veraval-Patan	87.1	1000000	Nil	Nil	No	Nil
Navsari	85	125	Nil	details enclosed	Yes	Nil
Bharuch	145.71	225	No	details enclosed	Nil	Nil
Gandhidham	572	Nil	Nil	Nil	Nil	Nil
Rajkot	Nil	Nil	Nil	details enclosed	Nil	Nil
Junagarh	7.5	Nil	Nil	Nil	Nil	Nil
Anand	121	Nil	Nil	Nil	Nil	Nil
Bhavnagar	Nil	Nil	Nil	Nil	No	Nil
Vadodara	85.71	n.a.	Yes	details enclosed	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	General						SW generation and collection			
	Area (sq.km.)	Pop. 1991	Pop 1998	Slum pop. & urban poor	No. of house-holds	No. of wards/ zones	SW gene-ration per capita/ day (gm.)	SW Generated/day (MT) Total	Domes-tic	Comm. & Indus.
Haryana										
Karnal	22.1	176131	220000	46000	39064	31	400	88	50	15
Sonipat	22	143922	n.a.	n.a.	n.a.	n.a.	50	40	n.a.	n.a.
Sirsa	27	112542	138293	n.a.	26616	31	250	35	20	15
Karnataka										
Tenali	15.12	143726	7500000	40567	36000	36	500	96	76	20
Mysore	91.73	653345	775332	229366	122885	65	450	303.72	205.25	98.52
Gudug-Betageri	19.71	133914	150336	9348	23400	35	500	75	20	50
Mangalore	115.4	272000	450000	n.a.	107071	60	450	22.5	29	23
Raichur	60	157477	200926	51136	21291	35	1250	125	100	25
Hassan	12.6	111486	130000	18000	18000	35	1.63	68	45.33	22.67
Bellery	81.95	287601	343818	81995	60500	35	250	86	78	8
Kerala										
Palakkad	26.6	122389	n.a.	List attached	List attached	36	2.5	20	3	17
Kollam	18.48	139852	141778	10800	26713	36	350	62	20	25
Vadakara	21.34	72434	70325	27483	10081	32	300	25.3	12.4	12
Charthala	16.18	41326	45536	7755	10705	28	500	6	1	5
Guruvayoor	7.476	20216	22141	n.a.	4615	20	12	10	1	Nil
Kannur	11.67	65238	78764	4121	11252	32	460	30	12	18
Kottayam	16.446	63155	n.a.	4011	12735	32	300	39	28	11
Madhya Pradesh										
Satna	62.24	156409	200000	50000	30000	45	Nil	50	Nil	Nil
Bhind	17.179	109731	175000	35000	18000	39	360	28	28	Nil
Rewa	90	128918	180000	55816	28868	45	48	48	Nil	Nil.
Rajnandgaon	51.13	120394	160000	58740	Nil	Wards 45 zones 3	Nil	39	35	2
Korba	215.02	241273	350000	69000	70000	51	285	100	45	55
Bhopal	285.09	1062771	1390480	380622	290378	66 wards, 11 zones	260	600	450	250
Shivpuri	72	108274	140000	30000	25800	39	250	30	24	6

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	SW Collected/day (MT)	Periodicity of SW collection	No. of community dustbins	No. of disposal sites (land fill sites)	Details of waste transportation: No. of hand carts/ trolleys	No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. no. of trips made by each truck/ tractor per day distance travelled (km.)	Avg. quantity of SW carried by each vehicle per trip (MT)
Haryana											
Karnal	66	Twice a day	65	Nil	180	Nil	Nil	6	Nil	4 trips, 40 km.	1
Sonipat	45	N.A.	Nil.	Nil	4	5	2	Nil	Nil	n.a.	
Sirsa	30	210	Nil	2	105	Nil	Nil	4	Nil	6 trips, 3 kms.	2
Karnataka											
Tenali	96	Daily collection	482	5	4	6	Nil	6	Nil	6 trips, 3 km.	2
Mysore	197.42	Once in 2 days	3800	1	100	4	6	22	Nil	3 trips, 20km.	6
Gadag-Betageri	50	Once a week	541	2	Nil	Nil	Nil	6	3	4 trips, 8 km.	2
Mangalore	200	7 days in a week	1200	1	100	19	3	Nil	Nil	2 trips 60 km.	6
Raichur	50	350	336	4	70	9	Nil	8	Nil	2 trips, 3 km.	2.5
Hassan	22.67	336	2800	4	Nil	Nil	36	6	Nil	4 trips, 5 km.	2.5
Bellary	60	Daily collection	543	1	100	6	Nil	1	Nil	5 trips, 12 kms.	2.5
Kerala											
Palakkad	20	Daily collection	Nil	Nil	36	4	1	1	Nil	2 trips 30 km.	3
Kollam	58	Daily Collecation	190	1	50	4	25	9	Nil	2 trips	2
Vadakara	10.76	Daily collection	36	1	12	2	Nil	Nil	Nil	2	3.58
Cherthala	4	8	12	38	1	1	10	1	No.	1 trip, 10 km.	4
Guruvayoor	10	Daily collection	45	1	8	1	Nil	2	Nil	3 trips, 15 km.	1.5
Kannur	30	Daily collection	112	1	30	3	2	Nil	2	2 trips, 32 kms.	6
Kottayam	35	Daily collection	63	1	30	4	2	Nil	Nil	2 trips, 50 kms.	3
Madhya Pradesh											
Satna	50	350	320	Nil	100	1	5	11	1	6 trips, 5 km.	5
Bhind	24	Daily collection	Nil	Nil	57	12	3	8	Nil	3	2
Rewa	48	336	15	60	65	5	Nil	5	Nil	4 trips, 40 km.	7
Rajnandgaon	39	234	25	6	229	2	1	3	Nil	1 trip, 5 km.	3.25
Korba	100	600	35	4	30	2	3	6	Nil	3 trips, 10 km.	3
Bhopal	450	Daily collection	910	1	400	23	3	11	9	2 trips, 20-50 kms.	11
Shivpuri	28	20	41	Nil	103	3	1	3	Nil	2 trips 16 km.	4

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STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City name	% of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Details of waste transportation: Method of SWM treatment/ disposal	Waste Treatment: Land fill site: Area	Land fill site: Distance from transfer station/ city (km.)	Composting: No. of years designed	Composting: Manual/ mechanical	Is compost sold?	If yes, revenue generated/year
Haryana										
Karnal	20	No	Local market	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Sonipat	Nil	No	n.a.	Dumping in open land	11 acres	n.a.	Nil	Manual	Nil	Nil
Sirsa	25	Yes	Private workshop	Dumping in open land	1 Acre	5	20	Nil	Nil	Nil
Karnataka										
Tenali	25	No	Private workshop	Filling of low lying areas	Nil	3	Nil	No compost	Nil	Nil
Mysore	5	Yes	Authorised workshop	Nil	10	5	10	Nil	Nil	Nil
Gadag-Betegari	New vehicle	No	Private workshop	Dumping in open land	Nil	Nil	Nil	Manual	Yes	1605
Mangalore	10	No	Private workshop	Dumping in open land	40 Acres	15	Nil	Nil	Nil	Nil
Raichur	1	Yes	N.a.	Dumping in open land	1 sq. km.	5	5	Nil	Nil	Nil
Hassan	Nil	Nil	Nil	Dumping in open land	6 Acres	5	5	Nil	Nil	Nil
Bellary	20	No	Private workshop	Composed yard	No	Nil	Nil	Nil	Nil	Nil
Kerala										
Palakkad	10	Yes	n.a.	Dumping in open land	8.54	5	1	Nil	Nil	Nil
Kollam	25	No	Govt. authorised workshop	Composting	n.a.	Nil	Nil	Nil	Nil	Nil
Vadakara	Nil	Nil	Private workshop	Dumping in open land	8.54	5	1	Nil	Nil	Nil
Cherthala	Nil	No.	Govt. authorised workshop	Dumping in open land	n.a.	10	10	Nil	Nil	Nil
Guruvayoor	n.a.	No	Govt. authorised workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Kannur	15	No	Private workshop	Trenching & Composing	n.a.	n.a.	Nil	Manual	No	Nil
Kottayam	1	No	Private workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Madhya Pradesh										
Satna	10	Yes	n.a.	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Bhind	Nil	Nil	Private workshop	Road sides	n.a.	In the city	Nil	Nil	Nil	Nil
Rewa	20	No	Local workshop	Dumping in open land	2	Nil	Nil	Nil	Nil	Nil
Rajnandgaon	1	Yes	Nil	Dumping in open land	0.75	5	Tempo-rary	Manual	No	
Korba	5	Yes	n.a.	Nil	20 Acres	10	5	Nil	Nil	Nil
Bhopal	15	Yes	n.a.	Compositing land	76 Acres	20	15	Mechani-cal	Yes	71986
Shivpuri	25	No	Private workshop	Dumping in open land	Nil	Nil	Nil	Manual	No	Nil

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STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Gas Production						Institutional arrangements		
	Methane gas produced from land fill site (Y/N)	Methane gas If yes, quantity (cum./year)	How much is sold to public?	Total Revenue generated thro' sale of gas/year	Revenue generated thro' sale of compost methane gas	Annual expenditure incurred for SWM (Rs. Lakhs)	Agency incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
Haryana									
Karnal	Nil	Nil	Nil	Nil	Nil	13.92	Municipal Council	18	476
Sonipat	n.a.	Nil	Nil	Nil	Nil		Municipal Council	n.a.	n.a.
Sirsa	Nil	Nil	Nil	Nil	Nil	180	Municipal Council	9	380
Karnataka									
Tenali	Nil	Nil	Nil	Nil	Nil	Nil	Nil	21	276
Mysore	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	82	1120
Gadag-Betageri	Nil	Nil	Nil	Nil	Nil	14126373	Nil	Nil	Nil
Mangalore	Nil	Nil	Nil	Nil	Nil	317	Health department	62	422
Raichur	C.M.C.	Nil	Nil	Nil	Nil	Nil	C.M.C.	11	272
Hasan	Nil	Nil	Nil	Nil	Nil	1000000	Municipal Council	6	89
Bellary	Nil	Nil	Nil	Nil	Nil	341	Municipal Council	30	320
Kerala									
Palakkad	Nil	Nil	Nil	Nil	Nil	17128256	Municipal Council	25	300
Kollam	Nil	Nil	Nil	Nil	Nil	150	Municipal Health Department	22	147
Vadakara	Nil	Nil	Nil	Nil	Nil	3776226	Municipality Health Department	10	40
Cherthala	Nil	Nil	Nil	Nil	Nil	Nil	Municipality	5	26
Guruvayoor	Nil	Nil	Nil	Nil	Nil	Nil	Safe Motors, Kudungaloro, Kerala	5	50
Kannur	Nil	Nil	Nil	Nil	Nil	21.5	Municipal Council	17	107
Kottayam	Nil	Nil	Nil	Nil	Nil	3884100	Municipal Health Department	17	79
Madhya Pradesh									
Satna	Nil	Nil	Nil	Nil	Nil	Nil	Nil	41	412
Bhind	Nil	Nil	Nil	Nil	Nil	1793000	Nagar Palika	11	142
Rewa	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Rajnandgaon	Nil	Nil	Nil	Nil	Nil	50	Municipal Council	10	325
Korba	Nil	Nil	Nil	Nil	Nil	105	Municipal Council	13	189
Bhopal	Nil	Nil	Nil	Nil	0.72	15.17 Crores	Municipal Council	140	2160
Shivpuri	No	Nil	Nil	Nil	Nil	98	Municipal Council	6	154

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)		Privatisation			
	Undertaken in the past	To be under taken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, details	If not, any future plan for privatisation	Details of NGO's working SWM
Haryana						
Karnal	6	10	No	Nil	Nil	Nil
Sonipat	n.a.	details enclose	Nil	details enclosed	Nil	Nil
Sirsa	4000 per month	5000 per month	No	details enclosed	No	
Karnataka						
Tenali	Nil	Nil	Nil	Nil	Nil	Nil
Mysore	90	120	Nil	details enclosed	Nil	Nil
Gadag-Betageri	Nil	Nil	Nil	Nil	Nil	Nil
Mangalore	Nil	Nil	details enclosed	details enclosed	Nil	Nil
Raichur	86.3	100	Yes	Nil	Yes	Nil
Hassan	90	1250	Nil	details enclosed	Nil	Nil
Bellary	100	140	yes	details enclosed	Nil	Nil
Kerala						
Palakkad	Nil	Nil	Nil	details enclosed	No	Nil
Kollam	106	200	No	details enclosed	No	Nil
Vadakara	47.6	61.88	No	details enclosed	No	Nil
Cherthala	Nil	Nil	Nil	Nil	Nil	Nil
Guruvayoor	350881	1649119	Nil	Nil	Nil	Nil
Kannur	95	Nil	No	details enclosed	No	Nil
Kottayam	Nil	Nil	Nil	details enclosed	Nil	Nil
Madhya Pradesh						
Satna	Nil	Nil	Nil	Nil	Nil	Nil
Bhind	23.5	70	No	details enclosed	Nil	Nil
Rewa	Nil	Nil	Nil	Nil	Nil	Nil
Rajnadgaon	Nil	Nil	Nil	details enclosed	Nil	Nil
Korba	30	100	Nil	details enclosed	Nil	Nil
Bhopal	80	200	Nil	details enclosed	Yes	NGO-CDC Jaipur
Shivpuri	0.2	0.6	No	details enclosed	No	No

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	General						SW generation and collection		
	Area (sq.km.)	Pop. 1991	Pop. 1998	Slum pop & urban poor	No. of house-hold	No. of wards/zones	SW gene-ration per capita/day (g.m.)	SW generated/day (MT)		
								Total	Domestic	Comm. & Indus.
Maharashtra										
Kamptee	4.27	78586	94334	75394	15032	Wards 30, Zones 2	587	55.45	35.45	n.a.
Thane	147	796620	1197000	359100		95	500	724	599	125
Bhusawal	13.58	145143	200000	40000	22000	43	n.a.	30	30	Nil
Nashik	259.13	656925	838760	200000	n. a.	87	300	300	251	22
Solapur	278	620000	929000	240000	42168	Ward 30, zones 6	500	400	60	25
Mumbai	437.11	9809547	11000000	4995000	249945	Ward 23, zones 6	450	6000	3000	1200
Pimpri Chinchwad	206	517073	900000	140000	113415	79	400	350	details enclosed	details enclosed
Nanded	46	274626	410000	164000	64062	79	250	149	110	39
Sangli Miraj	109	347489	n.a.	n.a.	45553	68	0.225	86.87	50	10.87
Navi	162.5	318447	501226	175429 & 325797	125306	9	400	400	200	200
Kolhapur	66.82	405118	500000	81370	80000	5	350	155	Nil	Nil
Chandrapur	45	226105	295000	88753	40468	53	400	150	15	28
Wardha	9.04	102974	120000	16900	14160	38	333	40	10	30
Nagpur	217.56	1624757	2300000	889988	400000	129 Wards, 11 zones	0.3	600	400	200
Ahmednagar	19.87	181000	300000	33025	30000	48 Wards, 9 zones	250	145	70	75
Parbhani	57.6	190235	240000	97994	40000	49	Nil	30	Nil	Nil
Jalna	n.a.	174975	225000	100000	28855	47	400	9	6	3
Amravati	121. 65	421576	269866	269866	80439	73	200	120	Nil	Nil
Bhiwandi	26.54	378546	30514	30514	31168	65	500	300	200	100
Navghar- Manickpur	16	59324		2252	34386	26	.988.73	60	42	12
Gondia	18.08	109470	174960	33994	8500	37	110	0.25	0.11	0.05
Dhule	46.46	n.a.	n.a.	n.a.	60000	60	500	35	n.a.	n.a.
Aurangabad	138.5	576000	868000	125000	136515	Wards 82, zones 8	500	300	125	80
Manipur										
Imphal	2957	198000	245000	n.a.	30676	26	250	61	20	41
Meghalaya										
Shillong	10.36	131719	216732	n.a.	8331	27	504	78	51	11.8

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Details of waste transportation										
	SW Collected/ day (MT)	Periodicity of SW collection per week	No. of community dustbins	No. of disposal sites (land fill sites)	No. of hand carts/ trolleys available	No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. no. of trips made by each truck/tractor per day and distance travelled (km)	Avg. quantity of SW carried by each vehicle per trip (MT)
Maharashtra											
Kamptee	40	240	10	4	Hearts-30, Refuse containers-11	1 Container carrier	Loader-1	3	Nil	6 trips, 2km	1.6
Thane	91	Daily collection	600	2	750	Nil	29	5	10	2 trips	5
Bhusawal	30	200	94	Nil	60	Nil	Nil	5	Nil	5 trips, 16 km.	1
Nashik	280	Daily collection	n.a.	1	26	6	Nil	2	1	2 trips, 8 km.	3
Solapur	400	n.a.	1451	2	100	26	Nil	2	Nil	4 trips. 9 km.	2
Mumbai	6000	Daily collection	6300	2	2000	15	82	18	156	2 tips, 20 km.	11
Pimpri Chinchwad	350	Nil	details enclosed	1	763	25	12	Nil	12	2 trips. 20 km.	14
Nanded	90	540	585	Nil	65	7	1	5	Nil	3 trips. 15 km.	4
Sangli Miraj	2.6	Daily collection	1327	2	276	12	Nil	1	Nil	3 trips.	3
Navi	400	Daily collection	1530	1	162	26	Nil	Nil	18	4 trips 20 km.	2.5
Kolhapur	115	Daily collection	1247	7	Nil	16	Nil	Nil	2	2 trips per day	4
Chandrapur	110	Daily collection	545	1	105	14	Nil	3	Nil	3 trips, 5 km.	4
Wardha	40	Weekly	399	1	76	4	Nil	2	Nil	3 trips. 4 kms.	4
Nagpur	450	Twice in a week	2000	1	387	35	7	2	Nil	2 trips, 15 kms.	5.5
Ahmednagar	60	233	233	1	40	5	1	1	Nil	4 trips, 4 kms.	Nil
Parbhani	30	No	1100	2	20	Nil	Nil	8	No	4 trips, per day	1
Jalna	9	Twice in a week	93	1	61	10	1	6	No	8 trips, 5-7 kms.	1
Amravati	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	4 trips, 5 kms.	2
Bhiwandi	250	1500	2000	1	500	Nil	27	3	3	2 trips. 5 kms.	2.5
Navghar-Manickpur	60	Daily collection	118	1	70	1	2	6	Nil	3 trips, 4 kms.	2
Gondia	40	240	125	4	39	Nil	Nil	8	Nil	3 trips, 8 kms.	Nil
Dhule	30	Daily collection	175	Nil	Nil	100	1	1	Nil	10 km.	Nil
Aurangabad	250	3	1635	1	300	15	19	Nil	2	3 trips, 12 km.	11
Manipur											
Imphal	38	Daily collection	60	1	20	2	4	4	Nil	2/4 trips, 2 times	5
Meghalaya											
Shillong	78	Daily collection	70	1	Nil	10	Nil	1	Nil	1 trips, 14 kms.	8

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	% of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Detail of waste disposal				Waste Treatment		
				Method of SWM treatment/disposal	Land fill site			Composting		
					Area	Distance from transfer station city (K.m)	No. of years designed	Manual/ mechanical	is com-post sold ?	If yes, revenue generated/ year
Maharashtra										
Kamptee	25	No	Authorised workshop, local mechanic	Dumping in open land	10000 sq.m.	3	3	Nil	—	—
Thane	42	Yes	n.a.	Dumping in open land	20 Acres	15	3	Nil	Nil	Nil
Bhusawal	Nil	No	Private workshop	Dumping in open land	Nil	6	Nil	Nil	Nil	Nil
Nashik	Nil	Yes	Nil	Dumping in open land	n.a	Nil	Nil	Nil	Nil	Nil
Solapur	5	Yes	Nil	Composing in trenches	Nil	Nil	Nil	Manual	Trenches	1000000
Mumbai	20	Yes	n.a	Dumping in open land	174 Hectors	25	20	Mechanical	Yes	Nil
Pimpri Chinchwad	20	Yes	n.a	Dumping in open land	n.a	20	Nil	Manual	Nil	Nil
Nanded	16	n.a	Private workshop	Dumping in open land	1	3	2	manual	Nil	Nil
Sangli Miraj	10	Yes	Nil	Composting	Nil	Nil	Nil	Nil	Yes	178680
Navi	20	Yes	n.a	Dumping in open land	30	10	10	Nil	Nil	Nil
Kolhapur	20	yes	n.a	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Chandrapur	2	No	Private workshop	Dumping in open land	11Acre	5	6	Nil	Nil	Nil
Wardha	10	No	Private workshop	Trench ground	35Acres	Nil	30	Nil	Nil	Nil
Nagpur	10	Yes	Private workshop	Dumping in open land	10	15	30	Nil	Nil	Nil
Ahmednagar	50	Yes	n.a.	n.a.	Nil	Nil	Nil	Nil	Nil	Nil
Parbhani	No	n.a.	Private Workshop	n.a.	n.a.	5	20	No	Yes	Nil
Jalna	2	Yes	Tender system	Trenching ground	10	5.7	Nil	Nanual	Nil	Nil
Amravati	Nil	Nil	Nil	Dumping inopen land	13 Hectare	5	20	Nil	Nil	Nil
Bhiwandi	15	No	Contractor system	land filling	6 Acres	5	1	Nil	Nil	Nil
Navghar Manikpur	Nil	No	Private workshop	Land filling	5 Acrie	2.5	Nil	Nil	No	Nil
Gondia	10	Yes	Nil	Nil	1.25	10	Nil	Nil	Nil	Nil
Dhule	20	Yes	Private workshop	Dumping in open land	n.a.	Nil	Nil	Nil	Nil	Nil
Aurangabad	5	Yes	n.a.	Bio-excel technology	18.53	12	30	Mechanical	yes	5
Manipur										
Imphal	70	Yes	n.a.	Dumping in open land	100x200xl0 m^3	Nil	2	Nil	Nil	Nil
Meghalaya										
Shillong	20	No	Private workshop	Dumping in open land	n.a.	10	Nil	Nil	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Gas Production				Total revenue generated thro, sale of compost, methane gas	Annual expenditure incurred for SWM (Rs.) Lakhs)	Institutional arrangements		
	Methane gas								
	Methane gas produced form land till site (Y/N)	If yes, quantity (cum./year)	How much is sold to public?	Revenue generated thro' sale of gas/year			Agency Incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
Maharashtra									
Kamptee	—	—	—	—	—	Nil	Municipal Council	16	207
Thane	Nil	Nil	Nil	Nil	Nil		Health	100	3374
Bhusawal	Nil	Nil	Nil	Nil	Nil	127.65	Municipal Council	6	317
Nashik	Nil	Nil	Nil	Nil	Nil	2450000	Contract basis	80	1884
Solapur	Nil	Nil	Nil	Nil	Nil	16010354	16010354	20	144
Mumbai	Nil	Nil	Nil	Nil	Nil	38000	Municipal Council	61	25768
Pimpri Chinchwad	Nil	Nil	Nil	Nil	Nil	26971303	P.C.M.C. Health Department	169	1888
Nanded	Nil	Nil	Nil	Nil	N	292	Municipal Council	7	631
Sangli Miraj	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	22	732
Navi	Nil	Nil	Nil	Nil	Nil	10	Municipal Council	Nil	Nil
Kolhapur	Nil	Nil	Nil	Nil	Nil	483.01	Municipal Council	69	1144
Chandrapur	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Wardha	Nil	Nil	Nil	Nil	Nil	91	Municipal Council	2	335
Nagpur	Nil	Nil	Nil	Nil	Nil	2666	Sanitation	211	3590
Ahmednagar	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	81	696
Parbhani	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Jalna	Nil	Nil	Nil	Nil	Nil	2 Crores	Municipal Council	24	314
Amravati	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Bhiwandi	No	Nil	Nil	Nil	Nil	Nil	Municipal Council	14	1565
Navghar-Manickpur	No	Nil	Nil	Nil	Nil	17	Municipal Council	13	276
Gondia	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	30	284
Dhule	Nil	Nil	Nil	Nil	Nil	Nil	n.a.	38	750
Aurangabad	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	23	1514
Manipur									
Imphal	Nil	Nil	Nil	Nil	Nil	83.48	Municipal Council	18	200
Meghalaya									
Shillong	Nil	Nil	Nil	Nil	Nil	86.32	Municipal Council	20	366

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)			Privatisation		
	Undertaken in the past	To be undertaken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, details	If no, any furture plan for privatisation	Details of NGO's Working in SWM
Maharashtra						
Kamptee	Nil	Nil	No		General wards & market, public latrines for cleaning work	
Thane	Nil	Nil	Yes	details enclosed	Private contractors	Nil
Bhusawal	63.8	100	Nil	Nil	Nil	Nil
Nashik	Nil	Nil	Nil	Nil	Nil	Nil
Solapur	Nil	Nil	Nil	details enclosed	Nil	Nil
Mumbai	No	Nil	Nil	details enclosed	No	213
Pimpri Chinchwad	30	Nil	Yes	details enclosed	-	Nil
Nanded	71.45	86.22	Nil	details enclosed	Nil	Nil
Sangli Miraj	24073	Nil	Nil	details enclosed	Nil	Nil
Navi	228	details enclosed	Nil	details enclosed	Nil	Nil
Kolhapur	96	100	No	details enclosed	Nil	Nil
Chandrapur	Nil	Nil	Nil	Nil	Nil	Nil
Wardha	Nil	Nil	Nil	Nil	Nil	Nil
Nagpur	115	n.a.	No	details enclosed	No	Nil
Ahmednagar	Nil	n.a.	No	Nil	Nil	Nil
Parbhani	Nil	Nil	Nil	Nil	Nil	Nil
Jalna	900	1866.66	No	details enclosed	Nil	Nil
Amravati	Nil	Nil	Nil	Nil	Nil	Nil
Bhiwandi	Nil	Nil	No	Nil	Nil	Adarsh Seva Society, Thane
Navghar-Manickpur	Nil	Nil	No	Nil	No	Nil
Gondia	Nil	Nil	Nil	Yes	Nil	Nil
Dhule	n.a.	n.a.	Yes	Nil	Yes	Nil
Aurangabad	58	details enclosed	Nil	details enclosed	Yes	Nil
Manipur						
Imphal	34.07	Nil	n.a.	details enclosed	Nil	3
Meghalaya						
Shillong	Nil	Nil	Nil	details enclosed	No	Nil

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STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	General							SW Generation and collection SW Generated/day (MT)		
	Area (sq. km.)	Pop. 1991	Pop. 1998	Slum pop. & urban poor	No. of households	No. of wards/ zones	SW Generation per capita/day (gm.)	Total	Domestic	Comm. & Indus.
Orissa										
Berhampur	33.52	210418	260918	70802	35901	27	1035	270	226	44
Balasore	19.25	85442	105948	20767	8131	31	25	2.6	1	1.6
Punjab										
Amritsar	133	709000	1000000	250000	160000	Ward 24, zones 8	750	600	375	225
Ambala Cantt.	5.5	90872	99009	22718	24580	29	n.a.	n.a.	10	3
Rajasthan										
Udaipur	56.89	395000	450000	40000	Nil	Wards 50, zones 10	150	150	70	15
Tamil Nadu										
Karur	5.96	73418	73818	20000	14314	10	450	30	Nil	n.a.
Erode	8.44	159232	183334	18890	35380	45	360	92	54	38
Chennai	174	4000000	5000000	500000	420000	155	500	2550	1530	1020
Madurai	52.95	946000	1045000	302000	68432	72	40	380	200	180
Malappuram	33.6	49692	56626	8906	9980	28	26	15	5	10
Tirunelveli	108.8	374058	414700	140999	85000	Ward 55, zones 4	400	160	70	30
Rajapalayam	11.36	114202	123408	15769	18857	42	362	15.75	9.25	35
Hospet	5096	135000	275000	68870	13774	35	60.75	60.75	20	30.75
Pudukottai	12.95	99058	108600	7962	17697	39	500	5.43	3	Nil
Nagercoil	24.27	200000		60700	40410	51	500	30	30	5
Tiruchengode	25.2	62903	32945	24415	24287	33	10	3	7	Nil

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STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Sw Collected/ day (MT)	Periodicity of Sw collection per week	No. of community dustbins	No. of disposal sites (land fill sites)	No. of hand carts/ trolleys available	Details of waste transportation					
						No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. no. of trips made by each truck/ tractor per day and distance travelled (km)	Avg. quantity of Sw carried by each vehicle per trip (MT)
Orissa											
Berhampur	196	Daily collection	300	1	300	Nil	Nil	18	Nil	4 trips, 40 km	2
Balasore	2	Daily collection	n.a.	1	50	2	Nil	2	Nil	n.a.	n.a.
Punjab											
Amritsar	500	Daily collection	225	3	500	56	17	1	56	4 trips, 10 km.	1.5
Ambala Cantt.	20	140	85	2	150	1	Nil	5	2	3 trips, 20km.	1
Rajasthan											
Udaipur	125	2 times in a week	58	Nil	400	67	6	3	Nil	3 trips, 13 km.	3
Tamil Nadu											
Karur	30	180	245	2 composting site	H. carts, 25 trollys	10	Nil	Nil	Nil	2 trips, 15 km.	3
Erode	76	Daily collection	Nil	1	25	7	Nil	1	Nil	6 trips, 64 km.	Nil
Chennai	2550	Daily collection	100	2	2500	284	Nil	40	1	2 trips	5
Madurai	Nil	Nil	400	1	166	31	14	11	Nil	3 trips, 4 km.	3
Malappuram	Nil	Daily collection	20	1	6	2	Nil	Nil	Nil	1.40 km.	4
Tirunelveli	100	Nil	60	3	110	22	1	2	Nil	3 trips.5 km.	2
Rajapalayam	44.25	Daily collection	50	Nil	80	5	Nil	4	Nil	3 trips. 15 km.	2.5
Hospet	60.75	425.25	500	5	25	1	Nil	4	Nil	3 tirps each truck	1
Pudukottai	31.5	220.5	326	1	Nil	5	Nil	2	Nil	6 trips 5 km.	1.5
Nagercoil	30	Daily collection	44	15	156	6	1	Nil	Nil	3 trips per day each	2.5
Tiruchengode	10	Daily collection	230	Nil	Nil	8	Nil	3	Nil	14	0.71

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	% of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Method of SWM treatment/ disposal	Details of waste disposal			Waste Treatment		
					Area	Land fill site Distance from transfer station/city (km.)	No. of years designed	Composting Manual/ mechanical	Is compost sold?	If yes, revenue generated/ year
Orissa										
Berhampur	15	Yes	Private Workshop	No.	0.02	Within city limits	Nil	Nil	n.a.	Nil
Balasore	n.a.	No	Private Workshop	No.	n.a.	Within city limits	Nil	Nil	Nil	Nil
Punjab										
Amritsar	1	Yes	Nil	Dumping in open land	27 Acres	5	30	Nil	Nil	Nil
Ambala Cantt.	10	n.a.	Authorised workshop	Dumping in open land	35 Acres	2	Nil	Manual	Nil	n.a.
Rajasthan										
Udaipur	30	Yes	n.a.	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Tamil Nadu										
Karur	10	No	Govt approved private workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Erode	207	No	Govt approved private workshop	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cheranai	5	Yes	n.a.	Dumping in open land	Kodungaryur 150 Perngudi 350 ha	15	15	Nil	Nil	Nil
Madurai	20	Yes	n.a.	Nil	150 sq.km.	15	25	yes	Nil	Nil
Malappuram	25	No	Private workshop	Dumping in open land	0.031	17	10	Nil	Nil	Nil
Tirunelveli	5	No	Local workshop	Dumping in open land	12 Acres	5	20	Nil	Nil	Nil
Rajapalayam	10	n.a.	Authorised workshop	Composting in trenches	n.a.	Nil	Nil	Nil	Nil	Nil
Hospet	25	No	Private workshop	Filling of ditch	n.a.	7	Nil	Nil	Nil	Nil
Pudukottai	Nil	No	Govt approved private workshop	Bangalore method (head system)	Nil	5	Nil	Manual	Yes	Nil
Nagercoil	20	No	Private workshop	Nil	Nil	2	30	Manual Mechanical	Yes	30250
Tiruchengode	Nil	No	Private workshop	Composting in trenches	Nil	Nil	Nil	Manual	Yes	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Gas Production								
	Methane gas				Total revenue generated thro. sale of compost, methane gas	Annual expenditure incurred for SWM (Rs. Lakhs)	Institutional arrangements		
	Methane gas produced form land fill site (Y/N)	If yes, quantity (cum./year)	How much is sold to public?	Revenue generated thro' sale of gas/year			Agency Incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
Orissa									
Berhampur	Nil	Nil	Nil	Nil	Nil	50	Municipal Council	45	762
Balasore	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	5	147
Punjab									
Amritsar	Nil	Nil	Nil	Nil	Nil	130	Municipal Council	27	1771
Ambala Cantt.	n.a.	n.a.	n.a.	n.a.	Nil	15.55	Municipal Council	25	300
Rajasthan									
Udaipur	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Tamil Nadu									
Karur	Nil	Nil	Nil	Nil	Nil	10.7	Nil	3	12
Erode	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	28	626
Chennai	Nil	Nil	Nil	Nil	Nil	70 crores	Municipal Council	306	10165
Madurai	Nil	Nil	Nil	Nil	Nil	75	Corporation	650	2700
Malappuram	Nil	Nil	Nil	Nil	Nil	30	Health department	6	28
Tirunelveli	Nil	Nil	Nil	Nil	Nil	429.26	Municipal Council	10	900
Rajapalayam	Nil	Nil	Nil	Nil	Nil	133	Municipal Council	296	Nil
Hospet	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	Nil	Nil
Pudukottai	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Nagercoil	No	Nil	Nil	Nil	Nil	17.64	Municipal Council	1	8
Tiruchengode	Nil	Nil	Nil	Nil	Nil	Nil	Municipal Council	3	240

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)			Privatisation		
	Undertaken in the past	To be undertaken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, details	If no any future plan for privatisation	Details of NGO's working in SWM
Orissa						
Berhampur	23.76	41.23	Nil	details enclosed	Yes	Nil
Balasore	140	184.34	No	details enclosed	No	Nil
Punjab						
Amritsar	Nil	Nil	Nil	details enclosed	Nil	Nil
Ambala Cantt.	55	1	No	details enclosed	n.a.	20
Rajasthan						
Udaipur	Nil	Nil	Nil	Nil	Nil	Nil
Tamil Nadu						
Karur	14.58	Nil	No	Nil	Nil	Nil
Erode	153	184	No	Nil	No	No
Chennai	140	150	Yes	details enclosed	Private contractors	Nil
Madurai	Nil	Nil	Nil	Nil	Private contractors	Nil
Malappuram	53	Nil	No	Nil	No	Nil
Tirunelveli	103	224	Nil	Nil	Nil	Nil
Rajapalayam	Nil	Nil	Nil	Nil	Nil	Nil
Hospet	Nil	Nil	Nil	Nil	Nil	Nil
Pudukottai	Nil	Nil	Nil	Nil	Nil	Nil
Nagercoil	85	Nil	No	Nil	No	Nil
Tiruchengode	108	Nil	Nil	Nil	No	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	General							SW Generation and collection SW Generated/day (MT)		
	Area (sq. km.)	Pop. 1991	Pop. 1998	Slum pop. & urban poor	No. of households	No. of wards/ zones	SW Generation per capita/day (gm.)	Total	Domestic	Comm. & Indus.
Komarapalayam	7.8	576732	72000	Nil	16896	33	Nil	18	6	10
Salem	91.06	583350	636500	148000	145000	4.6	250	250	160	90
Inamkarur	13	37177	50000	6250	14800	21	120	6	4	2
Karur	5.96	73418	107112	20000	14314	10	8	Nil	Nil	Nil
Thiruvottiyur	21.45	168542	220000	70000	42624	48	120	120	Nil	Nil
Avadi	65	183215	225000	60517	27250	48 Wards, 6 zones	500	110	59	51
Cuddalore	2762	144561	159200	63840	32518	Wards 45, zones 21	500	85	50.72	30.88
Neyveli	480	117409	133304	32000	3100	33	285	42	32	10
Karaikudi	14.5	71965	80880	12060	15472	36	250	2.75	2.75	Nil
Pallavapuram	18	111866	142500	39815	21839	42	500	84	71	6
Nellore	48.39	316445	404081	119917	51000	44	500	202	122	80
Kumbakonam	12.87	139483	144700	n.a.	n.a.	45	500	15	5	10
Thoothukudi	13.5	199854	205800	97539	51450	51	125	25	10	5
Kanchepuram	11.72	144055	156700	28426	31419	45	350	60	48	12
Tirappur	27.2	235661	318800	73153	53903	52	1.09	350	150	200

STATUS OF SOLID WASTE MANAGEMENT (As on 31-3-1999)

City Name	SW Collected/ day (MT)	Periodicity of SW collection per week	No. of community dustbins	No. of disposal sites (land fill sites)	No. of hand carts/ trolleys available	No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. No. of trips made by each truck/tractor per day and distance travelled (km)	Avg. quantity of SW carried by each vehicle per trip (MT)
Komarapalayam	6	Daily collection	27.5	Nil	Nil	3	2	Nil	Nil	3 trips 30 km.	0.75
Salem	250	Daily colleciton	1915	3	Nil	80	Nil	1	Nil	3 trips, 29 km.	2
Inamkarur	6	Twice in a week	120	1	Nil	4	4	4	Nil	4 trips, 12 km.	1.5
Karur	8	48	245	2	25	10	Nil	Nil	Nil	2 trips, 15 km.	2
Thiruvottiyur	80	480	2	2	Nil	12	Nil	2	Nil	3 trips, 16 km.	3
Avadi	100	600	700	Nil	10	14	Nil	Nil	Nil	5 trips, 12 km.	3.5
Cuddalore	80	Daily collection	272	2	56	8	Nil	1	Nil	3 trips, 30 km.	3
Neyveli	38	Daily collection	612	4	Nil	5	1	Nil	Nil	4 trips, 20 km.	1.5
Karaikudi	2.75	15.5	36	7	16	5	Nil	1	Nil	2 trips, 14.5 km.	4.5
Pallavapuram	62.6	75	450	3	30	7	Nil	2	Nil	2 trips.	details enclosed
Nellore	202	Daily collection	580	1	Nil	1		32	Nil	4 trips, 6 km.	1.5
Kumbakonam	15	Daily collection	144	Nil	8	13	Nil	Nil	Nil	2 trips.	6
Thoothukudi	22	154	35	1	Nil	5	Nil	4	Nil	5 trips, 8 kms.	1.5
Kancheepuram	50	Twice in a week	96	2	3	12	Nil	Nil	Nil	3 trips, 15 kms.	2
Tiruppur	300	2450	Nil	3	Nil	18	Nil	4	Nil	3 trips per day	6

STATUS OF SOLID WASTE MANAGEMENT (AS ON 31-3-1999)

City Name	Details of waste disposal				Waste Treatment					
					Land fill site			Composting		
	% of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Method of SWM treatment/disposal	Area	Distance from transfer Station/ city (km.)	No. of years designed	Manual/ mechanical	is compost sold?	If yes, revenue generated/ year
Komarapalayam	Nil	Nil	Govt. workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Salem	Nil	Nil	Private workshop	Dumping in open land	38 Acres	1	Nil	Manual	Nil	Nil
Inamkarur	25	Nil	Private workshop	Dumping in open land	1.50 Hectre	2	15	Nil	Nil	Nil
Karur	10	Nil	Govt. approved private workshop	Nil	Nil	Nil	Nil	Manual	No	Nil
Thiruvottiyur	5	No	Govt. authorised workshop	Dumping in open land	10 Acres	8	Permanent	n.a.	No	Nil
Avadi	Nil	Nil	Govt. authorised workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Cuddalore	Nil	Nil	n.a.	Dumping in open land	Nil	Nil	Nil	Normal	No	No
Neyveli	3.8	Yes	Nil	Disposed by burning	Nil	Nil	Nil	Nil	Nil	Nil
Karaikudi	Nil	No	Govt authorised workshop	Composting	Nil	3	Nil	Manual	Nil	Nil
Pallavapuram	10	No	Govt. authorised workshop	Dumping in open land	15 Acres	5	20	Nil	Nil	Nil
Nellore	10	No	Private workshop	Compost yard	Nil	Nil	Nil	Nil	Nil	Nil
Kumbakonam	Nil	No	Nil	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Thoothukudi	25	Yes	Nil	Composting yard	10 Acres	12	7	Manual	Yes	Nil
Kancheepuram	10	No	Tender Basis	Composting/Land filling	7.5	5	5	Yes	Nil	Nil
Tiruppur	22	No	Private workshop	Nil	2	Nil	3	Nil	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Gas Production						Institutional arrangements		
	Methane gas			Total revenue generated thro sale of compost methane gas	Annual expenditure incurred for SWM (Rs. Lakhs)	Agency Incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
	Methane gas produced from land fill site (Y/N)	If yes, quantity (cum./year)	How much is sold to public?	Revenue generated thro' sale of gas/year				
Komarapalayam	Nil	Nil	Nil	Nil	6	Town panchayat	5	30
Salem	Nil	Nil	Nil	Nil	616.57	Local body	100	1500
Inamkarur	Nil	Nil	Nil	Nil	18	Town panchayat	3	60
Karur	Nil	Nil	Nil	Nil	10.7	Nil	3	10
Thiruvottiyur	Nil	Nil	Nil	Nil	Nil	Municipality	34	261
Avadi	Nil	Nil	Nil	Nil	Nil	Municipality	6	280
Cuddalore	No	Nil	Nil	Nil	Nil	Municipality	30	447
Neyveli	Nil	Nil	Nil	Nil	17.8	Health Department	11	253
Karaikudi	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Pallavapuram	Nil	Nil	Nil	Nil	207.196	Municipality	33	334
Nellore	Nil	Nil	Nil	Nil	4.25	Public Health Section	50	585
Kumbakonam	Nil	Nil	Nil	Nil	2.37	Nil	Nil	7
Thoothukudi	Nil	Nil	Nil	Nil	2.40	Nil	2	432
Kanchoepuram	Nil	Nil	Nil	Nil	1.54	Sanitary Inspector	23	241
Tirupur	Nil	Nil	Nil	Nil	281.13	Municipal Council	Nil	30

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STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)		Privatisation			
	Undertaken in the past	To be undertaken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, details	If no any future plan for privatisation	Details of NGOs working in SWM
Komarapalayam	Nil	Nil	Nil	Nil	Nil	Nil
Salem	Nil	Nil	Nil	Nil	Nil	Nil
Inamkarur	36	Nil	No	Nil	No	Nil
Karur	10.58	Nil	Nil	Nil	Nil	Nil
Thiruvottiyur	Nil	Nil	Nil	Nil	No	Nil
Avadi	63.78	72.72	Nil	details enclosed	Nil	Nil
Cuddalore	15453	17150	Nil	Nil	No	Nil
Neyveli	13.35	15	Nil	details enclosed	Nil	Nil
Karaikudi	Nil	Nil	Nil	Nil	Nil	Nil
Pallavapuram	145.93	160.53	No	details enclosed	No	Nil
Nellore	105.19	details enclosed	Yes	details enclosed	Nil	DWCUA, NGO
Kumbakonam	Nil	Nil	Nil	Nil	Nil	Nil
Thoothukudi	240	390	Nil	details enclosed	Nil	Nil
Kancheepuram	99	103	No	Nil	Nil	Nil
Tiruppur	312	Nil	Nil	Nil	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

General								SW Generation and collection SW Generated/day (MT)		
City Name	Area (sq. km.)	Pop. 1991	Pop. 1998	Slum pop. & urban poor	No. of house-holds	No. of wards/ zones	SW Gene-ration per capita/day (gm.)	Total	Domestic	Comm. & Indus.
Uttar Pradesh										
Dehradun	52	271000	510000	118000	100000	60	500	255	216	39
Hathras	3	113658	185352	57119	37000	25	200	3	2.5	0.5
Gorakhpur	147	505000	600000	229000	65000	60	500	300	270	30
Jhansi	29.82	301304	506600	170000	60000	Wards 35, zones 5	360	180	100	60
Mathura	25.24	226157	300000	30	37188	31	300	170	Nil	Nil
Faizabad	16.6	124437	146835	21343	25825	26	300	45	30	15
Badaun	4.09	116706	n.a.	61573	17511	25	300	3.51	3	5.1
Bareilly	103.5	650000	925000	300000	180000	10	540	500	190	115
Itawa	16	125000	195000	17919	23911	57	200	40.5	38.5	2
West Bengal										
Santipur	25.88	109911	133911	64000	24900	25	250	33.477	20	13.477
Titagarh	3.24	113831	121351	100000	4218	Wards 23 zones 4	500	65	39	26
Calcutta	187.33	4388242	9000000	2000000	390000	141	450	2500	1375	1125
Raniganj	24.99	97458	120000	36439	12058	21	1000	142	108	21
Midnapore	18.85	125098	158000	51113	32000	24	400	63.4	33.4	22
Rishra	6763	106649	126553	68290	22340	23	40	67	77	51
Chanderanagar	20	140000	107000	50000	27000	33	300	42	30	12
Uttarpara	12.5	131645	142177	40000	25210	25	350	63.98	49.76	14.22
Howrah	5174	946732	1065304	328150	156000	50	700			
Kamarhati	10.96	266889	309591	231599	31700	35	899	278.32	115.58	97.3
Asansol	127.237	478395	545370	264382	45293	50	250	180	120	60
Barasat	34.5	177097	260000	64845	50000	30	350	108	91	17
Kanchrapara	9.07	111000	137000	Slum 46000, Urban 71000	18558	24	365	70	50	20
Bally	11.81	184077	270000	45210	21000	Wards 5, zones 29	500	150	60	40
Panihati	19.38	275359	360000	127860	60200	35	913	329	296.1	32.9
South Dum Dum	n.a.	257507	n.a.	n.a.	n.a.	35	120000	120000	60	n.a.

STATUS OF SOLID WASTE MANAGEMENT (as on 31-3-1999)

City Name	SW Collected/ day (MT)	Details of waste transportation: Periodicity of SW collection per week	No. of community dustbins	No. of disposal sites (land fill sites)	No. of hand carts/ trolleys available	No. of lorries/ trucks available	No. of dumpers available	No. of tractors available	No. of compactors available	Avg. no. of trips made by each truck/tractor per day and distance travelled (km.)	Avg. quantity of SW carried by each vehicle per trip (MT)
Uttar Pradesh											
Dehradun	50	6 times a week	104	1	306	3	2	7	1		2
Hathras	3	15	Nil	1	50	1	Nil	3	Nil	2	2
Gorakhpur	240	Twice in a week	300	Nil	550	8	2	18	3	5 trips, 50 km.	5
Jhansi	135	Nil	107	5	250	Nil	1	13	3	5 trips, 4 km	3
Mathura	170	Twice in a week	38	3	110	Nil	6	6	Nil	7 trips, 5 km.	6
Faizabad	35	Daily collection	37	No	85	Nil	2	4	Nil	5 trips, 3 km.	3
Badaun	3.2	224	1	3	150	Nil	Nil	4	Nil	3 trips, 1.5 km.	1.5
Bareilly	375	2625	499	2	821	30	3	21	3	4 trips, 120 kms.	3.5
Itawa	35.5	248.5	29	6	110	Nil	Nil	5	Nil	6 trips, 1 km.	1.5
West Bengal											
Santipur	33.477	Twice in a week	250	300	10	1	Nil	6	Nil	4 trips, 1 km.	3
Titagarh	50	6 days in a week	130	2	H.carts 50 trollns	2	Nil	8	Nil	3 trips, 2 km	3
Calcutta	2500	Daily collection	526	5	3600	65	52	10	Nil	3 trips, 50 km.	5
Raniganj	108	Twice in a week	158	80	50	Nil	Nil	6	Nil	36 trips, 5 km.	3
Midnapore	53.5	6 times	585	2	92	104	Nil	3	Nil	15 trips, 16 km.	3
Rishra	8	Twice in a week	164	1.25	46	Nil	Nil	3	Nil	3 trips, 10 km.	3
Chanderanagar	35	Daily collection	20	1	52	Nil	Nil	7	Nil	3 trips, 20 km.	1.5
Uttarpara	49	6 days in a week	13	n.a.	details enclosed	Nil	Nil	8	Nil	4 trips, 25 km.	2
Howrah	700	6 days in a week	502	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Kamarhati	123.83	110	155	1	75	2	Nil	19	Nil	4 trips, 30 km.	1.5
Asansol	138	Daily collection	1135	n.a.	250	23	Nil	2	Nil	3	2
Barasat	24	Every two weeks	180	1	35	1	Nil	6	Nil	3 trips	3
Kanchrapara	30	Once in a week	2	12	10	Nil	Nil	4	Nil	3 trips, 1.5 km.	5
Bally	140	Once in a week	587	Nil	60	2	Nil	16	Nil	8 trips, 10 km.	Nil
Panihati	164.5	987	700	3	105	3	2	12	10	2 trips, 15 km.	3.65
South Dum Dum	100	n.a.	6	Nil	40	12	Nil	9	Nil	5 trips per day	Nil

STATUS OF SOLID WASTE MANAGEMENT (AS ON 31-3-1999)

City Name	% of vehicles usually under repair	Vehicle maintenance workshop available (Y/N)	If no, how are vehicles repaired?	Method of SWM treatment/disposal	Details waste disposal: Land fill site: Area	Details waste disposal: Land fill site: Distance from transfer station/ city (km.)	Details waste disposal: Land fill site: No. of years designed	Waste Treatment: Composting: Manual/ mechanical	Waste Treatment: Composting: is compost sold?	Waste Treatment: Composting: If yes, revenue generated/ year
Uttar Pradesh										
Dehradun	20	yes	n.a.	Dumping in open land	2.36 Acre	10	3	Nil	Nil	Nil
Hathras	1	Nil	Private workshop	Land filling	8	3	5	Manual	Nil	Nil
Gorakhpur	10	No	Private workshop	Low lying area	n.a.	Nil	Nil	Nil	Nil	Nil
Jhansi	30	Yes	Nil	Dumping in open land	n.a.	Nil	Nil	Manual	Yes	10743
Mathura	30	Yes	Nil	Dumping in open land	5 Acres	6	Nil	Nil	Nil	Nil
Faizabad	35	No	Private workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Badaunn	1	No	Private workshop	Trinch ground	Nil	Nil	Nil	Nil	Nil	Nil
Bareilly	20	yes	n.a.	Composting/Dumping	Nil	Nil	Nil	Nil	Nil	Nil
Itawa	20	No	Private workshop	Dumping in open land	5	1	Nil	Manual	Yes	20
West Bengal										
Santipur	1	Yes	Nil	Dumping in open land	1 sq.km.	1.5	Nil	Manual	Nil	12000
Titagarh	50	No	Private workshop	Dumping in open land	Nil	1	Nil	Nil	Nil	Nil
Calcutta	5	Yes	Nil	Nil	8.4	20	6	Mecanical	Yes	2.5
Raniganj	33	No	Private workshop	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil
Midnapore	20	No	Private workshop	Dumping in open land	6 Acres	3	8	Manual	Yes	20000
Rishra	Nil	Yes	Private workshop	Dumping in open land	n.a.	Nil	Nil	Nil	Nil	Nil
Chandernagar	5	Yes	Nil	Nil	5	Nil	15	Nil	Nil	Nil
Uttarpara	40	Yes	Nil	n.a.	n.a.	25	Nil	n.a.	n.a.	n.a.
Howrah	Nil	n.a.	n.a.	Nil	50 Bighas	Nil	Nil	Nil	Nil	Nil
Kamarhati	10	Yes	n.a.	disposed off	Nil	Nil	Nil	Manual	Yes	4635
Asansol	Nil	No	n.a.	Dumping in open land	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Barasat	30	No	Private workshop	Dumping in open land	2.47	3	No	Nil	Nil	Nil
Kancharapara	20	No.	Private workshop	Dumping in open land	n.a.	1.5	Nil	Nil	Nil	Nil
Bally	2	No	Private workshop	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Panihati	20	Yes	n.a.	Trench ground	7.77	3	20	Manual	Yes	28400
South Dum Dum	Nil	Nil	Nil	Dumping in open land	Nil	Nil	Nil	Nil	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (AS ON 31-3-1999)

City Name	Gas Production								
	Methane gas				Total revenue generated thro' sale of compost methane gas	Annual expenditure Incurred for SWM (Rs. Lakhs)	Institutional arrangements		
	Methane gas produced form land fill site (Y/N)	If yes, quantity (cum./year)	How much is sold to public?	Revenue generated thro' sale of gas/year			Agency Incharge of SWM in the city	No. of supervisory staff	No. of subordinate staff including sweepers etc.
Uttar Pradesh									
Dehradun	Nil	Nil	Nil	Nil	Nil	4.07	Municipal Council	39	918
Hathras	Nil	Nil	Nil	Nil	Nil	1.39	Nagar Palika	10	246
Gorakhpur	Nil	Nil	Nil	Nil	Nil	Nil	Health & Sanitation	28	774
Jhansi	Nil	Nil	Nil	Nil	10743	240	Nagar palika	34	700
Mathura	Nil	Nil	Nil	Nil	Nil	124.22	Municipal Council	37	325
Faizabad	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Badaunn	Nil	Nil	Nil	Nil	14500	Nil	Health department	16	229
Bareilly	Nil	Nil	Nil	Nil	2.9	56	Municipal Council	85	1600
Itawa	Nil	Nil	Nil	Nil	Nil	100	Municipal Council	14	203
West Bengal									
Santipur	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Titagarh	Nil	Nil	Nil	Nil	Nil	11167000	Municipal Council	14	213
Calcutta	Nil	Nil	Nil	Nil	2.5	11400	Municipal Council	1560	13500
Raniganj	Nil	Nil	Nil	Nil	279911	390893	Nil	Nil	8
Midnapore	Nil	Nil	Nil	Nil	Nil	175000	Sanitary department	25	390
Rishra	Nil	Nil	Nil	Nil	Nil	75	Municipal Council	9	185
Chandernagar	Nil	Nil	Nil	Nil	Nil	1200000	Nil	16	300
Uttarpara	Nil	Nil	Nil	Nil	Nil	5193811	Own arrangement	7	162
Hawrah	Nil	Nil	Nil	Nil	Nil	855.5	Municipal Council	90	2182
Kamarhati	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Asansol	n.a.	n.a	n.a.	Nil	Nil	13726370	Municipal Council	20	487
Barasat	Nil	Nil	Nil	Nil	Nil	2081368	Municipality	6	115
Kanchrapara	Nil	Nil	Nil	Nil	Nil	15.37	Municipal Council	6	131
Bally	Nil	Nil	Nil	Nil	Nil	142483	Nil	9	433
Panihati	n.a.	Nil	Nil	Nil	Nil	99.93	Municipal Council	3	12
South Dum Dum	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

STATUS OF SOLID WASTE MANAGEMENT (AS ON 31-3-1999)

City Name	Per capita cost of SWM (Rs. Lakhs)		Privatisation			
	Undertaken in the past	To be undertaken in the future	Whether any unit of operation of SWM is privatised? (Y/N)	If yes, detalis	If no, future plan for privatisation	Details of NGO's Working in SWM
Uttar Pradesh						
Dehradun	80	200	No	details enclosed	No	Nil
Hathras	Nil	Nil	Nil	Nil	Nil	Nil
Gorakhpur	Nil	Nil	No	Nil		
Jhansi	7.9	12.67	Nil	Nil	No	Nil
Mathura	Nil	Nil	Nil	Nil	No	Nil
Faizabad	Nil	Nil	Nil	details enclosed	Nil	Nil
Badaunn	Nil	Nil	Nil	Nil	Nil	Nil
Bareilly	100	125	No	details enclosed	No	Nil
Itawa	Nil	Nil	Nil	Nil	Nil	Nil
West Bengal						
Santipur	Nil	Nil		Nil	Nil	Nil
Titagarh	98.1	Nil	Yes	Nil	Private constractors	Nil
Calcutta	126.5	148	yes	details enclosed	Private constractors	Nil
Raniganj	161	Nil	Nil	Nil	No	Nil
Midnapore	Nil	Nil	No	details enclosed	Nil	Nil
Rishra	0.75	Nil	No	details enclosed	yes	M/s.M.D.K. & Co.
Chandernagar	6	9	Nil	Nil	Nil	Nil
Uttarpara	39.49	45.8	details enclosed	details enclosed	No	No
Hawrah	Nil	Nil	Nil	details enclosed	Nil	Nil
Kamarhati	Nil	Nil	Nil	details enclosed	Nil	Nil
Asansol	n.a.	n.a.	Nil	details enclosed	Nil	Nil
Barasat	n.a.	Nil	Nil	Nil	Nil	Nil
Kancharapra	11.22	25	No	details enclosed	No	Nil
Bally	329	Nil	Nil	Nil	Nil	Nil
Panihati	20	30	Nil	Nil	Yes	Nil
South Dum Dum	Nil	Nil	Nil	Nil	Nil	Nil

ANNEXURE—4

TECHNOLOGY PROVIDERS ALONG WITH PROFILE OF THEIR REPORTED CAPABILITIES/PROCESSES

A. COMPOSTING :

1. Excel Industries Limited, Mumbai :

This company offers an aerobic composting technology for conversion of urban solid waste into organic manure.It consists of two stages. (a) A biolological process of decomposition of garbage followed by (b) a mechanical process of screening of the decompsed organic matter. The compost plants based on Excel technology are established in some of the major cities of India such as Mumbai, Kolkata, Delhi, Ahmedabad, Thane, Chandigarh, Vijayawada, Bhopal, Trivandrum, etc.

Sl. No.	Description	
1.	Address	Excel Industries Limited, Andheri, Mumbai
2.	Technology offered	Conversion of Uraban solid waste into organic manure
3.	Source of technology offered	Local
4.	Minimum, maximum capacity	100 Metric Tonnes—1000 metric tonnes per day
5.	Infrastructure required Land Water Power Other	For 1000 MT per day 20 Hectares Not furnished 350 HP Manpower—93 Permanent and 73 Casual
6.	Contribution from ULBs	Required land at dumping yard on 30 years lease on reasonable annual lease rent. Regular collection and delivery for garbage at the processing site with reasonable royalty on the basis of actual production of manure.
7.	Revenue generation	Annual lease rent as well as royalty on regular basis to meet the collection cost partially. Clean and segregated refuse will be available for reclamation of low lying areas through land filling.
8.	Capital cost and O & M cost	Rs. 975 lacs per 1000 MT and working capital Rs. 400 lacs per 1000 MT.
9.	Mode of provision	Not furnished
10.	Years of experience	Since 1997.
11.	Technology & volume reduction	Process consists of two stages—a biological process for decomposition of city garbage and a mechanical process for screening the decomposed organic matter. A mixture of mesophillic and thermophillic micro organisms identified to be more effective in speedy decomposition of organic waste will be used as an innoculum. The innoculum will be prepared using the mixture of bacteria, cow-dung and water. Solid wastes collected by Municipal Corporation will be delivered at project site regularly.

Sl. No.	Description	
		Soon on arrival, innoculum will be sprayed on the garbage and the treated garbage will be stacked in the form of windrows. Separate windrows will be formed for each day's collection. These windrows will be turned once in a week for proper aeration, so that aerobic process continues uninterrupted. Progress of composting will be monitored by measuring the inside temperature of the heap and the level of moisture. For optimum results, the temperature has to be between 65—70 degree centigrade and the moisture should be 25%. Composting will be completed in 20—25 days. Mechanical process is essential for screening out the digested organic matter in the form of powder from all impurities. The digested compost is highly heterogeneous having impurities of various shapes, sizes and texture. Hence, the screening has to be done in different stages. Suitable machines based on different screening principles will be employed at different stages. Various useful microbes like azetobactor, PSB, Rhyzobium and micro nutrients etc. will be added in required proportion for enriching the compost, before packing.
12.	Useful end product	Organic manure.
13.	Environmental impact	Nil
14.	Compatibility on MSW	Compatible

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2. KARNATAKA COMPOST DEVELOPMENT CORPORATION (KCDC) BANGALORE.

Karnataka Compost Development Corporation Ltd., a Government of Karnataka organization is undertaking **ECOFRIENDLY TREATMENT OF CITY HOUSEHOLD AND AGRICULTURAL WASTE THROUGH PRODUCTION OF COMPOST BASED ORGANIC MANURE AND VERMI COMPOST** since 1975.

KCDC's technology is indigenous, low investment oriented, suited to treat unseggregated garbage of Indian cities, low cost of operation and maintenance, less power consumption oriented, easy to be managed by any semi skilled operators and commercially viable.

KCDC's technology mainly comprises of two components viz.,

(a) The Process Methodology : Micro biological degradation over a specific period where the important factors like moisture, aeration, temperature, C/N ratio and pH are taken into consideration.

(b) Process Machinery : Separating the fully degraded organic manure from the non degradables inerts like plastics, rubber, metals, glasses etc., very easily without crushing or grinding.

Sl. No.	Technological Parameters	Description
1.	Name and address of the organization Registration No. Year of Establishment.	Karnataka Compost Development Corporation Ltd. Kudlu Gate, Hosur Road, Madivala Post, Bangalore-560068, Ph. 5732265, Tele Fax: 5730649 E-Mail;kcdc@vsnl.net Reg. No. 2857, 26th August 1975.
2.	Technology offered	Eco-friendly treatment of MUNICIPAL SOLID WASTE through production of compost based Organic Manure/Vermi Compost
3.	Source of technology	KCDC's own
4.	Size of the Project	Can treat 10 tpd to 1000tpd either for mechanical compost and /or vermi compost
5.	Infrastructure required	Compound wall with trees, adequate water facilities, Peripheral roads, internal roads, weighbridge with computer, concrete yard with drain all over and sufficient no. of leachate tank, pay-loaders, processing machinery, high roof shed, godown,vermi pits with roof, laminated plastic sheets, mist blower/fogging machine, diesel generator, tractor & pumps cowdung, EIA, SPCB-Consent, Inspector of factories licence.
	Disposal site :—	As large extent as possible if availability is not a constraint.
6.	Approximate cost of the projects	CAPACITY — APPROXIMATE COST 50 TPD — Rs. 70-100 LAKHS 100 TPD — Rs. 150-200 LAKHS 200 TPD — Rs. 300-350 LAKHS 300 TPD — Rs. 450-500 LAKHS 500 TPD — Rs. 750-800 LAKHS 1000 TPD AND ABOVE — Rs. 1500-1600 LAKHS.

Sl. No.	Technological Parameters	Description
7.	Power requirement	Approximately 85 HP for 350 tpd project
8.	End products	Pure organic manure & vermi compost
9.	Quality of Manure	Possess quality specifications of organic manure & vermi compost
10.	Quantity of manure marketed at present	10000 tpa

3. **Agro Organic India International Private Limited :**

This company offers technology of microbial windrow composting of waste. It has an agreement with Scarab Manufacturing and Leasing Inc. of USA for the supply of machinery, equipment, and spare components and parts manufactured by Scarab for MSW management/composting in India and Nepal. They also have an agreement with them for providing technology know-how, process and project design and training, etc. Both unsorted and semi-sorted Indian garbage is claimed to be suitable for composting through their technology.

Sl. No.	Description	
1.	Address	M/s. Agro Organic India International Pvt. Ltd. C-6B/103 Janakpuri, New Delhi-110058, Phone 91-11-26237596, Fax:-26410596 Web Site: www.agroorganic.com, Contact Person: Sanjeev Kumar, Director
2.	Technology offered	Microbial aerobic windrow composting using SCARB moveable equipment, which are diesel driven. Process involves size reduction/sorting of material and composting using windrow compost with a facility of monitoring, analyzing the physical and chemical properties of MSW. The biological sterility is also assessed with diagnostics. Temperature reaches 70 deg. C and kills lactors/sterlises the compost. Mobile screening machine is used to segregate compost from inert material, meeting USEPA standards for quality. 85% of the waste gets converted into compost and 10-15% goes as rejects. The composters are avaliable in various sizes, from 10 feet wide and 5 feet height to 20 feet and 10 feet height. The machine can handle 500 tons per hour to 4000 tons per hour of MSW. The time required for composting is 60 days. And also dealing in Home Composter, Toilet Composting & Water less urunal Systems.
3.	Source of technology offered	Foreign
4.	Minimum, maximum capacity.	25-1000 tpd
5.	Useful end product	Compost
6.	Infrastructure required Land Water Power Manpower	 1.5 acre per 50 tpd. 20 lit/tonne 25-100Kw as per site requirements. 10-15
7.	Capital cost/O & M cost	Rs. 40 lakh for 25 tpd Rs. 12 lakh per year
8.	Functional facilities	In India 150 MT and 300 MT plant is under construction at Faridabad and Ghaziabad respectively. In 15 developed countries, 5 units are functional and 280 machines supplied.
9.	Years of Experience	5 years in India and 30 years outside India.

4. Centre for Environment Education.

Centre for Environment Education offer community level composting technology. They lay stress against use of un-segregated waste for composting as it could have toxic waste, heavy metals, etc.

Sl. No.	Description	
1.	Address	Centre for Enviroment Education
2.	Technology offered	Composting of source segregated organic waste. Source segregation, composting of organic fraction of Municipal waste and recycling of papers, plastic bags etc.
3.	Source of technology offered	Indigenous
4.	Minimum Maximum capacity	300-500 kg./day for community composting to a maximum of 2 tpd for decentralized composting.
5.	Infrastructure required Land Water Power Manpower	 500-8800 sq. ft./1000 house holds 10-15 lit/day 1Kw/day (??) 8-10-persons
6.	Capital cost/O & M cost	Rs. 3.75 lakh per 1000 households Rs. 22,000 per 1000 households.
7.	Functional facilities	17 No in Karnataka at community level
8.	Years of experience	10 years
9.	Useful end product	Compost, recyclables: papers, plastic etc.

5. M.R. Morarka/(Sulabh International):

This company offers technology of vermi composting of segregated municipal solid waste. House to house collected garbage without any mix of toxic/hazardous waste, is needed.

Sl. No.	Description	
1.	Address	M.R. Morarka/(Sulabh International)
2.	Technology offered	Vermi Composting The MSW is collected in a heap from and cow dung slurry is sprayed on the grabage. 10% soil is added in the waste. 1 kg of earth worms are inserted per one sq. ft. of space. In 35 days time the waste is converted into vermi compost, which is 15% of the total waste brought for composting.
3.	Source of technology offered	Indian
4.	Minimum, Maximum capacity.	Any Capacity. No limits.
5.	Useful end product	Vermi Compost.
6.	Infrastructure required Land Water Power Other	 2500 sq. mtr. for 5 MT Daily spraying of water is necessary-quantity not specified No power required Nil
7.	Capital cost O & M cost	Re.1/- per kg.
8.	Functional facilities	—
9.	Years of experience	5 years

6. Sulabh International Limited

Sl. No.	Description	
1.	Address	Sulabh International, New Delhi
2.	Technology offered	Sulabh Thermofilic Aerobic Compostor, which composts waste in 10 days. An insulated drum is used to insulate the drum contents (MSW) from outside temperature. Suitable to dispose waste locally at the household or neighborhood level.
3.	Source of technology offered	Indian.
4.	Minimum, maximum capacity	1 to 1.5 kg./day
5.	Useful end product	Compost
6.	Infrastructure required Land Water Power Manpower	 Nil Nil Nil Nil
7.	Capital cost	Rs. 5000/-
	O & M cost	Nil
8.	Functional facilities	Nil
9	Years of experience	The process is under experimentation. Not yet marked.

7. Dewan Kraft Systems Private Limited :

The company offers two types of plant to make compost :

* Forced Air Composting Plant
* Containerized Composting Plant, also called Tunnel Reactors.

The company claims that the total time required for composting with the help of tunnel reactor is just seven days and the end product will be free from pathogen whereas through forced-air technology the composting can take place in fifteen days and both the process reduce the cost of material handling. Not a single plant has been established in India or even outside India with this technology. The technology is, therefore, not proven. It requires to be tried out through a pilot project before it could be recommended for conversion of municipal solid waste into compost :

Sl. No.	Description	
1.	Address	Dewan Kraft Systems Pvt. Ltd.,
2.	Technology offered	Composting using Tunnel reactor/Forced air circulation system (closed/in-vessel systems). Tunnel reactor-will compost MSW in 7 days. Forced air composting technology—will compost MSW in 15 days.
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity	50-60 MT/day
5.	Useful end product	Compost
6.	Infrastructure required Land Water Power	 0.75 ha for 50 tpd; 6ha for 600 tpd 10KL for 50 tpd; 100 KL for 600 tpd 40 KVA for 50 tpd; 14 KVA for 600 tpd.
7.	Capital cost	Rs. 1.33 crores for 50 tpd. Rs. 5.16 crores for 600 tpd.
	O & M cost	—
8.	Functional facilities	Nil
9.	Years of experience	Nil

8. **Vauchesa, Boulevard Gambetta, France/Seaguli Engineers (India), New Delhi:**

They offer French patented technology for sorting, recycling/composting of waste. Only the following details have been furnished; but no presentation has been made before the Core Group on appropriate technologies. No comments are, therefore, given about the suitability of the technology.

Sl. No.	Description	
1.	Address	Vauchesa, Boulevard Gambetta-08200, Seda, France. Indian Agent :— Seaguli Engineers (India), 3791, Darya Ganj, New Delhi-110002.
2.	Technology offered	Sorting, recycling, composting, refining
3.	Source of technology offered	Patented French process
4.	Minimum, Maximum capacity	30,000 T-60,000T per year
5.	Infrastructure required	
	Land	8000 sqm. for 30,000 tpa and 8,000 sqm. for 50,000 tpa plant
	Water	—
	Power	—
	Manpower	—
6.	Capital cost	Case to case basis
	O & M cost	—
7.	Functional facilities	Outside India-20, Two Feasibility reports submitted in India, one in Calcutta, another in Bhubaneshwar.
8.	Years of experience	More than 20 years
9.	Useful end product	Compost.

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9. Project Nature Pvt. Ltd., Mumbai:

This company offers composting technology using mechanical segregation before composting. They claim that they do not need to store the waste in an open ground in the form of windrows. They use a continuous process, which reduces the requirement of land. Special crushing arrangements are provided for fast composting. Prime process is completed in a reactor with right mixing of micros in the process. The technology is developed by a group of people under one roof and is under the process of being patented. No presentation is made by this company before the Technology Advisory Group or Core Group.

Sl. No.	Description	
1.	Address	Project Nature Pvt. Ltd., Priya Building, Flat No. 2, Sector-I, Charkop Kandivalli (W), Mumbai-400087.
2.	Technology offered	Composting, Process involves mechanical segregation and composting
3.	Source of technology offered	Under process of patent.
4.	Minimum, Maximum capacity.	50-1000 tpd.
5.	Useful end product	Compost
6.	Infrastructure required Land	Not furnished.
	Water Power Manpower	
7.	Expectations from ULBs	Land on nominal lease, for minimum 30 years. Compound wall, internal roads, water and power at the site
8	Capital cost	Not furnished
	O & M cost	
9.	Functional facilities	Nil.
10.	Years of experience	New Company.

10. Bidhan Chandra Krishi Vishwavidyalaya, Monapur:

This company has furnished the following details about their technology but have made no presentation before the Technology Advisory Group or the Core Group.

Sl. No.	Description	
1	Address	Bidhan Chandra Krishi Vishwavidyalaya, Monapur-741252
2.	Technology offered	Composting. Segregation of MSW, Green organic waste mixed with sewage sludge and pulverized. This passes through two step fermentation. Dry material subject to sterilization and inoculation of beneficial microbes.
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity.	25-26 tpd, comprising 8-9 tonnes organic waste
5.	Useful end product	Manure
6.	Infrastructure required Land Water Power Manpower	 10 acres for 10MT HT station required Required 10-15 workers.
7.	Capital cost	Rs. 56.62 lakh
	O & M cost	Not furnished
8.	Functional facilities	Not furnished
9.	Years of experience	28 years in research

11. **Pravin Vermi Culture Pvt. Ltd., Pune:**

This company has furnished the following information about their technology but have not made any presentation before the Technology Advisory Group or the Core Group.

Sl. No.	Description	
1.	Address	Pravin Vermi Culture Pvt. Ltd., 2/1, Shri Parshwanath Society, Market Yard Road, Pune-410037
2.	Technology offered	Vermiculture
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity	1tpd and above.
5.	Useful end product	Compost
6.	Infrastructure required Land Water Power Manpower	 4 acres/10MT 10000—1,00,000 lpd 5 KW Skilled 1, unskilled—10-15, Manager—1
7.	Capital cost	Rs. 10 lakhs/10tonne
	O & M cost	Rs. 10-12 lakhs
8.	Functional facilities	3 plants :— Chloride food processing unit, 10 MT/d. PCMC-Maharashtra 20 MT/d Prawin Masala Factory-6 MT/d.
9.	Years of experience	2 years

12. Terra Firma Bio-Technologies Ltd., Bangalore:

This company has furnished the following information about their technology provided by them but have made no presentation before the Technology Advisory Group or the Core Group on appropriate technologies.

Sl. No.	Description	
1.	Address	Terra Firma Bio-Technologies Ltd., 104, Ranka Park, No. 5, Lal Bagh Road, Bangalore
2.	Technology offered	Composting
3.	Source of technology offered	Indigenous.
4.	Minimum, Maximum capacity.	For 50,000 population and above.
5.	Useful end product	Compost
6.	Infrastructure required	
	Land	? acres for 10 tonne
	Water	100 liters/tonne
	Power	3 KW
	Manpower	10 workers
7.	Capital cost	Rs. 10 lakhs for 5-lakhs population
		Rs. 90 lakhs for 5-lakhs population
	O & M cost	Not furnished.
8.	Functional facilities	No details furnished.
9.	Years of experience	7 years

13. Monica Processing Plants

Sl. No.	Description	
1.	Address	**Monica Processing Plants** 44-D-2, Sanwer Road, Industrial Estate, Indore-452015 (M.P.), India Ph: 91-731-2720337, Fax : 91-731-5023323 Mobile : 09827060888 , 09425065857
2.	Technology offered	**Composting :** Micro-organism based aerobic and/or facultative bacterial decomposition of all biodegradable matter present in unsegregated municipal solid waste. The process uses windrow based arrangement and periodic turning of heaps to facilitate proper decomposition, size reduction and sterilization of solid waste. The process is as per the guidelines prescribed in the Indian Municipal Solid Waste (Management & Handling) Rules, 2000. **Screening :** A series of different types of indigenously developed Trommel Screens are used to segregate compost from Digested Mass. All inerts and non-bio-degradable material such as plastics, stones, metals etc. can be manually sorted and sent for various end users.
3.	Source of technology offered	Indian
4.	Minimum, Maximum capacity	5 TPD to 1000 TPD
5.	Useful end product	(a) Compost (b) Sorted, recyclable metals, plastics etc.
6.	Infrastructure required Land Water Power Manpower	 1.5 hectare (for 100 TPD plant) 20 lts/ ton (varies as per climatic conditions) 110 KW (for 100 TPD plant) 30 (for 100 TPD plant)
7.	Capital Cost O&M Cost	Rs.130 lakhs Rs.60 lakhs p.a.
8.	Functional facilities	Total 16 plants have already been installed and commissioned in various parts of the country. A few of them are as under :— (1) 600 MT/day plant at New Delhi & Ahmedabad (2) 300 MT/day plant at Trivandrum & Calicut. (3) 150 MT/day plant at Vijayawada (4) 25 MT/day plant at Valsad & Solan
9.	Years of experience	14 years

14. Mayo Vesseles & Machines

Sl.No.	Description	
1.	Address	**Mayo Vesseles & Machines** C-19, M.I.D.C. Indl. Area, Waluj, Aurangabad-431 133, Maharashtra, India Ph. (F) Wallluj 91-240-2554534, 2554838 (F) Chikalthana 91-240-2486087 (O) 912402354688 Tele Fax : 91-240-2336408 E-mail mayovesscls@rediffmail.com
2.	Technology offered	**Composting :** Micro-organism based aerobic and/or facultative bacterial decomposition of all biodegradable matter present in unsegregated municipal solid waste. The process uses windrow based arrangement and periodic turning of heaps to facilitate proper decomposition, size reduction and sterilization of solid waste. The process is as per the guideless prescribed in the Indian Municipal Solid Waste (Management & Handling) Rules, 2000 **Screening :** A series of different type of indigenously developed Trommel Screens are used to segregate compost from Digested Mass. All inerts and non-bio–degradable material such as plastic, stones, metals etc. can be manually sorted and sent for various end users.
3.	Source of technology offered	Indian
4.	Minimum , Maximum capacity	50 TPD to 600 TPD
5.	Useful end product	Supply and commission of world's latest best suited Compost Plants
6.	Infrastructure required	
	Land	1.5 hectare (for 100 **TPD** Plant)
	Water	20 lts./ton(varies as per climatic conditions)
	Power	110KW (100 TPD Plant)
	Manpower	30 (for 100 **TPD** Plant)
7.	Capital Cost	Rs.130 lakhs
	O&M Cost	Rs. 60 lakhs p.a.
8.	Functional facilities	Total 6 plants from 50 TPD to 600 TPD capacity plants installed and commissioned in various parts of the country and in abroad : (1) 100 TPD G.L.L.S Muscut (Arab Country) (2) 50 PTD Parle Export, Chitoor, India (3) 300 TPD Satyam Bio Fertilizer Pvt. Ltd., Aurangabad. (4) 500 TPD B.E.T.L. Colombo, Srilanka. (5) 200 TPD Cuddapah Solid Waste Conversion Hi-Tech Welfare Environment Pvt. Ltd. (6) 600 TPD Hyquip Export for Zeddah (Arab Country)
9.	Years of experience	15 years

15. Bull Machines Pvt. Ltd.

Sl. No.	Description	
1.	Address	Bull Machines Pvt. Ltd. S.F. No.663, Trichy Road, Ravathur Post, Coimbatore-641103, Tamil Nadu, India Phone: 0422 – 5586677, 5586655 Fax : 0422 – 2687770 E.Mail : bullmach@eth.net Mobile : 9842287770, 09312069285
2.	Technology offered	**Composting Solutions :** Bull offers "In-Vessel Rapid Composting Systems" which are not affected by external weather conditions in technical collaboration with Transform Compost, Canada. The process is as per the guidelines prescribed in the Indian Municipal Solid Waste (Management & Handling) Rules, 2000. **SWM Handling & Compost Plant Equipment & Machinery** The equipment & machinery for primary & secondary collection, transportation and waste management including handling equipment / machinery received at compost plants. For smaller ULBs, tractor based equipment/machinery available.
3.	Source of technology offered	Indian / in collaboration with Transform Compost, Canada.
4	Minimum, Maximum capacity	As per requirement
5.	Useful end product	(c) Compost (d) Sorted, recyclable metals, plastics etc.
6.	Infrastructure required Land, Water, Power, Manpower	As per the size of plant
7.	Capital Cost O&M Cost	Capital and O&M cost varies with size of plant
8.	Functional facilities	Company's R&D & Manufacturing Unit at Coimbatore at above mentioned address - Tractor based Windrow Turner - Self-propelled Windrow Turner - Other solid waste handling equipment are already in use in distillery industry & agriculture and ULBs
9.	Years of experience	14 years

B. WASTE-TO-ENERGY :

1. Burn Standard Company Limited

This company offers technology of producing biogas/ electricity and organic manure from municipal solid waste using anaerobic digester. Their experience so far is limited to handling green waste from the vegetable and fruit makers and hotel food wastes but not general municipal solid waste.

Sl. No.	Description	
1.	Address	Burn Standard Co., Ltd., 10-C, Hunger Road Street, Calcutta-17
2.	Technology offered	Anaerobic digestion
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity.	1 tpd and above
5.	Useful end product	Power and Manure 5Kw power and 20 kg. manure is expected from 1tpd waste
6.	Infrastructure required	
	Land	30,000 sq. ft. for 10 tpd
	Water	28,000 lpd for 10 tpd
	Power/Energy consumption	120 kw-hr for 10 tpd
	Manpower	6 persons
7.	Capital cost	Rs. 20 lakh for 1tpd plant
	O & M cost	Rs. 3.6 lakhs/annum for 5KW plant
		Rs. 4.5 lakhs/annum for 500 KW plant
8.	Functional facilities	1 ton/day MSW utilization plant in Calcutta installed in the year 1984 at a cost of Rs. 20 lacs. Another plant of the same capacity has been put up in Howrah. The plants are mainly for processing of green, leafy vegetable market waste and food waste from hotels and restaurants.
9.	Experience	16 years

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2. Om Consultants

This company offers Anaerobic Digestion technology developed by a German firm. It is claimed to be suited to the composition of Indian waste, with several benefits:—relatively small land requirement; process time of only two weeks and absolutely no smell/emission noticeable beyond 50 meters of plant boundaries—so setting up of such plants is possible even within the residential areas to reduce the cost of transportation. No such plant has so far come up in India and its suitability under Indian conditions is yet to be proved.

Sl. No.	Description	
1.	Address	OM Consultants, D-80, Anand Niketan, New Delhi-21
2.	Technology offered	Anaerobic digestion Incorporates arrangement for automatic segregation of mixed household waste in the plants Excess heat generated could be used for cooling energy for air conditioning, etc.
3.	Source of technology offered	German firm—Inter Engineering
4.	MSW processing capacity	250 to 1000 TPD
5.	Useful end product	Power and compost. Would generate power ranging from 800 to 3000 KW out of which 20% would be consumed; rest will be available for sale
6.	Infrastructure required Land	For 250 tpd plant. 3000 sqm. Covered building +30,000 sqm. open area.
	Water	Nil. (The plant only uses water extracted from waste)
	Power	Nil. (The power generated will range from 800—3000 Kw, 20% of which would be consumed in the plant; rest will be available for sale).
7.	Capital cost	250 tpd plant—Rs. 300 lakhs 1000 tpd plant—Rs. 8,500 lakhs
	O & M cost	Rs. 300 per tonne (?-check).
8.	Functional facilities	4 plants installed in Germany. The plants so far constructed during last five years have a capacity of 10000 tons to 35000 tons a year. All plants are reported to be under full operation with 120 to 150 per cent capacity utilization.
9.	Years of experience	7 years

3. M/s. Nestler Ecotech Private Limited:

This Company offers Wabio Anaerobic Digestion technology for processing of MSW to produce energy and compost. The technology is patented and owned by SKANSKA Econetory of Finland. M/s. Nestler Ecotech are the licensee of that company. It is a closed vessel technology with no problems of odour or flies. The process takes place under Mesophilic conditions. No such plants has so far been put up in India. Kalyan Municipal Corporation is reported to have signed an agreement with this company for setting up 200 MT plant on 3 acres of land where land is proposed to be granted for 20 years by the local body and local body is expected to get in return Rs. 25 lacs per year for using municipal land and for providing garbage at the plant site without levying any charges.

Sl. No.	Description	
1.	Address	Nestler Ecotech (P). Ltd., 30, Sadhna, 4th Floor, Gamadi Road, Bombay-26
2.	Technology offered	Anaerobic digestion—Wabio process
3.	Source of technology offered	Foreign technology, patented and owned by SKANSKA ECONETORY of Finland
4.	Minimum, Maximum capacity	200 tpd and above in multiples of it
5.	Useful end product	Power-2 MW & Compost-200 TPA from 200 tpd MSW Net power for sale would be 17000 KVA i.e. 13.6 million units per year assuming 8000 operational hours
6.	Infrastructure required Land Water Power Manpower	 4 acres/2000 tpd 250M3/200 tpd 300KW/200 tpd+ 60 persons (Both skilled and unskilled)
7.	Capital Cost O&M cost	Rs. 25 crores for 200 TPD plant— —
8.	Functional facilities	One in Germany, 6500 pd of separated waste 3 to 4 plants are in operation in Finland and Germany
9.	Years of Experience	10 Years

4. **EDL India Private Limited:**

EDL India Private Limited offer Gasification/Pyrolysis Technology termed SWERF, developed by an Australian company. They have set up the first facility based on this technology to process, recycle and dispose of 600M. tons of mix waste in Australia recently; results are yet to be known. The **technology is claimed to be suitable for treatment of mixed/un-segregated MSW.** Its suitability under Indian conditions is yet to be established. The company is negotiating with Chennai Municipal Corporation for setting up a plant in Chennai and need to have an authorization from CPCB for putting up such plant. The company's principals have **a vast experience of conversion of landfill gas to electricity** abroad.

Sl. No.	Description	
1.	Address	EDL India Ltd., K-39A, Haus Khas, New Delhi.
2.	Technology offered	Gasification The input municipal waste is autoclaved at 130°-140°C and converted into organic pulp; the rags, plastics, metals and rejects are mechanically separated; the rejects stream is shredded and mixed with the organic pulp. Homogenized organic matter is fed to a two-stages pyrolysis and steam reforming gasification process. The product SYNGAS is cleaned at low temperature to achieve required fuel specification.
3	Source of technology offered	Foreign
4.	Minimum. Maximum capacity	600 tpd and above
5.	Useful end product	Power
6.	Infrastructure required Land Water Power	2.5 acres/100 MT; 15 acres/600 Mt.—
7.	Capital cost	For 14.85 MW plant for Rs. 180 crores, which includes Rs. 30 crores for MSW treatment component, Rs. 85 crores for Gasification component and Rs. 65 crores for Power geeration component.
	O & M cost	—details not furnished
8.	Functional facilities	First plant set up in Australia this year (2001).
9.	Years of Experience	—

5. Enkem Engineers Private Limited:

Enkem Engineers Private Limited offer BIMA digesters based high-rate Biomethanation technology developed by ENTEC of Austria, of which they are the licensee in India. BIMA digesters are stafed to be in operation in over 50 installations in the world. The company claims the technology to be most suited for present characteristics of Indian wastes. It has entered into an agreement for setting up a plant at Lucknow where the work is about to start soon. Its outcome needs to be watched to see the sutibility of this technology under Indian conditions.

Sl. No.	Description	
1.	Address	Enkem Engineering Pvt. Ltd., **824, Ponnamalli High Road, Near KCM, Chennai—10.**
2.	Technology offered	Anaerobic digestion-BIMA The input MSW is pre-processed to segregate inorganic and organic waste fractions, using system of drum screen, sorting station, magnetic separator, ballistic separator, shredder, mechanical separator. The organic fraction is converted into homogenized slurry and fed to the digesters generating biogas. The power is generated from the biogas using 100% gas engine; waste heat recovery system is used to recover additional electrical energy using steam turbine.
3.	Source of technology offered	Entec, Austria. Most equipment fabricated locally under license agreement. Some imported equipment.
4.	Minimum, Maximum capacity	300 tpd and in multiples thereof.
5.	Useful end product	Power and manure.
6	Infrastructure requred Land Water Power Manpower	 6.7 acres for 300 tpd 100 M3/day for 300 tpd Own source 6-7 technical persons
7.	Expectations from ULBs	—Land on lease, away from inhabitants —Free delivery of garage at site. —ULB should agree to compensate if there is a major Change in the waste. —Hospital waste and toxic waste should not be mixed.If so, ULB should take responsibility and pay compensation.
8.	Capital cost O & M cost	—
9.	Functional facilities	Over 10 plants in operation in other countries.
10.	Years of Experience	10 years.

6. **Cicon Environmental Techology Limited:**

This company offers DRANCO high-rate Biomethanation technology developed and patented by Organic Waste Systems, Belgium, of which they are the licensees in India. The company claims the technology is suitable for Indian waste. The company has 7 to 8 full scaled plants outside India and its first plant in India is being constructed at Nagpur.

Sl. No.	Description	
1.	Address	CICON Environmental Technology 61/B Kasturba Nagar, Bhopal
2.	Technology offered	Anaerobic digestion— DRANCO (Dry Anaerobic Composting) MSW pre-processing to separate organic waste from inorganic waste. The recyclables are hand picked and separated prior to Biomethanation. Leads to reduction in volume by 50-60%. Compost produced is 20-25%. Inerts/rejects of 20-25% are sent to landfill.
3.	Source of technology offered	OWS, Belgium.
4.	Minimum, Maximum capacity	300 to 450 TPD
5.	Useful end product	Power and manure.
6.	Infrastructure required Land Water Power Manpower	 10 acres for 450 tpd input. 100 cum. for 450 tpd input. — ? persons
7.	Capital cost O & M cost	Rs. 45 crore approx. for 450 tpd plant.—
8.	Functional facilities	7-8 full scale plant outside India.
9.	Years of Experience	12 years (of OWS, Belgium).

7. **G. I. T. Associates.**

This company offers technology of biomethanation of solid and liquid waste/ sewage together. Main experience is for the disposal of liquid waste, for which seven plants have been set up in Maharashtra.

Sl. No.	Description	
1.	Address	GIT Associates
2.	Technology offered	**Anaerobic Disgestion—** **Sewage is added to shredded garbage.** Anaerobic digester is of two compartment design—first compartment is UASB digester where the liquid effluent is treated and BOD is reduced to extent of 80%; remaining BOD is reduced in an aerobic system where the effluent is aerated and clarified in a tank using induced aeration system. The water is used either for gardening or discharged in drain. The biogas is collected and sold to nearby consumers.
3.	Source	Indigenous.
4.	Minimum, Maximum capacity	50 kg. / day.
5.	Useful end product	Biogas.
6.	Infrastructure required Land Water Power Other	 900 sqm. for 10tpd water/sewage: 10-30 cum/day — 3 skilled and 6 unskilled
7.	Capital cost	Rs. 85 lakhs for 10 tpd plant
	O & M cost	Rs. 4-5 lakh per annum.
8.	Functional facilities	—
9.	Years of Experience	20 years

8. Parv Holdings Limited:

Parv Holdings Limited offer plasma pyrolysis vitrification (PPV) technology for waste disposal developed and patented by an Australian company. It is claimed that all types of waste—for MSW, medical waste, industrial waste, tiers, papers, plastics, etc.—can be disposed of through this system and emissions will be as per USEPA norms. The company has furnished a list of 43 clients where technology has been given for variety of uses, mainly in the industrial sector. It is working on setting up projects for mixed MSW in Italy, Spain, Philippines and Malaysia. The company claims the technology is 50% cheaper than conventional incinerators and can treat MSW having calorific value even less than 800 kcal/kg.; is 100% environment friendly. The company has indicated that normally they would charge 60 US$ per tonne of waste as tipping fee for handling biomedical and industrial waste and they may charge a reduced rate of 10-15$ per tonne for MSW. So far no such plant has come up in India and its affordability for municipal solid waste has to be critically evaluated by the local body before considering this technology for the disposal of municipal solid waste. In cities where there is an availability of large quantities of biomedical and hazardous industrial waste, which can meet the principal cost of running such plant, combining municipal waste disposal along with such waste could then be considered after carefully examining the cost implication.

Sl. No.	Description	
1.	Address	Parv Holdings Pvt. Ltd., 6-Ajmal Khan Road, New Delhi-5.
2.	Technology offered	Plasma Pyrolysis Vitrification (PPV) The reactor operates under Pyrolysis condition, i.e. in the absence of oxygen; waste is heated to very high temperature by electrodes, resulting in decomposition to elemental state. Inorganic waste such as metal, dirt, glass, heavy metals etc. are simultaneously vitrified into glassy sludge that hardens when cooled and can be used for construction purposes. All the waste is completely recycled/ recovered as energy/ reused. Mostly used for disposal of industrial/ hazardous solid waste as well as biomedical waste.
3.	Source of technology offered	Foreign; patented.
4.	Minimum, Maximum capacity	2—2000 tpd.
5.	Useful end product	Power, building material
6.	Infrastructure required Land Water Power Manpower	 Less than 10 acres/1000 tpd. Nominal Self generation; surplus sold 10 persons
7.	Expectations from ULBs	Land on nominal lease; tipping fees for waste disposal.
8.	Capital cost O & M cost	US$ 100 million/ 1000 tpd. 3%
9.	Functional facilities	In other countries—mainly for disposal of hazardous industrial wastes.
10.	Years of Experience	14 years.

9. Amrit Non-Conventional Energy Systems :

This company offers technology for conversion of MSW into fuel pellets.

Sl. NO.	Description	
1.	Address	Amrut Non-Conventional Energy Systems Ltd/ Renovo Energy Ltd., New Delhi.
2.	Technology offered	Conversion of MSW into fuel pellets. MSW is sun dried, crushed and segregated using air density/cyclone separator to separate out plastics; rotary trominel separates out fine organics (< 50 mm) which are conveyed to manure section and bigger (>50 mm) particles sold as raw RDF. Less than 50 mm fraction is further segregated to <5 mm and >5 mm fractions. The smaller fraction is sent to Compost Centre whereas the bigger fraction is shredded, mixed with granular, low bulk density biomass, conditioned with steam, compressed and formed into pellets, of required size.
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity	250—1000 tpd.
5.	Useful end product	RDF pellets
6.	Infrastructure required Land Water Power Other	 500 sq. mtr. per 10 MT of waste 40—55 K. gals 50 HP connection Manpower skilled-3, unskilled-8 and unskilled-20
7.	Capital cost	Rs. 60000000 per 250 MT
	O & M cost	Rs. 1000 per MT
8.	Functional facilities	The company has supplied some machinery for a MSW pelletisation plant being set up at Hyderabad by M/s. Selco International Ltd. The success of the product is yet to be established.
9.	Years of Experience	About two years.

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10. **Ravi Entech Ltd., Chennai**

This company offered technology to generate natural gas from Municipal solid waste by using pressure swing absorption technology. The gas is used as fuel to run transport vehicle. There is no experience of this technology in India or Asia. However, 8 very small plants ranging from 5000 MTs to 12000 MTs per year have been set up in Switzerland during 1992 to 1996;

Sl. No.	Description	
1.	Address	Ravi Entech Ltd., Chennai
2.	Technology offered	1. Biomethanation 2. Biogas purification/conversion into natural gas. MSW with min 30% organic matter is fed to a fermenter where waste is converted into biogas. The gas is cleaned/enriched through pressure swing absorption technology to convert it into natural gas. This gas is used as fuel to run transport vehicles. The biomethanation technology is from Compogas of Germany and gas purification technology from Carbotech of Germany.
3.	Source of technology offered	Foreign technology (Germany). Indo Netherlands joint venture Company
4.	Minimum, Maximum capacity	30 tonnes per day.
5.	Useful end product	The end product is natural gas used as fuel for vehicles.
6.	Infrastructure required Land Water Power Manpower	 3000 sq. mtr. for 30 tpd 1 to 5 cum. per day 2000 Kw-hr per day skilled 3; semi-skilled-6
7.	Expectations from ULBs	Tipping fees for processing MSW
8	Capital cost	Rs. 10000 per MT
	O & M cost	Rs. 600 per MT
9.	Functional facilities	—
10.	Years of Experience	About 10 years abroad. No experience in India/Asia. However, plants ranging from 5000 tpa to 12000 tpa MSW have reportedly been set up in Switzerland in 1990 and 1996 whereas plants ranging from 37000 tpa to 75000 tpa sewage sludge have been set up in Sweden. One plant in 1992 and three others in 2000 using Carbotech technology for vehicle fuel and 7 more plants are reported to have been installed using landfill gas between 1964 and 1995.

11. **Maridi Exotherm Systems, Mumbai**

This company has furnished the following information about its technology but has made no presentation before the Core Group. The shortening of process of composting from 45 days to just 2 to 3 days is not explained. It is difficult to believe that composting process could be completed in 2 to 3 days. Therefore, until the process details are scrutinized and the suitability of the technology is established, no comments can be given.

Sl. No.	Description	
1.	Address	Maridi Exotherm Systems, Jer Mahal, 1st Floor, Dhibi Talco, Mumbai-400002
2.	Technology offered	Biomethanation Uses rotary composting-crunches the process time from 45 days to 2-3 days and without much odors; solid waste and the swerage waste is used as raw materials to generate power. [Other services provided-design/construction services for engineered land fills, solid waste transfer stations, recycling facilities, materials recovery facilities, waste water leaches treatment facilities, maintenance. Production of high purity methane gas for landfill gas by vacuum pressure swing absorption which is 5% efficient than other separator technology].
3.	Source of technology offered	Indigenous
4.	Minimum, Maximum capacity	200—10,000 tpd
5.	Useful end product	Compost, power, methane gas.
6.	Infrastructure required Land Water Power Manpower	 4 ha./tonne depending on situation. -do- 8 workers.
7.	Capital cost O & M Cost	Not furnished.
8.	Functional facilities	One plant being set up in India (no information). Many plants set up outside India.
9.	Years of Experience	Five years collaboration with M/s Ericsons, USA

12. Bobcock Borsig Power

Their principal could not come from abroad, so they could not give much information about their technology.

TECHNOLOGY PROVIDERS FOR LANDFILLS

LANDFILL OPERATORS

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(Attn. : Mr. Y. R. Nagaraja, Director)

Birla Technical Services
3rd Floor, Guru Angad Bhavan,
71 Nehru Place,
New Delhi-110019
(Attn. : Mr. J. C. Raja/Dr. V. K. Chaudhary)

Onyx Asia Services Pvt. Ltd.
6 Rajamannar Stree
T. Nagar,
Chennai-600017
(Attn. : Mr. Harinath Pabbathi)

Bharuch Enviro Infrastructure Ltd.
117 GIDC Estate.
Ankleshwar-393002
Dist. Bharuch, Gujarat
(Attn. : Mr. Panjwani, Director/Mr. P. N. Parameshwaran, G. M.)

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New Delhi-110016
(Attn. : Prof. Manoj Datta/Prof. G. V. Rao)

Environment Department
Engineers India Ltd.,
PTI Building, 4 Sansad Marg,
New Delhi-110001
(Attn. : Mr. B. S. Gill/Mr. Anil Jain)

Tetra Tech India Ltd.
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LANDFILL WASTE CHARACTERISATION AND ENVIRONMENTAL IMPACT AS ESSMENT CONSULTANTS

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Centre for Environmental Studies
Anna University, Chennai-600025

Sriram Institute for Industrial Research
19, University Road, Delhi-110007.

ANNEXURE—5

Annex 5.1

PSP in SWM Collection and Transportation

Sl. No.	State Agency/City	Components/Aspects Privatized	No. of Contractors	Milestones Yrs-Advertised/ Signed	Cost of Service/Operations (Rs.) Before PSP	After PSP
	Andhra Pradesh					
1.	Hyderabad M.C.	Sweeping	122	1998	n.a.	n.a.
2.	Visakhapatnam M.C.	Sweeping and Collection	5	1994	n.a.	n.a.
3.	Warangal M.C.	—	3	Contract	—	—
4.	Guntur M.C1	Collection and Disposal	3	1996 Contract	—	3864000
5.	Nellore M.C1	Sweeping	5	1998 Contract	23842929	27811917
6.	Anantapur M. C1	Sweeping	1	1997 Contract	11500000	14500000
7.	Qutubullapur M	Sweeping	5	1997 Contract	2000000	4200000
8.	Eluru M	Collection and Disposal	2	1998 Contract	n.a.	1800000
9.	Tirupati M. C1	Sweeping and Collection	4	1997 Contract	n.a.	n.a.
10.	Tenali M	Collection and Disposal	1	1998 Contract	n.a.	144000
11.	Nandyal M. C1	Sweeping	1	1998 NGO	n.a.	n.a.
12.	Chitoor M	Sweeping and Collection	1	1999 Contract	n.a.	n.a.
13.	Hindupur M	Sweeping and Collection	1	1996 Contract	n.a.	100000
14.	Kapra M	Sweeping	3	1999	4640000	2908800
15.	Rajendra Nagar M. C1.	Sweeping and Collection	1	1997 NGO	20000	85000
16.	Madanapalle M	Sweeping and Collection	2	n.a. Contract	n.a.	97000
17.	Narasaraopet M	Collection and Disposal	1	1998 Contract	n.a.	1248000
18.	Suryapet M. C1	Sweeping and Collection	2	1997 Contract	n.a.	n.a.
19.	Srikalahasti M	Sweeping and Collection	n.a.	1998 Contract	n.a.	n.a.
	Assam					
20.	Guwahati M.C.	Transportation	13	1988 Contract	n.a.	n.a.

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Annex 5.1

PSP in SWM Collection and Transportation—Contd.

Sl. No.	State Agency/City	Components/Aspects Privatized	No. of Contractors	Milestones Yrs-Advertised/ Signed	Cost of Service/Operations (Rs.) Before PSP	After PSP
	Gujarat					
21.	Surat M.C.	Collection and Transportation	2	n.a.	n.a.	n.a.
22.	Rajkot M.C.	Collection and Transportation	9	1990 Contract	n.a.	7000000
23.	Bhavnagar M.C.	Primary Collection	6	1987 Contract	8000000	2200000
24.	Bhuj M	Collection and Transportation	n.a.	n.a.	n.a.	n.a.
	Karnataka					
25.	Bangalore M.C.	Sweeping	120	1989 Contract	n.a.	n.a.
26.	Mysore M.C.	Sweeping and Transportation	7	1998 Contract	n.a.	n.a.
27.	Belgaum M.C.	Transportation	2	1994 Contract	n.a.	n.a.
28.	Bellary MC	Sweeping and Transportation	2	1998 Contract	n.a.	n.a.
29.	Shimoga MC	n.a.	6	1994 Contract	n.a.	n.a.
30.	Bagalkot MC	Sweeping	2	1999 Contract	n.a.	n.a.
31.	Chikmaglur MC	Collection and Transportation	1	1997 Contract	n.a.	n.a
32.	Rabkaiv-Banhtti MC	Transportation	n.a.	Auction	n.a.	n.a
33.	Gokak MC	Sweeping and Transportation	1	1999	n.a.	n.a
	Madhya Pradesh					
34.	Jabalpur M.C.	Street Sweeping	1	1998 Contract	1163722	770000
	Maharashtra					
35.	Greater Mumbai MC	Transportation		Contract		
36.	Amravati MC	Sweeping	2	1985 Contract		0.7
37.	Nagpur MC	Collection	2	1997 Contract		
38.	Nanded Waghala MC	Sweeping	1	Contract		1.0
39.	Parbhani MC	Transportation	2	1999 Contract		1.2
40.	Virar MCI	Sweeping and Collection	1	1999 Contract	4.5	3.5

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Annex 5.1

PSP in SWM Collection and Transportation—Contd.

Sl. No.	State Agency/City	Components/Aspects Privatized	No. of Contractors	Milestones Yrs-Advertised/ Signed	Cost of Service/Operations (Rs.) Before PSP	After PSP
41.	Kamptee MCI	Sweeping and Collection	1	1999 Contract	0.025	0.018
42.	Manmad MCI	Transportation	1	1999 Contract	0.3	0.147
	Orissa					
43.	Bhubaneshwar MC	Collection	n.a.	n.a. Contract	n.a.	n.a.
	Pujnab					
44.	Ludhiana	Sweeping and Collection	114	1999 CBO	2827200	n.a.
	Rajasthan					
45.	Jaipur M.C.	Transportation	18	1990 n.a.	n.a.	n.a.
46.	Ajmer M.CI	Transporation				
47.	Sriganganagar M	Sweeping	2	1994 Contract	n.a.	n.a.
	Tamil Nadu					
48.	Chennai Municipal Corporation	Collection and Transportation—2 zones (18 wards) Private firm—M/s. CGEA Asia Holding Pvt. Ltd.	1	Signed Nov. 1999 Implementation began March 2000	Anticipated savings of 10—12 crore per year	
49.	Tiruppur	Secondary Collection	1	1997		
50.	Madurai M.C.	Transportation	2	1998 Contract	n.a.	n.a.
	Uttar Pradesh					
51.	Greater Noida	Collection and Transportation				
	West Bengal					
52.	Calcutta M.C.	Transportation	n.a.	n.a.	n.a.	n.a.
53.	Asansol M.C.	Primary Collection and Transportation	7	n.a. Contract	n.a.	n.a.
	Chandigarh					
54.	Chandigarh M.C.	Sweeping and Collection	3	1996 Contract	n.a.	2719640
	Pondicherry					
55.	Pondicherry M	Sweeping and Collection	1	1997 Contract	n.a.	n.a.

Source : NIUA Survey (1999) Status of MSW, Data as provided by respective local bodies, various newspaper articles.

Annex 5.2

PSP—Resource Recovery Projects—Waste to Compost

Sl. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
	Andhra Pradesh				
1.	Vijayawada MC	BOO 30 year concession Excel Industries	150	14.5	Operational since September 1997
2.	Vizag Municipal Corporation	BOO Bommidala group with Excel Industries	300	45.0	Project under construction stage expected to be operational by October 1999
3.	Rajmundry MC	BOT Finlinc Finance Ltd. with Excel Industries	150	28.0	Project is under construction stage and is expected to be operational by December 1999
	Delhi				
4.	Delhi MC (Azadpur)	BOO Khurana group with Excel Industries	600	75.0	Operational since December 1999
5.	Okhla, Delhi	BOO Khurana group with Excel Industries	300	40.0	Opertaional since August 1999
	Goa				
6.	Panaji M.Cl.	Funding by GoG & HUDCO. O&M by a private firm			1995 Contract
	Gujarat				
7.	Ahmedabad MC	BOO Excel Industries	600	65.0	Operational since September 1999
	Himachal Pradesh				
8.	Solan MC	BOT Arrangement with NORAID/Janseva in association with Excel Industries	50	10.0	Plant construction by L&T Operational since 1999 NORAID funding involved
	Karnataka				
9.	Bangalore MC	BOO Sunrise compost Ltd. with Excel Industries	300	40.0	Operating since November 1997
10.	Bangalore MC	Karnataka Composting Development Corporation (a Government concern)	200		
11.	Mysore MC	Build and Operate by Excel Industries Finance and ownership with the ULB	200	20.0	projet under construction stage (civil work) and expected to be operational during year 2000
	Kerala				
12.	Calicut MC	Build and Operate by Excel Industries Financing and ownership with the ULB	300	45.0	MOU-Project under implementation, civil work has been completed HUDCO funding involved

Annex 5.2

PSP—Resource Recovery Projects—Waste to Compost—Contd.

Sl. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill).	Current Status/Remarks
14.	Kochi MC	Build and Operate by Excel Industries Financing and ownership with the ULB	300		Project under implementation
15.	Thiruvananta-puram M C	Build and Operate by Poabs Enviro Tech Group with Excel Industries Financing and ownership with the ULB	300	90.0	MOU Fully covered plant (12000 sq. ft.), commissioned in July 2000
16.	Allappuzha MC				1999 Contract
	Madhya Pradesh				
17.	Bhopal MC	BOOT MP StateAgro Industrial Development Corporation with Excel Industries	100	15.0	Operating since October 1995
18	Gwalior MC	BOOT MP State Agro Industrial Development Corporation with Excel Industries	100	18.0	Operating since April 1996
	Maharashtra				
19.	Mumbai MC (Amboli)	BOO (fixed period) Excel Industries	50		Operating since1990 operational at a lab scale (R&D unit)
20.	Mumbai MC (Amboli)	BOO (fixed period) Excel Industries	300	40.0	Operating (R&D unit)
21.	Mumbai MC (Deonar)	BOOT	500		Indag Fertilizers
22.	Mumbai (Chincholi)	Excel	300		Operational since October 1994 (R&D unit)
23.	Thane MC	BOO Leaf Biotech Ltd. with Excel Industries	300	48.0	Operational since November 1998
24.	Kolhapur MC	BOT -30 years Zoom Developers with Larsen Eng.Consultants, USA	150	50.0	Agreement signed in September, 2000
25.	Nasik MC	BOO Leaf Biotech Ltd. with Excel Industries	300	45.0	year 2000-under construction.
26.	Aurangabad MC	BOT Satyam fertilizers with Excel Industries	300	45.0	Contract signed in 1997 Facility operational since May 1999

Annex 5.2

PSP—Resource Recovery Projects—Waste to Compost—Contd.

S. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
27.	Madgaon	Komex International Ltd.	25		Under coonstruction
	Meghalaya				
28.	Shilong	Build and Operate by Excel Industries Financing and ownership with the ULB	100		Site survey being carried out HUDCO funding involved
	Orrisa				
29.	Puri Municipality	Build and Operate by Excel Industries Financing and ownership with the ULB	100	22.5	Operational sinee July, 1999
	Punjab				
30.	Jullandhar MC	BOO Punjab Grow More Fertilizers with Excel Industries	300		Site development underway
31.	Chandigarh MC	BOO SPJ Bio Agro Industries associates with Excel Industries	300	45.0	Site development started October 1999. Project finances still to be tied up
32.	Ludhiana	BOO Private firms in association with Excel Industries			Year 2000, ready to be signed
	Tamil Nadu				
33.	Allandur Municipality with TNUDF	20 years	100		Initial advertisement inviting bids issued Jan. 1998. Bid was on the concession period with a fixed price to be paid to the Municipality at Rs. 3.5 per ton for the garbage indexed to CPI. Lowest selected bid is for 20 years Agreement has been signed and the concessionaire is seeking to mobilize funds with help from the TNUDF
34.	Erode Municipality with TNUDF	BOOT-16 years	150		Bid was on the concessions period with a fixed price to be paid to the Municipality at Rs. 3.5 per ton for the garbage indexed to CPI. Lowest selected Selected bidder was the only one to agree to the BOOT format. Concession period of 16 years fixed through negotiations. Agreement has been signed and the concessionaire is arranging funds through NABARD or banks.

Annex 5.2

PSP—Resource Recovery Projects—Waste to Compost—Contd.

S. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
35.	Tiruppur Municipality with TNUDF	BOOT-20 years IVR Envire Projects Ltd. with AWM	150	30.0	Advertisement issued in 1999. Plant equipment purchased plant expected to be commissioned in 2000
	West Bengal				
36.	Calcutta MC	BOOT-30 years Eastern Organic Fertilizers Pvt. Ltd. with Excel Industries	700	75.0	Operational since October 1999

Sources : (1) Mehta meera (May 1999). "A review of Public Private Partnerships in water and Sanitation Sector in India" Water and Sanitation Group, Department for International Development, India.

(2) NIUA Survey (1999) Status of MSW, Data as provided by respective local bodies

(3) HUDCO Brochure (April 1999). HUDCOs Role in Waste Management

(4) Newspaper articles

(5) Discussions with Excel Industries, HUDCO, IDFC.

Annex 5.3

PSP Resource Recovery Projects-Waste to Compost (Proposed Projects)

	State/City	Implementation arrangement and Private Promoter	Treatment Cap. TPD
	Andhra Pradesh		
1	Hyderabad MC	BOO, A private industry with Excel Industries	500
2	Tirupathi Municipality	BOO, A private industry with Excel Industries	
	Assam		
3	Guwahati MC	Project conceptualized in Nov. 1997. Proposals expected	250
	Delhi		
4	Bhalswa	Excel Industries	500
	Gujarat		
5	Surat MC	BOO, Initial discussions held with Excel. SMC has advertised to invite proposals through a BOO arrangement with a private industry in association with excel	600
	Himachal Pradesh		
6	Shimla MC	BOO, A private industry with Excel Industries	100
	Kerala		
7	Salem MC	BOO, A private industry with Excel Industries	300
	Maharashtra		
8	Nagpur MC	BOO, A private industry with Excel Industries	300
9	Pune	BOO, A private industry with Excel Industries	
	Orissa		
10	Bhubaneshwar MC	BOO, A private industry with Excel Industries	300
	Rajasthan		
11	Jaipur MC	BOO, A private industry with Excel Industries	500
	Tamil Nadu		
12	Kannur Municipality	Build and Operate by Excel Industries Financing and ownership with the ULB	100
13	Tambavaram Municipality with TNUDF	Initial advertisement to invite proposals in Jan. 1998 Municipality has declined to give land on a long term lease due to the fear of misuse by the concessionaire	100
14	Trichi		
15	Coimbatore	Karnataka Compost Development Corporation, TANFED (TN fertilizers), LN Textile Group	
	Tripura		
16	Agartala M.C.I.	Advertised in 1999	
	Uttar Pradesh		
17	Kanpur MC	BOO, A private industry with Excel Industries	200
18	Greater Noida	BOT-20 Yr. Under bidding	300
	West Bengal		
19	Howra	Eastern Organic Fertilizers Pvt. Ltd.	300
20	Siliguri TPD	Eastern Organic Fertilizers Pvt. Ltd.	300

Source : Discussions with Excel Industries, HUDCO, IDFC

Annex 5.4

PSP/NGOS—Resource Recovery Projects—Waste to Vermi Compost

S. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
	Gujarat				
1.	Valsad	NGO	20		Operational
	Karnataka				
2.	Bangalore MC	Terra Firma Bio Technologies Ltd.	127		Operational
3.	Hubli Dharwad MC				Tendered in 1997 Contract signed in 1998
4.	Davangere	1996 Auction			1996 Auction
	MCI	55 Parties involved			
	M P				
5.	Chalakudy municipality				
6.	Parur municipality				
7.	Sehore	ENBEE Bio fertilizers in Collaboration with Terra Firma Boi Technologies Ltd	167		Operational HUDCO loan
	Maharashtra				
8.	Mumbai		400		Closed down
	Uttar Pradesh				
9.	Lucknow	Muskan Jyoti Samiti, NGO			Collection from 16000 HH in peripheral area
					Commercially viable and based upon user charges
					Monthly rates
					Slum dweller-Rs. 10, EWS-Rs. 20, Other-Rs. 25
					Proposal to expand waste collection services to 30000 HH (including 45 slum settlements)

SOURCE : (1) Mehta Meera (May 1999). "A Review of Public-Private Partnerships in Water and Sanitation Sector in India". Water and Sanitation Group, Department for International Development, India.

(2) Newspaper articles and Internet sites (CEE, Down to Earth)

Annex 5.5

PSP—Resource Recovery Projects—Waste to Energy (Biomethanation)

S. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estimated Project Costs (Rs. Mill)	Current Status/Remarks
	Andhra Pradesh				
1.	Hyderabad	BOT CELCO, preferred bidder.	700		HMC developed this project in association with MNES
	Maharashtra				
2.	Pune	Western Paques (India) Ltd.	400		For every 5 TPD waste treated-5 cu. m. of gas and 1.5. TPD of organic manure as designed to be produced The private firm has closed down.
	Pune	CICON Environmental Technologies Ltd.	450		Project agreement signed in September 2000. Land lease agreement signed during the first week of November.
3.	Nagpur MC	BOO-30 year concession extendable by another 30 years. CICON Environmental Technologies Ltd., in association with Enbee Infrastructure Ltd.	520	470 (1999)	LOI issued in 1997 520 TPD treatment to produce electricity of 5.4. MW and compost of 170 TPD. In year 2000, work commenced for setting up the facility.
4.	Pimpri-Chinchwad MC	BOT-30 years GENL	100	184 (1998)	Under Negotiation
5.	Solapur MC	BOO/BOOT/BOLT (30 year period)	300		Technology purchased by MSEB at Rs. 2.25 per kwh [base 1994-95) and a 5% annual escalation]
	Tamil Nadu				
6.	Chennai Municipal Corporation with Tamil Nadu Industrial Development Corporation (TIDCO)	BOOT M/s. EDL (India) Pvt. Ltd., (Australian technology)	300	1300 (1998)	Capacity to generate energy of 5 MW Project first advertised in July 1997 Pre-bid in April 1998 (following a high court response petition by a local citizens' action group from near the state in Chennai). RFP issued in July 1998 and only one bid received in September 1998.

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Annex 5.5

PSP—Resource Recovery Projects—Waste to Energy (Biomethanation)

S. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estimated Project Costs (Rs. Mill)	Current Status/Remarks
					GO has been issued on 15 Jan. 1999 for selection of the concessionaire, who is currently in the process of mobilizing resources.
	Uttar Pradesh				
7.	Lucknow	Enkam India Ltd.			A Project for generation of 5 MW power and about 70 M tonnes organic manure from about 500 tonnes of MSW through biomethanation technology is under construction at Lucknow. This plant is slated for commissioning in April 2003.
8.	Agra MC Agra, Aligarh, Allahabad, Bareilly Ghaziabad, Gorakhpur, Kanpur, Lucknow, Meerut, Moradabad, Varanasi (MCs) with NEDA	M/s Byford Leasing Ltd. BOO Up state electricity board to buy power at tariff applicable to non-conventional energy projects.			MOU signed. NEDA invited proposals through a global tender separately for each city.

SOURCE : (1) Mehta Meera (May 1999), "A Review of Public-Private partnerships in Water and Sanitation Sector in India", Water and Sanitation Group, Department for International Development, India.

(2) Resource material (1966), Workshop on power generation and energy recovery from MSW in Maharashtra, MEDA, Pune.

(3) HUDCO Brochure (April 1999), HUDCOs Role in Waste Management.

(4) MNES Annual Report.

(5) Discussions with HUDCO, IDFC, MNES.

Annex 5.5

PSP—Resource Recovery Projects—Waste to Energy (Biomethanation)—Proposed

Sl. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
1.	Brihan Mumbai Municipal Corporation.	BOO 1. Sound Craft Industries (technology collaboration with Ericsson America) 2. Bermaco Energy Systems Ltd. (technology collaboration with Neslter Ecotec Pvt. Ltd., a 100 per cent subsidiary of Ecotec Skanska, Finland). and 3. EDL India Ltd., (technology collaboration with EDL Australia)	1000 TPD each totaling 3000 TPD		The city has tied up with three separate firms for setting up a 1000 TPD waste to energy facilities each, on a BOO basis. A committee constituted by experts from MEDA, NEERI, MSEB, MRCB, Members of MNES, and scientist from Bangalore ISE reviewed these three porposals. The improvement committee and corporation sanctioned the projects in the year 2000. Two of these facilities will be sited at the Deonar waste site while the third will be at the Chincholi plant site at Malad.

SOURCE : (1) Discussions with BMC

Annex 5.6

PSP—Resource Recovery Projects—Waste to Energy (Pelletisation)

Sl. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
	Andhra Pradesh				
1.	Hyderabad	BOO-Private entrepreneur in association with Hyderabad Municipal Corporation	700		Facility to produce 210 TDP of RDF Pellets. Pelletisation technology developed by the Department of Science and Technology (DST). The pellets so produced would be used for industrial fuel initially and for 6 MW power generation ultimately. One line of 105 TDP fuel pellets has been established (yr. 2000) and is under trial operations.
2.	Vijaywada MC	UCAL	200		Agreement signed, however the project got stalled during the project development stage.
	Vijaywada MC	BOO-Entrepreneur tied up with Vijaywada Municipal Corporation			Produce RDF pellets from MSW and generate power from these pellets. The facility will also utilize waste from nearby Guntur city.
	Gujarat				
3.	Baroda				Closed down
	Karnataka				
4.	Bangalore				Closed down
	Maharashtra				
5.	Mumbai MC (Deonar)	Department of Science and Technology, GOI	150		Pilot plant set up in 1991, to produce 80 TPD of pellets Closed down
6.	Kalyan MC	BOOT-20 years M/s Future Fuels with Excel	150		Fixed fee Rs. 2.5 million/ annum, increased at 10 per cent per annum Right to collect addition garbage with KMC permission. Project recommended to Foreign Investment Promotion Board for clearance Cleared by FIPB

SOURCE : (1) Mehta Meera (May 1999), "A Review of Public-Private partnerships in Water and Sanitation Sector in India," Water and Sanitation Group, Department for International Development, India.

(2) Resource material (1996), Workshop on power generation and energy recovery from MSW in Maharashtra, MEDA, Pune.

Annex 5.7

PSP—Resource Recovery Projects—Waste to Energy (Incineration)

Sl. No.	State Agency/City	Implementation Arrangements and Private Promoter	Treatment Capacity TPD	Estd. Project Costs (Rs. Mill)	Current Status/Remarks
	Delhi				
1.	Delhi, Timarpur		Incinera-tion		Closed down since the input waste composition did not match technology requirement.
			(Danish funding, techno-logy)		At present the facility is under the ownership of MNES and is managed by DESU. Recently efforts were initiated to operationalise this incineration plant by involving a private entrepreneur and the Government of NCT of Delhi. Several meetings were held between the Government of NCT of Delhi DESU and entrepreneurs. A power purchase agreement with DESU was also discussed. Finally in May 2000 tenders were invited. Since no party could meet the ministries terms and conditions, environmental requirements and investment requirements and since the incineration facility and technology are almost 14 years old, the ministry has now decided to dismantle and sell the facility.

SOURCE : (1) Resource Material (1996), Workshop on power generation and energy recovery from MSW in Maharashtra MEDA. Pune.

(2) Newspaper articles.

(3) MNES

ANNEXURE—6

Government of India

MINISTRY OF URBAN DEVELOPMENT AND POVERTY ALLEVIATION

Central Public Health & Environmental Engg. Organisation New Delhi

ATTENTION

Solid Waste Management (SWM) Technology Providers, SWM Vehicle & Equipment Manufacturers & Suppliers

The Ministry of Urban Development & Poverty Alleviation has constituted a core group to identify appropriate SWM technologies vehicles & equipments suitable under Indian conditions to help urban local bodies in India in improving SWM practices.

All SWM technology providers and manufacturers /suppliers of SWM vehicles and equipments are invited to furnish details of their technology/vehicles/equipments together with information of their technology/product in a prescribed proforma obtainable from :

Shri K. A. Roy,
Asstt. Adviser (CPHEEO),
Room No. 528-A,
Central Public Health & Environmental Engg. Organisation,
Ministry of Urban Development & Poverty Alleviation,
Nirman Bhawan,
New Delhi-110011
Telefax : 3015043, Fax : 3014459
E.Mail : ramprasad@nb.nic.in

The information should reach at the above address on or before 22nd July, 2000 with an indication whether they would be willing to come at their own cost to make a small presentation at Delhi on 2nd & 25th August, 2000 or at a later date if invited to do so.

Dr. S. R. Shukla,
Advisor (PHEE), CPHEEO & Chairman
of Technology Advisory Group
on Solid Waste Management

ANNEXURE—7

GOVERNMENT OF INDIA

Ministry of Urban Development and Poverty Alleviation

Central Public Health & Environmental Engineering Organization, New Delhi

ATTENTION

NGOs working in the field of Solid Waste Management (SWM).

The Ministry of Urban Development & Poverty Alleviation has constituted a core group which amongst others will also identify the role of NGOs in citizen participation, involvement of waste pickers etc. The methodology and communication tools used for this purpose also have to be identified.

All NGOs working in the above mentioned aspects of SWM are invited to furnish details of their experience in the form of a profile to :

Shri M. Dhinadhayalan,
Asstt. Adviser (PHE),
Room No. 528-A,
Central Public Health and Environmental
Engineering Organisation,
Ministry of Urban Development and Poverty Alleviation,
Nirman Bhawan,
New Delhi-110 011.
Telefax : 3015043, Fax : 3014459
Email : ramprasad@nb.nic.in

The information profile should reach at the above address on or before July 22, 2K with an indication whether they would be willing to come at their own cost to make a small presentation at Delhi on August 03, 2K or at a later date if invited to do so.

Dr. S.R. Shukla,
Adviser (PHEE), CPHEEO & Chairman of Technology
Advisory Group on Solid Waste Management

Advertised in 'Statesman' Delhi Edition July 15, 2K

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ANNEXURE—8

Details of Some NGOs Engaged in Public Awareness Programs

1. Name & Address of NGO : Society for Research, Development and Communication Guwahati (Assam).

2. Represented by : Dr. Mahfuza Rahman, Secretary

3. Date Established : —

4. Main Areas of Activity :

   * To work in partnership with city authorities to find an appropriate method of waste collection and disposal in Guwahati
   * To create awareness among citizens
   * Use of domestic waste as manure
   * Construct roadside bins
   * Involve women in monitoring of vermi-composting

5. Significant Achievements in the area of SWM :

   * Carried out studies in Guwahati on the above aspects

1. Name & Address of NGO : Mass Education, 14/1, Townshend Road, Calcutta-700025.

2. Represented by : Mr. Sukumar Singh, Secretary General, Mass Education

3. Date Established : Working since 1978

4. Main Areas of Activity :

   * Mass Education
   * Micro finance for women empowerment
   * HRD training for target group
   * Mainstreaming of rag pickers

5. Significant Achievements in : the area of SWM

   * Undertaken garbage collection activities involving joint efforts of ragpickers, NGOs and Municipal Authorities
   * Used various approaches such as seminars, workshops, organised rallies to generate public awareness
   * Prepared and distributed posters, handouts, slides etc.
   * Introduced covered tipper vehicles for door to door collection of waste
   * Introduced 3 wheeler trailer and covered handcart for collection of waste

* Introduced special covered vehicles for transportation of biomedical waste

* Ensured financial sustainability of the project through voluntary donations, service charges for services provided to local authorities and hospitals and by sale of recyclable material

1. Name & Address of NGO : Asian Centre for Organisation, Research & Development, C-126, Greater Kailash-I, New Delhi-110048.

2. Represented by : Dr. Neena Gulabani,
Director-Consultancy, ACCORD
Sub Program Coordinator

3. Date Established : 1981

4. Main Areas of Activity :

* Environment & Natural Resource Management

* Micro Enterprise Development

* Life Enrichment & Gender Equality

* Integrated Health & Population Education

* Organisation Development

* Organisation of Training

* Market Research & Evaluation Studies

* Psychometric Profiling for Selection and Development

* Audio-Visual Communication Aids

5. Significant Achievements in the area of SWM :

* Field Project on establishing a decentralized model of Domestic Solid Waste Management in a low income community (Harkesh Nagar) in Delhi during two years project (Jan. 1996—Jan. 1998).

* Field Project on Solid Waste Management in rural areas of Bharatpur with the farming community. Awareness Education Campaigns on "Reduction in use of plastics and innovative ways of re-using plastics" with focus on children in the rural areas of Bharatpur. It is a three years project. (Oct. 96—Oct. 99).

* ACCORD provides professional inputs on 'Solid Waste Management' in the Certificate courses for School teachers organized by SEE (Society for Environment Education)

* Presently conducting two studies on Solid Waste Management for Bharatpur Town (Rajasthan) and Kuppam Town (Andhra Pradesh) involving capacity building of key implementing agencies and stakeholders.

* Consultancy of Cement Ambuja for setting up the decentralized system of solid Waste Management in the residential colonies and school respectively.

* Implementing project on setting up improved Solid Waste Management systems with the Municipalities at Bharatpur, Rajasthan and Kuppam in Andhra Pradesh with support from UNDP-WB.

* Implementing the project 'Upgrading Environmental Quality of Delhi' in partnership with Department of Urban Development, Delhi Government and MoEF, focusing on Solid Waste Management in Central Zone, MCD and Circle-3 of NDMC.

The project focuses on creating awarencess through plays, competitions, puppetry, group meetings etc. Posters, handbills and response sheets are distributed. A half hourly weekly program on AIR-FM started from July 16, 2K every Sunday during 07.30 to 08.00 A.M. entitled 'Aao Dilli Sawaren'.

Training of sanitary workers, private sweepers and Resident Welfare Association Workers is carried out.

1. Name & Address of NGO : Apnalaya,
New Jalphalawadi, Armed Police Colony,
Building No. 7, Tardeo,
Mumbai-400036

2. Represented by : Dr. Dyaneshwar Tarwade,
Assistant Director

3. Date Established : 1972

4. Main Areas of Activity :

* Develop local talent, knowledge, skills on expressed needs and also train local leadership and encourage self sufficiency
* Training programmes on leadership development and vocational training
* Meeting, home and site visits
* Counselling

5. Significant Achievements in the area of SWM

* Working with dumping ground workers since 1996
* Involved in education of children, women through Balawadi, Health Education and Awareness programmes
* Formation of saving and credit groups
* Formed Kachara Kamgar Sangathana on May 01, 1999 with 320 persons
* Since January 2000, I Card provided to 120 members
* Arranged Gynaec Clinics.

1. Name & Address of NGO : Stree Mukti Sangathana,
31, Sharamik, Lokmanya Tilak Colony,
Road No. 3, Mumbai-400014.

2. Represented by : Ms. Jyoti Mhapsekar,
President

3. Date Established : 1975

4. Main Areas of Activity :

* Counselling centres
* Day care centres
* Awareness campaigns
* Anti dowry campaigns
* Literacy campaigns
* Publication of books, posters, audio & video cassettes on the above topics and Advance Locality Management (ALM) newsletter
* Magazine
* Jidnyasa-project for school children
* Cultural troops, songs, plays etc.

5. Significant Achievements in the area of SWM

* Survey of 2000 women ragpickers out of which 1500 are members of the organisation now.
* Ragpickers were issued identity cards with the endorsement from Municipal Corporation of Greater Mumbai.
* A piece of land next to dumping ground was procured from Municipal Corporation and training-cum-community centre is constructed
* Balwadis were started in the communities with the help of Pratham Organisation, working on universalisation of Primary Education.
* Health camps were held with the help of Local Lions Clubs and Family Planning Association of India. Group Insurance scheme will be introduced in August 2000
* Creche, for the children of ragpickers, was started with the funds from Central Social Welfare Board in the Community Centre next to the Deonar dumping ground.
* 130 groups are established with a group leader, out of which 70 groups have already started working as saving groups and are in the process of forming a federation.
* Two training centres were established, in M-ward, for training ragpickers in biocomposting, vermicultrue and gardening.
* Work, which stated in M-ward has now spread to N-ward (Ghatkopar), L-ward (Kurla), G-ward (N) (Dharavi, Pratiksha Nagar, Mahim), and S-ward (Kanjurmarg) wards with the establishment of eight more local centres.
* Two awareness and leadership development camps were organised, for the group leaders with the help of Workers Education Centre. Awareness material developed by SMS over the year is extensively used for this purpose.

Name & Address of NGO : Centre for Environment Education,
Southern Regional Cell,
143, Infantry Road,
Bangalore - 560 001.

2. Represented by : Ms. Shyamala Krishna,
Coordinator, CEE Delhi Office;
S-230, Greater Kailash Part I,
New Delhi - 110 048.

3. Date Established : 1984

4. Main Areas of Activity :

* Environmental Education
* Training programmes
* Prepare and distribute Posters, Pamphlets, organise Rallies
* Field oriented work with waste pickers, composting

5. Significant Achievements in :
the area of SWM

* Prepared pamphlets, brochures
* Carried out education of citizens on need for source separation at Bangalore
* Organised waste pickers and arranged house to house collection in pilot areas in Bangalore
* Organised vermi-composting and sale of the same
* A film on the above activities

1. Name & Address of NGO : Tiljala Shed,
Development Tiljala Society for Human and Educational
6/C, Rifle Range Road, Calcutta - 700 019

2. Represented by : Ms. Nandini Sen,
Coordinator of Rag Pickers Project

3. Date Established : 1987

4. Main Areas of Activity :

* Educational and Cultural Upliftment Programme
* Health Care Programme (Preventive and Curative)
* Community Organization, Education, General Awareness
* Motivation for adolescant girls and destitute Women and Society in general
* Entrepreneurship Development Programmes for vulnerable children. Focus the role of Rag Pickers in Recycling and campaigns like keep the city clean and green.
* Environment upgradation through Scientific Waste Collection using door to door collection of segregated garbages involving the waste pickers (300 direct and 500 indirect)
* Establishment of the registered Association for rag pickers at two godowns at Narkeldanga and Park Circus for stocking and selling of waste by the rag pickers themselves at the most reasonable price under the guidance of T-SHED. At these godowns the children and the adult rag pickers can relax as share in their short leisure hours.

* Sponsorship and scholarship programmes for 100 girls, cash being paid to guardians for maintenance assistance, providing uniform, educational kit and overall medical facility.

* Networking with other NGOs, national and international forum for campaigning against pollution, child abuse (both physical and mental) and population productivity, poverty, contagious diseases, lack of education, Corruption. Empowerment of slum's adolescent boys, girls and women through Social-Economic programmes (500 direct). The NGO is involved with City Level Plan Of Action (CLPOA).

5. Significant Achievements in :
the area of SWM

* The activities of the organization involve providing of non-formal education, periodical medical check up for the children and their family members, godown facilities for the rag pickers children, formation of rag pickers association and collection of solid waste from different corporate houses.

ANNEXURE—9

The Bio-Medical Waste (Management & Handling) Rules, 1998

MINISTRY OF ENVIRONMENT AND FORESTS

NOTIFICATION

New Delhi, the 20th July, 1998

S.O. 630(E).—Whereas a notification in exercise of the powers conferred by Sections 6, 8 and 25 of the Environment (Protection) Act, 1986 (29 of 1986) was published in the Gazette vide S.O. 746(E) dated 16th October, 1997 inviting objections from the public within 60 days from the date of the publication of the said notification on the Bio-Medical Waste (Management and Handling) Rules, 1998 and whereas all objections received were duly considered.

Now, therefore, in exercise of the powers conferred by Sections 6, 8 and 25 of the Environment (Protection) Act, 1986 the central Government hereby notifies the rules for the management and handling of bio-medical waste.

1. Short title and commencement :

(1) These rules may be called the **Bio-Medical Waste (Management and Handling) Rules, 1998.**

(2) They shall come into force on the date of their publication in the Official Gazette.

2. Application :

These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form.

3. Definitions :

In these rules unless the context otherwise requires :—

(1) **"Act"** means the Environment (Protection) Act, 1986 (29 of 1986);

(2) **"Animal House"** means a place where animals are reared/kept for experiments or testing purposes;

(3) **"Authorisation"** means permission granted by the prescribed authority for the generation, collection, reception, storage, transportation, treatment, disposal and/or any other form of handling of bio-medical waste in accordance with these rules and any guidelines issued by the Central Government.

(4) **"Authorised Person"** means an occupier or operator authorised by the prescribed authority to generate, collect, receive, store, transport, treat, dispose and/or handle bio-medical waste in accordance with these rules and any guidelines issued by the Central Government.

(5) **"Bio-Medical Waste"** means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals, and including categories mentioned in Schedule I.

(6) **"Biologicals"** means any preparation made from organisms or micro-organisms or product of metabolism and biochemical reactons intended for use in the diagnosis, immunisation or the treatment of human beings or animals or in research activities pertaining thereto.

(7) **"Bio-medical waste treatment facility"** means any facility wherein treatment, disposal of bio-medical waste or processes incidental to such treatment or disposal is carried out.

(8) **"Occupier"** in relation to any institution generating bio-medical waste, which includes a hospital, nursing home, clinic dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called, means a person who has control over that institution and/or its premises.

(9) **"Operator of a bio-medical waste facility"** means a person who owns or controls or operates a facility for the collection, reception, storage, transport, treatment, disposal or any other form of handling of bio-medical waste.

(10) **"Schedule"** means schedule appended to these rules;

4. Duty of Occupier :

It shall be the duty of every occupier of an institution generating bio-medical waste which includes a hospital, nursing home, clinic, dispensary, veterinary institution, animal house, pathological laboratory, blood bank by whatever name called to take all steps to ensure that such waste is handled without any adverse effect to human health and the environment.

5. Treatment and Disposal

(1) Bio-medical waste shall be treated and disposed of in accordance with **Shedule I,** and in compliance with the standards prescribed in **Schedule V.**

(2) Every occupier, where required, shall set up in accordance with the time-schedule in **Schedule VI,** requisite bio-medical waste treatment facilities like incinerator, autoclave, microwave system for the treatment of waste, or, ensure requisite treatment of waste at a common waste treatment facility or any other waste treatment facility.

6. Segregation, Packaging, Transportation and Storage :

(1) Bio-medical waste shall not be mixed with other wastes.

(2) Bio-medical waste shall be segregated into containers/bags at the point of generation in accordance with **Schedule II** prior to its storage, transportation, treatment and disposal. The containers shall be labeled according to **Schedule III.**

(3) If a container is transported from the premises where bio-medical waste generated to any waste treatment facility outside the premises, the container shall, apart from the label prescribed in **Schedule III,** also carry information prescribed in **Schedule IV.**

(4) Notwithstanding anything contained in the **Motor Vehicle Act, 1988,** or rules thereunder untreated bio-medical waste shall be transported only in such vehicle as may be authorised for the purpose by the competent authority as specified by the government.

(5) No untreated bio-medical waste shall be kept stored beyond a period of 48 hours :

Provided that if for any reason it becomes necessary to store the waste beyond such period, the authorised person must take premission of the prescribed authority and take measures to ensure that the waste does not adversely affect human health and the environment.

7. Prescribed Authority :

(1) The Government of every State and the Union territory shall establish authority with such members as may be specified for granting authorisation and implementing these rules. If the prescribed authority comprises of more than one member, a chairperson for the authority shall be designated.

(2) The prescribed authority shall function under the supervision and control of the respective Government of the State or Union Territory.

(3) The prescribed authority shall function under the supervision and control of the respective Government of the State or the Union Territory.

(4) The prescribed authority shall on receipt of **Form I** make such enquiry as it deems fit and if it is satisfied that the applicant possesses necessary capacity to handle bio-medical waste in accordance with these rules, grant or renew an authorisation as the case may be.

(5) An authorisation shall be granted for a period of **three years**, including an initial trial period of **one year** from the date of issue. Thereafter, an application shall be made by the occupier/operator for renewal. All such subsequent authorisation shall be for a period of **three years**. A provisional authorisation shall be granted for the trial period, to enable the occupier/operator to demonstrate the capacity of the facility.

(6) The prescribed authority may after giving reasonable opportunity of being heard to the applicant and for reasons thereof to be recorded in writing, refuse to grant to renew authorisation.

(7) Every application for authorisation shall be disposed of by the prescribed authority within ninety days from the date of receipt of the application.

(8) The prescribed authority may cancel or suspend an authorisation, if for reasons, to be recorded in writing, the occupier/operator has failed to comply with any provision of the Act or these rules :

Provided that no authorisation shall be cancelled or suspended without giving a reasonable opportunity to the occupier/operator of being heard.

8. Authorisation :

(1) Every occupier of an institution generating, collecting, receiving, storing, transporting, treating, disposing and/or handling bio-medical waste in any other manner, except such occupier of clinics, dispensaries, pathological laboratories, blood banks, providing treatment/service to less than 1000 (one thousand) patients per month, shall make an application in **Form I** to the prescribed authority for grant of authorisation.

(2) Every operator of a bio-medical waste facility shall make an application in **Form I** to the prescribed authority for grant of authorisation.

(3) Every application in **Form I** for grant of authorisation shall be accompanied by a fee as may be prescribed by the Government of the State or Union Territory.

9. Advisory Committee :

The Government of every State/Union Territory shall constitute an advisory committee. The committee will include experts in the field of medical and health, animal husbandry and veterinary sciences, environmental management, municipal administrarion, and any other related department or organisation including non-governmental organisations. The State Pollution Control Board/Pollution Control Committee shall be represented. As and when required, the committee shall advise the Government of the State/Union Territory and the prescribed authority about matters related to the implementation of these rules.

10. Annual Report :

Every occupier/operator shall submit an annual report to the prescried authority in **Form II by 31 January every year,** to include information about the categories and quantities of bio-medical wastes handled during the preceding year. The prescribed authority shall send this information in a compiled form to the Central Pollution Control Board by 31 March every year.

11. Maintenance of Records :

(1) Every authorised person shall maintain records related to the generation, collection, reception, storage, transportation, treatment, disposal, and/or any form of handling of bio-medical waste in accordance with these rules and any guidlines issued.

(2) All records shall be subject to inspection and verification by the prescribed authority at any time.

12. Accident Reporting :

When any accident occurs at any institution or facility or any other site where bio-medical waste is handled or during transportation of such waste, the authorised person shall report the accident in **Form III** to the prescribed authority forthwith.

13. Appeal :

Any person aggrieved by an order made by the prescribed authority under these rules may, within thirty days from the date on which the order is communicated to him, prefer an appeal to such authority as the Government of State/Union Territory may think fit to constitute :

Provided that the authority may entertain the appeal after the expiry of the said period of thirty days if it is satisfied that the appellant was prevented by sufficient cause from filing the apeal in time.

SCHEDULE I

(See Rule 5)

CATEGORIES OF BIO-MEDICAL WASTE

Option	Waste Category	Treatment and Disposal
1	2	3
Category No. 1	**Human Anatomical Waste** (human tissues, organs, body parts)	Incineration@/deep burial*
Category No. 2	**Animal Waste** (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals animal houses)	Incineration@/deep burial*
Category No. 3	**Microbiology & Biotechnology Waste** (wastes from laboratory cultures, stocks or speciminens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of bilogicals toxins, dishes and devices used for transfer of cultures)	Local autoclaving/ microwaving/ incineration@
Category No. 4	**Waste Sharps** (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	disinfection by chemical treatment@@/auto claving/micro-waving and mutilation/shredding##
Category No. 5	**Discarded Medical and Cytotoxic drugs** (wastes comprising or outdated, contaminated and discarded medicines)	Insineration@/destruction drugs disposal in secured landfills
Category No. 6	**Solid Waste** (Items contaminated with blood, and body, fluids including cotton, dressings, soiled plaster casts, lines beddings, other material contaminated with blood)	incineration@/autoclaving/ microwaving
Category No. 7	**Solid Waste** (wastes generated from disposable items other than the waste sharps such as tubings, catheters, in travenous sets etc.)	disinfection by chemical treatment@@ autoclaving/microwaving and mutilation/shredding#
Category No. 8	**Liquid Waste** (waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities)	disinfection by chemical treatment@@and discharge into drains.

1	2	3
Category No. 9	**Incineration Ash**	
	(ash from incineration of any bio-medical waste)	disposal in municipal landfill
Category No. 10	**Chemical Waste**	
landfill	(chemicals used in production of biologicals, chemicals used in disinfection, as insecticiedes, etc.)	chemical treatment[@@] and discharged into drains for liquids and secured for solids.

[@@] *Chemicals treatment using at least 1% hypochlorite solution or any other equivalent chemical reagent. It must be ensured that chemical treatment ensures disinfection.*

[*] *Mutilation/shredding must be such so as to prevent unauthorised reuse.*

[$] *There will be no chemical pretreatment before incineration. Chlorinated plastics shall not be incinerated.*

[-] *Deep burial shall be an option available only in towns with population less than five lakhs and in rural areas.*

SCHEDULE II

(See Rule 6)

COLOUR CODING AND TYPE OF CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTES

Colour Coding	Type of Container	Waste Category	Treatment options as per Schedule I
Yellow	Plastic bag	Cat. 1, Cat. 2, and Cat. 3, Cat. 6	Incineration/deep burial
Red	Disinfected container/ plastic bag	Cat. 3, Cat. 6, Cat. 7	Autoclaving/ Microwaving Chemical Treatment
Blue/ White translucent	Plastic bag/ puncture proof container	Cat. 4, Cat. 7,	Autoclaving/ Microwaving Chemical Treatment and destruction / shredding
Black	Plastic bag	Cat. 5, and Cat. 9 Cat. 10 (solid)	Disposal in secured landfill

Notes :

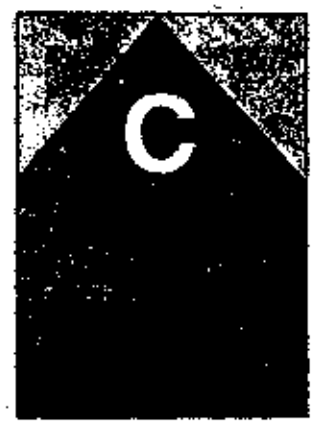
1. *Colour coding of waste categories with multiple treatment options as define in Schedule1, shall be selected depending on treatment option chosen, which shall be as specified in Schedule 1.*
2. *Waste collection bags for waste types needing incineration shall not be made of chlorinated plastics.*
3. *Categories 8 and 10 (liquid) do not require containers/bags.*
4. *Category 3 if distnfected locally need not be put in containers/bags.*

SCHEDULE III

(See Rule 6)

LABEL FOR BIO-MEDICAL WASTE CONTAINERS/BAGS

BIOHAZARD



CYTOTOXIC

HANDLE WITH CARE

Note : Label shall be non-washable and prominently visible.

SCHEDULE IV

(See Rule 6)

LABEL FOR TRANSPORT OF BIO-MEDICAL WASTE CONTAINERS/BAGS

Day..... Month .....

Year .....

Waste category No. .....

Date of generation .....

Waste class .....

Waste description .....

Sender's Name : & Address

Phone No. .....

Telex No. .....

Fax No. .....

Contact Person .....

Receiver's Name : & Address

Phone No. .....

Telex No. .....

Fax No. .....

Contact Person .....

In case of emergency please contact :

Name & Address :—

Phone No.

Note : Label shall be non-washable and prominently visible.

SCHEDULE V

(See Rule 5 and Schedule I)

STANDARDS FOR TREATMENT AND DISPOSAL OF BIO-MEDICAL WASTES

STANDARDS FOR INCINERATORS :

All incinerators shall meet the following operating and emission standards :

A. Operating Standards

1. Combustion Efficiency (CE) shall be atl east 99.00%.
2. The Combustion Efficiency is computed as follows :

$$C.E. = \frac{\%\ CO_2 \times 100}{\%\ CO_2 + \%\ CO}$$

3. The temperature of the primary chamber shall be 800 + 50 °C.
4. The secondary chamber gas residence time shall be at least 1 (one) second at 1050 °C± 50 °C, with minimum 3 % Oxygen in the stack gas.

B. Emission Standards

	Parameters	Concentration mg/Nm³ at (12 % CO_2 correction)
(1)	Particulate matter	150
(2)	Nitrogen Oxides	450
(3)	HC	50

(4) Minimum stack height shall be 30 metres above ground.

(5) Volatile organic compounds in ash shall not be more than 0.01 %.

Notes :

* Suitably designed pollution control devices should be installed/retrofitted with the incinerator to achieve the above emission limits, if necessary.
* Wastes to be incinerated shall not be chemically treated with any chlorinated disinfectants.
* Chlorinated plastics shall not be incinerated.
* Toxic metals in incineration ash shall be limited within the regulatory quantities as defined under the Hazardous Waste (Management and Handling Rules), 1989.
* Only low sulphur fuel like L.D.O./L.S.H.S./Diesel shall be used as fuel in the incinerator.

STANDARDS FOR WASTE AUTOCLAVING

The autoclave should be dedicated for the purposes of disinfecting and treating bio-medical waste.

(I) When Operating a gravity flow autoclave, medical waste shall be subjected to:

(i) a temperature of not less than 121 °C and pressure of 15 pounds per square inch (psi) for an autoclave residence time of not less than 60 minutes; or

(ii) a temperature of not less than 135 °C and a pressure of 31 psi for a autoclave residence time of not less than 45 minutes; or

(iii) a temperature of not less than 149 °C and a pressure of 52 psi for an autoclave residence time of not less than 30 minutes.

(II) When operating a vacuum autoclave, medical waste shall be subjected to a minimum of one pre-vacuum pulse to purge the autoclave of all air. The waste shall be subjected to the following :

(i) a temperature of not less than 121 °C and pressure of 15 psi per an autoclave residence time of not less than 45 mintures;

(ii) a temperature of not less than 135 °C and a pressure of 31 psi for a autoclave residence time of not less than 30 minutes; or

(III) Medical waste shall not be considered properly treated unless the time, temperature and pressure indicators indicate that the required time, temperature and pressure were reached during the autoclave process. If for any reasons, time temperature or pressure indicator indicates that the required temperature, pressure or residence time was not reached, the entire load of medical waste must be autoclaved again until the proper temperature, pressure and residence time were achieved.

(IV) Recording of operational parameters

Each autoclave shall have graphic or computer recording devices which will automatically and continuously monitor and record dates, time of day, load identification number and operation parameters throughout the entire length of the autoclave cycle.

(V) Validation Test

Spore testing;

The autoclave should completely and consistently kill the approved biological indicator at the maximum design capacity of each autoclave unit. Biological Indicator for autoclave shall be bacillus stearothermophilus spores using vials or spore strips with at least 1×10^4 spores per millilitre. Under no circumstances will an autoclave have minimum operating parameters less than a residence time of 30 minutes, regardless of temperature and pressure, a temperature less than 121 °C or a pressure less than 15 psi.

(VI) Routine Test

A chemical indicator strip/tape that changes colour when a certain temperature is reached can be used to verify that a specific temperature has been achieved . It may be necessary to use more than one strip over the waste package at different location to ensure that the inner content of the package has been adequately autoclaved.

STANDARDS FOR LIQUID WASTE

The effluent generated from the hospital should conform to the following limits :

PARAMETERS	PERMISSIBLE LIMITS
pH	6.5-9.0
Suspended solids	100 mg/l
Oil and grease	10 mg/l
BOD	30mg/l
COD	250 mg/l
Bio-assay test	90% survival of fish after 96 hours in 100% effluent.

These limits are applicable to those hospitals which are either connected with sewers without terminal sewage treatment plant or not connected to public sewers. For discharge into public sewers with terminal facilities, the general standards as notified under the Environment (Protection) Act, 1986 shall be applicable.

STANDARDS OF MICROWAVING

1. Microwave treatment shall not be used for cytotoxic, hazardous or radioactive wastes, contaminated animal carcasses, body and large metal items.
2. The microwave system shall comply with the efficacy test / routine tests and a performance guarantee may be provided by the supplier before operation of the unit.
3. The microwave should completely and consistently kill the bacteria and other pathogenic organisms that is ensured by approved biological indicator at the maximum design capacity of each microwave unit. Biological indicators for microwave shall be *Bacillus subtilis* spores using vials or spore strips with at least 1×10^4 spores per milliliter.

STANDARDS FOR DEEP BURIAL

1. A pit or trench should be dug about 2 meters deep. It should be half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of the pit with soil.
2. It must be ensured that animals do not have any access to burial sites. Covers of galvanised iron/ wire meshes may be used.
3. On each occasion, when wastes are added to the pit, a layer of 10 cm of soil shall be added to cover the wastes.
4. Burial must be performed under close and dedicated supervision.
5. The deep burial site should be relatively impermeable and no shallow well should be close to the site.
6. The pits should be distant from habitation, and sited so as to ensure that no contamination occures of any surface water or ground water. The area should not be prone to flooding or erosion.
7. the location of the deep burial site will be authorised by the prescribed authiority.
8. The institution shall maintain a record of all pits for deep burial.

SCHEDULE VI

(See Rule 5)

SCHEDULE FOR WASTE TREATMENT FACILITIES LIKE INCINERATAR/AUTOCLAVE/MICROWAVE SYSTEM

A.	Hospitals and nursing homes in towns with population of 30 lakhs and above	by 31st December, 1999 or earlier
B.	Hospitals and nursing homes in town with population of below 30 lakhs.	
	(a) with 500 beds and above	by 31st December, 1999 or earlier
	(b) with 200 beds and above but less than 500 beds	by 31st December, 2000 or earlier
	(c) with 50 beds and above but less than 200 beds	by 31st December, 2001 or earlier
	(d) with less than 50 beds	by 31st December, 2002 or earlier
C.	All other institutions generating bio-medical waste not included in A and B above.	by 31st December, 2002 or earlier

FORM 1

(See rule 8)

APPLICATION FOR AUTHORISATION

(To be submitted in duplicate)

To,

The Prescribed Authority
(Name of the State Govt./UT Administration)
Address :

1. Particulars of Applicant :
   (i) Name of the Applicant :
   (in block letters & in full)
   (ii) Name of the Institution :
   Address :

   Tel No. : Fax No.: Telex No. :

2. Activity for which authorisation is sought :
   (i) Generation
   (ii) Collection
   (iii) Reception
   (iv) Storage
   (v) Transportation
   (vi) Treatment
   (vii) Disposal
   (viii) Any other form of handling
3. Plaease state whether applying for fresh authorisation or for renewal :
   (In case of renewal previous authorisation number and date)
4. (i) Address of the institution handling bio-medical wastes :
   (ii) Address of the place of the treatment facility :
   (iii) Address of the place of disposal of the waste :
5. (i) Mode of transportation (in any) of bio-medical waste :
   (ii) Mode(s) of treatment :
6. Brief description of method to treatment and disposal (attach details)
7. (i) Category (See Schedule I) of waste to be handled
   (ii) Quantity of waste (category-wise) to be handled per month
8. **Declaration :**

   I do hereby declare that the statements made and information given above are true to the best of my knowledge and belief and that I have not concealed any information.

   I do also hereby undertake to provide any further information sought by the prescribed authority in relation to these rules and to fulfill any conditions stipulated by the prescribed authority.

Date : Signature of the applicant

Place : Designation of the applicant

FORM II

(See rule 10)

ANNUAL REPORT

(To be submitted to the Prescribed Authority by 31st January every year)

1. Particulars of Applicant :
   (i) Name of the authorised person (occupier/operator) :
   (ii) Name of the institution :
   Address
   Tel. No.
   Fax. No.
   Telex No.
2. Categories of waste generated and quantity on a monthly average basis.
3. Brief details of the treatment facility :
   In case of off-site facility : .
   (i) Name of the operator
   (ii) Name and address of the facility :
   Tel No. Fax No. Telex No. :
4. Category-wise quantity of waste treated :
5. Mode of treatment with details :
6. Any other information :
7. Certified that the above report is for the period from .....
   .....

Date . . . . . Signature .....

Place ..... Designation .....

FORM III

(See rule 12)

ACCIDENT REPORTING

1. Date and time of accident :
2. Sequence of events leading to accident :
3. The waste involved in accident :
4. Assessment of the effects of the accidents on human health and the environment :
5. Emergency measures taken :
6. Steps taken to alleviate the effects of accidents :
7. Steps taken to prevent the recurrence of such an accident :

Date ..... Signature .....

Place ..... Designation .....

[F. No. 23-2/96-HSMD]

VIJAY SHARMA

Joint Secretary

Source : The Gazette of India, Extraordinary, Part-II, Section 3-Sub-section (ii) Published by Authority, Delhi No. 460 Dtd. : 27-7-1998. Printed by the Manager, Govt. of India Press Ring Road, Mayapuri, New Delhi-110064 and published by the Controller of Publications, Delhi-110054-1998.

ANNEXURE—10

PARTICIPATORY LEARNING TOOL ON SOLID WASTE MANAGEMENT

Guidelines for the Trainer/Facilitator

1. The Tool consists of 46 Picture Cards on Solid Waste Management.
2. There are 4 Categories of picture cards. These are based on the activity for which these will be used. The four categories are :—
   - 16 Picture Cards with **red dots** on Good and Bad Practices of Solid Waste.
   - 12 Picture Cards with **black dots** on consequences of good and bad practices of Solid Waste.
   - 10 Picture Cards with **green dots** on Solid Waste Management Cycle.
   - 8 Picture Cards with **blue dots** on Community Action for improved Solid Waste Management.
3. The four activities based on these picture cards will require atleast four hours.
4. It is not essential that all the four activities must be done. The facilitator can use any activity depending upon the kind of the participants.
5. Use this participatory learning tool, with a group of 25—30 participants.
6. Before starting the activities, divide the participants into sub-groups of 5 members.
7. Ensure that all the participants participate equally.
8. Give the instructions clearly and manage time well.
9. Don't give any inputs while the groups are working but help the groups to understand the objective of the activity and provide all information once they have presented the work done on each activity.

3221 UD & PA/05—37

PARTICIPATORY LEARNING TOOL
ON
SOLID WASTE MANAGEMENT

Activity 1 : Sorting out cards into 3 Categories—Good practices, Bad practices & Neutral

Objective : Participants will be able to understand and differentiate between good and bad practices of solid waste management.

Materials :

- Sets of 16 picture cards with red dots. The number of sets required will depend upon the number of sub-groups.
- Three charts per sub-group. The number of charts required will also depend upon the number of sub-groups.
- Colored markers, tape, thumb pin, display boards.

Time : 50-min.

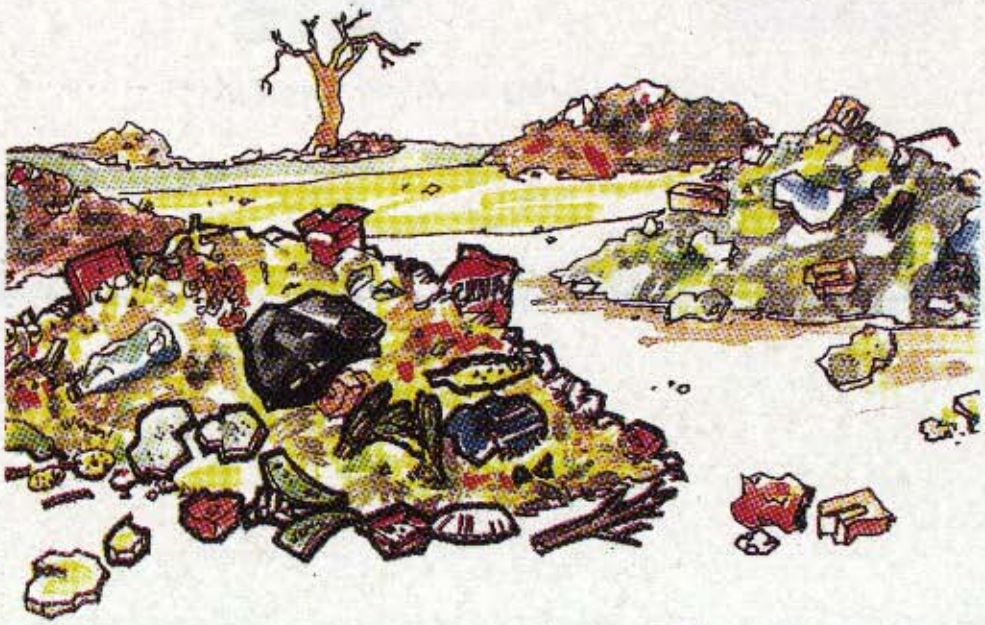
Methodology :

1. Give each sub-group the set of picture cards. These should be jumbled. **(1 min.)**
2. Give each sub-group 3 chart-papers marked A, B & C. **(2 min.)** Ask the sub-groups to sort out the picture cards and place them in three categories—good practices, bad practices and neutral.

   Chart paper marked 'A', to be used to place all the picture cards that the sub-group has kept under good-practices. Chart Paper marked 'B' to be used for keeping picture cards on bad practices. Chart paper marked 'C' to be used for placing the picture cards that the sub-group considers neutral. Each sub-group numbers should be indicated on all the three charts A, B & C. Each member in the respective sub-group to participate in the activity. Each sub-group to put-up their charts in the pre-designated area. (As an alternate, the picture cards can be arranged on the floor in three categories.) Each sub-group to designate the reporter. **(20 min.)**
3. Call each sub-group to present. Give only 2 min. Other sub-groups should be asked to come & see the charts and stand near the charts of the sub-group which is presenting. This will be repeated for all the sub-groups. **(15 min.)**
4. During each sub-group's presentation, don't allow any discussion. After each sub-group has presented, the facilitator should give his/her inputs, present the right sorting of the cards and discuss the good & bad practices. He/She should ask the group about what % age population follows good practices. **(10 min.)**

   Note for the Facilitator : *All cards indicate either good/bad practice. Help the group to get to a point so that they are able to identify their mistakes.*

16 PICTURE CARDS
(WITH RED DOTS)
ON GOOD AND BAD PRACTICES OF SOLID WASTE DISPOSAL

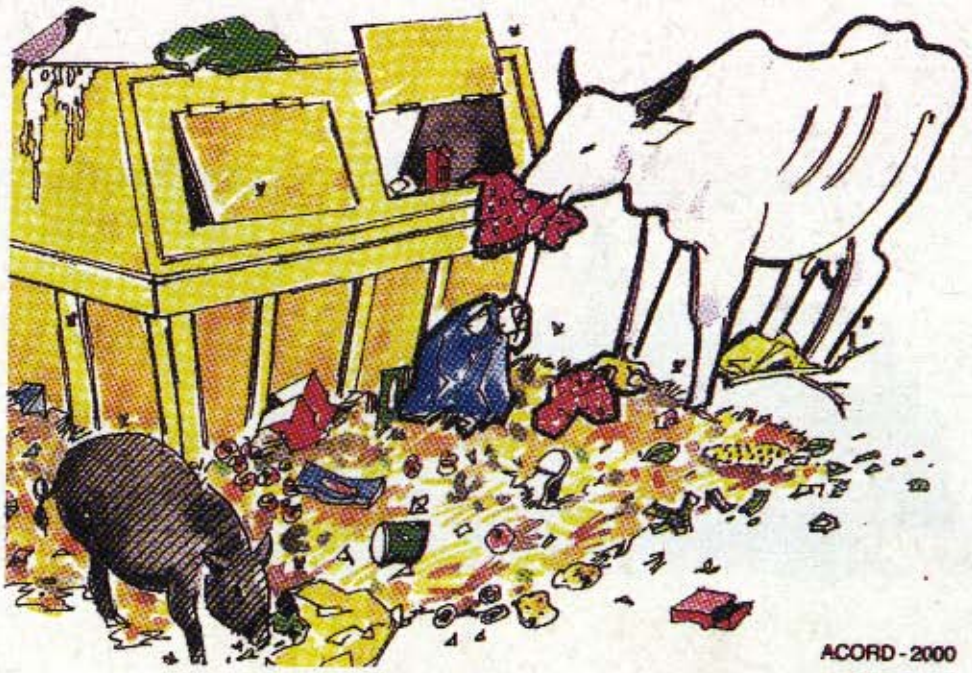


ACORD - 2000

BAD PRACTICE OF SOLID WASTE DISPOSAL

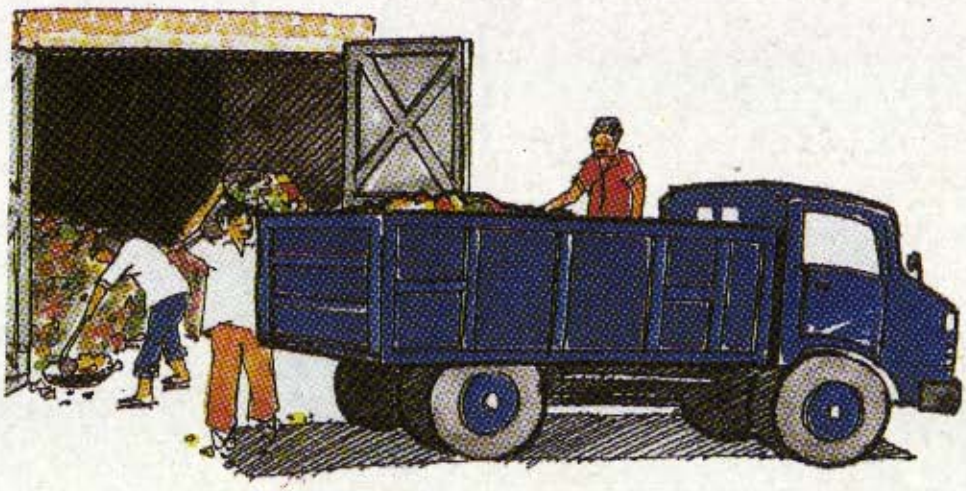
3221 UD & PA/03—38A

GOOD PRACTICE OF SOLID WASTE DISPOSAL



BAD PRACTICE OF SOLID WASTE DISPOSAL

GOOD PRACTICE OF SOLID WASTE DISPOSAL



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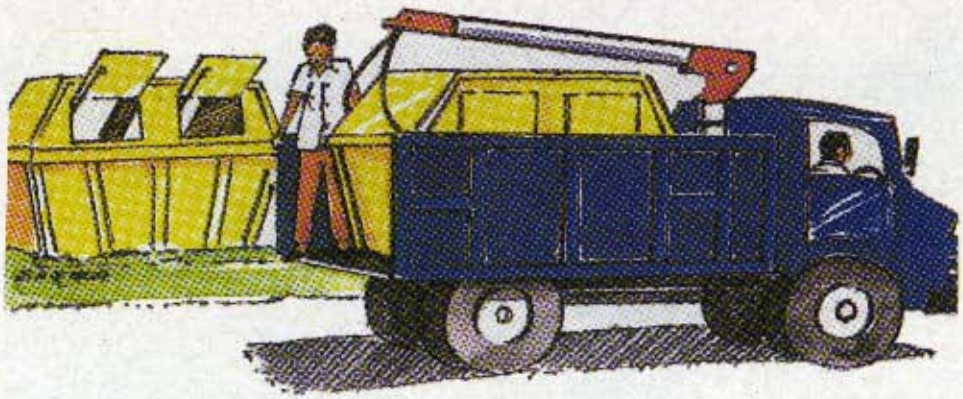
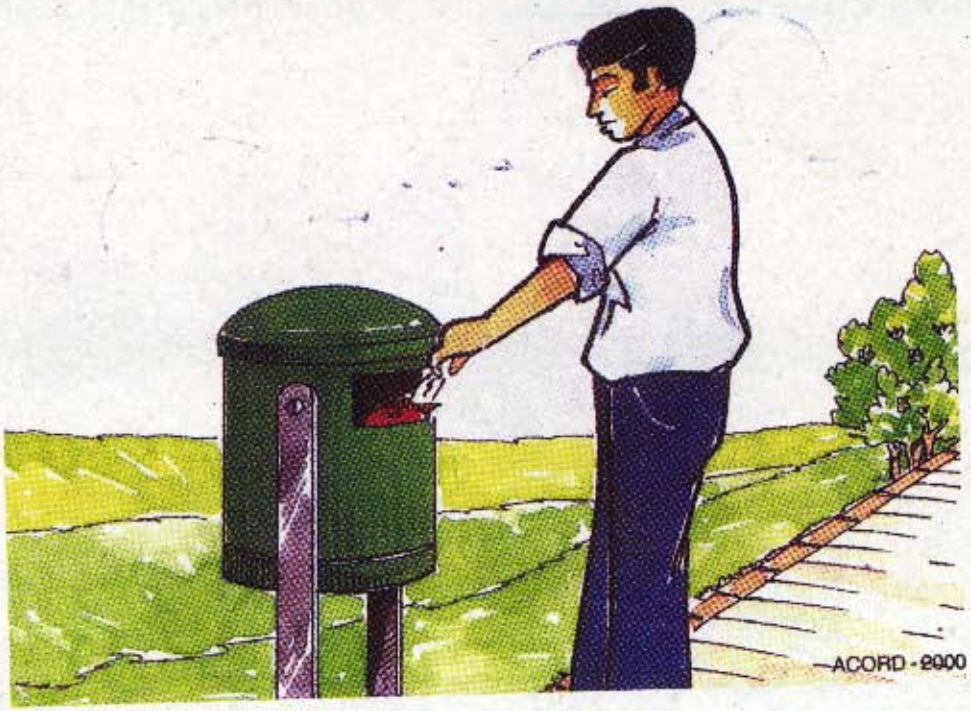


ACORD - 2000

GOOD PRACTICE OF SOLID WASTE DISPOSAL

BAD PRACTICE OF SOLID WASTE DISPOSAL



GOOD PRACTICE OF SOLID WASTE DISPOSAL

3221 UD&PA/03—39A

BAD PRACTICE OF SOLID WASTE DISPOSAL

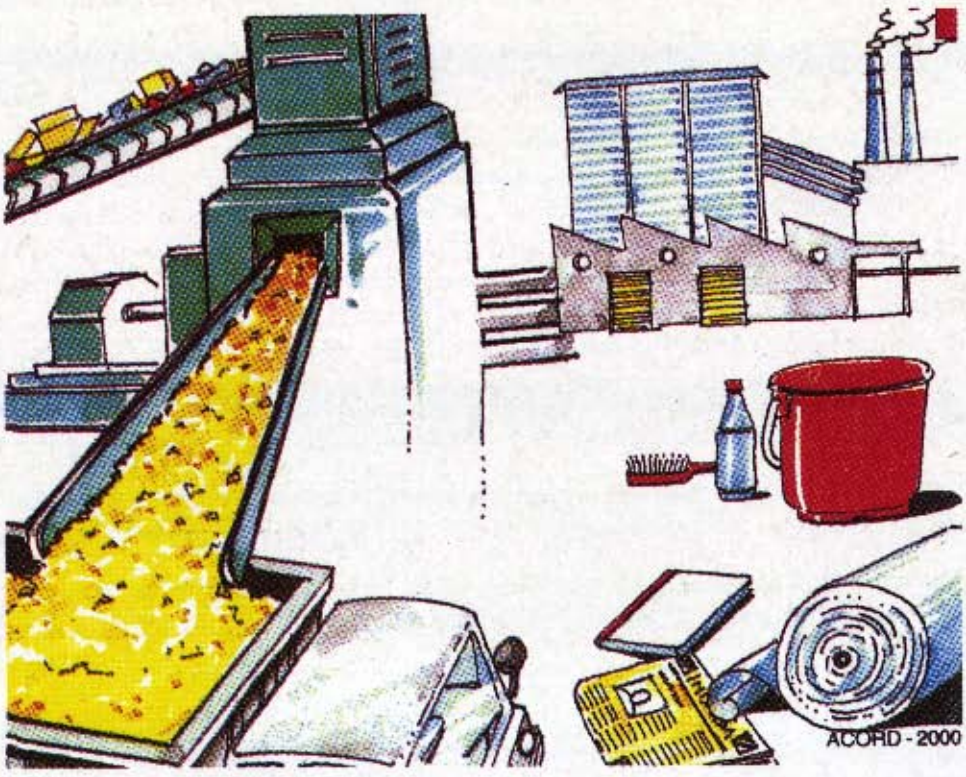
GOOD PRACTICE OF SOLID WASTE DISPOSAL

BAD PRACTICE OF SOLID WASTE DISPOSAL

GOOD PRACTICE OF SOLID WASTE DISPOSAL

BAD PRACTICE OF SOLID WASTE DISPOSAL

ACORD - 2000



ACORD - 2000

GOOD PRACTICE OF SOLID WASTE DISPOSAL

PARTICIPATORY LEARNING TOOL
ON
SOLID WASTE MANAGEMENT

Activity 2 : Mapping/Linking the Good and Bad practices with the consequences

Objective : Participants will be able to understand the consequences of good and bad practices of solid waste and their relationship to health.

Materials :

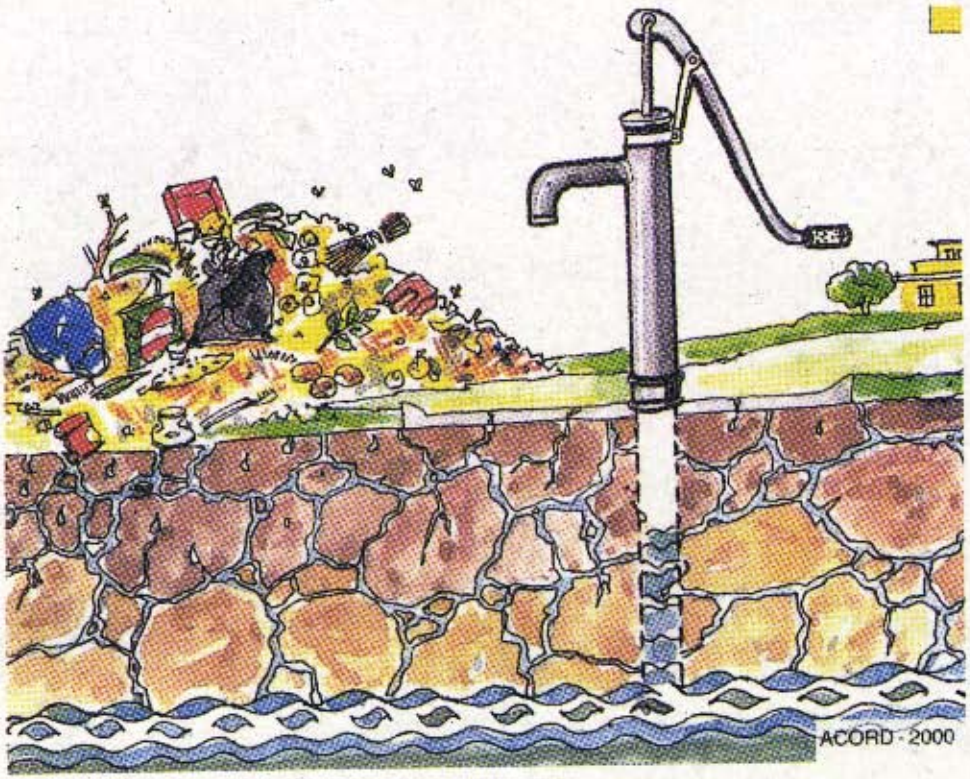
- Sets of 16 picture-cards on Good practices, Bad practices (These will be already with each sub-group as they have done activity-1.).
- Sets of 12 picture-cards on consequences of good and bad practices of solid waste with **black dots.** These should be jumbled. The number of sets of picture-cards required will depend upon the number of sub-groups in the workshop.
- Coloured markers, tape, thumb pin, display boards.

Time : 50-min.

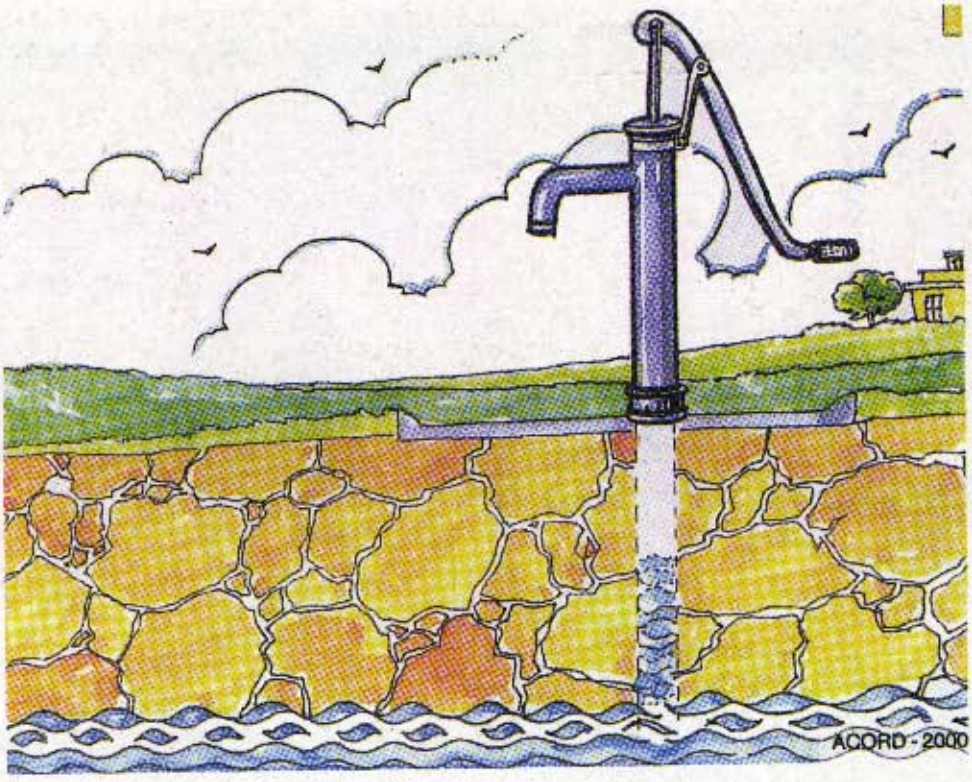
Methodology :

1. Each sub-group to keep its charts **'A'** and **'B'** with picture-cards depicting good and bad practices. After the completion of Activity-1, the sub-groups should be allowed to re-shift their picture-cards placed on the charts- **A, B** and **C,** if they wish to do so. **(2 min.)**
2. Each sub-group be given the set of pictures cards on consequences of good and bad practices. **(1 min.)**
3. Each sub-group to sort out the picture-cards depicting consequences of good practices. These should be arranged on chart **'A'** against the picture-cards on good practices. In case one practice has more than one consequence or vice-versa, it should be indicated by arrows (made with pen). The same should be followed for the picture-cards depicting consequences of bad practices. These should be arranged on chart **'B'** against the picture-cards on bad practices. In case one practice has more than one consequence and vice-versa, it should be indicated by arrows. The participants should discuss and if the group is literate they should be asked to write the reasons that they perceive for such consequences on the arrows. Each member in the respective sub-groups to participate in the activity. **(20 min.)**
4. Each sub-group to put up it's charts 'A' and 'B' in the pre-designated area. Facilitator to help. **(2 min.)**
5. Facilitator will call out each sub-group to report and present Other sub-groups will stand near the chart papers of the sub-group presenting. This will be repeated for all the sub-groups. **(15 min.)**
6. On the completion of presentations by all the sub-groups, the facilitator to give his/her inputs, discuss what was missed out by the group and re-inforce the learning by relating it with everyday experiences. **(10 min.)**

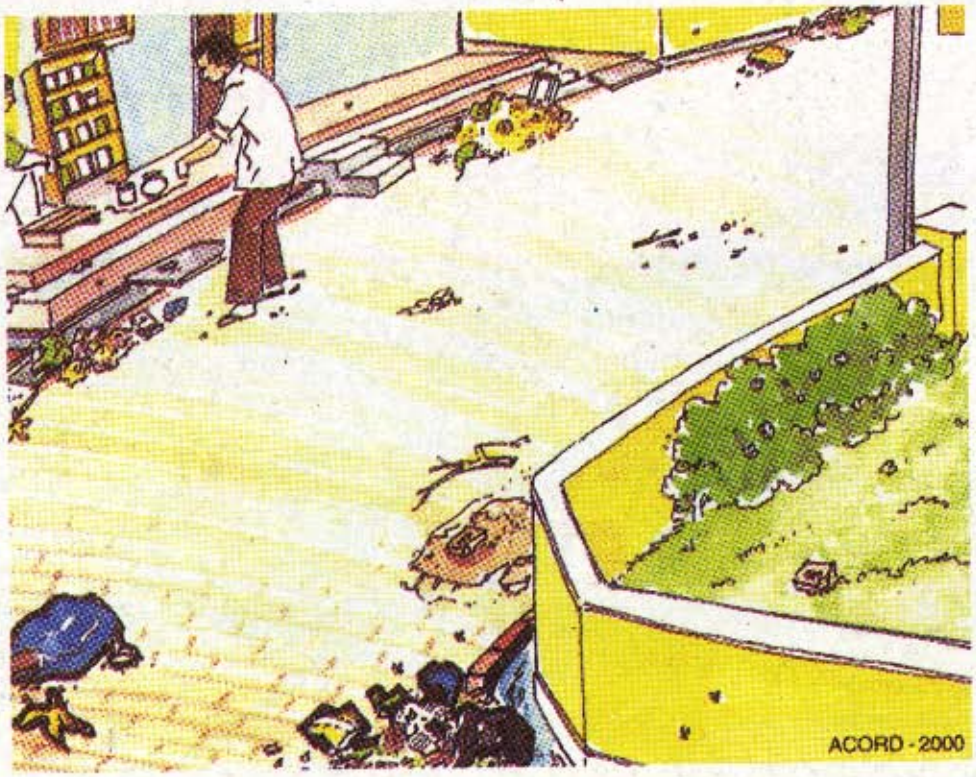
12 PICTURE-CARDS (WITH YELLOW DOTS) ON CONSEQUENCES OF GOOD AND BAD PRACTICES OF SOLID WASTE DISPOSAL



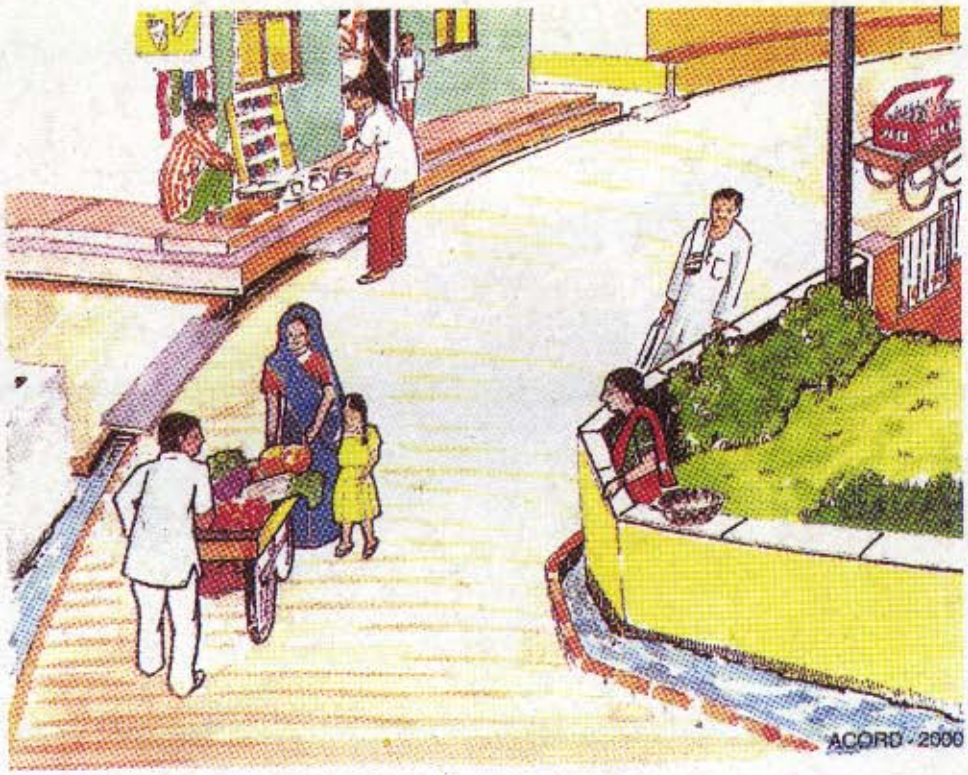
BAD PRACTICE OF SOLID WASTE DISPOSAL



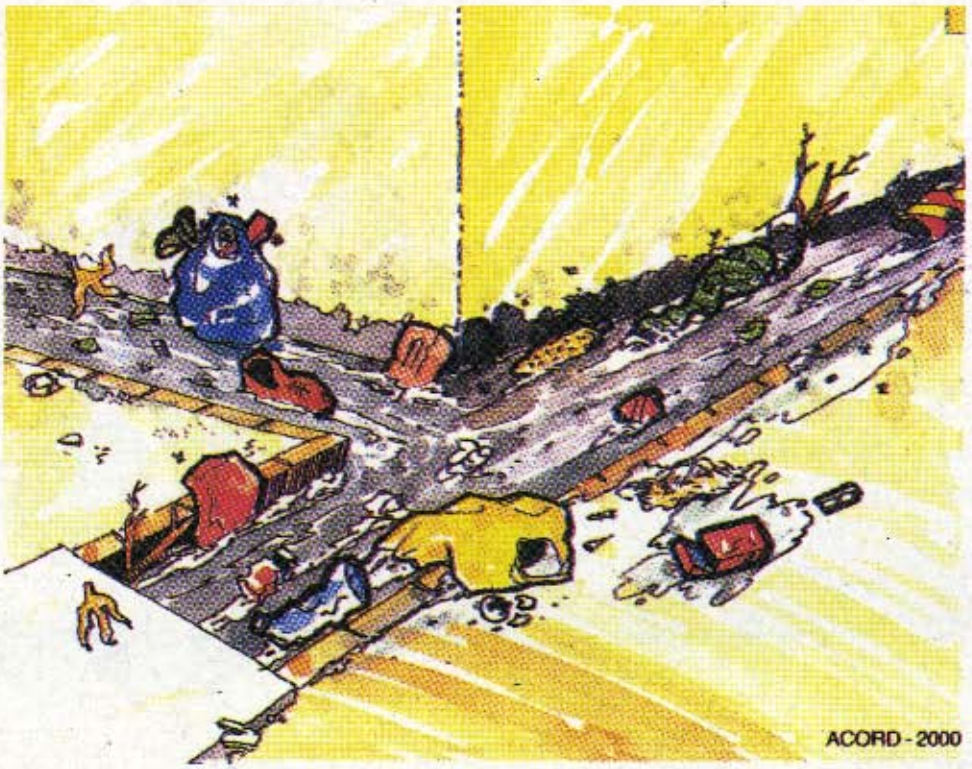
GOOD PRACTICE OF SOLID WASTE DISPOSAL



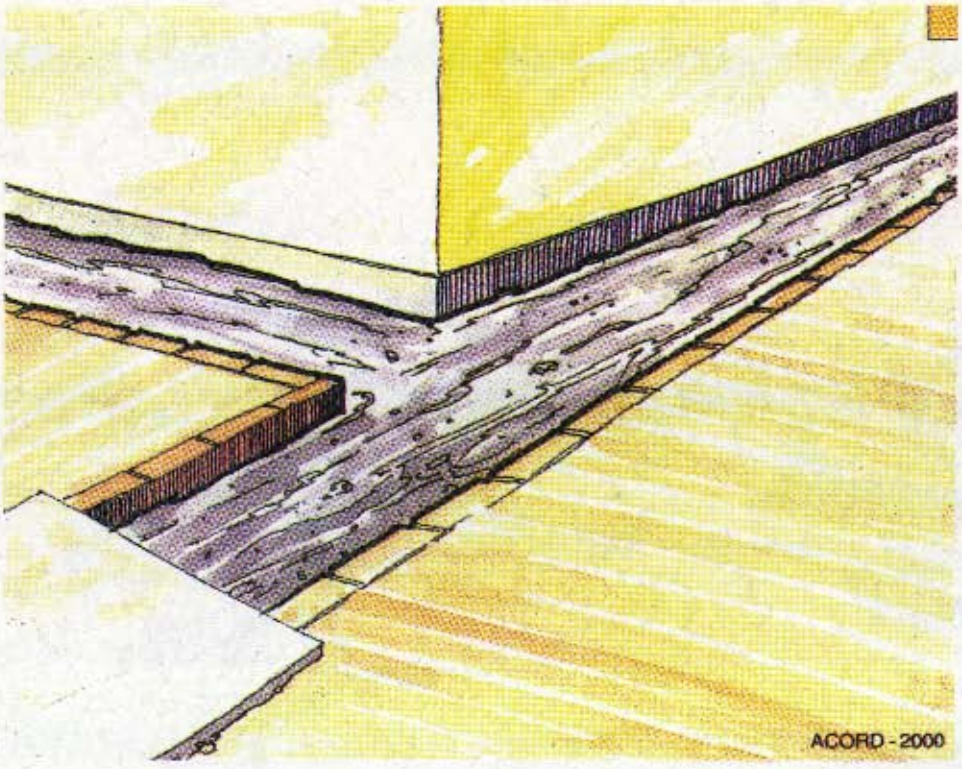
BAD PRACTICE OF SOLID WASTE DISPOSAL



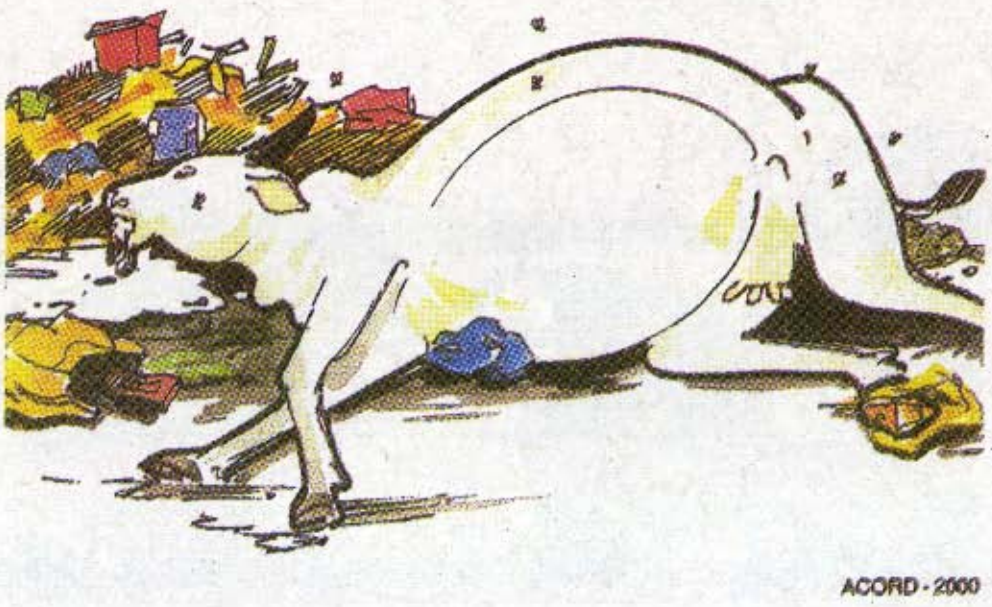
GOOD PRACTICE OF SOLID WASTE DISPOSAL



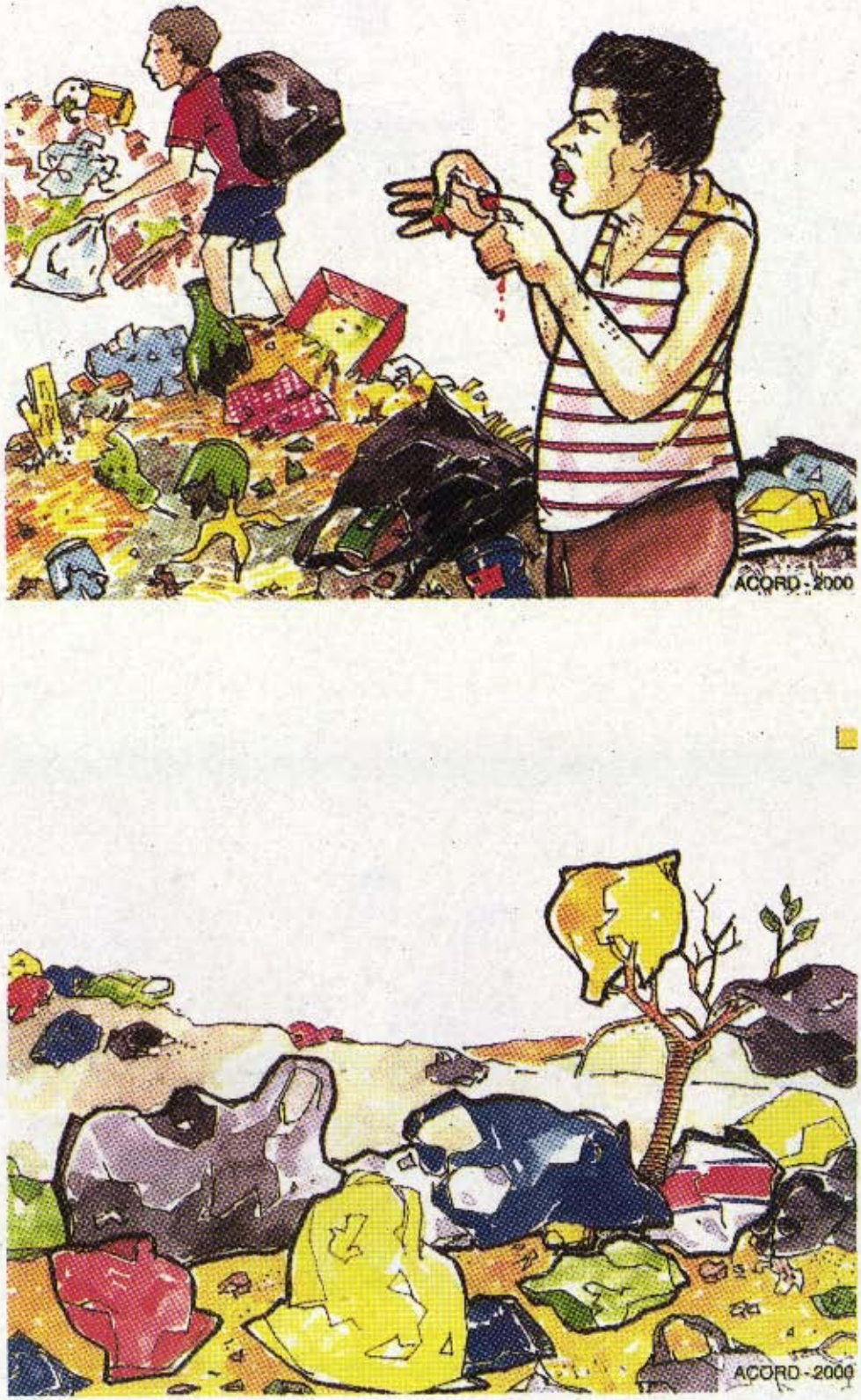
BAD PRACTICE OF SOLID WASTE DISPOSAL



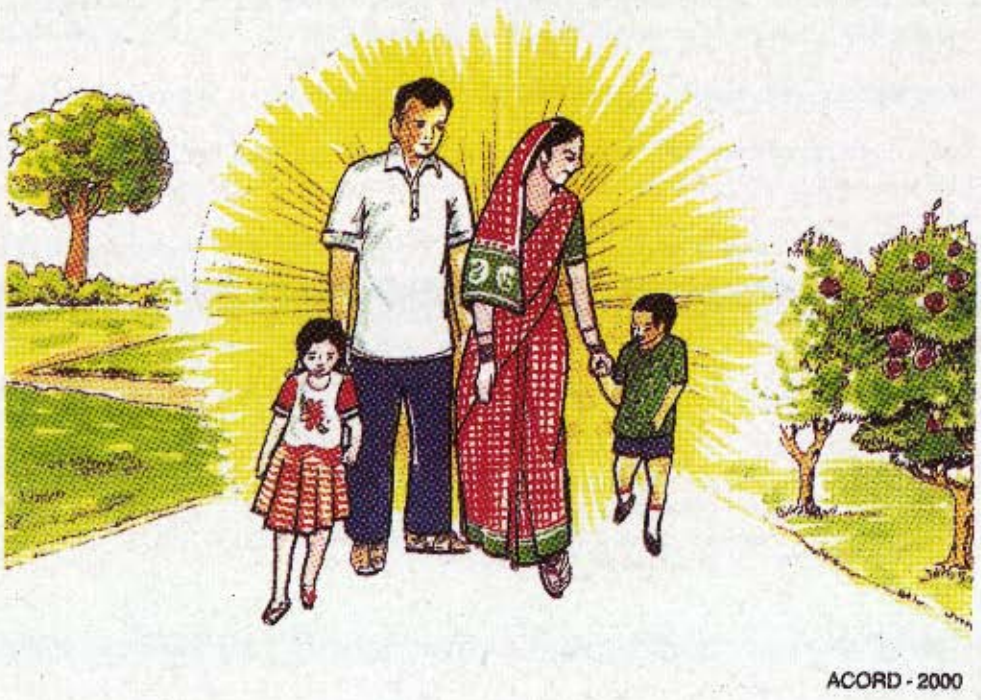
GOOD PRACTICE OF SOLID WASTE DISPOSAL



BAD PRACTICE OF SOLID WASTE DISPOSAL



BAD PRACTICE OF SOLID WASTE DISPOSAL



CONSEQUENCES

PARTICIPATORY LEARNING TOOL

ON

SOLID WASTE MANAGEMENT

Activity 3 : Sequencing the System of Solid Waste Management (SWM)

Objective : The Participants will be able to understand the complete chain/cycle of solid waste management & the significance of each and every step in the chain.

Materials :

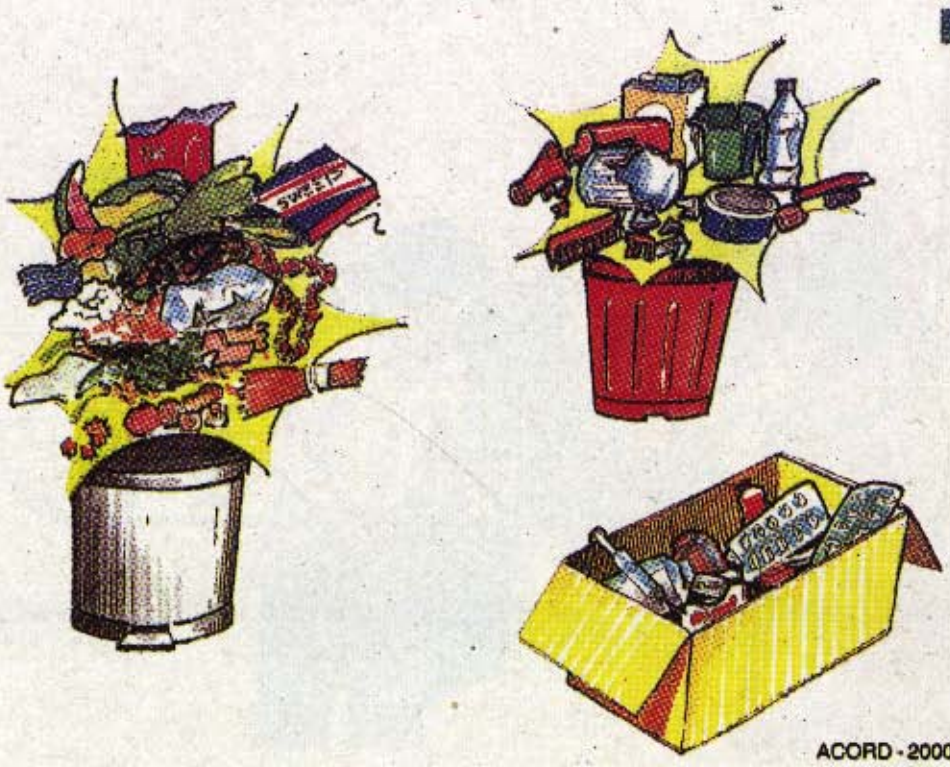
- Sets of 10 picture-cards **green** dots. The number of sets required will depend upon the number of sub-groups in the workshop.
- One chart paper per sub-group. The number of chart papers required will depend upon the number of sub-groups in the workshop.
- Marker, thumb-pins, tape, display boards.

Time : 40-45 min.

Methodology :

1. Each sub-group to be given the set of cards indicating the system of SWM. These should be jumbled. **(1 min.)**
2. Each sub-group to be given one Chart paper.
3. Each sub-group to put the picture-cards in a sequence/order on the chart paper as it sees the chain/ cycle of waste management. Each member in the sub-group to participate. **(15 min.)**
4. Each sub-group to put up the respective charts in the pre-designated area. Facilitator to help. **(1 min.)**
5. Facilitator will call out each sub-group to report & present. Other sub-groups will stand near the chart papers of the sub-group presenting. This will be repeated for all of the sub-groups. **(15 min.)**
6. On the completion of presentations by all the sub-groups, the facilitator to give his/her inputs, discuss what was missed out by the group & reinforce the learning by relating it with everyday experiences **(10 min.)**

10 PICTURE-CARDS (WITH GREEN DOTS) ON SOLID WASTE MANAGEMENT CYCLE



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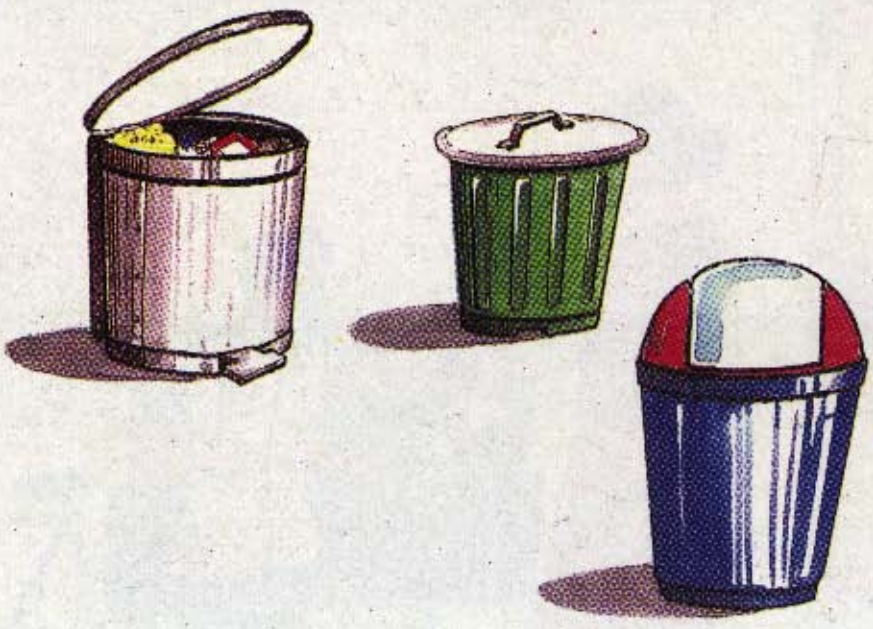

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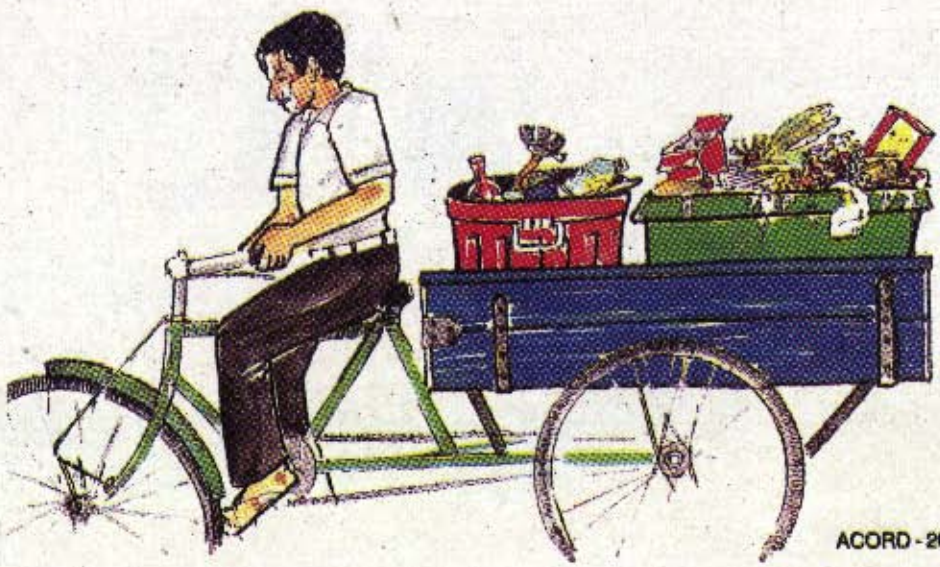
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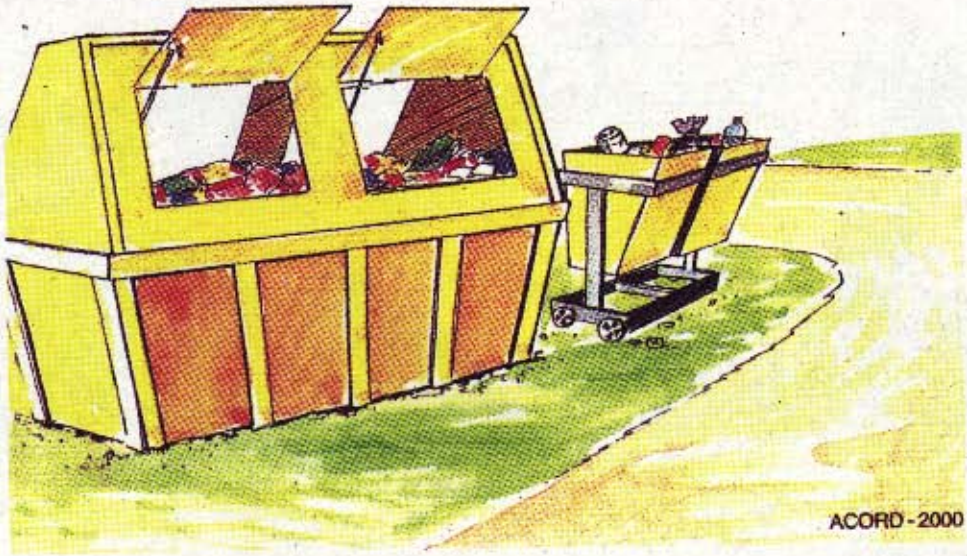
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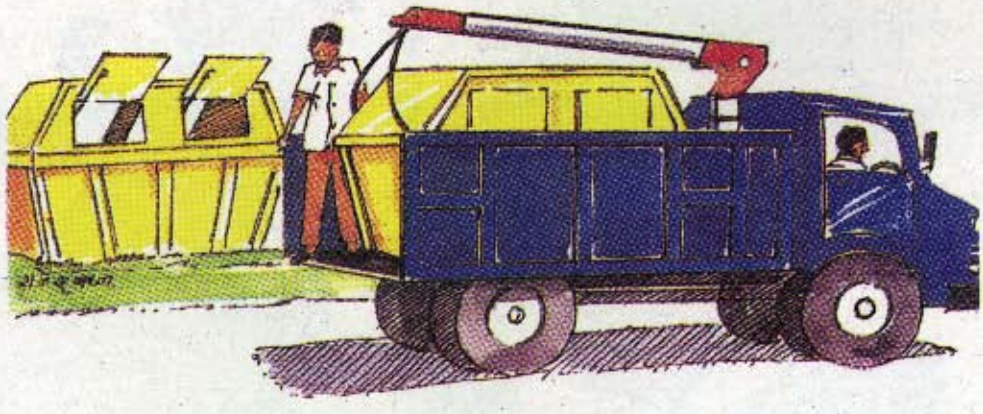
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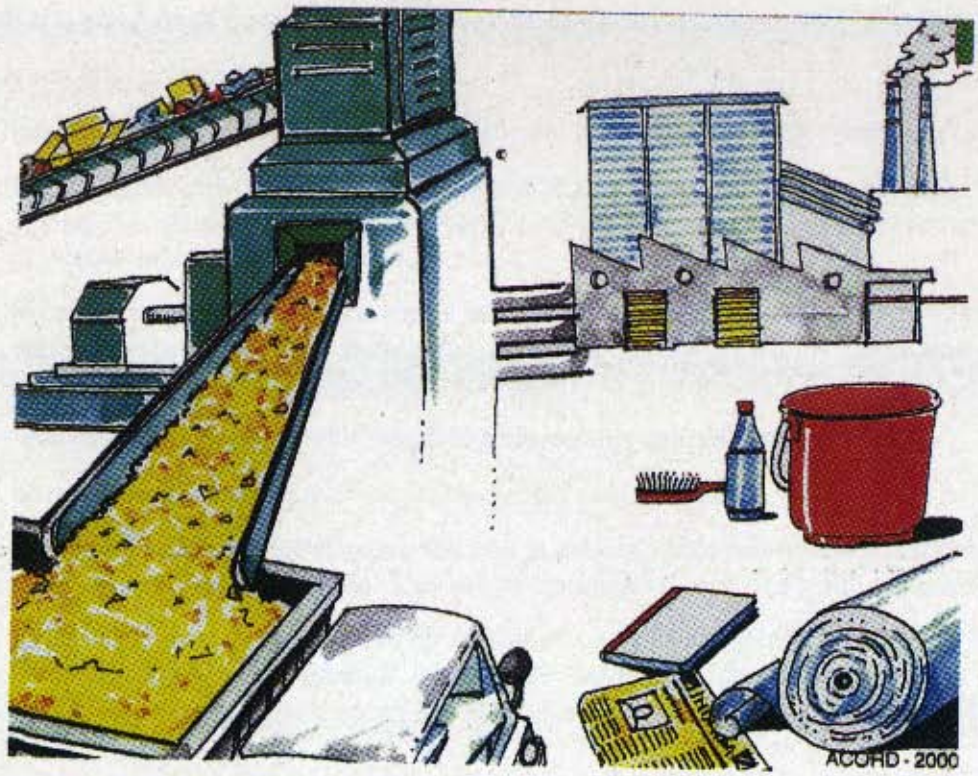

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PARTICIPATORY LEARNING TOOL

ON

SOLID WASTE MANAGEMENT

Activity 4 : Community Action

Objective : The Participants will understand how & what the community can/should do to follow a good system of solid waste management.

Materials :

- Sets of 8 picture-cards with **blue dots**. The number of sets required will depend upon the number of sub-groups.
- One chart paper per sub-group. The number of chart papers required will depend upon the number of sub-groups.
- Blank cards. Each sub-group will need about 10-15 blank cards.
- Markers, tape, thumb-pins, display board.

Time : 50 min.

Methodology :

1. Each sub-group to be given the set of 8 picture-cards dipicting community action. **(1 min.)**
2. Each sub-group to be given a set of 10-15 blank cards and one chart-paper. **(1 min.)**
3. Each sub-groups to do the following :
   (a) Place the picture-cards in a sequence vertically on the leftside of the chart paper. **(2 min.)**
   (b) Use the blank cards to write what the picture card indicates, giving specific action, who is doing-naming the agency/person. Use one blank card per picture card. Place these cards against the respective picture cards. **(10 min.)**
   (c) Write/draw what other actions can or need to be taken by the community to improve the solid waste situation. Discuss amongst the sub-group. Write/draw only the points on which the sub-group has arrived at a consensus. **(10 min.)**
   (d) Place these cards along with the given picture-cards in a sequence. **(2 min.)**
4. Put up your sub-group's chart in the pre-designated area. **(1 min.)**
5. Facilitator will call out each sub-group to report & present. Other sub-groups will stand near the chart papers of the sub-group presenting. This will be repeated for each of the sub-groups. **(15 min.)**

   On the completion of presentations by all the sub-groups, the facilitator to give his/her inputs, discuss what was missed out by the group & reinforce the learning by relating it with everyday experiences **(10 min.)**

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8 PICTURE-CARDS (WITH BLUE DOTS) ON COMMUNITY ACTION FOR IMPROVED SOLID WASTE MANAGEMENT


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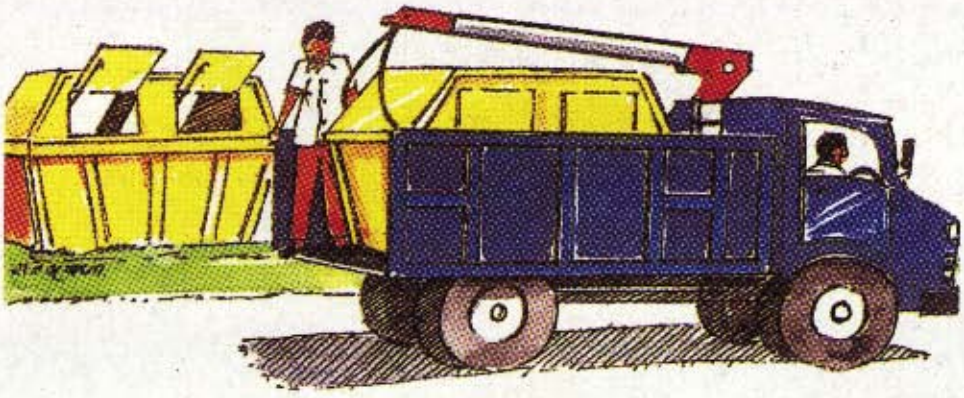

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