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TELLUS INSTITUTE
for Resource and Environmental Strategies

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MANAGEMENT OF PACKAGING WASTE IN MEXICO CITY

a final report to

United Nations International Development Organization
Project number SF/MEX/94/001
Lifecycle Analysis and Legislation for Packaging Materials in Mexico
Contract number 94/030

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I. Summary

Over the last several decades. Mexico's primarily agrarian and rural society has been transformed into a culture which is increasingly urban and industrial. The Mexico City area has become the focus of urbanization: more than fifteen million people live in the metropolitan area formed by the city itself (the Federal District) and the surrounding urban areas (in the state of Mexico). As the Federal District has grown. so too has the amount of garbage which its residents generate. The increase in population alone would imply tremendous increases in the amount of waste generated. In addition. manufactured consumer goods and packaging have entered the lives - and waste generation rates - of Federal District residents: the plastics. glass. metals and paper used to sell single-serving containers. prevent food spoilage. and package other consumer goods eventually find their way to the garbage can.

Increasing waste generation and environmental hazards have played a role in changing the District's waste management system. Until recently. none of the landfills into which the District's waste was dumped used modern pollution control techniques or technologies. Threats to the groundwater and air quality from landfill emissions led the government to construct a modern sanitary landfill. Bordo Poniente. which soon will become the sole site for final disposal of waste. Currently. valuable materials are collected for recycling throughout the waste management process: sanitation workers both on the garbage trucks and at transfer stations skim off some of the high-quality recyclable materials. while scavengers ("*pepenadores*"). who often live on landfill sites. pick through the garbage once it has been dumped. earning income from the materials they collect. The health hazards and poor working conditions of the landfill scavengers are another major impetus for changes in the existing waste management system. In 1995. landfill scavenging will be fully banned. and construction of "selection plants" - facilities where garbage can be sorted into recyclable and nonrecyclable fractions - will provide employment for the *pepenadores*.

How efficient is the current. informal system at diverting recyclable materials? And what effect will the introduction of selection plants and banning landfill scavenging have on diversion rates? Anecdotal evidence suggests that the current recycling/scavenging system diverts high percentages of the valuable materials in the District's trash. According to some journalistic accounts. nearly all of the high-quality recyclables are diverted by the sanitation workers and other scavengers during the collection process. while thousands of *pepenadores* salvage anything else of value. even animal bones and plastic dolls. at the landfills.[1]

Yet Tellus Institute's analysis of data provided by the International Recycling Institute reveals that scavenging. though effective at diverting some material types. is much less efficient than the anecdotal evidence would suggest. Moreover. although the selection plants will increase diversion of recyclable materials. significant percentages of many valuable materials

[1] For a detailed account in English. see Alma Guillermoprieto. "Letter from Mexico City". *The New Yorker*. September 17. 1990. pages 93-104.

will still be landfilled. This will occur because the selection plants do not have sufficient capacity to recover all of the recyclables generated in the District. Table 1 shows the percentage of five material types projected to be landfilled under the current and future waste management systems, in 1994 and 2000.

Table 1 - Percentage of material landfilled

Material Type	Percentage Landfilled in	
	1994	2000
Paper	71%	65%
Glass	44%	61%
Plastic	86%	78%
Aluminum	40%	37%
Other Metals	39%	29%

More glass and other metals are projected to be landfilled under the future system than under the past one. For these materials, the higher sorting efficiency of the selection plants is more than outweighed by the plants' limited capacity to handle trash.

Our results suggest three methods for improving the environmental effects of waste management in the Federal District:

- **Promote formal and informal systems for maximizing front-end recycling, especially of paper.** Paper forms the largest category of recyclable materials, and by far the largest quantity of valuable material being landfilled. It is also a material which must be kept separate from general waste collection to produce high-value feedstocks. Promoting collection of used paper from residences and businesses could significantly increase the quality and quantity of Mexican recycled paper.

- **Expand the capacity of the waste selection plants, or build additional plants.** The capacity of the three existing plants is already inadequate to recover all of the valuable recyclable materials in the waste stream. As the population and waste stream grows, the need for new capacity will become even greater.

- **Compost organic wastes.** Approximately half of the District's waste is food scraps and yard trimmings, which are readily compostable. After separation of recyclables, most of the remaining waste is compostable. Composting these wastes will convert organic materials destined for the landfill into a useful soil amendment.

II. Assumptions and Methodology

A. Introduction

Tellus Institute has analyzed the Federal District's solid waste system in order to project the effects of changes in waste management on the recycling of packaging materials. The analysis was performed for a seven-year period, from 1994 to the end of the century. Tellus used its WastePlan© computer software for the analysis. WastePlan is a sophisticated planning tool which facilitates integrated solid waste system planning based on user-input data. The International Recycling Institute (IIR) provided the data on the Federal District.

Three elements characterize the District's waste management system as of 1994.

- Three landfills - Prados de la Montana, Santa Catarina, and Bordo Poniente - are used for waste disposal.

- "Urban scavengers" - especially sanitation workers and "volunteers" who accompany them - separate valuable materials during collection and transfer.

- Once waste is sent to landfills, landfill scavengers (*"pepenadores"*) capture some of the remaining valuable materials. The *pepenadores* are only allowed to scavenge on the Prados de la Montana and Santa Catarina landfills.

Two of these elements are scheduled to change at the beginning of 1995.

- Prados de la Montana and Santa Catarina are scheduled to close at the end of 1994, leaving only Bordo Poniente for waste disposal; this will eliminate landfill scavenging.

- Three new "selection plants" will receive waste from the transfer stations, and there recyclable materials will be separated. The Bordo Poniente landfill will also receive waste directly from some transfer stations, as well as the residue from the selection plants. The former *pepenadores* will form the selection plants' labor force.

The urban scavengers' activities will likely continue as before.

B. Projecting municipal solid waste generation

In order to calculate the amount of recyclable material that is recovered, and the amount ending up in the landfill, it is first necessary to determine how much waste is being generated. For this purpose we used population and waste generation estimates by administrative district, or "delegation." The Federal District is subdivided into sixteen delegations, ranging in population from Milpa Alta, with a population of under 100,000, to Iztapalapa, with more than 1,500,000 people.

Estimates of each delegation's current population and tons of waste generated per day were used to calculate tons of waste generated per person per year. We assumed that this per capita generation rate would remain constant for each delegation: that is, all growth in waste comes from population growth. We therefore multiplied per capita generation rates by estimates of population in the year 2000 to project future waste generation. Table 2 shows population and waste generation by delegation for the years 1994 and 2000.

For our analysis it is necessary to estimate the composition of materials in the waste. We divided the Federal District's waste stream into eleven waste types. The first nine waste types comprise nearly all of the waste currently recycled in the District. Most of them are packaging materials.

- Paper
- Corrugated cardboard
- Paperboard boxes
- Glass bottles
- Plastic film
- Rigid plastic containers
- Tin-plated steel cans
- Aluminum cans
- Other ferrous metal
- Organic materials
- All other wastes

Table 3 shows the estimated composition of the District's waste in 1994. The table shows that just over one-third (35.47%) of the waste generated is considered recyclable. Paper products comprise more than half of the recyclables. Table 4 shows the estimate of total tonnes of each waste type generated in 1994 and 2000.

Table 2 - Population and waste generation by delegation in 1994 and 2000

Delegation	1994 Population	2000 Population	1994 Generation	2000 Generation
A. Obregón	683,326	996,300	246,394	359,246
Azcapotzalco	503,925	734,730	210,381	306,738
Benito Juarez	432,646	630,805	251,353	366,477
Coyoacan	733,283	1,069,138	261,564	381,364
Cuajimalpa	147,606	215,212	53,334	77,762
Cuauhtemoc	611,167	891,092	536,115	781,666
G. A. Madero	1,370,267	1,997,872	460,948	672,070
Iztacalco	475,754	693,658	179,394	261,560
Iztapalapa	1,691,900	2,466,818	612,637	893,235
Magdalena C.	249,135	363,243	75,749	110,443
M. Hidalgo	431,544	629,199	309,195	450,812
Milpa Alta	72,053	105,055	23,134	33,730
Tlahuac	253,721	369,930	56,054	81,728
Tlalpan	621,897	906,737	145,483	212,116
Venustiano C.	551,357	803,888	437,651	638,103
Xochimilco	317,400	462,775	82,729	120,620
Total	9,146,981	13,336,452	3,942,114	5,747,669

Source: IIR

Table 3 - The Federal District's waste composition

Material	Percentage of Waste Stream
Paper	12.64%
Corrugated cardboard	3.38%
Paperboard boxes	1.78%
Glass bottles	7.11%
Plastic film	4.84%
Rigid plastic containers	3.26%
Tin-plated steel cans	1.16%
Aluminum cans	0.52%
Other metals	0.78%
Organic materials	47.95%
All other wastes	16.58%

C. Waste collection

The Federal District's waste collection system, based on regular truck collection routes, bears a great deal of resemblance to those of the OECD countries. However, there are some differences. One difference is that a significant proportion of waste is not collected at all. Many outlying neighborhoods do not have formal waste collection services and some waste is littered or illegally dumped. IIR estimates that 1.518 tonnes of waste per day are not collected, which represents 14.08 percent of the total waste generated.

The remainder of the waste is collected by trucks and in most cases taken to transfer stations. At the transfer stations, waste is transferred from the collection trucks to larger trucks, which take the waste to the District's landfills. Thirteen of the District's sixteen delegations have transfer stations. Waste from Cuajimalpa, Ixtacalco and Tlalpan - smaller, low-income delegations on the District's periphery - is trucked directly to landfills.

D. "Urban scavenging"

Valuable recyclables are routinely removed from the collected garbage; this occurs both while trucks are collecting garbage and once waste is brought to the transfer stations. This "urban scavenging" is estimated to remove 350 tonnes of recyclables per day, or 3.24 percent of total generation. Table 5 shows the tonnages and diversion rate for each material.

Table 4 - Total tonnages generated by material in 1994 and 2000

Material	1994 Generation (1,000 MT)	2000 Generation (1,000 MT)
Paper	498	726
Corrugated cardboard	133	194
Paperboard boxes	70	102
Glass bottles	280	409
Plastic film	191	278
Rigid plastic container	128	187
Tin-plated steel cans	46	67
Aluminum cans	20	30
Other metals	31	45
Organic materials	1,890	2,756
All other wastes	654	953

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Table 5 - Tonnages and diversion rates from urban scavenging[2]

Material Type	Generation (tonnes)	Diversion (tonnes)	Percentage Diverted by Scavenging
Paper Products	701.000	93.000	13.3%
Glass	280.000	7.000	2.6%
Aluminum Cans	20.000	7.000	36.4%
Steel	77.000	15.000	19.5%
Other	654.000	4.000	0.6%

Aluminum is diverted at the highest rate, reflecting its high value per tonne. More than one-third of the aluminum generated is collected by urban scavenging. Approximately four-fifths of the total tonnage diverted by urban scavenging is paper products. The source of our data is shown in Appendix B.

E. Costs of waste collection and transfer

The costs of waste collection and transfer are lower than the costs in many OECD countries. Waste collection costs 100 pesos (N$) per tonne collected, or approximately US $30 at current exchange rates. Transfer stations cost N$ 47.50 per tonne transferred. Landfill costs are N$ 20 at the two older sites, and N$ 25 at Bordo Poniente. The total collection, transfer, and disposal cost of about US $50 per tonne is roughly comparable to costs in small, low-density U.S. cities with ample existing landfill capacity.

We were not able to determine how costs will change with the future growth of the waste stream, or with increases in recycling. Some observers suggest that total (not per-tonne) collection costs may be relatively inflexible. Therefore, we have not analyzed the cost implications of changes in waste management strategies.

F. Waste processing and final disposal - current system

Appendix A-1 shows where each delegation's waste is sent for transfer and then for disposal, as of 1994. The *pepenadores* are estimated to collect 432 tonnes per day of recyclables at Santa Catarina and Prados de la Montana, or 4 percent of the District's generation of waste. Table 6 shows the tonnages and diversion rates for several types of materials.

[2] Note that tonnages are rounded to the nearest 1,000 MT.

Comparing Tables 5 and 6 shows that urban scavengers collect higher-value material than do the landfill scavengers, as one might expect. Urban scavengers collect three times the aluminum as landfill scavengers do, while the landfill scavengers collect more steel than do their urban counterparts. Urban scavengers take much paper and cardboard but little glass, while landfill scavengers collect large quantities of glass, and small quantities of paper. Finally, the landfill scavengers collect large quantities of "other" materials and some plastics, materials which are too low in value for most urban scavengers to take. Appendix B shows the initial data from which the diversion rates were derived.

Table 6 - Tonnages and diversion rates from landfill scavenging, 1994[3]

Material	Tonnes Received at Landfills	Tonnes Diverted by Scavenging	Scavenging as Percentage of Material Generated
Paper Products	509,000	9,000	1.3%
Glass	233,000	110,000	39.3%
Aluminum Cans	10,000	2,000	10.0%
Steel	52,000	22,000	28.6%
Plastic	274,000	1,000	0.3%
Other	557,000	13,000	2.0%

G. Waste processing and final disposal - future system

The future system will change the routing of wastes from the delegations (and transfer stations). Waste will be sent directly to Bordo Poniente from four lower-income delegations whose wastes are likely to contain fewer recyclable materials. In the remaining delegations, waste will be sent from a transfer station to one of the three selection plants. There, the recyclable materials will be diverted, while the residue also will be sent to the landfill. But the selection plants only have a capacity of 1,500 tonnes per day; waste routed to the plants beyond their capacity will also be shunted to the landfill. Appendix A-2 shows the projected routing of waste materials in this new system.

It is estimated that recovery rates of recyclables will increase under this system; the selection plants are projected to divert 252,000 tonnes per year as compared to 157,000 tonnes per year diverted through landfill scavenging, an increase of over 60%. Table 7 shows future

[3] Note that tonnages are rounded to the nearest 1,000 MT. Percentages shown in column 4 are calculated by dividing the tonnage diverted (column 3) by the tons generated (see column 2 of Table 4).

diversion of recyclables, based on estimates of material specific diversion rates at the selection plants (see Appendix B).

Table 7 - Tonnages and diversion rates from selection plants, 2000[4]

Material	Tonnes Received at Plants	Tonnes Diverted at Plants	Diversion as Percentage of Material Generated
Paper Products	219,000	78,000	7.6%
Glass	102,000	90,000	22.2%
Aluminum Cans	3,000	3,000	10.0%
Steel	24,000	15,000	13.4%
Plastic	120,000	36,000	7.7%
Other	240,000	24,000	2.5%

Figure 1, which compares the information in Tables 6 and 7, shows that there are slight decreases in the diversion rates of glass and steel. This stems from the limited capacity of the selection plants, which can process only 4,500 tonnes of waste per day (1,500 per plant). The Federal District is projected to generate over 11,000 tonnes daily in 1995, when the plants begin operating. Even though workers at selection plants can capture materials more efficiently than can landfill scavengers, the *pepenadores* have access to more garbage coming into the landfills. The *pepenadores*, therefore, are projected to divert more glass and steel - the materials in which they currently collect most effectively. On the other hand, switching to selection plants is projected to increase the diversion rates of other materials, especially paper; increased paper recycling accounts for the bulk of the increases in tonnage as a result of the switch to selection plants.

The costs of waste management will be higher under this system. All landfilled waste will be sent to the more expensive Bordo Poniente landfill. Moreover, the municipal government will incur a cost of N$ 50 per tonne of waste **sent** to the selection plants, despite the fact that more than five-sixths of the waste sent to the plants will eventually be landfilled. These costs may be offset by the public health benefits resulting from the more sanitary working conditions offered by the selection plants and from the stronger environmental controls at Bordo Poniente.

[4] Note that tonnages are rounded to the nearest 1,000 MT. Percentages shown in column four are calculated by dividing the tonnage diverted by the tons generated (see column 3 of Table 4).

H. Environmental impacts of waste management

Management of solid waste in general, and packaging waste in particular, has a number of environmental impacts. Based on an examination of these effects, however, we concluded that it is not possible to assign differential impacts to individual packaging materials.

Garbage collection involves truck traffic: roughly 2,000 trucks pick up solid waste throughout the Federal District on a daily basis. While these trucks make an obvious contribution to traffic, and vehicle emissions, they account for a very small fraction of total vehicle use. On a per-tonne basis, the collection truck emissions are also quite small compared to the emissions from packaging production, as documented in the *Life Cycle Inventory* report by Franklin Associates. Moreover, the number of collection trucks may be determined by political constraints, rather than by the tonnage of waste being collected. For all of these reasons, we have not assigned collection truck emissions to individual packaging materials.

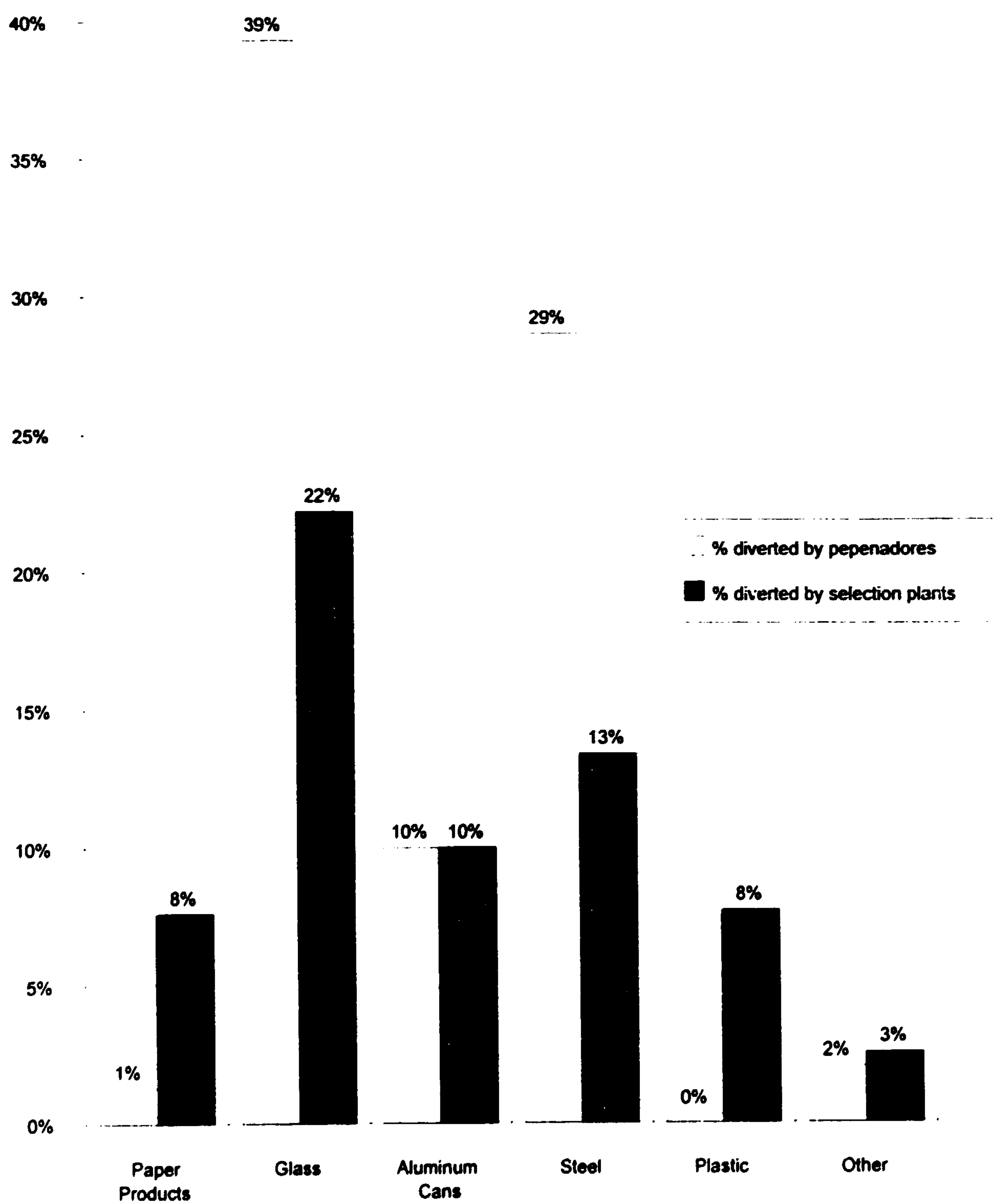
At the landfill there are several additional types of environmental impacts. Undoubtedly the most serious is the effect on health and safety of the *pepenadores*, at those landfills where scavenging is permitted. Almost all of the materials that are profitable to scavenge are packaging, so these effects could be attributed to packaging in general. However, we did not attempt to quantify the (obviously serious) health impacts of landfill scavenging.

Landfills also give rise to air and water emissions. Landfill gas emissions consist primarily of methane, which makes a significant contribution to global warming. Paper and other organic wastes are the sources of landfill methane, although there is continuing scientific controversy over the precise methane generation factors per tonne of each type of waste. Emissions of methane can be reduced by recycling of paper, and composting of food waste and other organic matter; and methane emissions can be captured and converted into useful fuel by modern control equipment.

Landfill leachate (water run-off) can contain many different hazardous pollutants. Many of these pollutants result from the small quantities of household hazardous wastes, such as batteries, oil-based paints, certain cleaning products, etc., that end up in landfills. These emissions can be reduced by programs to keep batteries and other hazardous materials out of landfills; emissions can also be captured by leachate control equipment.

While landfill emissions are important, they are difficult to associate with individual waste materials in most cases. Due to the joint handling of different waste materials, and the complex chemical processes that occur inside landfills, we cannot calculate the role of packaging in generating landfill emissions. In this and other cases, the environmental impacts of waste management activities should be addressed as joint problems of integrated waste management, rather than being assigned to specific waste materials.

Figure 1 - Comparison of diversion rates from landfill scavenging and selection plants



III. Results of WastePlan Analysis

A. Neither system diverts all the recyclables available

Despite the anecdotal evidence suggesting that scavenging in the District diverts huge proportions of the recyclable materials, the WastePlan analysis shows that significant proportions of many valuable materials are being landfilled. Moreover, the switch from landfill scavenging to selection plants still will not prevent the loss of many tonnes of recyclables. Table 8 shows, for all waste types, the number of tonnes and percentage of waste landfilled under the current and future systems. The accompanying graph compares the percentages of waste landfilled. Both currently and in the future, high percentages of the paper, plastics, organic materials and other wastes generated are landfilled, while smaller fractions of metals and glass are not recycled. Note that 14 percent of each waste material is assumed to be illegally dumped, as discussed above.

The analysis reveals that hundreds of tonnes of paper are landfilled every day. Much of the paper consumed in Mexico is produced from waste paper imported from the United States. It seems reasonable to assume that at least some portion of that feedstock could be replaced by Mexican wastepaper, if a sufficient supply of high-quality wastepaper could be provided.

This feedstock cannot be obtained given the Federal District's current, or its projected, recycling system. Obtaining high-quality recycled paper and cardboard depends upon keeping these products dry and separate from the general waste stream. The garbage truck personnel do have some opportunity to keep paper products separate from the bulk of the wastes they collect, and they are currently responsible for the bulk of the paper recycled. Once paper is mixed with wet waste and processed through the transfer stations, its value decreases sharply, which is why the landfill scavengers collect so little of it.

For the same reason, the selection plants will not yield high-quality wastepaper. The selection plants will improve the efficiency of the final scavenging process (and the health of the workers), but will have smaller effects on the types and quality of materials recovered, since paper, glass and plastics will still arrive at the facility highly contaminated.

B. The capacity of the selection plants is low

The selection plants do not have the capacity to process all of the waste from higher-income delegations at present, let alone in the future. Figure 2 displays the projected yearly capacity of the selection plants compared with the amount of waste available to be sent to them. In 1995 the selection plants are projected to have only 60 percent of the capacity required, even assuming that wastes from four of the lowest-income delegations[5] are sent

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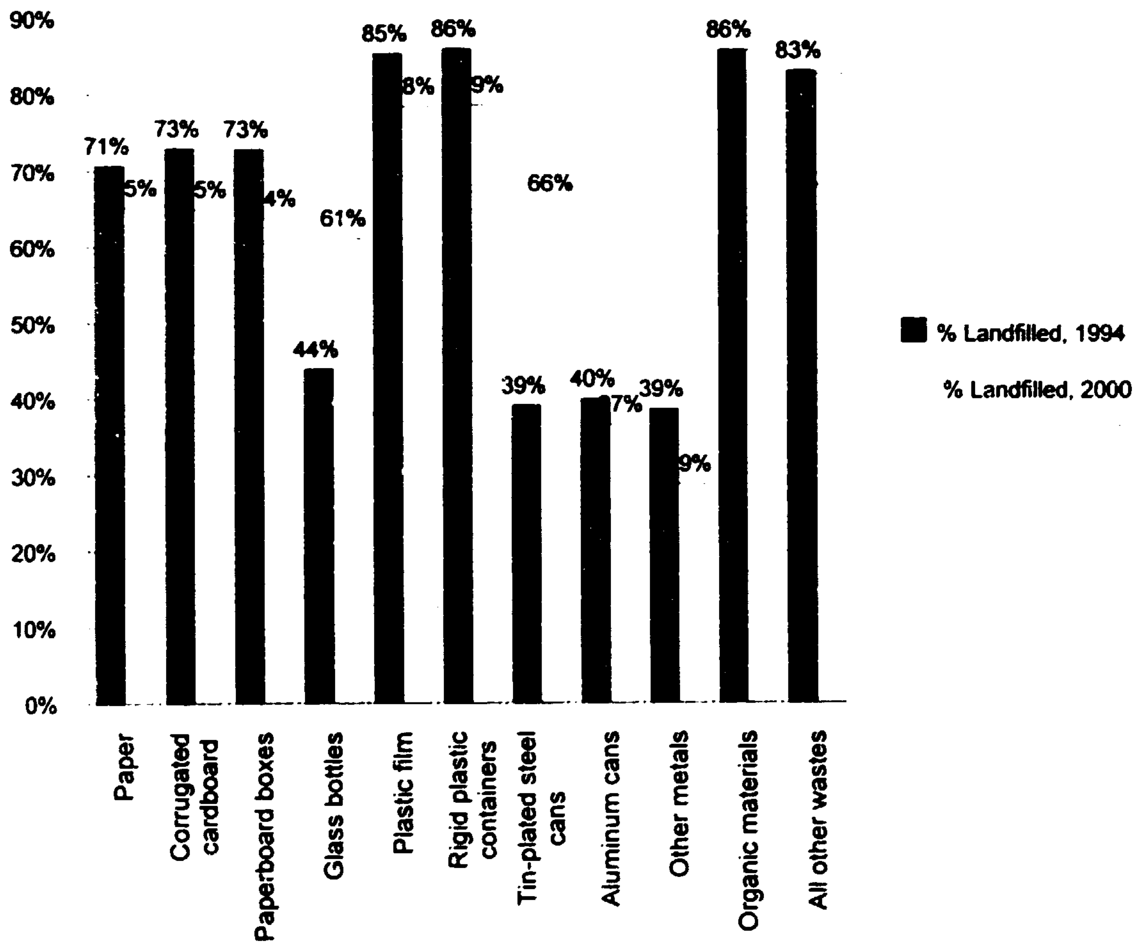
[5] Iztacalco, Iztapalapa, Milpa Alta, and Tlahuac.

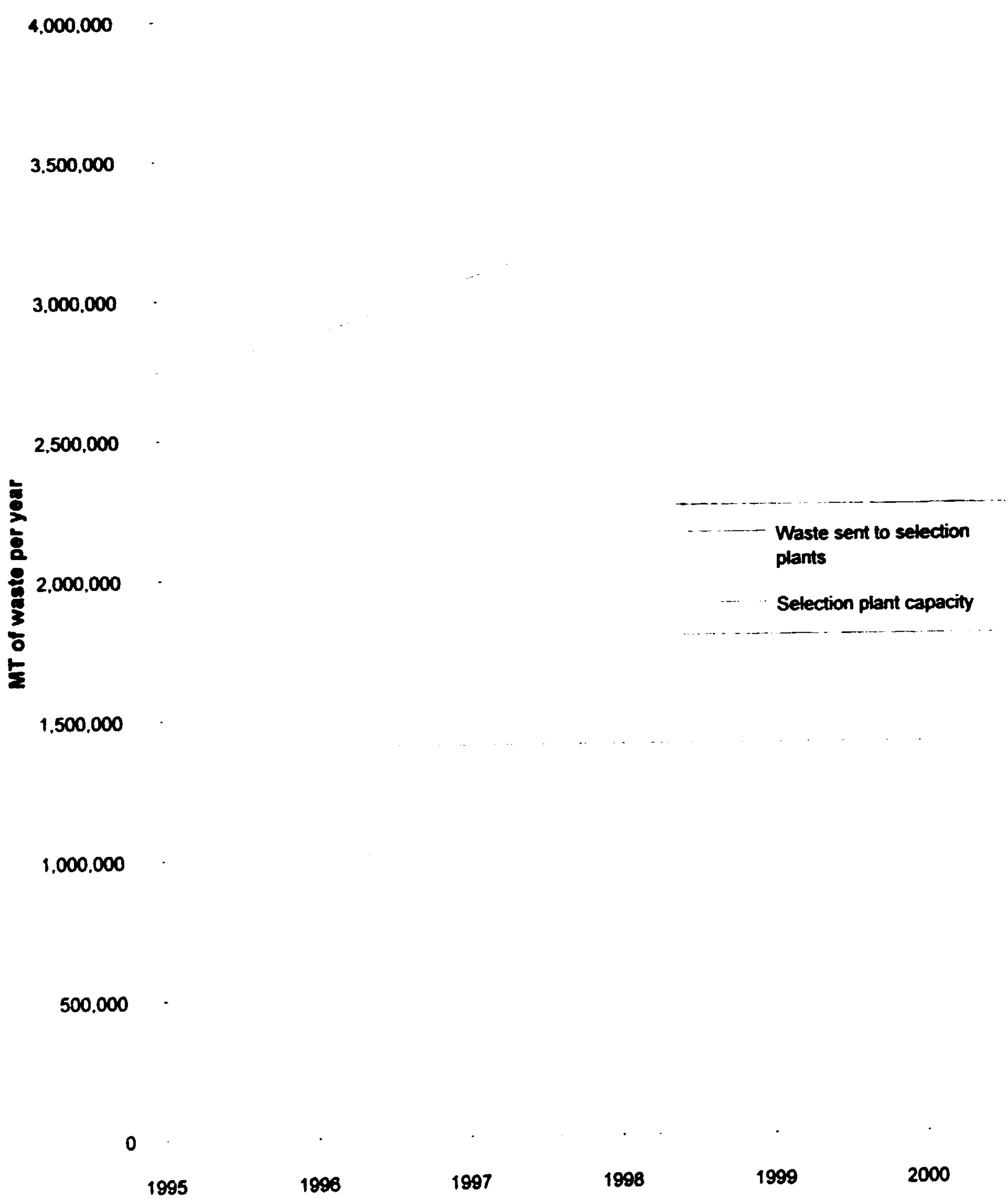
Table 8 - Number of tonnes of waste and percentage waste landfilled in 1994 and 2000

Material	1994 Landfilled (1,000 MT)	Percentage of Material Landfilled	2000 Landfilled (1,000 MT)	Percentage of Material Landfilled
Paper	352	71%	473	65%
Corrugated cardboard	97	73%	126	65%
Paperboard boxes	51	73%	65	64%
Glass bottles	123	44%	250	61%
Plastic film	163	85%	218	78%
Rigid plastic containers	110	86%	147	79%
Tin-plated steel cans	18	39%	44	66%
Aluminum cans	8	40%	11	37%
Other metals	12	39%	13	29%
Organic materials	1,623	86%	2,366	86%
All other wastes	544	83%	788	83%



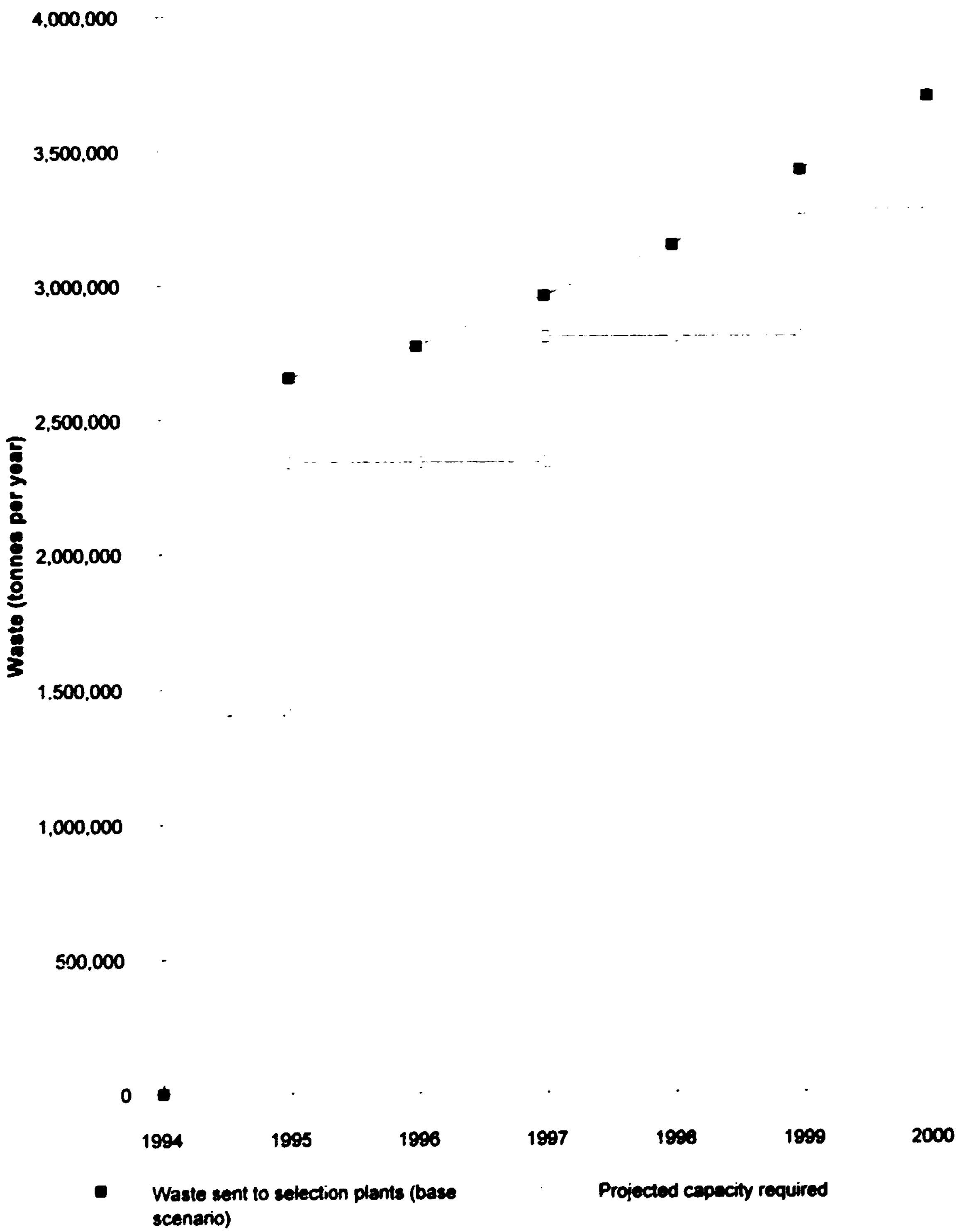
Source: IIR

Figure 2 - Comparison of waste sent to selection plants with selection plant capacity



1995, 1997 and 1999 values are interpolations.

Figure 3 - Projected amount of waste sent to selection plants and projected capacity required (base scenario)



directly to the Bordo Poniente landfill. By the end of the century, rapid population and waste generation growth imply that the three selection plants will be able to process 40 percent of the waste sent to them.

Figure 3 shows our projections of the waste that could be sent to the selection plants from the twelve delegations that currently use them. We developed a simple model which projected the time at which new plants would be built. We assumed that every time required capacity exceeded actual capacity by more than 1500 tons per day, a new plant would be built. The model calculated that two additional plants would be necessary to handle the waste stream in 1995, another in 1997, and yet another in 1999.

C. Paper separation and recycling could increase recovery and lower costs

We developed a second scenario to assess the impact of diverting paper through a separate recycling program. The separated paper could be collected and diverted by municipal garbage collectors, or, alternatively, by third-party businesses or individuals. We assumed that 50% of paper, cardboard and cardboard containers were removed from the waste stream by new recycling efforts, in addition to the amounts removed through illegal dumping and urban scavenging. The percent of paper product recovery at the selection plants was not changed; in this scenario the workers therefore divert the same percentage of a much smaller incoming quantity of each paper product category. The results are presented in Table 9, while Figure 4 shows the impact on the required plant capacity.

Figure 4 shows that the paper recycling program causes a noticeable impact on the amount of waste remaining for processing or disposal. The total amount of waste which could be sent to the selection plants drops slightly in 1996, the year the paper recycling program reaches peak diversion efficiency, and then begins to rise. The yearly increase in tonnage which could be sent to the selection plants is smaller in the paper recycling scenario than in the base scenario.

As a result of this waste reduction, the existing selection plants will be able to handle an increased percentage of the city's waste disposal, and will recover an increased percentage of the recyclables that remain in the trash. The plant capacity needed to process all of the Federal District's waste is also reduced by the paper recycling scenario, as shown in Figure 5. As in the base scenario, two new plants are needed in 1995; however, the third new plant is delayed from 1997 to 1999, and the fourth plant is delayed from 1999 to 2000. In short, the projected paper recycling program would delay the need for new plant capacity by one to two years, starting in 1997.

Figure 4 - Comparison of waste sent to selection plants in the two scenarios

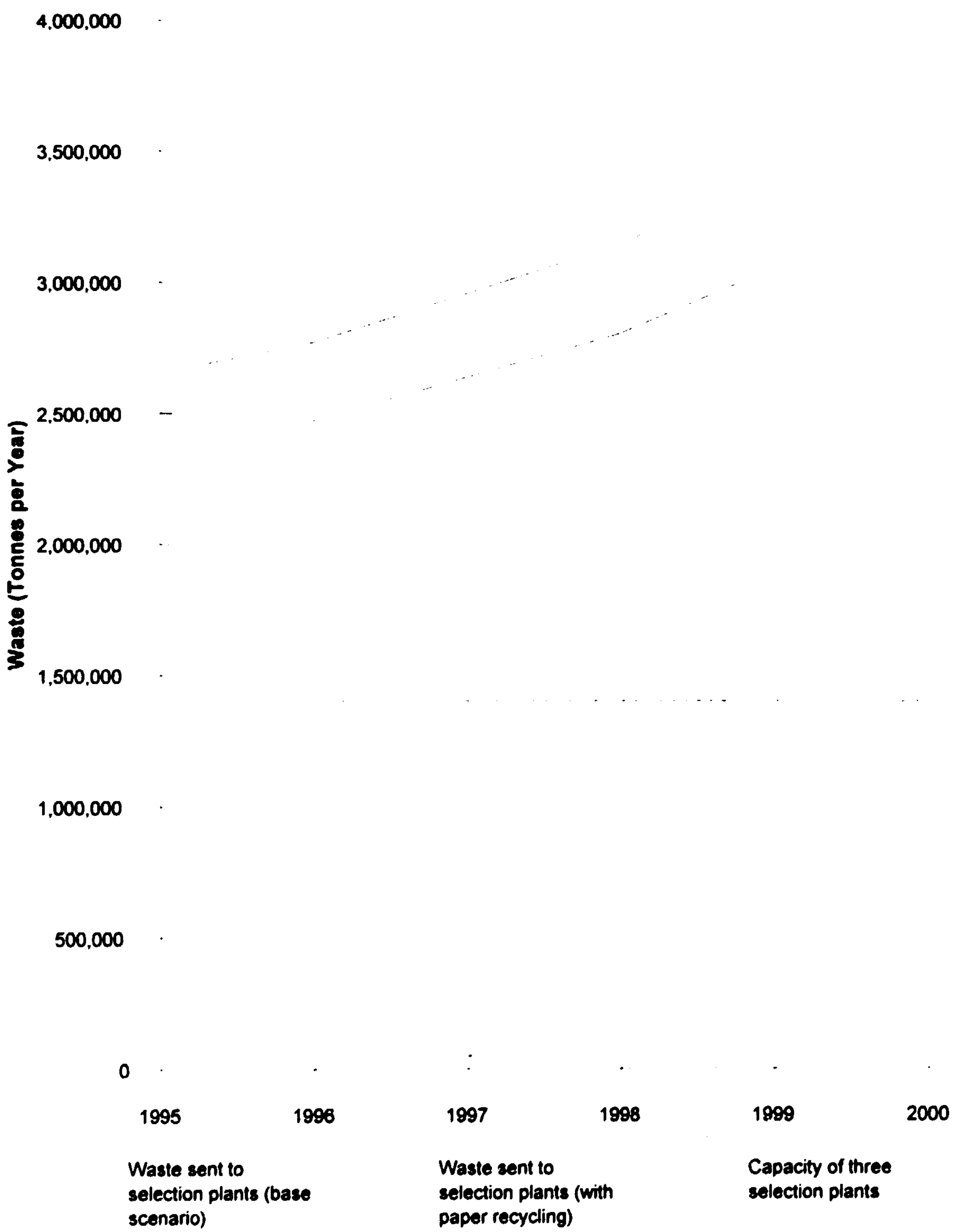


Figure 5 - Projected waste sent to selection plants and projected capacity needed (with paper recycling)

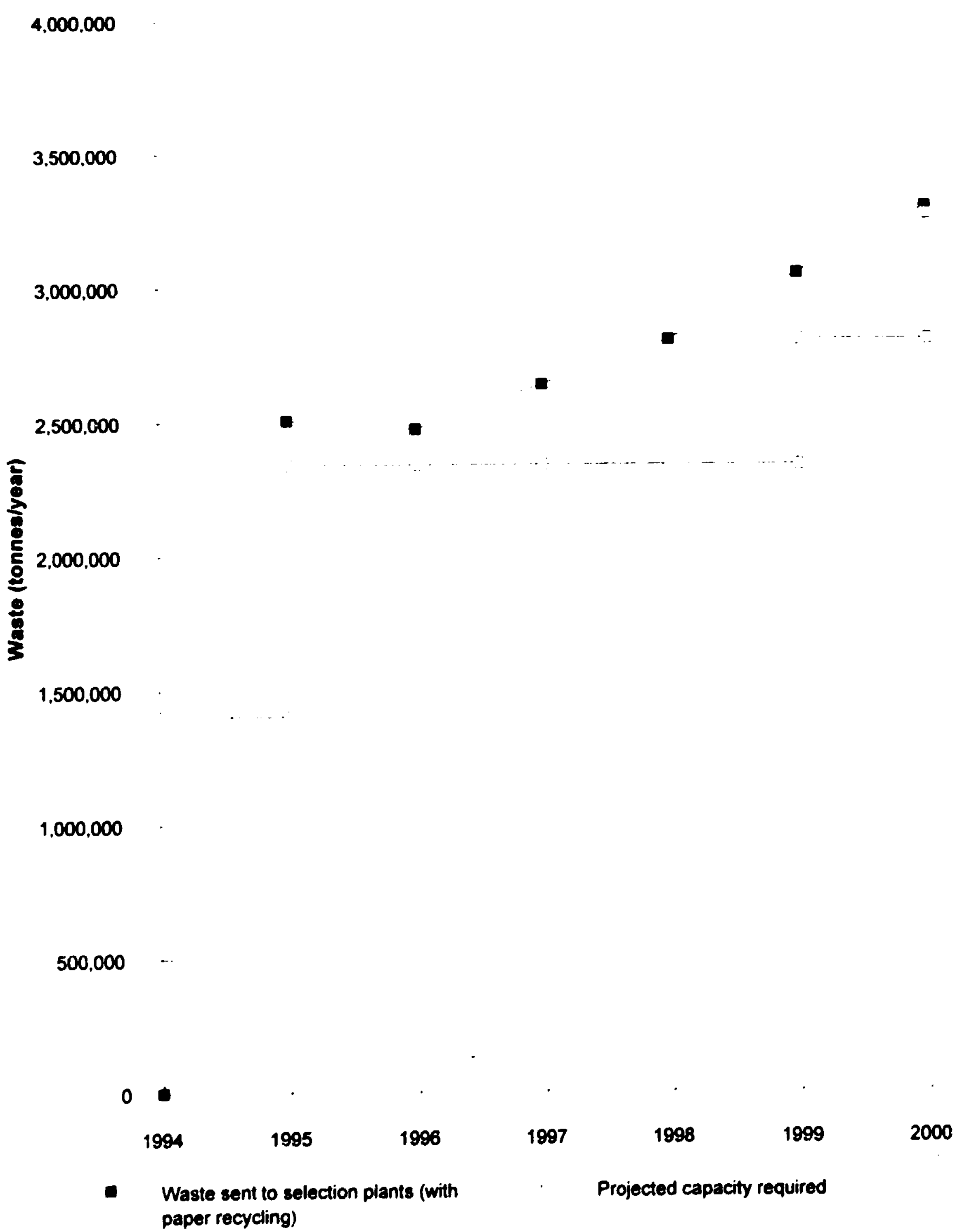
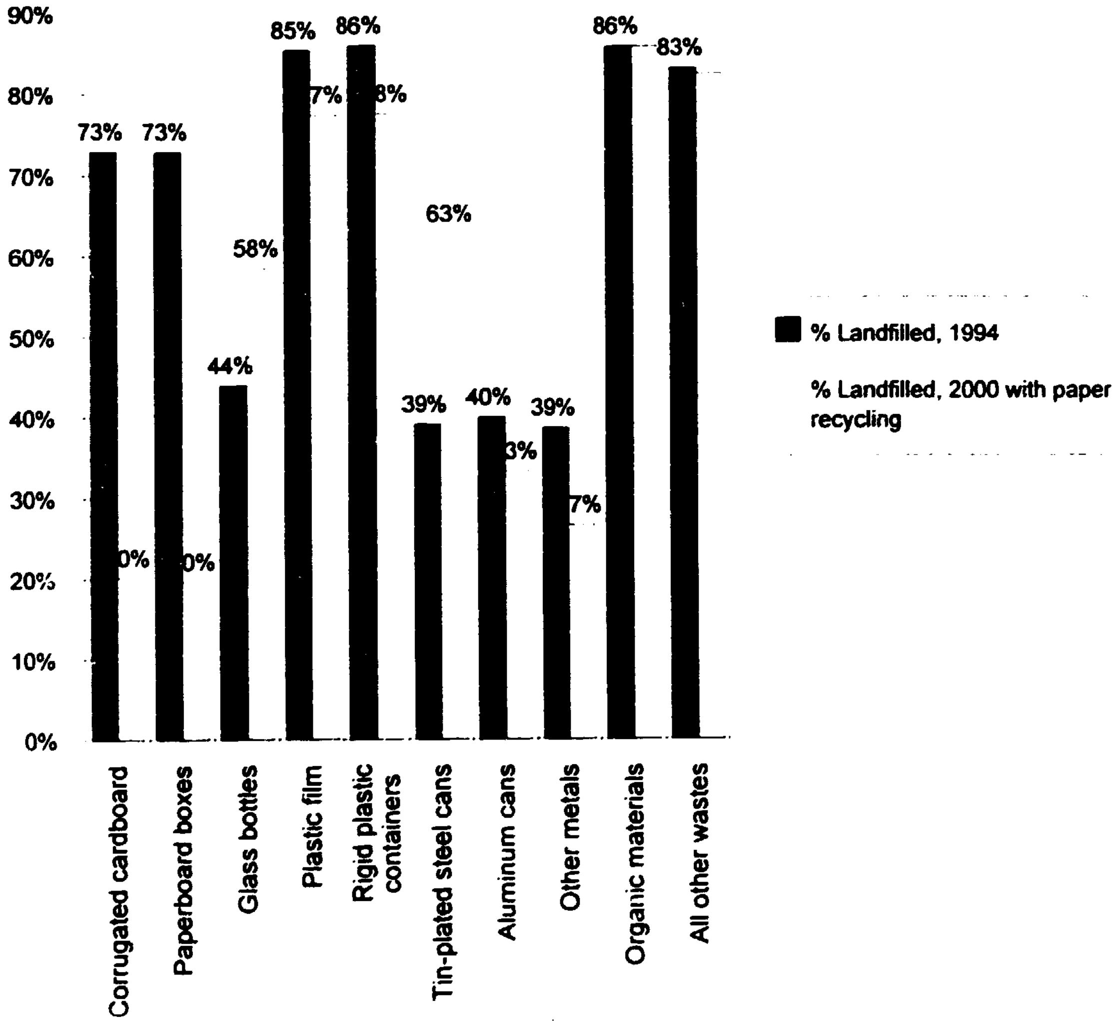


Table 9 - Number of tonnes of waste and percentage waste landfilled in 1994 and 2000, with paper recycling

Material	1994 Landfilled (1,000 MT)	Percentage of Material Landfilled	2000 Landfilled (1,000 MT)	Percentage of Material Landfilled
Paper	352	71%	145	20%
Corrugated cardboard	97	73%	39	20%
Paperboard boxes	51	73%	20	20%
Glass bottles	123	44%	239	58%
Plastic film	163	85%	215	77%
Rigid plastic containers	110	86%	145	78%
Tin-plated steel cans	18	39%	42	63%
Aluminum cans	8	40%	10	33%
Other metals	12	39%	12	27%
Organic materials	1,623	86%	2,366	86%
All other wastes	544	83%	786	82%



Source: IIR

D. Recommendations

Although the landfill scavenging ban and the construction of the selection plants will have positive public health benefits, these changes alone will not cause a significant long-term increase in the District's recycling rates. Growth in recycling in the Federal District will require further measures to complement the system to be implemented in 1995. One option would be to require businesses (and possibly residences) to separate paper products from their other garbage. It is possible that other materials, such as metals and glass, could also be separated and collected from residences and businesses.

A second option suggested by the WastePlan analysis is to expand the capacity of the existing selection plants, or build additional plants. By the year 2000, the waste stream available for processing or disposal will be more than twice as much as the three existing plants can handle. Recyclable materials in the waste that is not processed at the plants are simply lost in the landfill. At least two additional plants could be used immediately, and even more in a few years.

A final method of diverting large quantities of waste from the District's landfill would be to promote composting. Approximately half of the waste generated in the city consists of food scraps and yard trimmings. After removal of recyclables, the remaining waste stream consists primarily of compostable materials. Composting these wastes would extend the life of the Bordo Poniente landfill, and would create a valuable soil amendment that could be substituted for natural topsoil or imported fertilizers.

Appendix A - Waste Routings

Appendix A - Flow of collected garbage in 1994 and 2000

Flow of collected garbage in 1994

Delegation	Transfer Station	Landfill
A. Obregón	A. Obregón	Prados de la Montana
Azcapotzalco	Azcapotzalco	Bordo Poniente
Benito Juarez	Benito Juarez	Prados de la Montana
Coyoacan	Coyoacan	Santa Catarina
Cuajimalpa	None	Prados de la Montana
Cuauhtemoc	Cuauhtemoc	Santa Catarina
G. A. Madero	G. A. Madero	Bordo Poniente
Iztacalco	None	Bordo Poniente
Iztapalapa	Iztapalapa	Santa Catarina
Magdalena C.	Magdalena C.	Prados de la Montana
M. Hidalgo	M. Hidalgo	Prados de la Montana
Milpa Alta	Milpa Alta	Bordo Poniente
Tlahuac	None	Prados de la Montana
Tlalpan	Tlalpan	Santa Catarina
Venustiano C.	Venustiano C.	Bordo Poniente
Xochimilco	Xochimilco	Santa Catarina

Flow of collected garbage in 2000

Delegation	Transfer Station	Landfill or Selection Plant
A. Obregón	A. Obregón	Bordo Poniente Selection
Azcapotzalco	Azcapotzalco	Bordo Poniente Selection
Benito Juarez	Benito Juarez	San Juan de Aragon Selection
Coyoacan	Coyoacan	Santa Catarina Selection
Cuajimalpa	M. Hidalgo	San Juan de Aragon Selection
Cuauhtemoc	Cuauhtemoc	Santa Catarina Selection
G. A. Madero	G. A. Madero	San Juan de Aragon Selection
Iztacalco	None	Bordo Poniente Landfill
Iztapalapa	Iztapalapa	Bordo Poniente Landfill
Magdalena C.	Magdalena C.	Bordo Poniente Selection
M. Hidalgo	M. Hidalgo	San Juan de Aragon Selection
Milpa Alta	Milpa Alta	Bordo Poniente Landfill
Tlahuac	Iztapalapa	Bordo Poniente Landfill
Tlalpan	Tlalpan	Santa Catarina Selection
Venustiano C.	Venustiano C.	Bordo Poniente Selection
Xochimilco	Xochimilco	Bordo Poniente Selection

Appendix B - Diversion Rate Data for Intermediate Calculations

Appendix B- Diversion rate data for intermediate calculations

Material	Percentage of material collected recovered by urban scavengers [1]	Percentage of material entering landfill recovered by pepenadores [2]	Percentage of material entering selection plant recovered by plant workers [1]
Paper	13.28%	3.80%	35.00%
Corrugated cardboard	13.28%	0.00%	35.00%
Paperboard boxes	13.28%	0.00%	40.00%
Glass bottles	2.58%	70.20%	90.00%
Plastic film	0.00%	0.51%	30.00%
Rigid plastic container	0.00%	0.51%	30.00%
Tin-plated steel cans	0.00%	82.00%	80.00%
Aluminum cans	36.44%	33.00%	95.00%
Other metals	47.50%	0.00%	90.00%
Organic materials	0.00%	0.00%	0.00%
All other wastes	0.58%	3.50%	10.00%

Notes:

[1] Provided by IIR

[2] Provided by IIR. These rates apply to the two landfills (Santa Catarina and Prados de la Montana) where scavenging is permitted. No scavenging is permitted at Bordo Poniente, which accepts approximately fifty percent of all waste currently landfilled. This explains the discrepancy between the implied scavenging rates shown in Table Six and the rates shown here.