Identifying the barriers and opportunities for the implementation of an effective Integrated Solid Waste Management Program in the Mexican Federal District

by

Adriana Lopez de Alba Gomez

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Environmental Studies
in
Environment and Resource Studies

Waterloo, Ontario, Canada, 2009

Author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Generation of solid waste is a problem of great environmental significance in the Mexican Federal District. With an estimated daily generation of 12,500 tons waste management is a priority for the district government. Through the launch of a new initiative known as 'Green Plan', the government is proposing to implement an integrated waste management system that will not only reduce the amount of waste sent to landfills, increasing reuse and recycling of waste, but also will allow the district government to realize economic gains by charging a fee for collection services and selling energy generated from incinerating waste.

Integrated waste management programs have been implemented in the Mexican Federal District in the past. They have failed. This research has examined the most recent initiative in an effort to discover the causes of failure, using a case study approach. In addition to identifying barriers to and opportunities for implementation of an effective integrated waste management system in the Federal District, this research recommends options for the newly proposed waste management system that will achieve the objectives desired by the government, while aiding in the pursuit of sustainable development.

The research has revealed that the performance of the Federal District's Integrated Solid Waste Management Program, or any other program of the sort, is affected mainly by a combination of factors that are under the local government's control: legal instruments, administrative organization and political conflicts, allocation of resources, education and training, and citizen participation. Strengthening these areas will improve the performance of the program.

In comparison to much of the existing waste management literature that aims at identifying opportunities for supporting proposed systems through technological innovation (Chambal, et.al., 2003; Eriksson, et.al., 2005; Hung, et.al., 2007), this research has found that key barriers and opportunities lie in the strengthening of the institutional capacities of the local government. While

recommendations of this study have been developed within the specific context of Mexico City, they may offer some more general guidance about how to respond to concerns which are likely to apply to many other large urban municipalities in developing countries. Application of the Gibson principles for sustainability in the context of Sandra Cointreau's guidelines for sustainable waste management has provided a useful evaluation guide. This research has focused not just on evaluation of a particular waste management system, but also on the geographic and administrative context of the system in order to gain a broader insight into the factors over and above technical standards and mechanisms that affect the performance of the system.

Acknowledgements

I want to thank my family who supported me from the beginning of this journey. Thank you for making sure I was fine and doing well every step of the way; also, my Mexican friends, for cheering me on.

I give thanks to you, my loving husband who chose to travel over 3000 kilometres from home just so that I could fulfill one of my dreams.

Thank you, Professor Susan Wismer, for the time dedicated to me and my thesis, and for all the good advice and words of guidance. And to you, Professor Dana Svihlovà, for giving me direction when I didn't quite know where I was headed.

My thanks go out to the rest of the faculty in Environmental Studies for being always willing to lend a helping hand to students in distress and for always having words of courage to keep us going.

I am grateful to my sponsor, CONACYT, for supporting me in this endeavour and because by making me worthy of a scholarship you assured me I was up to the challenge. This research would not have been possible without your funding.

Thanks to all the wonderful people that paraded through my life in these past two years, who became very dear friends, and who made me feel at home in a foreign country.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

1.1 Background

1.1.1 Rationale

Each day, over 900 trailers line up at Bordo Poniente, Mexico City's only operational landfill, waiting to dump truckloads of solid waste. With more than 50 million tons of waste on 420 hectares, the sanitary landfill is nearing capacity. The estimated generation of waste in the Federal District is 12,500 tons per day (2009). This amount increases at a rate of 5% each year. If this waste generation trend continues, by the end of the current administration in 2012 waste generation will be 16,250 tons per day. By that time there will be no sanitary landfill space available[1] (IV Legislative Assembly of the Federal District, 2009).

Current legislation does not allow the Federal District government to charge for waste collection services. However, the population does pay for waste services in the form of informal 'tips' given to waste collectors and truck drivers. These economic resources never become part of the public treasury. Because of higher tips and more valuable materials found in the waste, richer neighbourhoods get better service than poor ones. This problem is exacerbated because the fleet of waste collection trucks is insufficient and obsolete. Further, the current arrangement creates other problems such as illegal scavenging of waste and clandestine open air dumps, with associated health and pollution problems. Many people agree that this system is socially inequitable, environmentally unsound, and economically unviable (Pearce and Turner, 1994; Medina, 1999; Buenrostro, 2006).

In 2004, the Federal District government enacted a series of legal instruments aimed at mitigating these problems. Among these instruments was an Integrated Solid Waste Management Program (ISWMP) with an operational period from 2004 to 2008. Initially, the program garnered

[1] http://www.asambleadf.gob.mx/cm/09/peds-14.pdf. Last access on May 14, 2009.

attention and praise from the media[2]. However, after about two years it lost momentum. By 2008, activities had ceased.

Now in 2009, a new administration is launching a new strategy to implement integrated waste management in the Federal District. This strategy includes the revision of the 2004-2008 ISWMP, changes in legislation that would allow the government to charge for the disposal of waste and the incineration of solid waste, the capture and utilization of methane generated in the sanitary landfill, and construction of a new facility that will include a dry temporary waste disposal site, an incinerator with energy generation, a compost plant, and a recycling center (Integral Energy and Recycling Center). All of this is to be coordinated through the creation of a Commission for the Management of Waste, a government organism that interacts with and is dependent on various secretariats, institutions, and on the head of the Federal District's government. The Federal District's ISWMP will have a secondary part in this new scheme (IV Legislative Assembly of the Federal District, 2009).

1.1.2 Research question

This research was intended to do a thorough evaluation of the Federal District's Integrated Solid Waste Management Program 2004-2008. Through this evaluation the researcher proposed to assess the performance of the program, identify its flaws and successes, and determine which factors negatively affected performance. Through this study, the researcher aimed to discover barriers and opportunities for the proposed new strategy.

[2] http://www.giresol.org/index.php?option=com_content&task=view&id=253&Itemid=116
http://chilangabanda.com/2007/03/05/separacion-de-residuos-solidos/
http://www2.eluniversal.com.mx/pls/impreso/noticia.html?id_nota=242843&tabla=notas
http://www.eluniversal.com.mx/graficos/animados/residuos.html

The main research question for this study is:

What are the barriers and opportunities for the implementation of an effective integrated solid waste management program in the Federal District and Mexico City?

This research problem was addressed through the following sub-questions?

- What are some criteria for the evaluation of the Federal District's ISWMP?
- How effective are these criteria for assessing the performance of the program?
- What other factors (social, economical, political) affect the performance of the program?
- What recommendations can be made for improving integrated solid waste management in the Federal District?
- Can these recommendations be applied to other environmental policies in Mexico?

1.1.3 Criteria for selection of the study site

The researcher chose the Federal district as a study site for several reasons. First, she is a native to the area of study; this grants an insider's perspective to the research problem. Second, the Federal District's ISWMP is the first of its kind to be implemented in Mexico. This program has been used as an example for the implementation of integrated solid waste management programs throughout the country. The findings of this research may be applicable to any of those other programs. Third, Mexico City is one the largest metropolitan areas in Latin America. Research about implementing an effective integrated waste management system in this city may provide information to decision makers in other large municipalities about how manage waste.

1.1.4 Assumptions

The main assumption for my proposed research is that the Mexico City ISWMP (2004-2008) has not achieved its goals in terms of source separation nor in terms of waste diversion. A further assumption is that the program can be improved.

1.1.5 Purpose

The purpose of this study is to help policymakers determine the best way possible to address waste management problems in Mexico City and to modify existing programs accordingly. The desired outcome of this research is to contribute to designing a new program that will meet the requirements for sustainable waste management and the needs of the city in terms of waste diversion.

1.2 Organization of the thesis

The thesis is organized in 9 chapters and 6 appendixes. Chapter 1: Introduction includes the rationale for this research project, the research question, and the research objectives. It also provides a brief description on what can be found in other chapters.

Chapter 2: Characteristics of the study site, the Mexican Federal District, provides a summary of relevant information. In this chapter the reader will find highlights of geographic, economic, and social information of the city.

Chapter 3 portrays the research process and methodology. The methodology includes a review of specialized literature. The literature review is presented in two chapters: Chapter 4: Waste Management, and Chapter 5: The Mexican Governance Context. Chapter 4 depicts a brief history and evolution of waste management, and presents waste management issues specific to developing countries such as Mexico. Chapter 5 provides an overview of how the Mexican government is organized, and what its functions are. Also in this chapter is a summary of the environmental legal instruments currently in existence in Mexico.

Chapters 6 and 7 present the data gathered for this research, and the results of its analysis. Chapter 6 examines the quantitative data involved in this study while Chapter 7 is dedicated to the qualitative part of the project.

Chapter 8 summarizes the findings and provides the concluding remarks and recommendations of this research. In the Afterword the reader will find the reflections of the author on the research process.

Chapter 2 Characteristics of Study Site

The research for this thesis took place in the Federal District, Mexico (Figure 2-1). The purpose of this chapter is to provide background and context information through a brief description of the study site. The chapter begins with a geographical description of the study area, followed by a short report on the site's political configuration. Information on the city's waste composition is provided as well as a brief report on waste management practices within the study area.

2.1 El Distrito Federal (the Federal District)

Mexico City – indistinctly referred to as the Federal District- is the Capital of Mexico. It sits at the center of the country, also being the cultural, economic, and political core of the nation. The term Mexico City can also be applied to the Metropolitan Area of the Valley of Mexico which includes municipalities state of Mexico which surround the original city. It constitutes one of the largest metropolitan areas in the world. The population is 8.8 million inhabitants distributed in an area of 1547 km^2. As in all large metropolitan areas, the city has many problems associated to its size which include poor housing and sanitation, pollution, and scarce water supplies (Encyclopaedia Encarta, 2008; Junior Worldmark Encyclopaedia of the Mexican States, 2004, Encyclopaedia Britannica, 2009).

2.1.1 Geography

The Federal District has an area of 1,547 square kilometres. The territory is divided into sixteen political districts or *delegaciones* (Figure 2-2). It borders the states of Mexico on the north, east, and west, and Morelos on the south. Mexico City is located in the south central portion of the country. It lies in the Valley of Mexico, a volcanic basin at an altitude of 2,380 m. The Valley of Mexico is surrounded by a series of mountain ranges. Much of Mexico City's adjoining valley is a lake basin with no outlet, and in the past during the rainy seasons, mountain runoff has engorged the lakes. In

addition to being built on soft subsoil, the city is located in a region of high seismic activity (Encyclopaedia Encarta, 2008; Columbia Encyclopaedia, 2008; World Encyclopaedia, 2005).

Mexico City's climate is consistent and steady. The combination of the city's latitude – located in a tropical climatic zone- and its altitude produces a moderate climate with a narrow range of temperatures. The average annual temperature is 16°C. Mexico City has a distinct rainy season from June through October, during which nearly 80% of its rainfall occurs (Junior Worldmark Encyclopaedia of the Mexican States, 2004; National Institute of Geographic Statistics and Information, 2008).

2.1.2 Population and society

In 2005, the population of the city was estimated at 8.813 million of inhabitants. Of these, 48% were male, and 52% were female. The population density was 5,799 people per square kilometre. The Federal District is the most densely populated region of the country. The population growth rate from 2000 to 2005 was estimated at 1.3%. Population has increased rapidly, spreading into many residential sections called *colonias* (National Institute of Geographic Statistics and Information, 2008; Junior Worldmark Encyclopaedia of the Mexican States, 2004).

Most of the people who live in Mexico City are of both Spanish and indigenous descent, although there is a small percentage of white, and Asian people living in the city. Mexico City's population includes immigrants from all around country and from diverse overseas locations. Most of the people in the city speak Spanish but about 1.8% of the population speaks one of the indigenous languages as a first language (National Institute of Geographic Statistics and Information, 2008).

There are profound socioeconomic and ethnic divisions in the Federal District. The major condition dividing the city's population is wealth. Living conditions and quality of life vary dramatically according to both socioeconomic class and the *colonia* where people live in. The more prosperous neighbourhoods have all the benefits and services of any city in a developed country

whereas in the poorest sections housing is substandard, access to services and utilities is limited, and the standard of living is below the poverty level (Encyclopaedia Encarta, 2008; Encyclopaedia Britannica, 2009).

2.1.3 Administration

The Federal District is the seat of Mexico's federal government, hence the name. Much of the political decision-making for the country occurs there. Scattered throughout the city one will find headquarters and offices for all of the federal executive, legislative, and judicial branches of government. The Federal District functions as the state and city government for Mexico City and the other communities within its jurisdiction (Encyclopaedia Encarta, 2008; Encyclopaedia Britannica, 2009).

Under the Constitution, Mexico City and the Federal District are defined as one. The sixteen administrative areas or *delegaciones* are: Álvaro Obregón, Azcapotzalco, Benito Juárez, Coyoacán, Cuajimalpa de Morelos, Cuauhtémoc, Gustavo A. Madero, Iztacalco, Iztapalapa, la Magdalena Contreras, Miguel Hidalgo, Milpa Alta, Tláhuac, Tlalpan, Venustiano Carranza, and Xochimilco (Figure 2-2). Many of the administrative functions of the Federal District are centralized, but some of the powers are divided among the *delegaciones* (Encyclopaedia Britannica, 2009).

Figure 2-1 Localization of the Federal District in Mexico

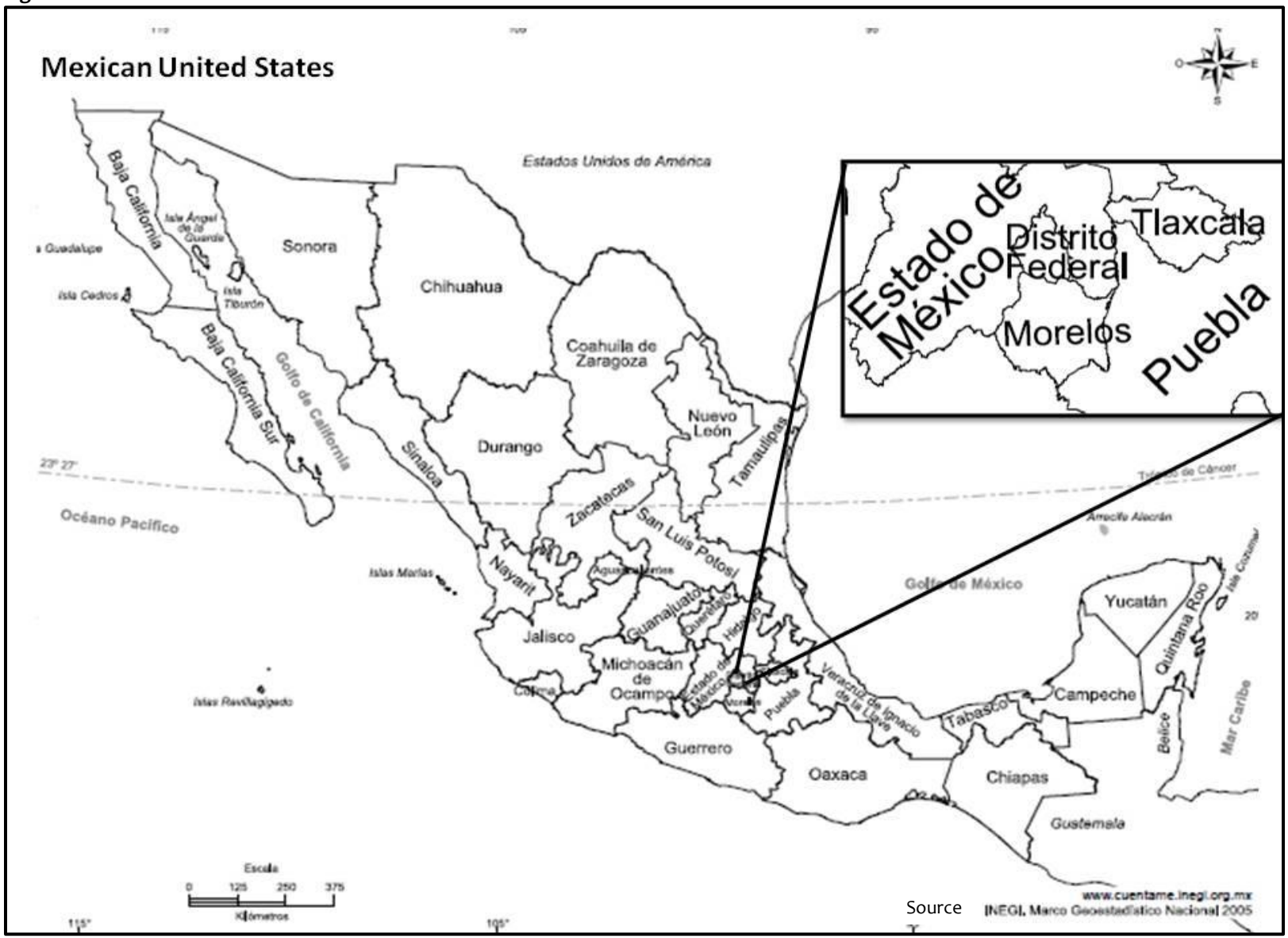
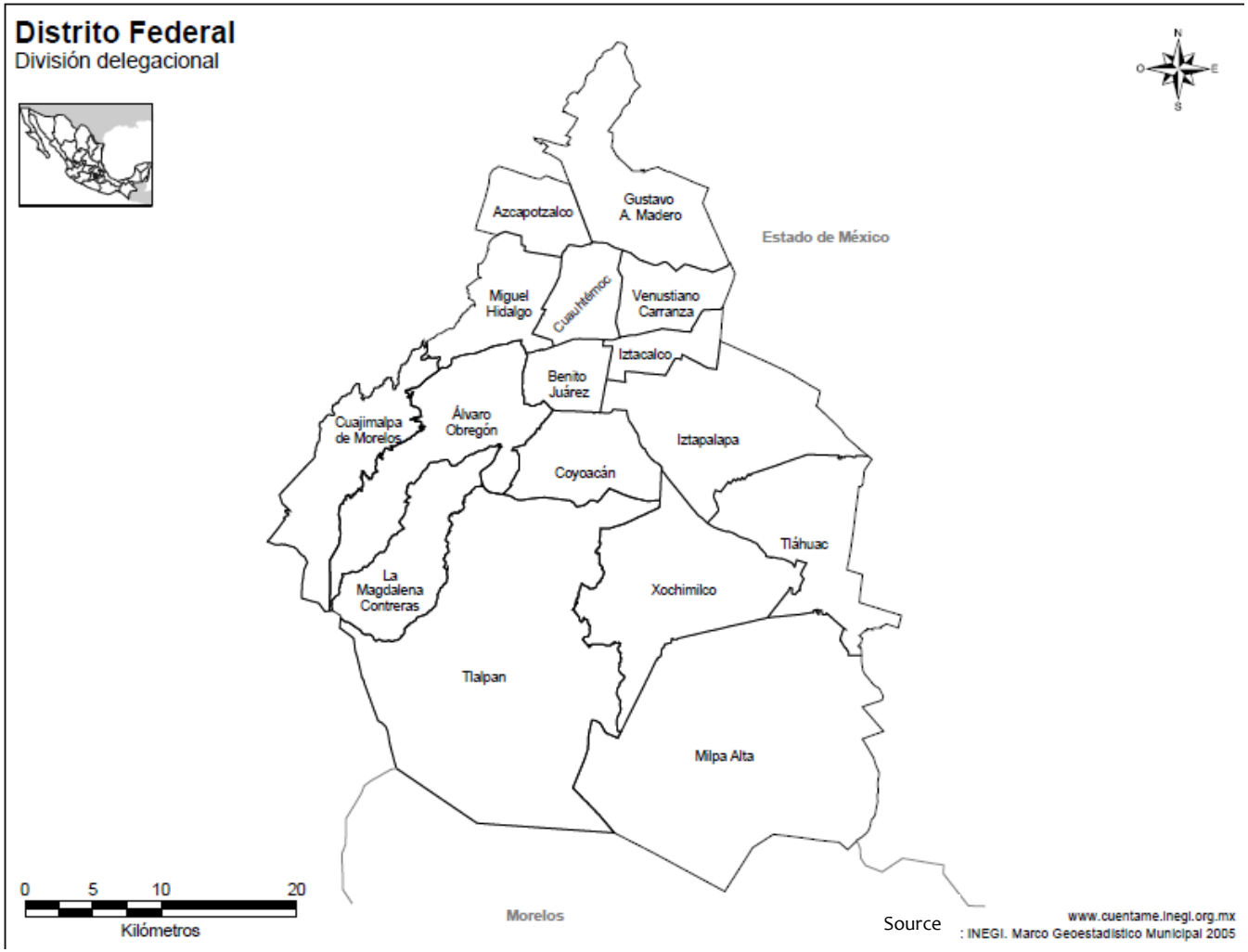


Figure 2-2 Federal District's administrative areas



The city's government is structured in a manner similar to the national government. There is a chief of government or mayor of the Federal District. He is democratically elected by the residents of the Federal District for a six year, non renewable term. The Executive Branch has secretariats that oversee public works and services and deal with matters such as public safety, finance, environment, transportation, and human welfare. Each of the sixteen political districts has a head, or *delegado*. The *delegados* are democratically elected by the residents of each specific *delegacion* for a three year term. Additionally, the Federal District has a legislative assembly of sixty-six members, similar to those of other Mexican states. Its members are also elected to three year terms. However, it is important to note that as in other country capitals, the federal government retains some authority to decide on important financial and administrative issues (Encyclopaedia Encarta, 2008; Junior Worldmark Encyclopaedia of the Mexican States, 2004; Encyclopaedia Britannica, 2009).

The three main political parties in all of Mexico are the Institutional Revolutionary Party (PRI), the National Action Party (PAN), and Party of the Democratic Revolution (PRD). These three parties have a strong presence in the Federal District. It is important to note that ever since 1997, when the chief of government of the Federal District stopped being appointed by the president and began to be elected, the chief executive of the country and that of the Federal District have been from opposing parties. This has created numerous conflicts in decision-making. The situation repeats itself inside Mexico City as *delegados* and the members of the legislative assembly belong to different political parties, making it hard to reach agreements on certain matters (Junior Worldmark Encyclopaedia of the Mexican States, 2004).

2.1.4 Economy

Over 10% of Mexico's gross domestic product (GDP) is produced in the Federal District. More than three-fourths of the district's income derives from the service sector, and about one-fourth derives from manufacturing. One big block of manufacturing activities includes clothing, paper

products, and consumer electronics. Chemicals, plastics, cement, and processed foods and beverages constitute the other big block of manufacturing activities. (Encyclopaedia Britannica, 2009; National Institute of Geography Statistics and Information, 2008).

After 1980, manufacturing activities in Mexico city have become the secondary generator of income. The service sector- financial services, restaurants, hotels, entertainment, business services, and government employment- is increasingly capturing the majority of the task force. Tourism leads by yielding the greater earnings within the sector (Encyclopaedia Britannica, 2009).

The economy also has a informal sector that is very hard to quantify. Among the labourers that integrate this sector are shoeshine boys, mobile candy-and-gum sellers, pre-paid cell phone card sellers, beggars, garbage scavengers, street vendors and performers, etcetera. Other people employed in informal jobs are live-in maids and unlicensed child-care providers. The last and least numerous part of the workforce are people employed in agriculture and mining (Encyclopaedia Britannica, 2009).

2.1.5 Waste composition

Given the number of people that live within the Federal District, waste generation is considerable (estimated at 12,000 tons per day). Bearing in mind the broad range of economic activities that take place in the city and the diversity of social classes, the composition of waste is very heterogeneous. According to the General Department of Urban Services of the Secretariat of Works and Services (1999) there are five different sources of urban waste: household, commercial, service, controlled, and others. They found thirty five different components of this waste. Table 2-1 provides the most recent available summary of waste composition per source.

Table 2-1 Waste composition by source

Component	Household (%)	Commerce (%)	Services (%)	Controlled (%)	Others (%)	Average (%)
Wooden tongue depressors	0.00	0.00	0.00	0.79	0.00	0.03
Cotton	2.15	0.43	0.97	0.93	0.00	1.32
Cardboard	5.36	8.55	9.67	5.74	1.60	6.81
Leather	0.11	0.00	0.37	0.00	0.00	0.11
Multi layer containers	1.96	2.09	1.58	3.43	1.25	1.96
Hard vegetal fibre	0.06	2.19	0.19	0.08	0.00	0.71
Synthetic fibre	1.45	0.58	0.09	0.18	0.00	0.87
Gauze	0.00	0.00	0.00	1.60	0.00	0.05
Bones	0.08	0.76	0.08	0.03	0.00	0.28
Rubber	0.20	0.64	0.41	0.83	0.00	0.38
Disposable syringe	0.00	0.00	0.00	1.15	0.00	0.04
Cans	1.58	0.86	1.00	3.28	0.00	1.27
Pottery and ceramic	0.37	0.11	0.42	0.00	0.00	0.27
Wood	0.10	1.19	1.30	0.20	14.03	1.23
Construction materials	0.63	0.00	0.32	0.04	0.04	0.35
Ferrous materials	1.39	1.39	0.82	0.95	31.08	2.61
Non-ferrous materials	0.06	0.27	2.14	0.05	0.92	0.48
Paper	1.19	3.67	15.78	6.18	2.74	4.39
Newspaper	4.61	5.28	6.50	7.91	0.89	5.04
Toilet paper	8.78	3.05	4.08	10.17	0.00	6.02
Disposable diapers	3.37	0.07	0.12	0.64	0.00	1.65
X-Ray charts	0.00	0.00	0.00	0.12	0.00	0.00
Film plastics	6.24	3.53	2.16	4.28	3.73	4.64
Rigid plastics	4.33	3.48	1.84	4.05	1.60	3.57
Polyurethane	0.16	0.09	0.34	0.34	0.00	0.17
Polystyrene	0.78	0.28	0.44	1.39	0.49	0.59
Food waste	34.66	50.32	42.93	17.36	0.00	38.45
Gardening waste	5.12	0.10	0.87	6.01	10.17	3.42

Component	Household (%)	Commerce (%)	Services (%)	Controlled (%)	Others (%)	Average (%)
Sanitary napkins	0.00	0.09	0.07	0.05	0.00	0.04
Rag	0.64	0.25	0.33	0.65	17.96	1.25
Bandages	0.00	0.00	0.00	0.15	0.00	0.01
Colour glass	4.00	1.07	1.51	7.44	0.00	2.69
Transparent glass	6.77	2.93	2.71	6.95	0.34	4.73
Fine waste	1.21	1.92	0.19	2.29	10.55	1.72
Other	2.66	4.81	0.75	4.74	2.62	3.08
Total	100	100	100	100	100	100

Source: Secretariat of Works and Services, 1999.

It is important to have a diagnostic of the waste generated within the city to be able to provide good management options.

2.1.6 Waste Management

Temporary storage of waste is done a variety of containers. Rarely is a proper garbage can with lid or waste basket used. Many household use the plastic bags from supermarkets or other commercial sites to store their waste and later hand it to the waste truck drivers (Secretariat of Works and Services, 1999).

The General Department of Urban Services is in charge of the cleaning, maintenance and conservation of the main road network, which has over 1,500 km altogether. Yearly, an average of 850,000 cubic meters of waste is collected in these roads. Cleaning of these streets is done with automatic sweepers. The waste collected by automatic sweepers is taken directly to the nearest transfer station (Secretariat of Works and Services, 1999).

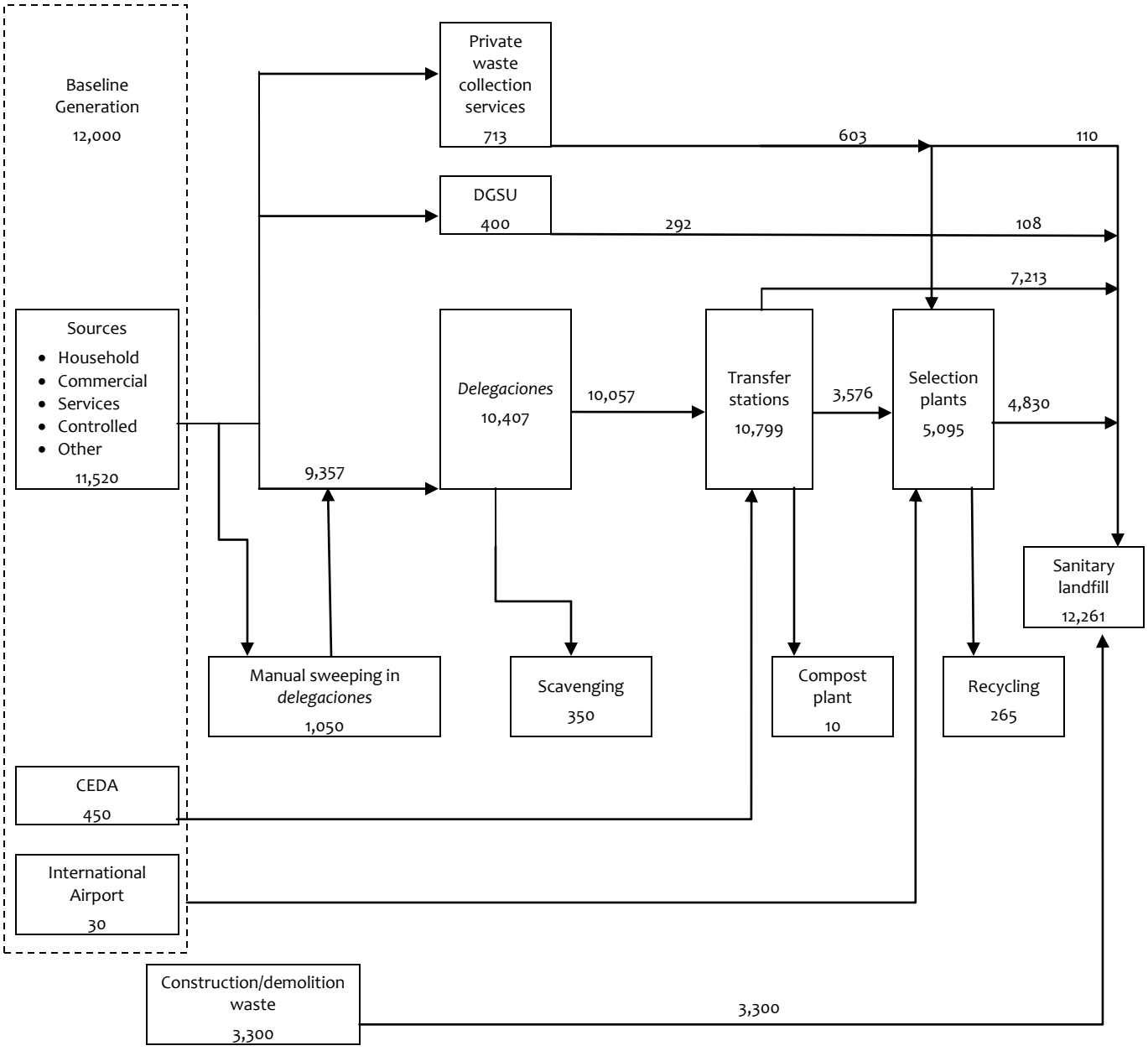
The *delegaciones* are in charge of cleaning the secondary and rural road networks. They do so by manual sweeping. In 2004 the workforce was over 7,000 sweepers. Besides cleaning the streets, these sweepers also collect waste from household and commercial sites for a tip. The sweepers hand the waste to the truck drivers in determined points in their regular routes.

Collection of waste is a responsibility of the *delegaciones,* including transport to and from the transfer stations, to waste selection plants, and to final disposal sites. Waste collection is done by two basic methods: in residential zones the truck driver drives slowly through the street, allowing his (usually two) helpers to take the bags from the person who takes it out of the household; for commercial zones and habitational units, waste is collected from the containers designated for this purpose. Sometimes more people will ride in the waste truck in order to do scavenging of the waste (Secretariat of Works and Services, 1999; Federal District's Integrated Solid Waste Management Program, 2004).

In the Federal District there are thirteen waste transfer stations that act as an intermediate point between the collection sites and the waste selection plants or the final disposal facility. All of them are closed facilities, allowing for control of dust, pollution and nuisance odours. There are three waste selection plants with joint capacity to process 6,500 tons of waste per day. They are operated both by the General Department of Urban Services and the Union of Waste Selectors (previously scavengers). The Federal District has four compost plants, three operated by *delegaciones* and one in Bordo Poniente –the final disposal site. The latter is operated by the General Department of Urban Services, as is the landfill.

There is only one sanitary landfill in Mexico City. It was inaugurated in 1985. It is approximately 680 hectares in area. It is designed to do proper management of lixiviates and biogas, although the gas is not currently being captured. The proposed changes (2009) in the waste management system by the current administration include the construction of a waste management center. This center would replace the current landfill. Incineration of waste is contemplated as is the generation of energy through using the heat from incinerated waste (Secretariat of Works and Services, 1999; Federal District's Integrated Solid Waste Management Program, 2004; Agenda Verde del Distrito Federal, 2008). Figure 2-3 shows a diagram of the waste management cycle.

Figure 2-3 Waste Management Cycle in the Mexican Federal District



Note: All amounts shown are in tons per day.

Adapted from PGIRSDF, 2004.

Chapter 3 Methodology

This research proposed to conduct a program evaluation of the Mexican Federal District's Integrated Solid Waste Management Program (ISWMP). The purpose was to assist policymakers to determine the best way possible to address waste management problems in Mexico City. The desired outcome of this research was to make recommendations for the design of a program that would meet the requirements for sustainable waste management and the expectations of the government in terms of waste diversion.

The conceptual framework developed for this study was based on the assumption that there is a policy implementation failure with respect to the Mexican Federal District's ISWMP. The research aimed to identify the factors that underpin this failure and once identified, to provide recommendations that would ensure the effective implementation of subsequent waste management programs.

Thus, the conceptual framework combined principles for sustainability with Integrated Waste Management Theory. Integrated Waste Management Theory suggests that waste management requires development of an array of options. None is good or bad. Each of them is equally valid depending on the particular circumstances under which it's applied (Gertsakis and Lewis, 2003). By integrating sustainability assessment criteria and environmental management theory into the equation, the research proposed to develop waste management options that would be catalogued as more desirable or less desirable in respect to sustainability.

The proposed method was to use this framework to identify criteria for an "ideal" integrated waste management program, against which the researcher could evaluate the existing Integrated Waste Management Program currently in operation in Mexico City. Based on the analysis of performance data against criteria for an ideal program, the researcher proposed to identify the

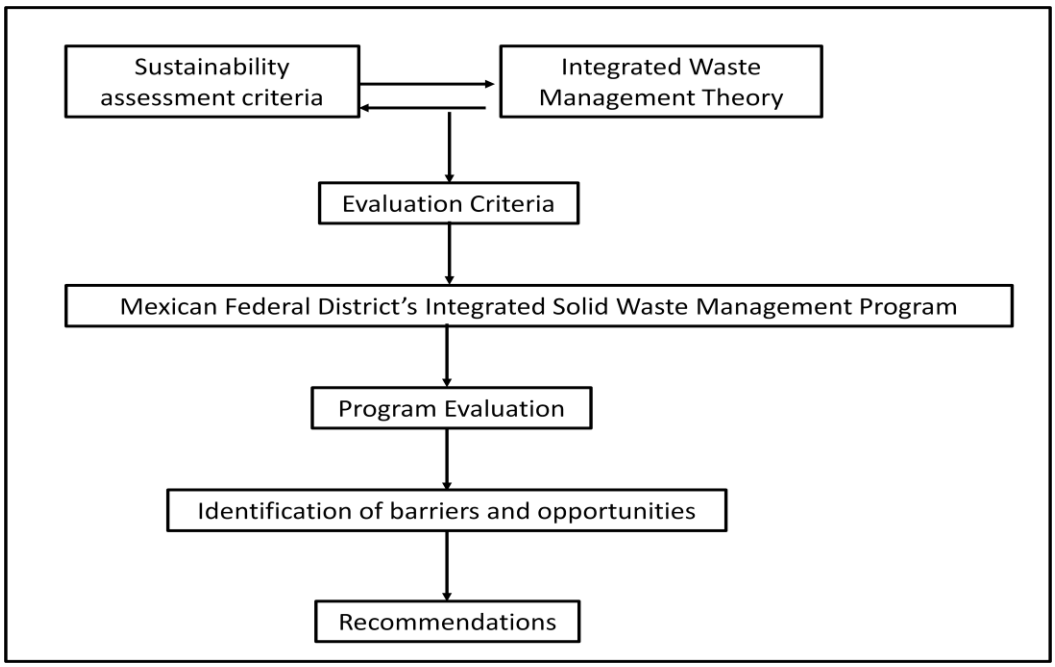
barriers that prevent the program from being applied in an effective and sustainable manner. To identify and analyze barriers, literature on Public Administration was examined. More specifically, the research method includes a review of literature on policy implementation in developing countries and the challenges it faces. Also it draws from literature on Mexican Political Systems.

Finally, when barriers had been identified and analyzed, the research proposed to develop recommendations on how to cope or overcome them. This would improve the performance of the program overall, mainly in terms of waste diverted but also in terms of sustainability and social capital.

Figure 3-1 shows a diagram of the conceptual framework and methodological map for the original research design.

For this program evaluation, a logical methodological approach was the case study. Within the case study quantitative data analysis and qualitative data analysis were used to inform the research.

Figure 3-1 Conceptual framework and methodological map



3.1 The case study approach

Case studies allow the researchers to seek both what is common and what is particular about a case. Researchers focus not only on what they can learn from a single study, but on how what they learn from a single case can be related to other cases. Some authors consider that case study research can be exploratory, descriptive and/or explanatory. This fit perfectly within the purpose of this research (Stake in Denzin and Lincoln, 2000; Yin, 2003). Another reason for choosing to do this research through a case study approach is that the researcher intended to investigate a contemporary phenomenon within a real-life context in which the boundaries between the phenomenon and the context are not very clear (Yin, 2003). From this perspective, the researcher considered that a case study would fit the purposes of the research and better help answer the original research question: **what are the barriers and opportunities for the implementation of an effective integrated solid waste management program in the Federal District and Mexico City**?

The research required both qualitative and quantitative data collection techniques. This is one more reason why the researcher chose a case study approach, as "case studies can be based on any mix of quantitative and qualitative evidence" (Yin, 2003, p. 15). In fact, this constitutes one of the unique strengths of a case study design: it can deal with a full variety of evidence such as documents, interviews and observation, which are the three data collection sources that the researcher chose to use. Using different data sources enhances the reliability and validity of case study research (Yin, 2003).

By combining quantitative and qualitative methods, a larger scope and breadth of information can be gathered. Qualitative techniques were used where contextual information is unknown. Quantitative methods were when variables are known or controllable. The case study research design comprised four parts: conducting a literature review, gathering and analyzing quantitative data, gathering and analyzing qualitative data collected in the form of interviews, and

issuing recommendations on how to improve the performance of the Mexican Federal District's ISWMP.

3.1.1 Strengths and limitations

Case studies provide examples of good or bad practice in the delivery of services, and they can exemplify the impact of a policy. Criteria for selection are very important for the success of the study. In this case, the Mexican Federal District's ISWMP was chosen as the case because it was the first Integrated Solid Waste Management program formally implemented in Mexico. Furthermore it is also a good example of an environmental program that is failing in its implementation (Jupp, 2006).

One of the main criticisms about the case study approach is that some authors believe that studying one particular case is not sufficiently representative to permit generalization to other situations. To overcome this shortcoming, many researchers decide to conduct multiple case studies. However, in policy research this is not necessary, as one example is enough to determine the impacts of a particular program (Yin, 2003: Jupp, 2006).

3.1.2 Literature review

Conducting a literature review serves several purposes. First, it helps the researcher demonstrate that she is familiar with a particular body of knowledge, and that gives her credibility. Second, it shows the path to previous research works, and demonstrates the development of the knowledge on the subject, allowing the researcher to place her research in context, fill gaps, and display its relevance. Third, it helps the researcher to expose and summarize what is known in an area at a given point in time; it also points out the course for further research. Fourth, a review of literature allows the researcher to learn from others as well as develop her own ideas. Fifth, it provides a benchmark for comparing the results with other studies. And sixth, a literature review

may improve the researcher's methodology (Jupp, 2006; Neuman, 2006; Oliver, 2008; and Creswell, 2009).

For this research, publications reviewed included peer reviewed journals, publications, newspapers, opinion magazines, books, dissertations, and government documents. The researcher chose this particular selection of sources because they provided the most complete information to place the research issue in a historical background and at the same time they were the most up to date sources. The choice of different sources of information helps to counteract each individual type's weaknesses. For example while information gathered from an opinion magazine may be value-based, information gathered from a peer-reviewed journal is very accurate and objective. Facts read in a peer reviewed journal may not always be current, but this is compensated for by newspapers (Neuman, 2006).

To better examine the available literature, the researcher subdivided the subject of study in two main themes: waste management and environmental policy. Table 1.1 shows the literature that was considered relevant for the thesis, classified under the chosen main themes. In a thematic review of the literature, the researcher does not discuss each reference separately and in detail, but rather just discusses the major ideas that support a theme (Creswell, 2002). The review of literature is presented in two different chapters named according to the themes (see Chapters 4 and 5).

Table 3-1 Literature relevant to the thesis

Waste Management	Environmental Policy
• Sustainability assessment criteria • History of waste management • Waste management in developing countries • Waste management in Mexico City	• Sustainability • Public administration in Mexico • Historical Environmental policy in Mexico • Mexican legal instruments • Mexican environmental policy making

The Integrated Waste Management literature along with the sustainability assessment criteria as shown in Chapter 4 provided the basis on which the researcher developed the criteria for

the evaluation of the Federal District's Integrated Solid Waste Management Program. The researcher decided to include sustainability assessment criteria because the program is itself described as a sustainable waste management program. However, the program does not define what sustainable waste management is. These bodies of literature helped the researcher to define the term 'sustainable waste management' in order to pinpoint whether the case program approaches the key issue of sustainability.

The remaining bodies of literature referred to above helped the researcher determine the barriers for the implementation of an effective environmental policy in Mexico City. Through understanding the Mexican Political system, the researcher was able to identify some challenges for implementing environmental policy and how to overcome them.

Conducting a literature review is not an easy task. The researcher must choose not only what types of sources to read, but the actual bibliography. The researcher has to choose criteria to identify which sources are not only reputable, but reliable. She also must decide where to start and most important, when to end. If a timeframe is not established for this task, the researcher risks dedicating too much of her time to reviewing the literature and might actually never get to other stages in her research (Booth, et. al., 2003; Oliver, 2008).

3.1.3 Quantitative data

There was an abundance of quantitative data required for this study. This data was collected to determine the amount and rate of waste diversion, source separation, separated and regular waste collection, waste management plans entered to the Secretariat of Environment, and waste management plans- private and public- implemented.

The specific data collected was:

1. Summary of the total number of colonies, routes, housing units, public building, schools and markets. This summary also includes the number of colonies, routes, units, public

building, schools and markets that do source separation and the projected goal for each specific month. Information is available from November 2004 to March 2008.

2. General data from each *delegacion* for 2005, 2006, 2007, and 2008. This data includes numbers on population, total waste generation, number of waste collection vehicles, number of waste collection routes, number of colonies, and the goals in terms of number of colonies and waste collection routes with waste separation.

3. General information from the *delegaciones* from November 2004 to March 2008. This information provides numbers on the amount of waste collected in routes with source separation. The report also provides the percentage of organic waste separated, inorganic waste separated, and mixed waste.

4. Summary of the colonies per *delegacion* in terms of total number of colonies, number of colonies with source separation already implemented, number of projected colonies with implemented source separation with data available from November 2004 to March 2008.

5. Summary from November 2004 to March 2008 of the waste collection routes per *delegacion* in terms of total number of routes, number of routes with source separation already implemented, number of projected routes with implemented source separation.

6. General information on public buildings in terms of number of public buildings and number of public buildings that have implemented source separation from March 2004 to March 2008.

7. Miscellaneous data. These include any other waste related information that was published within the time frame of data collection for this research that was relevant to the purpose of this study.

3.1.3.1 Accessing statistical data

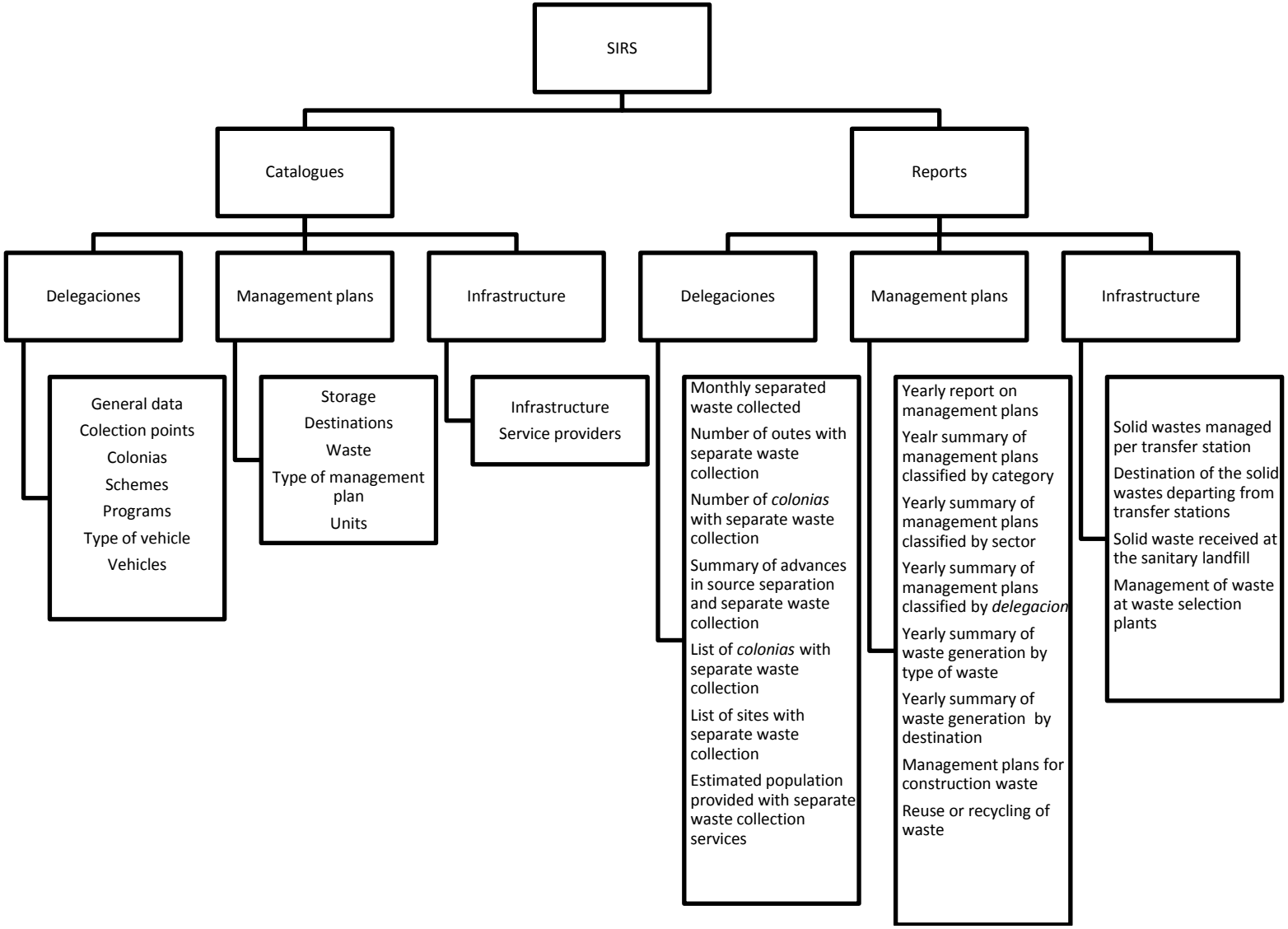
The data was gathered from the Federal District's Solid Waste Information System (SIRS). The SIRS is a database that contains all the relevant data regarding generation and management of solid waste within the Federal District. Figure 3-2 shows how the system is integrated.

Once the data that was considered to be relevant for this thesis was gathered, it was entered onto a spreadsheet to begin calculations. The original intent was to conduct statistical analysis of the data. Since the quantitative data was not collected by the researcher herself, it was double checked before any tests were conducted to reduce the risk of error. When double checking the data and the percentages published in the Secretariat of Environment's web page, the researcher found several inconsistencies and gaps in the datasets. As statistical analysis should not be conducted with data that is unreliable, the researcher chose to change the original research design to accommodate the new findings. Also, at this point in time, the researcher realized that with this erroneous data, she needed to modify her purpose and methods (see Chapter 1) This way, the researcher could still conduct a research that will contribute both to a body of knowledge and has a practical application in Mexican public administration while using the information and data that had already been collected. The Mexican Federal District's ISWMP remained case study, but the researcher reframed the research to rely more strongly on qualitative data.

3.1.3.2 Analysis of the quantitative data

After the data was entered onto a spreadsheet to allow manipulation, the researcher proceeded to recalculate the percentages of waste separation for the Federal District. Also, the researcher charted graphs that allow the reader to visually detect the trends in waste separation and in other waste related issues.

Figure 3-2 Structure of the Federal District's Solid Waste Information System (SIRS)



Adapted from www.sma.df.gob.mx

In total, although more quantitative information was collected, five different datasets were entered onto spreadsheets and analyzed: amounts of waste generated per *delegacion* and percentage of separation; waste management plans presented to the Secretariat of Environment; amount of waste sent to different destinations from the waste transfer stations; amount of waste processed and recovered at the waste selection plants; and amount of waste received at the sanitary landfill. This information was presented in Chapter 6: Quantitative Data and Preliminary Results.

The researcher took note of the errors found in the original datasets and gave hypothetical explanations for each. It can be said, that the researcher performed a data transformation by qualitizing these preliminary findings. Data transformation is the conversion of one data type into another so that both can be analyzed together. In this case, quantitative data was transformed into description and built-in with qualitative data in a thematic analysis (Greene, 2007).

These hypothetical explanations raised new questions to which the researcher had to find plausible answers. To help answer these questions and make sense of the preliminary findings, the rest of the research was done with a qualitative approach.

3.1.4 Qualitative data

Qualitative research uses a wide range of methods to focus on the significance and explanation of social phenomena and social processes in the contexts in which they occur. The qualitative approach suited this case study given that it focuses on trying to understand a particular situation in its own terms, but at the same time leaves the door open for further generalization and building of theory (Jupp, 2006; Palys, 2003). Such an approach was ideal to the purposes of this research: understanding what is failing in the implementation of the Federal District's ISWMP. Further it allowed for some consideration of whether the findings could be generalizable to environmental programs in Mexico, and if so, with what additional research.

The first part of the qualitative methodology has been explained above (the researcher performed a data transformation thus qualitizing the first data set to draw inferences from the preliminary findings). The second part of the methodology comprised gathering information that would either support or disqualify the findings. The choice was to gather this information through interviews.

3.1.4.1 Interviews with key informants

Interviews with ten key informants were conducted for this research. According to Yin (2003), interviews are one of the most important sources of case study information. The key informants were selected among four different groups of people:

a) Two people involved in the design/implementation of the Federal District's Integrated Solid Waste Management Program

b) Two experts in waste management

c) Three experts in policy design/implementation

d) Three experts in sustainability.

Four different questionnaires were designed, although they had some questions in common, in order to obtain more detailed information in the field of expertise of the interviewee. The questionnaire guide can be consulted in Appendix 3. The questionnaires comprised about twenty open ended questions; open ended questions allow the researcher to gather both facts and opinions about a particular event from the interviewee point of view. The interviews took from 20-25 minutes. The conversations were recorded and afterwards a verbatim transcription was done to make sure that the words of the interviewee were taken exactly as said and in context. Once interviews were fully transcribed, the data gathered was ready for analysis.

3.1.4.1.1 Strengths and limitations

One of the advantages of using interviews as a data gathering tool is that they allow the researcher to follow up on responses. Semi-structured interviews have a sequence of themes to be covered and have suggested questions. However, they are also is open to changes in sequence and forms of questions in order to follow up the answers given by the subjects.

Face to face interviews have the added value of nonverbal communication through which the qualitative aspects of the data could be enriched. They also have the highest response rates and permit longer questionnaires. On the other hand, face to face interviews have a major drawback, and that is the interviewer's biases may interfere with the interview. Also, the way that the interviewer poses the questions may affect the interviewee's response (Kvale, 1996; Palys, 2003; Jupp, 2006; Neuman, 2006).

Open ended interviews are very common to case studies. Open ended questions allow the researcher to hear the respondent's opinions in their own words; they allow the interviewee to respond in any way they wish. This makes the responses more informative but harder to analyze. Also there is the issue of becoming too dependent on the key informant's answers and insights instead of corroborating information with other informants and or data sources (Palys, 2003; Pelham and Blanton, 2003; Yin, 2003).

3.1.4.2 Procedures for qualitative analysis: thematic coding and constant comparative method.

The researcher chose to sort the data gathered in the interviews through thematic coding. The most common form of qualitative analysis is to organize the gathered data into categories or concepts that have features in common. This is known as coding and is an integral part of data analysis. It comprises two simultaneous activities: a mechanical reduction of data and its analytic categorization. Not only does it make data manageable, but it allows the researcher to retrieve relevant parts of it in a rapid manner (Neuman, 2006; Gibbs, 2007). The coding process for this

research was done by reading through each of the transcribed interviews to identify common themes in the interviewee's answers. With those themes in mind, the researcher read through the interviews a second time to highlight portions of the text that corresponded to the selected themes every time they came up. Finally a third reading of the text was done to verify that no new categories came up and that all corresponding portions of the text were marked accordingly. In total the researcher found ten common themes or categories. These categories were analyzed through the constant comparative method.

The constant comparative method is part of the methodology for building grounded theory (Glaser and Strauss, 1967). The idea behind these comparisons is to try and understand what might lie behind the surface text by bringing out what is distinctive about the text and its context. According to the authors, comparing the data throughout the analytic process is the most explicative way to knowledge. Constant comparison can be undertaken by first comparing similar coded passages to each other and then contrasting different codes. After several iterations, the categories will turn into concepts and the concepts into theories that answer the research question (Jupp, 2006; Gibbs, 2007).

3.1.4.2.1 Strengths and limitations

Coding is a primary analytic process for many types of qualitative research. It consists of identifying segments of text that typify some thematic idea and connecting them with a code. It is important to assure that the codes are not descriptions of the passages of text, but that they suggest theoretical or analytical ways of interpreting the gathered data. It is also important that the researcher does not simply accept the respondent's view of the world but that she remains analytical throughout the coding process and is able to detect abstract concepts in concrete data. There is also a risk of trying to present a list of codes along with their definitions and notes as the final result of the work (Jupp, 2006; Neuman, 2006; Gibbs, 2007).

Analyzing data through constant comparison represents a way to generalization in qualitative research. Making comparisons is an important stage of analysis in order to go beyond the descriptive level. Comparisons help the researcher understand relationships between phenomena. With this information, the researcher may be able to answer the research question identifying causes, strategies, actions and consequences (Jupp, 2006; Gibbs, 2007).

The researcher considers that the recommendations at the end of this study are specifically applicable to the Federal District's Integrated Solid Waste Management Program. However, the barriers and opportunities that were identified for its implementation have some general application to environmental programs implemented in Mexico. Taking advantage of the opportunities and overcoming the barriers identified will allow environmental programs to be more efficient and therefore will improve Mexican environmental policies.

Chapter 4 Sustainable Waste Management

4.1 History of Waste Management

Waste has existed since the beginning of human civilization, as a logical result of human activities (MacDonald, 1996). The first records of waste removal as a somewhat formal activity are from the 1800's. As the 19th century advanced, it became apparent that some of the objects dumped in the street had a resource value and could be sold for a profit. This encouraged people to do more thorough and differentiated collection of waste (Wilson, 2007).

By the end of the 1800's and through the mid 1900's, as diseases proliferated in expanding urban population centers, public health emerged as the key concern. Poor sanitation in city streets was eventually identified as a cause for disease, resulting in a stronger emphasis on waste collection (Wilson, 2007).

By 1970 waste disposal was on the political agenda throughout the developed world, with environmental protection in addition to public health as a key driver. Waste collection became waste management (Wilson, 2007). Waste management is a set of planned management activities that accompany waste from generation to disposal, it includes collection, transport, treatment, and disposal (Tchobanoglous, Theisen, and Vigil, 1993).

During the 1970s, two important waste management concepts were developed. One is the waste hierarchy; the other is integrated waste management (Staniskis, 2005). Both concepts started as a critique of disposal-based waste management. The waste hierarchy recognizes that the waste stream comprises diverse materials. To achieve waste minimization, different handling options are required. These options range from reduction, to disposal with the first being the most desirable option and the latter being the least desirable one. This concept, therefore introduces the preventive approach to waste management (Gertsakis and Lewis, 2003).

Integrated Waste Management was introduced in the 1970s, it was developed through the recognition that no single waste management practice is preferred over others. Research on the effects of traditional waste management demonstrate that the 'best' option or options for waste management depend on a number of specific factors, particularly with regards to locality (Powell, 1996).

Integrated solid waste management takes into consideration different waste streams and provides a range of options for management. Waste managers can select the option, or options that best fit the particular environmental, economical and social conditions of the selected locality (Tchobanoglous, Theisen and Vigil, 1993). A fairly recent innovation since the 1990's, in terms of criteria for evaluating waste management options, is an increased concern for the environment. New criteria such as resource use, environmental impact assessment and sustainability assessment have come into use (Powell, 1996).

To be able to develop a system that deals effectively with all types of waste, it is necessary to define them clearly. First, waste can be divided into two categories: solid waste, and liquid waste. Because of its characteristics, liquid waste is beyond the scope of this research. Solid waste can be categorized in several ways: according to its origin: household solid waste, and industrial solid waste, according to its composition, urban solid waste, and municipal solid waste; and according to its characteristics: organic solid waste, inorganic solid waste, recyclable solid waste, demolition waste, hazardous solid waste, etc. (Tchobanoglous, Theisen and Vigil, 1993).

The main interests of this research are municipal solid waste and/or urban solid waste. In Mexico, it is the responsibility of each municipality to provide public sanitation services. However, in the legislation, this service is limited to wastes that are catalogued as municipal solid waste (LGPGIR, 2003). Unfortunately, there is conceptual confusion in Mexican legislation due to the indistinct definitions of municipal solid wastes (MSW), urban solid wastes (USW), domiciliary SWs, and

domestic solid wastes (DSW) (See Appendix 1). In this research, we refer to municipal solid waste as applicable to all of these terms within the Mexican Legal framework (Buenrostro y Bocco, 2003).

Beede and Bloom, in a report for the World Bank, explain that:

"*most systems for managing municipal solid waste have three basic components: collection and transport, processing, and disposal. The purpose of collection and transport is to gather and remove MSW from its point of generation to safeguard public health, limit congestion, and preclude unpleasant odours and aesthetically offensive sights. The purpose of processing is to transform the physical characteristics of MSW by recycling, composting, burning, or compacting in order to reduce the threat it poses to human health and ecosystems, improve its disposability, and possibly capture value from the waste. The purpose of disposal is to isolate and contain the residual waste that is left after processing*" (1995, p.120)

In an ideal world, reliable and cost-effective solid waste management plans should be the result of a thorough evaluation of alternative plans. This ideal is far from being achieved. To ensure that communities will have reliable and cost-effective waste management services, it is important to base these services on long term plans. Two key reasons are: one, landfill space is often scarce; two, capital investments required to provide waste management infrastructure are very high, meaning that the infrastructure must be planned to last many years (Wilson, 1985).

A good long-term plan for waste management is one that has been chosen from a concise list of alternative plans, each of which has been evaluated in depth. It should include reference to the facilities that are to be provided for transfer, treatments, recycling, or disposal, and it should specify when, and with what capacity these facilities should be built (Wilson, 1985).

Ultimately, adopting a plan comes to a political decision, made after alternatives have been weighted from different perspectives – cost, environmental impacts, technical reliability, flexibility, etc. (Wilson, 1985).

Improper or inadequate waste management can lead to health and pollution problems, thus affecting the quality of life of a community. These adverse effects can be minimized with proper waste management. According to Rushbrook and Finnecy, 1988, a proper system for solid waste management can only emerge with the help of government. Since waste management is a social, environmental, economic, and technical issue, many activities have to be in existence before a waste management system can be developed. Although objectives of waste management policies can be generalized, each system in itself should be adapted to the particular context in which it will be implemented. According to Repa, "*a community can determine its most effective combination of waste management methods by examining the amount and composition of municipal solid waste (MSW), cost, environmental considerations, infrastructure, practicality, political realities, and the community's goals*" (2005, p. 54). This combination of methods is aimed to have a positive impact in the municipal environment and in human health.

Literature suggests that one of the first analyzes that should be made in choosing among the range of options available for each component of MSW management is cost-benefit analysis. Although estimating reliable monetary values for all costs and benefits is not always possible, the framework of cost-benefit analysis can provide guidance for decision making and evaluation. Traditionally, four factors weigh heavily when comparing alternative options for waste management: cost of labour and other production factors, physical characteristics of waste, efficient scales of operation, and non pecuniary costs and benefits. Other factors that should be considered are resource use and environmental impact (Beede, ad Bloom, 1995; Powell, 1996).

4.1.1 Solid Waste Management in developing countries

Municipal solid waste management constitutes a serious problem in many cities in developing countries. Rapid increases in population have resulted in major increases in waste generation. Economic scarcity in many large cities poses challenges to effectively managing solid

waste. Integrated Solid Waste Management is a concept that was created in the developed world. Implementing effective solid waste management in the developing world requires modifications (Medina, 1999).

Practices for waste management –collection, processing and disposal – vary from country to country, generally according to the characteristics of the waste stream and according to local environmental and economic features. Developing countries hold certain socio-economic conditions in common. These include rapid population growth, migration to urban areas, lack of sufficient funds and affordable services, and a low-skilled labour force. These countries are faced with serious environmental and administrative challenges with respect to solid waste management. In developing countries, one can find inefficient waste management practices, which leads to negative impacts in environmental quality and public health (Beede and Bloom, 1995). In general, organization and planning of waste collection systems in developing countries is very rudimentary; solid waste management systems are poorly run and operate at low standards due to inadequate and unsustainable planning. Many of the cities do not have any data on the amount and type of waste generated; neither do they have the resources to conduct such studies. Also, many communities still lack proper disposal sites for the waste generated and do not have any recovery and or recycling programs (Ojeda and Beraud, 2003, and Buenrostro and Bocco, 2003; Wilson, Velis, And Cheeseman, 2005). Strengthened institutions and/or new institutional models are required for effective waste management services in Third World cities. The goal is to collect and dispose of solid waste generated in an environmental and socially satisfactory manner, with the least possible use of economic resources (Bartone, 1991-a; 1991-b).

Third world cities spend up to 40% of their budgets trying to improve their waste management programs[3] (CEPIS, 2002). However, policy makers pay more attention to other problems such as air pollution or wastewater treatment than to solid waste management. Often programs that do get implemented involve solutions that are centralized and bureaucratic, with little public participation in the decision process (Medina, 1999). Another challenge that municipalities, in developing countries face is lack of administrative organization between departments. Usually, Municipal Governors are responsible for many urban services at the same time. The excessive responsibility has a negative effect both on the quality of the services provided and on the allocation of the monetary resources within the different services. Consequence of this poor administrative planning is that many of these services end up being assigned to personnel with low education levels and no technical training in the specific field. Also, due to the low salaries paid in this sector, many employees do not seek to achieve the best results possible in the tasks assigned to them. This lack of training is also reflected in the production of overly ambitious public bylaws that miss proper supervision and control mechanisms. This creates a huge gap between policy and practice (Buenrostro and Bocco, 2003).

In general, in developing countries solid waste management is scarce and insufficiently planned. There is an abundance of unskilled labour, therefore labour is cheap. This makes for a high rate of labour-intensive collection and processing of recyclable materials throughout the developing world. A common practice in developing countries' waste management systems is that collection workers often rummage through household waste handed in for collection; there are also scavengers who sift through waste at transfer stations and dumpsites (Beede and Bloom, 1995). This suggests that there is a need to modernize solid waste management by implementing recycling or reuse programs. Also, solid waste management plans should implement treatment systems that aim

[3] http://www.ambiente-ecologico.com/ediciones/2002/084_05.2002/084_Investigacion_Cepis.php3. Last access on June 5, 2009.

to counteract environmental problems, decreasing the consumption of natural resources, and minimizing the space required for final disposal (Buenrostro and Bocco, 2003).

4.2 Sustainability

Sustainable development has been defined as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (Brundtland Report, WCED, 1987).

In order to address problems caused by human activities it is necessary to consider not only natural/physical dimensions, but also socio-political and cultural ones. A sustainable society must be sustainable in both environmental and socio-economic terms.

One approach to environmental sustainability suggests that three strategies should be pursued: First, life support systems must be protected; second, biodiversity must be protected and enhanced, and third, resource management must enhance the integrity of ecosystems through careful management. Socio-economic sustainability involves all human activities and behaviours (Woollard, and Rees, 1999).

Sustainability then, is not a goal, but a process that will acquire particular characteristics depending on specific contexts and needs. (Gibson, et.al., 2005)

Sustainable development discourse dates back to the 1960's. Raised again in the 1970's with the Cocoyoc declaration, they reappear in 1980 with the World Conservation Strategy, and are defined in the Brundtland report in 1987. Sustainable development has been brought up in summits and conferences ever since (Hay, 2002).

Sustainable development is a complex concept involving economic, environmental, and social factors. It is difficult for organizations of any sort to come up with sustainability strategies because of the amorphous nature of the concept (Beloff, Tanzil, and Lines, 2004).

Lack of a clear-cut definition has allowed an incessant manipulation of the concept and has brought forth the creation of terms such as 'ecologically sustainable development' in order to distinguish from the interpretation of sustainable development as 'economically sustainable development' (Hay, 2002). Trying to integrate both extremes, Diesendorf (2000:23) defines sustainable development as '*types of economic and social development that protect and enhance the natural environment and social equity*'. It is clear that academics, authors, and policy makers will continue to debate the concept, and try to define it further in means that will suit their purpose (Gertsakis and Lewis, 2003; Gibson et. al., 2005; Hay, 2002).

Sustainability has been a key concept in environmentally-benign policymaking for over twenty years. A sustainable policy should find equilibrium between the social, economic, and environmental interests of the stake holders as much now as in the future (Brundtland, 1987). In general, decision making circumstances involve the need to evaluate a set number of possible alternatives based on a finite number of criteria (Shi, 2003; Gibson, et.al., 2005).

Sustainability is defined as the goal of sustainable development, and as such, it is the objective when developing practical strategies. One approach to these strategies is focused on eco-efficiency, or efficiency of resource use. Economists like Von Weizsacker, Lovins, and Lovins (1998), and Woollard and Rees (1999) have talked about factor-x reductions in resource use to improve eco-efficiency. Others argue in favour of technological innovation. Whichever the case, we must recognize that advances towards sustainability are complex because they involve not only technological and environmental considerations, but also require a change in social behaviour (Gertsakis and Lewis, 2003).

To effectively implement sustainability strategies, organizations must be able to frame all the issues that need to be considered. It is necessary to determine what is important in each of these aspects. This can be reflected in the creation of a sustainability framework. Through these

frameworks, organizations should be able to understand what sustainability means within its culture. Then, the sustainable development framework can be transformed into a practical decision-support system that addresses real-life problems (Beloff, Tanzil, and Lines, 2004).

Gibson, et.al. (2005), believe that any general list of decision criteria must be adjusted and developed in and for the particular circumstances where they are to be applied. They argue that any useful set of criteria must be able to fulfill two different roles:

a. The criteria must seek to identify areas where damage is to be avoided, and long-term improvements are wanted.

b. The criteria must support and increase awareness to possible links between the three pillars of sustainability or the triple-bottom-line –social, economic, and environmental issues.

In sustainability assessment, the basic framework for identifying and evaluating the options is a set of criteria based on the requirements for sustainability. Within this context, Gibson et.al point out a set of eight criteria that can be used as this general guideline for supporting decision making, than can later be adapted to each particular case, as it has previously been pointed out. These criteria are listed as requirements for progress towards sustainability:

1. Socio-ecological system integrity;
2. Livelihood sufficiency and opportunity;
3. Intra-generational equity;
4. Inter-generational equity;
5. Resource maintenance and efficiency;
6. Socio-ecological civility and democratic governance;
7. Precaution and adaptation;
8. Immediate and long term integration;

These requirements should serve as objectives underpinning any strategy aimed at future well being. They can be used as a checklist of themes that must be considered in a decision making process, but they are only a starting point. It is also important to consider the purposes, alternatives and potential effects of the enterprise in question (Gibson, et.al, 2005).

One of the main problems that have to be addressed is that, in real life problems, the three pillars of sustainability often conflict with each other. There is no one single way to satisfy all of the criteria (Shi, 2003; Gibson, et.al., 2005). When there are multiple objectives to comply with, the decision making process becomes difficult because there are several areas of concern, and no one course of action is best overall. The trade-offs are not obvious (Shi, 2003). However, the aim is always a positive contribution towards sustainability. This means that the application of sustainable criteria must be rigorous, but at the same time flexible enough to adapt to real-life circumstances.

Guidance is needed to deal with the unavoidable trade-offs. According to Huylenbroeck (1996) the conflicts between economic and environmental objectives in a project can be solved in three steps: 1) separate aggregation of the economic and ecological criteria; 2) visualization of trade-offs; and, 3) discrete compromise analysis to support the final choice. At the end of the day, it all comes down to a matter of choice. Even though the application of sustainability criteria can provide some guidance for the tough choices that need to be made, the decision is still difficult. It would then be important to try and establish a general set of trade-off rules.

For progress to sustainability, we need to recognize the interdependence of economy and environment, and find ways of making mutually supporting improvements on all fronts. Trade-offs allow some adverse effects in the interest of acquiring significant gains. Progress towards sustainability involves public choices and relies on building mutually supportive, positive links among many activities. (Gibson, et.al., 2005).

As a general guideline, it has been established that the purpose of the trade-offs is to seek the greatest possible environmentally benign gain. Other important objectives are the protection of the future, and the avoidance of significant adverse effects (Gibson, et.al., 2005). These general rules must be accompanied by a code of ethics which should have characteristics such as responsibility, justice, truthfulness, and integrity. Ultimately, this would mean that trade-offs should aim at maintaining ecological processes and life support systems, preserving biodiversity, and integrating natural resource conservation with socioeconomic development (Berry, et.al., 1992).

Another helpful decision support tool is indicators. Although "*it is not meaningful to measure the absolute sustainability of a society in any point in time… therefore, the best that is likely to be possible, even in principle, is to articulate general principles to assess the relative sustainability of the society*" (Francis, et.al., 1990: 40). Indicators have been used to measure the 'grade of sustainability' people live in. Sustainability indicators should let us know:

- How are we doing in comparison to how we were doing?
- Where are we heading?
- Are things looking better?
- How far and in what direction do we have to go?

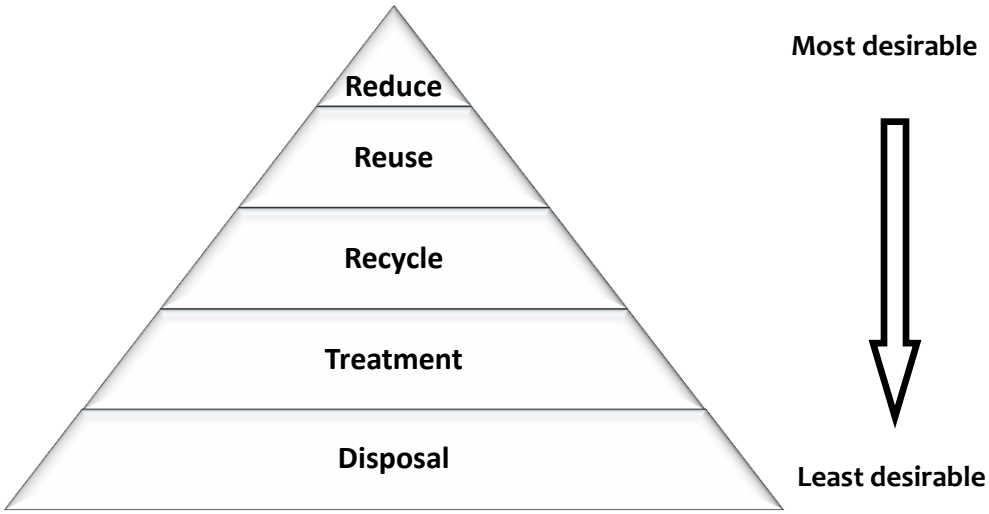
Indicators help decision makers in setting goals, estimating progress, benchmarking, and comparing alternatives in terms of sustainability (Beloff, Tanzil, and Lines, 2004). Each endeavour that is undertaken in this respect would have its own particular indicators that would help determine whether progress towards sustainability is being made, or whether the initiative complies or not with the requirements for sustainability that have been mentioned above.

4.2.1 Sustainability and waste management

The concept of the waste management hierarchy ties waste management and sustainability together very well. Interpretations of the hierarchy are varied. Some interpret it strictly as a 'most

preferred to least preferred' hierarchy, while others interpret it as part of an integrated approach that provides a scope of waste management options with each option equally valid to the rest depending on the circumstances. In any case, internationally there is increased recognition that waste management should focus first on prevention of waste, then reduction, then recovery. Preventive and reductive strategies are more effective in achieving sustainability (Gertsakis and Lewis, 2003). Figure 4-1 illustrates the waste hierarchy.

Figure 4-1 Waste hierarchy goals ordered from most desirable to least desirable.



Adapted from Gertzakis and Lewis, 2003.

Integrated waste management is the approach to waste management regarded as the most compatible with sustainable development. This approach takes into account the waste management options presented by the waste hierarchy. Through coordinating a set of actions such as waste prevention, reuse, recycling, composting, incineration, and sanitary landfilling, integrated waste management seeks to reduce pollution, maximize recovery of valuable materials, and protect human and environmental health (Medina, 1999).

In 2001, Sandra Cointreau published on the World Bank's web page a declaration of principles for the sustainable and integrated management of waste. According to her, for waste management to be both integrated and sustainable it must comply with the following principles:

1. It must be supportive of good governance
2. It should provide economic service delivery
3. It should establish cost recovery mechanisms for long-term financial sustainability
4. It should conserve natural resources
5. It should embrace public participation
6. It should foster environmentally appropriate technologies and sites
7. It should seek appropriate levels of source segregation, recycling and resource recovery
8. It should conduct strategic facility planning and development
9. It should build institutional capacity
10. It should invite private sector involvement

For the purposes of this research, these principles along with Gibson's (2005) requirements for progress towards sustainability provide a set of evaluation criteria for assessing the sustainability of integrated waste management systems.

Chapter 5 The Mexican Governance Context

5.1 Public administration in Mexico

Inability of federal governments to deal with complex environmental issues effectively has caused them to discharge responsibilities to local governments. A combination of external and internal factors has so far prevented many of these countries from achieving significant economic growth. This has caused some countries to restructure their economies. This restructuring has brought about the need to re-examine the role of the government in economic activities (Saxena, 1996).

To achieve a different behaviour toward economic decision making by the governments, many countries are applying Public Administration Re-engineering (PAR) (Saxena, 1996). PAR is similar in ways to Business Process Re-engineering (BPR). It is about focusing on processes instead of functions to improve performance. BPR provides organizations with a way to enhance efficiency and effectiveness. PAR takes the same ideas and modifies them to fit the public sector. The concept of PAR is holistic, and has four key elements: 1. strategy, 2. organizational structure, 3. information technology, and 4. culture. All key elements are of equal importance, and should be treated as such (Saxena, 1996).

Organizational culture, as opposed to individualist tendencies, is founded on the strength of collectivity to affect the way organizations operate. Organizations are based on the values of institutions. The institution is an abstract entity comprising aspirations, necessities, and values of a given society; this entity gives way to a defined set of social rules that attend to the particular necessities of an ample group of individuals (p. 5). Each institution is an autonomous entity. It is the base of the organizational legitimacy. The organization is comprised of political, structural, decisional, and affective elements that guide its view of truth and order (Montaño, 2005).

Complex societies have diverse institutions. Each institution has its own values, manifested through its organization's mission and vision. The structure of the Mexican government offers a wide range of institutions and responsibilities originating from its political system. To understand Mexican public administration it is important to know the objectives and the organs which make up the Mexican State, and, more importantly the executive branch. Mexico is a Federal Republic integrating three political and administrative levels: local (municipalities), state and federal. Within this constitutional framework, the organs of the State are able to choose among courses of action taking into account both the political and socio-economical requirements, and their administrative capacity. Accordingly, during each presidential term of office, governmental programs are defined- trying not to neglect the projects that go beyond these terms (Cervantes, 1974; Political Constitution of the Mexican United States, 2000).

During President Echeverria's mandate –in the 1970s – administrative reform was promoted. This reform was intended to increase the effectiveness of government bodies through improvement of their organizational structure and methods of work. One of the main objectives was to de-centralize the operative machinery of these governmental bodies so as to bring the services closer to the recipients, and speed up and simplify formalities (Cervantes, 1974). Through New Public Management, institutions are moving toward efficiency, justice, the markets, and the citizens as the main link between organizations and society (Montaño, 2005). From the 1970's on, the Mexican government has been making progress in modifying the responsibilities and the financial transfers between the various levels of government. Through decentralization, the government may be able to deal with problems that have become intractable at the central level.

Progress has been made in Mexico in involving local government and citizens in decision-making. This is a sign of a profound change in the traditional way of management (Greffe, 1998). In this sense under the De la Madrid administration –1982 to 1988-- the national System of Democratic

Planning, was established, after adding and reforming articles 25 and 26 of the Constitution, and publishing the National law for Planning. The basic goals of these reforms were to create a participatory system for national planning in such a way that many administrative decisions can be made at the local level, instead of the federal, with the goal of a more efficient form of management. The same is true for municipal institutions, as can be shown by the restructuring of the National Institute for Municipal Studies, transformed into the National Institute for Municipal Management. The aim is to convert it into an institution similar to the one existing in Spain, through which many municipal servants are trained (Calzada, 1983).

5.2 Environmental policy in Mexico

Mexico has a tradition of having policies that are perceived, defined, designed, and executed by the government. Mexico was traditionally an authoritarian state, and is now a democracy in transition. This means that social relations were developed in a vertical form, with very little interaction between actors, and a weak participatory tradition (Cabrero, 2000). The transition to a democracy from an authoritarian political system should promote administrative and political decentralization, while at the same time foster the growth of local government capacity in political and administrative processes. This is particularly true for environmental protection issues (Assetto, Hajba, and Mumme, 2003).

Mexico has, in the past decade made a substantial commitment to revamping its institutional basis for environmental protection. It has revised its environmental laws, decentralized aspects of environmental administration, invested more heavily in environmental protection, and made a number of international commitments to environmental protection. Mexico has made considerable progress at the formal level in recalibrating Mexican legislation and state and regional development programs to mandate environmental protection and express the values of sustainable development. States and municipalities have little by little gained more authority to protect the environment than

they had in the past. Progress is also seen in the increasing improvement of giving the citizens access to environmental information. However, at the implementation level there are still shortcomings. The federal government continues to dominate decision making, and the benefits of decentralization so far can only be seen in the urban-industrial states and regions (Mumme, 2007).

Implementation of national environmental policy is associated with democratic values and institutions, and it is an opportunity for increased public participation and local involvement in decision making (Assetto, Hajba, and Mumme, 2003). However, for democracies in transition, as is the Mexican case, there are very few actors involved –and the incorporation of new actors is difficult—in the process of defining the political agenda. Non-government participants are scarce, and their capacity and influence is limited; all of these happen under great pressure to subordinate to the public authority. The policy design process within the Mexican context becomes practically hermetic (Cabrero, 2000). This is one of the main challenges that are faced while the democratization process is ongoing.

Since the 1980's Mexico has advanced in decentralization by gradually transferring official functions to the states and municipalities (Assetto, Hajba, and Mumme, 2003). This was possible through the revision of Article 115 of the Mexican Constitution. In this article, municipalities were conferred with land use planning and environmental conservation functions (Political Constitution of the Mexican United States, 2000).

This decentralization process has allowed municipalities to create some of their own regulations. However, these regulations still have to follow the guidelines of the Federal Laws and Regulations. In terms of environmental policy, it is still the Federation that establishes general policies to be applied to the whole of the National territory. In Mexico, neither states nor municipalities have much fiscal autonomy. The practice is that all tax revenues collected flow directly to the Federal government which in turn gives a portion of this revenue to local authorities. It is also

the Federal government that decides the distribution of these resources. Within this scheme, it is difficult to allocate a large quantity of revenue to environmental protection (Asetto, Hajba, and Mumme, 2003).

Greater environmental protection powers were granted to the municipalities with the publication of a national environmental law (General Law for Ecological Equilibrium and Environmental Protection, LGEEPA) in 1988. However, it was not until 1992 that an organization was created specifically to aid in the design and implementation of Federal environmental policies through the creation of the National Institute of Ecology (INE). In this same year, the enforcement functions for environmental protection were placed in the hands of the Federal Attorney of Environmental Protection (PROFEPA) (Mumme, 2007).

Mexico's efforts to develop and implement environmental policy have faced two critical challenges: difficulties in defining and implementing the concept of sustainable development and organizational difficulties associated with the aforementioned public management reforms. Romero-Lankao (2000) believes that in order to overcome the shortcomings of the government in trying to find solutions to the problems in areas like the environment, it is necessary to create or rehabilitate public sector institutions.

In 1994, under President Zedillo's mandate, the Secretariat of Environment, Natural Resources and Fisheries (SEMARNAP) was created. The premise of the secretariat was to coordinate policies and programmes that promote social development, economic growth, and environmental protection (Romero-Lankao, 2000). These consolidated the important natural resources agencies under the administrative rubric of 'ecology'. The intent of this reform was clearly to send a political message that the government was giving a higher priority to environmental protection and has a stronger commitment to better enforcement of the environmental legislation (Mumme, 2007).

Since 1996, SEMARNAP has worked in amendments to LGEEPA in lieu of promoting intergovernmental agreements and institutional development for environmental protection (Asetto, Hajba, and Mumme, 2003). Among other changes, the amendments formally incorporate the language and goals of sustainable development, environmental decentralization, administrative simplification, strengthen compliance mechanisms, guarantee the public's right to know, and address public participation in policy implementation (Mumme, 2007). This addresses some of the shortcomings of the government in the implementation of environmental policies. In 2000, the Secretariat of Environment, Natural Resources and Fisheries evolved into the Secretariat of Environment and Natural Resources (SEMARNAT) with a renewed commitment to protecting the environment.

The inclusion of Mexico in NAFTA reinforced the pressure toward decentralization and capacity development. However, in practice this has not been achieved. Many municipalities still rely on the Federal or State government to enact environmental protection policies; others cannot enforce them for the lack of financial resources. In general, very few municipalities have the expertise to develop or implement environmental policies (Asetto, Hajba, and Mumme, 2003).

All states and the Federal District now have environmental laws in place that authorize and define sub national environmental policy functions and establish the framework for municipal environmental governance. State and local environmental management operates with the federal intergovernmental practice of *concurrencia*, in which higher levels of government are made responsible for subsidiary authority where that authority lacks capacity to perform assigned functions. Thus, most environmental policy at state and local levels remains with SEMARNAT's state field delegations (Mumme, 2007).

The key to strengthening environmental capacity of local governments is to understand the problems that arise in advancing the process of decentralizing environmental protection. In Mexico,

persistence of corporatist models of decision making in environmental protection favours central government dominance of the policy process. Also, although devolution has conferred upon municipalities numerous environmental functions, states have failed to provide essential regulatory authority in support of these. These obstacles restrict the sub national capacity for strategic action in environmental issues. Also, the lack of available funds has also greatly limited development of capacity to deal with environmental problems (Asetto, Hajba, and Mumme, 2003).

In 2000, SEMARNAT established two programs that may benefit sub national governments. One is a fund dedicated for local environmental protection priorities identified by state environmental authorities. The second is an institutional development program aimed to strengthen state and local environmental management. The Federal District is the leader in allocating resources to environmental protection; other municipalities, however, lack a budget for this purpose (Asetto, Hajba, and Mumme, 2003).

The way the Mexican government addresses environmental issues has also changed. During the first years after the creation of INE and PROFEPA, the first had all the powers for the creation of normative instruments. The Institute, then, had four main functions: ecological planning, environmental policy design and implementation, ecological use of natural resources, and technological research and development. In 1994, with the creation of the Secretariat of Environment, its main functions became environmental regulation, policy planning and environmental management (INE, 2008).

Basically, environmental policy instruments in Mexico have been divided into two groups. The first group is comprised of norms and regulations that help prevent pollution –air, soil and water. In this group we can find the norms related to waste management. The second group is oriented to designating natural conservation areas throughout the country. There are no regulations oriented

specifically to promoting a healthier environment, sustainability or adequate environmental and resource management (Guillén, 2007).

In October, 2003 the national legislature passed the General Law for the Prevention and Integrated Management of Waste in Mexico (LGPGIR). This federal law puts urban solid waste under the jurisdiction of each municipality. Under this legislation, the Federal District created its own Solid Waste Law (LRSDF, 2003). This Law allowed for the design, publishing, and implementation of the Federal District's Integrated Solid Waste Management Program 2004-2008 (PGIRSDF, 2004).

Considering that the Federal District is involved in creating programs that will drive the city towards sustainable development, this program fits well within that context. During the last 10 years the government has developed several programs aimed at increasing sustainability in the city, specifically, environmental sustainability. Such programs include land use planning, rational hydro resource management, designation of aquifer recharge zones, and designation of green conservation areas. These programs are aimed to curb environmental vulnerability in the metropolitan area. The Integrated Solid Waste Management Program is the newest program established for this purpose (Secretaria del Medio Ambiente del Distrito Federal, 2007).

5.2.1 Federal legal instruments

The Mexican Political Constitution specifies in its article 115 that municipalities are responsible for providing citizens with waste management services. These services include waste collection, transport, treatment and confinement. Municipalities are also in charge of cleaning public spaces. This article is the only one in the Constitution that refers to waste. From the provisions stated in the article it is clear that strategies for waste minimization or mitigation of impacts on the environment or human health have not been given consideration.

The General Law for Ecological Equilibrium and Environmental Protection (LGEEPA) does not address this shortcoming. In its two articles related to waste management, article 8 and article 137, the Law

dictates that municipalities are responsible for applying legal dispositions related to the generation, transport, confinement, management, treatment and final disposition of waste and of giving the authorizations necessary to perform any of these activities. This law also establishes in articles 7 and 8 that the States and Municipalities respectively have the authority to design, conduct, and evaluate local environmental policies.

In 2003, the General Law for the Prevention and Integrated Management of Waste (LGPGIR) was published. This Law incorporates the main elements of integrated waste management. It also provides a more narrow definition of competencies for the three levels of government in relation to waste management. Article 10 establishes that municipalities are responsible for the integrated management of urban solid wastes; this includes minimization, source separation, recycling, temporary confinement, transport and final disposal. Although in practice this rarely happens, article 10 also establishes that municipalities may charge a fee for waste management services and may use these resources to strengthen their waste management systems.

The LGPGIR incorporates principles addressing the remainder value of waste, shared responsibility, integrated management, prevention, minimization, among others. The distribution of authority among the three levels of government aims to put these principles into practice.

Table 5-1 shows a summary of the responsibilities given to each level of government by the LGPGIR.

Table 5-1 Responsibilities of the three levels of government according to the LGPGIR

National level	State level	Municipal level
• Dictating the national policies on waste. • Designing the National Program for the Prevention and Integrated Management of Waste (PNPGIR). • Designing the National Program for the Remediation of Sites Contaminated by Waste (PNRSCR). • Issuing regulations and official Mexican norms on hazardous waste. • Issuing the official Mexican norm on environmental performance of urban solid waste and special waste. • Regulate and control generator of hazardous waste not controlled by the States. • Monitoring compliance with the applicable regulations and imposing sanctions. • Authorizing waste management activities including importing, exporting and transit of hazardous waste. • Promote the creation of infrastructure for Integrated Waste Management (IWM) in coordination with the States and Municipalities. • Integration national information subsystems on the integrated management of waste. • Convene the States and Municipalities for the development of joint strategies related to waste that would allow the solution of related problems.	• Dictating the state policies on special waste. • Designing programs for the management of special waste according to the PNPGIR and the PNRSCR. • Issue legal systems in the field of special waste. • Authorizing integrated waste management activities related to special waste. • Record managing plans for special waste. • Establishing obligation of generators and services providers of special waste. • Regulate and lay the foundations for the charge for the provision of services related to special waste. • Promote the creation of infrastructure for the integrated management of urban solid waste, special waste, and hazardous waste, in coordination with the Federation and competent authorities. • Promote private and social sector participation in the design and implementation of actions to prevent the generation of special waste and carry out its integrated management properly. • To assist in the integration of the subsystems of national information on the integrated management of waste. • Determine indicators to evaluate the application of the LGPGIR.	• Design municipal programs for the integrated management of urban solid waste in compliance with the State programs. • Issue regulations and legal systems for the implementation of the LGPGIR and State dispositions. • Provide urban solid waste integrated waste management services. • Give authorizations or concessions related to these services. • Keep record of great generators of urban solid waste. • Verify compliance of regulations on urban solid waste and to impose sanctions. • Participate in controlling hazardous waste for micro generators and impose sanctions. • Charge for urban solid waste integrates waste management services and destine the proceeds to the operation and strengthening of the services.

Adapted from LGPGIR (2003)

5.2.2 Local legal instruments

In compliance with articles 7 and 8 of the General Law for Ecological Equilibrium and Environmental Protection (LGEEPA), the Federal District has developed its own set of legal instruments to aid in the implementation of environmental policies. The base for the environmental legal system is the Federal District's Environmental Law (LADF).

Regarding waste, the LADF establishes in Article 6 that there are four figures with authority in environmental matters: the Chief of Government of the Federal District, the Secretary of Environment, the Delegates, and the Federal District's Attorney of Environment and Land Use (PAOT). Activities related to waste management are the responsibility of the Secretary of Environment. **Error! Not a valid bookmark self-reference.** shows a summary of key responsibilities, and the relevant article.

To address specific issues related to waste generation and waste management, The Federal District published two more legal documents: The Solid Waste Law of the Federal District (LRSDF), published in 2003, and its corresponding Regulation Booklet (RLRSDF), published in 2008. It is important to note that both the LRSDF and the LGPGIR were published in 2003. However, the local law was published a few months before the federal law. Within both laws there are differences in the definitions of High Volume Generators, as they are referred to in the LRSDF, and Great Generators (LGPGIR). The amounts of waste considered in the definition vary considerably. In the LGPGIR a Great Generator is defined as the physical or moral entity that generates 10 or more tons of waste yearly, whereas in the LRSDF a High Volume Generator is considered to be the physical or moral entity that generates over 50 kilograms of waste per day. Another difference between both laws is the list of materials considered as special waste. Both laws agree however, that generators of special waste must present a management plan to the competent authority - in this particular case to the Secretariat of the Environment in the Federal District.

The other very important legal instrument, which is the main subject of this dissertation, is the Federal District's Integrated Solid Waste Management Program. This program is a vehicle for the implementation of the LRSDF and provided the basis for the implementation of integrated waste management in the Federal District.

Table 5-2 Responsibilities of the Secretary of Environment under LADF

Article	Responsibility
Article 9	Keep a record of the emissions and transfer of pollutants to the air, water, soil, materials, or waste.
Article 22	Develop and strengthen environmental culture through actions such as the correct management of waste, among others, in conjunction with the community.
Article 36	Issue environmental norms that will establish the requisites, conditions and permissible limits for the operation, collection, transport, storage, treatment, or final disposition of solid waste.
Article 76	Create an environmental information system for the Federal District that will include data on solid waste generation and management.
Article 127	Create and update regularly an inventory of solid waste generation and management.
Article 170	Elaborate programs that aim at minimizing the generation of waste.
Article 171	Issue environmental norms for the generation and management of waste. Inspect and monitor the implementation of this law and its regulations, Mexican Official Norms, and environmental norms regarding waste generation and management. Impose sanctions for lack of compliance.

Adapted from LADF (2000)

As all three of these instruments are very broad in content and contain elements key to the understanding of the environmental legal systems regarding waste within the Federal District, each is e described below.

5.2.3 Federal District's Solid Waste Law (LRSDF)

In April 2003, the Federal District enacted its solid Waste Law (LRSDF). This law applies to every generator of solid waste within the Federal District, and its main objective is the adequate separation and management of this waste in order to reduce the amount of inorganic solid waste that goes to

landfill sites. The implementation of this law requires a commitment from both the government and the society in general. Therefore, the most important activity is the dissemination of the law to inform the community and to create awareness so that in the medium term the waste generator will be educated regarding correct waste management. The law's general purpose is to achieve integrated waste management through the minimization of waste, valuing reusable waste, promotion of shared responsibility, support of research, and creation of legal instruments such as the Regulation Handbook, Management Plans, and an Integrated Solid Waste Management Program.

The law is composed of seven titles, eighteen chapters, seventy-seven articles, and nine transitory articles. Table 5-3 summarizes the content of the Solid Waste Law.

Table 5-3 Solid Waste Law

Title	
I	General Dispositions of the law
II	Competencies of the authorities
III	Dispositions for the prevention and minimization of solid waste generation
IV	Guidelines for public city cleaning services
V	Valorization of solid waste and composting
VI	Procedures for restoration, prevention, and control of soils contaminated with solid waste
VII	Sanctions, recourse of disagreement, and citizen complaint.

Adapted from LRSDF, 2003

Articles 4 to 10, establish who the figures of authority regarding the application of this law are, and their spheres of responsibility. The three main figures that participate in waste management are the

Secretariat of Environment, the Secretariat of Works and Services, and the d*elegaciones*. Table 5-4 shows a summary of their key responsibilities.

The main participants in the implementation of this law are waste generators. For regular generators – generators of urban solid waste in an amount lesser than 50 kilograms per day – their main obligation is to separate waste into two categories, organic and inorganic waste. High volume generators, generators of special waste, and waste management service providers, besides source separation, they have the obligation to present a management plan that the Secretariat of Environment must review and approve. Article 22 establishes that the guidelines for the elaboration of these management plans will be published in the Regulations Handbook. Waste management service providers must also be registered at the Secretariat of Works and Services.

Table 5-4 Spheres of Responsibility

Secretariat of Environment	Design and implement the Federal District's Integrated Solid Waste Management Program. Give authorization for the management plans proceeding from high volume generators, generators of special waste, and/or waste management service providers. Publish the solid waste generation inventory.
Secretariat of Works and Services	Maintain waste separation at transfer stations. Provide treatment services for reusable and recyclable waste. Keep a record of the waste management service providers. Aid in the elaboration and implementation of city cleaning programs.
Delegaciones	Maintain waste separation during collection and transport. Elaborate and implement city cleaning programs. Training and education for workers and citizens.

Adapted from LRSDF (2003)

The LRSDF has two articles that identify issues regarding the integrated management of solid waste. Article 24 establishes that it is the obligation of any physical or moral person to separate, reduce and prevent the generation of solid waste. It is also their responsibility to promote the reuse and recycling of such waste. Furthermore, it is their duty to let competent authorities know when an

infraction of the law is being perpetrated. Article 25 establishes that it is illegal to dump waste in open areas out of containers, and in unauthorized dumps. Also it says that scavenging of waste is strictly prohibited.

5.2.4 Federal District's Integrated Solid Waste Management Program (2004-2008)

In compliance with articles 6 and 11 of the LRSDF, the Secretariat of Environment issued the Federal District's Integrated Solid Waste Management Program (ISWMP). This program is a legal instrument that provides the guidelines, actions and goals for the elaboration and implementation of the city cleaning services by the Secretariat of Works and Services, and the *delegaciones*' street cleaning programs. It also provides guidelines for the sustainable management of waste by all sectors of society including industrial, commercial and service organizations.

The design of this program is based on thirteen guiding principles. These guiding principles incorporate sustainable development ideas and originate mainly from article 15 of the LGEEPA, article 18 of the LADF, article 11 of the LRSDF, and the Federal District's Environmental Protection Program 2002-2006, relating to environmentally sound management of waste.

The thirteen principles are listed below:

- Principle of sustainable development.
- Principle of prevention and minimization.
- Principle of self-sufficiency.
- Principle of communication, education and training.
- Principle of information.
- Principle of social participation.
- Principle of shared responsibility.
- Principle of 'the polluter pays'.
- Principle of technological development.
- Principle of soil protection.
- Principle of harmonization of policies.
- Precautionary principle.

The Program reflects what is stipulated in the LRSDF. Therefore, it incorporates the guidelines, actions and targets of integrated management of waste in the provision of the city and street cleaning services. It contains six chapters. The first three chapters describe the legal

framework, infrastructure, generation and management of waste up until the program was published. The last three chapters present the objectives, specific actions, and evaluation instruments of the program itself.

The program has eight main objectives, among which the most relevant are: prevent and diminish the generation of waste through source separation, reuse, and recycling; promote the culture, education and training on integrated waste management for all sectors of society; involve all members of society in the integrated management of waste; and facilitate the transfer of information on waste generation and management.

The Federal District's ISWM program was applicable to the whole of the Federal District, applying to urban solid waste, special waste, and all solid waste deemed as non hazardous. Its obligations fell on every entity that generated, stored, transported, treated, disposed, reused or recycled solid waste.

Chapter 5 is considered the axis of the Program. It consisted of five main lines of action: 1. Prevention and minimization of waste generation; 2. Management; 3. Recovery value and utilization; 4. Prevention and control of soil pollution; and 5. Communication and environmental education. Each of these lines of action is, on its own, made up of various subprograms which describe the specific objectives, actions and goals to achieve. Each subprogram contains six elements: objectives, actors involved, background, benefits, instrumentation, and schedule.

Table 5-5 shows a summary of the subprograms grouped by strategic lines of action.

Table 5-5 Subprograms of the Federal District's IWSM Program

Strategic Line	Subprogram	Description
Prevention and minimization of generation	Management Plans	Applies to high volume generators, and generators of special waste, reusers, and recyclers. The Secretariat of Environment must review and approve them. Guidelines will be published in the Regulations Handbook.
	Solid waste inventory	It will concentrate the information on the generation and management of waste. The information will be gathered from the management plans, *Delegaciones*, and the Secretariat of Works and Services.
Management	Source separation and selective collection	Its implementation will be progressive and based on the result of pilot programs. As collection is a responsibility of the *delegaciones*, each *delegacion* will decide on the scheme for selective collection from alternate collection or simultaneous collection in separate compartments.
	Clean Schools	Implementation of source separation in educational institutions.
	Public buildings	Implementation of source separation in political district's sites and administrative offices.
	Waste bins	Installation and upkeep waste bins in the streets to permit waste separation.
	Collection of bulky waste	Establish a defined schedule for the collection of household appliances and bulky waste.
	Special collection in markets and street markets	Collection in areas where trade activities are carried out in a manner that separation and collection will be more efficient.
	Renewal of waste collection and transport vehicles	Acquire new units with the appropriate features to facilitate selective collection.
	Transfer and transport	Improve the logistics of arrivals and departures in the transfer stations to reduce waiting times.
	Final disposal	Closure of the sanitary landfill, with the subsequent actions of post closure. The construction and operation of a new sanitary landfill
Valorization and utilization	Compost plants	Utilize organic waste generated in the Federal District.
	Waste selection plants	Upkeep of the three existing waste selection plants and making the process more efficient.
	Storage centres and service providers	Create a registry of the storage centres and of the waste management service providers.

Strategic Line	Subprogram	Description
Prevention and control of soil pollution	Eradication of clandestine dumps	Implement programs that will aid in the eradication of clandestine dumps such as night time waste collection, cleaning of ravines and vacant lots, and collection of demolition waste abandoned in public roads.
Communication and environmental education	Educational communication	Includes the development of means to disseminate the existing information around the integrated management of solid waste throughout the Federal District.
	Training	Design courses, workshops, seminars and conferences aimed at audiences of different backgrounds that can contribute in the propagation of information concerning the handling of solid waste.

Adapted from the Federal District's ISWM Program (2004)

Source separation and separate collection was the subprogram that acts as the basis for the compliance with the LRSDF. It defines a specific set of actions needed to achieve this first stage of integrated waste management. The subprogram was divided in two phases: implementation of pilot programs, and expansion of the pilot programs to full functioning. Each of these phases had a planning and operation stage. Through the implementation of pilot programs, the *delegacione*s would have schemes that have already been tested to determine the response of the population to the program and other necessary data for the gradual extension of the program according to the availability of technical and economic resources.

The first actions of the management program were geared mainly to the development of the elements of communication, training and work with the operational staff of cleaning system and the unions involved in these activities. After agreements were reached, the pilot programs were designed and implemented. Each *delegacion* set goals for its own pilot programs. These pilots ran during 2004 until October 1st, when the program began implementation. This period was established to allow the *delegacione*s to make the necessary adjustments to the pilot programs to transform them into the expansion programs until full implementation was reached. The expected percentage

of implementation by December 2008 was 75-100% of source separation and selective collection of waste.

The strategic line Communication and Environmental Education is also essential to the implementation of the program. Development of these activities took place at two levels: first during the pilot programs by door to door information sessions, pamphlets, brochures, invitation letters and training courses; and also, at a local level for the whole of the Federal District through mass media, posters and spectaculars in public spaces, phone cards, and radio and TV spots.

The final section of the program is Monitoring, Evaluation, and Update. The first step in monitoring and evaluation is the application of performance indicators to determine the advancement in coverage, waste separation, reduction of waste in final disposal site, and presentation and implementation of management plans. The second step is the evaluation and update of the different parts of the program. The assessment was to be conducted in December 2008, based on the results from the indicators mentioned above. The full program was meant to be updated every four years. Chapter three was to be updated by the Secretariat of Works and Services on a yearly basis. The solid waste inventory was to be updated by the Secretariat of the Environment, also on a yearly basis. The goals and advances in the subprograms *source separation and selective collection*, and *clean schools* were to be updated by the *delegaciones* every year, as was the plan for the renovation of waste collection and transport vehicles.

5.2.4.1 First stages of implementation of the Integrated Solid Waste Management Program 2004-2008 and pilot programs

As it has been stated in the previous section, implementation of the Integrated Solid Waste Management Program was done in two stages: pilot programs and expansion programs. The intention of the pilot programs was to gather experiences on different forms of implementation and to stabilize the programs so that they could be continued indefinitely. The general guidelines were

that the pilot programs would be implemented by establishing source separation in a predetermined number of regular waste collection routes, and to increase these routes progressively. The number of routes at the start was determined by each *delegacion*. The expected percentage of routes to add each year was established in the ISWMP.

The *delegaciones* chose one of two method of separate waste collection, depending on their available resources. The first option was alternate waste collection: one day the organic fraction, another day the inorganic. Waste collection takes place six days a week, Sunday being the only day that waste is not collected in the city. This allowed for the alternate option to work without having excessive accumulation of waste of any type from one day to the other.

The other option was simultaneous waste collection, keeping the waste separated into two fractions. Some *delegaciones* that chose this option either had or purchased waste collection trucks with two compartments. Other *delegaciones* had different ways of achieving simultaneous separate waste collection. Some decided to collect organic waste in the morning and inorganic waste in the afternoon and vice versa. Others sent two vehicles to drive through the route at the same time, one collecting organic waste and the other inorganic. Photographs of some of the vehicles used in the separated waste collection routes can be seen in Appendix 4.

In the photographs two other things can be appreciated. One is that although waste is supposed to be separated in two fractions, this was not necessarily the case. One of the reasons for this is that the waste labourers that collect the waste from the generator do not have time to inspect the bags before putting them in the truck (see Chapter 2). Therefore, the waste goes in the truck just as it was delivered. Also sometimes the generator himself empties the bag in the truck, again leaving no opportunity for verifying that the waste is separated.

The other thing that can be observed in the photos is the type of containers used for storing waste. It can be seen that most of the people hand in their waste in grocery bags. Due to this, some

supermarkets decided to print two different sets of plastic bags, one that read 'organic waste' and other 'inorganic waste'. This action was aimed at making it easier to the waste labourers to identify what kind of waste was being handed in. Also, it helped waste generators solve the problem of having two distinct containers to separate waste in their households. These companied kept printing the bags for about two years. However, in 2006 as the momentum of the program decreased, the supermarkets stopped making this marked grocery bags available to the public.

The pilot programs also served to establish how the Integrated Solid Waste Management Program would be promoted in each *delegaciones*. The Department of Environmental Education of the Secretariat of Environment developed a training course that was given to the personnel in works and services of each of the *delegaciones*. This department was also in charge of designing promotion materials such as brochures and pamphlets, as well as invitation letters for the waste generators. With these available materials, each delegacion decided how to pass on the information both to the inside and to the public in general. Some of the chosen strategies were distribution door to door of the invitation letters and brochures. Other *delegaciones* accompanied the printed materials with a brief door to door explanation of the program. There were *delegaciones* that made up to three visits to each household in order to get the commitment of the waste generators to participate in the program by separating their waste. Two or three delegaciones took advantage of public events going on at the time when the pilot programs were in effect and they set up information booths to raise awareness and answer any questions that the public could have in regards to waste separation. All of these actions were parallel to the ongoing information campaign put in place by the Federal District's Government.

Results from the pilot programs were tracked until October 2004. From then on the Integrated Solid Waste Management Program went into full effect. There is no evidence that these

results were used in any way as input or feedback to determine the best strategy for the expansion programs.

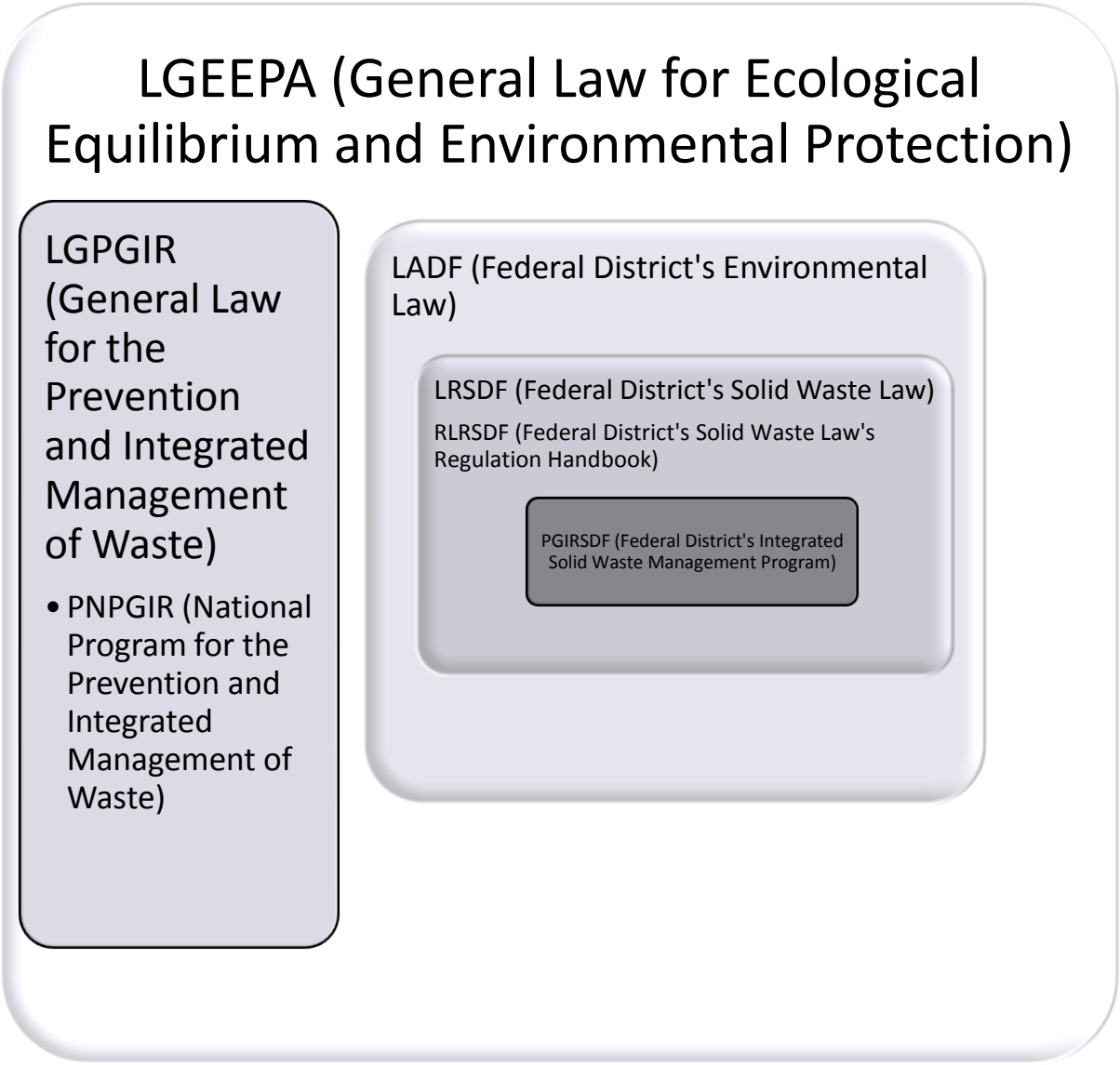
5.2.5 Federal District's Solid Waste Law Regulation Handbook (RLRSDF)

In October 2008 the Regulation Handbook for the Federal District's Solid Waste Law was published. This handbook serves as a complement for the regulations established in the LRSDF and includes the guidelines to the programs that stem from the law. Some of the articles relevant to this thesis are cited below.

- Article 5 establishes that the Federal District's ISWMP will be reviewed and updated every five years.
- Article 6 establishes that the political district's city cleaning programs should follow the guidelines presented in the Federal District's ISWMP.
- Article 9 establishes the content that should be included as a minimum in every environmental norm issued in the Federal District.
- Article 10 establishes that all educational institutions within the Federal District must incorporate environmental education and training in their school programs. Specific themes regarding integrated waste management must be included.
- Articles 13 to 25 establish the guidelines for the presentation of management plans. These articles include the different classifications of high volume generators and service providers. They also include a list of what the management plans for each of these classes of generators and/or service providers must include.
- Articles 26 and 27 establish the guidelines for the elaboration and publication of the solid waste inventory.
- Article 32 presents a list of the different subcategories of waste according to their organic or inorganic nature.
- Articles 101 and 102 establish the sanctions for the non compliance with the LRSDF or its Regulation Handbook.

These laws and regulations comprise the whole of the legal system regarding waste management in the Federal District. Figure 5-1 shows the relationship between existing environmental regulations regarding waste management.

Figure 5-1 Relationship between the Mexican environmental regulations


LGEEPA (General Law for Ecological Equilibrium and Environmental Protection)
LGPGIR (General Law for the Prevention and Integrated Management of Waste)
• PNPGIR (National Program for the Prevention and Integrated Management of Waste)
LADF (Federal District's Environmental Law)
LRSDF (Federal District's Solid Waste Law)
RLRSDF (Federal District's Solid Waste Law's Regulation Handbook)
PGIRSDF (Federal District's Integrated Solid Waste Management Program)

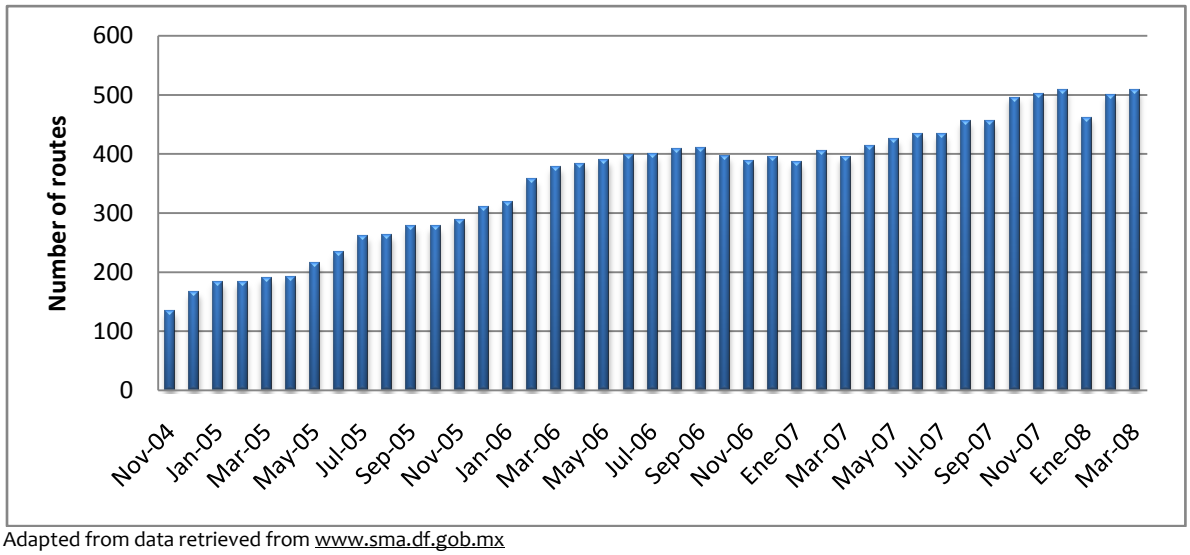
Chapter 6 Quantitative Data and Preliminary Results

In October 2004 the government of the Mexican Federal District published and implemented the Integrated Solid Waste Management Program (see Chapter 5). The government established that the participants of the program had to send monthly reports to show results of the program. Summaries of these results are published in the Secretariat of Environment's official web page, and have been used in part for this research. The specific data collected and results of the preliminary analysis of that data is presented in the following pages. The data that is presented in this thesis was initially obtained from the web page in December 2008 and updated in February 2009.

6.1 Sites involved in the implementation of the Federal District's Integrated Solid Waste Management Program

This section depicts the data associated with the sites incorporated in the Federal District's ISWMP after the run of the pilot programs (November 2004). Information will be presented for the whole of the Federal District and for each *delegacion*.

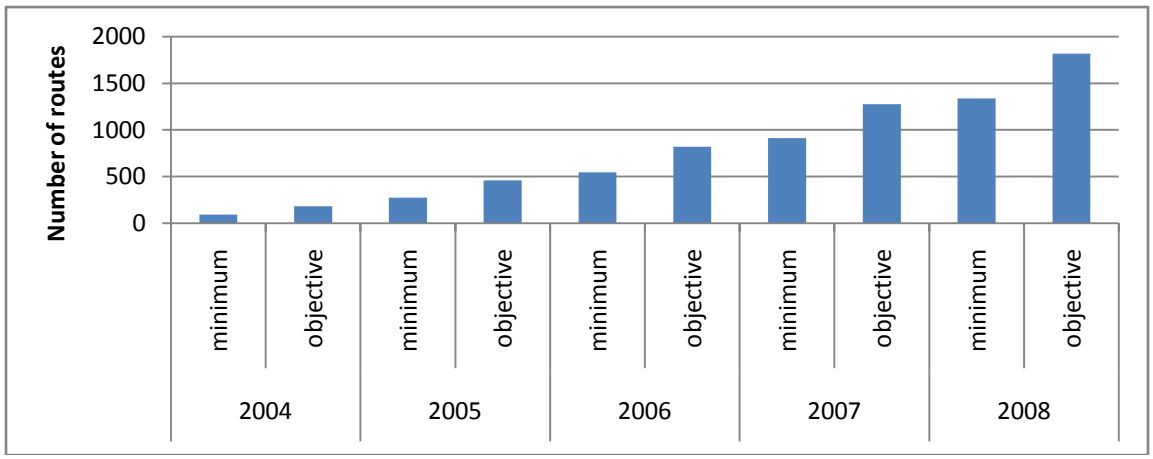
Figure 6-1 Number of waste collection routes with source separation and separate waste collection in the Federal District from Nov-04 to Mar-08



Adapted from data retrieved from www.sma.df.gob.mx

It can be observed from Figure 6-1 that the incorporation of routes with source separation and separate waste collection started off strong and continued in an upward trend up to March 2008 which constitutes the last data point reported.

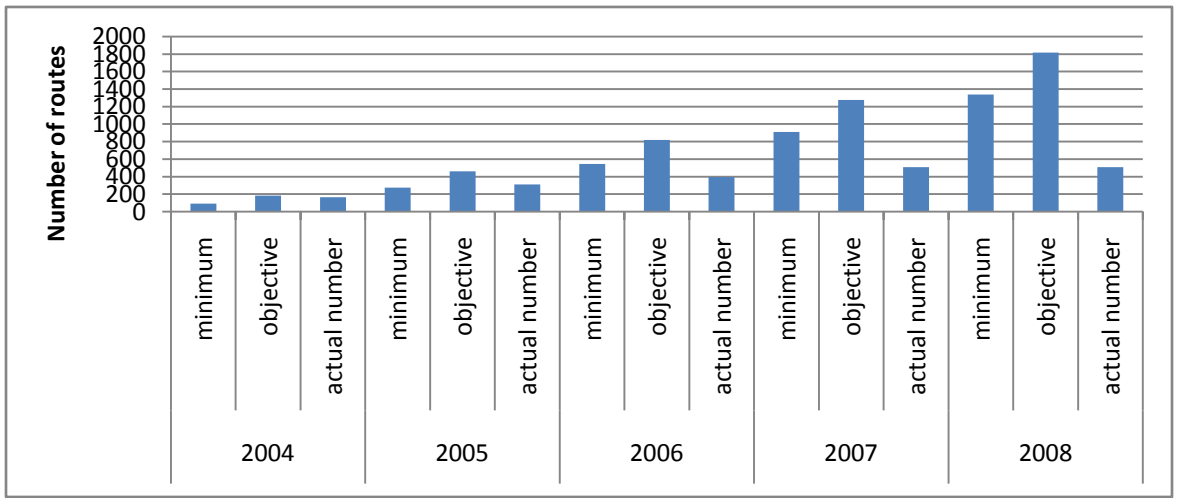
Figure 6-2 Number of proposed routes with source separation and separate waste collection



Adapted from data retrieved from www.sma.df.gob.mx

From Figure 6-2 we can determine that the objectives of the program were very ambitious. According to the chart, it can be observed that by 2008 the government expected at least 80% of the total number of waste collection routes in the Federal District to have source separation and separate waste collection already implemented. The optimal scenario was that by 2008, 100% of the routes would have been working under this scheme.

Figure 6-3 Number of routes with source separation and waste collection vs. proposed number of routes



Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-3 shows that in reality the program did not work as expected. During 2004 and throughout 2005 the number of routes with source separation and separate waste collection fell within the expected range. But from 2006 and onwards the number of routes implemented was well below the number of routes planned, indicating that the program was not performing as expected. The researcher considered that a more in depth analysis of this data might help determine the cause(s), therefore the data was further analyzed for each of the sixteen *delegaciones* (see chapter 2).

Figure 6-4 to Figure 6-19 show that each *delegacion* has different performance in terms of number of routes where source separation and separate waste collection was implemented. However, it is important to note that all *delegacione*s except Cuajimalpa (Figure 6-8) and Milpa Alta (Figure 6-15) have one thing in common: the number of routes for part of 2007 and all of 2008 remains constant. This result raises certain concerns about the integrity of the data and/or the program.

First, if the *delegacione*s were following the requirements of the program, the number of routes with source separation and separate waste collection should be increasing from one year to another. According to the objectives of the program (see Chapter 5) by 2008 at least 75% of the routes should have been implemented. This means from 2004 to 2008 the number of routes with source separation and separate waste collection should have gradually increased from 91 to 1,364.

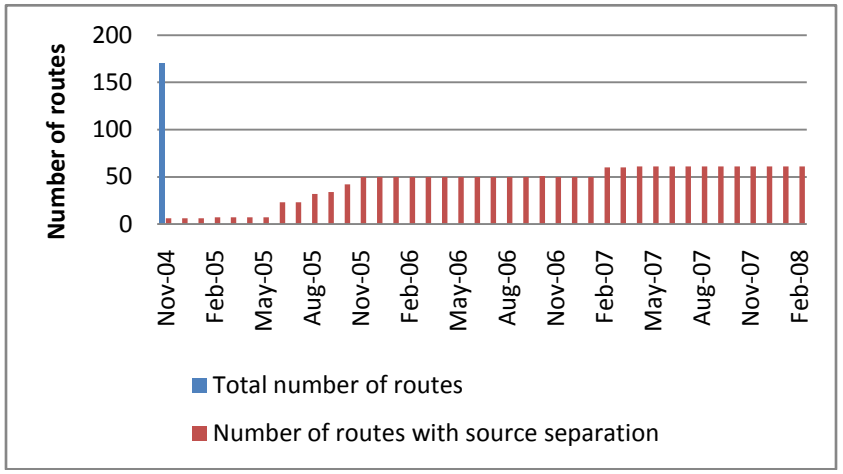
Second, the data indicates that the number of routes at which the *delegacione*s remain constant is at the highest number of routes incorporated at any point in time. Figure 6-8 and Figure 6-15 are different from the rest. These two last figures indicate that at some point in time the number of routes incorporated into the program decreased. The data regarding waste collected in these routes shows a declining trend, which suggests that the number of routes implemented decreased in

all the *delegaciones* and not only in Cuajimalpa and Milpa Alta.This finding will be noted and explained more thoroughly when the data for tons of waste collected in those routes is presented.

Benito Juarez (Figure 6-6), Cuahtemoc (Figure 6-9), Iztacalco (Figure 6-11), Iztapalapa (Figure 6-12), Magdalena Contreras (Figure 6-13), and Venustiano Carranza (Figure 6-18) show similar behaviour. Only two or three different numbers of routes were reported during extended periods of time. This behaviour is inconsistent with that of the other *delegacione*s. This may mean that data was collected and/or reported up to a certain time and then, for purposes of having a number to report on the waste inventory, the Secretariat of Environment decided to leave the number as a constant. This may prove true for the last months reported for all the *delegacione*s too.

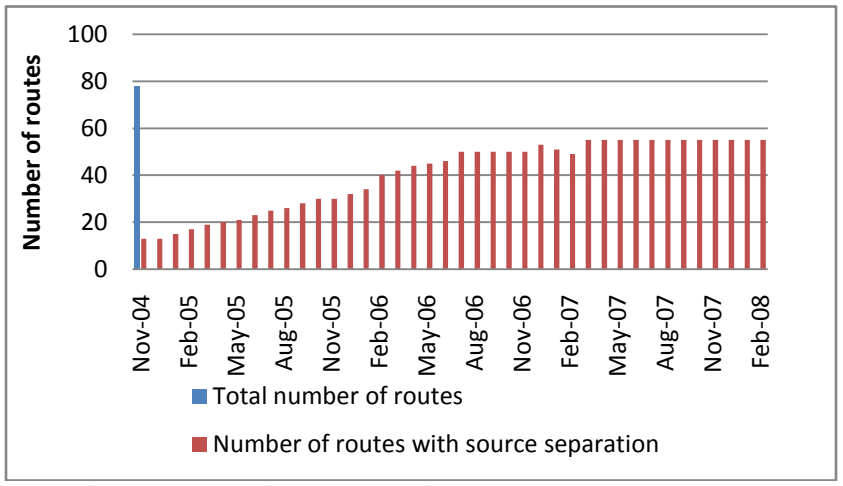
Viewing the figures suggests that some *delegacione*s decided to ignore the dispositions of the Federal District's Integrated Solid Waste Management Program. Coyoacán (Figure 6-7) and Iztapalapa (Figure 6-12) started reporting data in 2005 and 2006 respectively. Gustavo A. Madero (Figure 6-10) has quite a few gaps in the data reported. This may mean that either the program was not implemented until then or that data was not collected nor reported. Whichever the case, this is non-compliance with a mandatory government program.

Figure 6-4 Number of waste collection routes with source separation and separate waste collection in Alvaro Obregon from Nov-04 to Mar-08



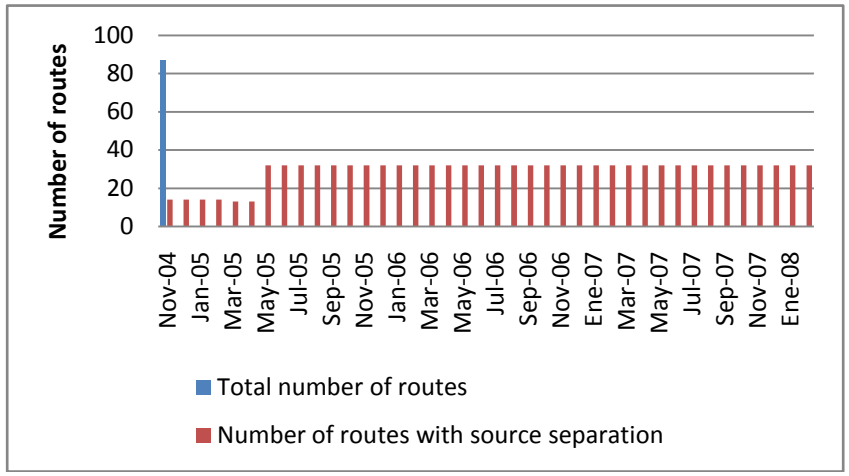
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-5 Number of waste collection routes with source separation and separate waste collection in Azcapotzalco from Nov-04 to Mar-08



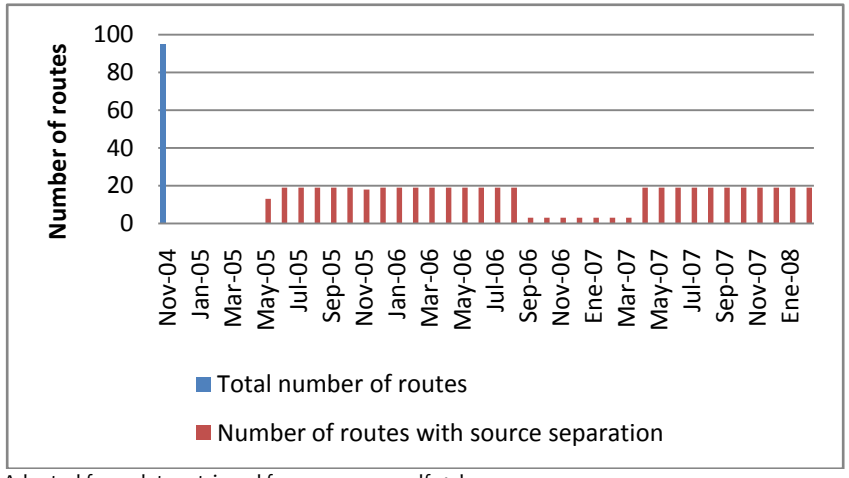
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-6 Number of waste collection routes with source separation and separate waste collection in Benito Juarez from Nov-04 to Mar-08



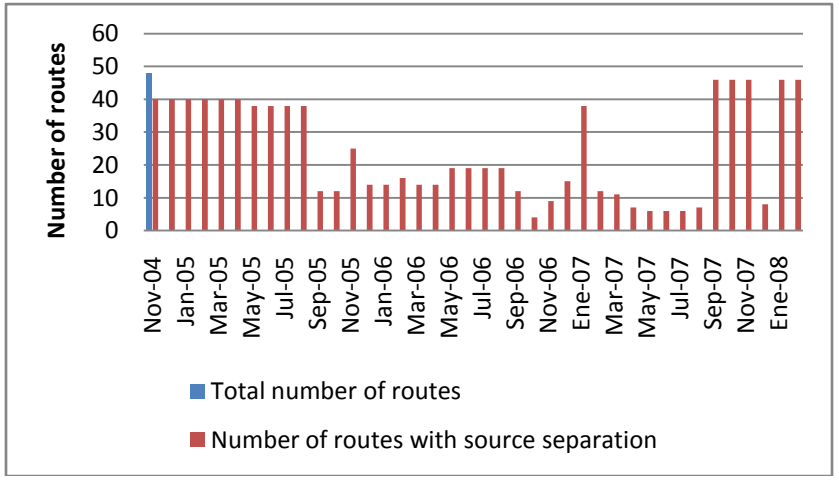
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-7 Number of waste collection routes with source separation and separate waste collection in Coyoacan from Nov-04 to Mar-08



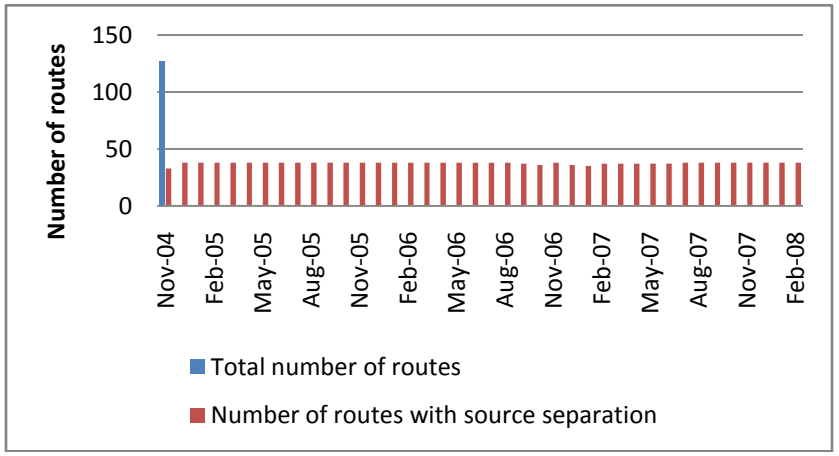
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-8 Number of waste collection routes with source separation and separate waste collection in Cuajimalpa from Nov-04 to Mar-08



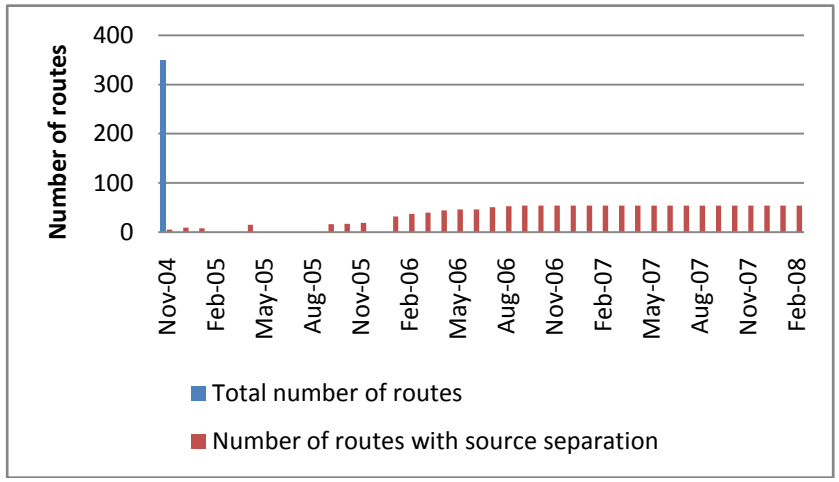
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-9 Number of waste collection routes with source separation and separate waste collection in Cuauhtemoc from Nov-04 to Mar-08



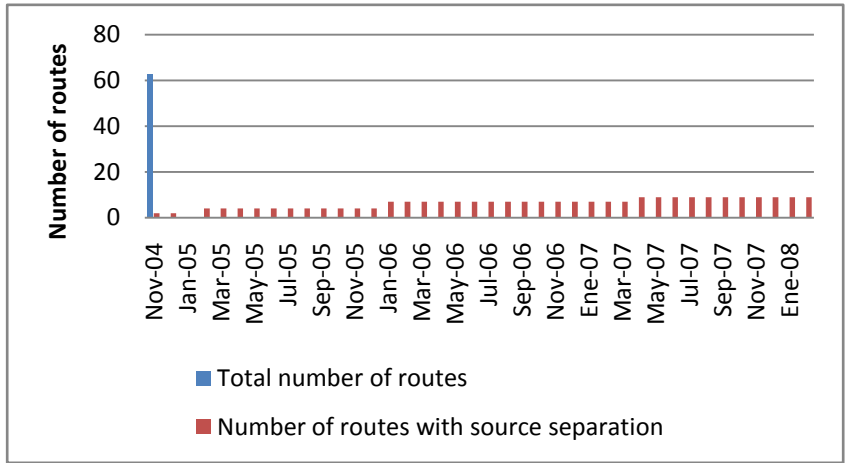
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-10 Number of waste collection routes with source separation and separate waste collection in Gustavo A. Madero from Nov-04 to Mar-08



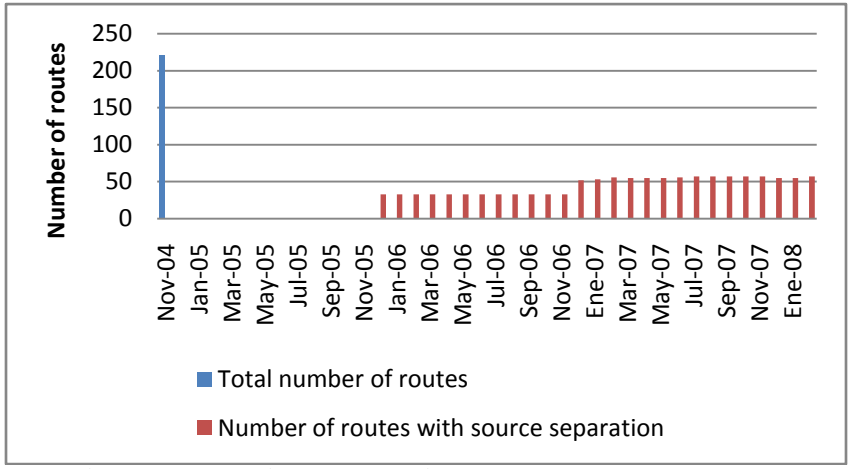
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-11 Number of waste collection routes with source separation and separate waste collection in Iztacalco from Nov-04 to Mar-08



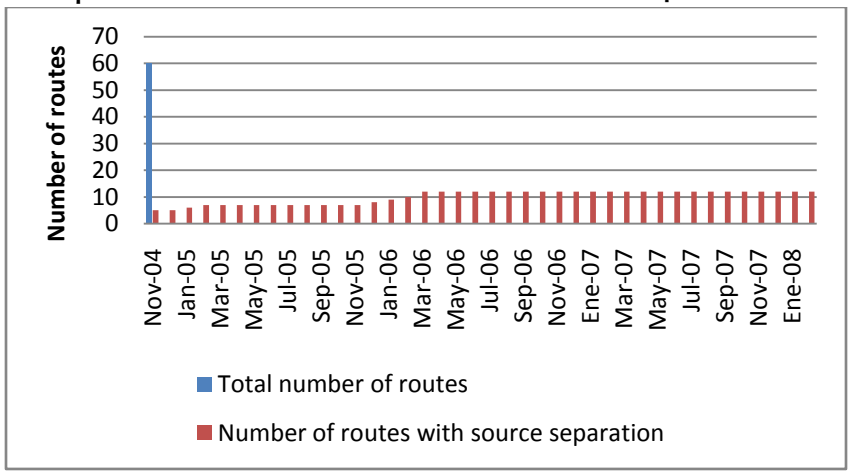
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-12 Number of waste collection routes with source separation and separate waste collection in Iztapalapa from Nov-04 to Mar-08



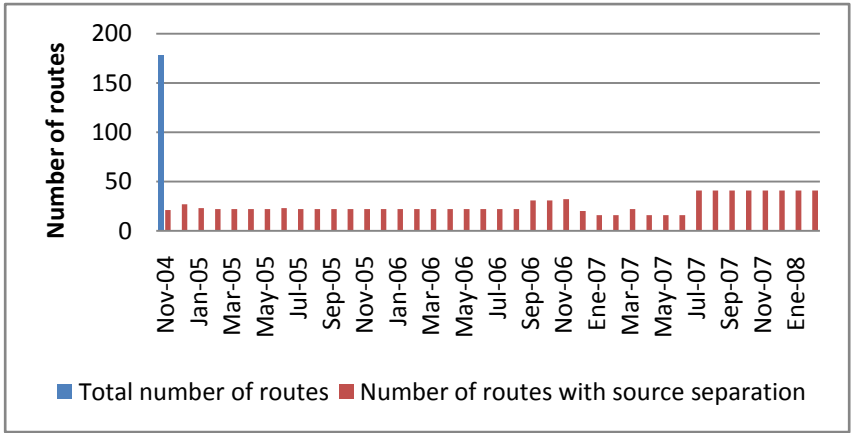
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-13 Number of waste collection routes with source separation and separate waste collection in M. Contreras from Nov-04 to Mar-08



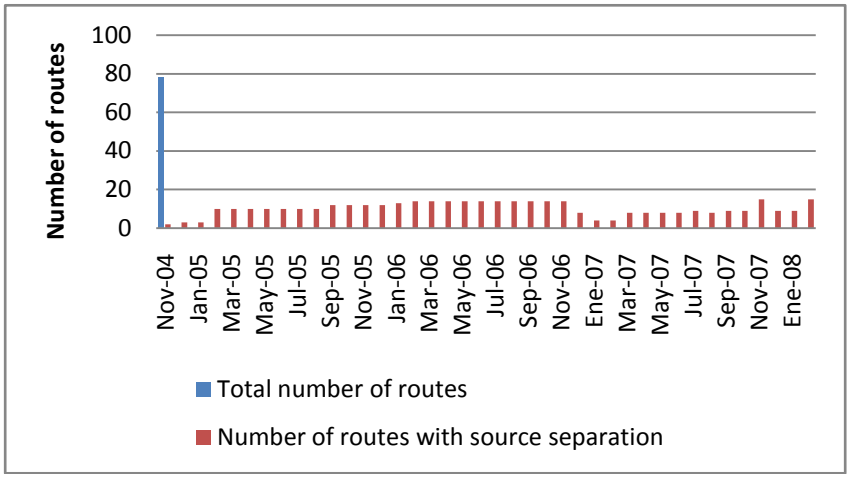
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-14 Number of waste collection routes with source separation and separate waste collection in Miguel Hidalgo from Nov-04 to Mar-08



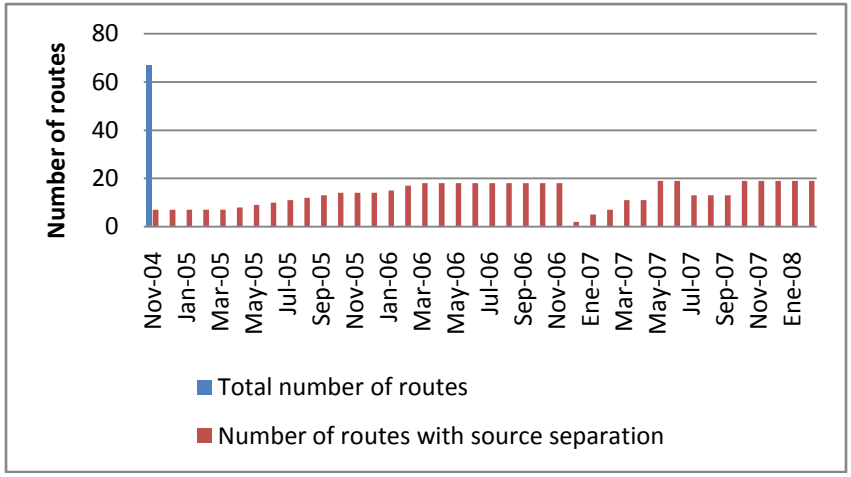
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-15 Number of waste collection routes with source separation and separate waste collection in Milpa Alta from Nov-04 to Mar-08



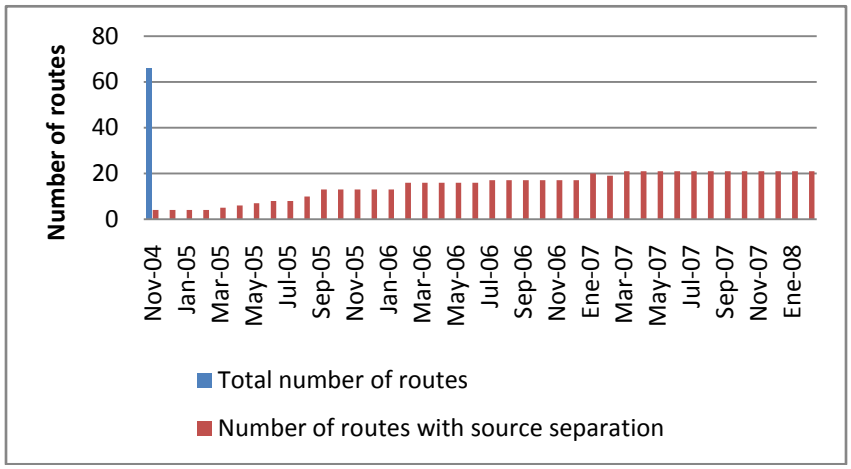
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-16 Number of waste collection routes with source separation and separate waste collection in Tlahuac from Nov-04 to Mar-08



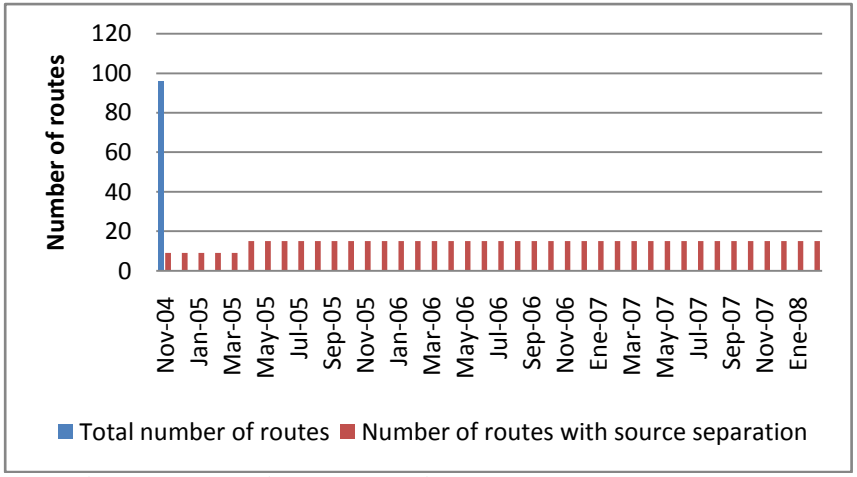
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-17 Number of waste collection routes with source separation and separate waste collection in Tlalpan from Nov-04 to Mar-08



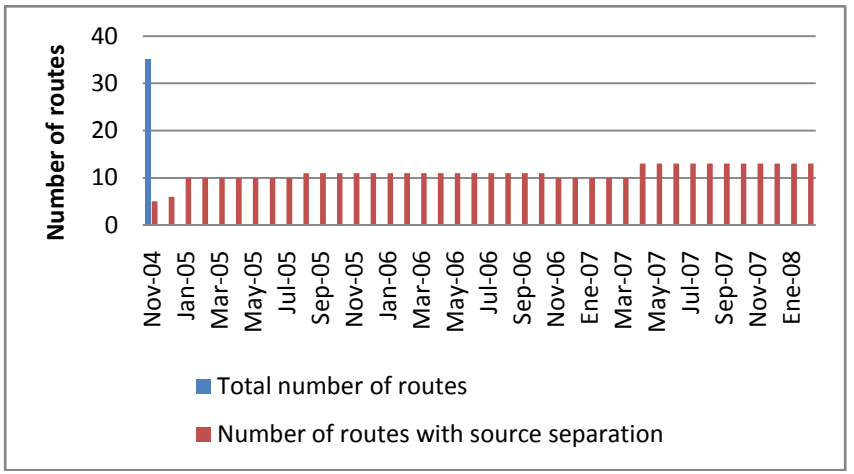
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-18 Number of waste collection routes with source separation and separate waste collection in V. Carranza from Nov-04 to Mar-08



Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-19 Number of waste collection routes with source separation and separate waste collection in Xochimilco from Nov-04 to Mar-08



Adapted from data retrieved from www.sma.df.gob.mx

Data presented and analyzed *delegacion* by *delegacion* suggests that information presented for the whole of the Federal District is misleading. It implies that the program though not performing quite as expected is still performing well and getting better all the time. This is not necessarily the case. The more detailed analysis of this first set of data helped the researcher determine that the datasets collected from the Secretariat of Environment's web page were invalid; hence they could not be used for a proper evaluation of the program. From this point on, analysis of the quantitative datasets focused on spotting errors and suggesting why and how they may have occurred. The veracity of these interpretations was then supported or disconfirmed by the complementary analysis of the qualitative data (see Chapter 7).

Regardless of the validity of the data, numeric analysis shows that even at its highest point in March 2008, the total number of routes incorporated to the program was less than 30% which is far less than established as a goal in the program. The only two *delegaciones* that individually came close to the minimum scenario and the optimal scenario were Azcapotzalco (71% of routes with source separation and selective waste collection) and Cuajimalpa (96% of routes) respectively. However, this will only be true if the data reported is also correct.

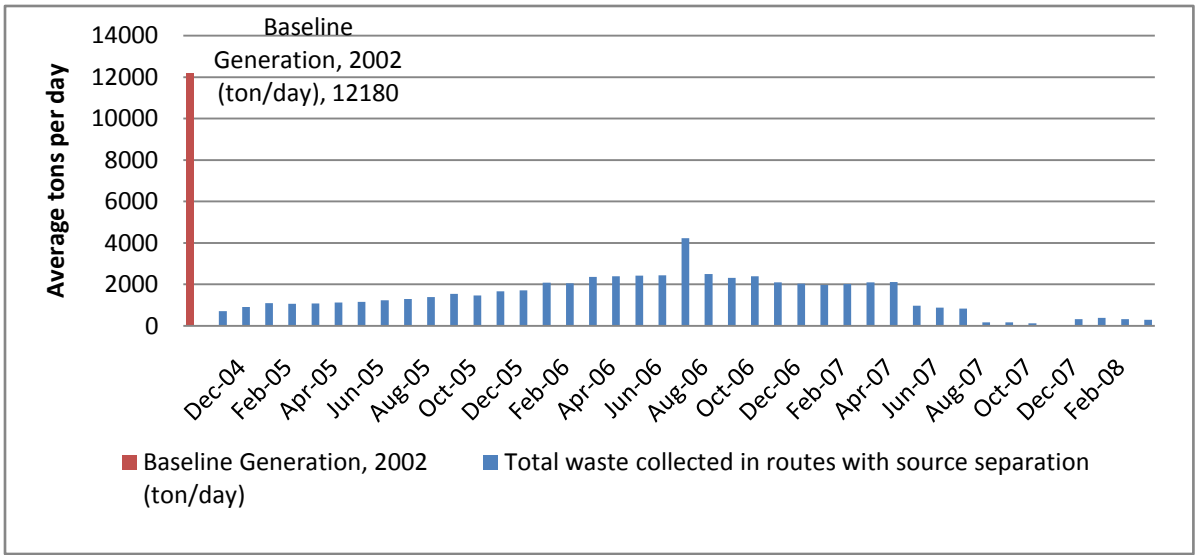
There are other specific sites such as public buildings, residential units and markets where source separation and separate waste collection was also implemented. However as the weight of the waste generated and collected lies within the residential areas covered by the waste collection routes referred to above, the researcher decided not to consider this data for her analysis.

6.2 *Waste collection in residential areas covered by waste collection routes with source separation and separate waste collection*

The graphs shown in this section present the quantitative analysis of the data reported in the Secretariat of Environment's Web page regarding amounts of solid waste collected in routes with

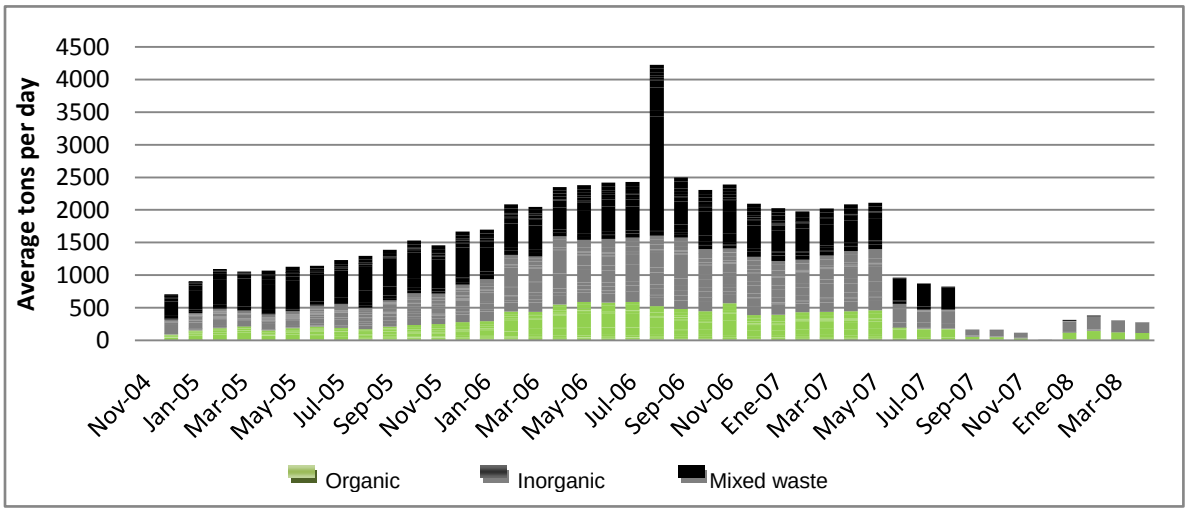
source separation and separate waste collection in residential areas. The graphs and analysis will be presented first in an overall evaluation for the Federal District, and then by *delegacion*.

Figure 6-20 Amount of waste collected in routes with source separation and separate waste collection in residential areas in the Federal District



Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-21 Amount of waste collected in routes with source separation and separate waste collection in residential areas in the Federal District by type of waste



Adapted from data retrieved from www.sma.df.gob.mx

From Figure 6-20 we observe that the performance of the Federal District's ISWMP in terms of collection of separated waste peaked during July 2006 and declined from there, more drastically

so in the months following July 2007. Even at its highest point, the total amount of waste collected in these routes sums approximately 4,227 tons/day, which represents only 35% of the total daily waste generated in the jurisdiction. When we look at Figure 6-21, the percentage becomes even smaller given that only about 40% of that waste was actually separated into organic and inorganic waste and the rest was mixed.

It can also be observed from both figures that the decline in waste collected was very steep from the months of April 2007 to May 2007 and it continues to decline steeply until November 2007. Lack of data for the month of November could indicate either that there was no waste collected during that month or that there was no report that specified the amount of waste collected. To determine if any of these explanations apply an analysis *delegacion* by *delegacion* was performed. Furthermore, this dataset (waste collection) was compared with the previous dataset (number of routes) to provide a more in depth analysis of the performance of the program and come up with possible explanations for the inaccuracies.

For each *delegacion* four different graphs are presented:

a. Amount of waste collected in routes with source separation and separate waste collection in residential areas
b. Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste
c. Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes
d. Percentage of waste separation vs. percentage in the increase of routes incorporated to the program

For graphs of the type 'a' no calculations were needed. They merely report the data published in the Secretariat of Environment's web page for each *delegacion* regarding the amount of waste collected in the waste collection routes with source separation and separate waste collection. Graphs of the type 'b' show which part of that total amount is constituted by each of three types of waste. For type 'c' graphs the following calculation was made:

$$Amount\ of\ waste\ that\ should\ have\ been\ collected\ from\ routes\ with\ source\ separation = \frac{total\ generation\ of\ waste\ per\ day}{total\ number\ of\ \ routes\ in\ the\ delegation} * routes\ in\ the\ program$$

This was calculated for each month from November 2004 to March 2008 for each *delegacion* and then contrasted to the amount of waste reportedly collected in the routes incorporated into the program. The calculation is arbitrary, and does not exactly represent reality. However it provides a benchmark for the purposes of evaluating the performance of the program. Type 'd' graphs were built to show trends. In order to compare numbers that are not in the same units first they had to be converted to percentages. The percentage of waste collected in routes with source separation was determined with the following formula:

$$\%\ of\ waste\ collected\ in\ routes\ with\ source\ separation\ vs.\ baseline\ generation = \frac{average\ amount\ of\ waste\ collected\ per\ day}{baseline\ generation\ of\ the\ delegation\ per\ day} * 100\%$$

Similarly the percentage of routes was calculated with:

$$\%\ of\ routes\ with\ source\ separation\ implemented\ vs.\ total\ number\ of\ routes = \frac{number\ of\ routes\ with\ source\ separation}{total\ number\ of\ routes} * 100\%$$

All data points were graphed and a trend line was added for each set of points for purposes of comparison. In an ideal situation both trends should have the same behaviour. Given the number of graphs required for this analysis, the researcher chose to present them in full in Appendix 5. The findings are summarized in Table 6-1.

Table 6-1 Observations and preliminary conclusions on each of the graphs for every *delegacion*

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Alvaro Obregon	No data available after April 2007 except for one isolated report on January 2008.	Most of the waste collected in these routes was separated into organic and inorganic. Very little mixed waste compared to the amount collected.	Waste collected in these routes surpasses the amount expected. This may be an indicator that the baseline generation is outdated.	The increase in the amount of waste collected in routes with source separation and waste collection is proportional to the increase in routes incorporated to the program.
Azcapotzalco	Both on October 2006 and November 2006 it was reported that the same number of routes with source separation had been incorporated to the program. However, waste collection in reported in November was more than double the waste collected in the previous month. Possible explanations: a) even though the number of routes was the same they could have been different routes in which more waste is generated; or b) a mistake was made when transcribing the data to the report and never corrected. There is no data reported after April 2007.	Most of the waste collected in routes with source separation was in fact separated into organic and inorganic waste. However, the total amount of waste collected was very low. At its highest it represents less than 20% of the total generation for the *delegacion*.	Amount of waste collected in routes with source separation is very few, less than 10% of what should have at least been collected.	Amount of waste collected, although relatively steady in time, is not proportional to the increase in the number of routes incorporated to the program.

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Benito Juarez	In the original datasets the exact same data is reported for July 2005 and August 2005. This occurrence is highly improbable. Possible explanation: the information provided by the *delegacion* was not correctly measured or simple wrong; or the Secretariat of Environment with the purpose of not having a gap in the data decided to arbitrarily repeat the number from the previous month. The data for July 2006 (1754.83 tons/day) was left out of the graph on purpose given that it represented three times the baseline generation. This data is inconsistent with the rest of the data reported and hence it is more probably a typo or other sort of mistake. However this number was not been corrected in the official report. There is no data available after July 2007.	Separated waste collected in routes with source separation is negligible when compared to baseline generation. This means that even though source separation was implemented in theory, it never really worked as such.	At its highest, waste collected in these routes was merely 5% of the total waste generated in the *delegacion*.	The amount of waste collected in these routes was fairly proportional to the number of routes with source separation and separate waste collection.
Coyoacan	This *delegacion* first reported data on July 2005. This means either that source separation was implemented in this *delegacion* 7 months late or they neglected to send in reports as required by the Secretariat of Environment. No data available after April 2007.	This is the only *delegacion* that reports no mixed waste collected in routes with source separation and separate waste collection, which makes it highly efficient in this aspect.	Waste collection in these routes never surpassed 35 tons/day which represents less than 5% of the total waste generated in the *delegacion* and only 10% of what should have at least been collected given the number of routes incorporated to the program.	Percentage of waste collected remained constant during the given timeline but not proportional to the increase in number of routes incorporated to the program.

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Cuajimalpa	Total waste collected in routes with source separation exceeds the baseline generation on most of the months when data was reported. A possible explanation for this is that the data from the diagnostic where baseline generation was calculated is outdated. Two reports missing on October and November 2007. No data available after January 2008.	Source separation was far from perfect. Although there were months when all waste collected in these routes was separated, there were others when collection of mixed waste was high.		
Cuauhtemoc	No data available after July 2007.	Collection in these routes was consistent during the time the program was working, however source separation was very low.		
Gustavo A. Madero	No data available after April 2007.	Source separation in this *delegacion* was fair.	When calculation how much waste should have been collected according to the number of routes and comparing the number to the actual collection, the latter surpasses the first number greatly. This means that either data for baseline generation was outdated or that there was an error in the number of routes reported.	Total waste collected in routes with source separation was proportional to the number of routes implemented.

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Iztacalco	The exact same data is reported for December 2004 and January 2005. This occurrence is highly improbable and needs to be explained. Both on July 2006 and August 2006 there were the same number of routes implemented. However, waste collection in August was more than double than waste collection in July. This needs to be explained. No data available after April 2007.	The *delegacion* reports that waste collected in these routes was separated in organic and inorganic starting May 2005. The amount of organic waste is close to zero, which does not match the characteristics of the waste generated in the Federal District.		Waste collected in routes with source separation was proportional to the number of routes implemented; however waste collection was still insufficient.
Iztapalapa	Source separation was implemented in January 2006 which is 1 year and 2 months after the Program was published. The data reported for July 2006 and August 2006 is almost identical. This is a highly improbable occurrence. This phenomenon has to be explained. This is the only *delegacion* with data reported up to March 2008.	Waste collected in routes with source separation, according to the reports, is mostly separated. This *delegacion* has high efficiency in source separation.	Actual waste collected in routes with source separation exceeds the expectations according to the calculations made. Again, this means most probably that the data for the baseline generation is outdated.	
Magdalena Contreras	The exact same data is reported for December 2004 and January 2005. The same happens with July 2005 and October 2005. This occurrence is highly improbable and needs to be explained. Total waste collected in routes with source separation was relatively constant from November 2004 to April 2007, which is the date for the last report available.	Source separation seems to have efficiency close to 50%.		Waste collection in routes with source separation is proportional to the number of routes implemented.
Miguel Hidalgo	Waste collection constant up to November 2006, and then suffered a slight decrease. It became constant again with this new amount until July 2007. After that there is no data available.	Source separation was acceptable.		Waste collected was proportional to the number of routes with source separation.

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Milpa Alta	Data was reported for every month from November 2004 until March 2008.	Source separation was high. Mixed waste reported in low amounts only in 7 months. This *delegacion* has a lot of rural areas, therefore it is odd that such a little amount of organic waste is reported.		Waste collection was constant throughout the duration of the program and proportional to the number of routes implemented.
Tlahuac	The exact same data is reported for December 2004 and January 2005. The same happens with December 2005 and January 2006. This occurrence is highly improbable and needs to be explained. No data reported for June and July 2007. Then data is reported for August, September and October 2007. No data is available after that.			Waste collection for the duration of the program was very variable but it was proportional to the increase and decrease in the number of routes incorporated to the program.
Tlalpan	No data available after April 2007.	Source separation was fair.		Waste collection proportional to the number of routes with source separation.
Venustiano Carranza	Both on July 006 and August 2006 there were the same number of routes with source separation implemented. However, waste collection in August was almost double the waste collection in July. This needs to be explained. No data available after December 2006.		Waste collection was consistent throughout the duration of the program.	Waste collection was not proportional to the number of routes with source separation.

Delegacion	Type 'a' graphs	Type 'b' graphs	Type 'c' graphs	Type 'd' graphs
Xochimilco	The exact same data is reported for April, May, and June 2006. The same happens with July, August, and October 2006. This occurrence is highly improbable and needs to be explained. No data available after April 2007.	Source separation was fair.	Amount of waste that should have been collected according to the number of routes surpasses greatly the amount of waste that was actually collected.	Waste collected in routes with source separation was consistent throughout the duration of the program.

6.2.1 Preliminary conclusions

The notes in the table above provide some clear indications regarding what some of the problems with the data collected are, and what those problems might mean. The data published in the Secretariat of the Environment's website was provided by the *delegacione*s but it was never audited or clarified. Some errors in the data become very obvious when analyzing the results; however they do not appear to have been detected by anyone in the Secretariat. This diminishes the validity of the results. There are two important things to note. First, what could be referred to as a 'chain of custody' for the data was never put into place. The results were delivered by the *delegacione*s to the Department of Water, Solid and Waste Projects, entered into a database and published without further verification. This suggests either a lack of personnel available to verify this data or carelessness on behalf of the Secretariat. Second and more important, this Department was responsible for visiting the *delegacione*s for the duration of the pilot programs and until 2006, when a change in administration occurred. If the results of the delegational programs were being monitored, the discrepancies in the data reported should have been noted.

Another problem lies in the lack of data available during and after 2007. In December 2008, when the data for this thesis was initially downloaded, no 2007 data was available. According to Jesús Hernández López, the person in charge of the implementation of the program in the Secretariat of the Environment, the lack of data coincides with the departure of Erika Ramos Guevara, the person who at the time was in charge of receiving the reports from the *delegacione*s and entering the data into the Solid Waste Information System (SIRS). This too suggests that the Secretariat of the Environment did not have sufficient resources to keep up with the monitoring of the program.

In general, it can be said that the data and analysis presented by the Secretariat of the Environment is inconsistent and unreliable. The statistical analysis originally planned for this research

would have provided equally unreliable results on the performance of the program. This is the reason why the performance of the program was evaluated relying on qualitative data, using the quantitative graphs as a support to interpreting results.

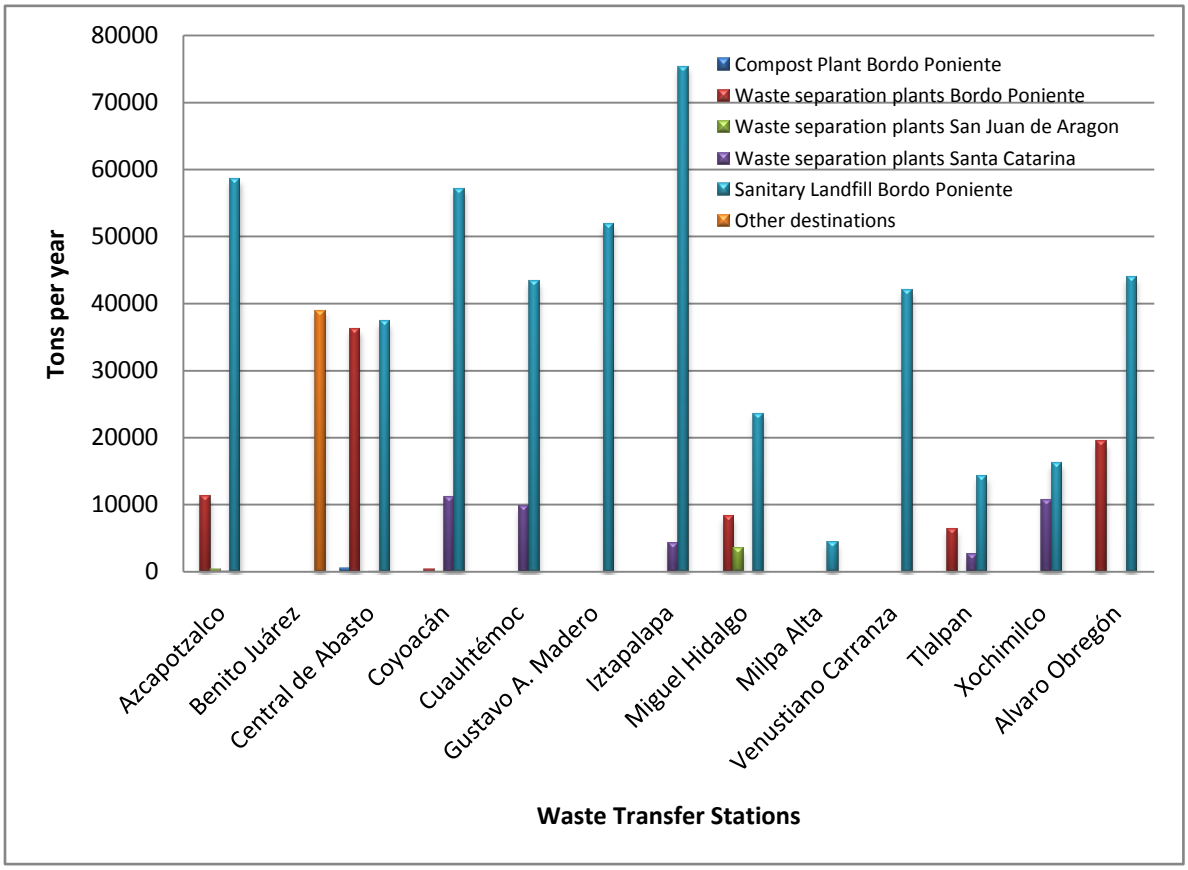
For analytical purposes it was important to see the behaviour of each specific *delegacion* to better understand where the information was coming from. In terms of performance evaluation however, the results are clearer when reported for the Federal District as a whole. First, baseline generation for 2002 is calculated at 12,000 tons per day. However, changes in population, consumption patterns, economic activities, and any other significant change that occurred in the Federal District from 2002 to 2009 affects baseline generation. In developing countries, the tendency is to increase waste generation rather than diminish it (Buenrostro and Bocco, 2003). Therefore, both the literature and the results themselves point in the direction of this calculation being outdated. Regardless of this, as it is the only data available of to this date, this number was (cautiously) used for performance evaluation purposes.

It can be said that although waste collection in routes with source separation and separate waste collection was at its highest point only 30% of the total waste generation, source separation had efficiency close to 50%. This means that citizen participation was low, but the citizens that did participate got somewhat involved with the program and did separate their waste into the two established categories. Two questions arose from this observation: a) why was citizen participation so low? b) What is missing that could be added so that people would do more complete source separation? These questions were considered when designing the questionnaires for the gathering of qualitative data. Chapter 8: Summary and Conclusion, discusses results relevant to these questions.

6.3 *Waste transfer stations*

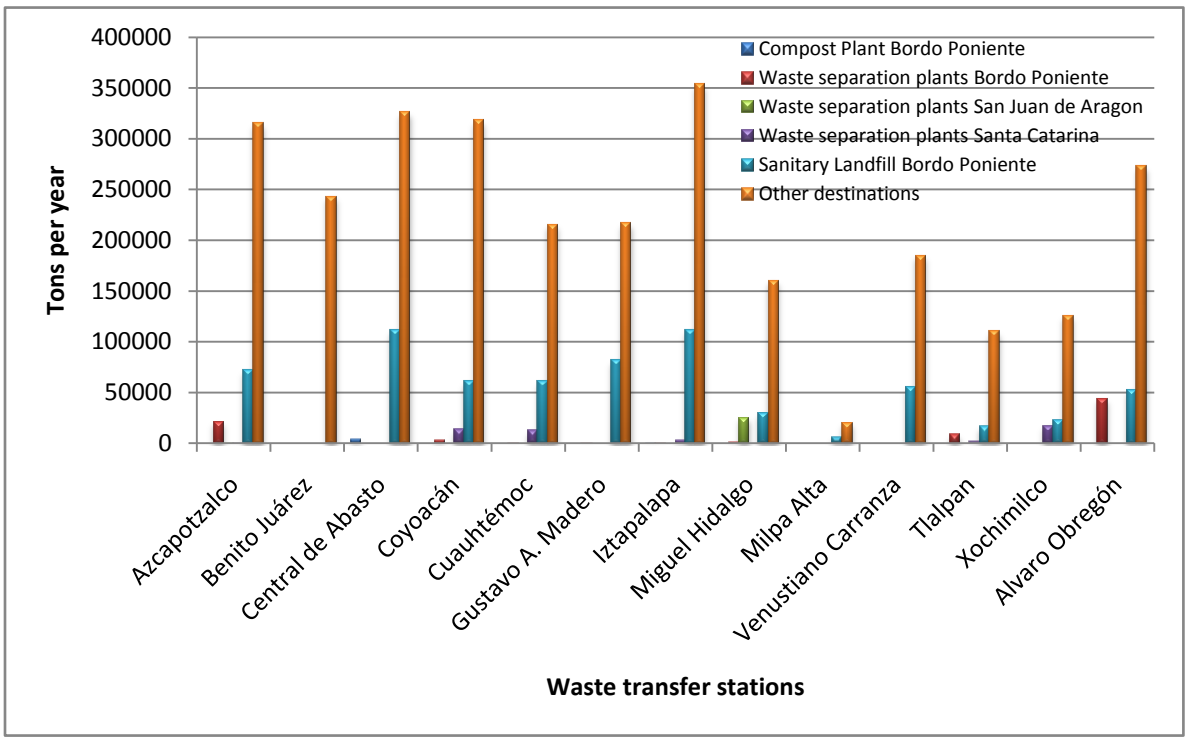
The data presented so far pertains only to waste collection and source separation. Given that the ultimate purpose of the Federal District's Integrated Solid Waste Management Program is a reduction in the amount of waste that is deposited at the landfill, a full evaluation of the program must include data that shows what goes on at transfer stations, waste selection plants, and the sanitary landfill.

Figure 6-22 Distribution of solid waste from each waste transfer station to different destinations in 2004



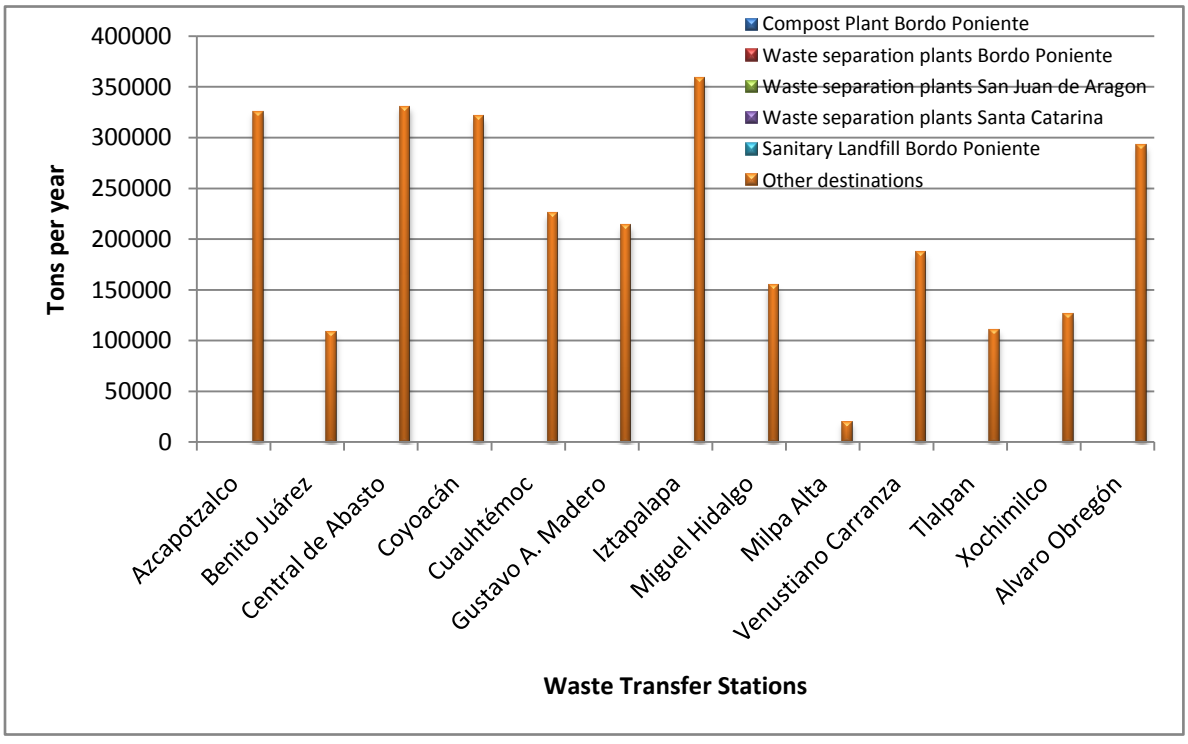
Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-23 Distribution of solid waste from each waste transfer station to different destinations in 2005



Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-24 Distribution of solid waste from each waste transfer station to different destinations in 2006



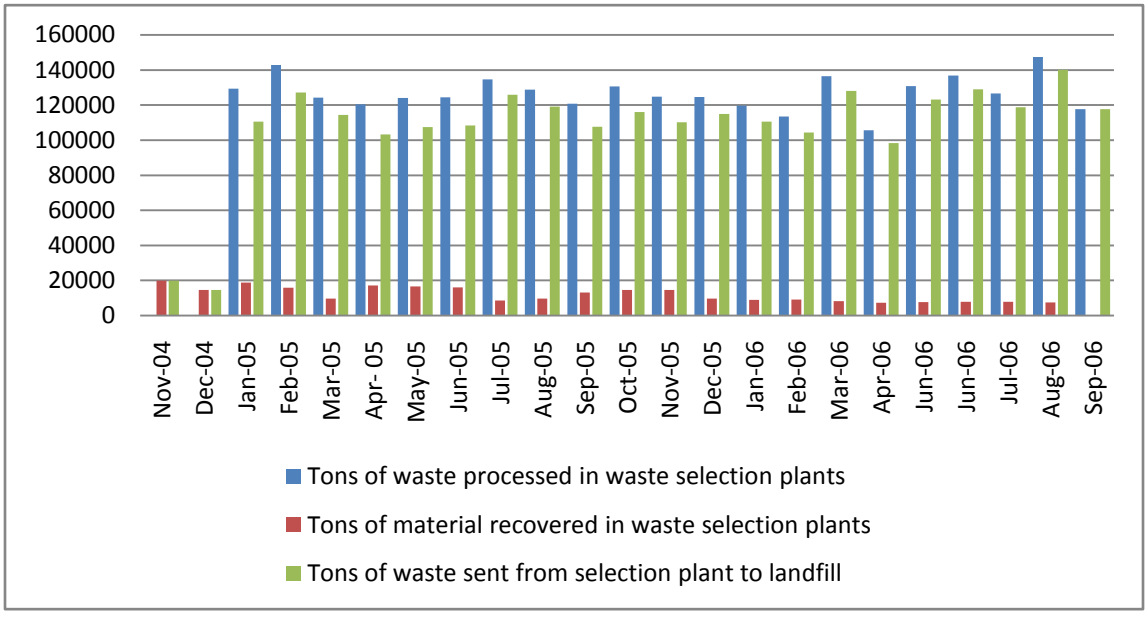
Adapted from data retrieved from www.sma.df.gob.mx

From these three graphs it can be observed that regardless of whether the waste was separated at the source or not, very little waste was sent to the waste separation plants, and most of it was being sent either to the sanitary landfill or to other destinations. Presumably, these 'other destinations' could include recycling facilities of some sort. However this information is not available on the Secretariat of Environment's web site nor did they reply to the researcher's request for information when contacting them through the appropriate link in said web page. Hence, it appears from our data that the ultimate objective of the program, which was to reduce the amount of waste deposited at the landfill every day, was not fulfilled.

It can also be seen that through time, apparently there was less waste being sent to the waste selection plants and to the sanitary landfill and more to other destinations. For the purposes of finding out whether this occurrence was an empirical reality or if it was symptomatic of inaccurate data, the researcher decided to study both destinations more fully.

6.4 *Waste selection plants*

Figure 6-25 Amount of waste received and processed at the three waste selection plants



Adapted from data retrieved from www.sma.df.gob.mx

From this data two things can be observed. First, the percentage of material recovered in the waste selection plants is less than 10% This does not comply either with the particular goals of the Federal District's Integrated Solid Waste Management Program nor with its ultimate objective. When the amount of waste sent to the landfill from waste selection plants is added to the amount of waste sent to the landfill from any other origin, the total amount adds up to just about the same amount of waste that was sent to the landfill prior to the implementation of the program.

Second, it can be seen that there are serious inconsistencies in the data from one report to the other, even though it is the same people in the Secretariat of Environment that are handling the data. This probably indicates a lack of supervision from the management of the people that input data into the system and also a lack of verification before officially publishing the data. This implies that there has been no established methodology for the collection, revision, verification, input, or publication of data.

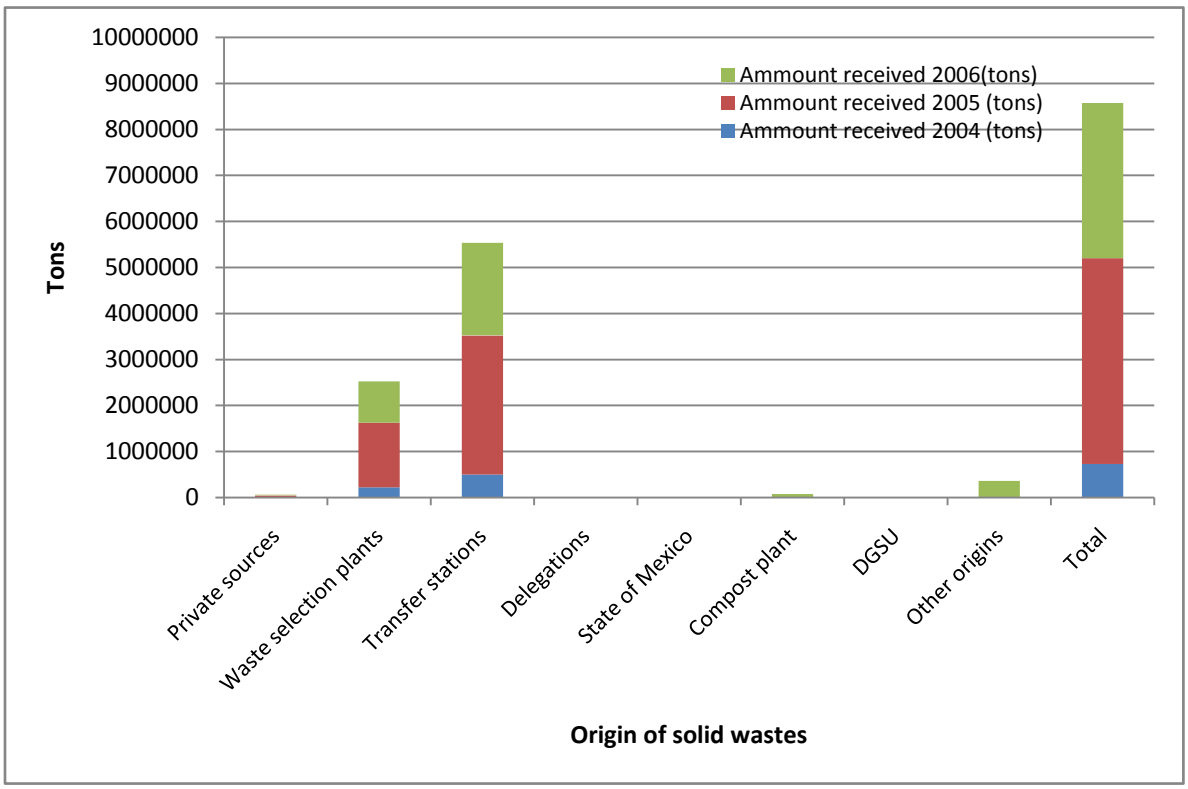
6.5 Sanitary landfill

Table 6-2 Waste received at the sanitary landfill distributed by origin

Origin of the waste	Amount received 2004 (tons)	Amount received 2005 (tons)	Amount received 2006 (tons)
Private sources	6,731.96	38,515.16	14,888.53
Waste selection plants	219,982	140,6691	898,782.3
Transfer stations	502,709	301,9612	2,013,064
Delegaciones	0	2.1	1.5
State of Mexico	1,236.73	6,430.216	0
Compost plant	0	0	76,295.2
DGSU (General Department of Urban Services)	150.63	360.89	7,726.78
Other origins	0	0	361,941.23
Total	730,810.32	4,471,611.366	3,372,699.54

Adapted from data retrieved from www.sma.df.gob.mx

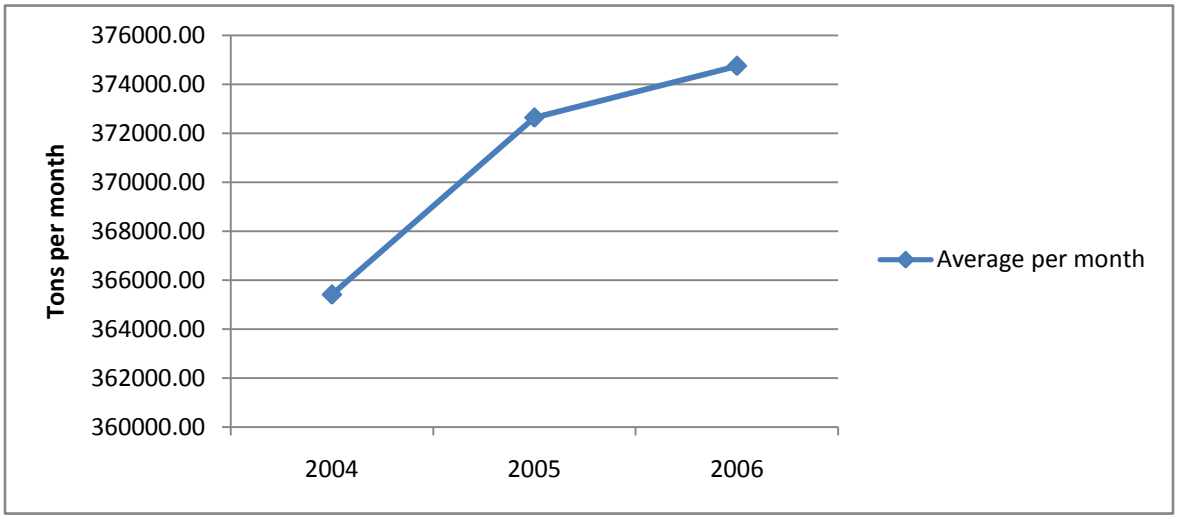
Figure 6-26 Waste received at the sanitary landfill distributed by origin



Adapted from data retrieved from www.sma.df.gob.mx

Table 6-2 and Figure 6-26 show that, again, there are inconsistencies between reports. It can be observed from here that most of the waste that was deposited at the sanitary landfill came from waste selection plants and transfer stations, even in 2006. Other reports show that the destination of the waste was other than waste selection plants or sanitary landfill. Also, the numbers do not match. For example, in the report for waste selection plants the amount of waste sent to the sanitary landfill from October 2004 to September 2006 adds up to 2.4 million tons of waste, while the data reported for the sanitary landfill reports 2.5 million tons of waste proceeding from the waste selection plants for the same time period. Similarly data from the waste transfer stations indicates that 1.1 million tons of waste was sent to the sanitary landfill while the landfill reports receiving 5.5 million tons of waste from the waste transfer stations.

Figure 6-27 Average monthly waste received at the sanitary landfill from October 2004 to September 2006



Adapted from data retrieved from www.sma.df.gob.mx

Figure 6-27 shows alarming data. Even with the program in operation, with source separation implemented and increased waste recovery, the average amount of waste per month received at the sanitary landfill increases 2% from 2004 to 2005 and another 0.6% from 2005 to 2006. Normally this increase in waste generation would be acceptable due to increase in population. However for that period of time the population grew only 0.1% (National Council of Housing and Population, 2008) which makes this increase in generation disproportionate. And, even if the increase in waste generation were proportional to population growth, this indicates that the objectives of the waste management program were not being fulfilled, as the amount of waste deposited in the sanitary landfill increased during this time period.

6.6 Preliminary conclusions

Urban solid waste management implies a series of activities that must be integrated in order to achieve efficient performance of the Federal District's Integrated Solid Waste Management Program. If the *delegaciones* keep viewing the management of waste as just one more mandatory service, they will not have a real commitment to the program. To prevent this, performance indicators should be applied. Such indicators were presented in the initial program description (See

Appendix 5). Some of them were never applied and some of them were misinterpreted and therefore miscalculated. The result is the same: right now there is no possible way to methodically evaluate the performance of the program. Even if the indicators were applied, they would only be helpful if the necessary and correct information was available for their analysis, which is clearly not the case at the moment. There is a clear need to establish an information system that would ensure the continuity and validity of the data provided by the *delegacione*s to the Secretariat of the Environment. There is also a need to develop reliable and useful indicators that will measure the performance of the program so that the competent authorities will be motivated to monitor and evaluate the service, and modify it accordingly if they see fit.

Regardless of the lack of reliability of the data available, all *delegacione*s have one particular behaviour in common, and that is low efficiency in source separation. Source separation is the basis of the program; if source is not separated, the rest of the steps may not be completed. This strongly suggests that there is a failure in the implementation of the program. However, the information analyzed so far is not sufficient to determine whether this has happened because the program does not have a strong technical foundation or for some other reason. To better address this and other questions, the researcher conducted interviews with key informants. This information is presented in the next chapter.

Chapter 7 Qualitative data and preliminary results

For the purpose of finding answers to the questions that arose when analyzing the quantitative data and for identifying what some of the barriers and opportunities to implement the Federal District's Integrated Solid Waste Management Program as an example of an environmental policy are, the researcher chose to conduct interviews with key informants.

7.1 Data

Ten people were interviewed in total. Interviewees were chosen from four different fields of expertise: people involved in the design and implementation of the Federal District's Integrated Solid Waste Management Program, waste management experts, experts on sustainability, and experts in environmental policy design and implementation. A different questionnaire was designed for each particular group of people, although questionnaires shared some questions in common. All the respondents live in the Mexico City Metropolitan Area, which ensures that they have previously heard of and/or participated in the program. Also, the choice of respondents included both people directly involved with the program and people who participated as citizens, to be able to gather different perspectives on the same issue(s).

Interviews were transcribed in full. Analysis of the data gathered through the interviews was analyzed through the constant comparative method (See Chapter 3). After the first reading and round of analysis, the researcher found ten common themes. Table 7-1 summarizes the information gathered from the interviews. Table 7-2 provides a guideline for the attribution of quotes to the respondents.

Table 7-1 Recurrent themes found in the interviews

Theme	Number of times mentioned	Field of Expertise of interviewee who mentioned the theme
Administrative issues	29	Waste management Sustainability Environmental policy Federal District's ISWMP
Behavioural change	7	Sustainability Environmental policy
Deficiencies of the program	8	Sustainability Environmental policy Federal District's ISWMP
Design Process	2	Waste Management Federal District's ISWMP
Economic issues	7	Sustainability Environmental policy Federal District's ISWMP
Education /training	14	Waste Management Sustainability Environmental policy Federal District's ISWMP
Objectives of the program	2	Sustainability Federal District's ISWMP
Sustainability	The questionnaires included questions that specifically address sustainability issues. Therefore, this theme was mentioned in all of the interviews.	Waste management Sustainability Environmental policy Federal District's ISWMP
Technical aspects of the program	9	Waste Management Sustainability Federal District's ISWMP
Work relations	8	Waste Management Sustainability Environmental Policy

Table 7-2 Guideline to identifying the respondents according to their field of expertise

Respondent Number	Field of expertise
Respondent 1	Federal District's ISWMP
Respondent 2	Federal District's ISWMP
Respondent 3	Environmental Policy
Respondent 4	Environmental policy
Respondent 5	Sustainability
Respondent 6	Waste Management
Respondent 7	Sustainability
Respondent 8	Sustainability
Respondent 9	Waste Management
Respondent 10	Environmental Policy

7.2 Results

The interviews revolved around the perceptions of the interviewees on the performance of the Federal District's Integrated Solid Waste Management Program. Questions were asked on whether they thought the program was working or not and why, and what do they think could be modified to make the program better in case they thought it was not working. Other questions included views on waste management and sustainability, waste management as an environmental policy, and the environmental policy making process in Mexico.

The first issue that the researcher decided to address was whether there had been a defined methodology for the **design of the waste management program**. Patton and Sawicki (1993) argue that although each planning endeavour may have its own particular methodology, a defined methodology is essential to determine if the policy is really needed or not and to foresee all the possible consequences of its implementation.

Two respondents answered this question. They both agreed that there was no pre-established methodology to follow when the program was being designed. Nonetheless, they described the process through which they came up with the program in their own words.

Respondent number 9 said: "*the first step in defining the program was to do a diagnosis. A diagnosis was made in '99, if I remember correctly, and it was made by the Japanese [Japanese International Cooperation Agency]. Then we made our own diagnostic. Ours didn't measure generation or composition because we lacked the time and resources for that. But we dug deeper in the aspects of waste collection, and the delegaciones, and final disposal, which we knew at that time, was already over capacity. So then, there was this diagnostic, and then we defined lines of work…*"

Respondent number 2's answer complements this information: "*No, there wasn't a methodology. Just as there weren't any parameters, there was no methodology. And there is no methodology that tells you how to make a program… However, the technical part did have a starting point. This starting point was to first establish an environmental policy. When this policy was established, the rest of the program came through. The real problem was to define where to begin. Normally, every work or program starts with the beginning, but the Federal District's Program started at the end. It started by deciding what we wanted out of integrated waste management. And the decision was to establish as a goal, as an environmental policy, the reduction of waste that is deposited at the final disposal site. With this goal as a basis, the previous stages were developed and structured. If this can be called a methodology, this is how it was done*".

Answers from these two respondents give us a very broad idea of what the process for the development of the design and implementation of the Federal District's Integrated Solid Waste Management Program was. From this it can be determined that, in fact, no identified methodology was followed. Hence a proper policy analysis was not performed before deciding to implement this policy. This decision carries with it certain consequences which are reflected primarily in the performance of the program as it was seen in the previous chapter.

When asked about the **objectives of the program**, the interviewees responded that the first and main objective is to have compliance with the law. The second objective was to reduce the

amount of waste. Excessive waste generation is a huge problem in terms of health, environment, economic and politics. The program is intended to take care of some of these problems. By abating waste generation, associated health and environmental problems are also abated.

When the interviewees were asked to give their **opinion on the program**, all of them agreed that from the technical point of view, it was a good idea and they could not see any flaws in the design as far as the basis on integrated waste management goes. However, all of them also agreed that the problems of the program lay in the implementation. In the words of one of the respondents, "*the program is good in its design. It was performing well at the beginning, but it came to a certain point of advancement and then it stopped. There have been no further advances*" (Respondent 1). Interviewees believe that if modifications are made to the program they should be made in terms of how to implement it and not on what is to be done. Interviewees agreed that the program is not performing as expected.

The first issue mentioned was **education and training**. Interviewees agree that there was not enough promotion for the program. This lack of education and training is considered by the respondents as one of the main drivers of the program's failure. Respondents consider that there should be greater efforts both in educating the public and in training the people involved in the waste collection services. Respondent 5 said "*… I do believe that there is a need for greater broadcasting, more communication on the importance and the impact that this activity [waste management] has on our daily lives*". Respondent 6 adds "*One of the main issues is the lack of training of the people who are making the program… I think one of the most crucial steps is to train the people… if we have boys that are happy with the work they are doing and they realize how important it is, their self-esteem will grow and they'll be more proactive in participating in the program*".

However, respondents also recognize that, up to a certain point, there have been some **behavioural changes** among the Federal District's population. "*Nowadays, the society in the Federal*

District is sensitive to the issue of waste management. Education and training are very important elements in a cultural and behavioural change in a society such as the Mexican" (Respondent 2). Access to information of all sorts results in more awareness of the public who have contact with it. This increased awareness allows people to understand the importance of these changes of habit. Changes of habit in how we eat, how we shop, how we work, in every aspect, are fundamental. "*No program will be successful if at the end of the day it does not become a reflex, something we do in automatic. To do this it is necessary to create a custom; custom creates a habit, habit creates behaviour, and the behaviour leads to the creation of a culture*" (Respondent 10). These transformations would permit the real application of the three R's (reduce, reuse, recycle), which is one of the fundamentals of integrated waste management.

Another of the problems that the interviewees found with the application of the program was the **lack of participation of other actors** during the planning phase. The government along with its consultants developed the program, but they never had meetings with citizens, NGO's nor private industries to get them to agree to the requirements of the program. Also, there was never any sort of **negotiation with the union of waste labourers nor with the union of waste selectors** (previously scavengers). Respondents believe that if there had been strong agreements between the actors affected by the implementation of the integrated waste management program, standing up to both unions mentioned above would have been easier. "*I believe that this subject is very complex because of all the matters associated with social impacts. The theme 'scavengers' in Mexico is a very sensitive topic, and I think it is one of the reasons why approaching integrated waste management has been difficult…" (Respondent 3)*.

Ultimately, the union of waste labourers and the union of waste separators are the ones who are physically dealing with the waste. If it could be made understood to them that respecting waste separation is not extra work for them, the efforts of the society could become more visible. Not only

that, these unions would have added benefits. "*Let us use a different approach to integrated waste management. A lot has been said about recycling and the social and economic benefits this has. The public is being asked to separate their waste at the source. This is not because you, as a citizen, will recover the valuables and sell them or recycle them to obtain a direct benefit; nor will the government. The idea is to dignify the labour of the waste collector and the work of scavengers, and let them reap the benefits*" (Respondent 3). If the waste is separated, the inorganic faction remains clean and uncontaminated. It is then easier to further separate the valuable (recyclable) portion of it and sell it for a profit. As the business of these unions is to make a profit from selling the scavenged waste, their profits would be higher.

Interviewees also believe that the **lack of resources and budget** assigned to it has negatively affected the implementation of the Federal District's Integrated Solid Waste Management Program. The general perception is that "*not enough money has been invested in the purchase of new waste collection trucks, or on information campaigns, nor on work related negotiations*" (Respondent 9). "*… when the authorities feel cornered, they assign resources to these programs, instead of having them budgeted from the beginning…It is necessary to identify a fixed source of resources to effectively implement the program*" (Respondent 6). The real problem is there is a regular assignment of resources for the management of waste within each *delegacion*. According to one of the interviewees, between 12 and 26% of the resources assigned for urban services is spent in waste management, however inefficient the system is. The respondents think that either the budget is not enough to comply with the requirements of the program, or that the money is not being used in an efficient manner. Respondent 4 added that somewhere along the chain more incentives are needed to involve the public in the program.

The biggest problem that the respondents found with the implementation of the program was not the program itself but the **administrative issues** associated with it. The interviewees, as key

informants with knowledge on the field of waste management, sustainability, and policy implementation see a great number of barriers that must be overcome for this or any other environmental programs to be implemented successfully. The most mentioned cause for the failure of the program is the **break in momentum** due to a change of administration in the Federal District's government. Following this change in administration, there was also a restructuring in the Secretariat of the Environment when some departments changed and some disappeared altogether. Of the people who were involved with the design and implementation of the Federal District's Integrated Solid Waste Management Program only one remained in what is now the Department of Projects Planning and Evaluation.

The respondents believe that any long term program that the city government, or even the Federal government, tries to implement will inevitably suffer a rupture in continuity whenever a change in administration occurs, as long as the implementation and monitoring of the program is the sole responsibility of the government. Some of the advantages that the Federal District's ISWMP program has over others is that, first and foremost it is backed by a local law; and that it is a written program, published in the Federal District's Gazette, and it establishes that it is a program with no expiration period and that is to be reviewed and modified accordingly every four years. This gives the program a greater chance of transcendence from one administration to the next. Still, the general view of the respondents is that "*when the administration changed, at a certain time the program was left aside. This new administration will have to take the program and give it a new impulse. Apparently, this was not meant to happen, but it did, as it always does in our country when a new government comes and what the last one did is forsaken even if it is a good program*" (Respondent 6). This new impulse that the respondent talks about is reflected in the creation of the 'Green Plan'. The Federal

District's 'Green Plan'[4] is a set of actions aimed at promoting sustainability in Mexico City. The document is divided in areas of action, one of which is waste management.

Respondents think that if the program has not performed as intended because of **lack of technical support from the authorities**. They believe that the government does not really have the sufficient infrastructure to back up the program. The waste management system in the Federal District is severely overloaded, and neither the law nor the program addresses means of dealing with this overload. The reality is that there are not enough waste collection trucks, transfer stations, temporary storage facilities or final disposal sites to deal effectively with this amount of waste. Hence, it becomes hard to implement integrated waste management when the system is still struggling to simply do appropriate waste management. This leads the public to think "*why do I have a law that requires me to do all sorts of things that I already know I can't comply with because I lack the equipment, infrastructure, personnel and capacity to maintain it*" (Respondent 8)?

The respondents also perceive a **lack of commitment from the authorities**. They believe the chief of government of the Federal District should make a commitment to the program and transmit this commitment to all the levels of the local government; "*… it is necessary to take the [integrated waste management] issues to a higher level; first to the chief of government, then to the delegates. But surely, the responsibility must not remain only in the chiefs of urban services of the delegaciones*" (Respondent 6). The perception is that not all the *delegaciones* are complying with the norm, and this is because agreements have not been made to establish a methodology for the implementation and monitoring of the program. Even then, making the different levels of government align is very hard to do. These **problems in coordination** are caused because all social components have different response speeds. Private institutions act first, then NGO's respond to the action, and the government is always the last to intervene. A law and a program create the basis for action, but the

[4] http://planverde.org/articulos/1/media/guiaverde.pdf

difficulties lie in the implementation of actions to the inside of the sectors and transversally. "*I would like to add that aligning the government is very complicated. Society believes that the government works like a machine… like an orchestra with Von Karajan making sure that everything runs smoothly. Unfortunately, it does not work that way. The government is like an out of key orchestra and it is hard to tune it*" (Respondent 4).

Another issue that the respondents consider is interfering with effective implementation of the Federal District's Integrated Solid Waste Management Program, and that has also affected other programs in the past, is that **political matters still weigh more than social matters**. Waste management is viewed as a political risk because it affects many and very different sectors of society. Implementing an integrated waste management programs can win votes with some interest groups but lose them with others. Also, there is an ongoing power struggle between the local government and the federal government. "*… in general, during the last administrations of the Federal District's government the political party frameworks have prevailed over public service. Hence, the struggle between the political party that governs the city and the political party that governs the country derives in a lack of congruency between federal dispositions and local dispositions. It is true that states are sovereign, but the Federal District is not sovereign, just autonomous. And I believe that in this misconception lays the lack of connection with national policy*" (Respondent 10).

The respondents also thought that overall, until there is a bigger advancement on educating the public and really creating an environmental conscience, the program will underperform as long as there are **no means of regulation and enforcement**. The Solid Waste Law establishes that people who do not comply with the program will be deserving of a sanction. However, this Law also establishes that the sanctions would be specified in the corresponding handbook. This handbook was published in October 2008. Therefore the perception is that "*the program lacks teeth to make it compulsory*" (Respondent 10).

As well, in retrospective, the interviewees recognized that the program does have **shortcomings**. While some believe that the program should remain as it is so that more experience could be gained as to what modifications would be needed; others are very clear on what the program lacks. One of the deficiencies cited is the **lack of strategic planning during the design phase and the lack of consultation with other sector of society**. Now as the federal guidelines for integrated waste management programs are being published, the interviewees realized that doing public consultations with the private sector, NGO's, the citizens, senators, representatives, and all government institutions involved in waste management results in a greater commitment to any program, and therefore the performance is better.

Second, the **goals of the program were too ambitious**. Expecting an 80%-100% of source separation in only four years is too much. Now, they understand that any program of this sort must be implemented gradually. Goals should still be specified yearly, but also these goals must be attainable and adapted to reality. Also the specific goals must be flexible as "*the issue of waste is very variable. The flux varies by season, and sometimes it even varies depending on the day of the week. So the decision makers need to keep in mind the concept of adaptability*" (Respondent 6).

Third, there is a **lack of evaluation mechanisms**. Although the program has its own indicators, they have not been applied. These indicators measure the percentage of waste separated and the number of routes with source separation and separate waste collection implemented, the number of management plants presented to the Secretariat of the Environment, and the percentage of waste reduction at the sanitary landfill. Given the objectives of the program, the last indicator is the only one that would actually yield a result that has any significance to evaluate and monitor it. Therefore, there is a need to develop new indicators or new evaluation mechanisms that allow decision makers to measure the achievements of the program. After all "*if the performance of the program is not evaluated, at the end of the day there isn't any feedback*" (Respondent 10). To develop

these evaluation mechanisms, first a new, updated baseline must be established. "*If we don't know where we stand, we can't know where we're heading*" (Respondent 7). Today, the Federal District is one of the entities that has generated the greater amount of information on waste management. It is important to make this information available to decision makers to help them determine what this starting point is. Finally, the program should also be integrated into a quality assurance system to guarantee that all the actors involved in the management of waste will follow the same guidelines. Only then this program will be recognized as "*an element of planning with clear objectives, policies, goals, lines of action, and unified criteria for implementation*" (Respondent 10).

The last subject, not necessarily in that order, to be addressed was **sustainability**. The researcher asked each of the respondents if they were familiar with the terms 'sustainable development' and 'sustainability', and then asked them to define them in their own words. Each of the respondents provided a more or less extended answer depending on how familiar they were with the issue. Most of the definitions agree on the definitions provided by specialized literature. The researcher then showed the participants a list of requirements for sustainability (Gibson, et.al. 2005) and a list of the requirements for a sustainable integrated solid waste management program (Sandra Cointreau for the World Bank, 2001). The participants were then asked: A) what are some other requirements for sustainability that you consider should be on the list? B) do you consider that the Federal District's ISWMP complies with the requirements? Most of the respondents just agreed with the requirements without adding others to the list or debating any of them. Two of the respondents did not understand the requirements. Due to this, it is nearly impossible to draw a conclusion on this respect.

Finally, when the respondents were asked if they thought that integrated waste management is an important part of sustainability, answers were divided. Some respondents believe that integrated waste management is a necessity in cities such as the Mexican Federal District.

Respondent 2 said "*I think waste management is a responsibility toward the city you live in. I would not like to mix the concept of waste management with the concept of sustainability. It is an obligation and a right of all of us who live on this world. It is something that every system must have: cities should have integrated waste management. It is part of the city's survival. It is a public service for everyone*". Others, like respondent 7, think that integrated waste management is not necessarily a part of sustainable development, but it could serve as an indicator of sustainability: "*if you check your garbage cans at home, you'll identify your idea of development and your consumption patterns. You will know what you are consuming and what you are generating. If we consider that integrated waste management produces a change in habits, and through time we see a reduction in waste generation and an increase in recycling and reuse, this is a good indicator that we're turning our development patterns into something more sustainable*". A third point of view is that, in fact, integrated waste management is a very important aspect of sustainable development. Respondents 5 and 10 believe that through the principle of the 3 R's several resources can be preserved, as they can be by using waste for energy generation. They think both of these activities promote sustainable development.

7.3 Limitations

The original questionnaires included a number of questions on sustainability issues. As the interviews progressed it became clear that, although most of the respondents were familiar with the subject of sustainability, some of the questions were being misinterpreted and the answers were not what the researcher expected. The views on sustainability were varied, as could be predicted given the subject. However, the answers were so varied that, solely based on the responses given by the interviewees, the researcher could not assess the sustainability of the Federal District's Integrated Solid Waste Management Program as intended.

.

Chapter 8 Summary and Conclusion

The main research goal was to analyze barriers and opportunities for implementation of an effective integrated solid waste management program in the Federal District. The research objectives were:

1. To evaluate the performance of the Federal District's Integrated Solid Waste Management Program from 2004 to 2008.
2. To understand the factors affecting the performance of this particular program and to analyze them in the context of current and potential policy.

   Below, the researcher summarizes key findings relevant to the two research objectives.

8.1 Evaluation of the performance of the Federal District's Integrated Solid Waste Management Program (ISWMP) from 2004 to 2008

The objectives of the Federal District's ISWMP 2004-2008 were:

1) Prevent and reduce the generation of solid waste competence of the Federal District by establishing measures such as source separation, reutilization, recycling, and other forms of exploitation.
2) Reinforce the safe and environmentally adequate integrated management of waste.
3) Establish guidelines for the provision of public waste management services.
4) Integrate procedures for the management of special waste.
5) Implement measures for the control and prevention of soil pollution as a consequence of inadequate waste management.
6) Involve all members of society in the integrated management of waste.
7) Promote culture, education and training of the social, work, and private sectors on integrated waste management.

8) Strengthen the systematization, analysis, exchange and broadcast of information regarding integrated waste management.

First, it can be seen that some of the objectives do not propose specific courses of action. They are very ambiguous and intangible, and therefore are not measurable. Also, the objectives are not established within defined time frames whether they are short term, medium term or long term. Because program objectives were not presented in a way that facilitates the identification of variables that can be measured and contrasted to different points in time, the program has been very difficult to evaluate.

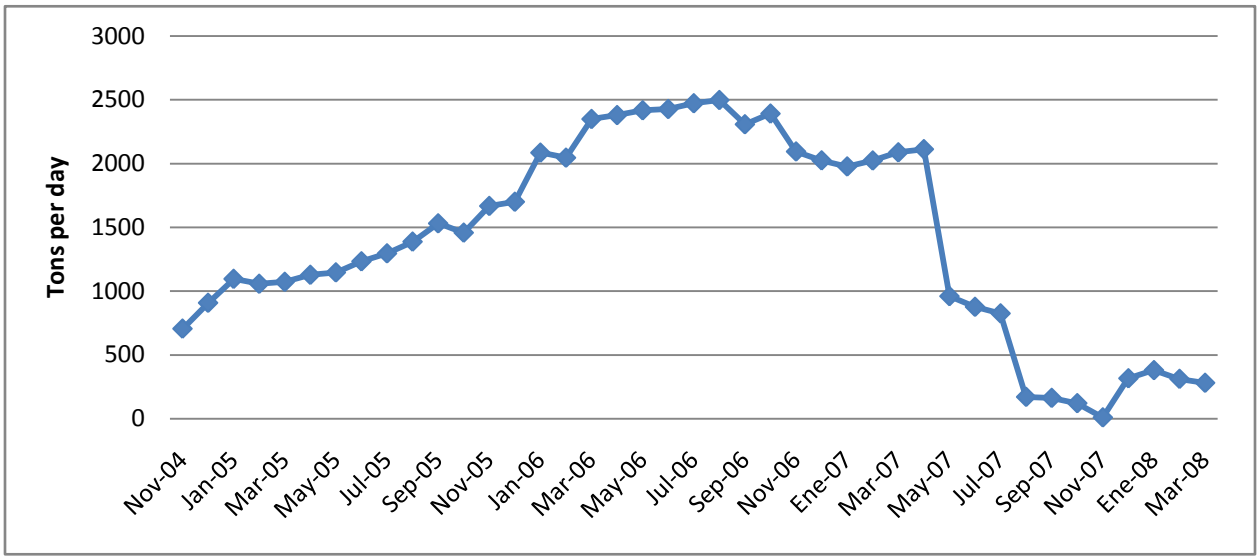
Of the eight objectives identified above, only objective number 1 is directly measurable. Quantitative data and analysis presented in this thesis addresses this objective. Our analysis of the available information suggests that the objective was not satisfied. Not only was there no reduction in the generation of waste in the Federal District, there was an increase. Actions were established, however, aimed at the reduction of this waste. These actions were source separation into two streams, separate waste collection, and reutilization or recycling of waste. Composting was included as one of the options for reutilization.

The basis of this program is source separation. It is the first and most necessary link in the chain. If source separation does not work, neither will the rest of the program. Source separation was implemented gradually by incrementing the number of pre-established waste collection routes that provided separate waste collection services. The trucks that provided this service were weighed at the waste transfer stations and this weight was reported to the Secretariat of Environment through monthly reports.

Analysis of data indicates that from November 2004 to January 2006 the amount of waste collected in routes with source separation was slowly, but consistently increasing. It remained stable throughout most of 2006 and began declining in November 2006, with a dramatic decrease between

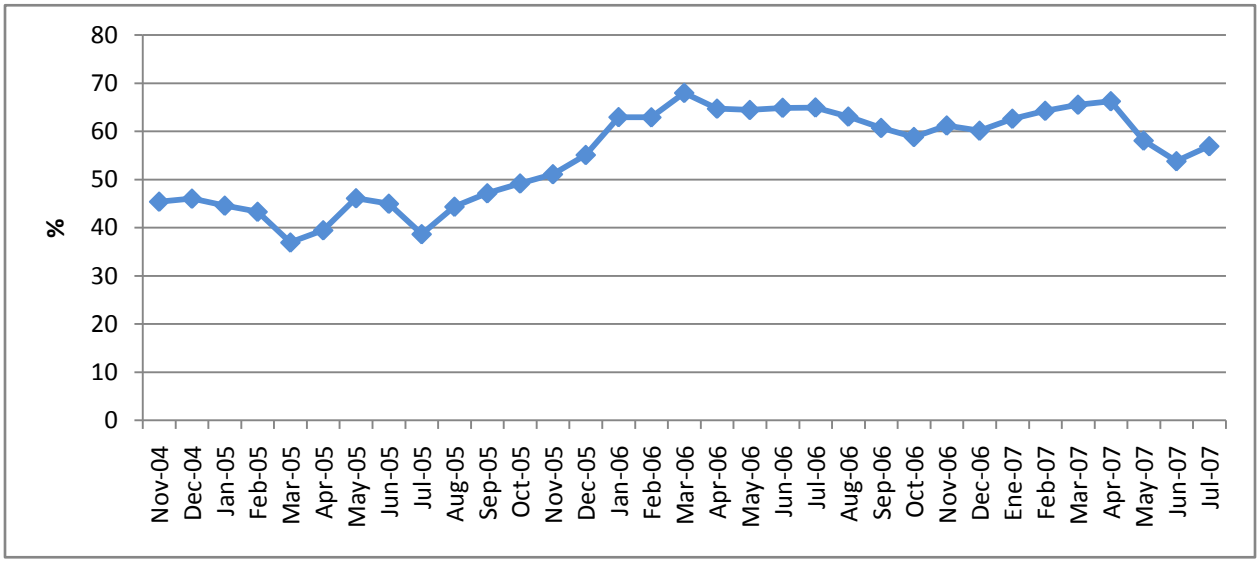
April and May 2007 and the greatest decrease after July 2007. At its highest point waste collected in these routes was roughly 2,500 tons per day in average. This represents only 16.7% of the total waste generated in the Federal district as reported in the diagnostic elaborated by the Secretariat of Urban Services in 1999. The efficiency of separation in these routes varied between 40 and 70% throughout the whole period of time that is reported.

Figure 8-1 Waste collection in routes with source separation from 2004 to 2008



Adapted from data retrieved from www.sma.df.gob.mx

Figure 8-2 Efficiency of separation in routes with source separation from 2004-2007



Adapted from data retrieved from www.sma.df.gob.mx

This available data suggests that in 2006 at least 1,000 tons of solid waste per day were separated into organic and inorganic waste. This separated waste was then no longer garbage, but valuable materials that were potentially reusable or recyclable. The program stipulates that separated organic waste will be sent to compost plants and inorganic waste will go to one of the three waste selection plants that exist in the Federal District. Data for the compost plants was not reported and therefore any success or lack thereof in this respect cannot be measured.

Data for the waste collection plants was available for the years 2004 to 2006. Analysis of this data shows that there was no significant variation in the amount of waste processed at the plants from 2005 to 2006. The analysis also reveals that during this time materials recovered at the plants represent at its highest only 15% of the total amount processed. Data prior to the implementation of the Federal District's ISWMP is not available for comparison. However the data analyzed is enough to determine that implementation of source separation did not impact the operation of the waste selection plants. The amount of waste processed and recuperated at these plants was roughly the same before and after the implementation of the waste management program.

At Bordo Poniente, the sanitary landfill currently in operation in the Federal District, the amount of waste received every month was slowly increasing over time (see Figure 6-27). This implies that all the efforts that have been put into the implementation of the Federal District's ISWMP have been in vain in terms of its first objective. Waste generation has neither been prevented nor reduced from 2004 to 2008. Our results indicate that objective number 1 of the program has not been achieved.

Objectives 3 to 5 have been partially achieved. Both the Federal District's ISWMP and the Handbook for the Federal District's Solid Waste law establish guidelines for the provision of the public waste management services, how special waste is to be managed, and measures to prevent soil pollution derived from the inadequate management of waste. However, these three actions

have been paper accomplishments. As said handbook was published in October 2008, these guidelines have yet to be implemented. For the purpose of this research, activities associated with them could not be observed and reported. Thus, it is too soon and information available is too little to fully evaluate the advancement in these objectives.

Objective number 6 was not effectively achieved. In fact, data collected and analyzed through the interviews shows that there was never an intention when designing the program to really integrate all members of society in the management of waste. The objectives and guidelines of the program were never discussed with anyone outside the government's workforce. Participation of citizen groups, NGO's, and the private sector in the design of the program could have made a difference in its performance.

Objective number 7 is in progress. From the observations of the researcher and the information gathered in the interviews, education and training on waste management does appear to be one area in which the government has invested time and money. However, this education and training has to be more effective if it is to make efficient use of the very limited resources available. The information campaign at the beginning of the program was a good start. However this information needs to reach more people. Also, education and training must be a continuous effort. Finally, training of the labourers involved in waste management activities is very important as they are the only ones who can physically verify that the stipulations of the program are being carried out. These workers comprise a highly significant and very large taskforce, and enlisting their help is vital to the success of this waste management program.

Objective number 8 was not accomplished either. It must be noted, however, that by designing and implementing the Solid Waste Information System (SIRS) the government has taken a very good first step. As a second step, it is now important for the government to verify information before publication. This will make the information more reliable and increase the validity of the

system. The system must also be kept updated. Finally, the Federal District's government should promote with other governments, national or international, the sharing and exchange of integrated waste management information. Waste management is an activity that must be specific to local contexts, but it is also true that outside experiences can aid decision makers in gaining a fresh look and new ideas about how to solve unresolved issues.

Overall, the Federal District's Integrated Solid Waste Management Program demonstrates good intention. The technical requirements of the program can be applied to the Federal District. The objectives need clarification for purposes of evaluation, but they are oriented in the right direction. With minor changes (see section 8.3), the program design has the potential to really make a change in how waste is managed in the Federal District. The failure of the program so far is not a result of design problems, but of unsolved challenges in implementation and management.

8.2 Understanding factors that affected the performance of the Federal District's Integrated Solid Waste Management Program (ISWMP)

The Federal District is experiencing an increased demand for waste management services. This is a very sensitive topic for the Federal District's government not only because of the immediate effects that deficient management has on everyday life, but also because of the political costs associated with these. The inadequate management of solid waste has serious repercussions for human health and the environment.

Integrated waste management is essential for promoting sustainable development at the municipal level. Some equity issues are resolved when the government can assure waste management services for lower-income and less accessible parts of the city. Also by improving conditions for waste scavengers and other low-income groups involved in the economy of waste management, sufficiency of livelihood is promoted. Democracy and governance issues are also tackled when all stakeholders are involved in the decision making process (Petts, 1995; Morrissey and

Browne, 2003; Morrissey and Browne, 2004). Last, but not least, there is always the issue of resource conservation and efficient use of resources promoted by reusing and recycling of waste. All of these are requirements for sustainability (Gibson, et.al. 2005).

In comparison to much of the existing waste management literature that aims at identifying opportunities for supporting proposed systems through technological innovation (Chambal, et.al., 2003; Eriksson, et.al., 2005; Hung, et.al., 2007), this research has found that key barriers and opportunities lie in the strengthening of the institutional capacities of the local government. This result is supported by the broader literature on environmental policy by the work of researchers such as Romero-Lankao (2000), Micheli (2002), and Assetto, Hajba, and Mumme (2003). There is also some limited support for this result among some authors in the waste management sector such as Pearce and Turner (1994). However, these authors do not identify specific barriers and opportunities for the implementation of environmental policies; neither do they give recommendations on how to overcome them. One academic and theoretical contribution of this research lies in the recommendations which follow. While they have been developed within the specific context of Mexico City, they may offer some more general guidance about how to respond to concerns which are likely to apply to many other large urban municipalities in developing countries.

Another theoretical contribution of this research lies in the conceptual framework used for the research (see Chapter 3). Application of the Gibson principles for sustainability in the context of Sandra Cointreau's guidelines for sustainable waste management has provided a useful evaluation guide (see section 8.4, below). In particular, it has allowed this research to take a case specific focus, while also developing recommendations that may have broader applicability. Rushbrook and Finnecy (1988), Bartone (1991-b), and Mickwitz (2003) all have established that environmental policy in general and waste management in particular should always be context specific. This research has focused not just on evaluation of a particular waste management system, but also on the geographic

and administrative context of the system in order to gain a broader insight into the factors over and above technical standards and mechanisms that affect the performance of the system.

Analysis of results from what the researcher observed during field work, previous experiences, and the information gathered from key interviewees has lead to the conclusions that follow.

8.2.1 Administrative organization and political conflicts

Integrated waste management is still a fairly new idea in Mexico and in the Federal District in particular. Society in general still views waste management as an activity to rid the city of garbage. They do not yet understand the benefits that come with integrated waste management. Currently, the government does not invest in promoting the reduction of waste. It is also suggested by the fact that a lot of valuable materials end up at the sanitary landfill without being exploited.

In the Federal District there is a current lack of support for the Integrated Solid Waste Management Program. The praise that the program garnered in the past has over time turned into criticism. In 2005 media outlets were reporting that source separation of waste was increasing slowly[5]. In 2007 newspapers were skeptical that the goals for the 2004-2008 ISWMP would be achieved by December 2008[6]. In 2009, news has revolved around the publishing of the Solid Waste Law's Handbook and how only few *delegaciones* have so far complied with its dispositions[7]. This lack of compliance is exemplified in the following occurrences.

For political reasons, what was a priority for the former administration is not necessarily a priority for the current one. This inconsistency in political support negatively affects the performance of the waste management system. The Federal District's government still has a tendency to change

[5] http://www2.eluniversal.com.mx/pls/impreso/noticia.html?id_nota=71207&tabla=ciudad
http://www.cronica.com.mx/nota.php?idc=182925
[6] http://www.eluniversal.com.mx/ciudad/86899.html
[7]http://www.vanguardia.com.mx/diario/noticia/nacional/estados/reciclaje:_todos_desechan_y_pocos_recogen/47593
http://www.eluniversal.com.mx/ciudad/94627.html

its employees every time a new administration is in charge. This makes it hard for any policy or program to have continuity. Lack of continuity interferes with the ongoing monitoring of the program and with enforcement and recommendations for the subsequent modifications.

The current administration, also for political reasons, is trying to revamp the Federal District's ISWMP by adding other environmental initiatives and changing its name to 'Green Plan' (see Chapter 7). The objective of the Green Plan in respect to waste management is to implement an integrated and sustainable system for waste management. In Chapter 5, it can be seen that this is the same objective established for the Federal District's Integrated Solid Waste Management Program. Changing the name of the programs with every new administration breaks their continuity and confuses the public. Proof of this is that the news outlets refer to source separation of waste and the application of sanctions to people who don't separate as if it were something newly established by the government. The researcher could not find any news that mentions the prior existence of the Federal District's Integrated Solid Waste Management Program[8] as of January 2009.

Another example of inconsistencies in political interests is the plan to build the Integral Energy and Recycling Center mentioned in Chapter 1. This center includes infrastructure for the incineration of waste and co-generation of electricity. Although incineration with proper pollution control equipment is permitted, traditionally, no administration had authorized the construction of any facility of the sort within the Federal District's jurisdiction. The current administration is determined to change this tradition in the interest of entering the carbon bonds trading market (IV Legislative Assembly, 2009). They seem unaffected by the fierce opposition of citizen's groups to the incineration of waste[9].

[8] http://www.am.com.mx/Nota.aspx?ID=201303&strPlaza=Leon&IDPlaza=1
http://www.exonline.com.mx/diario/noticia/comunidad/especiales/separacion_sin_dolor/386342
http://www.cronica.com.mx/notaImprimir.php?id_nota=405583
[9] http://elmercuriodigital.es/content/view/16092/81/
http://noalaincineracion.org/2009/01/23/no-a-la-incineracion-de-residuos-en-el-df/

8.2.2 Legislation

Legislation also affects the implementation of the Federal District's Integrated Solid Waste Management Program. The General Law for the Prevention and Integrated Management of Waste (LGPGIR) is an instrument that was designed in accordance with the current situation of waste management in Mexico. This regulatory instrument was planned as a guideline and support for local legislation. However, in the case of the Federal District the local regulations were published before the federal ones with the result that the federal law and local regulations contradict each other in some aspects.

In addition, many of the activities established as mandatory in the Federal District's Solid Waste Law (LRSDF) are mandated by the law's handbook, which was published four years after this first instrument. This left the Federal District's government without means to sanction non-compliance with the LRSDF. Because of the late publication of the handbook, the registry of waste management service providers has not been integrated. This regulation handbook changes the length of the duration of the ISWMP from four, to five years; includes subcategories for the separation of waste; and establishes the guidelines for the presentation of management plans to the Secretariat of Environment. It almost seems as if this latter instrument was designed to override the dispositions of the Solid Waste Law (LRSDF) and the Federal District's ISWMP instead of complementing them.

Also, sometimes the law is not enforced to avoid confrontation with certain sectors of the waste management chain, specifically the union of waste labourers and the union of waste selectors. A case in point is that scavenging and separation of waste still happens in transit from the waste collection point to the transfer stations, although it is officially prohibited by law. The scavenged waste is then sold. Revenue from the sale of this waste compensates the low wages of these workers as do 'tips' given by waste generators to waste labourers in 'gratitude' of ridding them of

waste. This other form of income is also prohibited by law; however no new provisions have been made to compensate for lost income.

8.2.3 Allocation of resources

The above situations suggest that the Federal District is technologically prepared to pursue integrated waste management, but not administratively. Different sectors of the Federal District's public administration are involved with the management of waste. This makes the Federal District's Integrated Solid Waste Management Program a transverse program. Nonetheless, the Federal District has exhibited very poor coordination between the departments related to the management of waste and other environmental protection areas. Coordination between departments is necessary in order to avoid duplicate activities, diminish overlap of functions, and reduce operation cost associated with these functions and activities.

In order to reduce operational costs and also to obtain more resources to allocate to waste management, the Federal District's Government decided to create in May 2009, the Commission for the Integrated Management of Waste. This commission is headed by the Chief of Government, and integrated by the Secretaries of Environment, Finance, Works and Services, Health and Government, and the Director of the Institute of Science and Technology and the Attorney of Environmental Protection and Land Use Planning. The purpose is to coordinate the operation, monitoring and evaluation of the policies regarding waste generation and management. This Commission also gives the local authorities the capacity to generate income proceeding from waste management. The revenue will proceed mainly from the capture of methane in the existing sanitary landfill and the generation of energy both from this methane and the incineration of waste in the proposed new facility (CIRE)[10].

[10] *cgservicios.**df**.gob.mx/prontuario/vigente/1784.doc*

Personnel and infrastructure for the implementation of the Federal District's ISWMP are a very important aspect. Therefore, it should be considered that as the program grows, i.e. as more routes are being incorporated to the program and more separated waste is being collected, more personnel should be assigned and more infrastructure and equipment acquired to match the needs of the provision of the service. It would be important for the government to make this a priority and to allocate resources to this purpose. Another part of the resources from and for integrated waste management should be allocated to education and training.

8.2.4 Education and training

In 2004, when the program was first published, there was an ongoing promotional campaign named 'Juntos pero no Revueltos' (Together but not Mixed). This campaign included posters, billboards, radio spots, brochures and pamphlets. All the printed materials included a logo that was designed specifically for the campaign. The logo has the name of the campaign in black letters; a drawing of an empty aluminum can on a gray background, a drawing of an eaten apple against a green background, and the legend 'Federal District's Solid Waste Law' in black bold letters. The gray and green colors were the official colors established in the program to identify the type of waste being handled. The image is property of the Federal District's government and cannot be reproduced without permission. It can be viewed at http://www.sma.df.gob.mx/rsolidos/index.htm. There were also a number of seminars aimed at educating people that work for the Federal District's government on the program, how it worked, and what their obligations were. All these promotional activities stopped in 2006, when there was a change in administration. New efforts have been conducted since August 2008 to spread the word again, however, the two year break broke the momentum of the educational campaign and the new campaign has virtually had to start from zero.

In the recently (2008) published Handbook for the Federal District's Solid Waste Law (LRSDF) it was established that by July 2009 all of the *delegaciones* must have implemented information

campaigns to inform the public on source separation of waste and integrated management. The Federal District's government must also have an information campaign to aid the efforts of the *delegaciones*. Starting January 2, 2009, training began for members of the waste labourers union and for administrative personnel assigned to the inspection of streets and parks to stop clandestine dumping of waste. This is a good start on education and training, but it should be kept as an ongoing activity with no expiration date.

Also, it has been reported that because of the economic crisis now faced by Mexico City and because there are upcoming elections, the information campaign has been reduced to only posters and billboards[11]. Information campaigns relying on such limited means are unlikely to be effective.

8.2.5 Citizen participation

Citizen participation is the last of these institutional factors that affects the performance of the program. The greater the involvement of the citizenship in a program of this sort, the better the performance will be in terms of participation (Petts, 1995). If the community participates in the design and implementation of the program then the goals and objectives become clearer to them, giving the program a stronger basis to perform. The goals and objectives of the program should take into account the specific needs of the Federal District. If the citizenship can clearly view how implementing a program of this sort has a direct impact in their daily life, however small, they are more likely to comply with the requirements of the program (Morrissey and Browne, 2003; 2004).

Table 8-1 summarizes the barriers and opportunities for implementing an effective Integrated Solid Waste Management Program in the Mexican Federal District as identified by the researcher.

[11] http://www.milenio.com/node/205342

Table 8-1 Barriers and opportunities for the implementation of an effective ISWMP in the Federal District

Barriers	Opportunities
• Political conflicts of the local government with the Federation and with previous administrations	• Strengthening institutional capacities • Promoting tolerance
• Lack of coordination between authorities	• Reinforcing compliance with regulations
• Bad administration of resources allocated to waste management	• Generating income from waste management and reinvesting it in the waste management system
• Not enough education and training	• Regulations that allow for ongoing information campaigns
• Programs mandated by the government without public consultation	• Increased public participation in decision making • Promoting democratic governance

From this summary it can be observed that many of the barriers and opportunities identified by the researcher are not only applicable to the Federal District's Integrated Solid Waste Management Program, but to other environmental programs. Environmental policy in Mexico is dictated by the Federation, but the specific programs through which the policies are enacted are a responsibility of the local governments. This is the reason why this case study research has significance. Barriers to the implementation of this program and opportunities for it are not occurring in isolation. Any environmental program in Mexico may find that it can be improved and implemented more effectively through review of the recommendations developed for this research. The case study's importance lies in the fact that the findings are not only important for the sake of waste management but also because it is reflective of barriers to and opportunities for implementation of environmental policy in general in Mexico and probably in other developing countries.

The performance of environmental programs is very dependent on whoever is in charge of their implementation. Therefore, the only way to assure that environmental policies will perform as

intended regardless of political and administrative conflicts that may arise in the government is through the strengthening of institutions (Bartone, 1991 (a, b); Pearce and Turner, 1994; Romero-Lankao, 2000).

The Federal government's administrative organization is replicated in every state of the Mexican Republic and also in the Federal District (See Chapter 2). The decision makers involved in environmental policy are the Secretariat of Environment or its equivalent at every level, and the head of government (Chief of Government, Governor, or President). The researcher, in her personal opinion and based on the results of the research believes that institutional strengthening and capacity building could occur in a bottom up approach. If the Federal District makes changes in order for the Secretariat of Environment to have the adequate technical, economical, and administrative resources to follow up on the environmental programs they put into effect, these programs would become more efficiently. If the states follow suit in these behaviour, the environmental institutions of the whole country would be stronger. Eventually, this would lead to the strengthening of environmental institutions at the federal level. This process is what makes the results of this research applicable to a broader environmental context.

8.3 Recommendations

There is a need to evaluate the program in more depth and to redefine it based on the experienced gathered from 2004 to date. This will help in having a better and more stable performance of the revised program announced in early 2009. Also, the redefined program should leave no space for political conflicts or interests to interfere with its performance. Finally, it should include good evaluation mechanisms.

After investigating barriers and opportunities for the implementation of an efficient integrated solid waste management program in the Federal District are, the researcher has the following recommendations:

- Keep the Commission for the Integrated Management of Waste, but make it independent from the Chief of Government and the Secretariats. Of the institutions involved, the only one that should remain is the Institute of Science and Technology. The head of the commission should be appointed by the head of this institute in consensus with academic institutions in the Federal District. The rest of the positions should be filled by people that have administrative and/or technical experience in waste management. Rotation of the people in non-management positions is not advisable. The purpose of this commission would be to deal with the administrative and technical aspects of the program. They would be responsible for keeping the program updated, gathering and publishing waste related information, and evaluating the performance of program on a periodic basis. Finally, the commission would provide guidelines for modifications to legislation and/or the program to better its performance and to further promote sustainable development. The funds for the operation of the commission should still come from the Federal District's government.
- Parallel to this commission there should be a citizen organization that serves as an observer. This citizen group would aid in making the government accountable for the results of the program. Also it would aid the commission in giving feedback from a citizen's point of view on how to modify the integrated waste management program to increase citizen participation.
- To ensure compliance both from the institutions involved in waste management, and from the waste generators, more emphasis should be put on the application of sanctions. If lack of compliance has a pecuniary cost, people would feel more encouraged implement the requirements of the Solid Waste Law and the Federal District's Integrated Solid Waste Management Program.

- To promote behavioural and cultural change in regards to waste management, ongoing education and training must be guaranteed. Article 10 of the Solid Waste Law's Handbook establishes that all educational institutions in the Federal District must have environmental education programs in their curriculum. This environmental education must include themes specifically related to solid waste and integrated waste management. This article must be complied with at all costs. Also, education and training should be scheduled on a periodic basis for waste labourers, decision makers, and administrative personnel in waste management positions. Education programs should also be made available to citizens, private industries, and NGO's.
- Access to waste related information should be assured. The solid waste inventory should be published at least every two years to guarantee that information is up to date. it is imperative that the information included in this waste inventory is verified before being published. To make the information more accessible it should be published in various media outlets like the Secretariat of the Environment's official web page, the Federal District's Official Gazette, in a paperback format available for purchase to the general public, and if possible in commercial sources such as newspapers and magazines.
- A new solid waste management diagnostic must be made. This information would provide all stakeholders with up to date information on waste generation. This information would provide a new baseline for comparison and would make any progress in integrated waste management quantifiable.

The researcher believes, according to the results of the analysis of this research, if these five recommendations are applied, integrated waste management in the Federal District could be well on its way to be fully implemented. If it were not possible to apply these recommendations, the researcher believes that decision makers should at least take into consideration the following key

ideas that could help the Federal District's Government shape a more effective waste management program:

1. Conduct a policy analysis before actually designing and implementing a policy. This way the government would have a better understanding of what the real needs of the society are in terms of waste management. Also through policy analysis they could be able to evaluate alternate policies and choose the alternative that is more suitable to fulfill those needs (Patton and Sawicki, 1993).
2. Look for examples in waste management in Asia (India, China, and Singapore) instead of at European directives. As advanced and promising as waste management options seem to be in Europe, the conditions under which they are applied are very different from the conditions in Mexico. Success stories in other developing countries are a better lead to follow.

8.4 Sustainability assessment

In chapters 1 and 3 the researcher stated that part of the research design included selecting criteria for assessing whether the Federal District's Integrated Waste Management is a sustainable program. The criteria selected for this purpose were the requirements for progress towards sustainability (Gibson, et.al., 2005) and the principles for sustainable and integrated waste management (Cointreau, 2001). The researcher was not able to go as far as she would have wanted to in investigating these issues with the case study. As it was explained in Chapter 7, the quantitative and qualitative data obtained were not sufficient to conduct a full sustainability assessment based on the afore mentioned criteria.. However, the criteria were useful first in detecting that the data was corrupt. Second, the criteria helped the researcher identify qualitative issues and themes for analysis.

Regardless of the lack of data to conduct a full sustainability assessment of the program, the researcher could - based on personal experience, direct observation, readings, and some of the data gathered through interviews- conduct a brief sustainability assessment by answering the following questions (see Chapter 4):

- How are we doing in comparison to how we were doing?
- Where are we heading?
- Are things looking better?
- How far and in what direction do we have to go?

The researcher believes that integrated waste management is an integral part of what cities and societies can do to become more sustainable. From this point of view, it can be said that the Mexican Federal District has indeed taken a big step in progress towards sustainability. However, the integrated solid waste management system is very deficient. Once modifications to increase its efficiency have been put into effect, the impact on sustainability will be more readily measurable. Any environmental program put into action will lead to the betterment of the environment, and the integrated solid waste management program is no exception. Nonetheless, the program should not have an expiry date if the government wants to see this ongoing improvement of environmental conditions.

8.5 Opportunities for further research

As it was explained in the previous section, Gibson's requirements for progress towards sustainability and Cointreau's principles for sustainable and integrated waste management were used as the base criteria for a sustainability assessment of the Federal District's Integrated Solid Waste Management Program. However, they could not be applied to conduct this assessment. The researcher believes that there should be more research done on what good criteria for assessing the sustainability of these types of programs could be. Since waste management is something that is

very context specific, research should be conducted on how to integrate both sets of criteria and on how to modify them to fit the Mexican context. One example is, the principle that reads 'sustainable integrated waste management should be supportive of good governance' could be rephrased to 'it must support decision maker among all involved stakeholders'. Another example is 'it should build institutional capacity'. This principle should perhaps include a list of the specific institutions that are in need of capacity building (referring to Mexican institutions). The same process could be followed for all the requirements and principles in the list (see chapter 4).

Mixed methods research should be done with cases for which there is reliable statistical information, using evaluation criteria for assessing sustainable waste management similar to those used in this study. Further, a follow up study to this one, drawing on additional qualitative and quantitative data would be very interesting in order to go further in answering the question of whether or not Mexico City's integrated solid waste management program can be, or is, sustainable

References

1. Assetto, V.J., Hajba, E. and Mumme, S.P. (2003). Democratization, decentralization and local environmental policy capacity: Hungary and Mexico. *The Social Science Journal.* 40(2), pp.249-68.
2. Bartone, C. R. (1991-a). Environmental challenge in third-world cities. *Journal of the American Planning Association, 57*(4), 411-415.
3. Bartone, C. R. (1991-b). Institutional and management approaches to solid waste disposal in large metropolitan areas. *Waste Management & Research, 9*(6), 525-536.
4. Beede, D. N., & Bloom, D. E. (1995). The economics of municipal solid-waste. *World Bank Research Observer, 10*(2), 113-150.
5. Beloff, B., Tanzil, D., and Lines, M. (2004). Sustainable development performance assessment. *Environmental Progress, 23*(4), 271-276.
6. Berry, R.J. et.al. (1992). "A code of environmental practice" in *Environmental Dilemmas: Ethics and Decisions.* Chapman and Hall. UK, pp.253-62.
7. Booth, W., Colomb, G. and Williams, J. (2003). The craft of research, 2nd Ed. Chicago, United States: University of Chicago Press.
8. Brundtland, G.H. Our Common Future. World Commission on Environment and Development. UN.
9. Buenrostro, O., and Bocco, G. (2003). Solid waste management in municipalities in Mexico: Goals and perspectives. *Resources, Conservation and Recycling, 39*(3), 251-263.
10. Buenrostro, O., Bocco, G., and Bernache, G. (2001). Urban solid waste generation and disposal in Mexico: A case study. *Waste Management and Research, 19*(2), 169-176.
11. Cabrero Mendoza, E. (2000). Usos y costumbres en la hechura de las políticas públicas en México: Límites de las "Policy Sciences" en contextos cultural y políticamente diferentes. *Gestión y Política Pública, 9*(2), 189-229.
12. Calzada Padron, F. (1983). Municipio Libre: Fortalecimiento del Federalismo. Mexico, Universidad Autonoma de Mexico.
13. Cardozo Brum, M. (2005). Social evaluation and participation within the framework of necessary public management. [Evaluacion y participacion social en el marco de la gerencia publica necesaria] *Revista Venezolana De Gerencia, 10*(29), 86-105.
14. Cervantes del Rio, H. (1974). Public administration in Mexico. *International Review of Administrative Sciences, 40*(1), 1-7.
15. Chambal, S., Shoviak, M., and Thal, J., Alfred E. (2003). Decision analysis methodology to evaluate integrated solid waste management alternatives. *Environmental Modeling and Assessment, 8*(1), 25-34.
16. Cresswell, J.W. (2002). Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research. Merrill/Prentice-Hall. USA.
17. Cresswell, J.W. (2009). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3rd ed. Sage Publications Inc. UK.
18. Diesendorf, M. (2000) "Sustainability and Sustainable Development" in *Sustainability, The Corporate Challenge of the 21st Century.* Dunphy et.al., eds. Allen & Unwin, Australia, pp. 19-37.
19. Eriksson, O., Carlsson Reich, M., Frostell, B., Björklund, A., Assefa, G., Sundqvist, J., et al. (2005). Municipal solid waste management from a systems perspective. *Journal of Cleaner Production, 13*(3), 241-252.

20. Francis, G. et.al. (1990). Defining a Sustainable Society: Values, Principles and Definitions. *Alternatives*. 17(2), pp.36-46.
21. Gertzakis, J. and Lewis, H. (2003). Sustainability and the Waste Management Hierarchy. A discussion paper prepared for EcoRecycle Victoria.
22. Gibbs, G. (2007). Analyzing Qualitative Data. Sage Publications Inc. UK.
23. Gibson, R. et.al. (2005). Sustainability Assessment Criteria and Processes. Earthscan. UK.
24. Glaser, B.G. and Strauss, A.L. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research.* Aldine. USA.
25. Greene, J.C. (2007). Mixed Methods in Social Inquiry. Jossey-Bass. USA.
26. Greffe, Xavier. (1998). Decentralization and local infrastructure in Mexico: a new public policy for development. Organisation for Economic Co-Operation and Development.
27. Guillén, Fedro. Fifteen Years of Environmental Policy in Mexico: a documented memory. (2007). National Institute of Ecology.
28. Hay, P. (2002). "All Hail Sustainable Development" in *Main Currents in Western European Thought*. New South Wales Press. Australia, pp.212-19.
29. Hostovsky, C. (2000). Integrating planning theory and waste Management—an annotated bibliography. *Journal of Planning Literature, 15*(2), 305-332.
30. Hung, M. L., Ma, H. W., & Yang, W. F. (2007). A novel sustainable decision making model for municipal solid waste management.
31. Huylenbroeck, G.V. (1996) A multi-criteria approach for trade-off analysis between economic and environmental objectives in rural planning. Conference paper for First International Conference on Multiple-Objective Decision Support Systems (MODDS) for Land, Water, and Environmental Management. Honolulu, Hawaii.
32. Jupp, V. (ed.) (2006). The Sage Dictionary of Social Research Methods. Sage Publications Inc. UK.
33. Kvale, S. (1996). InterViews: An Introduction to Qualitative Research Interviewing. Sage Publications Inc. USA.
34. MacDonald, M. L. (1996). Bias issues in the utilization of solid waste indicators. *Journal of the American Planning Association, 62*(2), 236(7)-243.
35. May, P.J. (1981). Hints for crafting alternative policies. *Policy Analysis*. 7(2), 227-244.
36. Mickwitz, P. (2003). A framework for evaluating environmental policy instruments: Context and key concepts. *Evaluation, 9*(4), 415-436.
37. Montaño Hirose, L. (2005). Organization and society: An approach to the Mexican public administration. *Gestion y Politica Publica, 14*(3), 465-495.
38. Morrissey, & Browne, J. (2004). A methodology for community based waste management decisions. *Journal of Solid Waste Technology and Management, 30*(3), 170-182.
39. Morrissey, A.J. and Browne, J. (2003). Waste Management Models and their Application to Sustainable Waste Management. *Waste Management.* 24(3), pp. 297-308.
40. Mumme, S.P. (2007). Trade integration, neoliberal reform, and environmental protection in Mexico. *Latin American Perspectives.* 34(3), pp. 91-107.
41. Neuman, W.L. (2006). Social Research Methods: Quantitative and Qualitative Approaches. 6th ed. Pearson Education Inc. USA.
42. Ojeda-Benítez, S., and Beraud-Lozano, J. L. (2003). The municipal solid waste cycle in Mexico: Final disposal. *Resources, Conservation and Recycling, 39*(3), 239-250.
43. Oliver, P. (2008). Writing your thesis. 2nd ed. Sage Publications Inc. UK.
44. Palys, T. (2003). *Research Decisions: Quantitative and Qualitative Perspectives, 3rd Edition.* Ontario, Canada: Thomson and Nelson.

45. Patton, C.V. and Sawicki, D.S. (1993). *Basic Methods of Policy Analysis and Planning*. 2nd ed. Prentice Hall, USA.
46. Pelham, B. and Blanton, H. (2003). Conducting Research in Psychology: Measuring the Weight of Smoke, 2nd Edition. Wadsworth/Thomson Learning. USA.
47. Petts, J. (1995) Waste management strategy development: A case study of community involvement and census building in Hampshire. *Journal of Environmental Planning.* 38(4), pp. 519-36.
48. Powell, J. C. (1996). The evaluation of waste management options. *Waste Management & Research, 14*(6), 515-526.
49. Repa, E. (2005). Bringing it together. *Waste Age, 36*(12), 54-55.
50. Romero-Lankao, P. (2000). Sustainable and Public Management Reform: Two Challenges for Mexican Environmental Policy. *American Review of Public Administration. 30(4), pp. 389-99.*
51. Rushbrook, P. E., & Finnecy, E. E. (1988). Planning for future waste management operations in developing countries. *Waste Management & Research, 6*(1), 1-21.
52. Saxena, K. B. C. (1996). Re-engineering public administration in developing countries. *Long Range Planning, 29*(5), 703-711.
53. Shah, K. (2000). *Basics of Solid and Hazardous Waste Management Technology*. United States, Prentice Hall.
54. Shi, J. (2003) A model for analysis of sustainability on environmental policy using decision theory. Thesis. University of Guelph.
55. Stake, R.E. "Case Studies" in Denzin and Lincoln (ed.). (2000). Handbook of qualitative research. 2nd ed. Sage Publications Inc.UK. p.435-54.
56. Staniskis, J. (2005). Integrated Waste Management: Concept and Implementation. *Environmental Research, Engineering and Management*. 3(33), p.40-46.
57. Tchobanoglous, G., Theisen, H., & Vigil, S. A. (1993). *Integrated solid waste management : Engineering principles and management issues*. New York ; Toronto: McGraw-Hill.
58. Thorpe, S. G. (2000). Integrated solid waste management: A framework for analysis. *Journal of Environmental Systems, 28*(2), 91-105.
59. Von Weizsacker, E. Lovins, L.H., and Lovins A.B. (1998) Factor Four: doubling wealth, halving resource use. *The Economist [London]*. 346(8059), p. Survey 9.
60. White, P. R., Franke, M., & Hindle, P. (1995). *Integrated solid waste management : A lifecycle inventory* (1st ed.). London: Blackie Academic & Professional.
61. Wilson, D. C. (2007). Development drivers for waste management. *Waste Management and Research, 25*(3), 198-207.
62. Wilson, D. C. (1985). Long-term planning for solid waste management. *Waste Management & Research, 3*(3), 203-216.
63. Wilson, D. C., Velis, C., & Cheeseman, C. (2006). Role of informal sector recycling in waste management in developing countries. *HABITAT INTERNATIONAL, 30*(4), 797-808.
64. Woollard, R. and Rees, W. (1999) "Social evolution and urban systems: directions for sustainability" in John T. Pierce and Ann Dale, eds., *Communities, Development and Sustainability across Canada.* UBC Press, Canada, pp. 27-45.
65. Yin, R. (2003). Case study research: design and methods 3rd edition. London, United Kingdom: Sage publication.

Online articles

1. "Distrito Federal" Junior Worldmark Encyclopedia of the Mexican States. The Gale Group Inc. 2004. Encyclopedia.com. (March 9, 2009). http://www.encyclopedia.com/doc/1G2-3435600018.html
2. "Mexico City" Encyclopaedia Britannica. 2009. Encyclopaedia Britannica Online. 09 Mar. 2009. http://www.britannica.com/EBchecked/topic/379415/Mexico-City
3. "Mexico City". Encyclopedia Encarta. 2008. Msn Encarta. (March 9, 2009). http://encarta.msn.com/encyclopedia_761569238/mexico_city.html
4. "Mexico City". World Encyclopedia. 2005. Encyclopedia.com (March 9, 2009). http://www.encyclopedia.com/doc/1O142-MexicoCity.html
5. "Mexico". The Columbia Encyclopedia, Sixth Edition. 2008. Encyclopedia.com. (March 9, 2009). http://www.encyclopedia.com/doc/1E1-MexCity.html
6. Buenrostro, O. (2006) La producción de residuos sólidos municipales y sus implicaciones ambientales. *Ciencia y desarrollo en internet*. Available at http://www.conacyt.mx/comunicacion/revista/ArticulosCompletos/pdf/Produccion.pdf. Last access on June 8th, 2009.
7. Cointreau, S. (2001). Declaration of Principles for Sustainable and Integrated Solid Waste Management (ISWM). Available at http://siteresources.worldbank.org/INTUSWM/Resources/siswm.pdf. Last access June 8th, 2009.
8. Medina, M. (1999). Globalization, Development, and Municipal Solid Waste Management in Third World Cities. El Colegio de la Frontera Norte, Mexico. URL: http://depot.gdnet.org:6666/gdnshare/pdf/2002AwardsMedalsWinners/OutstandingResearchDevelopment/martin_medina_martinez_paper.pdf.
9. Wright, F., Bernstein, J., & Bartone, C. (1990). Investments in solid waste management: Opportunities for environmental improvement. The World Bank, Policy Research Working Paper Series). ([URL:http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1990/04/01/000009265_3961001130446/Rendered/PDF/multi_page.pdf] URL)

Websites

Consejo Nacional de Población y Vivienda: http://www.conapo.gob.mx

Instituto Nacional de Ecología: http://www.ine.gob.mx

Instituto Nacional de Estadística y Geografía: http://www.inegi.org.mx

IV Legislative Assembly of the Federal District: http://www.asambleadf.gob.mx

Secretaría de Obras y Servicios del Distrito Federal: http://www.sos.df.gob.mx

Secretaría del Medio Ambiente del Distrito Federal: http://www.sma.df.gob.mx

Legislation

Constitución Política de los Estados Unidos Mexicanos
Ley Ambiental del Distrito Federal
Ley de Residuos Sólidos del Distrito Federal
Ley General del Equilibrio Ecológico y Protección al Ambiente
Ley General para la Prevención y Gestión Integral de los Residuos
Programa Nacional para la Restauración de Suelos Contaminados
Reglamento de la Ley de Residuos Sólidos del Distrito Federal

APPENDICES

Appendix 1 Glossary

Commercial solid wastes: "waste that has its origin in bulk sales establishments, sale establishments, or services such as office buildings, stores, markets, theatres, hotels and warehouses" (Tchobanoglous, et.al., 1993).

Compost: "a mixture of organic wastes partially decomposed by aerobic and/or anaerobic bacteria to an intermediate state" (Tchobanoglous, et. al., 1993).

Controlled waste: "waste generated in facilities that provide health services, and that does not fall within the category of hazardous waste" (SOS, 1999).

Demolition waste: "wastes produced from the demolition of buildings, roads, sidewalks and other structures" (Tchobanoglous, et. al., 1993).

Great generator: "any person that generates 10 or more tons of solid waste per year" (LGPGIR, 2003)

Hierarchy of Integrated Solid Waste Management: "source reduction, recycling, waste transformation, and disposal (in that order)" (Tchobanoglous, et. al., 1993).

High volume generator: "the person that generates over 50 kilograms of solid waste per day" (LRSDF; 2003)

Household waste: (a.k.a. residential waste): "waste generated in houses and apartment buildings including paper, cardboard, cans, plastic, food residues, glass containers and gardening waste" (Tchobanoglous, et.al., 1993).

Industrial Solid waste: "wastes generally discarded from industrial operations or derived from manufacturing processes" (Tchobanoglous, et. al., 1993).

Integrated Solid Waste Management: "the management of solid waste based on a consideration of source reduction, recycling, waste transformation, and disposal arranged in hierarchical order. The purposeful, systematic control of the functional elements of generation; waste handling, separation, and processing at the source; collection; separation and processing and transformation of solid waste; transfer and transport; and disposal associated with the management of solid wastes from the point of generation to the final disposal" (Tchobanoglous, et. al., 1993).

Landfill: "an engineered method of solid waste disposal by compaction and then placement of a cover made from impermeable material either on or in the land" (Shah, 2000).

Materials recovery facilities: "the physical facilities used for the further separation and processing of wastes that have been separated at the source and for the separation of commingled wastes" (Tchobanoglous, et. al., 1993).

Municipal solid waste: "includes all the wastes generated from residential households and apartment buildings, commercial and business establishments, institutional facilities, construction and demolition activities, municipal services, and treatment plant sites" (Tchobanoglous, et. al., 1993).

Recycling: "separating a given waste material from the waste stream and processing it so that it may be used again as a useful material for products which may or may not be similar to the original" (Tchobanoglous, et. al., 1993).

Reuse: "the use of a product or waste material more than once" (Shah, 2000).

Secondary separation: "the further separation and processing of wastes that have been separated at the source" (Tchobanoglous, et. al., 1993).

Solid Waste Management: "the planning, design, construction, and operation of facilities to collect, transport, process, and dispose of solid waste" (Shah, 2000).

Solid waste: "a variety of solid materials discarded as being spent, useless, worthless or in excess" (Tchobanoglous, et. al., 1993).

Source separation: "the separation of waste materials that have been separated at the point of generation" (Tchobanoglous, et. al., 1993).

Special Waste: "refers to items that require special or separate handling such as household hazardous wastes, bulky wastes, tires, used oil, electronic waste, etc." (Shah, 2000). "Waste generated in a production process, non hazardous, and non classifiable as urban solid waste, or that produced by great generators" (LGPGIR, 2003). "Waste originated in establishments where medical care is given; cosmetics and food not suitable for human consumption; waste generated in agro-forestry related activities; that generated in transport service activities; demolition waste; electronic waste; dehydrated sludge; tires, furniture and household appliances; waste generated in chemical, biological and industrial laboratories; all others determined by the Handbook" (LRSDF, 2003).

Urban solid waste: "all waste generated in households and waste with similar characteristics generated in other establishments, as long as they cannot be considered special waste" (LRSDF, 2003; LGPGIR, 2003).

Appendix 2 List of Acronyms

BPR	Business Process Re-Engineering
CIRE	Centro Integral de Reciclamiento y Energía (Integral Energy and Recycling Center)
DSW	Domestic Solid Waste
GDP	Gross Domestic Product
INE	Instituto Nacional de Ecología (National Institute of Ecology)
INEGI	Instituto Nacional de Estadística y Geografía (National Insitute of Geographic Statistics and Information)
ISWMP	Integrated Solid Waste Management Program
LADF	Ley Ambiental del Distrito Federal (Federal District's Environmental Law)
LGEEPA	Ley General del Equilibrio Ecológico y la Protección al Ambiente (General Law for Ecological Equilibrium and Environmental Protection)
LGPGIR	Ley General para la Prevención y Gestión Integral de los Residuos (General Law for the Prevention and Integrated Management of Waste)
LRSDF	Ley de Residuos Sólidos del Distrito Federal (Federal District's Solid Waste Law)
MSW	Municipal Solid Waste
NAFTA	North American Free Trade Agreement
NGO	Non-government Organization
NOMS	Normas Oficiales Mexicanas (Official Mexican Norms)
NPM	New Public Management
PAN	Partido Acción Nacional (National Action Party)

PAOT	Procuraduría Ambiental y del Ordenamiento Territorial (Attorney of Environment and Land Use)
PAR	Public Administration Re-engineering
PGIRSDF	Programa para la Gestión Integral de los Residuos Sólidos del Distrito Federal (Federal District's Integrated Solid Waste Management Program)
PNPGIR	Programa Nacional para la Prevención y Gestión de los Residuos (National Program for the Prevention and Integrated Management of Waste)
PNRSCR	Programa Nacional de Restauración de Suelos Contaminados por Residuos (National Program for the Remediation of Sites Contaminated by Waste)
PRD	Partido de la Revolución Democrática (Party of the Democratic Revolution)
PRI	Partido Revolucionario Intitucional (Institutional Revolutionary Party)
PROFEPA	Procuraduría Federal de Protección al Ambiente (Federal Attorney of Environmental Protection)
RLRSDF	Reglamento de La Ley de Residuos Sólidos del Distrito Federal (Solid Waste Law's Regulation Handbook)
SECOFI	Secretaría de Comercio y Fomento Industrial (Secretariat of Commerce and Industrial Promotion)
SEMARNAP	Secretaría de Ecología y Medio Ambiente, Recursos Naturales y Pesca (Secretariat of Environment, Natural Resources and Fisheries)
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources)
SIRS	Sistema de Información de Residuos Sólidos (Solid Waste Information System)
USW	Urban SOlid Waste

Appendix 3 Interview Guides

Introduction to the Interview Guide

The following are the questions for a 25 to 30 minute interview. The interview is about the Mexican Federal District's Integrated Solid Waste Management Program's design and performance, and its relation to sustainable development.

As it was expressed in the information letter you received at the first contact, you may choose to decline answering any of the questions. You may also decide to withdraw from participating in this interview, or stop the interview at any time. Furthermore, after the interview is concluded, you may still withdraw from participating in the study just by advising the researcher of your desire to do so.

This interview will be audio recorded for accuracy of the information provided by you. The information provided by you in this interview will be kept confidential. Your name or that of your organization will only be mentioned should you give your consent to do so. Before we begin the interview I will like you to go through this consent form (interviewer will hand out the consent form at this point) which authorizes me, the researcher, to make and keep audio or written records of this and any follow-up conversations. If you agree with this process, please sign the form and we will begin the interview.

Interview Guide for Experts in Waste Management

1. Please define waste management.
2. Are you familiar with the concept of integrated waste management? If yes, what does integrated waste management mean to you. If not, interviewer will provide a brief explanation.
3. Do you think the way waste is managed within the Mexican Federal District fits within a definition of integrated waste management? Please explain why or why not.
4. Are you familiar with the term sustainable development? Please define it in your own words. Is your definition of sustainability the same or different? Please explain.
5. Do you think waste management is an important aspect of sustainable development? Why or why not?
6. Are you familiar with the Federal District's Integrated Solid Waste Management Program? If yes, what have you heard about it? Were you actively participating in it? (If the interviewee has not heard about the program, the interviewer will explain what it entails in few words and in a clear colloquial manner).
7. Do you think the waste management system proposed in the program is adequate? If not, what suggestions do you have for improvement? If yes, why do you think the system is efficient?
8. How would you grade the overall performance of the program? Have you seen any significant changes in waste management since the program was implemented?
9. Are you familiar with the principles for Sustainable and Integrated Waste Management published by the World Bank in 2001? How about Gibson's, et.al requirements for sustainability? (Interviewer will provide a handout with these principles and requirements to prompt further comment from the interviewee). What would you consider are the requirements for sustainability? Do you think the Federal District's ISWM program complies with these principles? Please explain why or why not.
10. What are the main issues that you think should be reconsidered in making the Federal District's ISWM program more sustainable?
11. Is there any other feedback (positive or negative) that you would like to provide with regards to this waste management program?"

Thank you for your time.

Interview Guide for Experts in Environmental Policy

1. Please define waste management.
2. Are you familiar with the concept of integrated waste management? If yes, what does integrated waste management mean to you. If not, interviewer will provide a brief explanation.
3. Do you think the way waste is managed within the Mexican Federal District fits within a definition of integrated waste management? Please explain why or why not.
4. Are you familiar with the term sustainable development? Please define it in your own words. Is your definition of sustainability the same or different? Please explain.
5. Do you think waste management is an important aspect of sustainable development? Why or why not?
6. Are you familiar with the Federal District's Integrated Solid Waste Management Program? If yes, what have you heard about it? Were you actively participating in it? (If the interviewee has not heard about the program, the interviewer will explain what it entails in few words and in a clear colloquial manner).
7. Do you believe that garbage can cause environmental or health problems? Why or why not? If so, how?
8. Are you familiar with Mexico's policy on environmental protection? If yes, please describe it. If not, interviewee will provide a brief background on it.
9. Do you believe that the Federal District's ISWM Program is effective as a way to achieve Mexico's environmental protection goals? Please explain.
10. Are you familiar with the current [environmental] policy development process in Mexico? Please, describe it briefly. If yes, would you consider that proper policy analysis was done when designing the Federal District's ISWM program? Please explain.
11. In your opinion is this program a good vehicle for implementation of environmental protection policy? Why or why not?
12. Are there any changes that you would suggest be made to make it a more effective program?
13. Are there any other particular concerns that you would like to voice with regards to this waste management program in terms of policy making?
14. Would you have any suggestions on how to make Mexico's environmental policy more effective?

Thank you for your time

Interview Guide for Experts in Sustainable Development

1. Please define waste management.
2. Are you familiar with the concept of integrated waste management? If yes, what does integrated waste management mean to you. If not, interviewer will provide a brief explanation.
3. Do you think the way waste is managed within the Mexican Federal District fits within a definition of integrated waste management? Please explain why or why not.
4. Are you familiar with the term sustainable development? Please define it in your own words. Is your definition of sustainability the same or different? Please explain.
5. By law, each federal administration has to prepare and make public a National Development Plan. Since 1992, when Mexico made a declaration that the country will establish sustainable development as a development model, there is either a chapter or a declaration including guidelines to establish a public policy. Are you aware of how this administration is addressing sustainable development in the 2007-2012 NDP?
6. The National Development Plan's guidelines serve as the basis to the development of the sectorial action programs. In your opinion, are any of these sectorial programs really targeting how to achieve sustainable development?
7. Are you familiar with the Federal District's Integrated Solid Waste Management Program? If yes, what have you heard about it? Were you actively participating in it? (If the interviewee has not heard about the program, the interviewer will explain what in entails in few words and in a clear colloquial manner).
8. Do you think waste management is an important aspect of sustainable development? Why or why not?
9. Would you consider it important to directly address waste management in these documents in the future? Why?
10. In your opinion, if more emphasis would be put in enforcing waste management policies at a national level, would it help the country in achieving sustainable development? Please explain.
11. Are you familiar with the principles for Sustainable and Integrated Waste Management published by the World Bank in 2001? How about Gibson's, et.al requirements for sustainability? (Interviewer will provide a handout with these principles and requirements to prompt further comment from the interviewee). What would you consider are the requirements for sustainability? Do you think the Federal District's ISWM program complies with these principles? Please explain why or why not.
12. Is there any other feedback (positive or negative) that you would like to provide with regards to this management system with respect to sustainability?"

Thank you for your time

Interview Guide for public administrators responsible for the Mexican Federal District's ISWMP

There will be two slightly different versions of this questionnaire as the interviewees will both be people involved in the design and implementation of the program, and the people currently responsible for its application.

Questionnaire A: for the people involved in the design and implementation of the program

1. You were (position interviewee held at the time) at the Federal District's Ministry of Environment in 2004 and previous years. During this time, one of your main projects was the planning and design of the Federal District's ISWM program. Could you please describe this process?
2. Where did the idea come from? Did you follow a specific model or program that was already implemented elsewhere? Why did you consider this particular model could be applied in the Federal District?
3. Did you follow a predefined methodology when deciding which waste management options to choose? If yes, what was this methodology? If not, what were the criteria used in deciding which options would be included in the program?
4. What were the main driving forces in the development of this waste management program? Which were the main goals and objectives?
5. Did the program include tools for monitoring its performance? If yes, what are these tools? If not, why not?
6. Does the program include mechanisms for evaluation of its performance? If yes, how did you decide what the mechanisms for evaluation of the program would be? If not, why not?
7. Four years after the implementation of the program, how would you describe its performance? Would you consider the goals were achieved? Please explain.
8. Looking back, would you change anything in the design of the program?
9. Do you consider the program could be improved? How so?
10. Would you consider that the program was appropriately planned as a long-term policy?
11. Are you familiar with the term sustainable development? Please define it in your own words. Is your definition of sustainability the same or different? Please explain.
12. Do you think waste management is an important aspect of sustainable development? Why or why not?
13. Were the side effects of the chosen waste management options considered when the program was defined as a sustainable waste management program? Why or why not? How were they addressed within the ISWM program?
14. Are you familiar with the principles for Sustainable and Integrated Waste Management published by the World Bank in 2001? How about Gibson's, et.al requirements for sustainability? (Interviewer will provide a handout with these principles and requirements to prompt further comment from the interviewee). What would you consider are the requirements for sustainability? Do you think the Federal District's ISWM program complies with these principles? Please explain why or why not.
15. Are there any issues that you think should be reconsidered to make the Federal District's ISWM program more sustainable?
16. Is there any other feedback (positive or negative) that you would like to provide with regards to this waste management program?"

Questionnaire B for the people currently responsible for the application of the Mexican Federal District's ISWM program

1. In 2006 you became (current position of the interviewee) in the Federal District's Ministry of Environment. One of your responsibilities in this position is to monitor the application of the Federal District's ISWM program. Since you are in this position, how would you describe the performance of the program?
2. Would you consider that the targets set for 2008 were accomplished? How so?
3. Is the program still in effect? Explain what is being done in this sense (source separation still in effect, separate collection of waste, reports from the delegations, etc).
4. The program was designed to undergo revision in 2008. Has this revision taken effect? If yes, who performed it? What methodology or criteria was chosen for this revision? If not, why not?
5. Do you consider that the program needs to be modified? Why or why not? If yes, how?
6. Do you consider that the sanitary landfill crisis should be addressed in the revised program? If yes, how do you consider it should be addressed? If not, why not?
7. Are you familiar with the term sustainable development? Please define it in your own words. Is your definition of sustainability the same or different? Please explain.
8. Do you think waste management is an important aspect of sustainable development? Why or why not?
9. Are you familiar with the principles for Sustainable and Integrated Waste Management published by the World Bank in 2001? How about Gibson's, et.al requirements for sustainability? (Interviewer will provide a handout with these principles and requirements to prompt further comment from the interviewee). What would you consider are the requirements for sustainability? Do you think the Federal District's ISWM program complies with these principles? Please explain why or why not.
10. Are there any issues that you think should be reconsidered to make the Federal District's ISWM program more sustainable?
11. Is there any other feedback (positive or negative) that you would like to provide with regards to this waste management program?"

Thank you for your time.

Appendix 4 Photographs

Tubular, side-load waste collection truck for inorganic waste operating in route with simultaneous separate waste collection, two trucks driving through the route at the same time.

Back-load waste collection truck for organic waste operating in route with simultaneous separate waste collection, two trucks driving through the route at the same time.

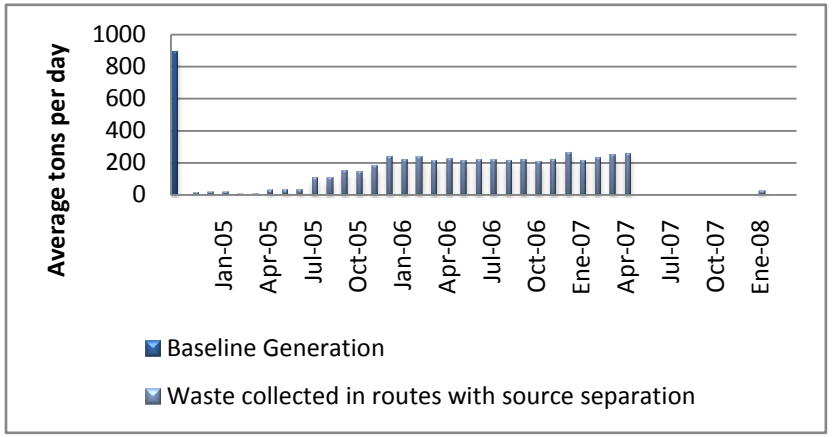
Three different types of waste collection vehicles with separate compartments for organic and inorganic waste.

Appendix 5 Graphs

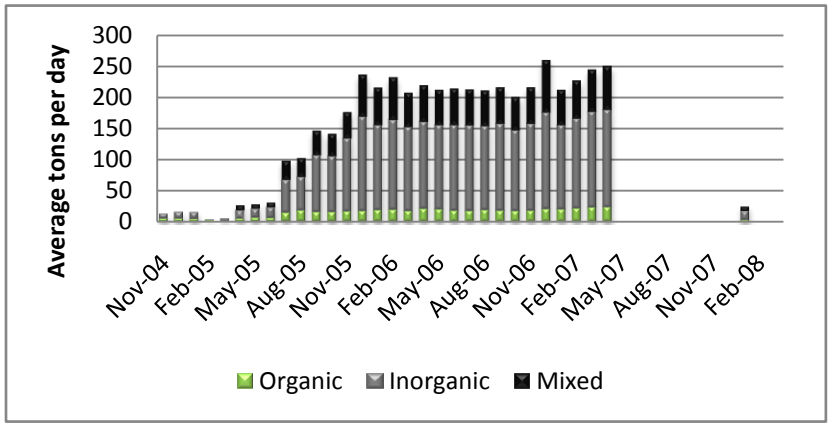
All of the graphs in this section were adapted from data retrieved from the Secretariat of Environment's Official Web Page at www.sma.df.gob.mx.

Alvaro Obregon

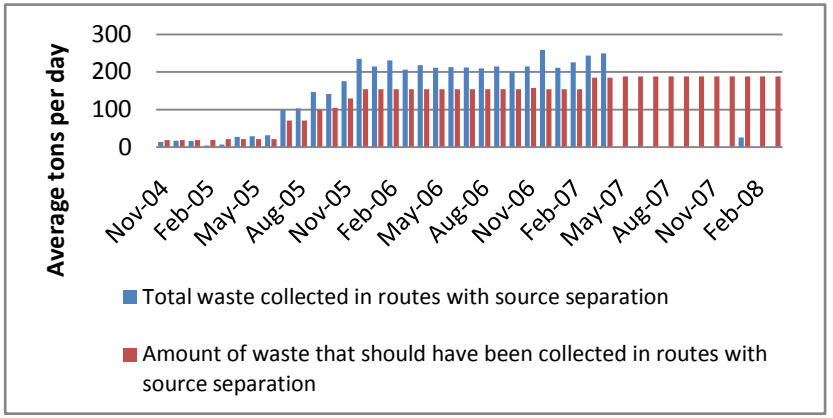
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



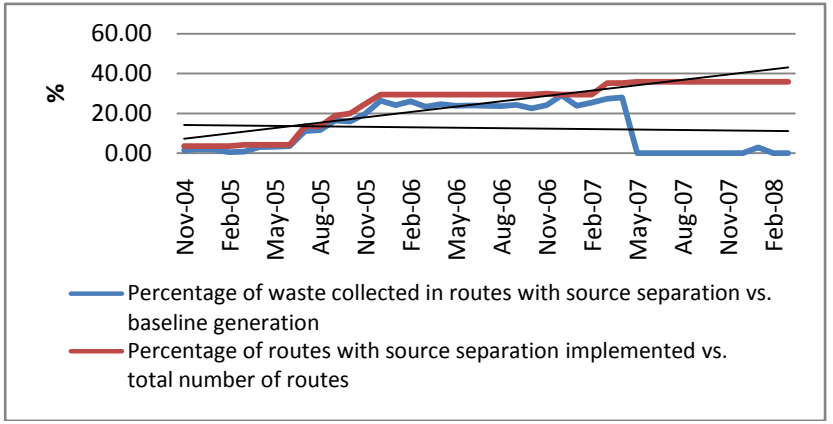
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

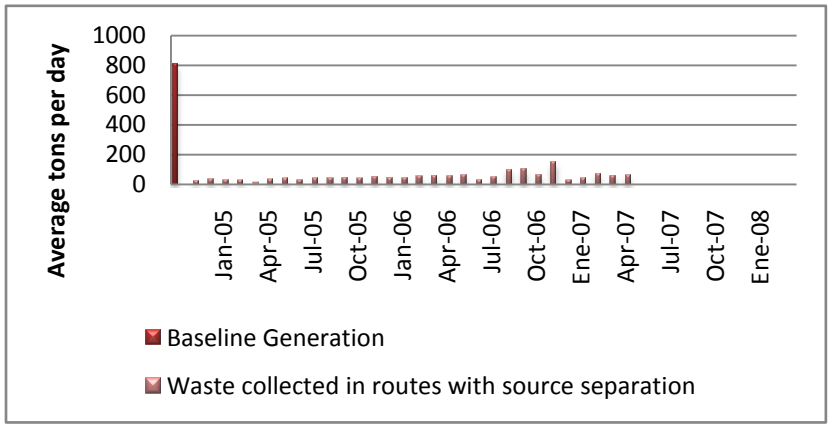


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

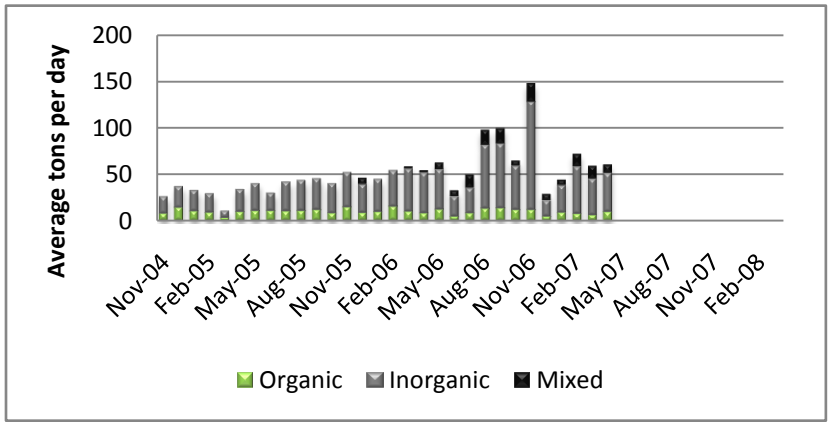


Azcapotzalco

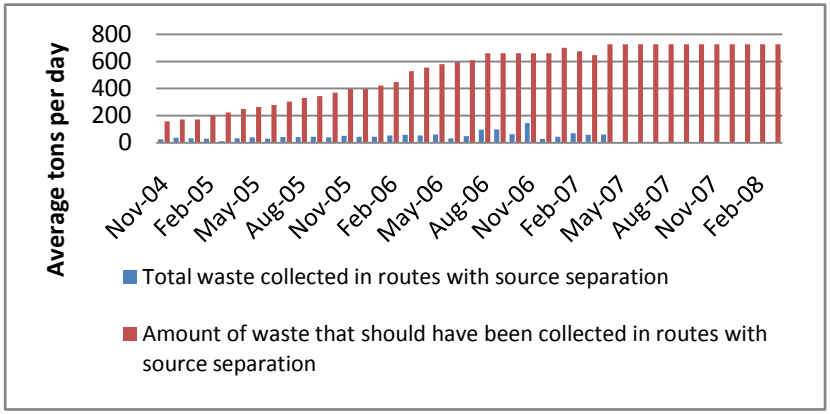
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



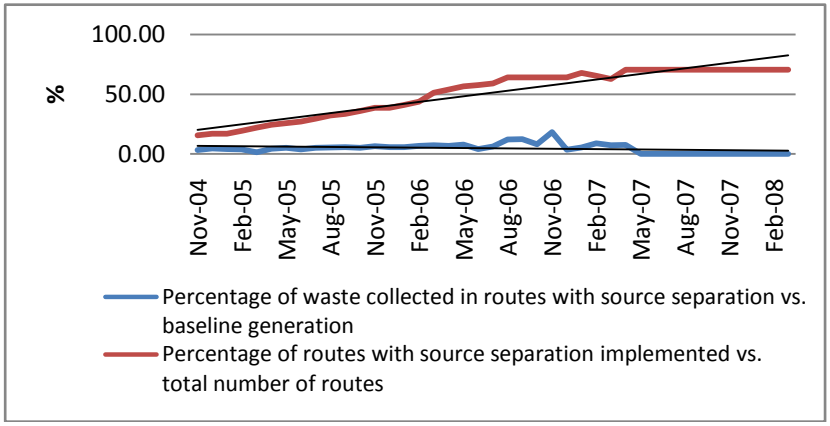
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

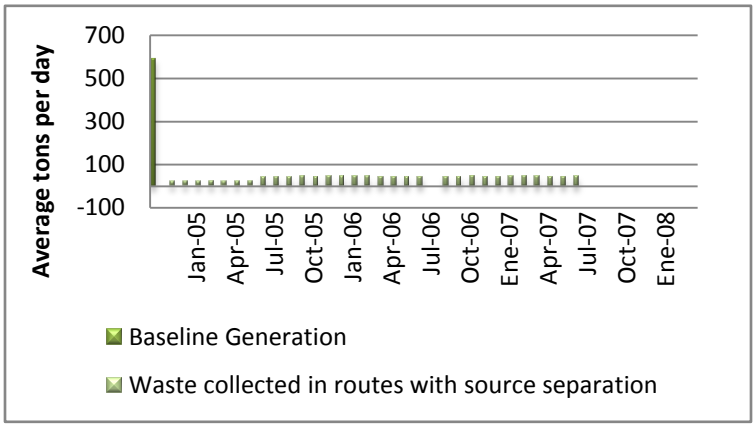


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

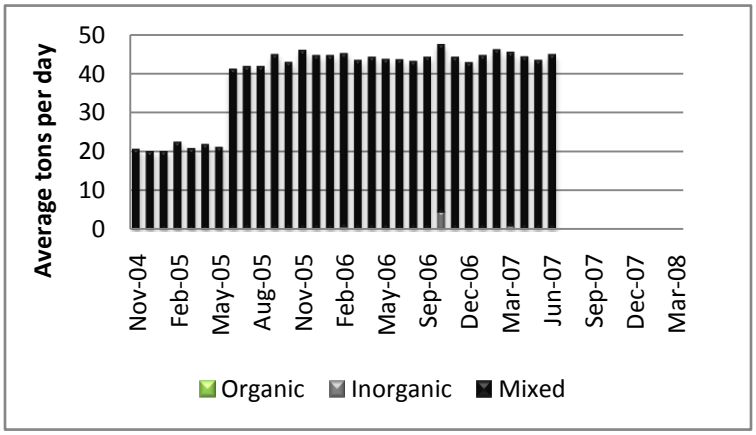


Benito Juarez

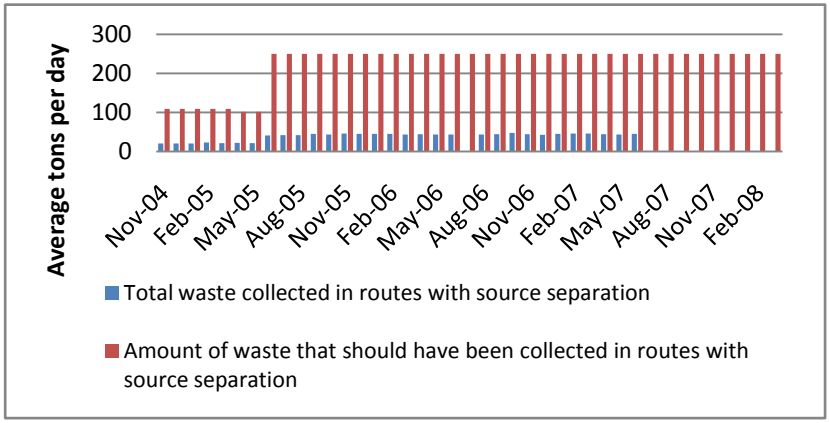
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



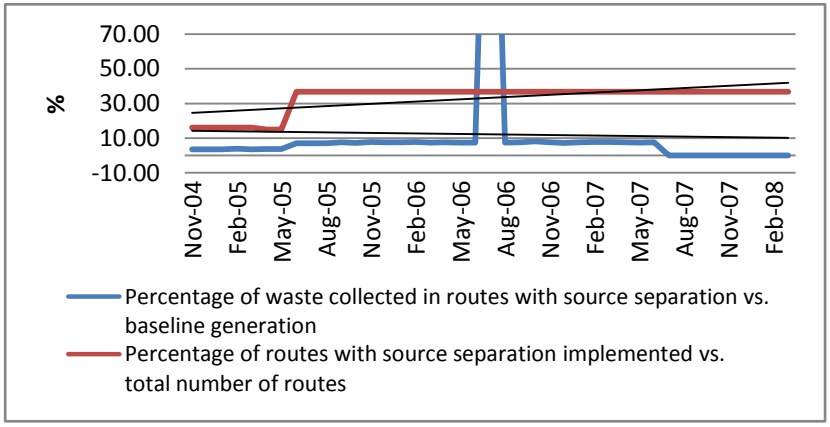
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

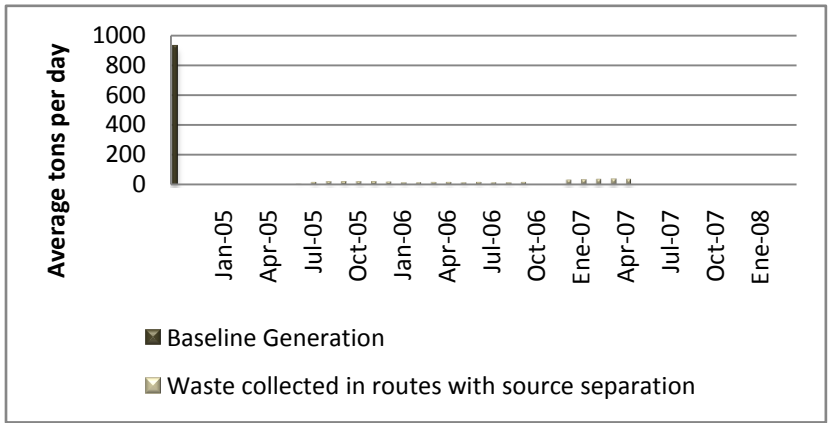


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

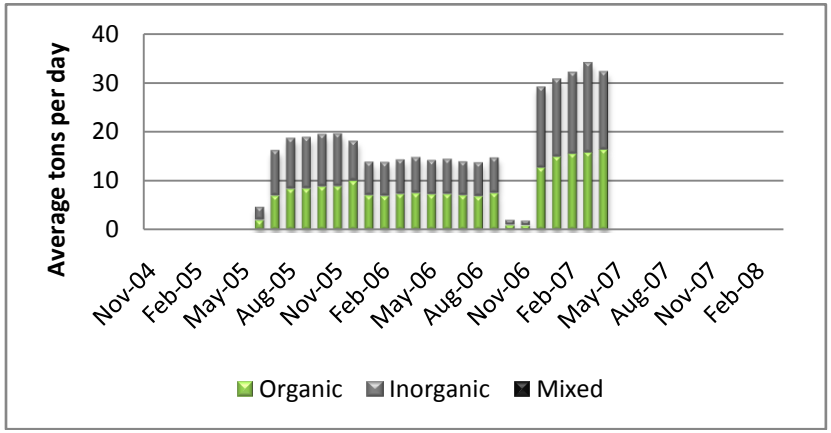


Coyoacan

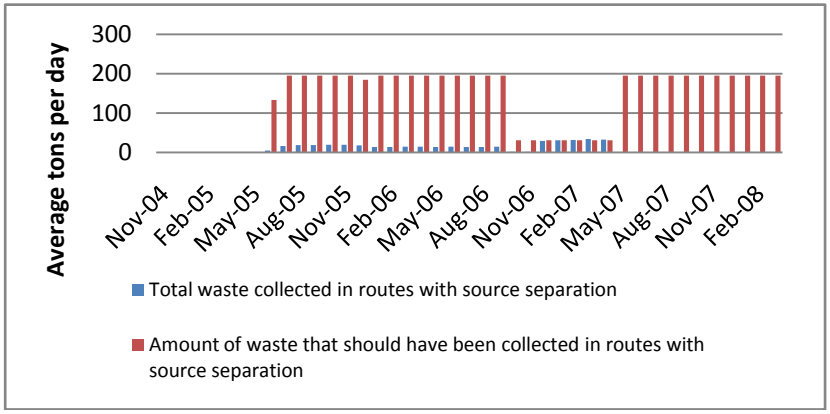
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



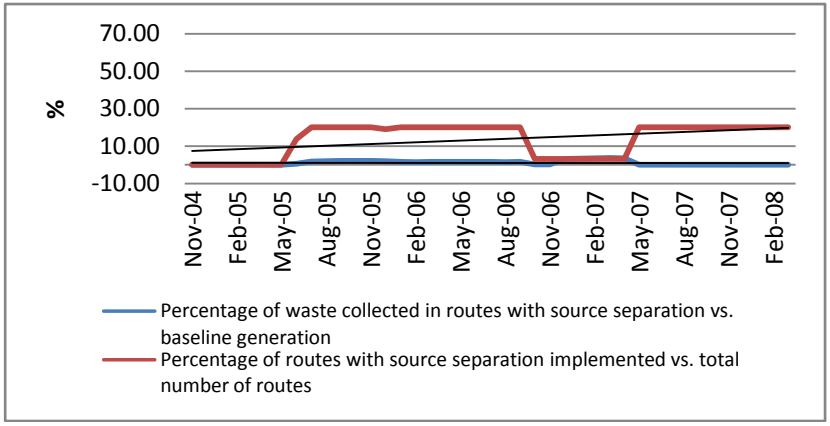
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

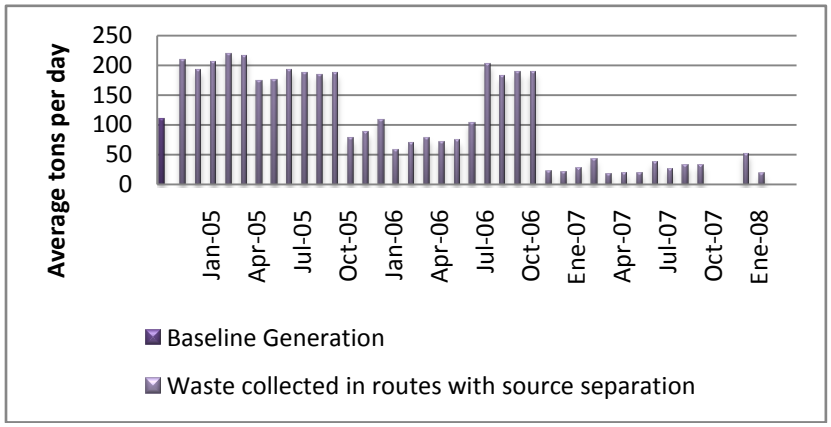


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

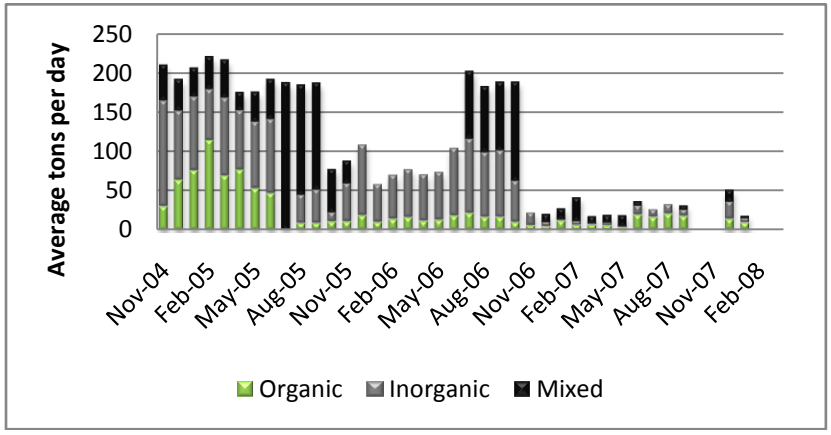


Cuajimalpa

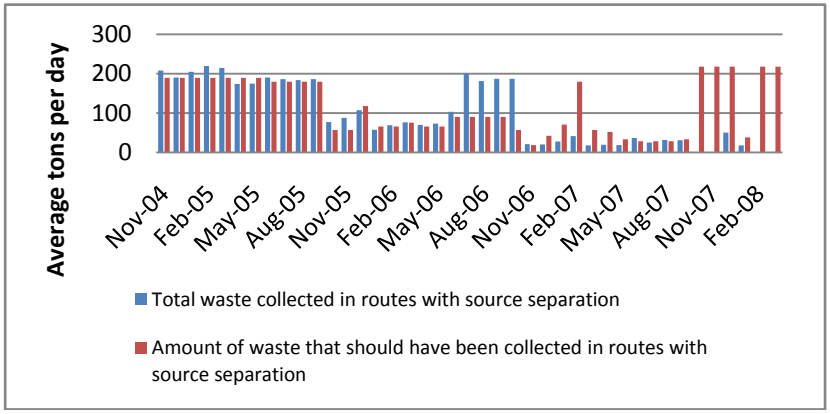
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



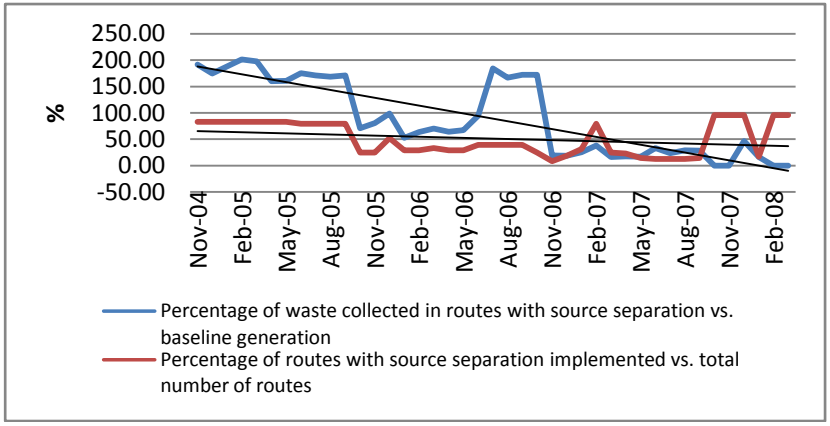
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

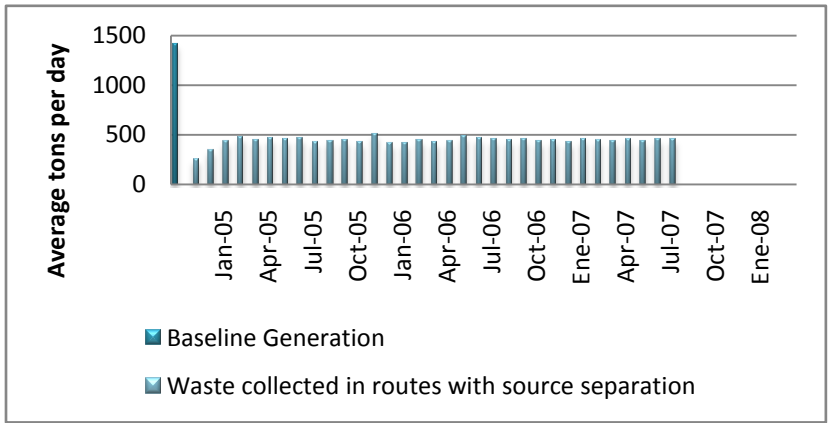


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

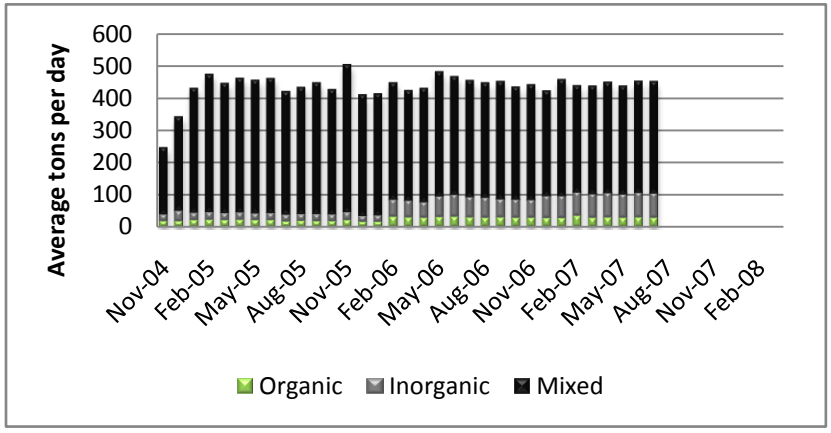


Cuauhtemoc

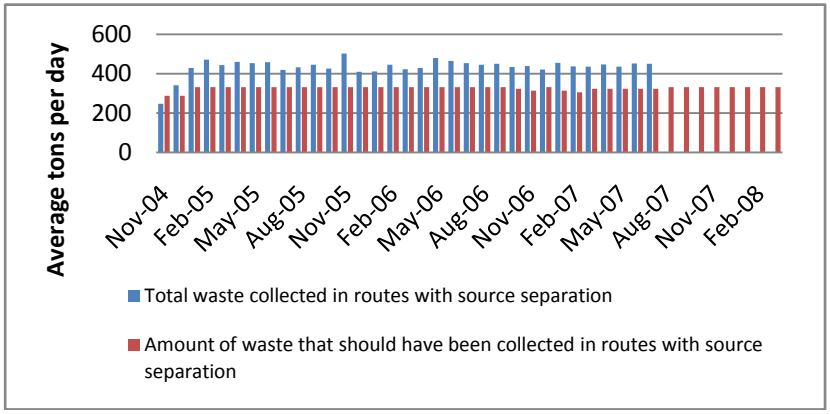
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



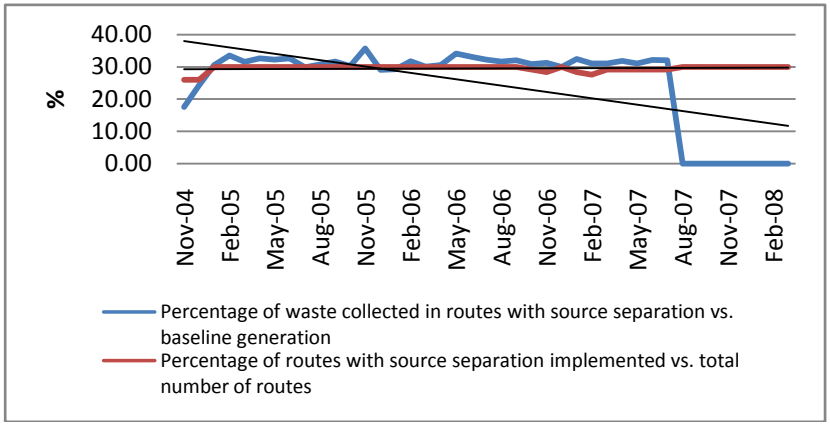
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

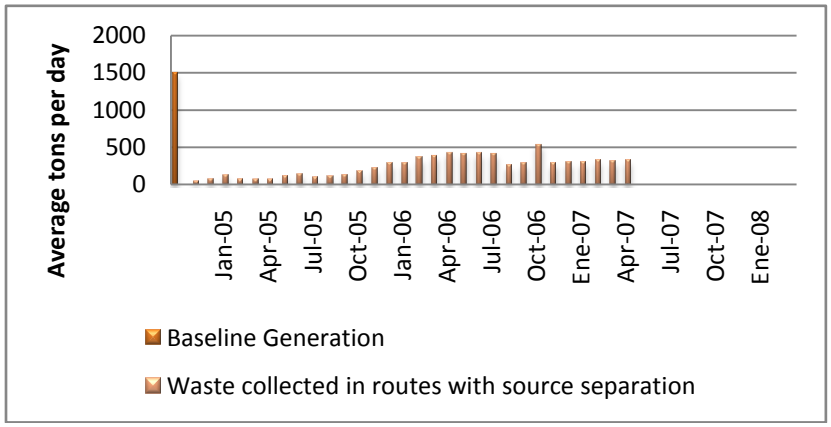


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

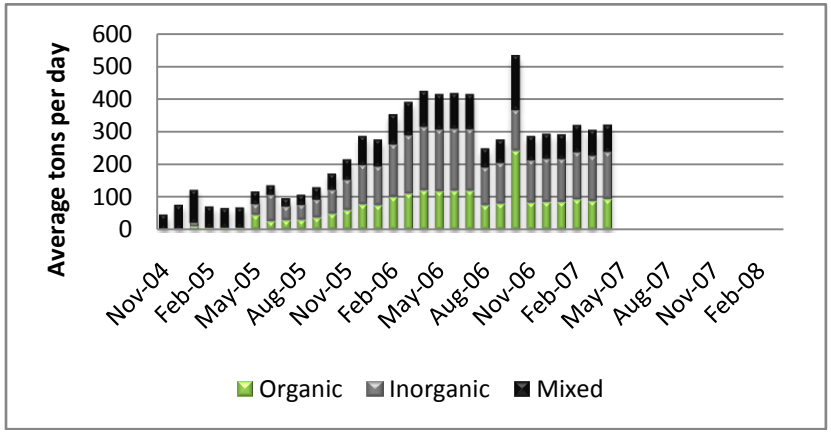


Gustavo A. Madero

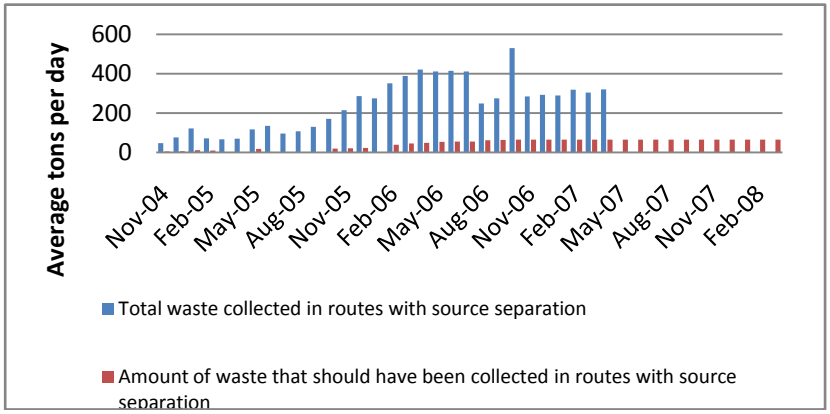
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



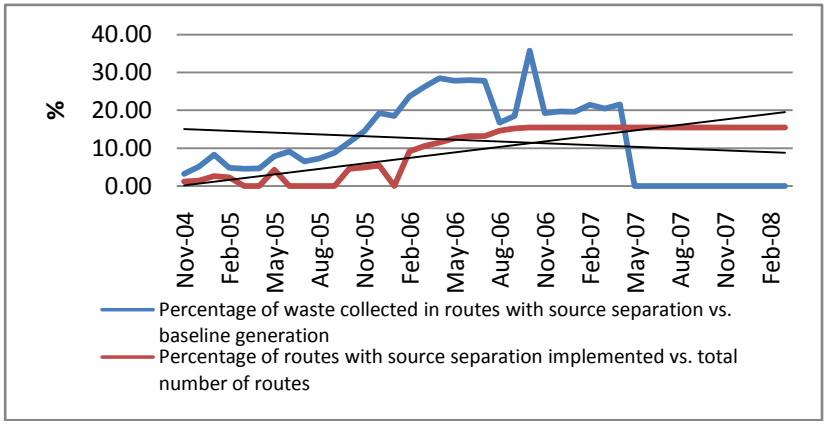
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

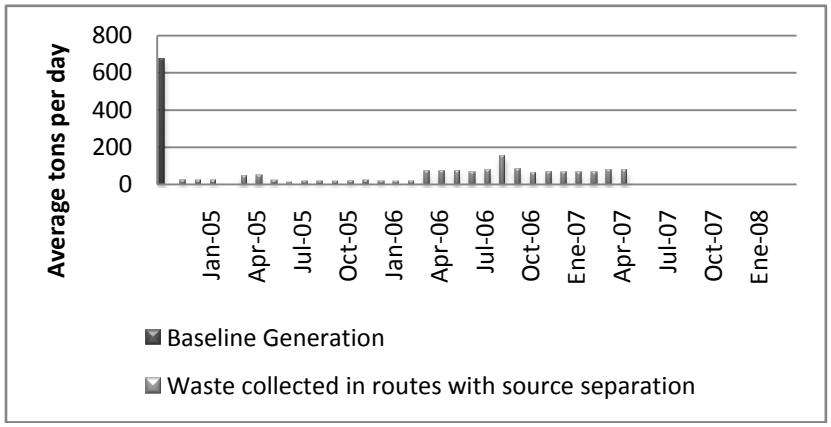


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

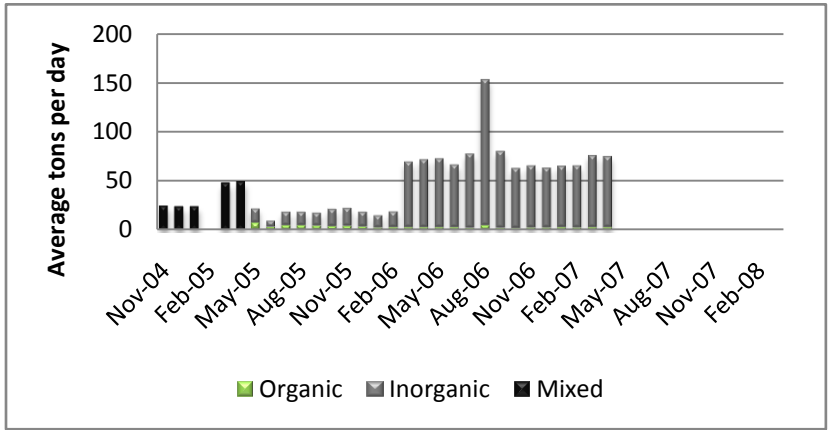


Iztacalco

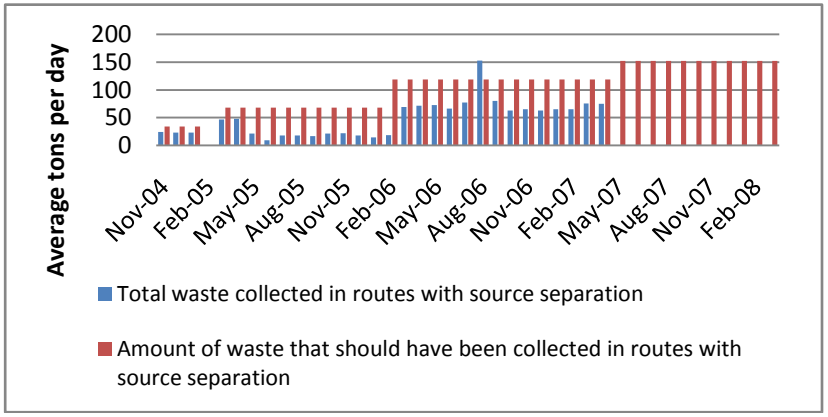
a) Amount of waste collected in routes with source separation and separate waste collection in residential areas



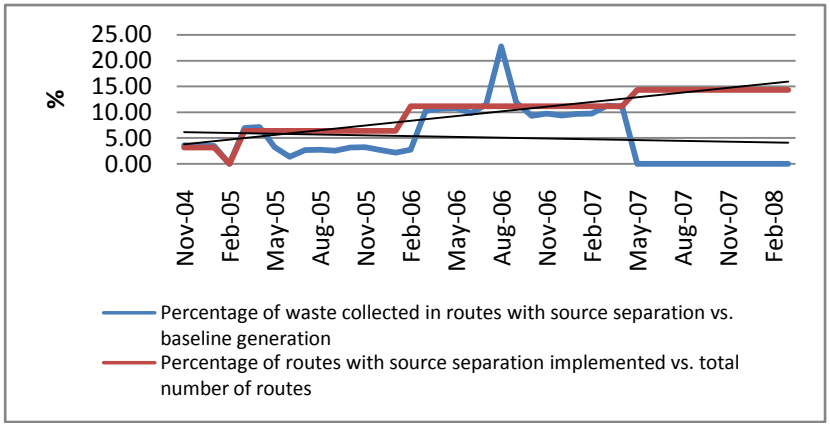
b) Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste



c) Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes

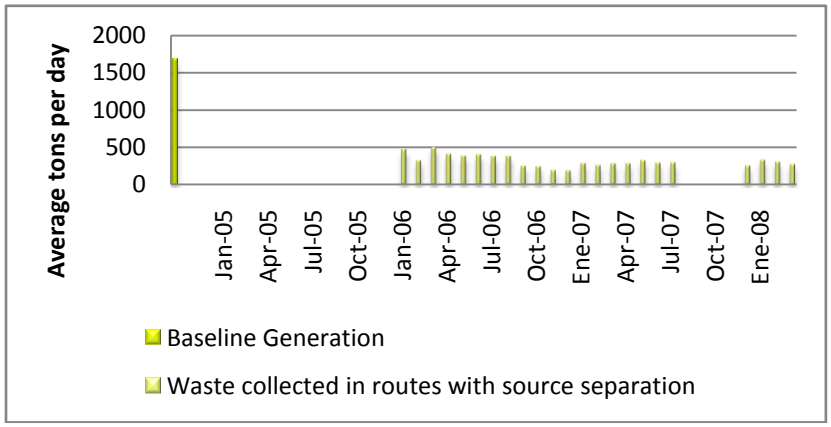


d) Percentage of waste separation vs. percentage in the increase of routes incorporated to the program

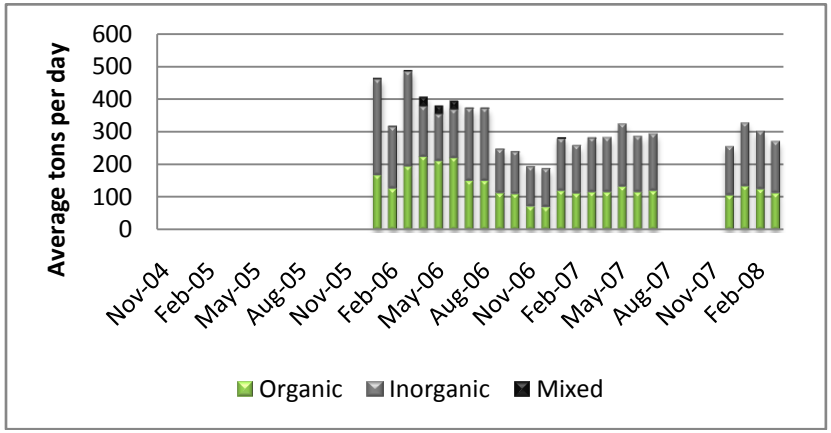


Iztapalapa

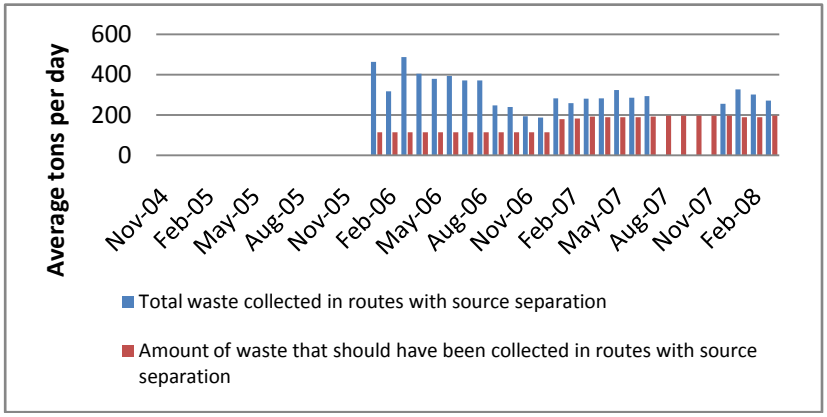
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



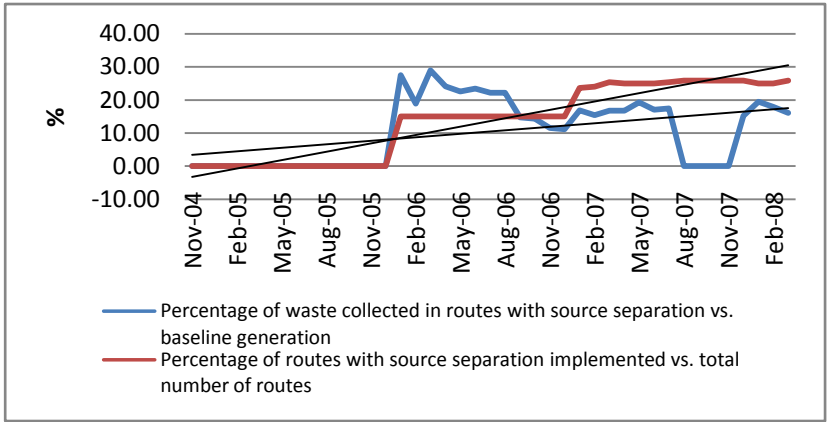
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

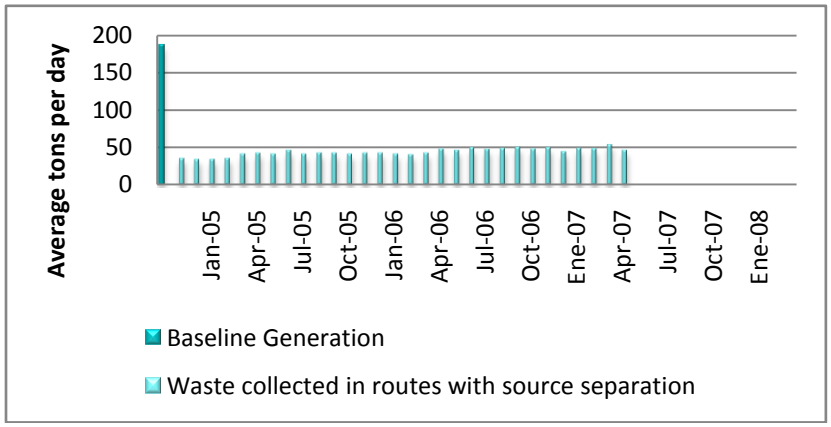


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

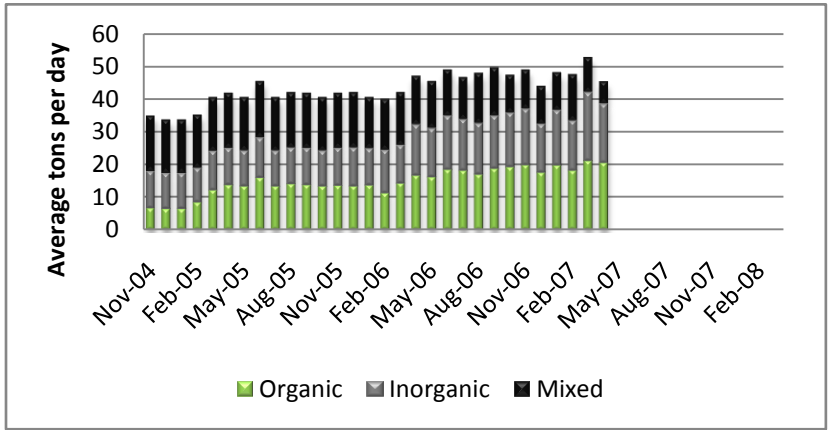


Magdalena Contreras

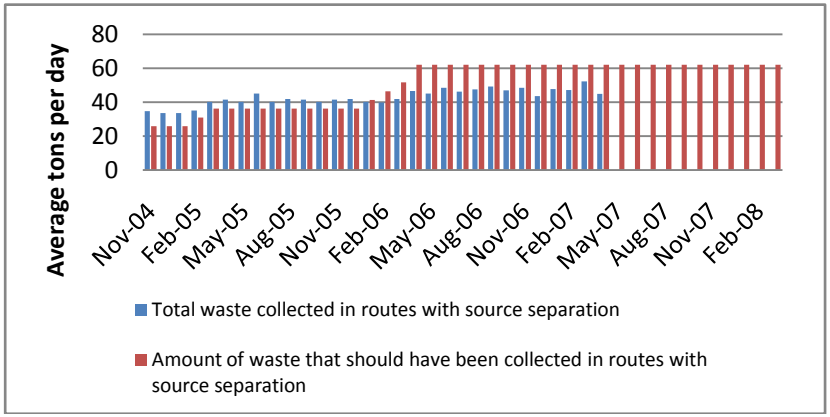
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



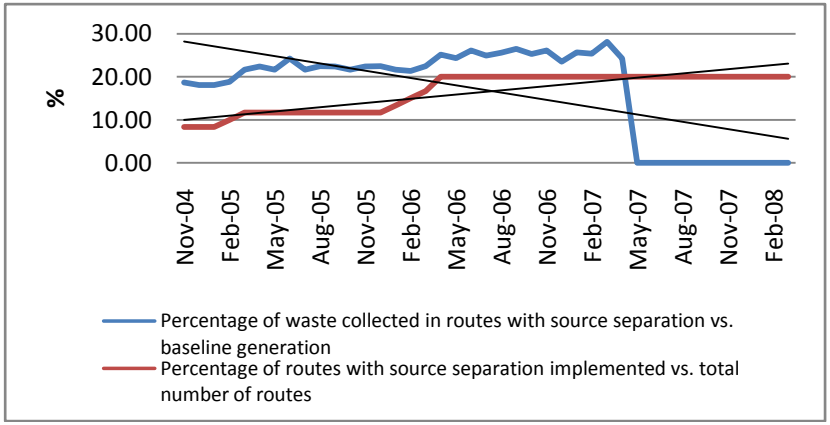
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

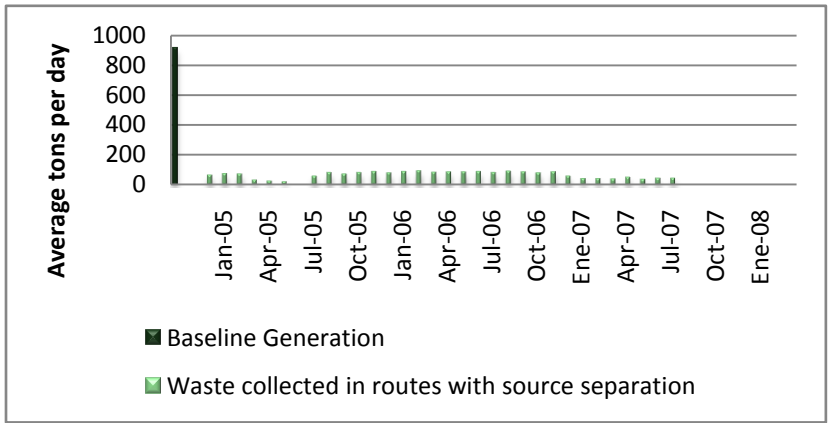


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

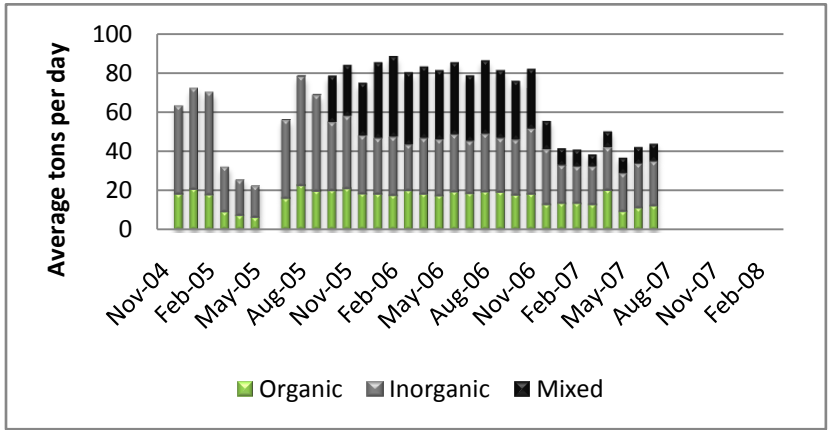


Miguel Hidalgo

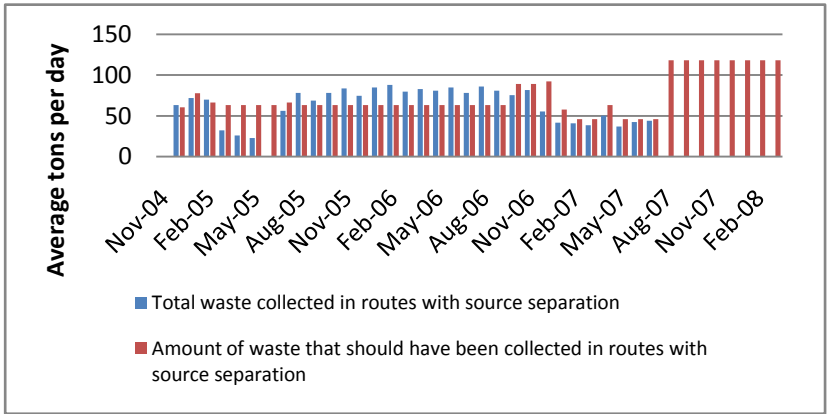
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



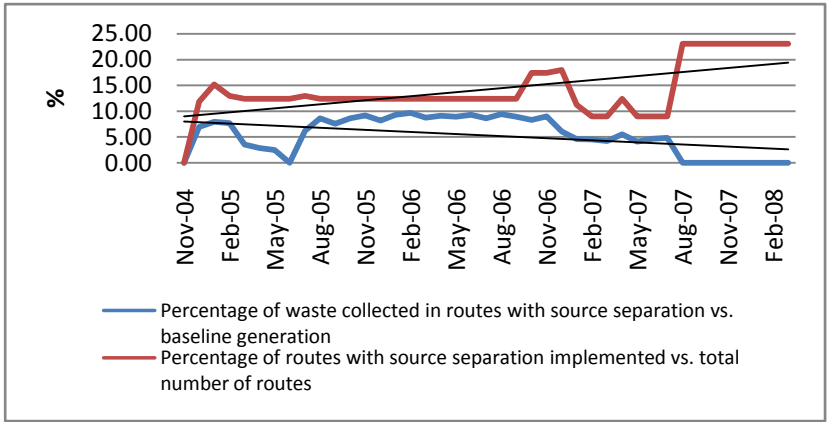
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

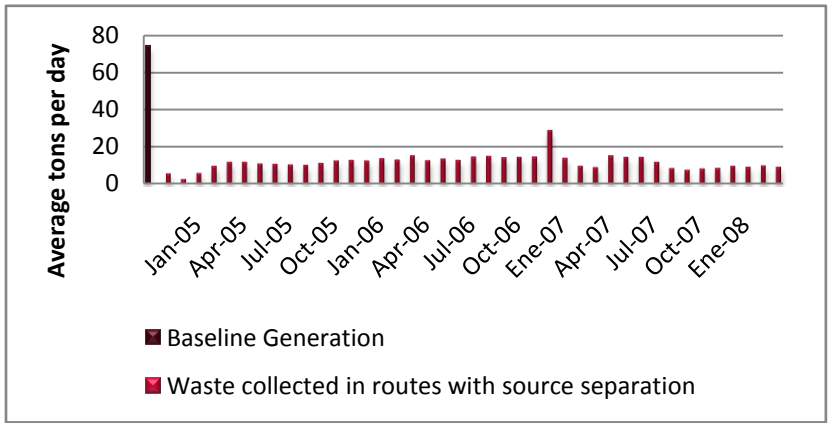


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

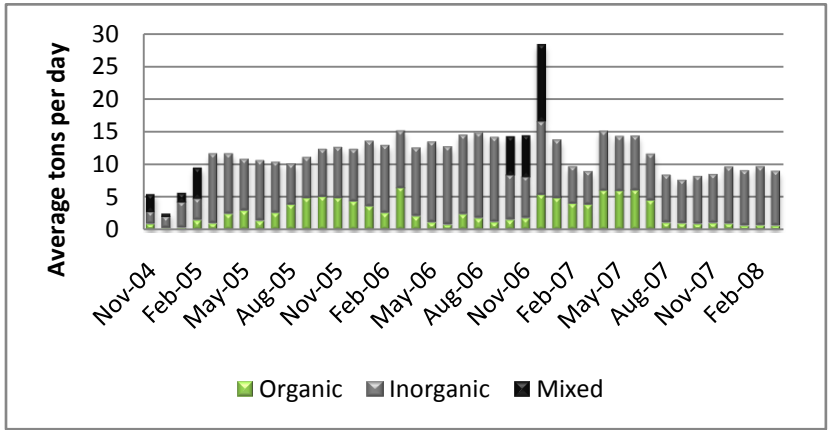


Milpa Alta

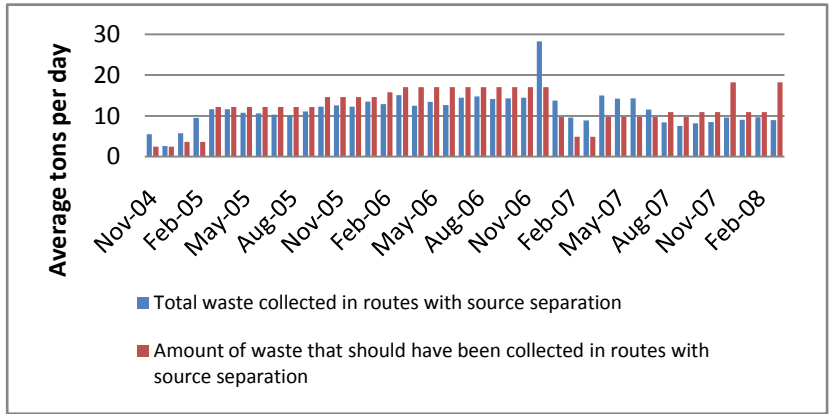
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



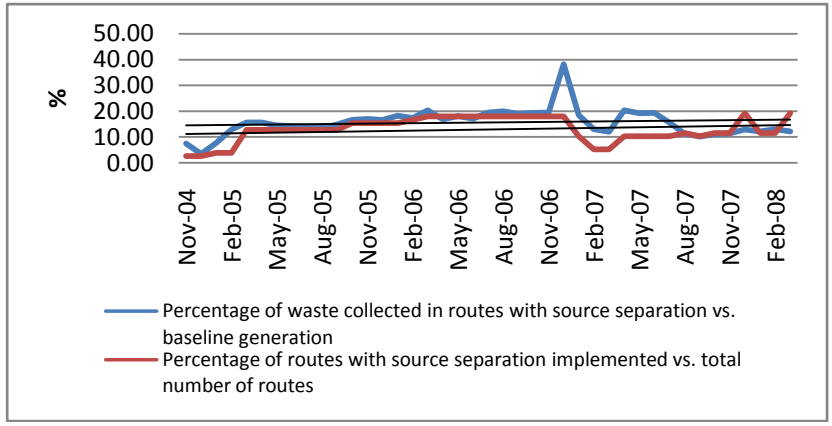
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

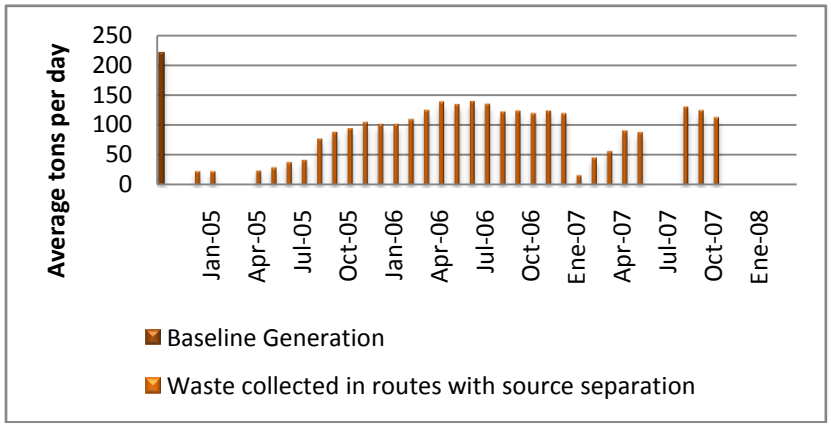


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

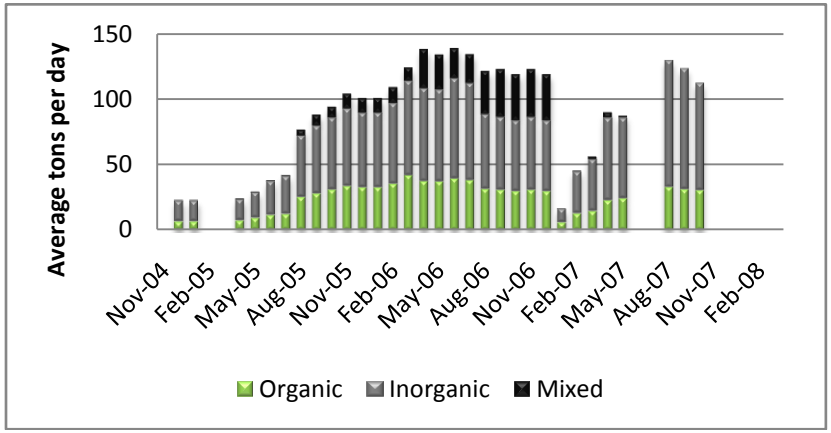


Tlahuac

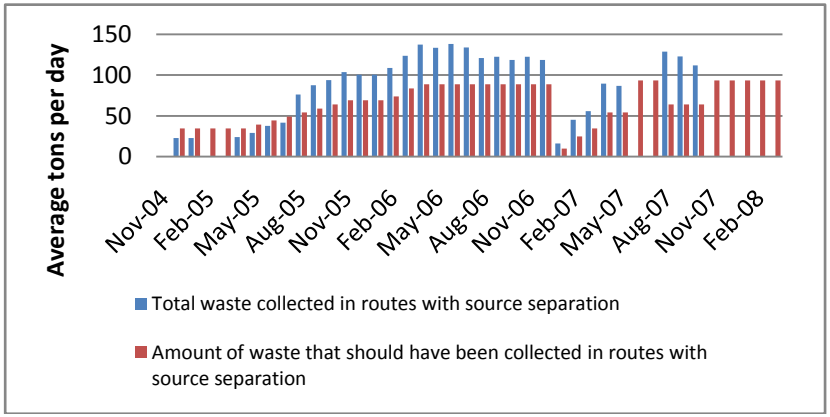
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



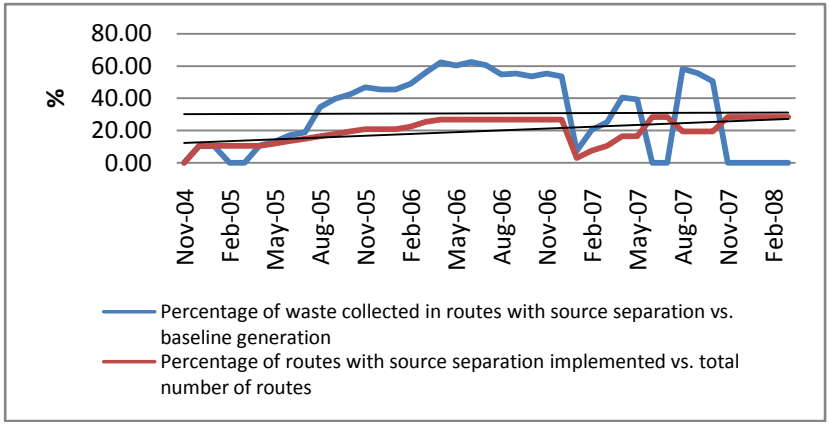
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

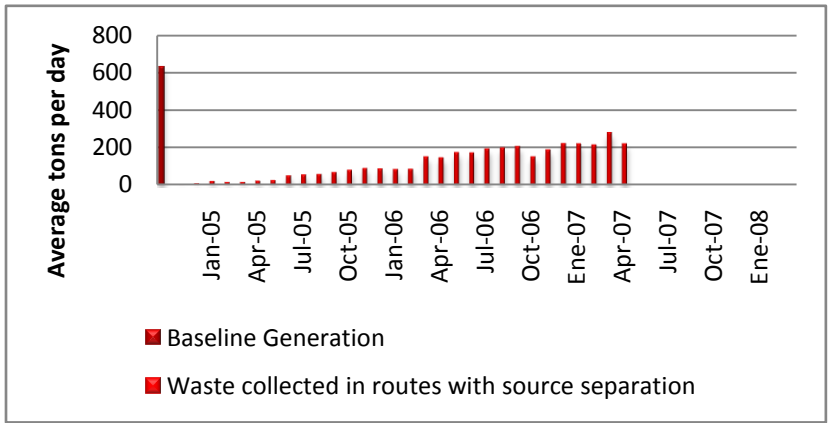


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

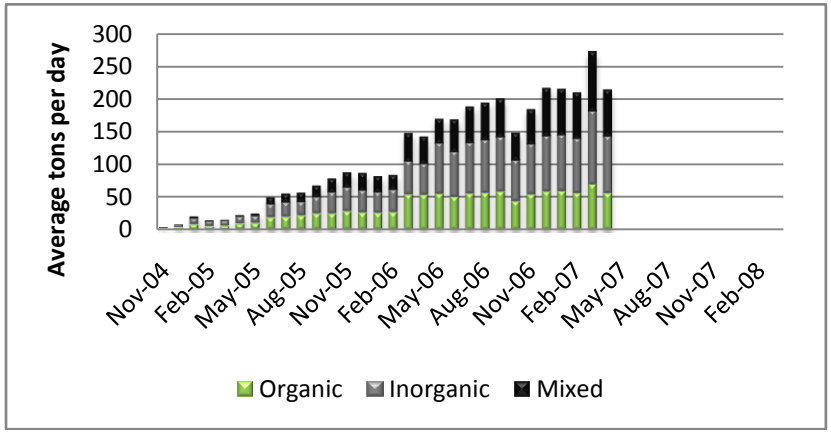


Tlalpan

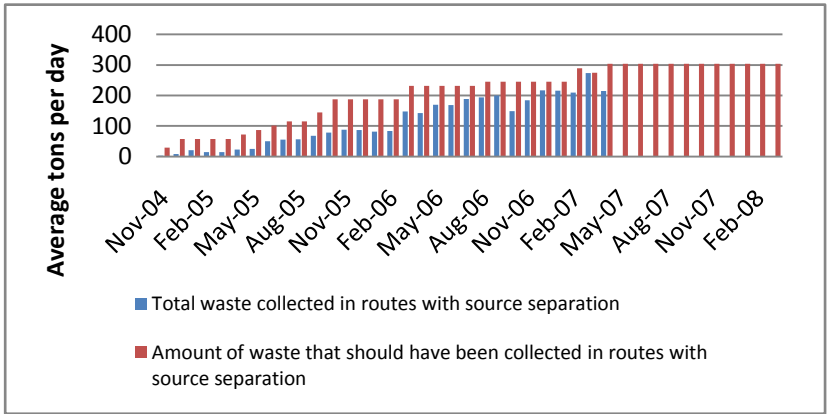
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



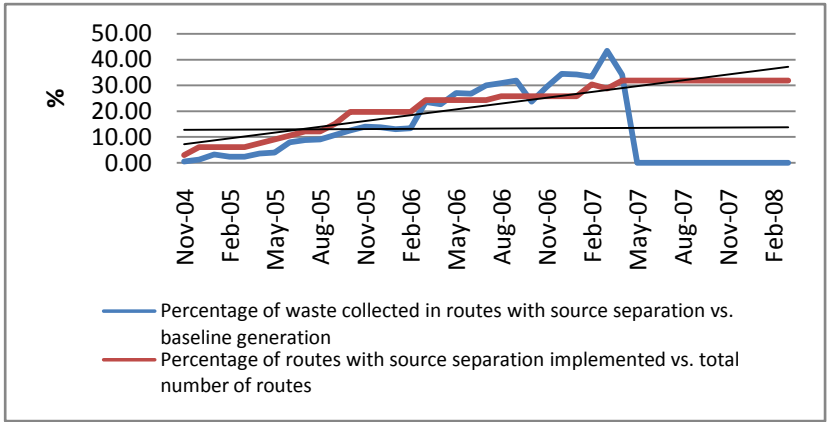
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

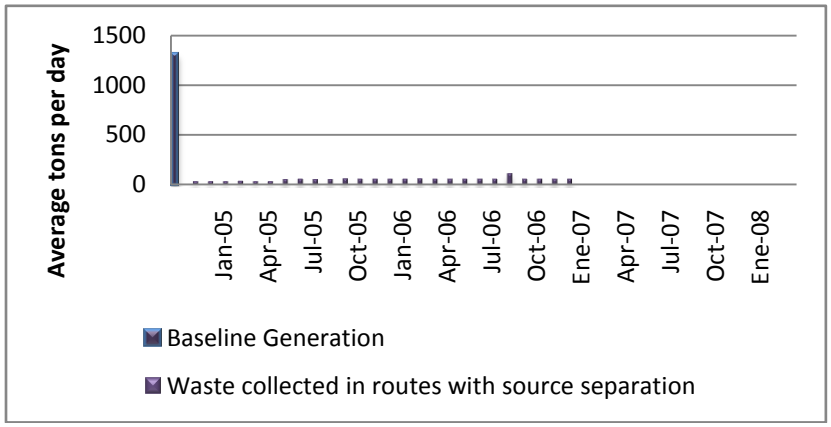


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

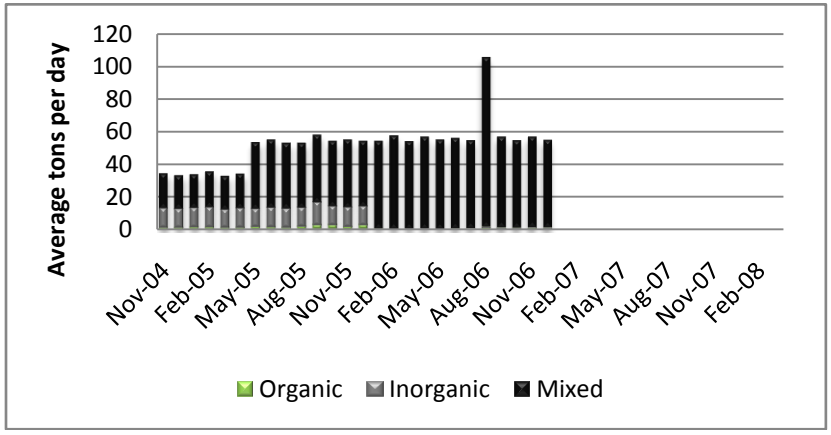


Venustiano Carranza

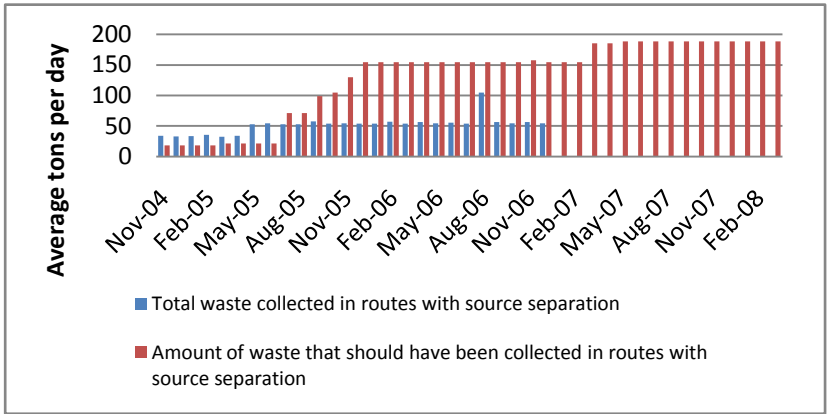
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



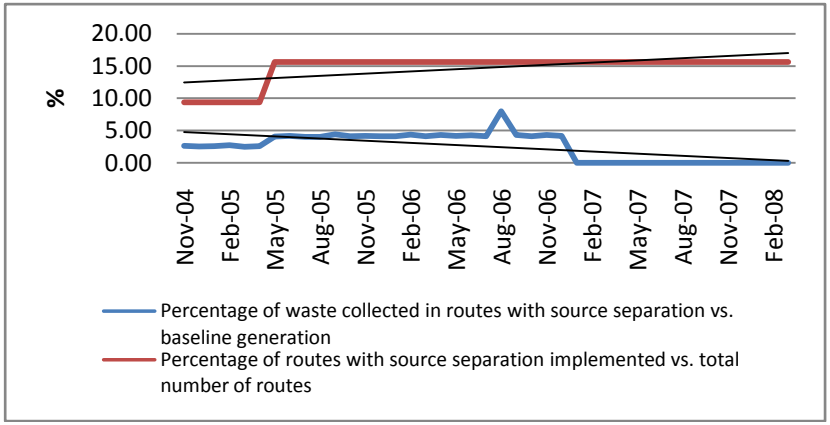
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**

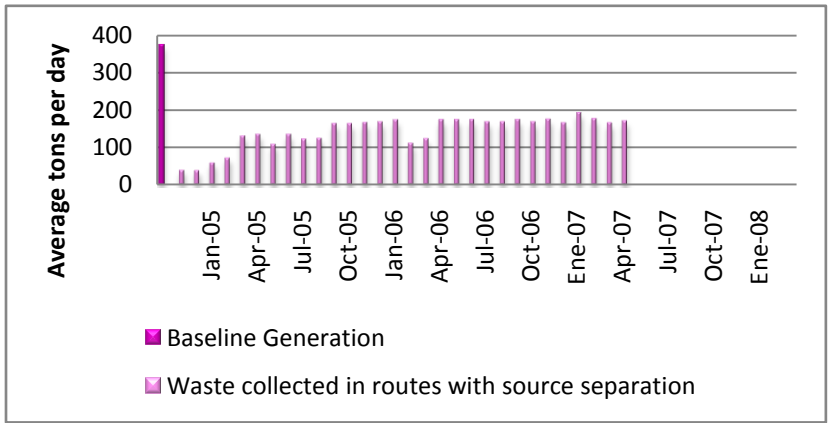


d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**

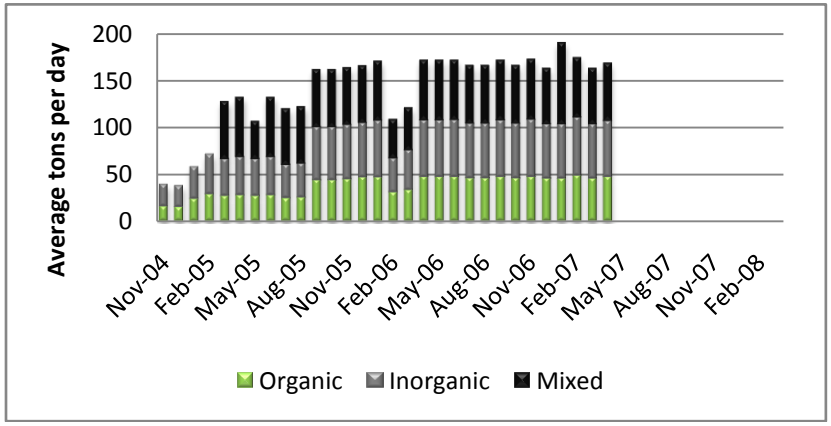


Xochimilco

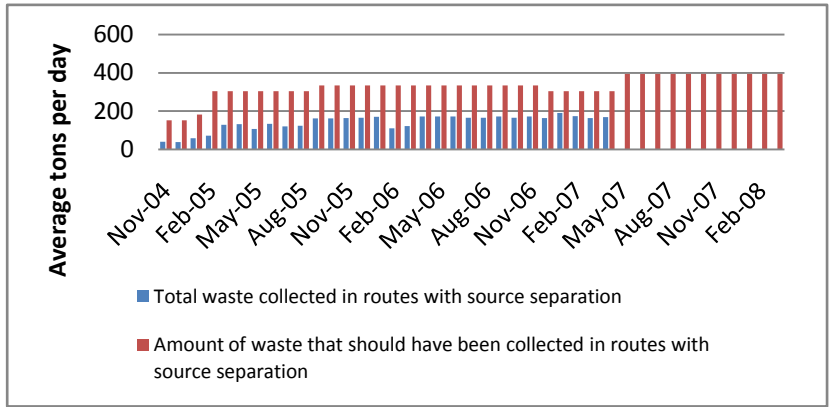
a) **Amount of waste collected in routes with source separation and separate waste collection in residential areas**



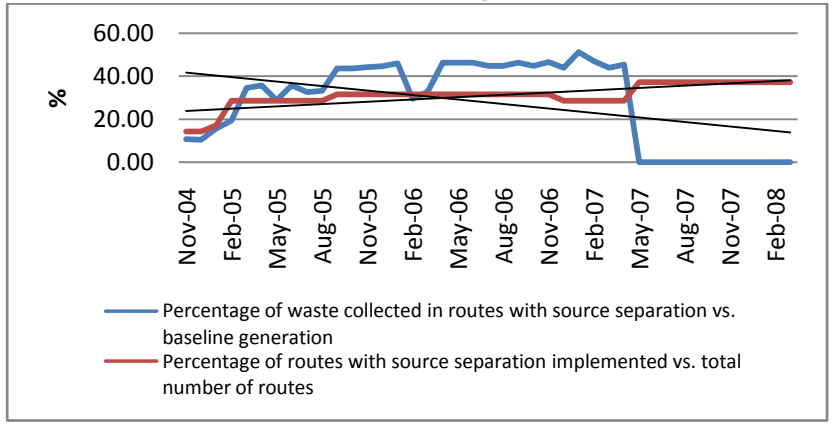
b) **Amount of waste collected in routes with source separation and separate waste collection in residential areas by type of waste**



c) **Amount of waste that should have been collected from routes with source separation and separate waste collection vs. waste that was actually collected in those routes**



d) **Percentage of waste separation vs. percentage in the increase of routes incorporated to the program**



Appendix 6 Performance Indicators for the Federal District's ISWMP

Coverage

It measures the percentage of advance of the implementation of source separation and separate waste collection activities in terms of the incorporation of routes and colonies compared to the total number of routes and colonies.

RT: Rutas o colonies totales (total number of routes or colonies)

RA: Rutas o colonias atendidas (number of incorporated routes or colonies)

COB: Porcentaje de cobertura (percentage of coverage)

$$COB = \left[\frac{RA}{RT}\right] * 100$$

Waste Separation

A measure in volume (m^3) or amount (ton) of the waste collected versus the waste generated expressed as a percentage of advancement.

RO: cantidad de residuos orgánicos (organic waste collected)

RI: cantidad de residuos inorgánicos (inorganic waste collected)

RST: cantidad de residuos recolectados selectivamente (total waste collected in routes with source separation)

$$RST = RO + RI$$

RGT: residuos generados totales (total waste generated)

SEP: avance en la separación y recolección selectiva (percentage of advance in source separation and separate waste collection)

$$SEP = \left[\frac{RST}{RGT}\right] * 100$$

Reduction in final disposal

This measurement allows the evaluator(s) to determine whether the dispositions of the PGIRS are effective or not. It measures the reduction in volume or amount of waste disposed of daily.

RDF: residuos que llegan diariamente a disposición final (daily amount of waste that requires final disposal)

RET: residuos que ingreasn diariamente a estaciones de transferencia (daily amount of waste that enters waste transfer stations)

RSPC: residuos que constituyen el rechazo diario de las plantas de composta (daily amount of waste rejected from composting plants)

RSPS: residuos que constituyen el rechado diario de las plantas de selección (daily amount of waste rejected from selection plants)

$$RDF = RET + RSPC + RSPS$$

RED: reducción del volumen en disposición final (reduction of waste that requires final disposal)

RDF_{actual}: volumen actual promedio de disposición (current average disposal requirement)

$RDF_{inicial}$: volumen línea base de disposición estimada en el 2003 (baseline average disposal requirement estimated in the year 2003)

$$RED = \left[\frac{RDF_{inicial} - RDF_{actual}}{RDF_{inicial}}\right] * 100$$

Waste management plans

This indicator measures the increase in the percentage of waste monitored with the waste management plans from great generators, generators of special waste, and waste manegement service providers.

RCP: incremento porcentual de volumen (percentage of increase in volumen or amount)

G_i: generación reportada al inicio del periodo (generation reported at the begining of the period)

G_f: generación reportada en la actualización anual de los datos (generation reported in the yearly update of data)

$$RCP = \left[\frac{G_i - G_f}{G_i}\right] * 100$$

Afterword: Reflections on the research process

This research process consisted mainly of two data collection periods. Neither went smoothly. The first part of the research was the collection of hard data published in the Federal District's Secretariat on Environment's official web page. Although it may seem that downloading data from a site and inputting it in a spreadsheet should be straightforward, it was not. First of all, there is not really a way of downloading the data. The copy/paste commands for the PC can be used to obtain these data. However, the database format the Secretariat uses has several programming errors that show up when copying the information. Therefore, many of the data had to be copied entry by entry into a new spreadsheet.

The second problem I encountered with the database is how slow the updating process is. The first time I copied information from the site was in November or December 2008. At the time, there was no data reported for that particular year. Having information that ran only from November 2004 to December 2006 would have made the evaluation process really hard. I decided to wait a few months. When I did my final data collection in April 2009, more information had been placed in the database, but it was still not complete[12].

The second part of this research was made possible thanks to the collaboration and openness of the interviewees associated with the ISWMP. Never for one moment did they hesitate in allowing an interview when they learned what the purpose for this was and the subject that was being addressed.

Sadly, the same cannot be said of the authorities of the Federal District's government. When the researcher asked a former chief of the Department of Regulation and Environmental Management of Water, Soil, and Waste, for 25 minutes of his time his reply was a negative. He

[12] I mention this in case any of the people involved with the publication of this database read this thesis; they might try and improve the situation

reported that his new responsibilities forbid him from discussing any prior work he had done for the Federal District's government.

Concerned that this might be an issue with other prospective interviewees I decided to review current Organic Laws on the matter. I couldn't find anywhere in the current legislation anything that would forbid a public servant from discussing work done in previous appointments. Unfortunately, in Mexico decision makers sometimes decide to take up an issue during their administration for political reasons, but not because of real commitment to the cause or issue. It is possible that factor was operating in this case. Sadly, in Mexico this is still very common and is just one of the reasons why policies or programs never go as far as they could in changing the current situation.

Lack of cooperation from other government officials was also evident. I solicited information that I am aware of because of my former employment that is currently not available in any publication or on the official web page, but that is available to people involved in the Federal District's Integrated Solid Waste Management Program. Although I sent four emails to them requesting this data, I did not get any sort of reply in response or acknowledgement.

As I mentioned in Chapter 3: Methodology, part of the research process included following the news and publications related to waste management issues in the Federal District. It became very frustrating to realize that the problems related to the management of waste in the Federal District are still the same as they were five years ago. It seems that little or nothing has been done to address them.

In retrospective, I must acknowledge that this research did not go as deeply as I envisioned while writing the first draft of my research proposal. Time constraints and lack of availability of certain information made it hard for me to perform the third part of the research that I originally intended. Fully assessing the sustainability of the program would have given me greater insight into

how much this particular program aids the Federal District in achieving sustainable development. Integrated Waste Management in general is viewed as an aid in achieving sustainable development. However, if wrongly applied, it can lead to problems such as air, water and soil pollution. It would be interesting to pursue this as further research on the topic.

In general, although the data collection and field work were challenging, the research process was a great experience. It has not only been an academic learning process, but a process of self knowledge as well. I now know how far I am willing to go to finish what I start no matter which hardships I encountered along the way. I have also learnt that, although this thesis hopefully proves that I am capable of doing good research, my interests lay in practical applications of the research. I did enjoy these two years of gaining new knowledge, and new insights into already known issues, but I am now looking forward to getting back in the working world and share it.