

Recycling Responsibility



Traditional systems and
new challenges of
urban solid waste in India

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of urban solid waste in India



A Srishti Report
June 2002

Srishti is an environment group registered as a society. It is involved in issues regarding the environment, waste, toxicity and communities. Srishti envisions a comprehensive waste management policy that would include public participation, industry responsibility and a sustainability-driven policy to deal with waste issues. Srishti has, over the years, done extensive work in the areas of medical waste, municipal waste, as well as waste trade issues and the Delhi Ridge Forest.

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2. Waste Situation in India, March 1996
3. No Fire without Smoke, March 1996
4. Paying the Price, Plastics and Rubber Recycling in Delhi, October 1997
5. Recycling Plastics in Delhi, March 1998
6. Handouts on Municipal Waste (set of 12), December 2001
7. Bookmarks (set of 4); Book labels (set of 10), December 2001
8. Making the Most of a Mess – A handbook on MSW, January 2002

Medical Waste

1. Be Careful with that Cure, May 1996
2. Status of Alternative Medical Waste Disposal Technologies in the US, February 1996
3. Medical Waste: Issues, Practices and Policies, July 1998
4. Emerging Experiences in Medical Waste Management in India, February 2000
5. Managing Hospital Waste (II edition), November 2000
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**Recycling
Responsibility**

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'Reduce – Reuse – Recycle' is known well, but then why is another 'R' needed, that of Responsibility?

Waste disposal, invariably entails environmental as well as human health impacts. The more waste that is generated, the greater the pressure of all to put it away, either buried in the ground, or burned and landfilled in the sky.

However waste examined only from a disposal perspective cannot ever lead to sustainable material and product economies. For, it cannot be forgotten that waste is essentially natural resources wasted, something, which never happens in nature, or truly sustainable systems. Zero waste is not just a concept it actually exists, and can steer human systems as well.

Waste reflects an imperfect human system of production and consumption, which if understood only in parts can lead to unworkable and even dangerous solutions which can cause more harm than good. The astronomically rising cost of waste incineration, and landfilling in developed countries, to mitigate health impacts of waste combustion releases to air, water and land, without enough emphasis on waste reduction and less wasteful resource use, show amply that these are not models we should follow.

Any sustainable waste interventions must be based in the overall production and consumption cycle, with disposal and treatment being the last resorts. Hence ensuring that waste generation is minimised, materials which are thrown as waste are recovered, products are designed which essentially facilitate this, and finally ensuring that waste disposal is carried out in a manner appropriate to its nature, with minimum health and environmental impact.

Recycling too has to be examined in this context, and cannot be looked upon as an activity which can exist on its own merely as an alternative disposal means. Hence Recycling is not just an activity; it is a way of ensuring a sustainable economy.

As a mere activity recycling becomes another end-of-pipe option, which attempts to convert some of what is disposed off, in a system which is not designed for such an effort. By doing so it fails, or only partially succeeds since:

1. Products have not been designed in a manner, which facilitate recycling. Used products are difficult if not impossible to dismantle, and constructed through processes and designs which in fact hamper recycling
2. The materials used for such products and packaging is not necessarily safe to recycle. Many materials used are toxics, especially if they are being broken down for recovery, which others simply cannot be recovered for reuse. Others are made as composite materials which either are extremely difficult and expensive to recycle, or just useless after disposal.
3. The way they are disposed, does not aid their recycling. Waste is often mixed and thrown out, especially in developing economies, and it takes a huge cost and effort to separate them and then attempt to recycle them. Some are unrecoverable, for example used paper if wet and soggy and mixed with other waste is useless for being recycled.
4. The economics of products are not constructed for recycling to be viable. Recycling in the current way of doing things competes with virgin material products, the raw materials of which are often directly or indirectly subsidised. For example pulp for making paper, does not factor in the cost of losing forests, and is often subsidised. Also recycling requires collection, sorting, and reprocessing a cost if not subsidised either directly, or by providing preference markets to recycled products, does not become economically viable.
5. Recycling is made to compete with other waste disposal options such as incineration or landfilling, either of which do not on their own encourage waste reduction or material recovery. Many countries in fact also subsidise incineration through preferential energy purchases, or loose environmental standards, which impact air, water, soil and community health. Landfill space is often un-costed by municipalities. On the other hand no incentive is provided to recycling, and the space used by say the informal sector in developing countries is deemed illegal.
6. In economies such as India's, as this report investigates, the informal sector heavily subsidises the recycling of products through underpaid wages, no social security, poor health and other forms of exploitation. It is a reverse subsidy of the poor for the richer consumers.

Hence there are many hurdles in path of sustainable product economies. Primarily they

spring from various narrow and established interests along the way, which are hurt or displaced if the production-consumption-recycling cycle is examined as a complete whole. Waste disposal has become a multi billion dollar industry for example, where waste becomes a commodity, the more the better, since it translates into a more profitable industry. However, though the industry thrives, our planet loses, as more resources are wasted away in air, or buried to rot in the ground. Similarly, redesigning products or expecting industry to take responsibility for waste has become an uphill task, with more being claimed than actually done.

In fact, examining waste from an overall perspective, should be looked upon as an opportunity rather than a threat. In a new way of doing things, products cannot only be improved, but in fact costs can be reduced, and consumption can be made more conscious. Reducing landfill space, and spending less money on air pollution control devices for incinerators, can save local as well as national governments millions of rupees. Recycling along with producer responsibility can create thousands of new jobs, keep communities safe from waste disposal releases, and avoid conflicts of landfill siting.

Hence specific responsibilities need to be fixed by society. The State should make policies and structured to encourage or mandate industry has to make products which are recyclable, and where the cost is built in. This would help generate finances and responsibilities for investments in the recycling sector. Recycling will not only create jobs, but also reduce the strain on natural systems, both through extraction as well as through ill effects of disposal.

In the future our economy can be sustainable only if we reduce, reuse and recycle within the framework of a fourth 'R' of responsibility.

Cities in India are faced with the growing problem of urban solid waste. Traditional methods of waste disposal, under the purview of municipal and civic bodies have largely limited themselves to 'collect and dispose' functions, which are becoming inadequate to cope with the increasing quantity and changing nature of waste. Rising per capita incomes, has led to changing consumption and waste generation patterns. There are a number of new materials being introduced into the waste stream, which are merely dumped since there is little else that can be done with them.

There are, however, a variety of communities, involved with the 'business of waste' who may not be casually visible. Besides households (who themselves differ in waste generation characteristics related to their economic class), there is the unacknowledged sector of waste pickers and recyclers, which handles over 10 to 15 per cent of the total waste stream. However, not all the dynamics, especially of informal sector recycling, are understood well enough for there to be adequate and effective interventions.

The informal sector has been involved traditionally and for decades in the process of recycling some of these materials such as plastics, metals and paper. It is characterised by underpaid and people-led collection systems with poor and rudimentary technologies for processing, involving a high degree of occupational and environmental hazards. The resultant recycled products are mostly of poor quality and low cost, incapable of finding markets occupied by virgin material based products. As a result, both the people involved in the trade as well as the products produced from recycled waste are largely a neglected lot.

On the other hand, developed countries have adopted centralised and highly technology-intensive approaches. These function within an economic paradigm where the large part of the cost is borne by the waste generator. Various disposal alternatives are possible within this paradigm, ranging from incineration, to recycling and landfilling; their mix depending on the degree of internalisation of the costs the fiscal system permits. Such models may not be cost-effective for countries like India, especially owing to the presence of the informal sector, as well as a lack of a comprehensive system of fiscal instruments, which could be used to regulate the generation and disposal of waste.

Also, in the emerging waste policies in India, though recycling has been accepted as a key option for urban solid waste, there has been almost no suggestion towards any interventions. Hence, there is a large lacuna in policy which urgently needs to be fulfilled. Is it then possible to adopt alternative approaches and models for a country like India, where cities such as Delhi have over 100,000 persons living off waste picking and recycling, the waste being largely biodegradable, and where 35 per cent of the population generates less than 15 per cent of the city's waste? If so what is the nature of interventions required? What roles do different stakeholders have in this area?

The report

Our involvement with the issue of urban waste started many years ago. Our first attempts were to integrate the informal sector waste pickers into community based waste management systems. In recent years such systems have been tried in communities around the country. Those of us who came from the perspective of waste, and the environmental and human health impacts it has, soon discovered the community of waste pickers as one which has been traditionally involved in it for decades. What better system could there be but to help improve their lives through linking these people with communities directly instead of them rummaging through waste bins?

In many parts of the country (for example, in Hyderabad), waste pickers were also adopted by communities given a place to stay, and taught vermicomposting or composting, to become part of a larger community. In others, they were organised (Mumbai and Ahmedabad) in an attempt to raise their livelihood opportunities and even to enhance their bargaining powers with the system as well as with their patrons, that is, the waste dealers.

Simultaneously, we were engaged in the issue of waste at various policy levels, and have been so for some time now. We are sharply aware of the changing nature of the system which is

dealing with managing urban waste. The municipalities around the country are being stretched to their limits, since waste quantities are increasing rapidly owing to a growing urbanisation. There has been and continues to be talk of municipality reform everywhere. Simultaneously, it is increasingly being voiced that waste collection needs to be privatised. It would be replaced by a pay-by-use basis, and all sectors of waste management would slowly be priced as a service.

This would, of course, deeply impact existing and traditional systems of managing waste, as it would those who lived off it. Implementing the new systems being talked about, and indeed being implemented in some cities (Chennai), would mean transfer of ownership of the waste as a commodity to a private operator who would take it to a processing facility, create a product out of it (mostly energy) and then raise revenues to become profitable. But what would happen to the traditional systems? Even though the conditions of work there are pitiable, yet this provides livelihood and service at a lower cost.

This is the scenario in urban India today. While there are proposed interventions, in fact with the support of government subsidies, to privatise the urban waste collection, disposal and processing sector, there has been little thought given to the issue of upgrading the traditional sector. In fact, the sector is directly being threatened by borrowed solutions from developed countries where such populations do not have to make a living off waste. Moreover, the new systems do not necessarily solve the problem of waste. Landfills are still being used, and sited in poor neighborhoods, and incinerators are prohibitively expensive and unsafe to operate. The solution does not lie in that direction, and we need to examine our options closer to home.

Also, while the Indian waste policy has looked at the collection, energy products as well as disposal of waste over the past years, it has completely ignored the area of recycling per se. Recycling of waste, to which the traditional sectors is inherently connected, needs interventions to upgrade it to meet the changing needs, and not be replaced by high cost and borrowed solutions.

Packaging waste

In the present report special emphasis has been given towards recycling of post consumer waste products focusing on plastics and Aluminium since these materials are most commonly used in the packaging industry. Packaging is the major application of plastics in India accounting for 52 per cent of plastic consumption, and a cause of much waste.¹ Over the past several years there has been a phenomenal growth in the packaging industry. The Indian demand for plastics packaging material increased from US\$ 1.1 billion in 1996 to US\$ 1.3 billion in 1997. The Indian plastic packaging industry is made up of 18,000 firms and employs more than 500,000 persons. It has been estimated that the annual average growth since 1990 has been 15 per cent per annum.

The packaging industry provides one of the largest single markets for the plastics industry and consumes 300,000 tons or 15 percent by volume of the total Indian plastics production. While all industries use some form of plastic packaging, the highest demand is from food processing, construction and the agricultural and water management sectors. Plastics packaging is estimated to account for 40 per cent of the total Indian packaging industry.²

The waste generated due to increased use of packaging should be recycled. Generally there is a high level of awareness for recycling of the packaging waste generated. Within the urban system a wide range of people are involved in managing post consumer waste. At every stage right from collection to finally recycling the material, all these people are economically benefited and are hence involved in their respective roles in the recycling chain.

This report is an attempt to identify the gap in waste policy, and to link those gaps with the needs and interventions possible in the traditional informal recycling sector. Updating and upgrading our understanding of this sector through a primary survey of both the recycling trade chain as well as the recycling units and their technology levels have provided information for us to do this.

Aim of the report

This particular investigation, which lasted more than 15 months, also had an outreach component to it – that of reaching out to children and sensitising them about recycling, waste and waste pickers as an integral part of urban living issues. The outreach program, its outcomes,

1 Recycling and Plastics Waste Management, CIPET, 1997.

2 Industry Sector Analysis, 1998.

materials produced as well as future actions are also described.

This report is based on a study which aims to investigate the nature of these informal sector processes, and underline the existing and possible linkages of the formal sector with the informal sector. It also attempts to identify the technologies and processes currently used for recycling some materials. In summary, it:

- 1. Identifies the gaps in waste policy in India as it concerns recycling of urban waste;**
- 2. Enhances and upgrades an understanding of the existing systems of urban waste recycling, from the trading chain to the recycling units and its technology;**
- 3. Discusses the possible interventions at the policy level to allow for the existing system to be integrated into waste policy issues, as well as industry responsibility issues; and**
- 4. Attempts to lay down a framework for a recycling policy in India.**

Report structure

The report is divided into four sections:

Section 1: This section examines the existing waste policy with respect to recycling. It also places in perspective the role of recycling in the changing urban waste scenario in India. The methodology used is both an analysis of secondary literature as well as primary data gathered over years of policy engagements on this issue at all levels.

Section 2: This section is based on a survey carried out in Delhi by a team of five researchers and investigators. It deals with both the social and economic nature of the waste trade, as well as various actors in it and the state of technologies and working conditions in recycling units.

Section 3: This details the outreach program, our partners in it, the materials we created for it, as well as the outcomes.

Section 4: This discusses our findings and attempts to merge them into the policy gaps through recommended interventions in order to lay out a framework for merging the traditional system into a modern urban waste management scenario in India with adequate industry responsibility.

Project objectives

The project specifically:

- 1. Investigates the nature and size of the recycling sector dealing with urban solid waste, and its social and economic linkages.**

This involved locating representative sample populations of various players in the recycling trade of urban solid waste in the informal sector and determining their economics and social conditions. Data was gathered through primary research, using fieldwork and analysed to develop an overall picture.

- 2. Links the materials emanating in urban solid waste to processes and technologies to recycle them**

This aspect concerned an evaluation of the materials which are currently being introduced into the urban solid waste stream as well as existing materials with respect to their technologies being used for recycling.

- 3. Suggests an overall national policy framework of interventions to make this sector more viable and sustainable.**

This analyses gaps in waste policy vis-a-vis recycling and uses the survey finding to suggest a policy framework for recycling in India.

- 4. Reaches out to communities involving school children and waste-pickers to sensitise to various aspects of recycling through workshops and field visits.**

Awareness workshops were held with schoolchildren and resident communities on aspects of recycling and waste management, along with other groups and outreach material was created.

- 5. Workshop with all stakeholders, held in New Delhi in June, 2002.**

Literature Review

The Wealth of Waste: Waste Pickers, Solid Waste and Urban Development, by Sandhya Venkateswaran is a critical analysis of rapid urbanization process and the burgeoning problem of waste generation in the Indian cities. She opines that the municipalities have failed in collecting all the waste, not to talk about resource recovery. Huge number of migrants who have come to cities looking for employment but failing, take to waste picking and do substantial resource recovery from streets, municipal bins and landfills.

She analyses the socio-economic condition of the waste pickers and brings out their economic and environmental contribution in managing the cities waste. She also emphasizes the role of different NGO's in making efforts to improve their working and living conditions. She gives an estimate of current recycling and future potential.

Recycling and Incineration: Evaluating the Choices, is an edited book by Richard A. Denison and John Ruston, Published by Environmental Defence Fund. The book starts with a little warning that managing garbage has already become a gigantic problem.

The book elaborates on different technological methods used for getting away with the garbage. While some of the developed countries took to incinerate it's waste, some other tried to export it to developing countries. It also gives a detail understanding of how the traditional way of disposing waste into landfill is not a viable option today.

The author says the challenge lies with the policy makers in identifying and implementing long term solutions which are environmentally safe, cost effective and socially acceptable. The book vehemently argues for a need to adopt a holistic approach to managing our waste. It emphasizes three simple methods, source reduction, recycling and composting to manage waste. It also takes a critical look at different technological drawbacks of incineration.

Recycling and Plastic Waste Management is an edited report of a proceedings of a national seminar held in Chennai in September 1997. The proceedings solely focus on use of plastics and the problems it leaves to manage. Various experts have dealt in technical aspects of plastic recycling, waste management and role of technology.

Managing plastics has become a major problem particularly in the developing countries with the added fear that in the coming decades the production and consumption will only increase. The report very categorically says that the biggest challenge will be cleaner production, eliminating waste at source and improving the quality of today's degraded environment. It says the industries should remain productive but also must play an active role and carry out their work in harmony with environment and with natural resources and raw materials.

Recycling: A Natural Response to India's Solid Waste Problems by Nancy Galloway (*Development Alternatives*, 1993) states that India, a country struggling to restrain oil consumption and reduce deforestation, recycling of plastic and paper is an economic necessity rather than an environmental choice. It says the waste dealers or kabadiwala provides employment to thousands of people, removes litter from the street, recycles them which would otherwise be choking drains or ending in landfills. Most importantly it saves scarce and costly resources.

It also elaborates that the recycling sector in India employs uneducated and unskilled in low pay with health hazard working conditions. Galloway further says most of the people employed receive daily wages that are only half that of a formal factory worker, and most work for daily wages. Women are paid only half as much as men.

Solid Waste Management In Delhi: An exploratory Study on Local Government and Community Interface (*Institute of Social Science Manuscript Report 14*) focuses on the solid waste problem in Delhi and the role and importance of local government, civil society and NGO's. It says the total mismanagement of the municipalities in solid waste disposal and apathy of the manpower has led to sorry state.

It further elaborates that such a situation has been created by both external and internal condition. The external factors like excessive population pressure, violation of the master plan

by the industrial sector, political interference in the administrative decisions has led to problems for the Municipal corporations in initiating policy changes in environmental management. The internal deficiencies have been inadequate financial allocation, extremely labour intensive nature and low infrastructure with also low technological adaptation.

It emphasizes that better interface between municipal corporation and NGO's and also other community groups could to a great extent tackle the problem.

Report on Scrap Collectors, Scrap Traders and Recycling Enterprises in Pune, by Poornima Chickermane, Medha Deshpande and Lakshmi Narayan is a study that focuses on the informal sector of all the people involved in reprocessing scrap. The study has been conducted focusing Kagad Kach Patra kashtakari Panchayat, a trade union of scrap collectors. They rightly describe the recycling sector as informal and dissecting the socio-economic profile of the people engaged state that most of the people in this are from the lower socio-economic strata.

The study traces the entire chain with all the aspects that factors in their life like livelihood questions, exploitation, marginalization, social security, occupational health child labour etc. It introduced many interventions during the course of the study like direct selling to the whole sellers, collection of segregated scrap from institutions and bonus for waste pickers who sell it to a newly formed cooperative.

It makes significant recommendations like recognizing waste pickers as 'unprotected manual workers' and endorsement by the municipalities, offering life and health insurance, recognizing the waste pickers as part of municipality and child labour as hazardous and to be listed in Child Labour Prohibition and Regulation Act.

SECTION 1

Policy Context for Recycling

Recycling and Urban Solid Waste in India

Waste in Indian cities

- Waste generation profile
- Nature of waste

The technology question

- Composting
- Incineration and similar methods
- Sanitary landfilling
- Biomethanation

Recycling dynamics

- Waste pickers
- Small recyclers
- Dealing with new materials
- Need for recycling interventions

Recycling and Waste Policy: Lack of a Framework

Various policy initiatives

Proposed legislation

Recycling and Urban Solid Waste in India

India is undergoing a massive migration of its population from rural to urban centres, and as a result new consumption patterns and social linkages are emerging. India will have more than 40 per cent of its population (that is, over 400 million people) clustered in cities over the next 30 years. With it will increase the quantum of waste and the need to manage it in the most economical manner. Urban living brings with it the problem of waste, which increases in quantity and changes in composition as well. There are clear linkages between urban development and solid waste management. With it are also linked the questions of urban environment and its bearing on the social and economic condition of the informal sector of recycling which, according to estimates, is managing 15 per cent of urban waste.

The quantity and quality of solid waste generated vary from country to country. There are many factors which influence the quantity, quality and most importantly the composition of the waste – the climate, income level, kind of production of the industry, population and consumption behaviour. Urban solid waste of developing countries also differs from the waste of industrialised countries. In the developing countries, waste densities and moisture contents are much higher.¹ There are also differences in solid waste composition due to season and region, for example, in India, coconut hulls and paper are more prevalent in spring and during festivals.

Indian urban waste is a complex mixture of household, construction, infectious, commercial, and toxic industrial elements. There is however, an inadequate understanding of the problem, both of infrastructure requirements as well as its social dimensions.

Waste in Indian cities

In 1991, urban India produced 23.86 million tonnes of waste. Urban Indians use twice as many resources per capita than those living in rural areas and 300 million of them generate an estimated 110,000 tonnes of waste every day. In 2001 it is estimated that urban India produced almost 40 million tonnes of it.² This actually means more than 120 million truckloads of waste.

Consumption, linked to per capita income,

Table 1. Waste generation in the mega cities

CITY : Waste per day (in tons)

| | |
|-----------|-----------|
| AHMEDABAD | : 2086.92 |
| BANGALORE | : 2480.00 |
| CHENNAI | : 2086.92 |
| DELHI | : 6500.00 |
| HYDERABAD | : 1941.84 |
| KOLKATA | : 4578.08 |
| MUMBAI | : 6640.20 |

has a strong relationship to waste generation. As per capita income rises, more savings are spent on goods especially when the transition is from a low income to a middle-income level. Though further increases in income may be invested more in the service sector, for India this is not likely to happen for even the next three decades, as we proceed from a per capita income of US\$ 330 to a projected one of US\$ 620, and an exploding urban waste graph. Urbanisation not only concentrates waste, but also raises generation rates since rural consumers consume less than urban ones. India will probably see a rise in waste generation from less than 40,000 MT per year to over 125,000 MT by the year 2030.³

Waste generation profile

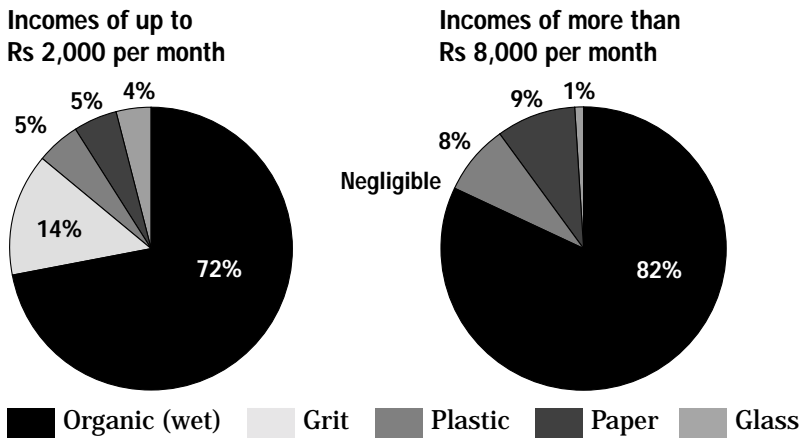
It is also important to understand that Indian cities are highly stratified across economic class. Communities living in poorer housing such as in slum and resettlement colony clusters (over 40 per cent in Delhi), produce less waste. According to a study conducted in Delhi jointly by Srishti and the Tata Energy Research Institute (TERI), people in higher income brackets having a monthly income of Rs 8,000 and above, generate about 800 gm of waste per capita every day, whereas, people living on a monthly income of Rs 2,000 generate just 200 gm of waste per day – that is, four times less! Not only does the quantity vary, there is also a variation in the composition of waste. Figure 1 provides an overview of the variation in the nature of waste generated based on the income levels of the people generating such waste.

Urban solid waste primarily contains such items as vegetable peels, paper, packaging, plastics etc, commonly discarded by households and commercial establishments like shops, and offices. Besides these elements, infectious and industrial wastes are also part of the mix

1 Cointreau, Sandra J.: Environmental Management of Urban Solid Waste in Developing Countries – A Project Guide, The World Bank, 1982.

2 Manual on Municipal Solid Waste Management 1st ed.). Prepared by the Expert Committee constituted by the Ministry of Urban Development, The government of India, January 2000.

3 Srishti, 2000.

Figure 1. Variation in types of waste generated

The poor suffer

Poor urban households, colonies and slums are provided none, or scanty, municipal services. The composition of the waste is more organic. Besides, land dumps have historically been unjustly sited by municipalities in poorer neighbourhoods, owing to political reasons as well as the lower value of land there. This may not be easily possible any more, as poorer communities are becoming more aware of their rights. October 2000 saw the scuttling of a municipal waste landfill sitting in outer Delhi, as villagers refused to accept the rubbish of their more affluent counterparts.⁴

Nature of waste

The second critical question relates to the nature of waste. Waste is not a homogeneous entity. It is made up of a wide variety of materials, which have largely emerged from urban activities. Indian waste is expected to grow substantially in its organic content and only marginally in non-biodegradable elements except paper. Organic waste will go up from 40 per cent to 60 per cent, plastics from 4 per cent to 6 per cent, metal from 1 per cent to 4 per cent, glass from 2 per cent to 3 per cent, while paper will increase substantially from 5 per cent to 15 per cent. 'Others', consisting mainly of ash, sand and grit will decrease from 47 per cent to 12 per cent indicating a shift from coal to gas and other cooking fuels.⁵ This composition shift is fundamental to the response the waste problem needs.

Non-municipal waste also part of mix

Medical waste: Any city in India has

capital's various healthcare institutions. Around 10-15 per cent (9-12 MT) of this waste is highly infectious. Besides comprising soiled bandages, used cotton, pathological and anatomical waste, hospital waste also includes used syringes, tubes, bottles and various plastic and glass material. Although it forms only a small proportion of the total waste, medical waste has the potential to contaminate huge amounts of municipal waste, if not disposed of according to norms. This type of urban waste poses dangers to the health, not only of waste pickers, but also of municipal workers who handle waste regularly. Although the government has made it mandatory for hospitals to segregate infectious and non-infectious waste, implementation of this order is questionable. Medical waste needs to be treated separately before disposal. The Ministry of Environment and Forests (MoEF), Government of India, formulated the Bio-Medical Waste (Management and Handling) Rules, 1998, to this effect, and all healthcare establishments in the country are bound by this law.

Construction waste: As our cities grow, so does the demand for offices, houses, markets, roads, etc. In most cases, old buildings are demolished to construct new ones; roads are widened by breaking old pavements; and new buildings are constructed to accommodate more people and offices. Such activities generate a high volume of construction and demolition waste, popularly called '*malba*' (rubble). Characteristically, *malba* is voluminous and is carelessly dumped on roadsides, back lanes or into *nallahs* (drains) adding to the ever burgeoning problem of waste.

numerous healthcare establishments that include hospitals, nursing homes, clinics, blood banks, veterinary hospitals, etc. All these establishments generate substantial amount of potentially infectious waste. In fact, in Delhi, 80 metric tonnes (MT) of medical waste is produced by the

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4 Toxics Link, 2000.

5 World Bank 2000.

Industrial waste: The pattern of urban growth has created a large number of industrial units, numerous factories and recycling units located all over cities. Though industrial waste is technically not a part of municipal waste, it nevertheless is a burden on the municipality. Many industries in the city do not manage their waste according to the norms and dump their waste along with municipal waste. Industrial waste that can be highly toxic in nature has the potential to contaminate municipal waste to increase the hazards it may pose. There are no good estimates available about the amount of industrial waste that is flowing into the municipal waste stream.

Hence, managing waste is a challenging task and as our cities grow it will become more complex. Due to a lack of serious efforts by town/city authorities, waste management has become a burning issue, despite the fact that the largest part of municipal expenditure is allotted to its management. Waste management services employ a large workforce. For example, about 26 per cent of the Municipal Corporation of Delhi's employees are *safai karamcharis*.⁶

Figure 2. Distribution of expenditure on waste

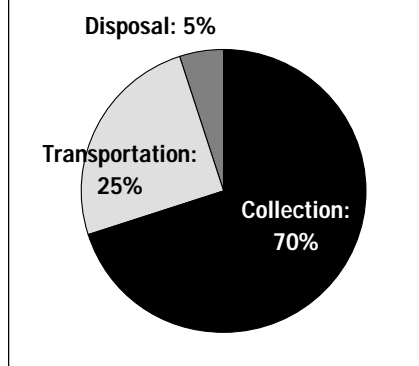


Figure 2 highlights an important fact – proper disposal is not a priority. Final disposal costs are also minimal as disposal is usually accomplished through open dumping. Ahmedabad, for example, spends 86 per cent of its solid waste budget on collection, 13 per cent on transportation and only 1 per cent on final disposal.⁷ On an average, waste collection

efficiency in an Indian city ranges from 50-90 per cent.⁸

The municipal bodies have been unable to clear all the waste that the city generates.

Recycling finds no place in any municipal budget, industry vision or governmental initiative, even though the rapidly growing 12+ per cent non-biodegradable fraction of Indian urban waste can be recycled better and safely. It is, however, paid lip service everywhere, while current policies are in fact killing even the existing sector.

The technology question

Waste needs to be examined from the trail it leaves during the conversion of natural resources into goods to their post-usage disposal. After consumption, or post-consumer waste, can be recycled, processed or dumped into landfills. Ideally waste should be minimised and recycled safely, rather than landfilled. Landfills not only leak over time (30 to 50 years) even if engineered well, but also require precious space.

Technologies must be chosen prudently, and should complement material recovery rather than replace recycling as a waste processing option.

Composting

In the Indian context, technologies which can process organic waste have to be a mainstay to any solution. The Supreme Court appointed Burman Committee which rightly recommended in 1999 that composting should be carried out in each municipality. Composting is probably the easiest and most appropriate technology to deal with a majority of our waste, given its predominantly organic nature. A mixture of large composting plants (1000 MT/day) and small decentralised ones (less than 100 MT/day) along with household or community ones will not only create job opportunities but will also recycle the waste to manure. The main caution to be taken here is to avoid mixed waste composting, since it may cause toxic elements to leach into the compost.

Composting is the recycling of plant remains and other organic materials to make an earthy, dark, crumbly substance, excellent for adding to plants or enriching garden soil. It is an ideal way to recycle kitchen waste and garden waste such as plant cuttings, leaves, etc, and an excellent method to reduce garbage sent to landfills for disposal.

However, currently composting plants have had a run for their money, since markets for compost from waste have not been adequately developed, and transportation costs of composts to far flung markets make them uncompetitive vis-a-vis chemical fertilisers. Efforts are needed to complement existing fertiliser use with compost for better nutrient quality. Both manual and mechanical composting have been tried, albeit at small levels, in different part of the country and have been quite successful. Mechanical

6 Solid Waste Management in Delhi. An Exploratory Study on Local Government – Community Interface. Institute of Social Sciences, New Delhi, 2000.

7 What a Waste: Solid Waste Management in Asia, May 1999.

8 Manual on Municipal Solid Waste Management 1st ed.). Prepared by the Expert Committee constituted by the Ministry of Urban Development, Government of India, January 2000.

composting has been a little costly owing to infrastructural costs (plant cost, technical resources, etc have not helped it to be either popular or cost-effective). The distance between the source of waste generation and composting plants has also led to an increase in the transportation cost. Besides non-availability of the market for compost has been the biggest hurdle in investing and promoting compost plants.

Incineration and similar methods

New and expensive technologies are being pushed to deal with our urban waste problem, ignoring their environmental and social implications. It is particularly true in the case of thermal treatment of waste using technologies such as gasification, incineration, pyrolysis or pelletisation. Since Indian waste content does not provide enough fuel value for profitable energy production (and is unlikely to do so in the near future), it needs the addition of auxiliary fuel or energy. These technologies, hence, have to be subsidised to ensure their viability. While 1 MegaWatt of coal-based energy costs about Rs 5 crore, energy from waste can exceed Rs 8 crore per MW.

Such technologies put the community to risk and are widely opposed. Incinerators routinely emit dioxins, furans and polychlorinated bi-phenyls (PCBs), which are deadly toxins, causing cancer and endocrine system damage. Other conventional toxins such as mercury and heavy metals are also released. In fact, pollution control costs for incinera-

tors exceed over 50 per cent of their already astronomical cost in Europe, and an incinerator for 2000 MT of waste per day can cost over US\$ 500 million. Ironically, the better the air control works, the more pollutants are transferred to land and water, through scrubbers and filters. Besides, the problem of safe landfill disposal of the ash remains. The lessons of incinerating Indian urban waste do not seem to have been learnt despite a disastrous experience with a Dutch-funded incinerator in Delhi. It ran for just one week in 1984, since the calorific value of the waste was less than half of what the incinerator needed.

Incinerators have inherent drawbacks, the most potent being the emissions of dioxins and furans.

Sanitary landfilling

Sanitary landfills are huge dumping grounds located mainly on the outskirts of cities (with the rapid expansion of urban areas, the landfills are sometime within the vast premises of the city itself, for example, Delhi's Okhla landfill). Ideally, a landfill should be lined to prevent leachate that pollutes underground water and can contaminate the soil. It also needs to have an elaborate system of pipes and tubes to avoid forming landfill gas. Waste dumped in landfills is compacted and covered with earth. Methane-rich gas, also known as landfill gas, is produced during anaerobic decomposition of the waste. However, none of the landfills in our cities or else-

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Dioxins and furans

- Dioxins and furans are among the deadliest chemicals known to us. They are potent carcinogens – cancer-causing agents.
- To produce dioxins we need organic matter, chlorine and reactive thermal environment – an environment that an incinerator readily provides.
- Dioxins are produced when chlorinated compounds, such as from garbage, medical waste and toxic chemicals, are burnt in incinerators.
- Since dioxins dissolve in oils, fats, etc, they bioaccumulate up in the food chain.
- Dioxins are transported through atmosphere and are eventually deposited on soil, plants, water bodies, etc.
- Dioxins contaminate air, water and food, passing these deadly pollutants on to people through meat, milk and fatty food products.
- Despite their potency, dioxins are either not monitored or very poorly monitored in most countries.

(Source: 'Molecules of Death'; Down to Earth, August 31, 2001)



Diversion of waste from landfills should be a prime concern: waste minimisation and recycling are sustainable options.

a severe land crunch.

Biomethanation

This is suitable when organic matter is separated and fed into the bioreactor. Here, in the presence of methanogenic bacteria and under anaerobic conditions, fermentation takes place and biogas is produced. In addition, high quality organic manure in the form of sludge, which may be dried, is also obtained.

Waste segregation

"Municipal Solid Waste (MSW) collection systems that segregate the waste at source could reduce the amount of waste destined for landfilling. The separating out of paper, glass, textiles, and plastics from MSW would not only reduce household waste but also help conserve materials and energy. Having separated out the useful fractions of MSW, the next step is to ensure adequate and environment-friendly recycling facilities for the secondary raw material and a market for products made with recycled products. Currently, waste pickers, *kabaris* and recycling factories in India carry out this activity in the informal sector. This needs to be propped up though the availability of safer technologies for recycling as well as recognising and supporting the role waste pickers play in this crucial task."

(No Fire Without Smoke. A Critical look at Municipal and Hazardous Waste Incineration, Srishti, 1996)

Recycling dynamics

In the above context, promoting recycling is an important intervention. Recycling results in material recovery and preservation of virgin natural resources. On the face of it, India is a recycling and reuse society. There is a tradition of reusing bottles, clothes, tins and glass. However with the advent of consumerism, and the use of packaging for goods such as food, it is changing fast. Plastic packaging for example, uses up over 50 per cent of the 4 million tonnes of plastic production

per year in India. Most of it becomes waste immediately, the product coming into use through discarded wrappers, bags, etc, and adding over 1 million tonnes of plastic to the waste stream.

Similarly, paper will constitute the largest non-organic waste in the next 25 years. Currently we recycle less than 36 per cent of it. Old newspapers, writing paper, paper wrappers, etc, are sold to roving *kabaris* and taken back to the paper mills, but this needs to increase, as it originates from scarce forest resources. Despite all this we have not given much thought to increasing the recycling rate in India in the coming years.

Almost all recycling activities of urban municipal waste in India are undertaken through the informal and semi-formal sector mechanisms. This sector is also the human face of waste in India. By some estimates over one million people are involved in the business of waste.

Waste pickers

The waste pickers – often marginalised in our society – just about manage to survive. They are actually reducing our waste thereby lessening the burden of the municipality. In Delhi alone, there are approximately 80,000 to 100,000 waste pickers who take away about 10-15 per cent of the waste. Waste pickers collect different recyclable items such as plastic bags, metal cans, wires, paper, plastic items, etc, and sell it to local *kabariwallas* (waste dealers) who again sell them to recycling units located in different parts of the city. Waste pickers are very poorly paid. Most of them do not earn more than Rs 45 to 80 per day. Waste picking is not a formally recognised profession, and our municipal authorities are undecided on how to handle them, although these waste pickers apparently ease their job to some extent.

Waste picking is not only a thankless profession, it is also dangerous. Municipal waste often includes hazardous items from hospitals, industries and homes. Scavenging through waste dumps, waste pickers are injured by sharp items like needles and glass. If these sharps happen to be from a medical unit, waste pickers can contract hepatitis, HIV and other deadly infections. Fecal matter, often present in waste dumps, can also infect them. Constant bending over to pick up waste may also lead to severe back problems. Besides, rats, dogs and insects that in-

habit the dump area may also bite the waste pickers.

Some waste pickers extract copper wire from discarded PVC wire by burning it. The resulting dioxins are highly poisonous and are known to cause cancer. Due to their poor socio-economic condition they do not have access to proper medical facilities to counter these dangers.

Small recyclers

The demand for such material emanates from the tiny or small recycler. With basic technology, such as extruders and dryers, they separate materials and recycle them into granules or metal lumps to be used for making cheap recycled products like buckets, mugs, slippers, suitcases, etc. Paper is often sold to mainstream paper mills to be mixed with virgin pulp. Metals like Aluminium, too, are sold to foundries to be recast. However, there are occupational and environmental hazards galore. These small units, of which Delhi was said to have over 10,000 before the recent crackdown, exposed their underpaid contract workers to deadly plastic and metal fumes. In 1999, for the second time in four years, more than 40 illegal lead smelters were closed in Delhi – these were recycling car batteries with no concerns of exposure to workers from the toxic and deadly metals.

Dealing with new materials

Another problem relates to new materials which are being introduced in the waste stream. Many types of plastics, or multilayered materials are not possible to recycle in the existing setup, or are just not economical to collect and recover. For example the plastic commonly known as 'PET' needs scales of investment in recycling not within reach of tiny units. Hence, though possible to recycle, there is no demand for it and it is not collected by waste pickers everywhere. New plastic packaging, such as beverage bottles, food containers, etc, is often made of PET. Also, fused material such as tetrapacks or plastic-coated Aluminium lining (typically used for wafer packs) are not always collected. Other problematic packing materials include styrofoam and thermocol. The flimsy plastic carrybag takes back-breaking labour to collect with very little remuneration. It can take half a day's work to collect the four hundred odd bags needed to make a kilo which fetches a mere two rupees or less.

Plastics have increasingly taken over many aspects of our lives, especially in the past decade. India produces over 4 million MT of plastics annually. As a material, plastic raises concerns from environmental and toxicity standpoints, especially since much of it (over 50 per cent) is used for packaging consumer non-durables. Other concerns with plastics arise from their replacing, across the board, a multitude of traditionally used materials such as clay, paper, metal, glass, jute, etc, which have greater potential for reuse.

Plastics also replace livelihoods and lives which have been dependent on working with these materials such as those of local village potters, the jute industry, etc. Plastics thus have an impact on various aspects of modern living, and need a policy to ensure that their impact is not negative.

Of late plastic litter has raised many reactions from the citizenry and the State. People have begun to react to the most obnoxious symptom of plastic usage, the polybag, which is light, flimsy and toxic. It has been known to choke gutters, kill cows, and also perpetuate litter. The State has only offered placebos through incomplete and half-baked legislations to restrict the usage of such bags to non-food usage. A product policy does not tackle the basic problems of plastics as a materiel, and leaves one wondering if consequently there would be a separate legislation for each new plastic product. The new and upcoming legislations are not only unimplementable, since they permit bags based on thickness, which is difficult if not impossible to impose, but also give recycling a bad name, instead of providing incentives for it.

Need for recycling interventions

Clearly a more comprehensive material recycling policy is needed – one which emphasises producer responsibility and waste minimisation before introducing a particular type of packaging, and encourages recycling by providing incentives for technology upgradation and collection. Recycling thrives under shanty and unhealthy informal sector conditions, and is unable to deal with newer and growing variety of materials coming into usage. Besides as the example of compost shows, market development is a critical part of any recycling intervention.



Many types of plastics or multi-layered materials are not possible to recycle in the existing setup, or are just not economical to collect and recover. For example, the plastic commonly known as 'PET' needs scales of investment in recycling not within the reach of tiny units. Hence though possible to recycle, there is no demand for it and it is not collected by waste pickers everywhere

Recycling and Waste Policy: Lack of a Framework

Recycling mentioned but not addressed

Though there have been a variety of policy responses to the problem of urban solid waste in India, especially over the past three years, yet recycling remains an untapped, and unattended area. All policy documents as well as legislation dealing with urban solid waste mention or acknowledge recycling as one of the ways of diverting waste, but they do so in a piecemeal manner and do not address the framework needed to enable this to happen. Critical issues such as industry responsibility, a paradigm to enable sustainable recycling and to catalyse waste reduction through, say, better packing has not been touched upon.

Recognising the role of the traditional and largely informal sector in the recycling of some types of plastics, paper and metals is not enough. As this study shows, the ground picture reveals that many types of new materials are not, or indeed cannot be, recycled in the low-end technology being employed. Besides, there are serious issues of poor occupational safety provisions of the waste pickers as well as workers. Also, this sector faces a severe threat from the new business model approach to managing waste being promoted, without any attempts to integrate existing systems with them. There is an urgent need to build upon existing systems instead of attempting to replace them blindly with models from developed countries.

Isolated policies discourage recycling

Surveys in fact point out that isolated waste policies are in effect discouraging recycling of waste instead of promoting it. For example, merely banning plastic carry bags, which are mostly made from recycled plastics, effectively puts a brake on a recycling unit without creating an alternative scope for increasing recycling per se. The same goes for other item-wise bans, which are desirable from a public littering and safety point of view, but need to be made a part of other recycling catalysts. These bans need to be part of an overall waste management strategy, and not in lieu of it or exist in isolation to it.

The main response from the Government for non-biodegradable waste has been in the area of plastics. However, even here, the response is not based on plastic as a material but certain products of plastics which have

found wider use and are more visibly littering. These include plastic carry bags, plastic cups, plates and glasses, and plastic water bottles.

The response has been largely owing to community pressure, highlighted through the media as well as some responsive and outgoing officials. It has been an outcome of an outcry with school children joining in the campaigns. *Even the plastic industry has been happy to go along with this response of the State*, since, for them, it has in effect taken the pressure of the issue of producer responsibility and refocused it on managing plastic waste as one of littering. The plastic industry has been long asking that plastic waste needs to be managed as a consumer and municipal responsibility rather than an industry one.

Energy subsidies displace recycling

Similarly, waste-to-energy schemes are prompting energy from waste, which is economically unsustainable, but are silent on material recovery (recycling) options. Indian waste, typical of a low-income country (LIC), is largely organic, with high moisture content and high percentage (40 per cent) of inerts. Its composition will in fact rise in its organic content to 60 per cent with a reduction in inert content, as per World Bank figures. Accordingly, countries such as Philippines have banned incineration under their recently promulgated Clean Air Act to promote recycling, and similar moves are going on in other poorer parts of the world. In India too the Supreme Court appointed Burman Committee has rightly recommended bio-methanation and composting, along with recycling as the ways to go.

Surprisingly, those who see waste solely as a resource for energy, irrespective of the human and livelihood context and the direct health and social cost of such conversions, for example the Ministry of Non Conventional Energy Sources, pursue this strategy. It is particularly true in the case of thermal treatment of waste using technologies such as gasification, incineration, pyrolysis or pelletisation. Since the Indian waste content does not provide enough fuel value for profitable energy production (and is unlikely to do so as soon) it needs the addition of auxiliary fuel or energy, and hence these technologies have to be subsidised to ensure their viability. While one MegaWatt of coal-based energy costs

Recognising the role of the traditional and largely informal sector in recycling is not enough. Many types of new materials are not, or indeed cannot be, recycled using the low-end technology being employed. There are serious issues of poor occupational safety provisions for waste pickers and other workers. Also, this sector faces a severe threat from the new business model approach to managing waste being promoted. There is an urgent need to build upon existing systems instead of attempting to replace them blindly with models from developed countries

about Rs 5 crore, energy from waste can exceed Rs 8 crore. The same subsidy if provided for recycling can build more sustainable and long-term systems in India.

Recycling support would entail, amongst other things, creating a producer responsibility based fund for investments in the recycling sector. This needs technology upgradation, adequate collection, and the support of the informal sector, which is currently very hazardingly engaged in the activity, and creating markets for higher quality recycled products.

Various policy initiatives

Clearly, Indian policy has not been very creative in determining an adequate response to the problem here. An integrated waste management plan has not been thought of in India. The sole exception to this has been the Justice Ranganathan Mishra Committee's directive to the mineral bottle industry to collect 60 per cent of its over 1 billion waste water bottles over a period of one year. The industry has been forced to install collection centres and provide an incentive of 25 p (which may be too low) for bottle take-back. This particular initiative has also been made possible owing to the existence of pre-installed capacity for PET recycling in India, which is lying under-utilised. If this works in the long run, it becomes a win-win situation for all. The only drawback is that in India PET plastic recycling is being done to convert it into fibers by shredding, and not back into PET. Hence, there is still no recycling of the material back into the virgin material market, and it does not result in any natural resource saving per sé.

At the national policy level, the Ministry of Environment and Forests has recently legislated the Municipal Waste Management and Handling Rules, 2000. Other recent policy documents include the Ministry of Urban Affairs and Employment's Shukla Committee Report (January 2000), the Supreme Court appointed Burman Committee's Report (March 1999), and the Report of the National Plastic Waste Management Task Force (August 1997).

The government has also banned the use of thin colored plastic bags for food. Many States have had their own responses too. Himachal Pradesh, Haryana, Goa, Maharashtra, Andhra Pradesh, Andaman & Nicobar Is-

lands, Lakshadweep and Sikkim are amongst those who have implemented legislation in various forms to limit scattering of these bags or outright banning them.

Ranganath Mishra Committee on Plastic Waste Disposal –

Constituted by: Ministry of Environment and Forests, Government of India

Date of constitution: January 2001

The committee had the following terms of reference:

1. Examine various environmental issues related to littering of plastic wastes with particular reference to disposal.
2. Examine various regulations on plastic waste disposal brought by Central and State Governments and suggest appropriate measures for collection, segregation, treatment and disposal of plastic wastes.
3. To consider any other related issues.

The committee has met several times since and has made the following recommendations regarding recycling:

1. The Recycled Plastics Manufacture and Usage Rules, 1999, do not provide for seizure/confiscation of the illegal material; also, there is no provision for compounding the offence. As the prosecution takes a long time, it will be desirable to have a compounding provision that will have a salutary effect.
2. The plastics industry is to be made responsible to retrieve empty packaging and should be asked to have a proper disposal system. The cost of recycling of plastic materials could be built into the product.
3. Industry should strengthen the network of concerned industry associations for promoting waste management and to organise recycling as per BIS norms.

Comment: This initiative has forced the plastics industry to actually set up collection centers for PET bottled water bottles, with a take-back monetary incentive. Though it is a welcome initiative, it does not address the issue of how the traditional/informal waste picker driven recycling sector will be integrated into the mainstream systems.

Municipal Solid Waste (Management and Handling Rules), 2000

Ministry of Environment and Forests, Government of India

Notified on: September 2000

Recycling as described in these rules: Re-

Since the Indian waste content does not provide enough fuel value for profitable energy production (and is unlikely to do so as soon) it needs the addition of auxiliary fuel or energy, and hence these technologies have to be subsidised to ensure their viability. While one MegaWatt of coal-based energy costs about Rs 5 crore, energy from waste can exceed Rs 8 crore per MW. The same subsidy if provided for recycling can build more sustainable and long-term systems in India

cycling means the process of transforming segregated solid wastes into raw materials for producing new products, which may or may not be similar to the original product.

Recommendations with regard to recycling

1. Composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilisation of waste shall process the biodegradable wastes.
2. Mixed waste containing recoverable resources shall follow the route of recycling. Incineration with or without energy recovery including pelletisation can be used for processing waste in specific cases.

Comments: Although the rules recommend recycling, they are silent on how to follow it. There is no direction on promoting recycling even though waste-to-energy is encouraged through the formulation of technology standards. It also implies the equating of incineration to material recycling, which is arguable.

Manual on Municipal Solid Waste Management

*Prepared by Expert Committee, constituted by Ministry of Urban Development, Government of India
Date: January 2000*

The committee, after a series of deliberations, included various aspects in the Manual such as quantity of solid waste, storage, primary collection, composting, energy recovery, merging technologies, landfilling community participation, etc.

Recommendations with regard to recycling

1. For an economically and environmentally sustainable solid waste management system, resource recovery through sorting and recycling, that is, recovery of materials (glass, paper, metals, etc) through separation is important.
2. Recycling is next only to waste reduction as a waste management option. Recycling is an important factor that helps to reduce the demand on resources and the amount of waste to be landfilled.

Comments: The document is silent on the mechanism or intervention required to promote recycling or to make it more viable.

Recycled Plastics Manufacture and Usage Rules

*Ministry of Environment and Forests, Government of India
Notified on: September 1999*

Recommendations with regard to recycling

Recycling of plastics shall be undertaken strictly in accordance with the Bureau of Indian Standards specification IS 14534: 1998 entitled 'The Guidelines for Recycling of Plastics'.

Marking/codification: Manufacturers shall print on each packet of carry bags as to whether these are made of "recycled material" or of "virgin plastic" as per Bureau of Indian Standard specification IS 14534: 1998 entitled 'The Guidelines for Recycling of Plastics'. The end product made out of recycled plastics shall be marked as "recycled" along with the indication of the percentage of use of recycled material.

Comments: This is an un-implementable standard, owing to the sector being mostly in the informal sector and there being no standard market for recycled products where such labeling requirements can be enforced.

Solid Waste Management in Class 1 cities in India

*Constituted by Hon. Supreme Court of India headed by Mr Asim Burman, Municipal Commissioner, Calcutta Municipal Corporation
Date: March 1999*

The terms of reference of the committee are:

1. Examine the existing practices and to suggest hygienic processing and waste disposal practices and proven technologies on the basis of economic feasibility and safety which the Corporation/Government may directly or indirectly adopt/sponsor.
2. Examine and suggest ways to improve conditions in the formal and informal sector for promoting eco-friendly sorting, collection, transportation, disposal, recycling and reuse.
3. To review municipal bye-laws and the powers of local bodies and regional planning authorities and suggest necessary modifications to ensure effective budgeting, financing, administration, monitoring and compliance.
4. Examine and formulate standards and

regulations for management of urban solid waste and set time frames within which the authorities shall be bound to implement the same.

Recommendations/suggestions with regard to recycling

1. Ragpickers may be organised with help from NGOs to collect recyclable waste from shops and establishments. These rag pickers help reduce the burden of local bodies by several million rupees a year in collection, transport and disposal costs and saving of landfill space. This will add value to recyclable waste and will help in conserving national resources. Their contribution and role has not been recognized by the society.
2. Such recyclable material would give them a better return and will work as an incentive for them for door-to-door collection.
3. 10 per cent of waste produced in India can be reused or recycled. Part of it is collected by ragpickers and the rest goes to the landfills. Recycling can be encouraged by promoting the recycling industry through incentives like land allotment, power, water on priority, tax holiday, preferential purchase of recycled products by government and semi-government bodies.
4. All out efforts to retrieve recyclable material as feed stock to recycling industry.
5. Segregation of recyclable waste at source is not seriously practiced. 15 per cent of waste can be easily source segregated for recycling.
6. Informal sector can collect the following types of waste:
 - All types of paper and plastic
 - Cardboard and cartons
 - Containers except those containing hazardous chemicals
 - Packaging
 - Glass
 - Metals
 - Rags, rubber, wood
 - Cassettes, computer diskettes, printer cartridges, electronic parts
 - Discarded clothing, furniture and equipment.

Comments: This report suggests extensive measures for recycling of waste. However, it does not go far enough to suggest the nature of incentives required for doing this in the areas of market development for recycled products, enabling technology upgrad-

ation or improving working conditions in the existing sector.

National Plastic Waste Management Task Force

Constituted by Ministry of Environment and Forests, Government of India

Date: August 1997

The task force had the following objectives:

1. To formulate a strategy and prepare an action programme for management of plastic waste.
2. To propose incentives/penalties for checking the growth of plastics packaging waste.
3. To prepare guidelines for packaging using plastics material.

The task force made the following recommendations regarding recycling:

Some of the recommendations are based on BIS standards that classify post-consumer waste as:

Type I: Post-consumer clean plastic waste of known origin.

Type II: Post-consumer plastic waste of unknown waste of unknown origin having visible impurities (including recycled plastic waste with visible contaminants).

1. Beyond Type II materials, recycling plastic waste should be banned. Alternatively, use of such plastics waste (beyond Type II) should be used for energy recovery. Recycling of multi-layer film packaging and plastics beyond Type II also be considered for use as composites and applications, such as substitutes for wood/concrete products.
2. Consumer items such as toys, water bottles, carry bags, etc should not be allowed to use recycled plastic waste beyond Type I. Instead a blend of 50:50 with virgin plastics should be encouraged without degrading the quality of end products. Manufacture and use of dirty-coloured carry bags with visible contamination should be banned.
3. Integrated plastic waste management needs the cooperation of industry, local authorities and consumers. Industry should take the lead in supporting pilot collection schemes with the objective of channelising maximum post-consumer plastic waste for recycling.
4. To prevent indiscriminate plastic waste generation and to promote recycling, technical and financial assistance should be provided. Plastic products with appropri-

ate recycled content should be given price preferences/incentives. To promote increased use of plastics waste, incentives like sales tax concessions, duties for upgradation, import of recycling technology, equipment and machinery may be considered. Incentives should be provided by plastics industry to ragpickers and NGOs for collection of plastic waste from public places.

5. The plastic recycling industry depends primarily on local machinery for recycling plastic waste. However, as there is a scope of upgradation of technology, these units should compile an inventory of their machinery and their requirements.

Comments: The second term of reference, relating to economic measures to promote recycling, were not taken on board by the industry-dominated committee, which had no member representing the public interest. Hence the recommendations were again dealing with recycling and littering without any focus on industry responsibility. No economic cess or fund was proposed for upgrading the recycling industry, and though technology upgradation is recommended, its financing is not. The recommendations read like a statement of intent rather than a plan of action.

Bureau of Indian Standards (Doc. PCD 12 (1170) F)

Date: August 1997

1. The methods of recycling and technology need to be updated. Some industries even recycle the plastics waste/scrap that is a health hazard for persons who use items made from such plastics. Such material is even used at times for packaging food and medicines.
2. Plastic waste scrap needs to be segregated fully. Recycling of commingled plastic waste/scrap should not be carried out without appropriate technology.
3. Plastic recycling technologies are classified as:
 - Primary recycling, that involves processing of waste scrap into products with characteristics similar to those of original product.
 - Secondary recycling, which involves processing of waste into products with characteristics different from the original products.
 - Tertiary recycling, which involves the production of basic chemicals and fu-

els from plastic scrap as part of the municipal waste stream or as segregated waste.

- Quaternary recycling, which retrieves the energy content of waste plastic by burning/incineration.
4. The manufacturers of plastic end products from either virgin or recycled products shall mark the symbol (defined by Society of the Plastic Industry, USA) at the time of processing to help reproprocessors identify the basic raw material.
 5. All medical plastic waste and containers used for packaging toxic contents shall be segregated separately and incinerated for energy recovery.
 6. Appropriate measures shall be taken to dispose of the effluent generated as a result of washing of the waste as per Pollution Control Act before recycling.
 7. Efforts shall be made to avoid downgrading the quality and performance of end products using recycled materials.
 8. Recycling of dirty coloured plastics post-consumer (including recycled earlier) waste and use of recycle so generated for manufacture of critical consumer items like carry bags, blow moulded containers, water bottles, toys, shall be discouraged.

Comments: Not implemented, as the industry has not taken it up. In the existing recycling sector, since the markets are largely low end, there is no pressure for these to be adopted.

Report of the High-powered Committee on Urban Solid Waste Management in India, headed by Prof B.S. Bajaj, Member, Planning Commission

Constituted by the Planning Commission, Government of India, 1995

The committee, after several rounds of meetings, made the following recommendations with regard to recycling. None have been implemented.

1. Source segregation of recyclable materials. Informal sector scavenging from roadside dumps and disposal grounds be replaced by organised ward level recycling and recovery centres, which should be attached to transfer stations where primary collection carts are transferring their collection to the transport vehicles. The resource centres could be managed by NGOs of ragpickers. Municipal authorities could also employ ragpickers.

2. Industries engaged in processing of recycled garbage should be given financial assistance to upgrade their technology.
3. Assess the state of present technologies used for recycling and undertake R&D pilot scale studies to develop new technologies and upgrade existing ones.
4. Legislative and administrative measures to promote the use of products made of recycled materials like paper, plastic or glass.
5. Exemption with regard to duties applied to recycling and waste processing industries by state and central governments.

Comments: Many of the suggestions are very far-reaching in their vision, and any implementation would help boost the threatened recycling sector in India.

Yet, none of the above recommendations regarding recycling of waste have been implemented or followed in any subsequent policy document.

Proposed legislation

Tamil Nadu Plastics Articles (Prohibition of Sale, Storage, Transport and Use) Act, 2002

Comments: The proposed Act is probably the most far-reaching of the plastics notifications so far. It has many welcome provisions that empower the government to ban the use of certain plastic articles for the protection of environment and public health. However, since there is no recycling policy framework at the central level, it does not outline recycling or producer responsibility.

Waste-as-energy Policy

Promoted by The Ministry of Non-Conventional Energy Sources (MNES), 1995

The policy has the objective of promoting waste solely as an energy source. It provides incentives such as:

- Financial assistance up to 50 per cent of the capital costs of the project, limited to Rs 3 crore per MW for demonstration project.
- Urban Local Bodies receive financial incentives at Rs 15 lakh per MW for providing garbage free of cost to the site and land on long-term basis on nominal rent.
- Financial institutions also get financial incentives to promote non-conventional energy resources
- State electricity boards receive financial incentives on cost of equipment and dif-

ferential power tariff if the energy generated is fed to the grid.

Apart from the MNES, the Indian Renewable Energy Development Agency, a government of India enterprise, give about 70-80 per cent financial assistance to waste-to-energy projects.

Comments: Waste-to-energy without examining material recovery biases the management of urban solid waste. Technologies such as Incineration while giving the feeling that waste is being *managed*, are not sustainable either economically or from an environment or human health viewpoint. In a way, this policy legitimises the generation of waste. For example, to keep such technologies functioning at a viable level, waste has often to be imported from other areas. On the other hand, “on an average, recycling saves three to five times as much energy as is produced by incinerating municipal solid waste”.⁹

The current policy of the Union Ministry of Non-Conventional Energy Sources (MNES) to promote dioxin-emitting high-heat waste-to-energy technologies is fraught with disastrous consequences. The MNES has issued an executive order to all the state chief secretaries and the administrators of the Union Territories asking them to promote such waste-to-energy projects. As a consequence, agreements for many such toxic projects have been signed and are being signed in Delhi, Bhopal, Mumbai, Chennai and other cities about which there is total non-transparency.

A similar subsidy does not exist for other waste products such as compost or recycled goods, and places them at a disadvantage vis-a-vis energy.

⁹ Denison, R.A., and Ruston, John: Recycling and Incineration – Evaluating the Choices, 1990, p. 19.

Extended Producer Responsibility (EPR)

Extended Producer Responsibility (EPR) is a concept for products, which extends its impacts beyond the emissions and effluents generated by the extraction or manufacturing processes to the management of the product once it is discarded. It is based on the premise that the primary responsibility for waste generated during the production process (including extraction of raw materials) and after the product is discarded, is that of the producer of the product. Often the pollution costs, resource and energy consumption costs, and disposal costs are subsidized by the government and are therefore not reflected in the price of the product. EPR corrects that imbalance by internalising these externalities, and in doing so shifts these costs from government and taxpayers to producers and consumers.

Goals of EPR

The ultimate goal of EPR is sustainable development through environmentally responsible product development and product recovery. The theory is that by making producers pay for the waste (wasted resources and post consumer waste) and pollution they create, they will have an incentive to incorporate a broader range of environmental considerations into both their product design and choice of materials, thereby reducing consumption of resources at the various stages of the life-cycle of a product or package. Cleaner production and waste prevention are the goals.

Operationalising EPR

EPR works through various types of producer responsibility. Thomas Lindquist (referred to as the father of EPR) has identified five basic types of producer responsibility.

- **Liability** - producer is responsible for environmental damage caused by the product in question
- **Economic responsibility** - producer covers all or part of costs for collection, recycling or final disposal of products he manufactures, and may charge a special fee
- **Physical responsibility** - manufacturer is involved in physical management of the products or of the effect of the products. This can range from merely developing the necessary technology, to managing the to-

tal "take back" system for collecting or disposing of products he has manufactured for which he may charge a fee

- **Ownership** - producers assumes both physical and economic responsibility
- **Informative responsibility** - producer is responsible for providing information on the product or its effects at various stages of its life cycle

A number of instruments are currently being employed to shift responsibility for product and packaging waste from government and taxpayers to producers and consumers. Four policy instruments and examples of each are as follows:

- **Deposit refund systems:** Deposit refund systems can encourage reuse, but may also provide monetary incentives to the consumer to return the product or package, and help create an infrastructure for its collection and recycling. Ten states and one US city, most Canadian provinces and many European nations have enacted beverage container deposit laws. Deposit refund systems also exist for batteries and some hazardous wastes.
- **Product charges:** Product charges influence the choice of materials used. An eco-tax levied in Belgium reduced consumption of PVC.
- **Advanced disposal fees:** These fees are designed to influence the choice of materials used, and can generate substantial funds which may or may not be used by government for environmental projects. They are sometimes refunded to consumers, but generally the consumer is unaware of the fee. Austria has implemented such a fee for refrigerators and refundable disposal fees are required on automobiles in Sweden.
- **Voluntary agreements tied to mandatory regulations:** These agreements are used to phase out undesirable materials, encourage design for recyclability or ensure high rates of reuse or recycling. The voluntary deposit system for Aluminium cans in Sweden enable the Aluminium industry to achieve the government mandated recycling rate. However, if the recycling rate fixed by the government is not achieved then there is a provision for banning the industry, which proves to be the driving force to ensure proper collection of cans.

Policy Instruments

There are three categories of policy instruments that can be initiated by government to encourage product responsibility.

Regulatory Instruments: Mandatory take-back; minimum recycled content standards; secondary materials utilization rate requirements; rates and dates; energy-efficiency standards; disposal bans and restrictions; materials bans and restrictions; and product bans and restrictions

Economic Instruments: Advance disposal fees; virgin materials taxes; removing subsidies for virgin materials; deposit/refund systems; and environmentally preferable products procurement

Informative Instruments: Seal-of-approval types of environmental labelling (Green Seal, Blue Angel); environmental information labelling (energy efficiency, CFC use, recycled content); product hazard warnings; product durability labelling.

Examples of EPR worldwide

The concept of EPR was developed in Sweden, and now has found universal acceptance. EPR got its start in 1991, when Germany prompted by a serious landfill shortage adopted a law making producers responsible for product packaging after consumers discard it. The law simultaneously mandated that recycling rates for many materials (including glass, plastics, steel, and paper) be increased to anywhere from 64 to 72 percent—an enormous jump from previous levels. In response to the packaging law, German industry adopted the “Green Dot” system. Industry established a non-profit company called DSD to operate the system, says DSD licenses its logo, the green dot, for a fee.

EPR is now becoming institutionalized throughout much of the industrialized world. In most countries, EPR is first applied to packaging and then to other products. Following are descriptions of the spread of EPR to three major product sectors: packaging, electric/electronic equipment, and vehicles.

Packaging: As EPR policies for packaging began to spread throughout Europe; the European Union issued its own Packaging Directive in 1994 to harmonize policies in its member countries. This directive embraced the concept of EPR and mandated recycling targets for packaging waste of 25 to 45 percent, with a minimum 15 percent recycling rate for each material. As a result, all 15-

member countries (including almost all of Western Europe) will ultimately have EPR systems for packaging, although the policy is taking different forms in different countries. Many of these systems are already in operation, while others are still under development.

Eastern European countries like Poland, Hungary, and the Czech Republic have jumped on the EPR bandwagon and the policy is also spreading to Asian countries such as Korea and Taiwan. Japan’s law requiring EPR for packaging was passed in 1995 and went into effect in 1997. Twenty-eight countries now have packaging take-back laws.

Electric and Electronic Equipment: Electric and electronic equipment (EEE) are a major focus of EPR policies around the world. In Europe, EPR legislation for EEE has already been adopted in Switzerland, the Netherlands, Italy, and Norway, and is close to adoption in many other countries.

In Japan, EPR legislation for EEE was passed in May 1998 with implementation required by 2001. Initially, take-back of refrigerators, air conditioners, TVs, and washing machines will be required, with the possible expansion of the program later to include other products. Unlike the European countries, which preclude end-user fees for take-back, Japan is permitting industry to cover its actual costs by charging end users.

Vehicles: Vehicles are amongst the most highly recycled products in the world. About 75 percent of vehicles (by weight) consist of metals - mostly iron and steel - which have always been recycled in the industrialized countries. The target for EPR is the remaining 25 percent: the mixed materials (plastic, rubber, glass, textiles, fluids, and paint) that are often contaminated with hazardous substances such as lead, cadmium, waste oil, and PCBs. In some countries, these materials (known as auto shredder residue) are designated a hazardous waste. EPR for vehicles aims to keep this waste out of landfills and reduce the number of vehicles disposed of illegally.

Recovery targets (which allow waste-to-energy) are 85 percent for 2005 and 95 percent for 2015. To avoid paying fees, vehicle owners would have to obtain a “certificate of deregistration” signifying that the vehicle had been brought to an authorized recycling facility.

A number of countries with EPR policies

for vehicles already in place have recycling and recovery targets similar to those under consideration by the EU. Both France and Germany have negotiated ELV take-back agreements with industry, and Germany passed legislation in 1998 to facilitate enforcement. In Sweden, legislation passed in 1996 requiring EPR for vehicles supplements that country's 1975 vehicle scrapping law (which focused on reducing litter caused by abandoned vehicles).

In Japan, MITI has been developing EPR legislation for ELVs that sets recycling/recovery goals similar to those of the EU and individual countries in Europe. A common target in most programs is a 95 percent recovery rate for 2015, meaning that only 5 percent of ELVs would be permitted in landfills by that date.

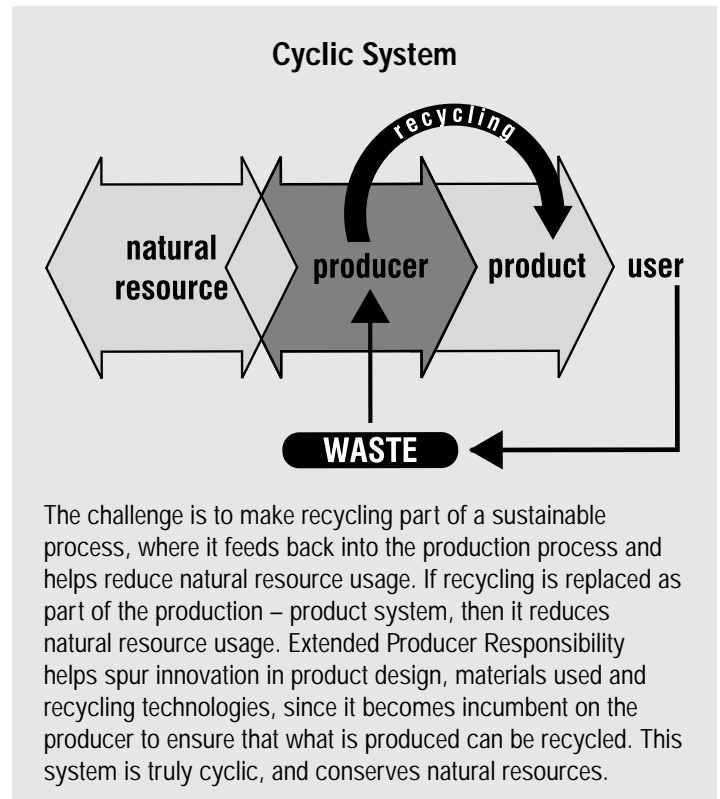
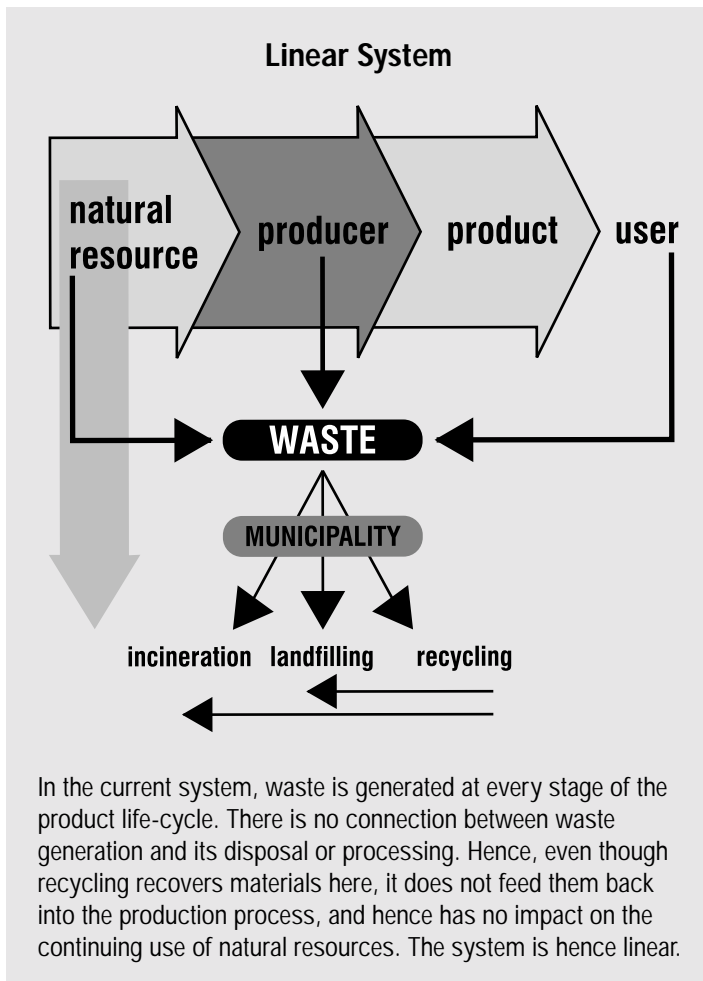
In fact, vehicles are an excellent example of how extended producer responsibility can have an impact on product design. Even in the United States, where no EPR policies are in place for ELVs, marketing goals and the

desire to pre-empt EPR legislation can lead to design innovations. For example, members of the voluntary Vehicle Recycling Partnership (which includes Chrysler, Ford, and General Motors) are working on design changes that would make it easier to recycle discarded vehicles.

EPR in India

One of the regulatory instruments that embody EPR includes mandatory take back where a producer takes back its product after its useful life either directly or through a third party. A take back or deposit refund system is not new in India. It has existed several years now with glass bottles. Presently an effort has been made to make use of EPR for PET bottle waste generated. The rationale behind a deposit refund for PET in India is to stimulate high level of collection, reuse and recycling which would help in alleviating the recycling problem.

During several meetings of the Task Force,



the Ministry of environment and the CPCB, the industries were asked to come up with an outline scheme of take back for PET bottles. The industry representatives suggested a voluntary scheme for collection of PET bottles with suitable incentives offered to the consumer. From a mandatory take back the industry moved the discussion to a voluntary take back. The industry evaded the producer responsibility by expressing inability to set up a system in view of the fact that PET consumption in soft drinks is minimal. For mineral and liquor bottles such a system will not be feasible. Another argument was that a large number of mass consumption beverages were still packed in glass bottles and establishing a take back for PET would not be financially viable.

The industry is not ready to accept a take

back policy as it would mean an increase in production cost, which it is not presently ready to incur. Further it may be because they are afraid that accepting the responsibility of PET would mean accepting responsibility for other problematic plastic like PVC in future (Edward, Kellet, 1999).

Although there is a consensus amongst the policy makers for take back policy of PET bottles but there is no clear picture as to how it may be possible considering the strong industrial resistance. The idea is still at a conceptual stage with ongoing discussions amongst various stake holders.

However the Ranganath Mishra Committee on Plastic Waste Disposal Constituted by Ministry of Environment and Forests, Government of India has made an attempt of collecting PET bottles by introducing the Deposit Return Scheme where whoso ever returns PET bottles is paid 25 paise. Since introduction of DRS would make clean PET waste available this would serve as an incentive for recycling units to recycle the local PET waste. DRS would also encourage bottle to bottle recycling helping in minimizing consumption. (Present collection pattern has been discussed in detail in the section on PET recycling).

The Ecomark Scheme

No single product in the market bears the ecomark scheme, a government certified green label. The ecomark was launched by the government in 1991 for the labelling of eco friendly products, which incorporates life cycle perspectives. The industry has no incentives to go for this scheme, as there is not enough export of majority of the Indian products. Also there is hardly any demand from Indian consumers for eco labelling of products. To successfully imbibe the concepts of EPR, interventions have to be made throughout the system amongst various stakeholders and not in isolation.



SECTION 2

Examining the existing recycling systems

Study design and methodology

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- Methodology
- Sampling
- Administering the questionnaire
- Recycling units study
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Bottom of the heap – the waste pickers

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- Social capital among waste pickers
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Invisible Hands – Waste Sorters

- Social profile of waste sorters
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Adding Value to Waste – The Waste Dealers

- The market mechanism of waste trade
- Social profile of small and medium waste dealers
- Hierarchy in waste trade chain
- Social profile of small and medium waste dealers
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Recycling units: people and technologies

- Technologies used for recycling
- Plastic waste – sources
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- Recycling process
- Mixed plastic waste recycling
- Specific materials: PET
- Expanded Polystyrene
- Aluminium
- Occupational health hazards of plastics recycling
- Owners of the recycling units and recycling enterprises
- Limitations faced by the recycling units

Study design and methodology

There is insufficient authentic data on several aspects of the informal sector's recycling of urban solid waste in India. Data on many aspects of waste pickers, waste sorters, waste dealers as well as recycling units is not available.

Though figures on the number of waste pickers exist (supposedly around 80,000 to 1 lakh in Delhi), they seem to be more of a conjecture. Owing to the floating nature of the job (new people joining or the old ones leaving on receiving better opportunity), estimating their numbers is an enormous task. Similarly, there is no study on the number of waste sorters working with the waste dealers or on the number of waste dealers themselves. This makes the task of gauging the number of people engaged in this profession more difficult.

Since we did not have sufficient data about the population of our target group, we decided to visit slums where waste pickers usually reside and sell their wares to the local small waste dealers. We concentrated on areas with a higher number of small waste dealers assuming that the more the number of waste dealers, the more would be the number of waste pickers.

To begin with, we would visit the area and get an estimate about its total population either through residents or from an organisation working there. After cross-verifying this to an extent possible, we would draw a sample. In case of conflicting figures we would make further assessments and then take an average. We also asked waste dealers about the total number of waste pickers (in the respective area) selling waste to them. Their information was fairly accurate.

To further authenticate the information we also inquired from waste pickers about the number of waste dealers in that particular area, besides inquiring from the waste dealers themselves about their numbers. This helped us corroborate figures and arrive at reasonable estimates.

Getting an estimate about waste sorters was a little cumbersome. Each waste dealer usually employs sorters according to his requirements that tend to vary. The number of sorters varied from two to 20. Many waste pickers also worked as

sorters to supplement their income. This exacerbated the problem of gauging the target group population.

Study objectives

- Make an assessment of the waste trade and identify the various players.
- Draw an assessment of the socio economic condition of the different players involved in the recycling trade.
- Understand entirely the trade of waste dealing in a manner where the role of each player could be defined.
- Understand the price mechanism of the trade.
- Examine the technologies being used and explore the scope for its improvement.

Methodology

Instrument used: Questionnaires with open-ended and multiple-choice queries.

Direct communication with the respondents is necessary to generate authentic data. Individual perceptions, observations are bound to be subjective and may suffer from certain prejudices. The instrument, which is most frequently used for measuring characteristics, attitudes, expectations, perceptions and situations of a respondent, is the questionnaire. One of the best methods of obtaining responses to a questionnaire, particularly where some of the respondents are illiterate is a personal interview.

It was thought ideal to put both kinds of questions (open- and closed-ended) in the questionnaire. An open-ended question does not lead the respondent. It, therefore may suggest new lines of investigation that may not have occurred to the investigator (as it happened when we found that there are more players in waste dealing than assumed: the agents). Closed-ended questions while overcoming the disadvantages of open-ended questions enables the respondents to conceal the lack of understanding or avoid sharing the correct answer if it is not on the checklist.

Six different questionnaires were prepared. They were administered to:

1. Waste pickers,
2. Waste sorters,
3. Waste dealers,
4. Owners of the recycling units,
5. Owners/persons in-charge at the recycling units (for technology in use), and
6. Workers at the recycling units.



We repeated certain number of questions to corroborate the authenticity of the different responses. For example, we asked the unit owners, “How much do you pay the workers at your unit?” We repeated the same question to the worker, “How much are you paid for the job?”

Questionnaires were developed after detailed discussion with experts, other staff members and the advisory committee. They were then extensively pre-tested. An effort was made to make most questions closed-ended for easy data entry. Some questions were left open-ended, as it was not possible to anticipate all the responses.

Interviewers were extensively trained to conduct the interview. They were encouraged to record verbatim any additional relevant information shared by the respondents.

The interviewers on their part kept the interview informal to the extent possible.

The questionnaires were then administered amongst a sample of unit owners and workers through personal interview eliciting detailed information.

Sampling

A team of five people belonging to different educational backgrounds undertook the study. Two rounds of pilot survey were conducted before the final commencement of the survey. The initial sample size was drawn at random as there was no preliminary or secondary data available for the purpose.

Delhi was divided into five zones – East, West, North, South and Central. The sample size depended upon the number of waste pickers in a particular area.

It was relatively simple to draw the sample for recycling unit owners. We contacted their associations to get the number of recycling units. Owing to the sensitivities involved (some of the recyclers being relocated or closed down by an order of the Supreme Court), it was decided that only certain areas would be chosen for the survey. Even in these areas, the survey was possible only where the respective associations consented.

The samples were then drawn on the basis of their number as well as the kind of technology being used, to cover all types possible. Initially, it was planned to investigate at least 40 units, but subsequently, it appeared that most of the recycling units had similar technologies with different capacities, hence the number was restricted.

Administering the Questionnaire

The pilot survey not only helped us in arriving at the final questionnaire but also enabled us to get a basic understanding of the nuances of the trade. It also helped us build a rapport with all the targeted respondents, mentioned below:

1. **Waste picker:** A person who scavenges in the municipal bin or at the landfill site, or collects waste from the street, market, home, offices, etc, for selling it to waste dealer or *kabadiwala*.
2. **Waste dealer or *kabadiwala*:** A waste dealer is one who purchases recyclable items from the waste pickers and the itinerant buyers of waste. The waste dealer was divided into three groups depending on whom they buy the waste from and their storage and holding capacity.
 - **Small waste dealer:** He generally buys waste from waste pickers and the itinerant buyer or *ferriwallas*. He buys all kinds of recyclable items.
 - **Medium waste dealer:** He generally buys waste from the small waste dealers and sometimes also from the itinerant buyers if it is in a large quantity. Generally he buys only a few items.
 - **Large waste dealer/supplier:** He buys from both the small and medium waste dealers and, like the medium waste dealers, deals only in a few items. There could be large waste dealers dealing in just one or two items.
 - **Agent:** He generally has no storage and holding capacity. He facilitates transactions between medium or large waste dealers and the recycling factories.
3. **Waste sorter:** He does sorting of different items at the waste dealer's premise.
4. **Recycling unit owner for recycling technology:** He is the owner of the recycling unit and produces marketable goods from melting recyclable items, which may be in the form of pellets to be made into consumer durables in the case of plastics recycling, or ingots or sheets in the case of Aluminium.
5. **Workers at recycling unit:** They work in the recycling units. Their work includes sorting, machine operation, cleaning, load-



ing and unloading materials, etc. They have no technical qualifications.

6. Recycling technology in use: The questionnaires on technology were administered to the owners and in their absence to the seniormost persons in charge of the machine for recycling.

To establish the credibility of the survey, letters were sent out about the project's objective. As the recent shifting of recycling units had created apprehensions, it was felt important to dispel their doubts and seek their cooperation.

Recycling units study

The study was conducted in various units (both organised and unorganised sectors) recycling post-consumer waste, particularly plastic and Aluminium, in and around Delhi. The association heads of recyclers in the organized sector were contacted and their permission sought to interview recycling unit owners and workers of those areas.

A different approach was adopted for the workers. The study undertaken for this sector was solely exploratory in nature. In the course of the study it was discovered that some approaches work, while others may not. Initially, the study adopted the survey method to be supplemented with detailed case studies in both the organised and unorganised sectors. However, it was soon realised that detailed case studies were not possible as the unit owners were reluctant to disclose information. Identification of cases became difficult and also ethically undesirable. Besides, rigorous working hours made it difficult to get to speak with workers.

It became evident that a proper understanding of the technology involved in recycling was not possible unless the survey method was complemented with qualitative data collection. Quantitative data collection was not emphasised as it was found that basic technology for recycling each material was the same. Hence more stress was laid on qualitative data collection.

Observation

Apart from the sample survey, observation was also an important part of the study. Observation helps add authenticity to the data collected and imparts objectivity to the study. In all the areas surveyed, the team made observations to corroborate the information. This gave us interesting stories about the life and work of waste pickers and dealers.

Time and Duration of the Survey

The survey was conducted from June 2001 to mid-January 2002. The timing of the survey was between 10 am to 4 pm. This timing may have some bearing on results of the survey of waste pickers, as it was observed later that women waste pickers generally move early in the morning and come back before noon to do the household work.

Difficulties faced in the field during investigation

Answers to certain questions were difficult to elicit, particularly questions related to pollution caused due to recycling, profit made by the waste dealers, unit owners, problems faced by workers, etc. In most cases while questioning the workers, the presence of the unit owners affected the answers. It was found that the workers were more forthcoming when the owner or people from the management were not around. However, it became very difficult to prevent them from being present.

Initially, detailed probing to certain questions was very difficult as the respondents were reluctant to answer. Frequent visits to a particular area led to trust-building and this problem was gradually overcome. At times the owner did not want to reveal their identity, or allow photographs to be taken.

The answers related to occupational health and working conditions have been taken down verbatim. No medical tests were done to verify the statements.

The total sample size during the exercise for different categories is as follows:

| | |
|--------------------------|-----|
| Waste pickers | 198 |
| Waste sorters | 69 |
| Waste dealers | 115 |
| Technology | 20 |
| Unit owners | 22 |
| Workers at factory | 24 |

Bottom of the Heap – The Waste Pickers

The municipal system in India has not proved efficient in collecting all the waste. Material recovery has been left to waste pickers, with no interventions to aid the process. It demonstrates the lack of effort by municipal bodies and policy makers to optimise the process, as well as to make it safer.

Waste pickers, for livelihood reasons, have been an integral part of any city's solid waste management system, even though their services have not been recognised and acknowledged, except in some cases through NGO efforts. Metropolitan cities have provided them with a type of self-employment, which requires few or no formal skills, education or financial investment. By collecting and selling waste to waste dealers, they reduce a sizeable quantity of it from going to the landfills and carry out a generous service to conserve resources. They also provide an unnoticed service to the municipal bodies by collecting refuse, saving crores of rupees in the process of disposal. Simultaneously, they feed recycling units with material resources to ensure their survival and reprocessing waste back into products.

Waste pickers, part of the lowest rung of urban poor, live in sub-human conditions of filth, deprivation and social ostracism despite the fact that they more or less work as service providers. They provide an *unacknowledged subsidy* to the waste producer, the consumer goods and packaging industry, and legal waste owner – the municipal body.

Reducing the municipality's burden

Waste pickers collect a substantial quantity of waste from the streets, municipal bins, and landfills reducing municipalities' work. Estimates say that this reduction is between 10 to 15 per cent. Delhi has an estimated 90,000 to 1,00,000 waste pickers, and assuming that even if on an average a waste picker collects a minimum of 15 kg of waste every day, it reduces the quantum of waste by more than 1200 tonnes. This corroborates the estimates – assuming waste pickers recover 10 to 15 per cent of waste, their contribution in reducing waste and resource recovery is more than 1000 tonnes, as Delhi generates 7000 tonnes of waste every day.

This activity takes place in the sector



where the conditions of work are informal and unorganised. It is possible that if waste pickers could be organised in a decentralised manner, the quantum of waste recovery would be much larger and there would be more recyclable materials feeding the recycling industry. Besides waste pickers save around 20 per cent of Delhi's municipal budget per annum, which is true for other metropolitan cities as well.

Instead of being recognised and rewarded, waste pickers are treated as outcasts, they are called 'scavengers', 'savages' and 'primitives', their way of living is despised, and their identities denied. They are not treated as human beings but as *kurawallas*.

A cursory look at waste pickers' contribution to the recycling industry reveals that not only do they supply raw materials to a host of industries, which in turn generate employment for a large number of people, but also save the nation's resources by making this recovery from waste.¹ Sandhya Venketeswaran calculates that 100 waste pickers facilitate the employment generation of another 37 people in the form of waste sorters, waste dealers and recycling units.²

Overview

Waste pickers are mostly from the lower social strata and do this work out of compulsion. Most of them are migrants and finding employment is as difficult for them as finding a place to stay. With nobody to back them

Instead of being recognised and rewarded, waste pickers are treated as outcasts, they are called 'scavengers', 'savages' and 'primitives', their way of living is despised, and their identities denied. They are not treated as human but as *kurawallas*

1 Venkateswaran, Sandhya: 'The Wealth of Waste, Waste pickers, Solid Waste and Urban Development', Friedrich Ebert Stiftung, 1994, p.67.

2 Ibid.



or take guarantee for an abode, it is the waste dealers who provide them shelter and subsequently buy their waste collection. Waste pickers do not often realize that they are the first step in the recycling sector, which is like a pyramid with the recyclers at the apex and they at its bottom.

Waste pickers collect whatever they can lay their hands on – and which is saleable. Their tools for picking waste are simple, innovative and varied. Most carry a sack, while the experienced ones own a cart, and some of them use devices like a magnet stuck at the end of a stick to look for metals. All waste pickers do some sort of broad sorting of their collection and sell it to the small waste dealers, often in the same area they collect the waste from.

Most waste pickers in Delhi are from the poorer states of India. Many of them are Muslims, belonging to the lower socio-economic strata. Attempts at categorising them socially have met with only limited success owing to their varied demographic and social characteristics. Age, religion, caste, community, marital status, none of these seem to display any single trend for waste pickers.³

Also, there has been no comprehensive study on the number of waste pickers. Different studies throw up different figures. According to De Souza (1991), the number of waste picking children in Bangalore city is about 35,000, whereas in Delhi rough estimates place the figure around 50,000 child waste pickers and a total of 80,000 to 100,000.⁴

In the absence of any formal census, it is difficult to pronounce the exact, or even the approximate, number of waste pickers. There are different reasons for this. Some of the people who have worked on these issues suggest that 60 per cent of the waste picker population consists of children, 30 per cent women and the remaining 10 per cent men.⁵ But this differs from city to city. The estimates would also largely differ on account of what time of the day and season the study has been conducted. In any study, which is conducted in the morning time, say, between 5 am to 12 noon, there is a fair chance of finding more women and girl children as they need to come back early for other household work. To some extent, it would also depend on whether the study is conducted in a residential, market or industrial area. A typical example of this

is a slum in West Delhi, which mainly consists of two communities, Tamils and Biharis, almost all of whom are waste pickers. Whereas amongst the Tamil community, the entire family was engaged in waste picking, the Bihari community was very categorical in not allowing their women and girls to do this work.⁶ On Mathura Road (Delhi), mostly men and a small percentage of children were found to be picking waste. Quite contrary to this, in Shastri Park, waste pickers were mostly children and women. The men preferred other work like being chowkidars, daily wage labourers, grocery shop workers, hotel employees, etc.

Social and demographic profile of waste pickers

The caste status of waste pickers is easier to establish. Most of them are from the lower socio-economic strata, like in any other unorganised sector of India. But waste picking is considered very low in the social order, no matter whether they earn more as a waste picker than they would as a wage labourer or by working in some shop/hotel.

One hundred and ninety-eight waste pickers were interviewed from different parts of the city from June 2001 to January 2002 between 10 am and 4 pm. The survey found 24 per cent female and 76 per cent male waste pickers. Out of these 45 per cent were above the age group of 25 and 24 per cent below the age of 16. Another 31 per cent were between the age group of 16 to 25. One reason for finding fewer females could be that most of them return to do their household work before noon as mentioned earlier. A very high percentage of these waste pickers were Muslims (52 per cent). Most of the Muslim families did not allow their women and adolescent girls for waste picking. Previous studies have shown a large number of child waste pickers, but the present study found only 24 per cent. One possible reason could be that most child waste pickers live with their families and undertake waste picking as a family occupation and move along with their mothers.

The women and the girl child, who do not go for waste picking, do the sorting work once it is brought to their home. Most waste pickers have come to Delhi looking for any employment, but failing to do so led them to waste picking. Only six per cent of the pickers were found to be of general caste and the rest are from SC and OBC.⁷

3 Op. cit, P.41

4 Quoted by Venketeswaran Sandhya

5 Rosario, Anselm, Solid Waste Management: An Alternative, Indonesia, 1992, Jain R.C., Compost Production in Delhi, Paper Presented in Kathmandu, 1990

6 Venketeswaran, Sandhya, Op. cit, P.41

7 The caste has been described by Waste pickers as per the reservation list of the Government of India. A caste is described as general who does not fall into the reservation category.

Table 1. Social and demographic profile of waste pickers in Delhi*(All figures in per cent)*

| SEX | | AGE GROUP | | | EDUCATION | | | | CASTE/COMMUNITY | | | | HOME STATE | |
|-----|----|-----------|-------|-----|-----------|--------|-------------|------------|-----------------|-----|---------|---------|------------|-----------|
| M | F | < 15 | 16-25 | 25+ | Primary | Middle | High School | Illiterate | SC/ST | OBC | General | Muslims | Local | Migratory |
| 76 | 24 | 24 | 31 | 45 | 18 | 3.5 | 1.5 | 77 | 32.5 | 9.5 | 6 | 52 | 2.5 | 97.5* |

* 33 per cent West Bengal; 22 per cent UP; 13 per cent Bihar; 10 per cent Bangladesh; rest from Tamil Nadu, Haryana, Maharashtra etc.

Table 2 . Social and demographic profile of waste pickers in Delhi (continued)*(All figures in per cent)*

| REASONS FOR MIGRATION | | | | | TYPE OF DWELLING | | | | NO OF FAMILY MEMBERS | | |
|-----------------------|---------|--------|-------------------|-------|------------------|--------------------------|------------------------|------------|----------------------|-----|--------------|
| Poverty | Runaway | Orphan | Family occupation | Other | Slum | Premises of waste dealer | Rented space in jhuggi | Open space | Single | 4-5 | More than 10 |
| 86 | 6.5 | 2.5 | 1.5 | 3.5 | 48.5 | 22 | 26 | 3.5 | 11 | 83 | 6 |

Seventy-seven per cent of waste pickers were found to be illiterate and only 18 per cent had attended primary education but did not complete it. They could just write their name. In some areas they were found to have passed high school (1.5 per cent).

Waste Pickers as Migrants

Most waste pickers are migrants from rural India who worked as sharecropper farmers or on some other manual employment with very low cash wages. Getting paid in cash, irrespective of what one does, is an important reason for these people to migrate to cities. 97.5 per cent of those surveyed are migrants who came looking for employment. Finding it difficult, they began waste picking and continued with it. In Delhi, 10 per cent of waste pickers were found to be Bangladeshi immigrants who have either come during the 1971 war as refugees or illegally entered India under conditions of extreme duress. These include both Hindu and Muslim refugees. Waste pickers from Bangladesh narrated that some of them also had to leave their native places because of regular floods, cyclone and perpetual poverty. They do not have any option and once in the city, they have to go in for waste picking.

As stated above most of waste pickers were from poorer states of India. 33 per cent of those surveyed were from West Bengal, 22 per cent were from Uttar Pradesh and 13 per cent from Bihar. They all stated poverty as the main reason to move to cities.

A small percentage of waste pickers who have said that they belong to Delhi, admit they feel ashamed and hate doing waste picking but there is no other option available. On being asked why there are so few local waste pickers (see Table 1), they reasoned that their relatives, neighbours and others with whom they are acquainted, strongly disapprove of this and if they come to know, would stop talking to them and they would be socially ostracised. It could be inferred from this that the migrants do not have this fear of social ostracisation by relatives, as back home nobody knows what their profession is, although it is not a strong inference.

The reason for a high percentage of migrant waste pickers is that it does not require any investment, skill, contacts, references or even a guarantor. Once they start as waste pickers often they might refuse to take employment as a daily wage labour, as one is not quite sure whether at the end of the day the entire wage would be paid. One such



waste picker said a building contractor of Lajpat Nagar employed him and he used to give him just enough for the meals promising that the rest of the money would be paid at the end of the contract which was later refused.

Poverty and unemployment are the overriding reasons of joining this profession. 86 per cent of the waste picker migrants of Delhi left their home due to poverty (see table 2). But poverty of the usual type is not always the reason for being a

waste picker. Quite a lot of them lost their family members and property, including agricultural land, due to floods or cyclones.

It is not necessary in a family that if the man is a waste picker, the women would be one, too. There are some communities like those from Bihar and Uttar Pradesh who do not allow their women to go out and do waste picking but the Tamils and those of Orissa, West Bengal and Bangladesh have no such reservations. In the case of the former, in a family where only the man is doing waste picking, his wife supports the family income by working as a maidservant, helping to sort the waste or some other occupation.

The gender division

About 24 per cent of the surveyed population were females. As stated earlier, most of the females moved early in the morning for waste picking. The condition of the female waste pickers was found to be worse than their male counterparts. Not only do they

have to move early in the morning but also come back early to do the household work and look after children. Not all communities allow their women and adolescent girls to go out for waste picking, as mentioned above. The main reason is that their guardians do not feel safe sending them out alone to be harassed by the police or municipal staff.

The markets also open only after 10 in the morning; this saves them from lewd comments from people. For the adolescent girls, it is particularly difficult to move alone. Even if they have to, they go in groups, and seldom alone. Another probable reason for young girls to move with their mothers in the morning is that it provides a sense of security to both of them. Waste dealers also exploit women by buying their collection at lower prices.

While interviewing sorters it was found that most of them had worked for sometime as waste pickers but due to regular harassment by the police, municipal staff and people in general, opted for sorting at the waste dealers place even though initially they received lower wages.

Home of waste pickers or residential status

The obvious places to stay for waste pickers are the slums popularly called *jhuggi jhopri*. 97 per cent of waste pickers stay in the slums and are all migrants. But the slums in which they stay are not their own space. In Khanpur, it was found that the local Jats and Gujjars have given the space to construct *jhuggies* on a rent of Rs 400 per month to

Shakina, aged 7, and her sister, 5, stay in one of the slums of South Delhi. They are from Assam but speak only Bengali. Their house was washed away in flood and hence they migrated to Delhi with the help of a relative staying here. They accompany their mother in waste picking. Shakina says the police often trouble them in the posh localities. Once while picking waste in a market she was slapped by a policeman for allegedly stealing a pair of sandals from a shop. The policeman searched the entire sack spilling her entire collection of waste on the road but did not find any sandals in the sack.

Both the sisters regret that they do not go to any school because their parents cannot afford to put them in private schools and the doors of government schools are always closed for them, as they do not have any ration or voter's identity card. They do not like waste picking but it contributes to the family income. They earn 15 to 20 rupees a day. Their day starts at 5.30 or 6 am and ends at 1 pm. The police take a bribe every month for allowing them to stay there.

A Muslim woman (Gandhi Camp, Lajpat Nagar) whom we convinced to talk about her experiences with the police, said that the bad days are when there is any theft reported in the nearby areas. The waste pickers are always the first ones to be interrogated. The police come and ask for their identity card or ration card, and if this is not produced, they use abusive language. She said, if they aren't satisfied, young girls would be touched and abused.

When she was narrating this story, the waste dealer arrived and shouted at the women and told us that this was not true. He said, "It happens everywhere" ("*aisa to har jagah hota hai*").

In one of the poor slum areas in Delhi, Bara Pulla, Nizamuddin, lives a man. He is 28 years old and his name is Mohammed Hanif. As a very little boy – he cannot remember when – he left his parents in Bangladesh and came to Delhi. Because he had no money to live by, survived his earlier years with begging. After some time, he started smoking and drinking and to pay for his addictions, he started stealing. He had little choice, without skills, education, work or money.

Once he broke into a municipal (MCD) officer's resident to steal. Unfortunately, he got caught. "This is the end," Hanif thought, "I'll end up in jail." But things turned out differently. When the MCD officer asked him why he was stealing, Hanif honestly answered that he had no choice because he couldn't get any employment. "It's only to survive and not to starve to death that I'm stealing".

The MCD officer recognised Hanif's plight. He realised that if he is put in jail, he would start stealing again after being released. So instead of turning him in, he offered him employment as an MCD sweeper, cleaning the streets as well as the officer's house. Hanif gratefully accepted this offer.

After employment, Hanif's life changed. Since he now had government employment, he found himself a wife, and has three children. After some years of sweeping he received a raise at the MCD as waste collector, raising his salary to Rs 1,500 a month, aside from Rs 60 to 70 a day he makes from selling his recyclable waste

which he collects in his own cycle rickshaw. The waste dealer has provided him a place to live with his family, in exchange for exclusive buying rights to his waste collection.

Until he was married, Hanif drank a lot; once, he fell unconscious on the street, and woke up the next day to find himself in a hospital. Constant drinking and smoking *bidis* resulted in several diseases including tuberculosis. The doctor warned him that if he didn't quit drinking and smoking, his life would be in danger. Gradually, he did quit both, and was cured of TB. But he does drink occasionally now.

Still, Hanif is not happy with his life. He doesn't like the dirty work of collecting waste but realises he has no other choice because he's illiterate and unskilled. He knows that many of his health problems are there because he works in dirt without any kind of protection. He knows little about other places in Delhi but hopes that "I would be going to Australia in the near future" and explains that the MCD officer's son is very happy with his work and has promised to take him there for the same kind of employment.

Hanif does not want to do this "dirty" employment, but has no option. He dreams of being a successful employee in any kind of clean employment where he is not required to collect dirt. He wants to send his children to a good school and build a home of his own by saving some money. "If I earn Rs 6000-7000 a month, I would be happy in my own home," he says beaming.

stay. Since it is difficult to pay such an amount, three to four waste pickers stay together and share the rent. 3.5 per cent of them were found to stay in open space and a high number of them were found to be drug addicts. 22 per cent of waste pickers were provided space to sleep and cook by the waste dealers who either have their shop in the slum or stay there. A substantial number of waste pickers (11 per cent) stay single and share their *jhuggies* with others (See Table 2).

Children and waste picking

The survey found 24 per cent child waste pickers aged below 16 years. Some of them have started waste picking from the early age of six years onward, along with their mothers. By doing this, they supplement the family income. Others were street children who have either run away (6.5 per cent) from home or are orphaned (2.5 per cent) (see Table 2). A study conducted by the National Labour Institute almost a decade and a half ago found that waste picking is the fourth largest occupation for street children in Delhi, the third largest in Madras (Chennai), while in Hyderabad and Bangalore it is the single largest occupation.⁸



8 NLI, A, Working and Street Children of Madras, National Labour Institute, Nioda, 1992.

Table 3. Social capital among waste pickers in Delhi
(All figures in per cent)

| Mutual sharing with other waste pickers | Help from waste dealers | Borrowing money | | Saving | | Storing waste for emergencies | Owning small assets | Allow other pickers in their areas |
|---|---|--|--|-----------|----------------------|---|--|------------------------------------|
| | | Frequency | Source | Practised | Where is money saved | | | |
| (56) Sharing food, lending money | (70) Advance money, shelter, meals, protection from police | (12) Often (60) Sometimes (15) Rarely (13) Never | (77) Waste dealer (33) Friends, relatives | (52) | (12) Waste dealer | (28) Aluminium, copper, steel, brass | (51) Cycle, cart, radio, TV (46) Others | (63) |

Social capital among waste pickers

Social capital is defined as help that comes from people during times of distress. Since waste pickers are some of the poorest people living at the mercy of waste dealers, it is important to know where they go to seek help in times of distress, and from whom. Social capital also reflects the trust placed in them by the people with whom they interact everyday. This brings out their socialisation process in the system they operate in, and helps one understand different ways of interaction in that system and the manner in which the system incorporates them.

As mentioned in Table 3, only 56 per cent of waste pickers share food and lend money to others, indicating that only half of their population have close interaction among themselves. In some survey areas, however, the relationships among waste pickers were found to be close-knit. For example, in East of Kailash and Garhi, there is a strong affiliation within the communities of different regions of waste pickers. In other areas, Bengali Muslims were found to be settling their disputes within their own community, in some cases not even mingling with other waste pickers from Bihar and Uttar Pradesh, and vice versa.

Physical assets

Since the level of social capital is not found to be very high, more than one-fourth (28 per cent) of waste pickers collect and keep certain kinds of waste (copper wire, brass, Aluminium utensils, etc) for emergencies. This they sell in times of distress to survive and also at times when a better price is offered.

51 per cent of waste pickers had some sort of assets, the most important being the bicycle or tricycle on which they collect waste. Owning a tricycle is a sign of earning more than other waste pickers and these people usually also possessed a radio or a TV set.

There is little saving for waste pickers. Those who save some money, keep it at home due to unavailability of a bank or post office account, which they cannot open without a ration, identity or voter's card. Some of them (12 per cent) keep their savings with the waste dealer they work with.

System of patronage

70 per cent of waste pickers are dependent on waste dealers for different kinds of needs and even protection, that is, more than two-thirds of waste pickers borrow money, sleep at the waste dealer's place and take offered meals. The waste dealers who have employed waste pickers, or who regularly buy their waste from them, also protects them from police harassment. This enables the waste dealer to exploit the waste picker by buying the waste at a lower price. But this is not a very common practice in all the areas. The dealers of East of Kailash and Nizamuddin were found to exploit waste pickers with the lure of providing shelter. The waste dealers of Mathura Road in the garb of providing shelter to the child waste pickers do not pay any wages, taking their collection and only providing meals and sometimes few rupees to watch movies.

Patronising the waste pickers in different ways assures the waste dealers of a regular supply of waste. Some exceptions were found

in areas where waste pickers own space to live or are in preponderance, and prefer to sell their waste at competitive prices. This allows other waste pickers to get better prices too.

12 per cent of waste pickers were found to be borrowing money often while 60 per cent borrowed money sometimes. This left only a small percentage of waste pickers who borrow rarely or do not borrow from the waste dealers. *Of all the above, shelter seems to be most important form of patronage relationship existing between the waste picker and the waste dealer.*

Territorial

There are some studies and indications that some kind of territorial boundary exists between waste pickers. The waste pickers of a particular area are not supposed to enter other areas. The survey found this only to be partially true. 63 per cent waste pickers have no problem allowing others to come. There are certain variations as in which area a particular group of waste pickers do the collection. This problem is less in the market areas and more in high-income residential areas as there is less quantity of waste. Moreover, only a small percentage of waste pickers walk for more than 10 km a day to collect waste, hence the problem of intruding into 'other's territory' has limited scope. The problem arises when new waste pickers are found in areas where the collection is paltry because they do not want to part with their livelihood.

Working conditions and occupational health

Almost all waste pickers collect waste every day. 75 per cent of the waste pickers said that they have no other option but to earn their livelihood daily. But those who collect waste from the nearby market or industrial areas take the day off on the weekly closure day. For different areas the timings are also different. While women workers mostly move in the morning, mainly in residential areas, and come back before noon to do household work and primary sorting, adult men move mostly after 7 am and come back at 1-2 pm. Some of the women move as early as 4 or 5 am. In the evening they do the sorting and sell it to the waste dealers. There are also other waste pickers who pick only a few items and sell them without sorting.

The street waste pickers move in their re-

Table 4. Occupational health condition of waste pickers
(All figures in per cent)

| Waste collected everyday | Injuries from waste picking | Harassment by police, municipal staff, local gundas, etc | Collect medical waste | Injuries from medical waste |
|--------------------------|--|--|-----------------------|-----------------------------|
| 75 | (11) Never (61) Sometimes (28) Often | 78 | 34 | 27 |

spective localities and pick up waste from streets, drains, municipal bins and open dumpings. Others go to landfills and collect waste. Those in the landfill usually carry a magnet fitted with a bamboo or wooden handle to find ferrous metals in the heap. Though the municipal law prohibits scavenging in the landfills, some officials allow them on humane grounds while others take money to allow collection. None of these places are hygienic enough to step in. They use bare hands and feet to rummage in waste heaps in the hope of finding some saleable item. None of them were found with any kind of protective gear like gum boots or gloves. Such risky conditions of work lead to frequent injury in the form of cuts from glass, metal sharps, broken bottles, etc. 28 per cent of waste pickers reported having experienced such injuries often while 61 per cent had had them some time.

Medical waste and safety

For waste pickers who stay near big hospitals or clinics, there seems to be a nexus between the waste dealers and the hospital staff. Either the staff calls the waste pickers through the waste dealer or dumps the waste at a place from convenient to the waste pickers. 27 per cent who collect medical waste get injuries from syringes and sharps. Some of them seemed well informed that selling or buying medical waste is illegal but there is more money to be made. Since most of the plastic medical waste is from high-quality plastic, it fetches a higher price than other items they collect.



Social and Physical Cost of Waste Picking

Police atrocities were found in almost all the areas. In some areas, the fear of police is so great that nobody wants to speak out against them. It is more acute in areas where Bangladeshi refugees and Bengali-speaking Muslims are settled. 78 per cent of waste pickers are troubled by the police or the municipal staff on one pretext or the other. The police intervention comes in different forms. Prohibiting them from visiting the high-income residential areas is one such common pretext. In the market areas they are deemed a nuisance to the public and shopkeepers. Apart from these two, the bigger trouble arrives when some theft is reported in the area. The police invariably target them and the punishment ranges from verbal abuse to beating and sometimes, for the women, extends to sexual assault, too.

This is what a waste picker had said about people's perception of his work:

"Admi ka to chhorro, yaha to kutta bhi nahi chhorta hai. Hame dekhte hi bhokana aur katne ke liye daur padta hai."

(Forget people; even dogs do not spare us. They start barking and biting as soon as they see us.)

Delhi JJ Unity Front has filed a petition before NHRC against police atrocities on the Bengali-speaking inhabitants of Yamuna Pushta. To them, it is a subtle device of the government to cleanse people of their communities. The president of the front, Jawahar Singh, a resident of the slum, alleges that the police in-charge of Yamuna Pushta without any good reason and proof arrests people of the area and uses third-degree torture on them. Even small children and women are not spared. Sometimes, the ration and identity cards of Bengali-speaking migrants of Assam and West Bengal are torn off. Other times, their belongings are sold to the *kabari* shops of other area, on the pretext that they are illegally acquired.

In Ashok Vihar, waste pickers have to inform the police if they want to enter the residential areas for picking. In some market areas too, the police demands money for allowing collection. 33 per cent of the waste pickers felt that they are exploited. They also stated that not only waste dealers but also the police and municipality harassed them and took their hard earned money away.

They all agree that waste picking is not a desired employment but they have no other option. Employment without a

guarantee or some reference is not perceived as possible. Though they realize that by doing this employment they are cleaning the city of waste and only earning their livelihoods, yet there is no recognition of their service. People always look down upon them, call them dirty and compare them with waste and dirt.

Independence of the employment

A frequently cited reason for waste picking was that there is lot of freedom in this employment with no master to shout at them. They can start working at any time of the day or night and go to sleep or watch movies whenever they wish to. One of the waste pickers said emphatically, "I am a free man. I go for my work any time of the day or night, I wish. There is no master to shout at me." They say that in either a hotel or a grocery shop, not only do they have to work from 7-8 am in the morning to late at night up to 10 pm, but also have to bear the shouting and abuses of the owner. But given a chance of a 'decent' employment, they would not like to do waste picking.

Income of waste pickers

There are three main different kinds of waste pickers.

- Those who carry a sack on their back and collect whatever they find.
- Those who carry a huge sack slung in as two partitions across a bicycle and keep the items separately.
- The third and less numerous ones, are those who use a tricycle and collect more than 50 kg of waste on a good day.

For all this labour a waste picker earns Rs 45 to 80. A child waste picker earns Rs 10 to 15, while working with his mother; if he is moving independently, he earns slightly more – between Rs 20 and Rs 30

Table 5. Social recognition of waste pickers work

| Trouble from police/ municipal worker/ local gunda | Feel Exploited | What other people think about rag picking | Would you like to do any other employment |
|--|---|--|---|
| Often – 78% Sometimes – 10% Rarely – 12% | Yes 33% No other option available | Dirty, outcast, looked down upon, contempt | 85% say any other decent employment with regular income |

as he devotes more time in picking. A waste picker with a cycle earns Rs 50 to 80 and one with a tricycle earns Rs 150 to 200 a day.

Quantity of different types of waste collected by waste pickers

Plastic is the most common item they collect, as it is found everywhere. On an average, an adult waste picker collects between 5 and 15 kg of plastic, besides collecting 10 to 15 kg of paper too. But it depends in which area they are doing the collection. In residential areas they would have mostly mixed items, which would include plastic, paper and glass. In the market areas they get more paper used for packaging different items, mostly cartons or *gatta*.



Table 6. Different recyclable waste materials collected by waste pickers, their colloquial names and prices

| Name of waste | Colloquial name | Selling price at waste dealer (Rs) |
|---|-----------------|------------------------------------|
| PLASTIC | | |
| Pet bottles (coke, mineral water bottles*) | Raincoat | 2 |
| Plastic thread, fibers, rope, chair cane | Cane | 6 – 7 |
| Milk sachet/packets** | Dudh Mom | 6 |
| Hard plastic like shampoo bottles, caps, plastic box, etc | Guddi | 7 |
| Plastic cups and glasses, LD, PP | Fresh PP | 7 – 8 |
| PAPER | | |
| White paper used in offices/press cutting | White | 3 |
| Mix shredded paper | Raddi | 2 |
| Cartons and brown packing papers | Gatta | 2.50 |
| All mixed paper | 2 No Raddi | 0.50 – 0.75 |
| Fresh newspaper | Gaddi | 3 – 3.50 |
| Carton sheets | Raddi | 3 – 3.50 |
| Tetrapack | Gutta Sheet | 2 |
| ALUMINIUM | | |
| Beer and cold drink cans | | 50 |
| Deodorant, scent cans*** | | 50 |
| Electrical wires | | 40 |
| Aluminium foil | Foil | 20 |
| OTHER METALS | | |
| Steel utensils | Steel bartan | 20 |
| Copper wire | Tamba | 80 |
| GLASS | | |
| Broken glass | Shisha | .50 |
| Bottles (beer) | Bottle | 2 |

* Some people come to buy uncrushed water bottles at Rs 1 apiece, to refill it illegally.

**Red printed milk sachets are costlier due to better quality

*** These Aluminium cans are thick and of good quality.

Sushil is nine years old and stays in Safdarjung Enclave near a dhaba. He went to school just for a year. His mother works as a maidservant; his father does not have a job. At night, generally after 7 pm, he collects beer and other liquor bottles and sells it to the nearby waste dealer. He earns Rs 20 to 25 every night. He has two other friends who do the same work. He gives this money to his mother and sometimes keeps a small sum to buy non-vegetarian food, which is not cooked at home as it is costly. He wants to study and does not like standing near people drinking liquor to collect their empty bottles.

Waste Picking at a Glance

- There are approximately 90,000 to 1,00,000 waste pickers in Delhi.
- On an average a waste picker carries 15 to 25 kg of waste.
- 97.5% of waste pickers are migrants from the poorer states of India.
- 24% of waste pickers are women.
- Waste pickers remove 10 to 15% of municipal waste, recovering more than 1,000 tonnes of recyclables, which helps to run over 1,000 recycling units.
- The ragpickers save almost 20% of Delhi's municipal budget by collecting waste.
- More than three-fourths of waste pickers are illiterate.
- 24% of the slum and street children also do waste picking.
- There is a system of patronage existing between waste pickers and waste dealers, in the form of lending money, providing shelter, etc.
- Waste pickers work in the most unhygienic condition with at least 28% getting injuries from different kind of sharps, some of them highly infectious.
- The police do not even spare waste pickers and extract money from them for allowing them to scavenge. Municipal staff also takes money for allowing them to collect waste from municipal bins.
- 85% of waste pickers say that given a chance to do a decent employment, they would not pick waste.

Similarly in industrial areas they get tin and iron plates, thermocol and cartons. Those who carry out collection near dhabas and small hotels where liquor is served, find glass items such as beer and other alcohol bottles. In fact, in some *dhabas* and hotels waste pickers do dishes or other work for free, in lieu of the liquor bottles. One beer bottle is sold at Rs 1 to 1.50 and the smaller bottles are sold at cheaper rates.

In case they obtain a clean bottle of fine quality liquor then it could be sold at a much higher price ranging from Rs 5 to 15. The waste dealers say that it is used for refilling spurious liquor and sold with the same brand name.

In general waste pickers find very little metal, such as iron, tin, Aluminium, brass etc. Most people keep old newspapers and metal items to be sold to itinerant waste dealers or *ferriwalas*.

Invisible Hands – Waste Sorters

Nature of waste sorting

There has been hardly any mention in any study about waste sorters, who sort different kinds of plastic, paper and glass right from the small waste dealer to the reprocessors. The sorting of waste takes place at all levels of waste dealing. The waste sorters do a specialised job in sorting recyclable items. The dexterity or skill of sorting comes with experience. There is no training for recognising different types of recyclable items like plastic or paper. They have had some experience as waste pickers and learn to recognise the items from the senior waste pickers and sorters. Sorters categorise materials by touch, feel, softness, hardness, flexibility and sometime by dipping it in water. They are so skilled in recognising plastic that they can tell whether the plastic has been recycled once or twice. Though the survey found fewer women sorters at the small waste dealer, their numbers were much higher at the large waste dealer. The male-female ratio is about 12:8 with the large waste dealer. The women sorters seem to display more skill than their male counterparts.

Social profile of the waste sorters

The number of sorters surveyed was 69. Of this, 35 per cent were female and 65 per cent were male workers. The females exclusively do the job of sorting while men mainly do packing and loading apart from sorting. The sorters also like the waste pickers, are mostly illiterate (78 per cent) (see Table 7). Among those surveyed, a very high percentage were Muslims (52 per cent) and another 39 per cent were from the lower social strata. Only 9 per cent were from general castes.

Table 7. Social profile of waste sorters in Delhi
(All figures in per cent)

| SEX | | EDUCATION | | | | CASTE/COMMUNITY | | | |
|-----|----|-----------|--------|-------------|------------|-----------------|-----|---------|---------|
| M | F | Primary | Middle | High school | Illiterate | SC/ST | OBC | General | Muslims |
| 65 | 35 | 15 | 7 | – | 78 | 32 | 7 | 9 | 52 |

Waste sorters as migrants

The waste sorter population too, like the waste pickers, is a migrant one with 94 per cent coming from the poorer states of India (see Table 8). 78 per cent of those surveyed have migrated from Uttar Pradesh, Bihar, and West Bengal. Quite a large number of them have earlier worked as waste pickers and during their off-time worked with waste dealers as sorters for extra income and learned to recognise different recyclables according to their quality and category. Gradually they found the job easier than roaming in the town for long hours to collect waste and settled as sorters even though at the initial stage they got paid less. But with experience they find the sorter's job easier than waste picking. There is less harassment from the police and the municipal staff, particularly for the women doing sorting rather than waste picking, as the sorter's job provides them better social security.

Most of them stay near the waste dealer's shop and get time to look after their household work. This gives them twin advantages of earning money by staying near their *jhuggies* and looking after their household work and children.

Table 8. Waste sorters as migrants
(All figures in per cent)

| STATUS | | MIGRATED FROM | | | REASONS FOR MIGRATION | | TYPE OF DWELLING | | | |
|--------|-----------|------------------------|------------|---------------|-----------------------|-----------------|------------------|----------------------|---------------------|--------------------------|
| Local | Migratory | Bihar, UP, West Bengal | Bangladesh | Other regions | Poverty | Orphan/ Runaway | Space in jhuggi | Hired room in jhuggi | Own space in jhuggi | Owner has provided space |
| 6 | 94 | 71 | 10 | 19 | 92 | 8 | 46 | 23 | 3 | 28 |

Coming to a dream city

The story of women is slightly different as most of them came after getting married in their native states and settled with their husbands. They came with the hope that in the capital of India they would have more comforts of life than their native village. They did not anticipate the problems of water, hygiene, electricity and the lack of a place to stay comfortably. Only after coming here did they realise that it is a much tougher life than the village life, with the biggest problem being the lack of enough space to stay and cook.

Women: more work, less wages

The daily or monthly payment for women was found to be lesser than that of men even though they sort out larger quantities of waste. Sorting is women's only exclusive job. The reason cited for paying men more than women was that men's job is slightly more strenuous than the women as they do loading also. The women work for more hours than men and the waste dealers confess that the over all productivity of the women is more than the men.

The system of payment for the sorter is either of the two forms. There are daily wage labours, or those who work on monthly contracts. The daily wagger depends either on the number of hours they work or quantity of

waste sorted. Of those surveyed, 49 per cent were found to be working on daily wages. On an average, a daily wage waste sorter earns between Rs 30 and 70. The children who work for primary sorting earn Rs 20 to 30 a day. Sometimes the dealer also provides children with a meal. Mostly, it is the same waste sorter working on daily wages with the same waste dealer. The payment of the other kind of sorters, who work on monthly basis, varies between Rs 1,200 and Rs 1,800 (see Table 9).

The more experience the sorter has, the more salary he draws. But this system operates simply on a verbal contract and there is no written contract signed as such.

Saving

49 per cent of the sorters say that they are able to save some money to send home. 30 per cent of them send it to their native place to support their family. Again like the waste pickers, they do not have bank accounts and keep the money at home (93 per cent) and a small percentage (7 per cent) keeps the money with the waste dealer.

System of patronage

In cases where there are three or four members of a family working with the same waste dealer, he is the '*Mai-Baap*' (benefactor) of the family. They are overtly dependent on the waste dealer for their every need and this provides the waste dealer with opportunities to exploit them in different manners.

Once again, the system of patronage is seen existing here, with 28 per cent of the sorters staying at the waste dealer's place. It was also found that the family members of those sorters who stayed at the waste dealer's (49 per cent), were in the same occupation, either as a waste picker or a sorter. Only 3 per cent of the sorters had their own *jhuggies* (see Table 8).

Table 9. Payments and savings

| SYSTEM OF PAYMENT | | SAVINGS | | SEND MONEY |
|--------------------------|--------------------------------|--------------|-----------------------------|------------|
| Daily | Monthly | Able to save | Place of saving | HOME |
| 49% Rs 30 to Rs 70 | 51% Rs 1,200 to Rs 1,800 | 49% | 93% Home 7% Waste dealer | Yes 30% |

Table 10. Borrowing money
(All figures in per cent)

| Family members in same occupation | Incidence of borrowing money | Source of borrowing money | | | Rate of interest | Are you able to meet your family's needs through the profession? | | |
|---|------------------------------------|---------------------------|----------|-------|------------------------|---|----|------------|
| | | Moneylender | Employer | Other | | Yes | No | Just about |
| 49 | 62 | 9 | 67 | 24 | 3% to 10% per month | 11 | 41 | 48 |

This system of patronage further continues with borrowing money from the waste dealer. But unlike the waste pickers who got their money in advance without any interest, the sorters had to cough up a substantial interest on their borrowings with per month interest rates ranging from 3 to 10 per cent. If we convert it into per annum, it is as high as 36 per cent to 120 per cent (*see Table 10*). But with the waste dealers, there is no such system as annual interest. It is interesting to note that the waste dealers do not take any interest from the waste pickers because they exploit them by cheating in weighing, drying the waste in sun for few hours before weighing and buying it at their own prices, which is usually less than the market price, though not in all the areas. Here the sorters are also exploited in the form of huge interest rates on their borrowings since the other ways of exploitation are closed.

Occupational health and working conditions

The waste sorters mostly carry out their work in open spaces. Generally plastics are sorted in an open space and paper, indoors. Since most of the places for sorting are open spaces, it is well ventilated. But none of the sorters are found to wear any kind of protective gloves or mask.

The sorters generally work for more than 8 or 10 hours. The women do get some break in between for looking after their children or cooking, but they work till late in the evening to compensate. 30 per cent of the sorters surveyed reported experiencing occupational related problems such as coughing and skin diseases due to dirt and other hazards in the waste. In some places the sorters and waste pickers found to burn electrical wires to recover copper and Aluminium. These kinds of wires are coated with PVC plastic and burning them emits dioxins, which is a known car-

cinogen. Another 51 per cent said that fever and skin disease is quite common though they cannot be sure that it happens because of sorting. 19 per cent stated to have all the three health problems at different points of time. A very small percentage (17 per cent) received some kind of medical benefit from the waste dealer (*see Table 11*). The waste dealer would only provide either the doctor's fee or some medicine. But for the days they do not work due to sickness, no compensation was given to them. 61 per cent of the waste sorters also said that most of the health problems occur during the summer and monsoon season. It could not be ascertained why more health problems occur only in summer and the monsoon season and not during the winter.

There is a more serious problem, that is, frequent fire accidents in the waste dealing areas. Some of the waste sorters who have been working for many years have seen fires breaking out two to six times. Most of the time the fire brigade arrives after everything is gutted. In Jwalapuri and Yamuna Pushta human lives were lost in such accidents. Since paper and plastic burn easily, the need for fire-tending services is immediate, which seldom arrives in time.

Waste Sorters at a Glance

- Most of the sorters have had some experience as waste pickers.
- Quite a lot of them (mostly women) left waste picking because of police and municipal harassment.
- 35 per cent of the sorters are females, less in number at the small waste dealer and more at the larger waste dealer's shop
- Like the waste pickers more than $\frac{3}{4}$ of the waste sorters are illiterates
- And also like the waste pickers, 94 per cent of them are migrants
- On an average a sorter earns between Rs 30 and 70 a day, a child waste sorter earns between Rs 20 and Rs 30
- Like the waste pickers, the waste dealers also patronise the sorters
- 49 per cent of sorters have one or more of their family members working as waste picker or sorter for the waste dealer
- There is high occupational and health hazard related to sorting like skin disease, cough, etc.

Table 11. Occupation health and working conditions

| Years in Sorting | Working Hours | Health problems | | | Any Medical Benefits? | Season of More Health Problems | Incidence of fire accidents |
|----------------------------------|-------------------|----------------------------|-------------------------------------|---------------|------------------------------------|--------------------------------|-----------------------------------|
| Few months to more than 20 years | 8 -10 hours a day | 30% cough and skin disease | 51% frequent fever and skin disease | 19% all three | 17% Yes, medicines or doctor's fee | 61% Yes, summer and monsoon | 46% Yes, 2 to 6 times in 10 years |

Adding Value to Waste – The Waste Dealer

The Market Mechanism of Waste Trade

The market mechanism of waste trade translates into a complex chain, which at times appears deceptively simple, while at other times very complicated. The waste market is connected through a citywide network, which apparently may seem to work on logic of its own. A sound understanding of waste trade per se, needs a clearer understanding of the nature of the market mechanism, an identification and role of each player in the trade, its informal or formal nature of work.

The entire chain of recycling is based on hierarchies, which move more or less in linear way. This linear chain is not homogeneous. It differs from place to place and is influenced by patterns of settlement of waste pickers and their number, number of waste dealers and their socio-economic position and type of relationship with waste pickers etc.

The criteria of deciding the categories of waste dealers as small, medium and large also known as suppliers (later cited as large waste dealers), which you would find in later pages, are their storage and holding capacity, who they buy the scrap from and sell it in the chain. It was generally found that the large waste dealers sell either directly to the factory or through the agent but it is not uncommon to find even the medium waste dealers selling it directly to the factory or through the agent. In all cases small waste dealers sell their waste scraps to medium and large dealers, depending on their capacity and turn over. The wealth of waste increases from small as value is added which averages more than 80 per cent by the time it reaches the large waste dealers. The trade operates broadly through three different kinds of players

- Small waste dealers
- Medium waste dealers
- Large waste dealers/supplier

Beside the above there are Agents who facilitate the transaction between the recycling units and the medium or large waste dealers. As the trade chain moves upward, it becomes more organised with Waste Trader's Associations appear, with members who have large financial outlays in the business. It is at this level that the trade starts to appear more like a organised sector though not in the true sense of the term.

Waste Trade in Informal Sector

The root basis of this informal sector is the waste pickers, who occupy the bottom most rung of the trade chain. As discussed in detail earlier, they collect recyclable waste in demand and feed up into the trade chain,

A typical structure of the waste trade would look like this



turning waste into a commodity. At this point *value addition* is a maximum but is probably negated when the costs of occupational health and other form of exploitation and social ostracism borne by the waste pickers are factored in.

The small waste dealers are based in slums and buy all kind of waste like paper, plastic, Aluminium, brass, glass etc. from the waste pickers. The small waste dealers also buy from the itinerant waste dealers, popularly known as ferriwala (roving) kabariwallas. They do some sort of primary sorting and sell the waste up to the medium waste dealer.

The medium waste dealer deals in fewer items than the small waste dealer and also does further sorting, into more specific categories.

Finally the large waste dealer deals in few particular type of waste, which too involves further sorting, else he may just buy one particular item pre-sorted.

Social Profile of Small and Medium Waste Dealers

It is difficult to gauge the exact number of waste dealers in Delhi. They are scattered all

9 The respondents on the basis define the caste whether they enjoy the benefits of the Reservation policy of Government of India or their respective states.

Table 12. Social profile of small waste dealers
(All figures in per cent)

| SEX | | EDUCATION | | | | | CASTE/COMMUNITY | | | |
|-----|---|-----------|--------|-------------|---------|------------|-----------------|-----|---------|---------|
| M | F | Primary | Middle | High school | College | Illiterate | SC | OBC | General | Muslims |
| 96 | 4 | 27 | 17 | 17 | 1 | 38 | 5 | 13 | 16 | 66 |

over the city and almost in all the slums where waste pickers live. The waste trade seems to be a male bastion and there is hardly any female waste dealer.

Of the 106 small and medium waste dealers surveyed, 96 per cent were males in the small waste dealer category and 97 per cent males in the medium waste dealer's category. The female waste dealers were 4 per cent and 3 per cent respectively, in contrast to the waste pickers. Overall more than three-fourths of the waste traders were Muslims, SC and OBC⁹. In the small waste dealer category 66 per cent were Muslims, 13 per cent OBC, 5 per cent SC and 16 per cent general. The percentage of the medium waste dealer for the same is 51 per cent, 18 per cent, 18 per cent and 13 per cent in the same order.

Most of these waste dealers are not from the lower rung of the caste hierarchy as is generally thought. Only 12 per cent and 5 per cent of the small and medium waste dealers are from SC. In the small and medium waste trader category a very high percentage have been found to be Muslims at 66 per cent and 51 per cent, respectively. The general caste also has its share in the waste trade at 16 per cent and 18 per cent, respectively.

It is often thought that those who deal in waste trade have little education and it is more or less a family business. To a certain extent this may be true, but not all waste dealers are illiterate or less educated. Though the small waste dealers are found to be less educated yet they have ample education to run their business.

Of those surveyed in the small waste dealer category, 34 per cent of them have been found to be either middle or high school passed. Nevertheless, the highest 38 per cent are illiterates, and 27 per cent with only primary education. The medium waste dealer

Table 13. Social profile of medium waste dealers
(All figures in per cent)

| SEX | | EDUCATION | | | | | CASTE/COMMUNITY | | | |
|-----|---|-----------|--------|-------------|---------|------------|-----------------|-----|---------|---------|
| M | F | Primary | Middle | High school | College | Illiterate | SC | OBC | General | Muslims |
| 97 | 3 | 15 | 6 | 37 | 12 | 30 | 12 | 18 | 18 | 57 |

Table 14. Seasons of waste and incentive
(All figures in per cent)

| SEASON OF WASTE | | | | INCENTIVE | |
|----------------------|---------|--------|----------|-----------|------|
| Summer | Monsoon | Winter | Constant | Yes | No |
| <i>Small dealer</i> | | | | | |
| 34 | — | 8 | — | 56 | 44 |
| <i>Medium dealer</i> | | | | | |
| 44 | 4 | 16 | 36 | 54.5 | 45.5 |

are more educated with 37 per cent high school graduates and another 6 per cent and 15 per cent with middle school and college education respectively. Though in both small as well as medium waste dealers category, the numbers of illiterates are very high at 38 per cent and 30 per cent respectively, they have been initiated into the business from their fathers and relatives. But they do calculate, weigh and keep records; it is just that they have no formal education and a certificate.

Seasonality

During the summer more waste particularly paper and plastics is available. During winter, the consumption of certain products such as packaged bottle waters, juices, cold drinks and other items that come in paper,

plastic and Aluminium packaging drops, as does their waste. Hence in the summer the recovery rate by the waste pickers is also higher since it is not wet unlike monsoon and winter. 34per cent and 44per cent of small and medium waste dealers stated that they get more waste in summer.

During the winter season paper waste is burnt by people to keep warm while it is thrown either in the municipal bins or on the street to be collected by the waste pickers in other seasons. Apart from this, during the festival times too, paper waste peaks.

Income of Waste Dealers

The small waste dealers earn Rs. 1500 to 12,000/ per month depending on their area of operation and capacity of storage and holding. In small areas where there is not much space available, they operate on encroached land, preferring to sell waste either on alternate days or in small truckloads. The medium waste dealers earn Rs. 2000 to 15000 or more depending on the season and capacity to store and hold inventory. The large dealers earn more though none of them specified the amount. Their monthly turnover suggests it to be more than Rs 20,000.

Hierarchy in Waste Trade chain

As stated above, there are a minimum of three levels of players in the waste trade. The first two levels of players are scattered all over the city but mostly in East and West Delhi and fewer in South Delhi, while large waste dealers are present mainly in Mundawa, Nangloi, Jwalapuri, Jahangirpuri etc.

In the middle level of the chain, the small

waste dealers have had some experience in waste dealing either as a waste picker or sorter or joined this trade through the help of relatives who are already into it. It is unlikely that waste trade is entered into like other businesses for instance, a grocery shop.

There are also instances where the large waste dealer's relatives are owners of recycling units or are agents for procuring waste from different places of the country, as also imported waste. It is not uncommon to see large waste dealers owning luxurious cars.

The interesting thing about this trade is, it gets specialised as it moves up. At every stage of the transaction waste is sorted out more specifically, although manually.

Entering the Trade

It is relatively easy to become a waste dealer at the small level with some exposure as waste pickers or sorter. However, to be a large waste dealer one needs another set of capacities. This includes not only a higher investment but also demands knowledge of the nuances of the trade. At this level the trade becomes close knit because of the presence of Trader's Association and close proximity to the reprocessors that in many cases are relatives, kiths or kin.

Most small waste dealers are there in the trade for more then 3 years and some with more than 10 years experience. One waste dealer surveyed had been in the trade for 35 years. The medium and large waste dealers also have experiences extending for more then 10 years.

In industrial areas the number of waste dealers are more than in other areas. For

The Waste Trade Hierarchy



This is the story of **Md. Jamal**. He started as a waste picker and accumulated enough money to become a waste dealer. For some years he ran his business successfully and had a comfortable life. At one point of time, he thought of becoming a large dealer. So, when the price of a particular waste was increasing and the item was in demand, in anticipation of making big money, he kept buying that waste from waste pickers. He also borrowed money from his buyers, apart from putting his own savings into the effort. He tried to hedge waste for more prosperity. But he was not lucky enough to make it really big. A sudden slash in prices entailed huge losses of Rs 75,000. He lost all his savings and went into debt.

He is now back to waste picking. But he has not lost all hope. Again he is thinking to start a small waste dealing business. He is looking for a loan but neither the large dealers nor the moneylenders or the bank is ready to help him.

Jamal and his friends say that they will welcome any move by government to legalize their trade and give due recognition to it, after all he asserts, "we help to keep the city clean and also earn our livelihood from it".

example, in Okhla there are many waste dealers of paper as it is available from many industries as used packaging. In such areas the concentration of waste pickers is less since sweepers either collect the waste or the industry itself sells the waste to the dealer directly, being in large quantities.

The small waste dealers buy everything that can be recycled or down cycled. This ranges from plastic items, metal, Aluminium cans, utensils, copper, brass, steel to paper and Aluminium foils. There are waste dealers who buy thermo Cole (Extended Poly Styrene), which was earlier not known to be recycled.

Employment Opportunities

Small waste dealers employ the maximum number of waste pickers and sorters. There are also a large number of independent waste pickers, who come and sell their daily collection. The small waste dealers employ on an average 5 to 7 people and a minimum 20 to 25 waste pickers come to sell their waste. The medium waste dealers also employ 10 to 15 people for sorting waste. The large waste dealers again employ 10 to 15 people for sorting waste, besides packing and loading.

Sorting Waste

The sorting of waste takes place right from the waste pickers to the recycling units and at each level it gets more specialized, although at all level it is done manually. It is interesting to know that most of the sorting is done by women. They have become so adept in doing this (sorting plastics) that by merely looking at its thickness, colour, softness, hardness, brittleness etc, they can categorise the plastics. The glass items are sorted out by colour, size of the bottle, whether refillable bottle or not, and sometime even the brand of the bottle (for e.g. alcohol bottles).¹⁰ Paper is sorted out in categories of fresh, mixed, carton, press cutting etc.

Inventory storage capacity

Most of the small waste dealers have an average space of 160 square feet though some of them have more than 400 square feet too. The medium waste dealers have little more space averaging around 200 square feet and a maximum of more than 400 Square feet too. The large waste dealers have between 500 to 800 square feet of space.

Table 15. Mode of payment for sorters

| | Rs/day | Rs/month | Rs/week | Rs/kg |
|----------|--------|-----------|---------|----------------------------|
| Men | 40-100 | 1500-2000 | – | – |
| Women | 40-60 | 1200-1500 | – | 25-30 (for 100 kg sorting) |
| Children | 15-20 | – | – | – |

Table 16. Price mechanism

| Who decides price of goods? | | | Does agent have cut/commission? | |
|-----------------------------|---------------|---------------------------|---------------------------------|-----------|
| <i>Factory</i> | <i>Market</i> | <i>Large waste dealer</i> | <i>Yes</i> | <i>No</i> |
| <i>Small dealer</i> | | | | |
| 6 | 94↔ | 19 | 81 | – |
| <i>Medium dealer</i> | | | | |
| 66 | 27 | 7 | 51.5 | 48.5 |

Market Operation

There is no clear distinction between fixed buyers and sellers. Dealers can be buyers and sellers at the same time. The system operates in a complex way. A medium level waste dealer could buy one particular item from another middle level dealer particularly when he is dealing in specialized items. The Pune Study also shows the complexity of the trade, "the buyer's side in this market segment consists of exclusive retail traders as well as retail traders combining retail trade with stocking and wholesale. The middle level market segment comprises retailers combining retailer and higher level of trading activity as buyers and the exclusive retail trader's as sellers. However, the buying selling transactions are complex in this market segment. There exists a buyer seller relationship within this group of buyers. At the top level buying selling classes are mixed and the clear distinction between buyer and seller is difficult."¹¹



¹⁰ Costly alcohol bottles are sold at higher prices as they are refilled with spurious liquor.

¹¹ Report on Scrap Collectors, Scrap Traders and recycling enterprises in Pune, ILO, UNDP, 2002, p 121.

Table 17. Price of Various Commodities at Different waste Dealer's Shop and value added

| Name of Waste | Colloquial name | Price at Small Waste Dealer (Rs) | Price at Medium Waste Dealer (Rs) | Price at Large Waste Dealer/Supplier (Rs) | Value added in the process (%) |
|---|-----------------|----------------------------------|-----------------------------------|---|--------------------------------|
| PLASTIC | | | | | |
| Pet bottles (coke, mineral water bottles*) | Raincoat | 2 | 4.00 | 4.50-5 | 125 |
| Plastic thread, fibers, rope, chair cane | Cane | 6 – 7 | 9 - 10 | 10 | 65 |
| Milk sachet/packets** | Dudh Mom | 6 | 8 | 9 | 50 |
| Hard plastic like shampoo bottles, caps, plastic box, etc | Guddi | 7 | 9 | 10 | 30 |
| Plastic cups and glasses | Fresh | 7-8 | 12-15 | 16-17 | 130 |
| Fresh virgin plastic (LD), polypropylene | PP | | 15-18 | | 115 |
| | | | 13-14 | | 90 |
| PAPER | | | | | |
| White paper used in offices/press cutting | White | 3 | 4.50 | 6 (if not dirty) | 100 |
| Mix shredded paper | Raddi | 2 | | 3 | 50 |
| Cartons and brown packing papers | Gatta | 2.50 | | 3 | 20 |
| All mixed paper | 2 No Raddi- | .50 - .75 | | 1 | 100 |
| Fresh newspaper | Gaddi | 3 - 3.50 | | 4-4.25 | 30 |
| Carton sheets | Raddi | 3 – 3.50 | | 4-4.25 | 30 |
| Tetrapack | Gutta Sheet | 2 | | 3 | 50 |
| ALUMINIUM | | | | | |
| Beer and cold drink cans | | 50 | 55 | 90-100 (reprocessor) | 80 |
| Deodorant, scent cans*** | | 50 | 65 | | |
| | | 40 | 55-60 | 100 | 100 |
| Aluminium foil | Foil | 20 | 25-26 | | 25 |
| OTHER METALS | | | | | |
| Steel utensils | Steel bartan | 20 | 25-27 | 30 | 50 |
| Copper wire | Tamba | 80 | 90 | 100-110 | 25 |
| GLASS | | | | | |
| Broken glass | Shisha | .50 | 1 | | 100 |
| Bottles (beer) | Bottle | 2 | 2.25-2.50 | | NA |

* Some people come to buy uncrushed bottles at Rs. 1 a piece to refill it again illegally.

**Red printed milk sachets are costlier due to better quality

*** Because these cans are thick and of good quality.

| Name of the Type of Plastic | Price at Large Waste Dealer/Supplier (Rs per kg) |
|---|--|
| LD Bottles | 20 |
| Liquor Pouch | 16 |
| Mineral/Purified Water Bottles | 5 |
| Pet Bottles (Cold Drink, Water bottles) . | 4.50 |
| PVC Boot | 10 |
| Cable | 10 -11 |
| Water Pipe | 12 |
| Pipe Churiwala(Irrigation Pipes) | 13 – 14 |
| Newar (Bed Strap) | 5.50 |
| Black Cans | 2.50 |
| White Poly Ethylene Pipes | 16 |
| Colour Polyethylene Pipes | 14 |
| Water Bucket White | 17 |
| Water Bucket Colour | 14 |
| Chair Cans (Fibres) | 8 |
| Radio Body, Toys (Kadak) | 8 |
| Conduit Pipes | 14 |
| Crystal Audio Tape | 22 |
| Audio tape black | 8 |
| Pen/Combs, Cleaning Brush | 11 |
| Roof Top Water Tanks | 28 |

Price Mechanism

The pricing of a particular waste depends how much of an item is in demand and how many players are there for the same item. For example, if there is only one stockist of HDPE type of plastic waste, then there is high probability that the stockist will exploit the monopolistic situation and dictate the price. But if there are many players selling the same item, market decides the price. The price will also be dictated by the prevailing price of virgin material.

The small waste dealers stated that the market as well as the large waste dealers command the price and recycling units (reprocessors) have little say in (6 per cent) in fixing it, while the medium waste dealers felt that the factory (66 per cent) and market (27 per cent) are the deciding factors in fixing price.

There is also other price mechanism, namely season. Some of the large waste dealers who have the holding and storage capacity store the waste till the demand rises, and hedge prices. For example PVC plastics is much in demand during the pre monsoon period for making plastic shoes, sandals, slippers and soles.

Table 18. Holding capacity and price mechanism

| Type of Player | Holding Capacity (in tons) | Buys from | Sells to | Price Mechanism |
|---------------------|----------------------------|--|---------------------|------------------------|
| Large Waste Dealer | 7 to 15 | Medium and Small Waste Dealer | Factory/Agent | Market/ Factory owners |
| Medium Waste Dealer | 3 to 4 | Small Waste Dealers | Factory/Agent | Factory/Market |
| Small Waste Dealer | 2 to 12 | Waste Pickers/ Itinerant Buyers/ ferriwala | Medium Waste Dealer | Waste Dealer/ Factory |

Table 19. Association and relation with government

| Is there an association? | | Do you need licence/permit | | Interference from government and municipal corporation | | |
|-----------------------------|----|----------------------------|----|--|-----|------|
| Yes | No | Yes | No | Police | MCD | Both |
| <i>Small waste dealers</i> | | | | | | |
| 23 | 77 | 3 | 97 | 78 | 3 | 19 |
| <i>Medium waste dealers</i> | | | | | | |
| 44 | 56 | 13 | 87 | 49 | 16 | 35 |

Relation with the Government

Most of these dealers pay bribe to police and municipal authorities, as the status of the trade is ambiguous. The Delhi Government does not give any license to run such a trade, even though a huge value of transaction takes place everyday. The traders have to pay bribe mostly on two accounts. First, the land they operate is generally encroached upon by them or is a squatter settlement. Secondly, the government as such does not give any license to carry out waste trade, while the space they use is often government land. The police make this an excuse to harass the traders and force them to pay money. Though at the medium dealers level almost 36 per cent had their own land to do the trade.

The waste dealers have little knowledge about the government providing them with any kind of License or a Sales Tax Number to carry on their business. For them it is the

usual visit of the police and the Weight and the Measures Department, which arrives to claim their share of the bribe. Most of the small waste dealers in particular were found to be paying bribe to the Weight and Measures Department, as their weighing scales were not calibrated. This also points to malpractices (cheating) in weighing.

It is worthwhile to mention that these waste dealers have little or no idea whether they require a license either from the government or the municipality to run the business. 97 per cent of small waste dealers and 87 per cent of medium waste dealer said that they do not know if they need any kind of license to run their business.

While the small waste dealers pay some-

Salim has been staying in Yamuna Pushta, Delhi, since his childhood. He is a waste dealer and buys waste from both the itinerant waste dealers and small waste dealers. Before coming to this business he had tried his hand at being a fruit and vegetable vendor, a rickshaw puller, etc. Salim says that in this slum there have been fire accidents more often than other areas. He expresses doubt that all of these are mere accidents. He cites one example of fire accidents, which occurred on 14th of March 1998. The fire broke out in a small jhuggi and subsequently engulfed the entire area. The wind was blowing so fast as if it had come to destroy the entire slum. The fire spread on all sides and all the roads got blocked because of high flames. Soon some people realized that there is no other way then to jump the wall and cross to the temple side. Most of the men were able to cross the wall but the women could not. They rushed to the mosque for safety. The mosque had a concrete roof but unfortunately it also caught fire and some 30 children and women got trapped. Soon the women saw smoke pouring fast into the room.

Salim heard children and women screaming and rushed to the room. He had to jump a wall to reach and help them. The children had already started getting asphyxiation and falling unconscious. Their mothers thought that their children are already dead. He had no other option but to cross the burning wall. While crossing the wall he burnt his hand but was able to close the door from where the fumes/smoke was entering the room. He went back frantically and along with other people started pouring water on the walls so that it does not catch fire. While removing a hot iron bench he realized that he cannot move his hands and fell unconscious. But by the time he was able to prevent fire from entering the room.

When he regained consciousness, people lifted him on their shoulders and congratulated him on his bravery. The government gave him Rs. 20,000 for his act of bravery. But he had gained and lost more than that. He lost his entire waste stock, which was worth more than a lakh. People started singing his praise for his bravery and he became a respected man. The government did not provide any other help. He had to build his life afresh right from the scratch once again. Today Salim is a happy man and contributes in social work also. He along with other people are collecting money to put water pump sets so that such fires could be controlled as they know well that the government fire brigades always reach when the slum people have lost their home and hearth. This fire took the life of 28 people and left many with indelible marks of its devastation.

where between Rs 200 and 400 per month to the police and the municipality, the medium waste dealers have to bribe larger amounts, from Rs 1000 to 1500 depending on the space used for the trade. In more than 90 per cent cases, both the categories of waste dealers pay bribe to police as well as the municipal staff but the larger share goes to the police.

For the waste dealers, the largest nuisance to the trade is not the Sales Tax, or income tax departments, but the police and the municipality. Since they are not aware of the status of the trade, the police often come and ask for bribe. Lack of land is their biggest problem as the police can come at any time and brand them as encroachers. They are also harassed on the pretext of buying stolen goods. Giving physical punishment to waste pickers and sometime even to the small dealers on the pretext of buying and selling stolen items is not uncommon.

Fire accidents have been one fearsome problem for all kind of dealers. There have been regular fire accidents in one area or the other. But the waste dealers say, in very few places there is any fire brigade station nearby and even if it arrives when a fire is reported, all is gutted. The government as such has not done to prevent the fire accidents in spite of the fact that it is a regular occurrence. The 1995 fire accident of Jwalapuri still remains one of the most traumatic experiences of the medium and large waste dealers when along with their stock they lost everything they had.

Lack of Trader's Association

The small and medium waste traders do not have any formal association of their own, though in some areas where their numbers are high, like Yamuna Pushta, they have formed associations along with other residents. This is mainly to protest against the government's drive against encroachment and to demand basic amenities such as water, electricity, toilets, etc, not for trade negotiations. Also to safeguard themselves from police harassment, 23 per cent of small waste dealers and 44 per cent of medium waste dealers said that they have loosely formed an association. However, they have never demanded any policy which can make their trade more sustainable. In contrast, the large dealers have a registered association and for the last few years have been negotiating with the government for legal ownership of land and other infrastructural facilities.

Incentives provided by waste dealers

More than half of the small waste dealers (56 per cent) provide incentives to the waste pickers in different form to assure continuous supply of waste. These incentives come chiefly in the form of giving advance money, both to the waste pickers and the itinerant waste dealers (*kabariwalla*) since he/she needs liquidity to buy waste from households. The waste pickers though use it as a social net, for when he/she is sick or on days when they do not get enough waste. The waste pickers also use an advance as an assurance that the waste dealer will buy the waste from them. 77 per cent of the waste pickers were found to borrow money from the waste dealers.

The large or medium waste dealers also provide incentive mainly in the form of advance money and sometime space too for storage. This works out to be mutually beneficial. The Pune study cited earlier also confirms a similar finding. The report states, "in order to ensure adequate supplies and retain their hold over the market, the older, established retail traders often start by distributing advances and lifting a few commodities from smaller retailers who face space and capital constraints. Stockist earns a trading margin on bulk purchases over and above that from the retail activity. They specialize in specific commodities in order to reduce the competition among themselves. They are in a better position than retail traders to negotiate prices with the larger wholesalers due to the larger quantity they trade. In turn the larger wholesalers also give advances to the stockist to ensure adequate supplies."¹²

The other form of incentives to the waste pickers is providing shelter, protection from police and sometimes from the municipal staff. Some waste dealers also provide meals during work. In case the waste dealer does not give these incentives, the waste picker may switch dealers. Even providing a place to sleep is a good incentive for them to continue working with the same dealer until they get better incentives. All this points to the certain kind of patronage that exists between the waste dealer and the waste pickers. Almost the same percentage (54.5 per cent) of medium waste dealers provide incentives to the small waste dealer, the only difference being that here it comes only as cash advance, and in some cases space for storage.

The large waste dealers and the agents generally deal in few items unlike the small

Table 20. Supply of waste

| From whom do you buy waste? | To whom do you sell waste? | | |
|---|-----------------------------|----------------------------|--------------------------|
| <i>Ragpickers Kabadiwallahs Small waste dealers</i> | <i>Medium waste dealers</i> | <i>Large waste dealers</i> | <i>Recycling factory</i> |
| <i>Small waste dealers</i> 100 per cent | Yes | Yes | No |
| <i>Medium waste dealers</i> No Yes Yes | 51 per cent | 27 per cent | 21 per cent |

waste dealers who buy everything. The agents have generally no storage facility. They merely facilitate the exchange between the Recycling unit as well as the dealer, at a percentage of commission either from the recy-

12 Report on Scrap Collectors, Scrap Traders and Recycling Enterprises in Pune ILO, UNDP, 2002.

Glossary of colloquial words at a waste dealer's shop

PAPER

| | |
|---|-----------------|
| White paper used in offices | White |
| Mix paper | Raddi mix |
| Thick cartons and yellow packing papers | Gatta |
| All mixed paper | 2 No. paper |
| Mix paper of all kinds (before sorting) | Raddi/Gaddi Mix |
| Fresh Newspaper | Raddi newspaper |

PLASTIC

| | |
|---|--------------|
| PET bottles (coke, mineral water bottles) | Raincoat |
| Plastic thread, fibres | Cane |
| Milk sachet/packets | Dudh Moam |
| Hard plastic like shampoo bottles, caps, plastic box, etc | Guddi |
| White fresh plastic, plastic sheets thicker and softer | L.D. |
| Thin plastic sheet coloured or white | P.P. |
| Plastic sheet thin or colour bags | P.P.I. |
| Carry bags of different colour | H.M. (Panni) |
| Broken chairs, buckets | Guddi |

ALUMINIUM

| | |
|---|--------|
| Aluminium foil | Panni |
| Breakable Aluminium like wires and plates | Kaskut |
| Aluminium utensils | Bartan |

OTHER COLLOQUIAL NAMES

| | |
|----------------------|---------------------------|
| Kurrawala | A Waste Picker |
| Kabadiwala/Ferriwala | Itinerant Buyers of Waste |
| Dhaba | An Eating Joint |
| Jhuggi-Jhopari | A Slum Settlement |

Waste dealers at a glance

- The Waste trade is in the informal sector.
- There are three different kinds of waste dealers, namely small, medium and large waste dealers or suppliers besides agents who work on commission
- The Agent has no investment or inventory; he facilitates business between recycler and the waste dealers
- The waste dealers are predominantly male
- Of those surveyed 66 per cent of Small and 51 per cent of Medium waste dealers were Muslims
- There is more waste generation in summer
- A small waste dealer buys waste from 20 to 25 waste pickers
- Medium and Large waste dealers employ 10 to 15 waste sorters for waste segregation, packing and loading
- A small waste dealer earns 1500 to 12000, a medium waste dealer 2000 to 15000 and large waste dealers earn more than 20,000 per month.
- The small waste dealers patronise waste pickers by lending money, providing space to sleep, for getting regular supply of waste
- All the three different waste dealers provide incentive to the lower rung player for continuous supply of waste
- The waste dealers cannot avail loan or insurance facility on their trade.
- Mostly the buyer of waste decides the price
- All the dealers bribe the police for running their business.

cler or the waste dealer.

It is imperative to understand why this advance money as incentive operates at all levels. This system helps in morally binding the seller to give his stock to the person who has offered advance. It also helps in business sense that the constraint of space and investment is reduced for the smaller dealers and in turn the larger dealer gets an assured supply of an item of his choice.

Suppliers of Waste

Almost all small waste dealers buy their waste from the waste pickers and itinerant waste dealers (Kabariwallas) who buy paper and plastic and other recyclable materials moving in the residential areas. But the bulk of the supply comes from the waste pickers. These waste dealers then sort out the different items and sell it to medium waste dealers. The medium waste dealers buy their supply from these small waste dealers and sometime s from some kabariwallas who have the capacity and money to store their waste for some time.

The Large Waste Dealers

The large waste dealers are based in Mundaka and Nangloi. Here they mainly deal in plastic waste. The large waste dealers have a Jwalapuri Waste Dealer's Association though all the dealers are not its members. They mainly deal only in few items of a certain type of waste, for example within plastics PVC, HDPE, LD etc. This gives them a certain amount of monopolistic hold in that category. They keep changing buying items according to season and the demand of a particular waste. The markets for various items are scattered geographically.

For example, most of the big waste dealers dealing in paper are in Okhla, and for Aluminium in Mandoli, Jhilmil and Samaipur Badli. Besides these, there are overlaps too. Paper, for example has fewer players as small waste dealers sell it directly to the agents or large waste dealers, bypassing the medium waste dealer.

The large waste dealers also buy waste from other states. Apart from this they deal in imported waste, which they say is of better quality and fetches a better price in the market. The storage capacity of these dealers is many times higher than the medium

waste dealers averaging 9.6 tons per day. They can hold waste for 2 weeks to 6 weeks and sell it at a higher price. Availability of land/space has been their single most important problem. Almost half of the respondents surveyed are members of the trade association. A similar number also have sales tax numbers and pay income tax as well as profession tax. However this does not imply that they do not bribe the police.

The large waste dealers believe that the waste recovery could be enhanced if the government provides loans, subsidies on recycling machines and legalise waste trade, by giving them license to deal in specific waste items. Some also want a ban on imported waste as prices of domestic waste gets diminished even though they accept that imported waste may be of better quality.

Almost all of them agree that due to relocation of recycling industries, their profit margin has reduced owing to higher transportation cost, customer displacement and more bribes to the police. At the relocated area there is little labour available due to the lack of infrastructure and basic amenities.

The Agents

The agents have no holding and storage capacity of their own. They merely facilitate transactions between recyclers and medium, or large, waste dealers. At times the agents buy waste and hold it for sometime for better prices, but that is not a common feature. The agent gets a commission from either the waste dealer or the recycling factory and sometimes from both.

The existence of agents is as that of a mediator. The recyclers find it difficult to move in the waste market and look for the required material and here the agents help them.

Mr. Kartar Singh is an Agent. Before coming in to waste trade, he was a government employee as Assistant Traffic Inspector with Delhi Transport Corporation in 1968. He started waste dealing as a part-time job to earn some extra money. He bought his first consignment of 400 kg of shoe soles and saved Rs 70. His monthly salary then was Rs 90. Comparing these figures, he thought, why not take the plunge and make this a full-time job. Today, he reveals, he earns more than Rs 25,000 per month.

Recycling units: people and technologies

In the present report special emphasis has been given towards recycling of post consumer waste products focusing on plastics and Aluminium. The process for recycling plastics and Aluminium has been discussed in the following section. During the survey we acquired substantial information on recycling of PET and EPS amongst post consumer plastic waste. Hence the technology used to recycle these two materials has been separately discussed.

Viability of Recycling Units

The economics of recycling units encompasses a medley of issues, which includes collection costs for disposed materials, market demand for recycled product, landfill costs saved as a result of recycling the product (if factored in, which is not the case in India as yet), and industrial infrastructure and technology available. From an economic perspective recycling pays only when additional costs of collecting materials, sorting them for recycling and finally recycling and marketing them is substantially recovered from the value of the recycled product.

There are also environmental costs, human costs and savings for not using land fill space, which are not usually estimated. It is difficult to quantify the 'environmental' or 'human' costs. For instance there are severe costs of trauma in dislocation, more so when relocation is not followed properly. In many areas surveyed, recycling unit owners have lost their livelihood and were forced to take up other odd jobs following the sealing of recycling units.

The infrastructural facilities in the relocated areas are poor, lacking in proper roads. Transportation during the rainy season becomes very difficult. Power cuts are frequent, and all this adds to the plight of the unit owners and workers. The working population stands to lose crores of rupees every year on transportation costs alone. Again many workers will lose their jobs as recycling units seek to mechanize/modernize to reduce operational costs. Sometimes there are social tensions that emerge in new areas where plots are allotted by draws and neighbors have no social links with the new allottees.

The economics of recycling need to be so determined to ensure that recycling can be made into a profitable business for all in-

involved in it. Profit opportunities in recycling vary widely with the type and quality of waste. The return on investment should be adequate for people to recycle waste.

For example, it is necessary that virgin raw materials be priced correctly to cover their full costs including the cost of final disposal. The recycled materials should be of good quality and priced reasonably lower than virgin materials so that recycling can become sustainable. However, commodity markets are inherently unpredictable and more so for recycled materials. This may be because recycled materials tend to be of lower grade, which can be readily substituted by low priced better quality virgin materials. Moreover, virgin material has the advantage of being of predictable and uniform quality and therefore have more versatile applications. To make recycling economically viable recycled materials should be competitive in quality as well as in price.

Need to upgrade the traditional recycling system:

- If recycling is not done properly then the

For this study surveys have been conducted in the following places:

Plastic

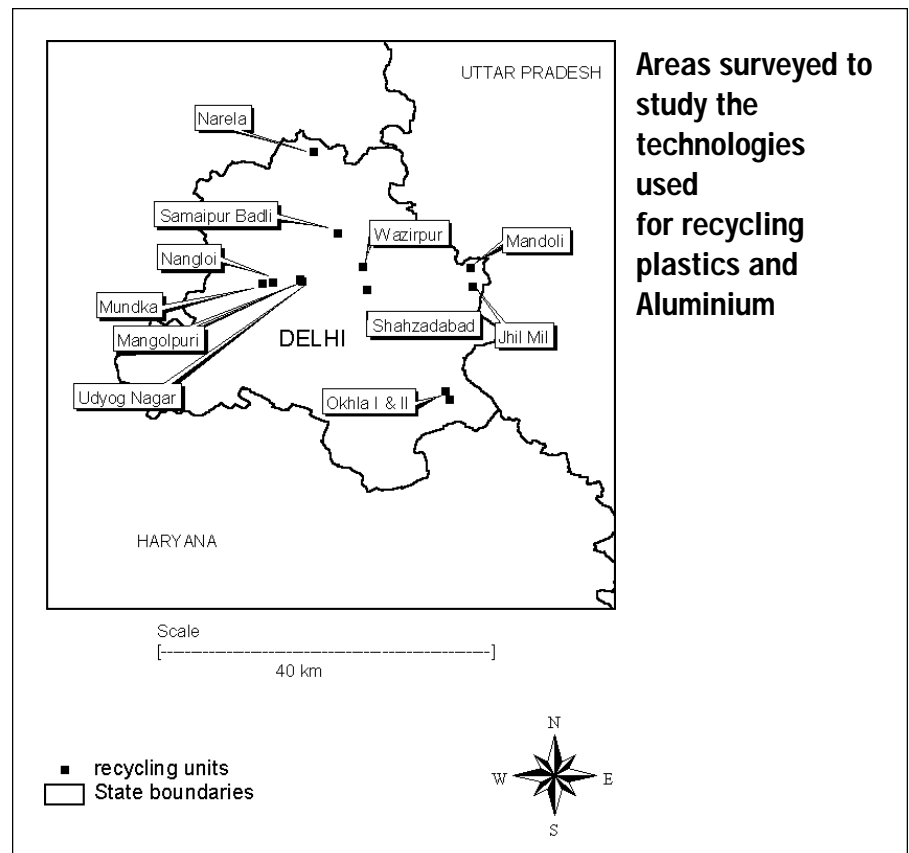
Samaipur
Badli
Narela
Nangloi
Mangolpuri
Wazirpur
Udyog Nagar

Expanded Polystyrene

Okhla
Shahzadabad

Aluminium

Jhilmil
Badli
Mandoli



very process of recycling can be polluting. Adulteration of virgin plastics with post consumer recycled material is undesirable for food packaging and other health related products (like blood bags, blood transfusion kits, syringes etc.).

- New types of materials, composites etc. cannot be properly recycled using traditional recycling technologies.
- The quality of outputs of recycled products is poor and need improvements.
- When recycling is used in lieu of waste reduction rather than alongside, as a sustainable strategy.
- A large number of people employed in recycling units (both in the formal and informal sector) are involved in waste sorting, cleaning, loading and unloading of waste and machine operation. Such people are vulnerable to the adverse effects of recycling.

Recycling does not take place when:

- The cost involved in recycling the material far exceeds the cost of the virgin material.
- There is no market for the recycled material, which may be due to depressed demand.
- Due to downcycling of the material the quality of the material has degraded so much that it cannot be recycled further.

Technologies used for recycling

Commonly practised technology for plastics recycling

Plastic resins can be placed under two broad categories namely thermoplastics and thermosets.

Thermoplastics: They are linear or branched polymers which can be melted upon heat application and can be moulded and remoulded using conventional techniques.

Thermosets: They are heavily cross linked polymers which are normally rigid and intractable and degrades rather than melt on heat application. Almost all the plastics used in consumer packaging are thermoplastic. The recyclability of a package is considered most desirable alternative from environmental viewpoint. In this section an attempt has been made to study broadly the existing technology in practice for recycling post consumer plastic waste.

Depending on the input raw material there could be a significant design variation in some

or all of these equipments, as there is no universal single solution for recycling of all polymers in any or all forms. Each recycling task and the series of equipments used to complete it is not discussed, rather an attempt has been made to give a broad overview of the technologies involved in recycling.

Plastic Waste – Sources

Broadly there are two main sources of plastic wastes:

- Manufacturers (ie. resin producers, fabricators, converters, assemblers, packagers and distributors) and
- Consumers of plastic products

Options for Recycling of Plastic

Landfill solutions are no longer acceptable. Product reuse applies only to specific and special cases. Energy recovery is in some ways a last resort. This is because of the environmental problems they pose due to release of toxic fumes when certain resins are incinerated. Again incineration of waste often produces noncombustible material, which has to be ultimately disposed off in landfills. Feedstock recycling usually implies a high volume supply of a particular type of polymer. This leaves Mechanical Recycling as the only viable option for most thermoplastic products.

In the present report a detailed study has been made on Mechanical Recycling of plastic material.

Mechanical Recycling

Mechanical recycling or recovery refers to recovery and processing of used plastics by sorting, cleaning and Recycling into pellets ready for production of new products. Mechanical recycling is very suitable for thermoplastics.

At times mechanical recycling is not desirable or possible because of the following reasons:

- The material is grossly polluted or burnt
- The material has absorbed moisture from air
- The material maybe of composite nature
- Sometimes plastic scrap does not have the same bulk density and flow properties as virgin material. Addition of such material may alter the temperature and viscosity of the melted product. This in turn will af-

fect the filling and pressure in the mould. So recycled material is often added in a fixed proportion to virgin material.

Types of polymers recycled

Primarily, all varieties of Polyolefins ie. Low Density Polyethelene (LDPE), High Density Polyethelene (HDPE), Linear Low Density Polyehelene (LLDPE), High Molecular Polyethelene (HMPE), Polypropylene (PP) and Poly Vinyl Chloride (PVC) are the types of plastics that are recycled in Delhi. Polyethelene Terephthalate (PET) is collected and compacted or shredded in Delhi but not recycled here, being transported to recycling units in Chennai. Mixed plastic waste is re-processed n Sonia Vihar and Sultanpuri, Delhi.

Recycling process

Sorting: The sorters employed by waste dealers do initial sorting. At the recycling unit final sorting of waste is done as per the type of plastic required for recycling. To determine the type of plastic, mainly, visual methods are employed to link the scrap with its previous use. Mostly the sorters through their experience are able to identify the plastic type. However, in case of confusion plastic is either, broken and identified according to the strength of the polymer or burnt to determine the type of plastic by fragrance. Sometimes, flotation method is used to differentiate plastic on the basis of density.

Sorting of waste plastic is essential as there are some plastics which can be mixed and extruded while other plastic cannot be mixed because of their different material and melting characteristics. For example PE and PP can be used in a mixture as they have similar liquidifying characteristics. On the other hand PVC cannot be used in a mixture with PE or PP for the above mentioned reason.

Size reduction: The uniform variety of plastic scrap are manually fed into the shredder/grinder/cut-ter and is subsequently shredded into flakes or grounded or cut to reduce the size of the waste. The shredder is approximately of 15 to 20 horsepower (HP). Sometimes to further reduce the particle size of the material a Grinder of 20-25 HP maybe used. The grinder/cutter (*Figure 1*) is mostly used for hard plastics.

Washing: Once the waste is sorted it is then washed to remove all visible contaminants and dirt. Contamination in plastic recycling encompasses a diversity of forms such as dirt, partially oxidized polymers, printing inks, paper, pesticides, metals, foil, additives (e.g., fire retardants and antioxidants) and

their transformation products. Contamination in polymers for recycling is ubiquitous; be it soil in LDPE mulch film or metal fragments from Aluminium caps in PET. Furthermore, plastic products are increasingly multicomponed systems comprising pigments, fillers, labels, glues, laminates and coatings. The potential for undesirable/antagonistic interactions and the probability of undetected contamination being present, leading to a reduction of the recycle quality, is high. To eliminate this possibility the waste should be properly washed.

Usually, cheap detergents or caustic soda are used for cleaning. Cleaning and removal of contaminants from plastic waste is sometimes difficult. At times the plastic part consists of components which maybe metallic or ceramic. These non-polymeric contaminants if not completely removed may cause undesired effect on either the recycling process or the recycled product. The flakes or chips are soaked in soap solution for a few hours to a

Figure 1. Plastics grinder

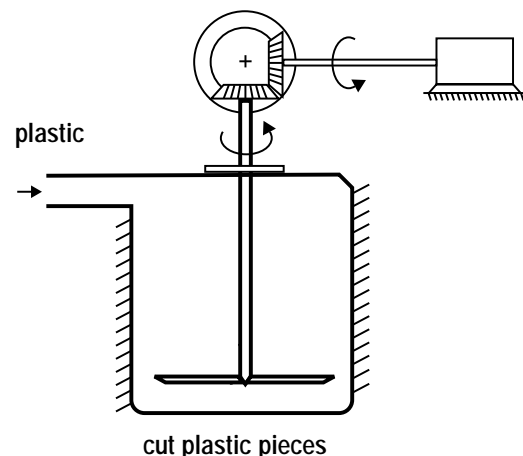


Figure 2. Sink

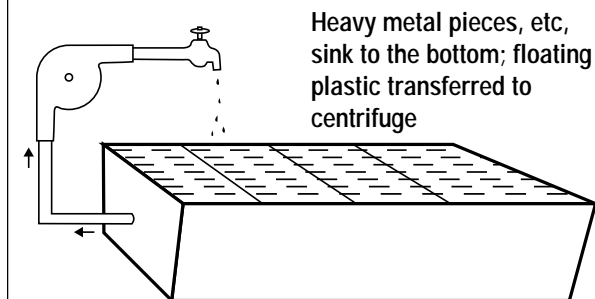
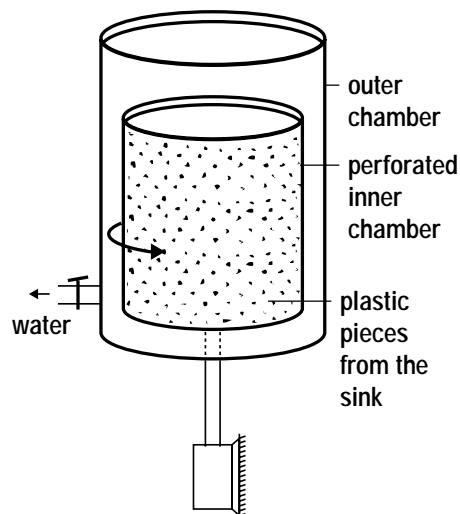


Table 21. Size Reduction

| MACHINE | RAW MATERIAL |
|----------|--|
| Shredder | Films, sheets, foams |
| Grinder | Lumps, Injection moulded items, large blow moulded items |
| Cutter | Big lumps |

Figure 3. Centrifuge



few days in drums or cemented tanks. The non-polymeric contaminants, which might have been dislodged during shredding or grinding process sink to the bottom due to gravity. Before rinsing they are washed with hands. This operation requires the workers to soak their hands in the soap water for long hours.

Centrifuge: This is a cylindrical vessel. Inside it another perforated vessel is placed that rotates with the help of a motor at high speed. This is used to dry the material. Sometimes to further dry the material it is transferred to a blower.

Blower: The ambient air is heated with the help of heaters us-

- Iron Oxide (red)
- Benzandine (yellow)
- Cadmium (red)
- Carbon (black)

The colour pigments are mostly complex organic compounds, usually with a metal chelate. There are two blades, which rotates with the help of a motor and mixes the color with the plastic.

Extruders: Next the plastic scrap is fed into an extruder. For polymer processing extrusion is most important. The basis of a good recycling line is the Extruder and most forming operations involve extrusion. Extruders maybe used to perform the following operations:

- **Primary** (melt, pump and form)
- **Secondary** (devolatilize and mix)
- **Tertiary** (Conduct chemical reactions)

According to the principal element of their construction, the extruders are divided into:

- Single, Twin & Multi-screw
- Single, Twin & Multi-shaft
- Gear or Disk
- Others

The choice of the extruder depends on the process task and the raw materials.

During the survey conducted the extruders most commonly used were found to be single, twin and multi-screw extruders. The operation of the Extruder requires close monitoring of the composition, morphology, characteristics of the final product etc. The standard method of monitoring adopted to test the quality of the final product ie. the recycled material is executed by an experienced worker who uses discretion and expertise to judge the quality of the final out put. Many parts of the extruder are hot. So as to cool these parts, a standard table fan is used.

The contaminants remain in the waste, even after washing, are filtered by breaker plate during the extrusion process. This waste is removed by burning at least once depending on the quality of the waste and the quantity of the material extruded.

Pelletizer: The last component of the recycling process is the pelletizer. The materials, after being filtered by the breaker plate during the extrusion process, flow in the form of strings, which are finally cut into granules or danas. Before being cut, the strings pass through a water bath. This cools the strings. The strings of plastic are cut into small granules with the help of rotating blades, which rotate continuously on the die plate.

Figure 4. Blower

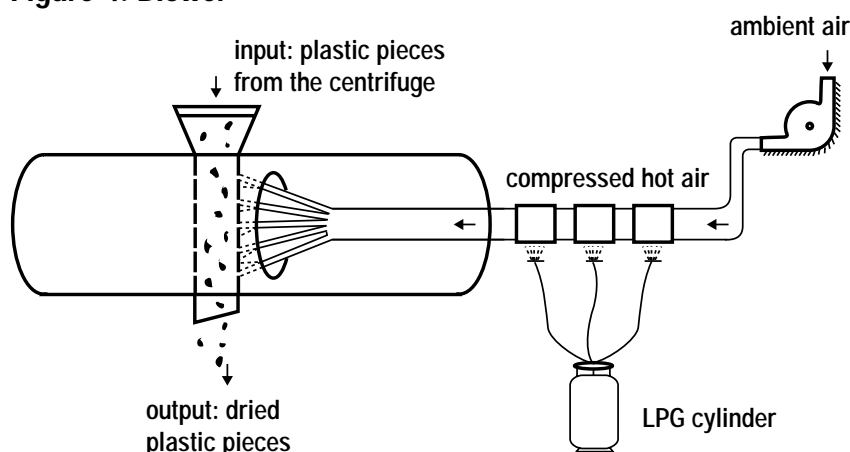
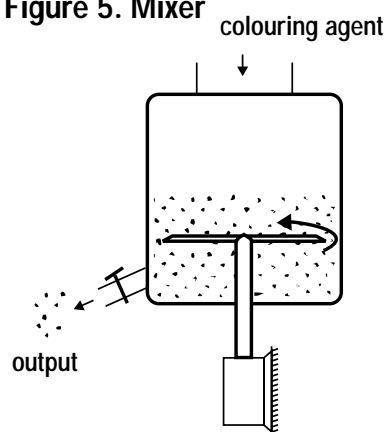


Figure 5. Mixer



ing LPG gas to dry the material. The plastic is dried and passed to a mixer.

Mixer: The uniform variety of plastic scrap is then put in the mixer. If the plastic waste is clean then it is directly put after shredding and grinding. Pigment in the form of masterbatch is mixed at this stage. Pigments in powder form or concentrated pigments are generally used.

Commonly used colors are:

- Titanium oxide (white)
- Thelocynine (green and blue)

Once the granules are produced they are either sold in the local markets or they are used to manufacture consumer durables like mugs, jugs, stools, trays, etc. Most often the recycled danas are mixed with virgin danas so as to increase its durability. Amongst the various equipments and machines the extruders, Filters + Pelletizer have great influence on the quality of the final polymer pellets.

Figure 6. Extruder

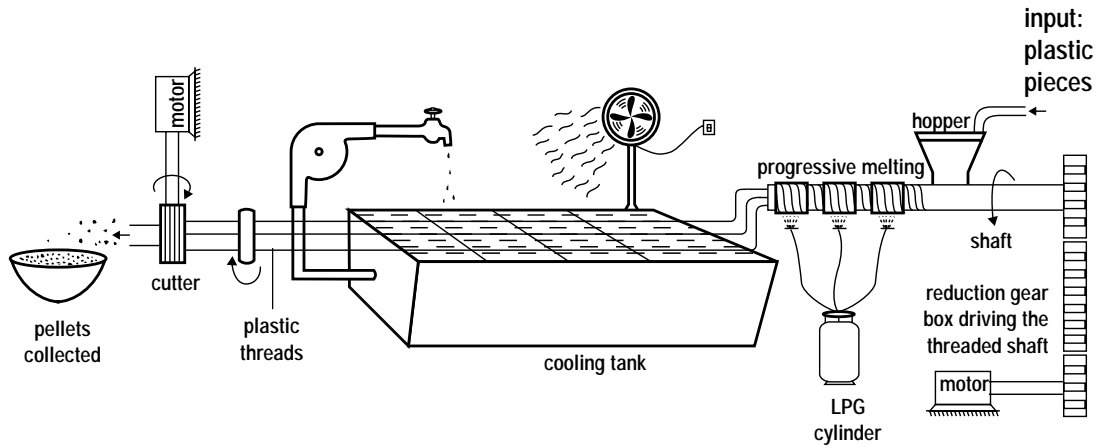
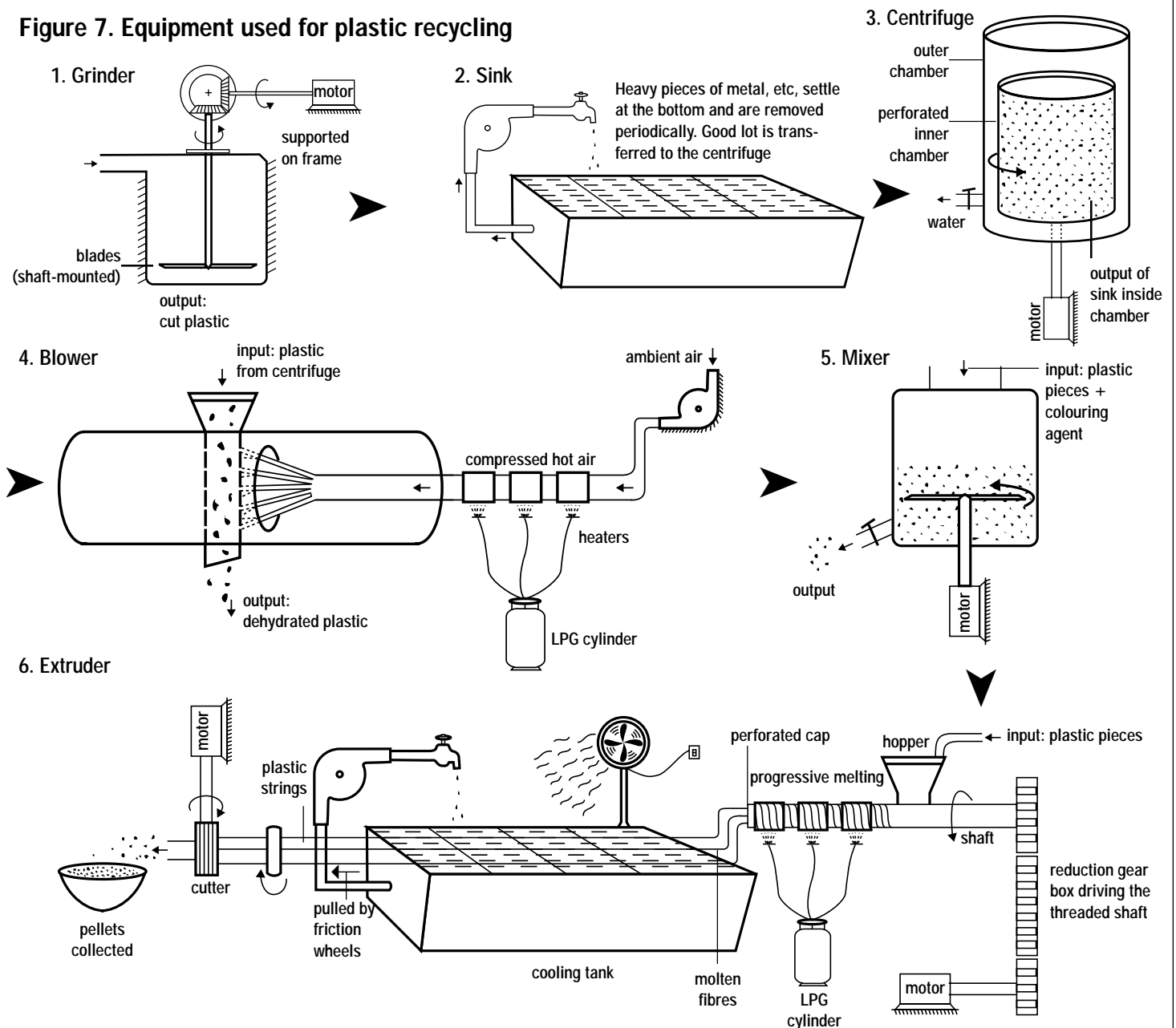


Figure 7. Equipment used for plastic recycling



Mixed plastic waste recycling

Sometimes plastic waste contains numerous kinds of polymeric resins, which is not feasible to separate owing to the complex mixing of all polymers. This is then recycled as a mixed or commingled plastic waste. The polymers commonly coming in this sort of waste stream are LDPE, HDPE, LLDPE, HMHDPE, PP, PVC, PS, PC, ABS, Polyamide etc. Such kind of waste is mixed thoroughly and then extruded or moulded directly into linear shapes called Plastic Lumber¹³. This is highly contaminated by paper, soft metal, dirt or thermoset plastics. Products from mixed post consumer plastic waste are used in agriculture, recreation, gardening and horticulture, construction and industry. Recycling of mixed plastic waste has been observed in Sonia Vihar and Sultanpuri during the survey. Various other technologies are available to recycle mixed plastic which have not been investigated due to time constrain.

Problems related to Technology

Presence of moisture in the extrudate in the extreme condition may lead to explosion. Thin carry bags made of PP should be carefully separated from PE and extruded into lumps. Here presence of air, moisture or other polymers can lead to degradation and clogging of the screw channel. When there is no way for volatile matter to go out, there can be explosion given high temperature.

Overheating due to lack of automatic temperature control may lead to degradation and eventual clogging of delivery channel and subsequent release of volatile matter

There is high risk of short circuit: Most of these machines are fabricated in local workshops, in all likelihood from second-hand discarded machinery and have bare minimum parts. Usually heaters and electric wiring connected with barrel are exposed without any casing. The wiring is connected in many cases without even insulation tapes.

Heated barrel without protective casing may cause accidents particularly at the time of changing wire mesh. A wire mesh is attached with a breaker plate to remove contaminants. There is invariably a fair amount of impurities in shredded material loaded into the extruder. In normal operation the mesh get heated very fast and needs replacement. This operation is performed manually, wherein the screws of the hot bar-

rel are opened with the help of a spanner, sometimes without switching off the heating to change the wire mesh.

Degradation due to unscheduled power shut down: Each time production is stopped due to unscheduled power shut down, the matter inside the extruder, due to long residence time, starts degrading. Particularly PVC emits Hydrogen Chloride and other products of degradation when removed from the extruder once power is restored.

Specific Materials

PET

Polyester resins, also known as Polyethylene Terephthalate (PET) resins are thermoplastic materials and are referred to as thermoplastic polyester or linear saturated polyesters.

PET resins are manufactured from mono ethylene glycol (MEG) and dimethyl-terephthalate (DMT) or purified terephthalic acid (PTA). There are broadly three categories of PET resins viz. bottle grade, film grade and fibre grade.

PET Recycling in India

Source of waste and collection

Presently PET recycling has assumed importance in India as consumption of PET packaging material has increased. This may be attributed to various reasons. Changing life styles in urban India, higher incomes, increasing awareness and concern about health and hygiene has boosted the increasing consumption of PET in the form of PET bottles, assorted containers and films.

The main sources of PET in India are bottles, films and fibers. Fibre waste emerges in process operations. In fibre waste there is little contamination. Post consumer waste is mostly constituted of bottles, containers and films. For PET bottles and films the recovery and reuse is greatly dependent on the form of waste, nature of contamination present in the waste, the extend to which it has been degraded during earlier reprocessing, if at all it happened and its use history.

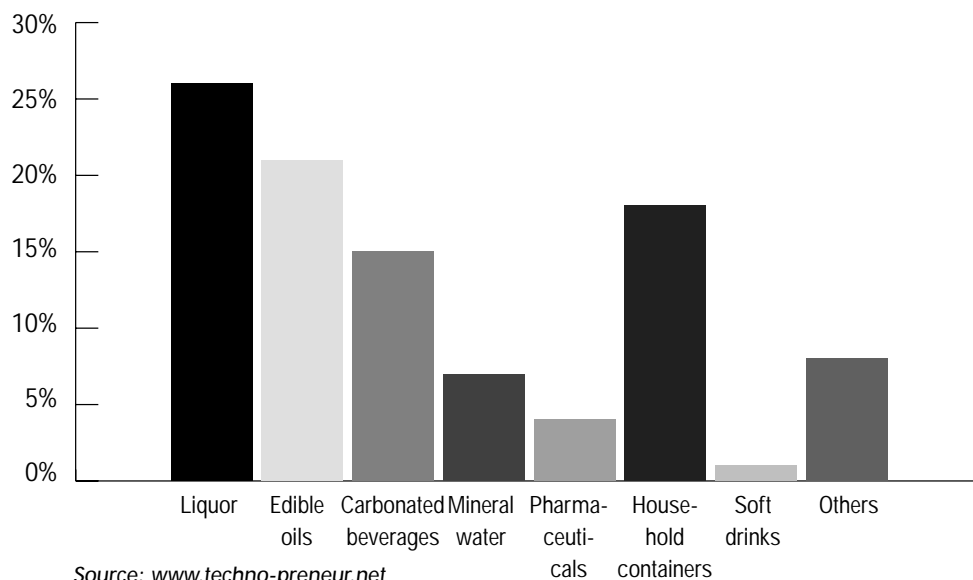
A major chunk of the containers manufactured from PET become permanent assets with the consumers because of the durability and glass like quality of PET.

Annual usage of PET in India is approxi-

mately 40,000 tons. Almost 25,000 tons goes into manufacturing assorted containers. Hence annually nearly 15,000 tons are used for soft drinks, liquor bottles and mineral water bottles. The total collection of PET bottles from Delhi and adjoining areas is approximately 400 tons per month i.e. 4,800 tons per year.¹⁴ The percentage of collection of PET bottles from Delhi and adjoining area is about 32 per cent.

These PET bottles are then recycled. PET manufacturers and users in India, which is expected to look into the organized collection and recycling of PET bottles and container waste, have formed a National Association of PET industry for the same purpose.

Figure 8. Projection of end use of PET bottles percentage wise in India



Bottles

Mostly two kinds of PET beverage (soft drink) bottles are available.

- A two piece container with a HDPE cap
- One piece container

The two bottles differ in their resin com-

Table 22. PET Bottle Composition¹⁵

| Plastic | Two Piece Bottle 2 Litre (gms) | One piece Bottle 2 Litre (gms) |
|----------|-----------------------------------|-----------------------------------|
| PET | 47-50 | 54-58 |
| HDPE | 19.5 | |
| Total | 66.5-69.5 | 54-58 |
| HDPE (%) | 29 | |

position. A one-piece bottle requires stiffer PET resin having higher intrinsic viscosity for its production using blow molding as compared to two-piece bottle. PET recycling operations are usually designed based on these bottle specifications.

Apart from resin specifications the nature of bottle closure also varies. In some bottles Aluminium metal roll on closures having weight around 1.5g are used. They are now replaced with PP plastic closures. The liner in the closure consists of Ethyl Vinyl Acetate (EVA) copolymer as base material. All PET bottles use labels that are made of either paper or have a plastic base.

Use of PET bottles

PET has virtually replaced glass bottles in soft drink applications. PET bottles are also used for liquid, food, toiletries, cosmetics, medical and health products. These non beverage bottle markets are growing rapidly.

PET films

Polyester film is manufactured by extruding film grade PET resins and subjecting it to biaxial orientation. In comparison to other packaging material polyester film offers the advantage of high strength (thereby permitting use of lower thickness), transparency, gas and aroma barrier (thereby extending product shelf life) and better printability and gloss.

PET films are available in a variety of

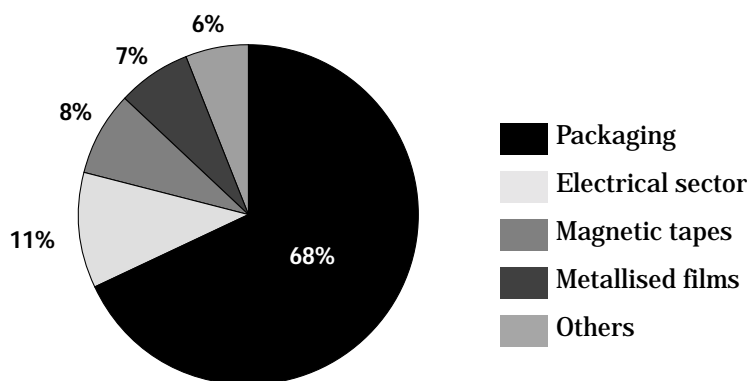
Table 23. PET used by non-beverage bottle market

| Year | Quantity in tons |
|------|-----------------------|
| 1988 | 96 X 10 ³ |
| 1990 | 152 X 10 ³ |

¹⁴ Data from Indian Organics Chemicals Limited

¹⁵ Recycling and plastics waste management, 1997, pg 317

Figure 9. Estimated sector-wise demand for PET films in 1999-2000



Source: www.techno-preneur.net

grades suitable for:

- Packaging
- Photographic and X-ray film, and as
- Magnetic recording film used in video and computers as recording tapes

Chief application areas include processed foods, pan masala, photographic and X-ray films and magnetic tapes.

Market

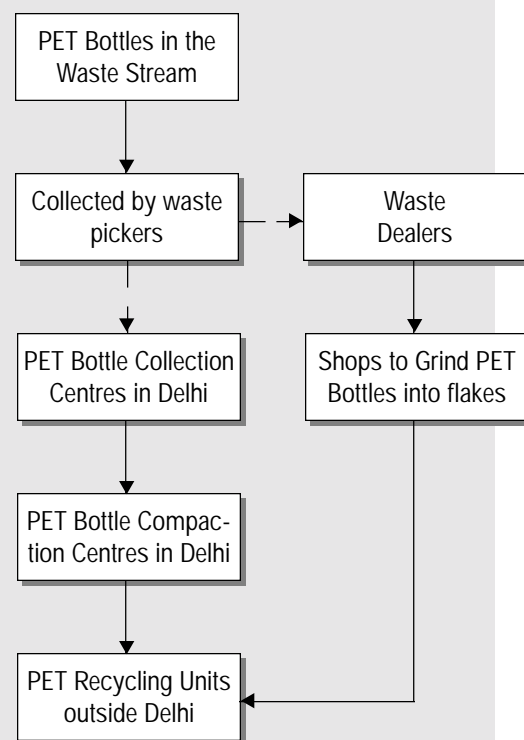
The consumption of polyester film during 1994-95 was 21000 tons assuming a 23per cent compounded annual growth rate.

PET bottle recycling in Delhi

While interviewing the waste pickers it was found that they even collected PET bottles amongst various other things. Following the chain from the waste pickers to the waste dealers etc. it was found that there are no PET recycling units in Delhi. PET was being collected, compacted and transported to other recycling units located in Mumbai and Chennai.

There were various collection centres where PET bottles were collected. In Delhi, Indian Organic Chemicals Ltd. mobilized the waste pickers so that they collect PET bottles in and around Delhi. The waste pickers in each area usually form a group and choose a group leader from amongst them. They are being paid Rs 5 per Kg of PET bottles sold. The PET bottle caps, which are made from HDPE are sold by the waste pickers for Rs 14-15/Kg. The collection centres are open from 9a.m to 9p.m. It was noticed that better quality material was supplied during the day-

PET bottle recycling in Delhi



time as the waste can be checked in the daylight.

Problems faced by the owners of the collection centres

Often the waste pickers increase the weight of the PET bottles by introducing sand, water etc. into it. At night quality assessment of the material becomes all the more difficult. Daytime loss due to increase in the weight is about 15per cent whereas at night the loss is doubled to almost 30per cent.

The bottles collected are then taken to the different compaction units.

The compaction units are located at:

- Delhi
- Ahmedabad
- Jaipur
- Indore &
- Mumbai

The compaction unit visited was at Nagloi. Here the bottles were sorted once again. The compaction machine is of 30 HP costing Rs 8-10 lacs. About 25-30 kgs of PET bottles can be compacted in it at a time into cubical bales of dimensions about 1foot. The total time taken for the bottles to be compacted is about

Table 23a. Collection Centres – PET Bottle Scrap – Phase I

| Region | City | No of collection Centres | | | Expected* PET Scrap (MT/Month Water & Beverage) * Depending on Season | |
|---------|-----------|--------------------------|-------------------|-------------------|---|-------------------|
| | | Existing | Add | Total | Existing | Total |
| | | as on 31.03.01 | as on 31.03.02 | as on 31.03.02 | as on 31.03.01 | as on 31.03.02 |
| North | Delhi | 2 | 3 | 5 | 300-450 | 450-600 |
| | Kanpur | 0 | 1 | 1 | | 50 |
| East | Kolkata | 0 | 1 | 1 | | 50 |
| South | Chennai | 1 | 1 | 2 | 25 | 50 |
| | Bangalore | 0 | 1 | 1 | | 50 |
| | Hyderabad | 0 | 1 | 1 | | 50 |
| West | Mumbai | 2 | 1 | 3 | 200-350 | 300-450 |
| | Goa | 0 | 1 | 1 | | 50 |
| | Ahmedabad | 1 | 1 | 2 | 25 | 50 |
| | Jaipur | 1 | 1 | 2 | 25 | 50 |
| Central | Indore | 1 | 1 | 2 | 25 | 50 |
| Total | | 8 | 12 | 20 | 600-800 | 1,200-1,500 |

Table 23b. Collection Centres – PET Bottle Scrap – Phase II

| Region City | Expected Additional Qty (MT/Month) |
|---|--|
| North Lucknow, Allahabad, Haridwar, Agra, Shimla, Chandigarh, Varanasi | 200 |
| East Bhuvaneshwar, Ranchi, Patna | 200 |
| South Pondicherry, Thiruvananthapuram, Tirupati, Mysore | 100 |
| West Baroda, Udaipur, Jodhpur | 100 |
| Central Bhopal, Nagpur | 100 |
| Total | 700 |

Source: Data on Tables 23a and 23b, and on
Table 24 provided by IOCL

90 seconds. After compaction the bottles are then transported to the recycling units.

A survey was conducted at Futura Polymers Ltd., which is a subsidiary of Indian Organic Chemicals Ltd. located at Manali Industrial Estate to the North of Chennai city. Here PET is being recycled. Established in the late 80's the plant has been importing PET waste from various parts of the world and converting it into PET flakes, which are then either mixed with other plastic waste and made into pellets or used for plastic applications in other areas. In the past few years the plant has been handling PET waste from various parts of India as well. The plant handles a combined load of about 1000 tons/day (600 tons imported and 400 tons Indian).

The Process

First the bales are separated into individual bottles and subjected to hot water treatment. The crushed bottles regain their original size and are then sent for manual separation. The workers working along a con-

Table 24. Present Recycling Capacity

| Recycler | Location | State | Capacity (MT/Yr) |
|------------------|------------|----------------------|------------------|
| Daga Fibres | Silvassa | Dadra & Nagar Haveli | NA |
| IOCL | Chennai | Tamil Nadu | 36,000 |
| Viral Filaments | Bharuch | Gujarat | 20,000 |
| Sharc Star | Coimbatore | Tamil Nadu | 12,000 |
| Maskara Fibres | Nasik | Maharashtra | 6,000 |
| Arora Fibres | Silvassa | Dadra & Nagar Haveli | 6,000 |
| Ganesh Polytex | Kanpur | UP | 6,000 |
| Gareware | Mumbai | Maharashtra | 4,000 |
| Padmini Polimers | Sahibabad | UP | 3,000 |
| Nirmal Fibres | Moradabad | UP | 2,000 |
| Total | | | 91,000 |

veyor system separate the bottles that are unclean (oil stained, fluids remaining inside the bottles etc.) and these are then again sent back for cleaning.

Next the clean bottles are crushed. After crushing a simple flotation process is employed to separate the bottle caps, neck and other polyethylene material, as well as external brand labels if any. Based on the level of contamination of the batch, either caustic soda or detergent is used to clean and disinfect. Further washing, both manual and mechanical is undertaken and then magnetic separation is used to separate the foreign particles. The batch is then finally crushed into raw flakes.

Expanded Polystyrene

While conducting the surveys, a huge amount of 'thermocole' waste was noticed piled up outside factories. Curious we probed further to discover that 'thermocole' as it is commonly known in India is actually EPS. EPS is the abbreviation used for both Expandable Polystyrene or EPS resin and Expanded Polystyrene, which is the finished product. In the world market the finished product is referred to as Polystyrene foam.

Polystyrene is made from two chemicals extracted from oil, ethylene and benzene. These are then combined to make molecules of styrene. By polymerisation thousands of small styrene monomers unite to form large molecules of polystyrene.

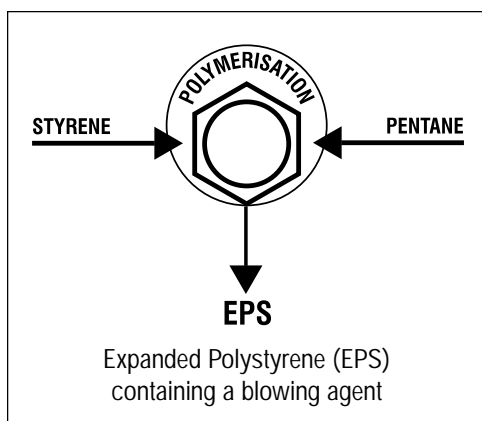
Chemical formula: $C_6H_5CH=CH_2$

EPS resins are made from polystyrene and pentane.

EPS is one of the most versatile and cost effective packaging material available. The advantages being:

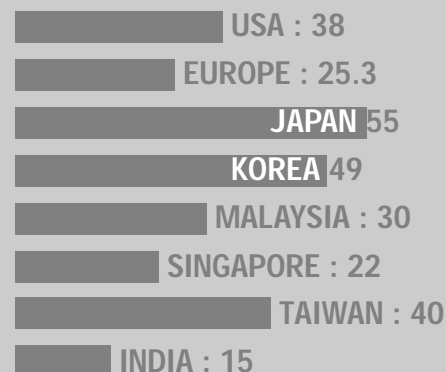
- Lightweight as it is 98per cent air
- Shock absorbing
- Highly Protective
- Durable
- Thermally insulating
- Inert
- Moisture resistant

As EPS is voluminous containing 98per cent air and is white in color it is highly visible. EPS waste is not aesthetically pleasant and occupies large space. Hence there is a need to recycle used EPS through mechanical recycling.



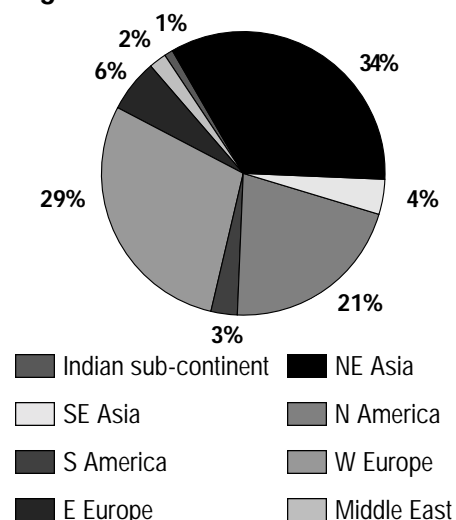
International Usage of EPS and Recycling

Figure 10. Recycling rate worldwide year 1999



Source: AMEPS, 2000

Figure 11. World EPS Demand



European Data

Table 25. EPS Recycling Data (1999)

| | |
|----------------|---------|
| Recovered | 70.5 Tm |
| Recycled | 50.0 Tm |
| Recovery Rate | 35.8 % |
| Recycling Rate | 25.3 % |

Source: EUMEPS Report 9=11 Oct 2000, Penang

Asian Data

| Country | Production (MT) 1999 | Recycling Percentage 1999 |
|-------------|----------------------|---------------------------|
| Australia | 22,000 | 15 |
| China | 5,20,000 | 64 |
| Hong Kong | 54-72,000 | 5 |
| Japan | 2,12,000 | 55 |
| Korea | 1,74,426 | 49 |
| Malaysia | 23,000 | 30 |
| Philippines | 7,000 | 15 |
| Singapore | 8,350 | 22 |
| Taiwan | 36,000 | 40 |
| Thailand | 24,000 | 5 |

Source: AMEPS Report, 6 May, New Delhi

Indian Scenario

Total current demand for EPS in India is 23,000 MT. Out of this, a substantial amount – about 45 per cent (10,350 MT) – is used for insulation. EPS used in the packaging industry is 55 per cent (12,650 MT). Recycling rate is about 15 per cent of the packaging usage.¹⁶

Recycling of EPS

In the course of the study it was realized that in Delhi there is a great demand for EPS packaging waste for recycling. As EPS waste is voluminous it occupies a lot of space and proves to be a problem. Hence the EPS manufacturers are very keen to get rid of the waste from their factory premises. Some quantities of the EPS waste are grounded by the manufacturers into small pieces and mixed with the fresh EPS as a partial or direct substitute for the virgin polymer for the production of loosefill packing or for new EPS mouldings. Recyclers in the informal sector using low cost and very crude technology recycle all other waste.

Most often the recycling unit owners get the waste free of cost from the factories. In these units the EPS waste are cut into straight slabs of a fixed dimension in a cutting machine. In the process the cut pieces that are produced, are then taken away by the kabariwallas to be sold in mostly to brick kiln industries. Here these small pieces are mixed

with other combustible waste and burnt to produce energy. Heavily soiled packaging are collected by rag pickers and sold to brick making factories directly. The heat release value of EPS waste is 9,600 kcal/kg, which is thermally equivalent to 1.2-1.4 litres of fuel oil, depending on the density and calorific value of oil. Once cut very rudimentary technology is used to melt the EPS. There are bhattis or earthen kilns for this purpose. Into these earthen kiln the EPS sheets are put from the top. The fuel used is firewood. To melt 100 Kgs of EPS about 20 Kgs of firewood is required. The molten EPS in the form of a mass comes out from the bottom of the kiln. According to the unit owners about 10 per cent of the EPS is converted to gas and the remaining is melted down. The molten EPS mass is of three qualities; white, brown and black which are then grounded into small bits and sold to plastic recycling units in and around Delhi for Rs14/Kg, Rs 12/Kg and Rs 6/Kg respectively. The best quality is the white followed by brown and black. The plastic recycling unit owners on their part re use the molten EPS in the production of non foam applications by mixing it with plastics waste to make plastic stationary products, video and CD cases, coat hangers, etc.

16 Personal interview with President of Expanded Polystyrene Recycling Association of India (EPSRAI).

Figure 12. India, Business Dimension of EPS

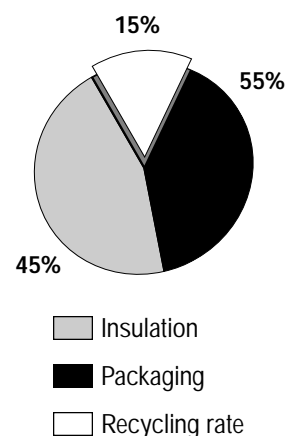


Figure 13. Cutting machine

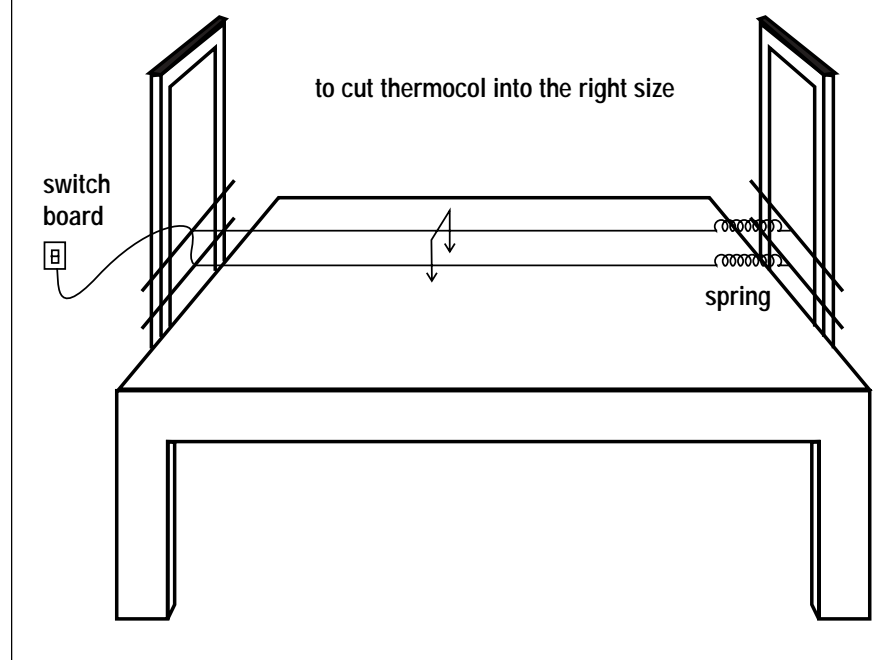


Figure 14. Bhatti used for EPS melting

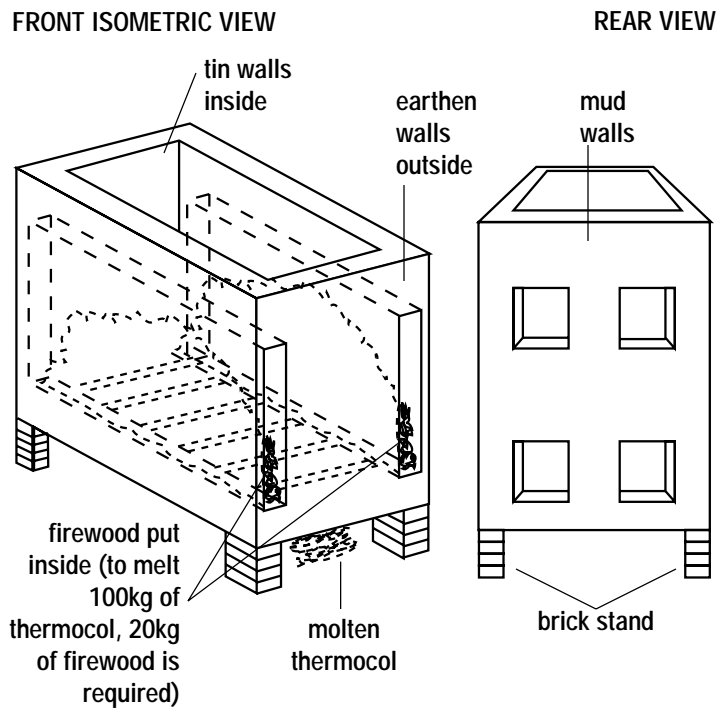
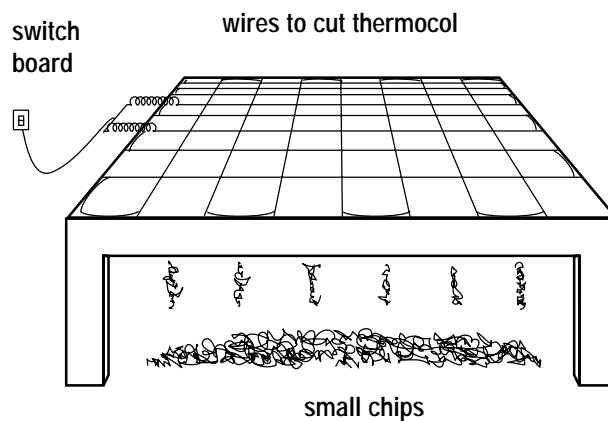
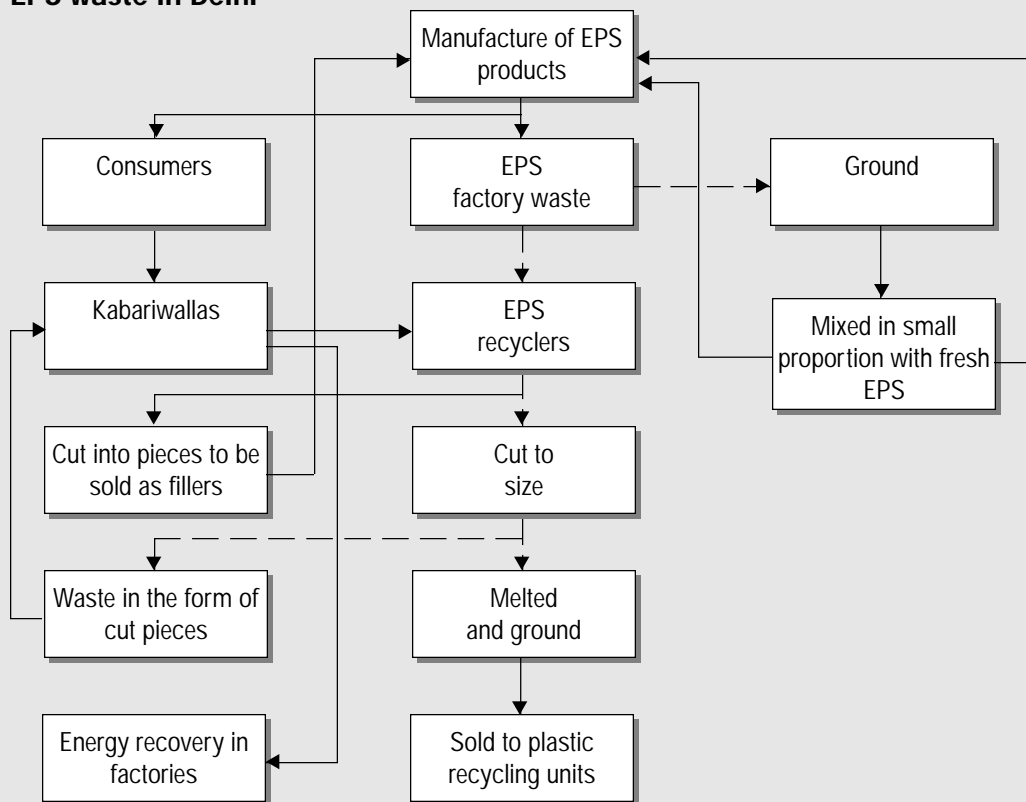


Figure 15. Chips machine



EPS waste in Delhi



Aluminium

Aluminium occurs naturally and makes up about 8 per cent of the surface of the earth. It is always found combined with other elements such as oxygen, silicon, and fluorine.

Aluminium metal is silver-white and flexible. It is often used in cooking utensils, containers such as beverage cans, foils, appliances, and building materials. It is also used in paints and fireworks; to produce glass, rubber, and ceramics; and in consumer products such as antacids, astringents, buffered aspirin, food additives, and antiperspirants.

Recycling of Aluminium

Aluminium can be repeatedly recycled into the same or other products with effectively no deterioration in quality or in the metal's intrinsic value. Recycling Aluminium only requires about 5 per cent of the energy required to produce primary metal. This makes Aluminium one of the most recyclable of all materials. **In fact, recycling of Aluminium has proven economically so valuable that recovery and recycling has become its own industry, and success.**

Worldwide, recycled metal contributes to 25 per cent of the total metal produced. By 2003, the ratio will be 30 per cent and many countries are making recycling mandatory. In Delhi, recycling is carried out in small, highly polluting units, under hazardous conditions to produce degraded metal of poor quality. Elsewhere in the world, recycling is a medium to large scale (25,000 - 200,000 tpa) industry, sophisticated and high-tech.

With increasing consumption of Aluminium in India, the country is expected to be a net importer of the metal by the turn of the century. Hence, the Working Group on Non-Ferrous Metals for the ninth five year plan has strongly recommended encouragement of recycling as it is estimated that about 25,000 tonnes of sheet applications and 40,000 tonnes of extrusion applications can be better served by recycled Aluminium metal.

Aluminium cans are so far the most valuable component in the consumer waste stream that can be successfully recycled. With the cost price of used Aluminium cans being Rs 45-50/Kg and the selling price of ingots Rs 100/Kg Aluminium can recycling has the potential to become the backbone of municipal and private recycling programme in India. The price can fluctuate with the com-

modity price for new Aluminium, but Aluminium can scrap has always had a strong price in comparison to other recyclables.

Aluminium recycling is just not about cans

While cans are the most visible part of the Aluminium recycling story, they are far from the whole story. During the survey conducted to acquire information related to can recycling it was found that Aluminium dust mostly from factories and dust of Aluminium utensils were also recycled using the same technology to recycle cans.

Recycling Process

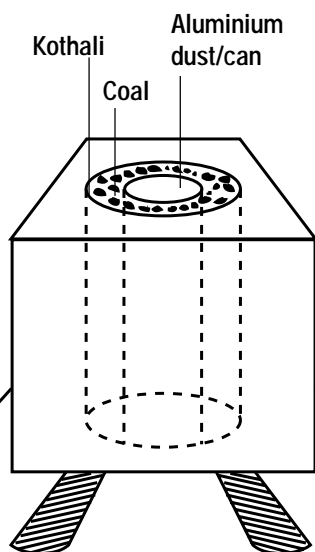
The bhatti or furnace is used to melt the Aluminium dust (utensils grounded or factory waste) or Aluminium UBC (used beverage cans). The furnace may be of three types:

- Coal furnace
- Oil furnace
- Electric furnace (not looked into)

In the coal furnaces, at a time 10-15 Kgs of Aluminium dust or cans can be melted. Aluminium melts at 660.24 °C and blends with the molten material already in the furnace. The time taken to melt is 1 hr. In the oil furnace 300 Kgs can be melted at a time in 2-3 hrs. The oil furnace has certain advantages over coal furnace. It takes less time to melt the Aluminium. In the oil furnace there is less smoke emission. More quantity of Aluminium can be melted in an oil furnace than in a coal furnace.

To melt the Aluminium in the oil furnace atmospheric air is blown with the help of a blower to which there is attached a motor of 3 HP. At the base of the furnace the oil and the air is mixed and ignited so as to provide good flame. The oil used is called LDO and is purchased for Rs 9/Kg. In the coal furnace to melt 150 Kgs of Aluminium 50-60Kgs of coal is required in a day. The coal furnace is double chambered. In the outer chamber coal is placed and in the inner chamber the Aluminium cans are placed. When the Aluminium melts it is checked for proper chemistry (usually depends on the know how of the workers who have learnt it through experience) and then it is scooped out with the help of long iron spoons and put inside moulds that cast sheet ingots. Ammonium Chloride/Zinc dust is added which acts as a grain refiner or flux to clean the molten Aluminium by separating out any oxides (dross) that are skimmed

Figure 16. Coal furnace used for Aluminium recycling



off. The amount of dross generated is about 200Kgs /ton of molten Aluminium. In 150 Kgs of Aluminium 150 gm of Ammonium Chloride/ Zinc dust is put. The dirt in the molten Aluminium comes to the surface. It is then scooped out and disposed off. The molten Aluminium cools to form ingots. In some units only ingots are manufactured while in some the slabs are made into sheets. These slabs are then put into **hot rolling machine**. From there they are taken out with the help of pincers and put into **cold rolling machine**. Then they are put in the **shearing machine** where they are flattened out into sheets. The sheet is passed through a few more times until it is about 1/2 an inch (1.25 Cm) thick. This long sheet is then annealed to soften it and passed to a series of rollers in a finishing mill where it acquires

the necessary hardness and thickness. The edges are trimmed in a slitter and the coil is rolled up for transportation to a can manufacturer. Sometimes the sheets are put through a **cutting machine** to be cut into circular shapes as per requirement.

Quantity Recovered

From cans: Quantity of Aluminium recovered is almost 85 per cent. The paint vapourises.

From dust (grounded utensil or factory waste): Depending on the quality of the waste 10-40 Sper cent may be recovered.

Cost and Selling Price

Cost Price of Aluminium dust: Price varies from Rs 5-40/Kg depending on quality.

Selling Price of ingots: Rs 45-90/Kg

Selling Price of Aluminium Sheets (cut in circular shape): Rs 85/Kg

Cost Price of Aluminium cans: Rs 55-60/Kg

Selling Price of ingots: Rs 100/Kg

Table 26. Recycling units surveyed

| Kind of waste handled | Equipments and operations for recycling | Time duration of operation of each machine (hrs) | Final output | Method of storage of recycled product | Waste generated during recycling | Use if any of the waste |
|-----------------------|---|--|--------------|---------------------------------------|--|---|
| PP | Grinder | 8 | Pellets | Open Land | Plastic pieces, small leather pieces, Fe scrap | Plastic pieces sold at Rs 2/Kg to brick kiln industries for energy recovery Fe scrap also sold to kabariwallas |
| | Washing | 4 | | | | |
| | Mixer | 6 | | | | |
| | Extruder | 6 | | | | |
| PP | Grinder | 12 | Pellets | Open Land | Plastic pieces and iron pieces | Plastic pieces sold at Rs 2-3/Kg to brick kiln industries for energy recovery Fe scrap also sold to kabariwallas |
| | Washing | 4 | | | | |
| | Extruder | 12 | | | | |
| PP | Grinder | 6 | Pellets | Gunny bags | Plastic pieces and iron pieces | Plastic pieces sold at Rs 2-3/Kg to brick kiln industries for energy recovery Fe scrap also sold to kabariwalla |
| | Mixture | 6 | | | | |
| | Extruder | 6 | | | | |

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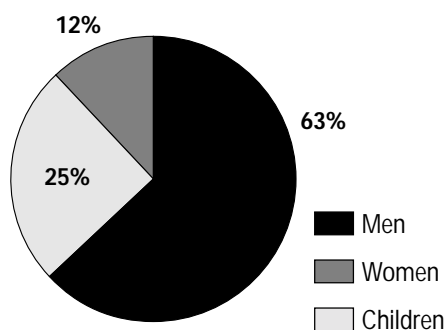
Table 26 (continued). Recycling units surveyed

| Kind of waste handled | Equipments and operations for recycling | Time duration of operation of each machine (hrs) | Final output | Method of storage of recycled product | Waste generated during recycling | Use if any of the waste |
|------------------------------|---|--|------------------|---------------------------------------|---|------------------------------|
| PP | Grinder/Agglomerator | 6 | Mugs, | Open Land | Needles. | Sold to kabariwallas |
| HD | Washing | 8 | buckets, | | Plastic pieces | |
| LD | Mixture | 12 | stools and | | | |
| | Extruder | 12 | containers | | | |
| HM | Shredder | 4 | Pellets & | Open Land | Waste plastic | Sold at Rs 2-3/Kg |
| | Washing | 4 | Carrybags | | materials | to brick kiln industries |
| | Mixture | 7 | | | | for energy recovery |
| | Extruder | 8 | | | | |
| Polybags | Extruder | 10 | Gulla | Open Land | | |
| Polybags | Extruder | 10-12 | Gulla | Open Land | Plastic waste | Extruded again with polybags |
| PVC | Grinder | 3 | Soles of | Gunny bags | Plastic gullas | Mixed and extruded again |
| | Mixture | 2 | chappal | | | |
| | Extruder | 3 | | | | |
| PVC | Grinder | 8 | Soles of | Gunny bags | Plastic gullas | Mixed and extruded again |
| | Mixture | 8 | chappal | | | |
| | Extruder | 8 | | | | |
| PET | Crushing | 8 | PET Flakes | Gunny bags | PP/HDPE caps, | Sold at rate of Rs 1-3 |
| | Washing | 8 | | | non PET containers | and recycled elsewhere |
| EPS | Furnace | 8 | Molten EPS | Stored within the unit | Cut pieces of EPS | Used as packing material |
| EPS | Furnace | 10 | Molten EPS | Stored within the unit | Cut pieces of EPS | Used as packing material |
| Aluminium cans and dust | Coal Furnace | 12 | Ingots | Stored within factory premises | Fine Al particles and scum from the molten Al | Dumped on the road side |
| Aluminium cans and dust | Coal Furnace | 14 | Ingots | Stored within factory premises | Fine Al particles and scum from the molten Al | Dumped on the road side |
| Aluminium pieces and Al cans | Coal Furnace | 12 | Aluminium sheets | Stored within factory premises | Fine Al particles and scum from the molten Al | Dumped on the road side |
| | Hot Rolling Machine | 6 | | | | |
| | Cold Rolling Machine | 6 | | | | |
| | Shearing Machine | 5 | | | | |
| | Cutting Machine | 5 | | | | |
| Aluminium cans | Oil Furnace | 7 | Aluminium sheets | Stored within factory premises | Fine Al particles and scum from the molten Al | Dumped on the road side |
| | Hot Rolling Machine | 7 | | | | |
| | Cold Rolling Machine | 7 | | | | |
| | Cutting Machine | 4 | | | | |
| Aluminium cans and dust | Coal Furnace | 8 | Aluminium sheets | Stored within factory premises | Fine Al particles and scum from the molten Al | Dumped on the road side |
| | Hot Rolling Machine | 7 | | | | |

Workers and working conditions

The absorption of labor in the recycling units varies from 4 in small units in the unorganized sector to 120 in large PET recycling unit. Though the units employ male, female and children the proportion of male labor is much higher than that of female or child laborers. The workers have no technical qualification, however, through experience they know how to regulate the temperature, segregation of plastic, etc.

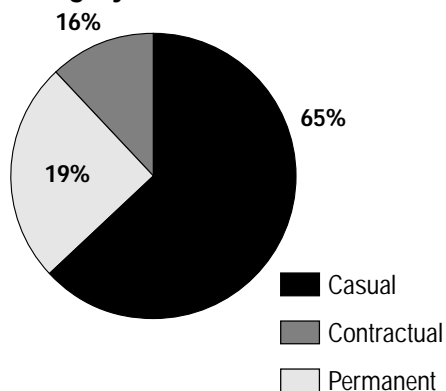
Figure 17. Percentage of men, women and children working in recycling units surveyed



The terms of the payment are relative to the capacity of the units in handling the waste. The workers are mostly casual. A few units have permanent and contractual workers.

Most of them are underpaid. Only large recycling units covered by the Factories Act, 1948 offer more favorable employment terms. The mode of payment is monthly for both contractual and permanent workers. Where casual workers are employed they are paid on daily basis. They receive about Rs 100-120 per day. Only in the unit manufacturing HM carry bags they are paid

Figure 18. Percentage of each category of workers in the units



by the quantity of carry bags (Kgs of carry bags) manufactured.

In one unit recycling plastics waste a child worker revealed that he was not paid. However, he earned some money by selling metal and other scrap segregated from the waste. While most units pay for overtime to the male workers who work on the machines, the female workers who do mostly the sorting are not paid any overtime.

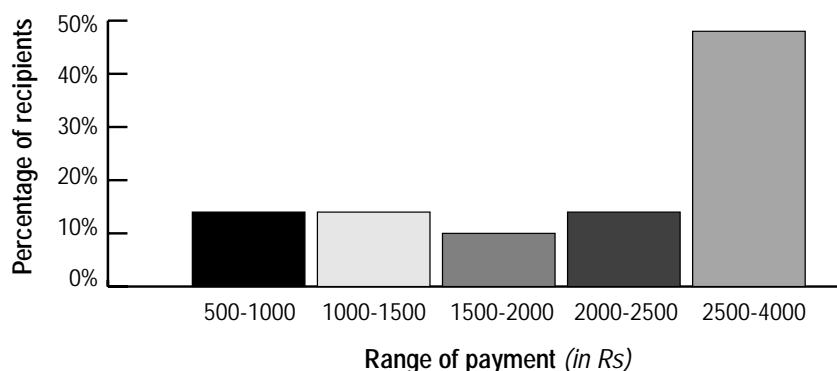
Most of the workers come from adjoining areas. There are some units in Narela, which even after relocation has still retained their permanent workers. However, for the majority of the workers relocation has meant loss of livelihood. These workers usually come from far-flung areas. Due to closure of many recycling units the casual workers are readily available and are prepared to work at low wages.

Generally adult males are employed in mechanized production. They work on machines, which, includes grinders, sinks, water removing centrifuge, mixer, extruders, cooling water system cutting machine etc. Some of them also help in loading and unloading the waste material or the finished products. Female workers are preferred in manual production activities. They are engaged in segregating waste manually or in cleaning of the waste. Child workers (usually in the age group of 10-16 years) either work with the female workers or help in loading/unloading and transferring the material from one machine to other or to the tempos to be carried away. Most of the workers work for 10-12 hrs everyday with infrequent breaks, sometimes with minimal access to food or water, under tremendous heat, polluted and toxic air, often with noisy machinery.

The respondents spoke about the terrible working conditions and the poor pay they receive. They however have little faith in their ability to bring about improvements, as they do not have unions or leaders to represent their problems to the management.

The workers are not provided with any protective gear like gloves masks etc. while working. It has been noticed in one unit that women workers cover their noses while segregating. In case of any illness, cuts or injuries usually the owner of the unit provides medical aid. Though the recycling units are spacious yet most of them are poorly ventilated. In most units the exhaust fans either do not work or are not used.

Figure 19. Payscales received



Occupational Health Hazards of Plastics Recycling

The following description is based on preliminary observation; interaction with the workers of the recycling units, and on secondary information collected through research.

Safety Hazards

Regarding machinery safety there are some issues, which are common to all or most of these machines whereas other requirements are more machine specific. The information provided is based on existing machines used in recycling units.

Common Issues

Usually most of the machines used in recycling are by and large fabricated in local workshops, in all probability from second hand or discarded machinery parts. They have bare minimum parts. The unit owners themselves are not aware of the manufacturing date of the machine. The electrical wiring connecting the machines in most units are exposed without any casing. This can prove to be very dangerous. Two recycling units reported fire accident caused due to short circuit.

Feed/Discharge openings: There are chances of accidents occurring at the feed openings and the discharge points to and from dangerous parts of machines (these may be rotors, blades, screws etc.)

Film Feeding: In recycling units where thin films of plastic are being recycled there is a chance of the operator getting entangled in the plastic film while feeding them and be drawn forcibly against the machine. This may be prevented if the film is fed in after pre shredding it. Compacting it also reduces its volume and minimizes risk of entanglement.

Ejection of metal scraps: Often metal scraps are mixed in the plastic waste. During machine operation at times such metal pieces eject out of the machines with great speed when they come in contact with high speed blades, cutter etc. The workers are at a great risk to be injured when the material eject out of the openings with high velocity. This can be avoided if hand sorting is done carefully or if metal detectors can be used.

Ejection of Process materials: Sometimes there is a risk of the process materials flying out of the openings. These materials

are ejected at high velocity. This poses a great risk to the workers working near such machines. This may be avoided if screens are used or flaps to cover the openings of machines are used so as to prevent the workers from getting struck.

Emergency Stops: In spite of taking all the necessary precautions sometimes the machinery does not function properly. Hence emergency stops should be present with easy access from operating positions. These emergency stops will end all dangerous operations so that positive resetting of the machine parts can be done.

Maintenance: For any machinery to work efficiently proper maintenance is an absolute necessary. Where the maintenance work involves access into the machine then care should be taken that the power is shut off properly. The maintenance should be done only after all machine operations ceases completely. Prior information should be given to all the staff that machines are being maintained so that no accidents are caused due to negligence.

Hazards related to specific machines used

Granulators: Again, there are chances of accidents occurring during blade changing and clearing of blockages in granulators. Workers in three recycling units reported that such accidents were quite frequent. Therefore, the workers should be educated and care taken that the moving rotor is stopped before such procedures.

Agglomerators/crumblers: The feed opening should be positioned at least 1 m above the blades to minimize chances of accidents occurring. The working platform should be at least 1.1m below the level of the feed opening so that it becomes easier for the workers to operate the machines. The feed opening should be central to the lid.

Shredders: There are chances that the operators over and trip onto the dangerous parts of the machines. The working platform should be at least 1.2m below the level of feed opening to prevent accidents. There are chances of accidents if the workers use his/her hands or feet to apply downward thrust on the feed material. Such unsafe practices should be avoided at all cost.

Extruders: Many parts of the extruders are very hot when functional. To prevent burn injuries these parts should be properly insulated.

lated. There is also a risk of molten plastics being ejected from the machine. Impact grade face and hand protection (suitable for heat, cuts, puncture and chemicals) should be provided and worn.

Hazards Related to Material Handling and Unsafe Access to materials

A number of accidents at work place may be avoided if materials are handled properly with due care and if they are stored safely.

Loading and unloading: Before unloading of waste material care should be taken that the waste material are in a stable/secure position on the vehicle so that the waste doesn't topple over and cause accident. Again, recycled dana or finished product should be loaded properly into the vehicle used for transportation.

Precautions during storage: During storage itself unnecessary contaminants eg metals, cans, boxes etc. in the delivered waste material should be removed. The waste material should be properly stacked. To ensure stability the stacks should be built on firm level ground and its height should be limited. There should be adequate spacing between the stacks. When the waste is in the form of loose material it should be either piled in a corner, which is less frequented or transferred into appropriate storage bins and stored. Polyethylene bottles are sometimes tied up and stored. These bottles expand considerably when exposed to sunlight. This may lead to bales breaking up. The risk is less if the bottles are crushed or punctured and the lids removed before storage.

Fire accidents: It is very difficult to extinguish fires as it spreads rapidly in plastics. Black acrid fumes and smoke are generated along with noxious gases. Therefore certain precautions should be taken. Smoking should be prohibited in plastic recycling units. Easily ignitable material like paper should be removed. Electric wiring should be properly insulated and regular checking should be conducted for safety purpose.

Breaking of Bales: In case of waste, which is stored in bales there are chances of these breaking up suddenly when the straps are removed. Care should be taken while cutting open these straps as they may fly apart and pose a hazard to the face and eyes. If the bales are opened with long bolt cutters at arms length then the risks are reduced.

Work done at a height: For all work done

at a height safe access and suitable protection against falling is required. Ladders with safe working platforms attached to them should be used whether for routine or maintenance jobs.

Health and Hygiene Hazards during recycling process

There are many physical hazards, given the nature of crude technology used in the recycling sector. Improper ventilation increases the susceptibility to exposure to noxious gases. Again, continuous exposure to high noise level, heat and lack of fresh air can cause fatigue and over a period of time reduce the immunity levels. Probability of accidents is very high under such circumstances.

Noise: Most machine operations involving grinding, extrusion etc. generates a lot of noise. As a thumb rule, if normal conversation in work place cannot be clearly heard when one is 2 meter away from the speaker then the noise level is likely to be around 85 dB(A) or higher. If a person cannot be heard clearly at a distance of 1 m, the level is likely to be 90 dB(A) or higher. In the units visited the noisy machines identified are the granulators, agglomerators or crumblers and the extruders. Amongst these the granulators are the most noisy, with some emitting well over 100 dB(A). Agglomerators usually exceed 90 dB(A) and extruders 85 dB(A).

A worker's noise exposure averages over an 8 hour working period or more, in case of overtime. Some of these workers are more susceptible to hearing loss than others and so risk of hearing loss or impairment from noise generated in recycling units cannot be eliminated.

Exposure to high noise level daily and over a number of years can cause incurable hearing damage. The noise at work can cause other problems like disturbance, irritation, and interference with communication and stress.

The Noise at Work Regulations 1989 is intended to reduce work related hearing damage and states the procedures by which this may be achieved. Three action levels are mentioned. These action levels are:

- "the first action level" means a daily personal noise exposure of 85 dB(A);
- "the peak action level" means a level of peak sound pressure of 200 pascals;
- "the second action level" means a daily personal noise exposure of 90 dB(A).

Duties of employers of recycling units

If the noise levels are at 85dB(A) or above

- The risk is to be assessed by a competent person
- The workers have to be told about the risks and precautions and
- Make hearing protection freely available to those who want it

If the noise levels are at 90dB(A) or above

- Everything has to be done that is reasonably practicable to reduce exposure without relying on hearing protection and
- Signs to be used to identify these areas and require the staff to wear hearing protection when working inside them

However, in all the recycling units visited it was observed that the employers provided none of the workers with any hearing aids nor were they told of the risks of high noise level in the work areas and precautions. Signs used to identify noisy areas were not noticed anywhere not even in the recycling units visited in the organized formal sector. The unit owners had special air conditioned chambers which were more or less sound proof. They are either not aware of this problem or simply not interested in the welfare of the workers.

Cleaning: The cleaning operation requires the worker to soak his or her hand in water for a period of 6 to 8 hrs daily. For cleaning purpose mostly caustic soda or other cheap detergents are used. The workers are not provided with any gloves and do not use any during the cleaning operation.

The usual result of continuous and excessive exposure of the skin to detergents is drying, fissuring and dotting of the keratin layer leading to increased permeability that causes sensitisation, which may develop into dermatitis. Women workers who are involved in the cleaning process are susceptible to infections that may lead to developing eczema. It was noticed that most of the women workers who were involved in the cleaning operation had drying and dotting of the keratin layer. A few women workers were also noticed to have eczema.

Some times there may be sharp objects attached to the plastics. At times waste ma-

terials may be contaminated with a variety of hazardous substances. These may be chemical residues, used syringes, pesticides etc. During cleaning and drying process cuts and injuries are routine. The unit owners in such cases usually provide first aid but workers are not given tetanus injections. The workers may be protected from chemical, biological, and other hazards while cleaning waste by using suitable personal protective equipment like gloves, eye protection and impervious aprons none of which are provided by the employers.

Machine Operation

Granulators: During the grinding operation major products are RPM (Respirable Particulate Matter) and SPM (Suspended Particulate Matter). Smoke arising during the grinding process comprises of dust and ash. Particles of size above 10 micron do not enter human breath. If the size of the particle is in the range of 5 to 10 micron then it is retained in the upper respiratory tract. Particles less than 5 microns, known as respirable particulate matter reach lungs. These may cause upper respiratory tract ailments. The workers in the units are subjected to this high concentration of SPM and RPM in the air they breathe. Some of the workers complained of cough and asthma problems. However, due to time constrain, no air quality monitoring was conducted in any of the reprocessing units visited.

Mixer: In the mixer, to the cut and dried plastic pieces the coloring agent (master batch, black carbon etc.) is added. There are two blades, which rotates with the help of a motor and mixes the color with the plastic.

Pigments in powder form or concentrated pigments known as masterbatch are used for coloring. Masterbatch is a capsule of concentrated colors with certain additives: Silicon Dioxide for uniformity and handling ease, dispersing agents like easter and waxes and coupling agents like salts of Silicon and Titanium. Most of the color pigments are complex organic compounds usually with a metal chelate, which accounts for the typical color. Metals present include Cadmium, Copper, Iron, Tin

| Color | Chemical Composition |
|----------------|-----------------------------|
| White | Titanium Oxide |
| Green and Blue | Thelocynine |
| Red | Scarlet City and Iron Oxide |
| Yellow | Benzandine |
| Black | Carbon |

etc.

If coloring in the form of powder is used then there is dispersion of powder elements. This possibility is reduced if master batch is used. Master batch is much expensive as compared to powdered color. So in most recycling units powdered form of color is used. Particulate matter chemically loaded due to heavy metal contamination, which originates from these pigments can affect pulmonary area of lung and in long run can result in fibrosis, fever and oedema¹⁷.

Extrusion: Volatile matter is generated at two levels: during normal processing at elevated temperature and during degradation at abnormally high temperature. All plastics are subjected to varied degree of degradation during normal reprocessing temperature. This is due to the presence of contaminants, additives and pigments, inappropriate temperature control and inferior type of machinery used. Depending upon the type of material, temperature and presence or absence of oxygen, the gaseous matter include: HC, HCN, NO_x, SO₂, CO, CO₂, HCHO and chlorinated gases in case of PVC¹⁸.

Breaker Plate burning: The contaminants filtered by breaker plate during the process of extrusion are removed by burning the plate at least once a day. Volatile products may contain saturated and unsaturated hydrocarbons in case of PE and PP; and hydrogen chloride, HC, colored tars and soot in case of PVC in addition to products of heating¹⁹.

Hazards of PVC Recycling

During the survey conducted we found that PVC, which is being used as soles of chappals are being recycled at Narela, Mongolpuri etc. PVC recycling means remelting and then reforming the used plastics. The complex combination of chemicals in plastics prevents its complete recovery as a single material resultant, the material recovered after melting is a low quality product that threatens to have more serious health consequences.

The whole process of recycling also emits a good amount of dioxin compound.

In Jwalapuri, Seemapuri and a few other areas, it was found that PVC coated copper and Aluminium wires were burnt to recover the metal. Burning of PVC emits dioxins, which are known carcinogens. Moreover PVC incineration creates hazardous waste in the form of residual salts from Hydrochloric acid

neutralization that needs to be disposed off in special landfills.

Dioxin and dioxin like compounds are extremely long lived in the environment and because they are fat soluble they concentrate on the humans and other species high on the food chain. Tiny doses of dioxins can interfere with the bodies hormone potentially causing a wide variety of effects on reproduction, child development, and the immune system, as well as cancer.

Problems related to Expanded Polystyrene Recycling

Fire and Explosion risks from pentane in Expanded Polystyrene

Raw expandable polystyrene beads contains a flammable gas usually pentane. Pentane is extremely flammable, its flash point is minus 50°C and boiling point 36°C. It is heavier than air and odourless making its detection all the more difficult. Pentane vapor can be given off from in house EPS waste. Hence it is advisable to store the waste in well ventilated storehouse. It has been observed in some of the EPS recycling units visited the waste is stored in the very place where recycling is happening. Hot work in the recycling units including grinding and cutting with power tools can provide a source of ignition. Residual heat from such hot works can even cause ignition sometime after the hot work has ceased.

This may be avoided by:

- Keeping the area clear of any thing that could catch fire
- The electrical wiring should be encased and regularly checked to prevent fire from short circuit
- It is a good practice to keep the area under observation for incipient fire for an hour or so after the work has finished

Despite taking these precautions the residual risks of fire still remains. So one must think of the implications of fire in advance and act accordingly.

Styrene Oligomers and the safety of Styrene polymers in contact with food

PS foams are used for hot beverage cups, egg cartons, meat trays, and preparation cups for instant foods such as noodles and soups. PS foam is approved for food use with aqueous acid or non-acid foods and beverages containing no fat or oils²⁰.

17 Murdoch, C.M., 'Toxicity of gases', 1993

18 Papaspyrides, 1996; Chanda and Roy, 1987; Williamson, 1992; Ingenieure, 1980; Mark, 1989

19 Crider and Holbrook, 1977

20 EPA Federal Register, December 14, 2000 (Volume 65, Number 241)

Likely Health Effects and hazards of Aluminium Recycling

A lot of dust is generated during the melting of Aluminium. The SPM concentration in the areas where Aluminium recycling is done is very high due to the dust generated during recycling process. After the reprocessing process the metal dust and dirt from the molten Aluminium is just dumped outside the premises of the units. One unit owner in Mandoli proudly stated how he helped in making the road outside his unit from Aluminium waste produced in his unit. As the workers of the recycling units visited are mostly contractual and casual hence no health studies could be conducted. However the common problems associated with Aluminium particles are as follows:

Aluminium particles deposited in the eye may cause local tissue destruction. Aluminium in aerosols has been referenced in studies involving Alzheimer's disease.

The American Council of Governmental Industrial Hygienists (ACGIH) recommends the need for five separate Threshold Limit Values (TLVs) for Aluminium, depending on its form (Aluminium metal dust, Aluminium pyro powders, Aluminium welding fumes, Aluminium soluble salts, and Aluminium alkyls). The Occupational Safety and Health Administration (OSHA) has also established Permissible Exposure Limits (PELs) for Aluminium.

Aluminium dust is strongly fibrogenic. Metallic Aluminium dust may cause nodular lung fibrosis, interstitial lung fibrosis, and emphysema as indicated in animal experimentation, and effects appear to be correlated to particle size of the dust.

Though Aluminium is stable under normal conditions of use, storage and transportation but molten Aluminium can react violently with water, rust certain metal oxides (oxides of copper, iron, lead) and nitrates (ammonium nitrate and fertilizers containing nitrate). So molten Aluminium should be handled with care.

Another hazard encountered in the Aluminium recycling sector is the hazard of molten Aluminium metal. 25 per cent of the workers working in these recycling units reported that small burn injuries were daily affair.

Owners of the recycling units and recycling enterprises

Recycling in Delhi is done both in the organized and unorganized sector. In terms of size (for both plastics and Aluminium) the range of the units extends from small, unregistered units to medium size labor-intensive small-scale industry to large modern automated factory (in case of PET recycling). All the units surveyed are located in Industrial Areas though not necessarily in Industrial Estates. All the recycling units utilize power. In the plastic reprocessing units the power is in the form of electricity while for Aluminium coal or oil is used to generate power. The capital investment for setting up the units varies from a few thousand rupees in case of expanded polystyrene recycling to crores of rupees (30 crores for PET recycling).

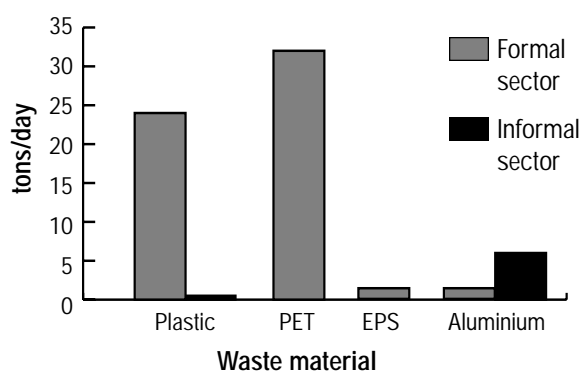
The production process in all the recycling units surveyed excepting PET is manual process. Only for reprocessing of PET there is high degree of automation.

The daily waste requirement varies from unit to unit depending on the capacity to reprocess the waste. For plastic waste it ranges between 500 kg in small recycling units in informal sector to 25 tons in bigger units in the organized sector. Survey revealed that PET recycling unit located at Chennai where recycling is semi automated recycles 30-32 tons/day. EPS units in Delhi recycle 750 Kgs to 1ton per day. Aluminium recycling units recycle about 1 ton of cans per day in the informal sector whereas in the formal sector 4-



| Material | Quantity of Waste handled (tons/day) | |
|-----------|--------------------------------------|-----------------|
| | Formal sector | Informal sector |
| Plastic | 25 | 0.5 |
| PET | 30-32 | NA |
| EPS | NA | 0.75-1 |
| Aluminium | 1 | 4-5 |

Figure 20. Quantity of waste handled



The figures mentioned are approximate values. There is day-to-day variance in the quantity of waste handled by each unit, which again depends on the market demand.

countries. Aluminium waste in the form of beverage cans are imported from Gulf countries particularly Dubai. Such imported waste finds their way into the waste markets in Delhi or directly to the importers who recycle the waste.

The quantum of utilization of the waste material is determined by the role played by the waste in the production process of the recycled product. Some units utilize only the waste, for example,

Aluminium recycling and recycling of polybags, etc, in others it constitutes only a proportion of the total raw material input. An example may be cited where for reprocessing waste plastic some unit owners mix it with virgin plastic materials. In the latter the quality of the recycled product is much better.

However, the selling price of the recycled product is less in the former. The selling price of the recycled product is directly proportional to the quality. The procurement price of the waste varies depending on the kind of waste, transportation cost, market demand of recycled product produced and terms of payment.

The recycled pellets produced by the plastic recycling units are sometimes intermediate products that constitutes the raw material for the end product usually consumer durables. The consumers of such products span the poor people of the rural and urban segment to the urban elite and other industries. The recycled products are either sold directly to shops or industries or to other consumers through distributors or wholesale market.

The minimum area occupied by each unit is about 200 sq mt. In the organized sector the units are enclosed with concrete walls and have proper gates as seen in Narela, Mongolpuri, Udyog Nagar and Jhilmil amongst the surveyed areas. Even in the unorganized sector the units are never located in within household premises as found in the survey. The constructed plastic recycling units vary between concrete buildings to house the office of the unit owner and recycle the waste and corrugated tin sheds to store and wash the waste. The Aluminium recycling mostly in the unorganized sector is done in the open as seen in the units visited at Mandoli and Badli. Such units are however enclosed by boundary walls.

The areas where the recycling units are located have very poor infrastructure, which according to all the unit owners affect production. Almost 90 per cent of the owners who have been relocated are not against relocation but are angry about the fact that the government has not provided suitable infrastructure in the areas where relocation has happened. There is no regular water supply and supply required for recycling is met through bore wells as seen in all the areas surveyed. Continuity of production is affected by transport problems, frequent power cuts, labor problem in areas where the recycling units have been relocated. The problem has been exacerbated by a lack of demand for the finished product which depends on price fluctuation of virgin material and inadequate supply of raw materials. Hence several units are not working to full capacity.

| Material | Market for waste purchase in Delhi |
|-----------|--|
| Plastics | Nandnagri, Mundka, Jwalapuri |
| EPS | Directly from manufacturers located at Okhla, Noida, Faridabad, Nangloi, Pitampura, Ballabgarh |
| PET | PET collection centres located at Nangloi, Mandoli, Seemapuri, Sarojini Nagar, East of Kailash |
| Aluminium | Seelampur, Sadar Bazar |

The unit owners are generally between 27 and 55 years old, Hindus. All of them are literate both in the organized as well as in the unorganized sector though none of them has any technical qualification. Two of the unit owners, one in Shahzadabad and the other in Narela were waste traders prior to their entry into the recycling trade. All the other unit owners have been in this trade for two generations. The unit owners of the organized sector are all very affluent people, making a profit of Rs 20,000-Rs 50,000/month from recycling depending on the quantity and kind of waste recycled. In the unorganized sector the unit owners make a profit ranging from Rs 5,000- 7,000/month.

All of them try to hold back critical information for fear of being confronted by concerned government officials. They have been relocated to industrial areas like Narela, Mangolpuri, Jhilmil, etc. where they expanded their business. Most of the units are owned but there are also units, which, has been taken on rent. The rent paid is around Rs 20,000 per month in the formal sector and about Rs 3,000-5000 in the informal sector. Medical waste comprised of syringes and glucose bags is being recycled as discovered in the survey at Narela, Noida etc..

All the owners feel that the technology used by them is the best though about 50 per cent want to purchase machines from Taiwan that are automatic to recycle plastic waste as using them their labour cost will be decreased and production will be enhanced. But most of the owners cannot afford the high cost involved in the purchase of the machines.

The owners of all the units in the organized sector visited are members of associations they have formed. They organize one formal annual meeting, discuss problems of mutual interest and raise relevant issues with concerned authorities of DSIDC and DVB. Associations are also prevalent in the unorganized sector, though not as active as in the organized sector.

Limitations faced by the recycling units

A close look at the present recycling units in certain parts of Delhi has projected the following major shortcomings.

- Recycling is done in the most dirty and unhygienic environment. A lot of dust, sludge, waste from the unit etc. accumulates out-

side the unit creating pollution.

- The technology involved in recycling is very old and the machines are very rudimentary.
- As the machines are not well maintained hence there is heavy usage of power and energy.
- A unique 'hand pick' system for sorting and separation are employed which is based on expertise and experience of the sorters. Taking for example, even a small percentage of mix of PVC and PE leads to disastrous results. In the future down cycling of the mixed materials, spreads more and more contaminations.
- The recyclers do not follow any standards such as "Prime Grade", "Once Recycled", "Second Recycled" and so on. This creates a lot of confusions when materials are recycled.
- The government is not strict in enforcing implementations of the rules and regulations set by them. As most plastics are "uncoded" this creates lot of problems in identifying plastic types before recycling.
- The government policy of relocating industries has made unit owners very insecure. Many units have been shut down without properly relocating them.
- The infrastructure of the areas in which recycling units are located, for example Narela, Mangolpuri etc. are very poor. The approach roads to these units are very poorly constructed and ill maintained. There are frequent power failures.
- Most areas where recycling units are located are not provided with an Effluent Treatment Plant (ETP) or wastewater disposal facilities.

All the owners irrespective of the materials they are recycling both in the organized and unorganized sector expect the government to make pro recycling policies like to give them soft loans at a low interest rate, provide subsidies, and install ETP in the area. The owners especially in the informal sector complain that the police are regularly harassing them by demanding bribes to allow them to function. Even people from the Pollution Control Board ask for bribes as revealed by the unit owners in Narela and Mangolpuri.

The owners feel that they can do a better job of recycling waste if they are allowed to operate without facing these problems and if the government provides them with the facilities mentioned.

Table 27. Summary of survey

| Waste material | Units surveyed | Kind of waste | Quantity of waste handled per month (kg) | Cost of purchase (Rs/kg) | Other expenses incurred per month (Rs) | | | |
|----------------|----------------|-------------------------------------|--|--------------------------|--|-------------|------------|--------|
| | | | | | Labor | Electricity | Maintenace | Others |
| Plastic | 1 | HM | 4,500 | 1.5 | 7,000 | 1,000 | | |
| | 2 | HDPE | 4,000-20,000 | 20 | 8,000 | 20,000 | 4,000 | |
| | 3 | PVC | 25,000 | 15 to 20 | 20,000 | 15,000 | 1,000 | |
| | 4 | PP | | | 20,000 | 20,000 | 500 | 2,500 |
| | 5 | PVC | 20,000 | 20 | 15,000 | 12,000 | 3,000 | |
| | 6 | PVC | 30,000 | 12 to 14 | 15,000 | 20,000 | | 1,000 |
| | 7 | PVC | 300 to 400 pairs | 10 | 15,000 | 8,000 | | |
| | 8 | HDPE | | 20 | 15,000 | 20,000 | 1,000 | |
| | 9 | PP | 1,200 | 25 | 12,000 | 25,000 | 5,000 | |
| | 10 | PVC | 2,500 | 11 to 15 | 10,000 | 15,000 | 1,000 | |
| | 11 | PP | 25,000 | 15 | 50,000 | 12,000 | 1,000 | 500 |
| | 12 | PP LD HDPE | 25,000 | 27 34 15 | 50,000 | 12,000 | 1,000 | |
| | 13 | PP LD HDPE | 12-15000 | 15 | 30,000 | 35,000 | 1,200 | 4,000 |
| | 14 | PP | 8,000 | 12 | 20,000 | 30,000 | 1,000 | |
| PET | 1 | PET | 30-32000 | | 3,75,000 | 3,75,000 | 1,50,000 | |
| EPS | 1 | White EPS Brown EPS Black EPS | 10,000 | 2 to 4 | 4,000 | 1,000 | | |
| | 2 | EPS | 8,000-10,000 | 2 to 4 | family members | 1,500 | | |
| Aluminium | 1 | Dust Can | | 5 to 40 55 to 60 | 2,000 | | | |
| | 2 | Can | 9,000 | 60 to 70 | 2,000 | | | |
| | 3 | Cans | 1,350 | 70 | | | | |
| | 4 | Dust | 1,000 | 30 to 35 | | 1,500 | | |
| | 5 | Dust | 30,000 | 5 to 12 | | | | |

| Place of purchase | Quantity of recycled output per month (Rs) | Selling price of final product Rupees per kg | Percentage loss during recycling |
|--------------------------------|--|--|----------------------------------|
| Mundka | 3,000 | 6 | 30 |
| Mumbai, Ludhiana, local market | 3,200-16,000 | 25-30 | 20 |
| Local market | 20,000 | 20-25 | 20 |
| Local Market | 15-18,000 | 25 | 25 |
| Local market | 24,000 | 20-25 | 20 |
| | | 20 | 25 |
| Mundka | | 35-40 | |
| Aurangabad | 900 | 30 | |
| Nagloi | 15000 to 18,000 pairs | 10-15 per pair | |
| Jwalapuri | 20,000 | 4 to 5/item | 20 |
| Jwalapuri | 20,000 | 37 42 27 | 20 |
| Local market | 12,000 | 20 - 22 | 25 |
| Nagloi | 6,400 | 15 - 20 | 20 |
| Delhi, Mumbai, Chennai | | | |
| Okhla | 9,000 | 14 12 6 | 10 |
| Okhla | 7000-9000 | 10 | 10 |
| Sadar Bazar | | | 60 15 |
| Sadar Bazar | 7,500 | 100 | 20 |
| Sadar Bazar | 9,000 | 85 | 33 |
| Sadar Bazar | 9,000 | 80 to 85 | 33 |
| Anant Parvat, Trinagar, Sadhra | | 40 to 45 | |

Table 28. Abbreviations and acronyms used

| | |
|---------|--|
| ABS | Acrylonitrile-butadiene-styrene |
| ACGIH | American council of Governmental Industrial Hygienists |
| AFPR | United States Association of Foam Packaging Recyclers |
| Al | Aluminium |
| AMEPS | Asian Manufacturers of Expanded Polystyrene |
| BIS | Bureau of Indian Standards |
| EPS | Expanded Polystyrene |
| EPSRAI | Expanded Polystyrene Recycling Association of India |
| EUMEPS | European Manufacturers of Expanded Polystyrene |
| EVA | Ethyl Vinyl Acetate |
| HDPE | High Density polyethylene |
| HMWHDPE | High Molecular weight High Density polyethylene |
| HP | Horsepower |
| INEPSA | International Expanded Polystyrene Alliance |
| LDPE | Low Density polyethylene |
| MT | Metric tonne |
| OSHA | Occupational Safety and Health Administration |
| PE | Polyethylene |
| PEL | Permissible Exposure Limits |
| PET | Polyethyleneterephthalate |
| PP | Polypropylene |
| PS | Polystyrene |
| PVC | Polyvinyl chloride |

SECTION 3

An Outreach Programme for Schools

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The current state of environment education

Environment Education (EE) for long had been associated with nature – forests, birds, animals, etc. Environment was seen as something distinct and ‘out there’ – unassociated and unattached from our lives. Being environment friendly and conscious for many meant planting trees, using jute bags, or watching nature related programmes on TV. In schools too, environment education was limited to Nature study or excursions to wild life sanctuaries, making presentations about animals, birds and forests etc. Environment as a subject was seen in isolation from Languages, Mathematics, History, Physics, etc. Environment Education classes if at all happened were considered as an extra-curricular activity.

But in recent years, environment education has thankfully expanded and acquired new meaning and dimension. It has begun to address issues linked to our lives. Air pollution, water shortage, health, pesticides, food, poverty, lifestyles, waste, problem of refugees, uncontrolled urbanisation, even war among nations etc have been brought into its fold. Impact of our life styles on other beings and the earth are being increasingly questioned. For e.g. use of pesticides in one part of the world has had its impact on Inuit people of Polar Regions where no insecticides have ever been used. Environment is everywhere. Even the computer that helped type this report has had its impact on our environment somewhere.

Environment Education need not become a distinct subject. It can be woven into regular subjects and become a part of our regular mainstream curriculum.



Recycling
Responsibility

One can talk about environment through history by sharing about life styles of people living in various valley civilizations and its impact around it. Similarly the rise and fall of cities, empires for e.g. Delhi too can be linked to environment. Environment can be as much part of chemistry by learning about various toxics, air pollution, pesticides etc. Physics need not be confined to Newton, Kepler, etc. The phenomena of climate change; global warming, ozone, depletion etc can too be made a part of it. The famous Chief Seattle’s speech can be a part of the language courses. Likewise life sciences too can be brought more into its fold.

The possibilities exist. There is a need to form linkages and associations with which a student relates, identifies and hence understands.

Srishti and Environment Education

Srishti felt a need to reach out to students. Students are possibly the best means to address and bring about a positive change. Once they get out of schools and college, they can influence change and policy to a great extent. Students are also more open to new ideas and change. Adults, on the other hand, may have rigid ideas that are not easily altered. Moreover, working with students also provides space to exploring creative ideas and methodologies.

Srishti, too since its inception has been involved with environmental issues that concern everybody. It has actively worked to save Delhi’s Ridge forest, been a part of waterfowl census, addressed the issue of municipal waste and toxins, set up waste management systems for communities, medical waste, etc. In the process it has reached out to diverse range of audiences – policy makers, common man, waste pickers, students etc.

Why pick out waste?

Municipal Solid Waste has been one of Srishti’s key areas of work. To take it further and reach out to more people Srishti chose waste for its outreach programme. More importantly, everyone relates to waste. Ask a city dweller about civic problems she or he faces – cleanliness or rather lack of it is always among the top along with water, transport etc.

Moreover, municipal waste is little addressed in schools. It is as important an is-

sue as water and air pollution, soil contamination, forests etc. Municipal waste is not only a civic problem but also linked to our health and safety as it directly affects air, water and soil. Most of us do not make efforts to proactively address the problem, nor do we pay anything for getting rid of *our* garbage. Waste segregation, reduction, recycling is still jargon.

Srishti believes that an effective waste management system must have involvement of all stakeholders viz citizens who generate garbage, waste collectors and waste pickers who collect our waste, the municipal workers who help dispose it and the municipality that oversees and manages the entire system. Also, for an effective waste management, a decentralised community managed system for a large city like Delhi, may be more effective. In such a system, involvement of people is of primary importance but only by working together with the rest of the stakeholders. Through this outreach, an attempt has been made to communicate the message that managing *our* waste is in *our* hands.

Developing the Outreach Programme – The process

School outreach was a new area for Srishti. Though it had been involved with students earlier, it never really had a full time school outreach programme. Our strength lay in conducting the programme with strong knowledge base. Where we lacked was forming networks with schools. So to overcome this we...

Joined hands...

...to synergise with other organizations having a very effective and extensive school outreach programme. Pravah, an NGO, became our major partner, since we have worked together for its Making Change Makers and the SMILE (Students Mobilisation Initiative in Learning through Exposure) college programme. Our partnership involved conducting workshops on waste at Pravah's partner schools and college students.

We have also partnered with Development Alternatives in its CLEAN initiative.

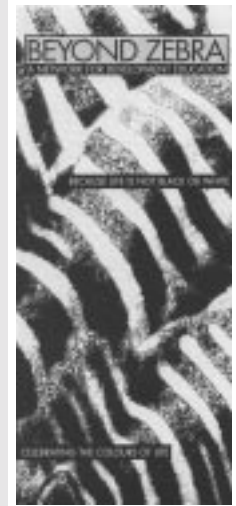
To further the outreach we were also part of...

Developing networks...

...like Beyond Zebra

About Beyond Zebra

Beyond Zebra (BZ) the Network for development education seeks to empower potential youth leaders with life skills and citizenship education, offer opportunities to proactively engage with them with social issues so that they have the capability and knowledge to promote social responsibility. BZ is a pioneer project, which works with principals, teachers and students to make youth leaders in and build sustainability in the school to continue the same. Other partner NGOs in the Network are *Ashray Adhikar Abhiyan* working on homelessness, *Butterflies on street* and working children, *Centre for Science and Environment* on air pollution and water, *Development Alternatives* on environment, *Pravah* on social responsibility, *Toxics Link* (sister organization of Srishti) on toxics in the environment and *Youth Reach*.



Beyond the black and white, between right and wrong the programme aims to explore the grey areas of the emotional self and its relationships with others. Understanding this ambiguous, dynamic inter relatedness with the environment will unleash the potential of young people to make a better world.

From the Beyond Zebra brochure

Developing outreach material

For effective outreach programme it helps to have a high quality outreach material. It helps to enhance what it is being communicated through workshops and also helps to retain information as students have something to carry back home. It also lends a greater visibility to the programme. It was our effort to develop a range of outreach material that communicates the information in an easy to understand manner by relating it to our lives.

Some of the Outreach material.



We explored various options and alternatives for the right kind of outreach material and the information it should contain. After several rounds of discussions and brainstorming sessions with designers and team members, we zeroed in on following types of material.

- ★ Handouts
- ★ Stickers
- ★ Notebook labels
- ★ Posters
- ★ Bookmarks

All our outreach material is meant for free distribution among students during workshops and other events.

We still needed something more. A name for the programme. We could have chosen a long winding name like Srishti's Initiative For Action Programme for Waste Reduction in Schools and Communities. But the programme needed – a name that everybody understands, relates to is catchy, informal and is something that suggests proactive action. Several suggestions came like WOW – War on Waste, Kachra Peti, Winning Over Waste etc. Finally we selected...

Karamati Kachra

Bindas is born

Name done, something was still missing...

A cartoon character perhaps... that talks about what we wish to communicate. Many students relate to comic characters and even remember them in their later years. So many of us remember the jungle lore of Phantom, the quick thinking Chacha Chowdhury whose "mind works faster than a computer", the clever and cunning Asterix, the travails of Tintin and Haddock the mischievous Calvin and Hobbes...

Our character may never have the fan following of the above, as it is meant for the very specific purpose of communicating about waste. Nevertheless the character had to be living, breathing (not eating or drinking though) waste. A friend of ours suggested the name Bindas. Bindas! – the name stuck, liked by most. Bindas, or bin *ki* das. Bindas now

Bindas in different moods



needed to physically appear. Will it be solid figure like Superman, Tintin etc or will look like some one who has just emerged from a waste bin, should Bindas be a waste picker, someone suggested Bindas should also have flies as a companion – Dogmatix-Obelix style. Finally Bindas assumed the form of the genius genie of the bin, a girl who knows all about waste.

Bindas assumes different roles in outreach material. She may be a teacher, a waste picker, a *kabaadiwala*, she also falls sick due to waste, etc. But still is a Superwoman of waste. She has become a mascot of sorts. Bindas not only stayed in posters, handouts, stickers etc, but also assumed physical form in shape of wire frame cut out.

Getting On with the Outreach

Meanwhile we also developed an outreach module on municipal waste for the programme. We had a basic premise in mind that learning must be enjoyed. We have tried to make our workshops module interactive and fun. We have made an effort to present it in a manner that students can easily relate to. The outreach programme has two broad components with schools

- ★ In house workshops
- ★ Outdoor field trips

In-house workshops

The workshops varied in duration from 2 to 5 hours depending upon the time allowed by the school. We evolved the following structure for the workshops with a view to address the issue as holistically as possible. The structure though defined was not rigid as at times some sessions were modified depending upon the interest of the students.

1st session

Introduction to Municipal Solid Waste and Solid Waste Management: The Waste Stream. This activity helps students to develop an understanding of waste management, its importance and the role it plays in the community. Students will develop a historical sense of solid waste, thereby learning how people have managed it throughout time and how it affected their lives and identify environment issues stemming from solid waste, hazards of plastics, the problems associated with managing it. An introduction about how production of goods generates waste at every stage.

2nd session

Different role players – who generates how much, who manages it – MCD, RWAs, ragpickers. What are solid waste problems in the community? Cost of solid waste management – environmental, social and economic. Waste disposal, land filling, incineration.

Suggested activities

- ★ Slide show
- ★ Investigate the quantity and nature of waste generated over a period in school and report on it and suggest ways to improve it. Students can do a similar activity at their homes.
- ★ Back to nature game

3rd session

Waste minimisation. Students will learn about the importance of source reduction, or of generating less waste in the first place. They will analyze various products in terms of packaging waste generated, and toxicity. They will look at household hazardous waste products and ways to reduce the use of toxic products at home.

Consumption patterns, packaging of goods – discuss what all the students / house holds consume, things they buy, clothes, books, food, toys, games. Discuss how waste



minimisation is possible without affecting the way we live. Making informed choices about buying products, refusing goods with excessive packaging.

Suggested activity

How can waste be minimised, share about different ways it can be done at home, in the school and at the community level.

4th Session – Recycling segregation

This session familiarizes students with recycling, the need for segregation and recycling, and costs attached to it. Students also share and learn about:

- ★ Segregation of waste and its role in waste management/recycling
- ★ Recycling methods and means available
- ★ Recycling in the informal sector
- ★ Advantages and disadvantages of recycling
- ★ Role of waste pickers
- ★ What all can you recycle
- ★ Case studies about successful recycling for improving solid waste management and understand the need for responsible citizenship action.

Suggested activity

Take Action: Example of success stories and making personal choices. Students will analyze and try to improve their own waste generation habits. In addition, they try to develop and Implement a plan to reduce waste generated in their school and understand the need for responsible citizenship action.

Methodology

It is based on experiential learning using resource material like posters, handouts, etc, along with interactive workshops and classroom activities like slide shows, games, hands on learning and monitoring activities and field trips To add an element of fun we also use energizers and ice breakers in our sessions. The goals of these workshops were

- ★ To raise awareness, spur interest, and increase understanding on issue of municipal waste.
- ★ To engage in activities that help understand the interrelationships among human activity and waste.
- ★ To help explore strategies and solutions to the above issue
- ★ To help address the problem at the individual and possibly at community levels.

Activities with Schools

Going to a school and interacting with group of curious students was quite an experience. One better be good otherwise we all know what students can do. We too have gone through similar experiences in our school days. *Disrupting a workshop was so much fun!*

In the following section we have tried to take you through a typical workshop.



Energisers and Icebreakers

To begin with our sessions we always had some energizers that simply involved students to move around, make noise etc.

One such activity is Tempest. In tempest the participants sit on chairs. One of the participant acts as a facilitator. He or she will then make a statement for e.g. "All those people who wear spectacles" and every one wearing spectacles in the group exchange places. Alternatively the facilitator may ask the participants to move a number of places to their left or right. This continues for

a while. Facilitator then at any point of time says "Tempest!" and joins the group. He/ she can then sit on any chair and one person who is left out becomes the facilitator to continue the game.

The exercise proved to be very enjoyable. Students came with unusual statements situations like people who have pet anacondas, or have seen the movie *Lagaan* more than two times or got a scolding from their parents in the last one week for not studying etc. The aim was to help focus and get their positive energies together for the sessions ahead. This also helps lend a certain informality amongst facilitators and students.

Next we move on to the issue of waste with an interactive session called

Ye Kachra Kachra kya hai

In this students listed out their feelings, perception of waste. They also then list out things they threw away or see lying around as waste A vast list of more than fifty items usually emerged.

One came to know how observant students are and can come up with most unusual and unexpected answers. Besides the usual vegetable peels, paper, plastic, glass, there were interesting examples like hair, candles, cut nails, marbles (*kanchae*), teeth, expired medicines, dead animals, insects etc.

Now that we had the list, it was developed further. We introduced the concepts of natural resources – renewable and non-renewable and their relationship with waste items that were listed out. For e.g. plastics are derived from crude oil, paper from trees, food from plants, metals from ores etc.

We then calculated how much of our waste is coming from renewable resources and how much from non-renewable ones.

Next we shared about biodegradable, non-biodegradable, recyclable and non-recyclable waste. The items listed earlier were then classified accordingly.

We have also borrowed methodologies from other fields like theatre in our programme. An exercise of object association is at times used. Discarded items like pencil, a broken wire, battery; Aluminium can, etc were put in front of the students. They were then asked to use one or more of them as something else Participant came up innovative improvisations one used a battery as a rolling pin, or wire as moustache, pencil as a flute and so on.

I am very sad about how I myself have contributed to the pitiful state of garbage situation.

Rohan

Springdales School, Dhaula Kuan

Kabad ki Katha – garbage through the ages

In this session we share about how waste has changed over time with development of human civilization. We begin with prehistoric times – the times of cave men and moving on to ancient civilizations, middle ages, advent of industrial revolution and finally to modern age i.e. today. In this we emphasize how our dependence has moved from renewable resources to non-renewable ones and its effect on nature and quantity of waste.

We now realise that waste is very damaging, there is large demand for resources as there is little recycling and reuse.

Prem Singh

BR Mehta Vidhyalaya

To help understand the above more, the group was divided into three to five equal groups and asked to draw, write sketch on chart paper -- life styles and waste generation in pre- and post-Industrial Revolution years. Each group then made presentations of their work to others.

The drawings that came up were very creative and imaginative. At times students drew people having pet dinosaurs and its excreta as waste, while some drew weapons and bones of early man. Plastic waste, packaging,

Dogs, Cats and Donkeys

To divide the group into three smaller groups we used a small exercise. Students were randomly given slips of paper on which the names of the animals were mentioned. The students then went around the room mimicking the sound of the respective animals and found others making similar sounds to form respective groups.

Such sessions are done to introduce an element of fun that helps students unwind after an involved session.

ing, dirty streets, industrial effluents were depicted in modern times.

Bin main khoj...

A peep inside the bin: The session was conducted through a game to emphasize the biodegradability of various items in our waste and problems they pose with disposal.

One student at a time came and blindly picked out an item from the dustbin prepared earlier, and tried to guess the basic source of the item (for e.g. plastic bottle from petroleum) and when it will degrade. There was wide array of items in the bin like plastic bottle, tin can, fruit peels, old socks, wood, Aluminium foil, paper, glass, styrofoam cup, etc. We even had an old leather shoe that always drew laughter from students. The session drew mixed responses from students. While some thought it to be interesting and a learning experience, others did not quite like the idea of rummaging into a bin.

Through this activity we shared that there is no waste in nature and all the waste that is generated is due to human activity.

Kachra ka Caravan – journey of waste

This was a slide show that showed various steps involved in waste management from disposal at household to final dumping in landfills. The session also shared about the social price we have to pay in terms of health and environmental degradation because of waste generation.

The aim of the session was to get students to understand the issue of environmental justice; who produces the waste and who gets affected by it? Does the polluter really pay? The connection between lifestyles (economy and growth) and waste (pollution and ecological damage) was established by getting them to reflect on the waste that they generated themselves. They were asked to think of economic systems that fuelled the demand for more materials but did not take into account the costs.

The session actively discussed the role of the waste picker especially the children in waste management. Economic and social factors like poverty, unbalanced development that force people to take up waste picking were also brought forth.



The drawings that came up were very creative and imaginative. At times students drew people having pet dinosaurs and its excreta as the waste, while some drew weapons and bones of early man. Plastic waste, packaging, dirty streets, industrial effluents were depicted in modern times.

Previously we did not think after throwing our garbage. But now we will think about small children who work for this... earlier we always blamed someone else for this.

Sachleen Kaur

BR Mehta Vidhyalaya

“It was a huge heap of garbage – dirty, filthy and pathetic. I realize how cruel we humans are to the environment.”

Nazia Jasleen

Hamdard Public School

“Some quarter of this landfill may be my share also.”

Ayeha Saeedi

Hamdard Public School

Feedback

To make the outreach more effective and participatory, feedback was taken from the students. Feedback is the only means available to us at this stage where we can actually learn about the effect of the programme / workshop on students. The feedback was taken through a predesigned form that students filled up at the end of the workshops. The feedback reflected upon their learnings, the quality of the sessions, the level of information shared, and also took student's suggestions on improving the sessions. A copy of the form is annexed.

Follow up

We have proposed a waste management plans for the schools outreached, and hope to implement them in the coming academic year. The waste management plan will involve all the stakeholder viz students, teachers, administrative staff, cleaning staff, municipal corporation etc. It is proposed to carried out in a scientific manner that will involve waste monitoring, waste audit, orientation and training programmes, setting up of waste disposal system (compost pits, collection of recyclables).

Outdoor field trips

Any learning is best imbibed through first hand look or hands on experience of the situation. For the outreach programme we undertook field trips to municipal landfills and composting plants and also to proposed landfill sites. The daylong outings offered a first hand look or rather a walk over thousands of tonnes of waste lying in open.

Arrival at the Bhalaswa landfill was always greeted with strong stench of rotting garbage prompting the group to put on their facemasks. At the landfill Junior Engineer of the site took the group around. The entire process from truck's arrival, weighing of trucks at the weighbridge and final dumping was shown and explained. They

also saw numerous waste pickers who were picking out recyclable items from huge dumps.

Seeing such a huge volume of waste at one place was a revelation to most of us. As the enormity of the situation was right there in front of everybody – physically.

The aim was also to look at alternatives available and being practised to manage waste. Hence the visit to the composting plant during field trips. The students got to see all the equipment that was in plant that helped to make compost. The students became familiar with the process of segregation, drying of garbage, wind rows formation, packing of compost, etc.

College Outreach Programme

Our outreach programme also involved various college students from Action Research Group of Pravah's SMILE programme. The students who join this group select an area of concern and then undertake research on the subject. They undertake library research, conduct interviews with various stakeholders, conduct file studies etc. This year's students of Action Research Group selected municipal waste as their area of interest.

The Srishti outreach team conducted a number of sessions on municipal waste prior to the field trip, to orient the students with various aspects of municipal solid waste. The college students under the outreach programme visited Bhatti Mines – a proposed municipal landfill site.

They carried out a study of waste pickers, waste dealers and *kabaadi wallas* and conducted a small survey in two economically diverse localities of Delhi to gain a basic understanding of the relationship between income levels and waste generation. During the process students designed and administered a waste generation questionnaire. Later, they analyzed and documented the findings.

“The core issue was landfill and what problems will it bring along if its project is started by the government. Apart from this we were also exposed to the fact that how weaker sections of the society were exploited and cheated.”

Richard

St Stephen's College



Public Events

To reach out to a diverse audience we also participated in public events. Materdei School Social Development Fair, Tiger Mela and Dastkar's Nature bazaar offered us this opportunity. We put up colourful stalls that displayed, sold and distributed all our outreach material. At the stalls we had activities like vermicomposting demonstrations face painting, etc.

For the first time, we organized several performances of the street plays on waste management at Tiger Mela and Dastkar's Nature Bazaar. The play - *Karamati Kachra* - developed jointly with Pravah and a youth group called *Diwana Mastana* from Nizamuddin managed to communicate our message to large number of people. The play had improvised songs, situations with Bindas talking about waste.

Materdei School Social Development Fair

The outreach programme at Materdei School entailed participation at the Social Development Fair organised by it. Srishti participated in the fair with Beyond Zebra network.

The fair had large number of students from various schools visiting the stalls put up by different NGOs. Srishti on its part organised a quiz competition on municipal waste at its stall. The competition attracted about hundred enthusiastic students from different classes of various schools. Three rounds of the quiz were held and prizes were given to the winner of each round.

To generate awareness about waste Srishti also distributed handouts prepared by Toxics Link to the students who visited the stall.

Tiger Mela

Tiger Mela was jointly organised by INTACH – Indian National Trust for Art and Cultural Heritage, Sanctuary Magazine and Britannia. The central theme was *Kids for Tiger*. The Mela aimed to generate awareness and the urgent need for conservation of Tiger.

The Mela had participation from various schools of Delhi who had put stalls on the theme of Tiger Conservation. Non Government Organisations like Delhi Bird Club, Centre for Environment Education also participated in the Mela

Srishti participated with Pravah and Beyond Zebra Network at the Mela. Srishti and its sister organisation Toxics Link displayed their publications. Outreach material was also distributed to the children and others who visited the stall.

Srishti organised three shows of its street play. The play reached out to a large audience. To add an element of fun and enjoyment we also had face painting and tattoo making at the stall. This activity not only attracted students but at times their accompanying teachers too!

The Tiger Mela helped give Srishti's outreach initiative a new exposure. More than 14,000 school children attended the Tiger Mela over the three days.

Dastkar Nature Bazaar

Srishti for the first time participated in Nature Bazaar – an annual event organised by Dastkar an NGO working with community groups and organisations from different parts of the country. The Bazaar brings them together to share their work and sell their products. There were craftsmen, toy makers, people involved with organic farming, NGOs working with environment, youth, women, etc.

Srishti and Toxics Link had a stall at the Nature Bazaar. The stall displayed, sold and distributed various publications. The outreach material developed under the IAELP project was bought by large number of people. More than five hundred copies of Bindas poster and Karamati Kachra stickers were distributed free to various people who visited the stall.

We also organised six performances of the street play for the occasion.

In order to actually demonstrate better waste management techniques Srishti along with Mr Murthy, an expert on vermicomposting, demonstrated the technique of vermicomposting through a portable vermicomposting pit with live earth worms.



Outreach with community groups

Srishti also collaborated with CASP and Action India to conduct awareness and training workshops for the youth. The workshop with CASP was held with the local youth group involved in mobilizing people for proper waste management in Govindpuri. The workshop with Action India was held with adolescent girl students at New Seemapuri. Both the workshops focused on waste, cleanliness and its effect on local environment. The workshops also tried to identify the means that the respective communities may adopt to overcome the problem.

This was a new area that was ventured into but the experience was very positive. The youth in these areas are far more affected with waste than the school children and hence tended to be relatively more aware and concerned about the situation.

Almost all of them for instance attributed the problem of blocked drains and choked sewers to careless disposal of waste by the people. Another point that came forth was lack of open spaces. All the parks and other open spaces in their localities were taken over by garbage and stray animals attracted by waste.

Our learnings

This has been the first major outreach programme with students on municipal waste.

In the process we been able to form linkages and develop partnerships with several other groups, and institutions. This has contributed positively to our outreach. All our outreach was carried out in partnership.

Moreover, working together helped us adopt methodologies that our partners use for their programmes. This we feel made the programme more interesting and interactive. For example, energisers and icebreakers that Pravah uses in their sessions on Self and Social Responsibility were sometimes modified and used for our sessions on municipal waste. For the first time Srishti adopted a novel way of using street plays to communicate messages about waste. Though this medium has been used by numerous other organisations, for Srishti it was a new experience that it hopes to use more in future.

During the process we have felt that communicating with school and college students

has to be highly interactive, participatory and enjoyable, both for the students and the facilitators. Some of our sessions that involved sketching drawing, painting, slide shows, outdoor field trips, etc were liked by most of the students.

I liked the slide on garbage as it showed photographs of waste and also liked the friendly way in which it was presented.

Sushil Sharma

Andhra School

The drawing session where we were asked to draw garbage condition.

Tarun Naithani

Balwantrai Mehta Vidhyalaya

The sessions where information, facts and figures were given were found to be not too interesting. Not all our sessions received positive response from students some were outrightly boring for them

This is a gray area where we need to work more in future programmes.

The session where we talked about packaging in our country, quality and quantity of sales, packaging and efficiency of the goods were the worst.

B. Rajshree

Andhra School

Our outreach material has helped to make a greater impact and visibility to the programme as it gave students something to carry back home with them.

Most of the schools that we outreached to were contacted only once. In order to make the outreach programme more successful and effective it needs to have an implementation component to it. We have had workshops in different schools and suggested implementation of a school waste management system. Some schools are very willing and open to have such a system. This could not be carried out presently due to project constraints. In future programmes we hope to implement such systems. This will also facilitate more realistic evaluation of change of attitudes among students towards waste.

Outdoor field trips were perhaps the most interesting part of our methodology. Walking on landfills helped to provide a first hand look

at our waste disposal sites. This we feel must continue.

Regular innovation and trying out new ideas with regard to delivery of the programme is essential. This not only keeps the programme alive but also helps the facilitators to be more creative and develop new ideas and methodologies. Assistance of people with special skills, for children, for example painters, cartoonists, theatre persons, filmmakers, writers, puppeteers etc may be helpful. This is an area where we could improve upon, as our facilitators at times felt handicapped due to lack of new ideas. Short training programmes in communication skills could also help in this regard.

Future Plans

In the coming academic year *Karamati Kachra* programme plans to be actively involved in implementation of waste management plans with some of the schools it has outreached. It may also involve other interested schools.

The programme will also continue with current pattern of workshops, field trips. We also plan to extend our outreach to colleges and outstation schools.

Participation in public events helped us outreach to diverse audiences through innovative means like street plays. This we plan to continue with.

Our outreach material has been very well received with school students as well as general public. This year we plan to publish comic/hand books on waste and toxins. These publications will have Bindas as the central character. The handbooks will again be targeted at students and the general audiences.

To enhance our capacity and improve community outreach skills, we also plan to network and train our staff in partnership with other organisations.

Outreach Programme schools/institutions and events

| Name of the School | Number of workshops/events |
|--------------------|----------------------------|
|--------------------|----------------------------|

In House School Workshops

| | |
|---------------------------|---|
| 1 Springdales School | 1 |
| 2 Salwan Public School | 1 |
| 3 Balwant Rai Mehta | 1 |
| 4 Karnataka School | 1 |
| 5 Andhra School* | 3 |
| 6 St Thomas School | 4 |
| 7 Bhartiya Vidhya Bhawan* | 4 |

Field Trips

| | |
|-----------------------------------|---|
| 1 Andhra School | 1 |
| 2 Hamdard Public School | 1 |
| 3 Action Research Group of Pravah | 1 |

Other Outreach

| | |
|---|---|
| 1 Workshops with Action Research Group. Research and waste monitoring and survey* | 3 |
| 2 Youth group, CASP | 1 |
| 3 Girls group, Acton India | 1 |

Public Events

| | |
|---|---|
| 1 Materdei School Social Development Fair | 1 |
| 2 Tiger Mela** | 3 |
| 3 Dastkar Nature Bazaar** | 5 |

* Multiple workshops with same lot of students

** Implies theatre performances

Total number impacted: approximately 2,500

Evaluation and feedback

1. Name Class

School Date

2. What are your overall impressions of the garbage situation?

3. Has your awareness and understanding of waste and waste management changed? If Yes, how?

4. What are your views about the sessions on the following parameters? Please rate them on the scale 1 to 5 (*1 for bad and 5 for excellent*)

a. Providing relevant information i.e. were you able to relate to it ____

b. Involvement of students i.e. level of interaction between students and resource persons ____

5. Which was the session you liked the most and why?

6. Which was the session that you liked the least and why?

7. What are your impressions about the workshop? Please rate it on the scale of 1 to 5 (*1 for bad and 5 for excellent*) ____

8. What kinds of activities/sessions should be conducted in a workshop to make it more interesting and fun?

SECTION 4

Discussion and recommendations

The state of recycling today

The waste-to-energy conflict

Policy blinkers

The Extended Producer Responsibility (EPR) framework

The need for recycling interventions

Specific interventions

A Discussion of the Major Issues

This study raises various policy issues relating to urban waste as well as of the socio-economic environment of traditional waste recycling in India. They may seem unconnected, since currently these two operate at different levels, and no attempt has been made to see the interconnections at a policy level. However the issue needs to be addressed comprehensively since their interdependencies are critical.

These links encompass product design, post consumer waste disposal, collection, segregation and conditions within the recycling sector, and need specific roles to be played by the various stakeholders involved. A set of interventions that emerge from such an approach will guide national, local governments as well as the industry to make comprehensive and synergistic improvements in this area. The role of the import of waste must also be accounted for, as well as the dynamics of international policies, which lead to such an export.

The aim must be to:

1. Improve the design and materials used in products and packaging to enable their easy and safe recycling.
2. Enhance collection and recovery rates.
3. Increase employment opportunities, wage levels, social status and security of waste pickers.
4. Upgradation of recycling technologies, infrastructure and recycled product quality.
5. Expanded markets and consumer acceptability of recycled goods.

As discussed in earlier chapters, recycling faces a number of bottlenecks. These include, poor product design, toxic, composite and unsafe materials, mixed disposal leading to deterioration in their recyclability, higher costs of recycled products as compared to virgin material based products owing to unequal subsidies, and competition with other waste disposal options such as incineration and landfilling.

The state of recycling today

As this study shows, the waste trade in India is mostly in the informal sector or what is commonly termed as the unorganized sector. These are small and tiny production units run mostly on informal and self-employment basis. Most of the labour force engaged in this is migrant from the poorer states of India. It is estimated that around 45 per cent of people so employed in Calcutta, Bombay, Ahmedabad and Delhi are found in this informal sector and the number seems to be increasing with time. While municipal agencies are more engaged in the collection and disposal of waste, the industry has been wary of taking any product responsibility. The government steps in mainly when there is an outcry, or if the Courts order so. The brunt of all this is borne by the general public, waste pickers or all those who are involved in ridding the urban landscape of dirt.

The sector suffers from severe infrastructure, marketing and technological disadvantages and hence characterized by not only poor working conditions, but also sub-standard products. More importantly people engaged in it have been marginalized both economically and socially.

Over the past years there has been a tremendous, though sporadic growth of the recycling sector. With new kind of packaging materials being introduced, increasing amounts of plastic waste, as well as unchecked waste imports, new avenues for reprocessors have been created. In fact some waste processing units are based in export promotion zones, and only process imported wastes of plastic and metal. Though the technology for reprocessing remains basic with no concern for pollution prevention, occupational safety, or the quality of products, it has yet been growing consistently, mainly in the small and tiny scale waste dealing and reprocessing area.

Today though the waste pickers work as service providers and save the municipality a substantial budget (about 20%), there is no acknowledgement or recognition to this service. It is essential to recognize their services and give them a right over the collection of dry waste.

Ultimately any reform in this sector needs to be translated to the lowest actor in the chain, the waste picker. This study shows that this group is underpaid, has no insurance of health and depends on its social network for survival. Increasing its sustainability in terms of social and health standing would at the very least imply an increase in its economic sustainability. This

could be done either by reducing the number of middlemen in the fray or through increasing the power of the waste pickers to do collective bargaining. Any intervention to remove the small waste dealer, without dealing with issues of social dependence on them, could leave the waste pickers more vulnerable. This is especially so if they have not devised their own substitute bargaining powers and collective strength to sustain themselves through hardships, since their relationship with the small waste dealer is not merely an economic one, but also one of security.

As one goes further up the chain, the problems change from that of security to that of legitimacy. The role of the waste trade is still questionable. While it is true that they help channelise the waste to the recycling units, it is also true that they contribute to higher collection costs, and exploiting the price of the waste. A more direct collection system that feeds into the recycling units (upgraded and of higher capacities of scale) may make the system more competitive to produce higher quality products at lower costs.

The technology currently in use is rudimentary with no care for pollution prevention and occupational health hazards. The machines are mostly locally fabricated from discarded machinery parts. Most of the process followed is manual putting the workmen at a high risk of accidents. Also the working conditions are cruel and exhausting. There has been no quality control on the products made from recyclable waste, which might be contaminated and could lead to serious health hazards.

After the product is made, it has market mainly for the lower income group. There is no labeling on the product whether made from recyclable or virgin materials. There is also no labeling regarding the type of plastic.

Recycling cannot survive without adequate marketing support for recycled products. Market support for recycled products to make them competitive along with products made from virgin materials need policy interventions. Especially purchases by institutions as well as governmental agencies should encourage products with a recycled content in preference to other products. Other market development funds could include catalysing innovation in recycled products, reworking the eco-design scheme and creating social value for buying recycled.

The waste-to-energy conflict

Subsidized waste to energy schemes are also excluding recycling and hampering material recovery by putting recycled products at a disadvantage vis a vis. is energy products. Indian waste, typical of a low-income country (LIC), is largely organic, with high moisture content and high percentage (40%) of inerts. Its composition will in fact rise in its organic content to 60% with a reduction in inert content. Accordingly, countries such as Philippines have banned incineration under their recently promulgated Clean Air Act to promote recycling, and similar moves are going on in other poorer parts of the world. In India too the Supreme Court appointed Burman Committee has recommended bio-methanation and composting, along with recycling as the way to go.

This report also argues that it is appropriate and economical to use existing organizations of the informal sector for development rather than dismantle them to build costlier structures. In the current context of urban solid waste management, setting up an incinerator or pyrolysis technologies not only put the viable recycling sector under a severe threat but also takes away thousands of jobs besides burning valuable resources. While an incineration provides one job per 10 tons of waste, recycling generates more than 400 jobs in the form of waste picking, sorting, reprocessing etc., or say a collection of 100 waste pickers facilitates employment creation for another 37 people in sorting and reprocessing.

Similarly, such technologies will not only have high operation and maintenance cost but also unsuitable to the Indian conditions. This sector makes a greater use of abundantly available human resources, due to the lower capital intensity production with no rigid barriers on entry. The employment in this sector is more accessible to those lacking economic and social empowerment. The daily transaction of waste runs in crores only in plastics in Delhi. There is major value addition in each of the waste with plastic being the highest, ranging from 80 to 125%.

Policy blinkers

Though there are several documents dealing with urban municipal waste per se but there is no Indian policy document, which examines waste as part of a cycle of production-consumption- recovery or perceives the issue of waste through a prism of overall sustainability. In fact interventions have been fragmented and often contradictory.

The government as such has no policy on urban waste recycling and hence the activity has no legal status. This has opened the gate for unwanted interference and harassment from the police and the municipal staff at all levels of waste dealing, whether it is the waste pickers or the large waste dealers or the recyclers. The government has not provided any land to them hence at the bottom level the trade carries on either on 'encroached' or rented land. In areas where recycling is carried out, there is a severe lack of infrastructure like water, electricity, roads etc. Waste dealers do not have a permanent space to do business, nor can avail loan facilities or insure their stock against fire and other accidents.

The Extended Producer Responsibility (EPR) framework

The concept of Extended Producer Responsibility (EPR) has been introduced as a suggested framework to allow interventions to take place. The funding of the reform in this sector can be secured within a framework of EPR as well. EPR would provide the basis for the responsibility, the need for change in product design as well as the needed resources to seed the reform in the recycling sector. Such as take-back policy under EPR will help in better collection rates and subsequently recycling. In India, it has been practiced with soft drink glass bottles and the same can be applied to PET bottles and some other products as well.

Although there is a consensus amongst the policy makers for take back policy of PET bottles but there is no clear picture as to how it may be possible considering the strong industry resistance. The idea is still at a conceptual stage with ongoing discussions amongst various stakeholders. The industry fears that accepting a take-back policy under EPR will mean incurring an extra expenditure, making the product costlier to produce. Apart from this, the industry will then have to design and label the product fit for recycling.

The National Plastics Task Force (1997), asked the industry to evolve an outline scheme of take-back for PET bottles. The Industry, instead pushed hard for a voluntary system of take-back and not a mandatory system, thus evading all responsibilities. The industry argued that since PET consumption in soft drinks was minimal (it was over 1 billion bottles in 2001!), such a policy would not suit them. Another misleading argument was that a large number of mass consumption beverages were still packed in glass bottles and establishing a take back for PET would not be financially viable.

However now, the Ranganathan Mishra Committee on Plastic Waste Disposal (2001-2) constituted by Ministry of Environment and Forests, Government of India has forced the industry to collect PET bottles by introducing the Deposit Return Scheme, where whosoever returns PET bottles is paid 25 paise. It is a start, but far from an overall framework.

The need for recycling interventions

If this informal sector is helped to mitigate the disadvantages it suffers, it will help in more labour absorption; their working condition will improve and subsequently will help in over all productivity and quality. But more importantly there is a need to look at the issues holistically rather than as a piecemeal approach, as the present policy seems to be.

It is critical that any system that is proposed deals with the question of adaptability. Is it possible to adapt alternate approaches and models for a country like India, with large number of urban poor living off waste picking and recycling, the waste being largely biodegradable, and where 35% of the population generates less than 15% of the city's waste? If so what is the nature of interventions needed and what is the framework under which such interventions should exist? Such questions need to be addressed.

Municipalities for example could organise systems for waste collection making waste pickers part of it. They could also provide the waste pickers with identity cards and train them for

house-to-house collection. The government or the local bodies should provide health and insurance benefits and shelter to them. Some of this is being tried with the involvement of NGOs, in all parts of the country, but is piecemeal, sporadic, and not part of a scheme of things.

Clearly a more comprehensive material recycling policy and subsequent interventions are needed which emphasizes producer responsibility and waste minimization, before introducing a particular type of packaging. It should also encourage recycling through providing incentives for technology upgradation and collection. Besides, as the experience of compost from urban waste shows, market development has to be a critical part of any successful recycling intervention.

Such interventions must encourage recycling of urban solid waste, safely and economically with a view to increase material recovery and increase diversion rates from landfills, through an upgradation of the existing system. More specifically, they need to

1. Encourage industry responsibility for packaging wastes with labeling requirements.
2. Create a system of fiscal incentives and disincentives for enhancing recyclable material collection and reprocessing.
3. Ban materials and products, which are toxic or cannot be recycled.
4. Encourage technology upgradation for waste recycling.
5. Help create markets for good quality recyclable products.
6. Provide opportunities and encourage the organization of the waste pickers sector in order to increase their margins and improve their social security needs through enhancing their livelihood needs.
7. Aid in the legitimization of the waste trade chain.
8. Prohibit the import of urban or packaging waste.
9. Promote, through incentives recycling rather than energy recovery of waste.

Some suggested interventions

For waste pickers

- **Collection improvement:** Collection centers to help in cleaner recovery of waste and for better prices to the waste pickers. These can be run along with NGOs or entrepreneurs, as well as by the municipality in partnership with them.
- **Organised waste pickers:** Presently there is not even minimal organization of waste pickers and their work depends on the mercy of police, municipality etc. Organizing waste pickers through the help of local bodies and NGOs will help in better collection; reduce harassment by the police and the municipal staff.
- **Other interventions:** Access to health clinics, livelihood skills and opportunities, improved legal and social status, and saving schemes.

Within the recycling trade

- **Sorting, Direct selling:** Direct selling by the waste pickers will eliminate the need for small waste dealers and will enhance waste pickers income.
- **Land legitimacy:** Allotment of land by the local bodies will provide social security both to the waste dealers and the waste pickers and provide a much-needed legitimacy for this profession.
- **Social net:** Through better organisations of waste pickers, to help in removing patronage based relationship and replacing them with a better social net. Include various interventions such as for livelihoods enhancement, health clinics, saving channels etc.
- **Prohibit imports:** Import of waste leads to diminishing of prices of the domestic waste and hence is a direct threat to the livelihood of the waste pickers. Moreover, the required technology for reprocessing such waste is not available.
- **Police harassment:** Police has been the biggest troublemakers for all the players involved, whether it is a waste picker or dealer or reprocessing units.
- **Form a forum to listen to demands;** Creating such a platform will help to reduce the grievances of all the players in waste trade.

For Waste Dealers

- Land Allotment
- Fire Insurance (the insurance companies do not insure because the business is done in open space)
- Monetary Loans
- Infrastructural Facilities like roads, fire safety, electricity, etc.

For Recycling Units

- **Infrastructure:** The areas where the recycling units are located are marred by poor infrastructure like roads, power, land etc.
- **Economies of Scale and technology upgradation:** Since recycling is already a reality, there is a need to upgrade the existing technology, which is rudimentary and basic with severe occupational hazards.
- Exemption from all import duties for import of plastic re-cycling equipment
- **Extension of seed finance:** This will enable both the waste dealers and recyclers to upgrade their inventory and technologies.

Stakeholder Roles

Industry

- Sustainable packaging policy
- Buy back schemes to encourage collection- Incentive to the waste pickers for collection.
- Waste collection centers as business models.
- Recycling approval before introducing new packaging materials.

Local Government/ Municipalities

- Notate a nodal officer to deal with this issue and help develop programs.
- Increase collaborations with NGO, and other stakeholders as a partner.
- Help initiate various interventions for waste pickers such as for health improvement, livelihood enhancement, saving channels etc.
- Help in legitimising the activity through supporting other interventions as suggested above.
- Play a catalyst role in helping in the evolution and development of recycling systems.
- Desist from preferring Energy products to material and recycling products.
- Allow financial incentives for supporting recycling as cost saving through this sector.
- Allow for the use of land to support collection and segregation centres.

Non-Government Organisations

- Should be provided a specific role in the area of organising waste pickers, interventions in their community to improve livelihood skills, health provisions, as well as improve bargaining power.
- Can also help train this sector, making them more aware of their rights and responsibilities, and help obtain fair working conditions and wages.
- Encouraged to play a role of an intermediary with other stakeholders for this sector.
- Encouraged to become partners with the private sector and the municipalities or local governments to play these roles.
- Monitoring and watchdog role of functioning of collection centres, recycling units etc.

Government

- Examine the issue of recycling within the framework of Extended Producer Responsibility. Specific product bans (such as for carry bags) should operate within this framework, where while some products are banned owing to their inability to be recycled or their toxics nature, the recycling of others is simultaneously made possible and sustainable.
- Subsidy for recycling equating it to energy recovery
- Import policy to permit low duty import of re-cycling equipment.
- Local governments to consider establishment of recycling centers in partnership with the industry, and NGOs.

- Technical training to industry owners and workers should be provided on proper recycling so as to minimize the environmental impacts of recycling and also on waste management of the waste generated in recycling units
- To evolve standards with other nodal agencies like Bureau of Indian Standards, Indian Institute of Packaging, etc.
- Encourage preferential buying with recycled content: This will help gaining market for recycled products.
- Labeling: It will help in proper recycling and also make the consumer aware about the product packaging they are buying.
- Implement laws: The most urgent need is to make necessary reforms in the existing policies and if needed, make fresh laws to be implemented forcefully.

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Recycling Responsibility

This report explores the changing face of Indian waste and its management, comparing new technologies and traditional systems, in an attempt to define the essential roles and responsibilities of various players in this critical sector



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less waste is best

