

An Integrated System of Waste Management in a Developing Country

Case Study: Santiago de Cali – Colombia

by

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## **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.

## **Acknowledgements**

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## **Abstract**

The government of Colombia has implemented programs to reduce waste and manage refuse more sustainably. Knowledge obtained from the Multifamily Recycling Program (MFRP), created to address recycling in multi-family dwellings within the city of Santiago de Cali, Colombia can be applicable to cities in similar countries that include active participation of recyclers, the community and private waste companies. This study adopts both qualitative and quantitative approaches, where direct field observations and face-to-face interviews were undertaken with key informants' stakeholders in solid waste management. 100 questionnaires surveys were carried out with recyclers, condo managers and residents. Condo participants were chosen as representatives of each socio-economic group (high, medium, and low strata) and were selected from all areas of the city. The MFRP was assessed according to the Integrated System Waste Management (ISWM) framework, considering environmental, economic and social aspects. Environmentally, the program aimed at reducing waste and extending the life of the landfill. Most participants (98%) surveyed, are aware of the environmental benefits generated by the MFRP, and most residents (86%) sort waste within their dwellings and prefer using grocery bags to dispose of recyclables. Condominiums surveyed (88%) have adequate room for garbage and recyclables storage. Recyclers also, receive economic benefits from all levels of government and private companies, plus recognition, support, job creation and poverty alleviation. On the other hand, (76%) of the managers and (74%) of the residents participants agreed that recyclers are not accepted as condo staff. Socially, the MFRP has benefitted recyclers and their families, with training on social, environmental and technical aspects.

In conclusion, the MFRP is an excellent example of waste management planning and can serve as a model for other cities in developing countries. The goals set by the MFRP can be achieved by increasing advertising and educational campaigns; creating an entity to lead, effectively planning and permanently monitoring the program.

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## Acronyms

CVC	Corporation Autonoma Regional del Valle del Cauca- Autonomous Regional Corporation of the Valle del Cauca
DAGMA	Departamento Administrativo de Gestion del Medio Ambiente- Administrative Department for Environment Management
DANE	Departamento Administrativo Nacional de Estadistica – National Administrative Statistics Department
DAPM	Departamento Administrativo de Planeacion Municipal – Municipal Administrative Planning Department
EMCALI	Empresas Municipales de Cali –Cali’s Municipal Water Service Company
EMSIRVA	Empresa de Servicios Publico de Aseo de Cali- Solid Waste Municipal Service Company
MAVDT	Ministerio de Ambiente, Vivienda y Desarrollo Territorial – Ministry of Environment, Housing and Territorial Development
PGIRS	Plan de gestion Integral de Residuos Solidos- Plan for the Integrated Management of Solid Waste
POT	Plan de Ordenamiento Territorial – Land Use Planning

## **Chapter 1**

### **Introduction**

People always generate waste through their daily activities. Collection and disposal of this waste have always been a major concern of societies, due to economic, environmental and health reasons. With today's rise in population and levels of consumption, the amount of solid waste is growing, increasing the demand for new waste disposal facilities, including more landfill capacity (Suttibak and Nitivattananon, 2008). Solid waste must be well managed so as to reduce risks to the environment and health (Salha and Mansor, 2006).

The composition of waste varies according to the level of economic development of the individual country. Developed countries tend to generate more waste than developing countries (Statistics Canada, 2005). Industrialized countries produce domestic refuse with more paper, metals, plastics and other synthetics, while the domestic refuse of less- developed countries is primarily organic.

Many countries in the world are engaging with an effective waste management program that provides security and economic management to their municipal solid waste. In developing countries, there is an increasing concern about the deficiencies of solid waste management, and recently, many of the problems in waste management have started to be addressed. In the management of municipal solid waste (MSW), reduction, reuse and recycling are considered priorities (Al-Khabit, Arafat, & Basheer, 2007). Recycling is widely recognized as a sustainable municipal waste management method for local authorities, because of its potential to reduce disposal costs and waste transport cost, to prolong the life spans of sanitary landfill sites and to help conserve valued resources (Suttibak and Nitivattananon, 2008). In developing countries recycling is a common practice undertaken by low-income people known as informal recyclers (Medina, 2000). As well, recycling waste creates livelihood for the recyclers in terms of employment and business opportunities (Salha& Mansoor, 2006).

This research focuses on the domestic solid waste generated by households including residential single-family homes, duplexes, town houses, and apartments in condos, in Santiago

de Cali, Colombia<sup>1</sup>. The location of Santiago de Cali, Valle del Cauca and Colombia are shown in Figure 1; the black area shows the Department of Valle del Cauca<sup>2</sup> in Colombia; the blue area represents the municipality within of the department and the red area shows the location of Colombia within the American Continent.



**Figure 1.1 Geography location of the Municipality of Santiago de Cali, Colombia and South America**

Source: <https://www.pinterest.com/ncisneva/colombia/>

Cali, the third largest city in economic importance in Colombia, was one of the first cities in Colombia to face severe waste disposal problems and social conflicts linked to recycling. In 2006, when the Navarro landfill reached its capacity and was closed after fifty years of operation, various social and financial crises arose. For one thing, families who supported

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<sup>1</sup> Colombia is a developing country located in the North- West corner of South America (Figure 1). Colombia in 2005 presented a population of 42,888,594 inhabitants and the projection to 2015 is a population total of 48,143,196 inhabitants (DANE, 2012).

<sup>2</sup> Colombia has 32 Departments (Departments are country subdivisions and are granted a certain degree of autonomy).

themselves as informal recyclers could no longer do so. The city's official waste management service (called EMSIRVA) had no place to dispose of the garbage generated daily and there was also inefficient financial management as well as an ineffective service. All these problems led to the liquidation of EMSIRVA by the Superintendent of Public Services<sup>3</sup> on November 2006 (Perilla, 2013; Superintendencia de Servicios Publicos –SSPD 2013,).

In 2006, the municipal government in Cali following the national legislation implemented a Waste Management Plan Program called the Plan de Gestion de Residuos Solidos–PGRS [in Spanish] over a period of fifteen years. The Plan was focused on sustainable strategies and established that waste needs to be regarded more as a resource, and its management needs to be environmentally effective, economically affordable and socially acceptable. In 2008, a new landscape started as the city began to export its waste to a new regional sanitary landfill located in Yotoco, another municipality within the province of Valle del Cauca<sup>4</sup>. Additionally, the city organized a new waste management service and hired four private waste management companies to provide 100% coverage in the urban and rural areas. These measures have subsequently addressed both the financial and social crises of the city (Alcaldia de Santiago de Cali, 2009). However, in 2009, the waste management plan (PGRS) approved for Cali created a radical change because the city needed to meet the obligations imposed by the national government through resolution T-291, which was passed in response to the action taken by 3207 recyclers who appealed for the right to work. The resolution T-291 imposed to the local government, the regional, and the local conservation authorities (CVC and Dagma respectively) the hard task of converting recyclers into entrepreneurs' recyclers<sup>5</sup>. The first action in response to the sentence T-291 began with a program of attention to the 660 Navarro's recyclers and their families, because they lost their work area. The program included a census, training, health services, recreation and education (Interview Conservation authority- CVC, 2013).

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<sup>3</sup> SSPD is a Colombian entity that monitors and controls the delivery of public services, protects competition and the rights of users

<sup>4</sup> Colombia is a unitary republic administrative and politically divided into provinces, municipalities and towns. The province of Valle Del Cauca is one of the most important in the country by its economic development and population. It is located in the southwestern side of the country and its capital is Santiago de Cali.

<sup>5</sup> Sentence T-291/09 Summary in appendix D

The planning process in the city identified in the 70s as the period in which intensive construction of multifamily residences, or condominiums, began. The main factors generating the planning transformation in Cali are diverse, such as: the influence of modern urban design, intensified land use and increased value per square meter in the city, increased crime and need to reduce insecurity. The majority of the condos in Cali are located in the south, the north and west sections of the city. The reasons why Cali' citizens prefer to live in condos include security, cleaning, recreation, quality of public services, good access roads, proximity to malls and universities, and social status. In 2006, approximately 25% of the total population of the city lived in condos, around 1300 units divided between the socioeconomic strata 2,3,4,5 and 6 (Maldonado et al., 2007).

The use of incentives in environmental management has gained more acceptance in the last decade worldwide. The multi-user pricing system known as Pay- As-Your- Throw (PAYT) or Pay-By-Use (PBU) is an economic incentive aimed at reducing solid waste generation and increasing the separation of waste at source. In Colombia this incentive is being implemented in several cities such as Bogota, Medellin and Cali. The philosophy of this system is based on the idea that individuals pay for the collection of municipal solid waste as a group of dwellings, or condos, instead of individually based on the amount they throw away and not for a fixed rate.

Proper legislation, coupled with education and intensive householders' participation, a well-planned and well-implemented recycling program have been very successful at reducing waste and cost generating great environmental, social and economic benefits. In Cali, efficient planning and waste management programs with active community participation could greatly assist in helping to solve the problems of waste management; at the same time, provide benefit to the environment and to the local economies.

## **1.1 Purpose**

The purpose of this thesis is to assess the current Multi-Family Recycling Program (MFRP) in the urban area of Santiago de Cali, Colombia within a framework of an Integrated System of Waste Management (ISWM); and the pillars of sustainability that includes economic, social and environmental aspects. The main objectives of this thesis are:

- To describe, analyze and evaluate the multifamily recycling program of Santiago de Cali according to an ISWM framework (environmental, economic and social aspects)
- To describe the participation of recyclers in the MFRP

- To determine whether the existing system can be refined so as to maximise the amount of household waste recycled and to minimise the amount of waste disposed of in landfills.
- To determine whether the Multifamily Recycling Program can be replicated in other municipalities with similar characteristics.

## **1.2 Research Questions and Objectives**

The main research question pertains to the potential for integrated planning and management of municipal solid waste in developing countries, and in Santiago de Cali in particular:

### **How well does the multifamily recycling program in Cali, Colombia correspond to the ISWM framework?**

This question will be clarified by answering the following sub-questions:

- What are the main characteristics of the multifamily recycling program in Cali?
- How well does the program meet the criteria of economic affordability, environment effectiveness, and social acceptability, the three pillars of ISWM?
- What benefits does this program offer to the community and to the environment?
- How well does the multifamily recycling program meet the goals imposed by the National government related to the participation of recyclers in the program?
- How well is the informal sector (recyclers) integrated into the multifamily recycling program in Cali
- Could Cali's multifamily recycling program act as a model for other cities in Colombia and other developing urban areas?

## **1.3 Thesis Structure**

The rest of the thesis is organized into six chapters and five appendices.

Chapter 2: Presents a literature review on several key areas, such as waste definition the implications of solid waste for health, municipal solid waste management (MSWM) and planning in general and in developing countries, sustainable solid waste management, planning models, recycling in municipalities of developed and developing countries and recycling in multi-

residential buildings, the role of the informal sector in developing countries, stakeholders' participation in MSWM, urban management and planning in developing countries.

Chapter 3: Describes the methodology used in this study; it also, highlights the significance and limitations of this research.

Chapter 4: Presents the main characteristics of the country and the city under study including the geography, demographics and economy. An overview of the current waste management in the national and local legislation is also included, and the solid waste management program implemented at national and local levels is summarised. Finally, the reader will find a detailed explanation of the multifamily recycling program locally running in condominiums of urban Cali.

Chapter 5: Provides the findings collected through survey questionnaires, interviews, and field observations.

Chapter 6: Discusses the findings

Chapter 7: Summarizes the results and provides the conclusions and recommendations of this research. It also, indicates directions for future research.



## Chapter 2

### Literature Review

An analysis of the literature relating to waste management and recycling in general, waste management in developing countries, and recycling in multi-family dwellings offers a perspective for the assessment of the multi-family recycling program (MFRP) in this case study.

#### 2.1 Waste definition

Authors writing in the waste management field generally define waste as items that are no longer wanted by the original owner or user, and are thus discarded or abandoned by them (Chandrappa and Das, 2012; Statistic Canada, 2005). On the other hand, several authors have demarcated the term “waste” as a resource. According to Tchobanoglous, Theisen and Vigil (1993) many types of waste have value due to “their intrinsic properties; discarded waste materials are often reusable and may be considered a resource in another setting” (p. xvii). As stated by Flintoff (1984), the term waste is now more important, and it is the basis for developing waste management programs in both developed and developing countries, and concluded that waste disposal philosophy is to undertake to treat all waste as resource material for recycling, source of energy or fertilizer.

Solid waste is often distinguished from liquid waste; the latter term is used to refer to sewage and wastewater. Cointreau-Levine (1994). Tchobanoglous et al. (1993), and Statistics Canada (2005), classified waste into two categories: general and hazardous. They agreed that general waste can be generated in “households, commercial and industrial premises (offices, malls, massive events, and markets), institutions and on the streets”; this general garbage also contains ordinary refuse, organic trash, swill, rubbish and ash. In this thesis only general waste generated by households is considered. While a variety of definitions of the term waste have been suggested, this thesis will use the definition suggested by Tchobanoglous et al. (1993), who defined waste as discarded or rejected solid material, some of which may be considered a resource.

#### 2.2 Municipal solid waste

According to Chandrappa and Das (2012), Municipal Solid Waste (MSW) is a term used to refer to the collection of wastes produced and collected from urban areas. The United States Environmental Protection Agency [US-EPA] (2008) has defined municipal solid waste as: “The materials traditionally managed by municipalities whether by burning, burying, recycling, or

composting” (pg. 5). Memon (2013) specified that MSW has varying definitions in different parts of the world, and these include some or all household wastes, including hazardous wastes; bulky waste; street sweepings and litter; park and garden wastes; and wastes from institutions, commercial establishments, and offices. Haight (1991) argues that MSW is a heterogeneous mixture of both valueless and once-expensive materials, as well as a mixture of biologically inert and hazardous substances.

Troschinetz and Mihelci (2009) argue that MSW is the most complex solid waste stream. MSW can be classified as hazardous or non-hazardous; by the source as residential, commercial, institutional or industrial; and by composition as organic, paper, glass, metal, or plastic (Statistics Canada, 2005; Kaseva & Gupta, 1996; Kreith, 1994). Memon (2013) also incorporated in MSW waste from healthcare services; waste from discarded electronic equipment including computers (e-waste); waste from end-of-life vehicles (ELV); waste from urban agriculture; waste from construction and demolition activities; and from catastrophic events such as urban floods and earthquakes.

### **2.3 Solid waste: Implications for health**

Several authors agree that inadequate collection, recycling or treatment and improper disposal of solid waste pose risks to human health and the environment, because they constitute a source of land, air and water pollution (Al-Khatib et al., 2007; U.S EPA, 2011; Memon, 2013; Unnisa & Rav, 2013; Yousuf, 2014).

The United Nations Human Settlements Programme-[UNHABITAT] (2010 (a)) states that direct impacts upon health, length of life and the urban environment in cities are due to poor solid waste management practices, e.g. uncollected waste in many developing countries. Moreover, inadequate waste collection may accumulate garbage on the streets and clog drains when it rains; also, it could cause flooding and create breeding grounds for mosquitoes. Waste can also affect ecosystems when carried away by runoff water to rivers, lakes, and seas. Implications of buried solid waste for ground and surface water pollution frequently arise, as well as the problems created by pests, particularly flies and rats, have become very serious in many cities of developing countries, affecting not only the environment, but also sanitation personnel, and those who scavenge refuse in dumps and streets. Related, to air emissions, landfills are the largest anthropogenic source (The U.S. EPA, 2011; The world Bank, 2012). Waste collection and transportation activities may generate air pollution, impair the aesthetic value of the natural environment, and increase traffic accidents (Da Silva, Fassa, Siqueira, & Kriebel, 2005).

UNHABITAT, 2010 (a) reported data from Demographic and Health Surveys, which shows significant increases in the incident of sickness among children living in households where garbage is dumped or burned in the yard. Poulsen et al.,(1995), referred to studies conducted in developed countries related to occupational exposures and/or health problems in the waste sorting and recycling industry, and concluded that workers in this industry have an excess risk of work-related health problems such as gastrointestinal problems, musculoskeletal problems, pulmonary diseases, organic dust toxic syndrome (ODTS) symptoms, eye inflammation, irritation of the skin and upper airways; as well as life-long reduction in work capacity and quality of life.

In Europe after the outbreak of the worst public health impacts, the removal of waste becomes one of the top priorities for the public health. This was applicable to both biodegradable and non-biodegradable wastes, which produce disease and affecting sanitary conditions (Memon, 2013). Recently studies related to recyclers' health in developing countries show that the hazards associated with waste contact are inherent to informal recycling. Da Silva et al., (2005) stated that the health risks that have been associated with recyclers include safety hazards (risk from recyclers being hit by traffic); common injuries to workers who handle solid wastes (cuts and punctures by glass, cans and sharp objects). Likewise, ergonomic hazards faced by recyclers walking long distances often pulling heavy carts and in awkward positions as they collect and separate trash and chemical hazards result from contact with hazardous substances found in trash. Parizeau (2015) argues that health risks observed among informal recyclers in Buenos Aires, Argentina comprised of chemical hazards, infections, ergonomic and musculoskeletal damages, mechanical traumas, impacts on emotional well-being, and potential contamination of the living environments by waste materials.

Few studies related to health problems and wastes examine Colombia, and more specifically Cali have been reported. Mosquera and Gomez (2009) found how the health of Santiago de Cali's inhabitants has been affected by methane released into the air without treatment. They concluded that the study participants perceived respiratory health problems as mainly arising from sickening odours emanating from the Navarro landfill. Waste's health impacts can be classified under three categories: direct, indirect and global. Table 2.1. shows the three categories of classification of waste's health impacts and describes shortly each category.

**Table 2.1 Classification of health impacts generated by solid waste**

Direct Effects	Indirect Effects	Global Effects
Refer to risk resulting from routine management or mismanagement of solid wastes.	Occur where solid wastes have been treated as non-waste, such as when particulates from point sources are emitted into the air in uncontrolled burning or inadequate management of gases in a landfill may also pollute the air, generating serious health problems.	Is the worldwide opportunity cost, in terms of human health and well-being, which result from the volume of solid wastes we produce. The challenge of linking over consumption and waste. The problem will be translating new knowledge and appropriate attitudes into behaviour change.

Source: author, content drawn from Hertzman (1991)

#### **2.4 Solid waste management and Municipal solid waste management**

Several authors (Tchobanoglous, et al., (1993); Srivastava, Kulshreshtha, Monanty, Pushpangadan, & Singh (2005)); Jha, Singh S.C, Singh G.P, & Gupta (2011)) have demarcated solid waste management (SWM) as a complex process, due to the changing lifestyles of people, rapid urbanization, and under-estimated contributor and stakeholder roles. SWM should integrate different concerns, including economic, technical, legislative, and social. In other words, SWM involves many technologies, disciplines and components, among which, social components and community participation are key factors in decision-making.

Jha et al. (2011) stated that municipal solid waste management (MSWM) involves planning, engineering, organization, administration, financial and legal aspects of activities associated with generation, storage, collection, transport, processing and disposition, adopting principles of economy, aesthetics, energy and conservation. The World Bank Organization (1996) declared that the general objective of municipal solid waste management (MSWM) is to collect, treat and dispose of solid wastes generated by all urban population groups, in an environmentally and socially satisfactory manner, using the most economical means available. McDougall and Hruska (2000) stated that the objectives of MSWM have evolved from the primary concerns of environmental health protection to considering human safety, resource conservation, and the reduction of, as much as possible, the environmental burdens of waste management (energy consumption, pollution of air, land and water and loss of amenities).

## 2.5 Waste and municipal waste management in developed and developing countries

Distinct differences have been identified in the literature between MSWM in developed and developing countries. MSWM over the years has been undertaken with many drivers worldwide. In most developed countries, public health is no longer the major driver of waste management; the current focus is on optimization of waste management practices with a broader goal of resource conservation. On the other hand, in developing countries' MSWM is considered a serious challenge to local government authorities (Wilson, 2007)

**Table 2.2 Nations' Composition of MSW by economic classification**

CURRENT ESTIMATES						
Income level	Organic (%)	Paper (%)	Plastic (%)	Glass (%)	Metal (%)	Other (%)
Low Income	64	5	8	3	3	17
Lower middle Income	59	9	12	3	2	15
Upper Middle Income	54	14	11	5	3	13
High Income	28	31	11	7	6	17

**Source: The World Bank, 2012**

Although the main constituents of domestic solid waste are similar worldwide, a number of studies have found large differences between the solid waste of developed and developing countries. For example, the composition of MSW changes from country to country, especially from developed economies compared to developing. In developed countries the highest percentage of waste is paper (31%), while in developing countries the organic fraction represents the highest percentage (64%) (The United States Environmental Protection Agency [EPA], 2011; The World Bank, 2012). Table 2.2 below shows the difference in composition of MSW from countries with low, lower and upper middle and high income. Blight and Mbande (1998) concluded that "the differences in refuse composition in developing countries arise from the particular nature of the culture, climate, differences in fuel used, and variations in diet" (p.13).

In general, in developed and developing countries, the generation rate of municipal solid waste has been accelerating because of urban population increases, rapid economic growth, and rising community living standards, with resultant changes in consumerism and packing, and increasing general use of toxic and non-biodegradables materials. The rate of waste generation generally increases in direct proportion to that of a nation's advance in development (Claggett,

Hattie, & Watson, 1998; Statistics Canada, 2005; The United Nations Environment Program [UNEP], 2005; The World Bank, 2012; Yousuf, 2014).

In addition, the generated quantity, the density and the proportion of components, and the frequency of collection vary widely, even within a country, according to the level of economic development, geographic location, weather and social conditions (Sufian and Bala, 2007; Thoschinez and Mihelcid, 2009; Chandrappa and Das 2012). Additionally, Blight and Mbande (1998) also showed that several different elements directly affect the quantity of waste generated in developing countries including:

- The life style and living standards affect the quantities and characteristics of waste generated in any region.
- The number of people in a household has shown a correlation to per capita waste generation, as a higher number of people in a given household results in less waste generation per person per day.
- Socio-economic development and the degree of industrialization influence waste generation rates by generally affecting income and consumption patterns.
- Climate and seasonal changes impact waste generation by having an effect on the amount of organic material generated as a waste product of preparing fresh foods in season or climates that allow such preparation.

Related to economic aspects, in developing countries municipal solid waste (MSW) poses serious management problems and consumes a relatively high proportion of municipal budgets. Low-income countries continue to spend most of their SWM budgets on waste collection, while only a fraction goes toward disposition (the World Bank, 2012). Moreover, Memon (2010) showed that in low-income countries collection alone uses up 80-90% of the MSWM budget; in middle income countries collection cost 50-80% of total budget, while in high-income countries collection accounts for less than 10% of budget and the main expenditure is on disposal.

On environmental aspects, researchers identified one of the major problems in the collection of MSW in developing countries over the past decades; since in many areas, municipal authorities were either incapable of or unwilling to provide waste collection services to all residents in their jurisdiction and waste disposal was uncontrolled (Al-khatib, et al., 2007). Nevertheless, now more recent literature suggests that most cities in middle-income countries

are achieving at least a basic level of control for the disposal of more than 95% of their waste. The key priorities in low and lower middle-income countries are extending service coverage to all citizens and eliminating uncontrolled dumping of waste (Wilson, 2007; Wilson, Velis & Rodic, 2013).

According to Al- Khatib et al. (2007), developed countries have established regulated programs for the disposal of wastes, they have effective legislation, regulations and action plans. However, in most developing countries the problem of upgrading policies and practices for the disposal of municipal solid waste is far more difficult than in developed countries. According to Thomas-Hope (1998) the challenge in waste management for developing countries can be met by municipalities finding an appropriate strategy that combines: 1) the acquisition of financial means to close the existing gap between technological need and capability in the various aspects of environment management, and 2) the creation of local methods for dealing with the problems within the particular economic and sociocultural constraints and opportunities of each country.

Related to social aspects, the high levels of an informal economy present in developing countries reflect a population, which is deriving a livelihood from scavenging. This becomes a problem when social aspects are linked to the challenge of waste management (Da Silva et. al., 2005). It is essential for municipalities in developing countries to take into consideration their own understanding of various economic, social, and cultural contexts, so that appropriate solutions can be found. Wilson et al. (2013) concluded that in developing countries the current reality of solid waste management is much better than in the past decade; there are now many examples of authorities and their communities working together to achieve locally appropriate and sustainable solutions, one such example is the case in Santiago de Cali.

## **2.6 Sustainable development and integrated solid waste management (ISWM)**

During the last three decades, global environmental problems have become severe, generating great concern, and questions have arisen about how we can use less, cause less environmental destruction, and still improve the lives of people. In the latter decades of the 20th century, as a response to the detrimental social and environmental effects of economic growth, the concept of sustainable development was introduced. This was developed from the implication of the “only one earth” philosophy that appeared in the United Nations conference on the Human Environment (1972). At that time, the most popular definition of sustainable development was the one of the World Commission on Environment and Development (WCED)

of 1987, also known as the Brundtland Commission, which defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. As well, there was the concept of “*think global act locally*” (Perdan, 2011, p.5) originally agreed to in UN Agenda 21, 1992.

There are various definitions and concepts about sustainability and sustainable development. Several authors have defined sustainable development as a methodology of development with emphases on incorporating economic activity with environmental protection and social concerns and agreed that in developed and developing countries, the increasing amounts of waste require appropriate and practical solutions based on the three key principles of sustainability (Perdan, 2011; Shafer, 2010). Yousuf (2014) defined the three pillars of

sustainability applicable to solid waste management as:



- Environmentally responsible solutions to our waste management needs
- Economically viable initial financial analysis of possible strategies and technologies to suggest cost savings from the current waste management system.
- Socially acceptable solutions

**Figure 2.1 Pillars of sustainability**

Source: Yousuf, 2014

Today, sustainability of waste management is the key to providing an effective service that satisfies the needs of end users. There is recognition that waste needs to be regarded more as a resource and its management needs to be environmentally effective, economically affordable, and socially acceptable. Figure 2.1 shows the pillars of sustainability (Yousuf, 2014).

International agreements specifically commit to the pursuit of sustainable development, and many countries have formally established sustainable development as a policy goal at national and local levels. Since waste legislation has now been introduced in many countries around world, the desired direction of waste management is toward sustainability strategies, such as waste minimization, separation and re-use of materials, all of which reduce the volume



of waste, energy consumption, and raw material (Scharfe, 2010; Mc Dougall, White, Frank & Hindle, 2001; Perdan, 2011).

Memon (2013) suggests that the concept of Integrated Solid Waste management (ISWM) is changing: firstly, Tchobanoglous, et al., (1993) indicated that ISWM was established to achieve minimal environmental impacts and maximum utilization of resources, at a reasonable cost and with the coordinated use of waste reduction, recycling, treatment, and disposal systems. Then the ISWM became a process using the 3R approach (reduce, reuse, and recycle, intended at optimizing the management of solid waste from all the waste generation sectors (municipal, construction and demolition, industrial, urban, agriculture, and healthcare facilities). Involving all stakeholders (waste generators, service providers, regulators, government, and community/ neighbourhoods) within a geographic or administrative area such as a city/town, covering all stages of the waste management chain. An ISWM based on a 3R approach at the town/city level can be optimally designed and implemented due to the simple role of local government in providing waste collection and management services. The roles the regional, provincial and national governments play are essential, in terms of passing suitable policies and regulations, as well as creating an enabling environment for ISWM and strengthening institutions.

## **2.7 Planning and Integrated System Waste management (ISWM)**

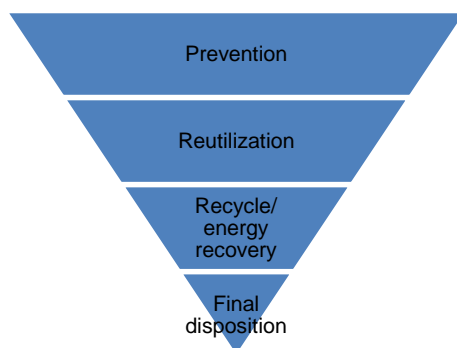
The integrated approach to solid waste management (ISWM) refers to a waste management programme that integrates some or all of the various components of waste management and emphasizes decision-making based on thorough analysis and planning (Claggett et al. 1998).

Traditionally, many cities in developing countries did not have a specific waste management plan; however, in some nations the legislation has been adapted to permit the execution of an ISWM to improve the system. In Latin America for example, there have been efforts to conduct a proper management of waste, by the strategic planning and organization from the national level that properly sets goals and targets in a time frame. Furthermore, in some countries such as Colombia, Brazil, Ecuador, Chile, Argentina and Paraguay, the municipalities have embraced their responsibility of creating municipal plans for the ISWM (Rosell, 2011)

As stated by Memon (2013), currently the planning and implementation of ISWM requires the following seven steps, involving all the main stakeholders (p.140)

1. Develop baseline data: Include characterization and quantification of waste from various sources and future projections.
2. Collect information and analyze to it develop baseline data on the current waste management systems
3. Create goals for ISWM in agreement with local stakeholders
4. Identify concerns of ISWM (financial, technical, environmental, and social) of concern to local stakeholders
5. Develop an ISWM plan
6. Develop an implementation strategy for ISWM
7. Develop a monitoring and feedback system for ISWM

Guidelines and directives to decrease waste generation and encourage waste recovery are placed according to the waste management hierarchy, in which waste prevention, minimization, reuse, recycle and energy recovery are designed to minimise the amount of waste left for final and ensure safe disposition. Figure 2.2 shows the pyramided that represent the sequence in the solid waste management adopted by sustainable cities.



**Figure 2.2 Waste management hierarchy**

Source: Rosell, 2011

In Latin America countries as Argentina, Brazil, Chile, Colombia, Costa Rica, El Salvador, Mexico, Nicaragua, Peru, Puerto Rico, have oriented significant efforts within planning of MSWM to meet the requirements of international agreements. These governments established a system based in the European waste management hierarchy, “which generally lays down a priority order of what constitutes the best overall environmental option in waste legislation and policy” (Rosell, 2011)

## **2.8 Recycling in municipalities of developed and developing countries**

There are differences between recycling in developed and developing countries. Developed countries generally utilize curbside recycling programs and sort waste for recycling processing; while, in developing countries scavengers (citizens with low –to –no income that

sort and collect materials either dispersed throughout the city or concentrated at dumpsites) handle recycle of products and sell to middlemen (Troschinetz & Mihelcic, 2009).

In most countries, recycling of solid waste is especially attractive for local officials and waste management planners because of its potential to reduce disposal cost, conserve available landfill capacity, and contribute to meeting national goals of energy and resource conservation. Recycling success however, depends upon a strong and sustained public willingness to continue the practice over time. At the level of local governments, recycling is a chief example of collective effort. Knowledge of what works and why, with respect to recycling solid waste, can help local officials design or fine-tune recycling programs to obtain higher rates of citizen participation and waste stream diversion.

The process by which recycling program design decisions are made, therefore, assumes special importance as it offers opportunities to maximize the number of stakeholders involved in the quality and success of the service. If citizens are involved in the decisions about the service in which they are expected to play a major role, they may be more likely to feel a duty, obligation, or responsibility to participate in order to help the program's success (Percy, 1984).

## **2.9 Recycling in multi-residential buildings**

The literature on recycling in multi- residential buildings (multifamily) has scarcely been analyzed. Several studies (Lansana, 1993; Vining and Ebreo, 1991) showed a correlation between demographic factors such as income and education against attitude about recycling participation.

Recycling Council of Ontario Canada (RCO, 2000); Katzet, Blake and Messer, (1993) and McLaren (1991) also presented examples of recycling programs which consisted of case studies on multi-residential dwellings and examined determinants of recycling participation, identifying four major determining variables in individual recycling participation that include recycling knowledge, recycling program convenience, demographic measures of recycling, and environmental attitude.

**Table 2.3 Reasons found for differences in rate recycling between multi-unit and single house**

<b>Reasons</b>	<b>Residents in multi-units</b>	<b>Residents in single house with recycling program</b>
Recycling Collection service	Residents are require to deliver their source separated, recyclable materials to central storage areas	Residents receiving door to door collection
Waste system service	They may take their waste to a garbage room or chute on each floor	Residents receiving door to door collection
Storage area	Some multi-units may have less storage area per capita creating storage problems for recyclable containers (e.g. blue boxes)	The majority of single residents have enough storage area for blue boxes
Cooperation	Cooperation of residents, condo' managers is required	Residents know schedule of collection and they do not require cooperation between neighbours

Source: Author, content drawn from RCO (2000).

Other research on multifamily recycling programs shows that the size of a multi-family dwelling complex significantly affects the amount of recyclables collected and the level of contamination. Smaller units also had fewer problems with contamination in their recyclables “Smaller complexes with less than ten units recycled up to three times the amount on a per unit basis as complexes with more units” (De Young, Boergching, Carney, Dillenberk & Elter, 1995). RCO (2000) argues that recycling programs serving residents of multi-units building are less convenient than recycling programs serving single households. RCO demonstrated that the participation and rate of multi-unit programs in the province of Ontario, Canada where recycling is mandatory for multi-units with six or more units, participation rate from building to building vary intensely and are generally lower than in single family households recycling programs. The reasons for these differences are summarized in Table 2.3.

## **2.10 Stakeholders’ participation in MSWM**

In general, stakeholders include all people or groups interested in working with waste, such as waste generators (households, private industries, schools), waste pickers, private solid waste businesses, community associations, non-governmental organizations (NGOs) social activists, environmentalists, the mass media (Chandrappa and Das, 2012; Furedy, 1994; Ouano and Ogawa, 1993; and Yudoko, 2000). Stakeholders are found in national, regional and local governments.

Each stakeholder plays an important role in a waste management program. In particular, municipal governments play roles in each activity. The main functions of the central and municipal governments are enforcing laws and monitoring their compliance. The private sector workers executing every waste management activity from collection to final disposal. The private sector and Non-Government Organizations (NGOs) may be mainly involved in supportive roles, such as educational campaigns to attain diverse goals in recycling. The most important roll of households is taking action on waste recycling as sorter, storage and separation (Yudoko, 2000). Troschinetz and Mihelcic (2009) agree that scavengers are a legitimate agent of MSWM. Institutional collaboration, greatly influence the success of sustainable recycling; this means that collaboration between stakeholders demand active participation by all parties working toward a common goal: increase recycling.

### 2.11 Informal sector in developing countries

The current problems associated with solid waste management lie not only in the increased quantities and greater urban concentration of waste being generated, but also in the related social aspects. In particular, of the high levels of informal economy present in developing countries, reflect in populations deriving a livelihood from scavenging at refuse collection points and dump sites (Medina, 2000). DaSilva, Fassa, Siguiera, and Kriebel (2005) agree that high unemployment, increasing amount of solid waste and global market have facilitated the rapid expansion of recycling.

**Table 2.4 Main waste recovery categories**

Main waste recovery categories			
Itinerant waste buyers	Street waste picking	Municipal waste collection crew	Waste picking from dumps
Waste collectors, who collect and sort dry recyclable material (often door to door) from householders. They buy or barter and then sell to recycling shops, the next step in the chain	They work by recovering secondary raw materials from mixed wastes (thrown on streets or from communal bins)	They recover raw materials from vehicles transporting MSW to disposal sites	Waste pickers or scavengers sort through wastes in dumps or landfills before the material is covered

Source: Content from: Wilson et al. 2006

Wilson et al. (2006) defined in the context of municipal solid waste management (MSWM), the term “informal recycling sector” as those engaged in waste-recycling activities (scavengers) and waste pickers. Recycling activities by scavengers occur in the street, in temporary storage sites, at dumpsites and sometimes in landfills for income generation and sometimes even for everyday survival. Additionally, waste recovery can be classified into four categories depending on what material is recovered and who carries it out. Table 2.4 summarizes waste recovery categories and describes the main characteristics of each group.

In many developing countries, the informal waste recycling systems that already exist, help to reduce the cost of formal waste management systems. The quantity of waste for collection is reduced, resulting in less money to spent on collection, transport, treatment and final disposal. In the informal sector, waste is perceived as a resource. Several authors agree that building on existing informal sector recycling and integrating it into the formal system can create a win-win opportunity, because it is already saving many cities millions of dollars and providing livelihoods to large numbers of the urban poor people (Wilson, 2007; Velis & Rodic, 2013). Blight and Mbande (1998) and Da Silva et al. (2005) state that scavenging “is not itself a bad thing”, because it provides a source of income to the scavengers and their families. From curbside collection recyclers recover recyclable and re-usable products, which allows them to mediate their poverty, provides valuable inputs to industry and reduces the volume of materials destined for landfill. Moreover, these economic benefits are achieved at no direct cost to the taxpayers (Da Silva et al., 2005).

Other social benefits generated by recycling is that many scavengers may not be able to enter formal sector employment because of poor education or physical disability are able to find a source of employment recycling. If waste pickers do find alternative employment in the formal sector, other individuals are highly replaced them as long as poverty continues and waste remains accessible. On the other hand, scavenging in some developing countries is associated with risks, unhygienic environments, criminal activities, homeless, unemployment, unskilled, unorganized (Parizeau, 2013; Sembiring & Nitivattananon, 2010; Birkbeck, 1978). Da Silva et al. (2005) argue that recyclers are discriminated against the work that they perform. Sometimes they are seen as a source of embarrassment for cities, and its contribution is not recognized (Mitchell, 2008). However, this discrimination has been amended in many countries where by law recycling is a permitted activity and recyclers are valued and respected for their work, as in Colombia.

Commonly collected materials are newspaper, glass, plastic, paper, aluminium cardboard/corrugated paper, and textiles (Schultz, Oskamp, & Mainieri, 1995). The degree to which a particular material is recycled depends on the income levels and the existence of local and national markets, need for secondary raw materials, the level of financial and regulatory governmental intervention, the prices of virgin materials, international trade in secondary raw materials and relevant treaties.

## **2.12. Summary**

Increasing waste generation rates due to population growth, changing lifestyles, and the development have led to the diverse challenges for municipal solid waste management (MSWM) in various cities of the world. In developed and developing countries, collection, processing, transport, and disposal of solid waste are all important aspects of planning. Furthermore, an adequate waste management for public health, aesthetic, and environmental reasons is desirable.

Regarding the differences in waste between developed and developing countries, several authors agreed that waste generated, quantity, density and proportion of components, and the frequency of collection vary widely, this holds true even within a country. Waste composition varies according to the level of economic development, geographic location, weather, and social conditions. For example, in developing countries waste stream is comprised of organic matter (55%), while in developed countries, paper is the major percentage (31%) in the waste stream composition (Chandrappa and Das, 2012; Thoschinez and Mihelcid, 2009; Sufian and Bala, 2007; and Rushbrook & Finneycy, 1998).

Today, sustainability of waste management is the key to providing an effective service that satisfies the needs of end users. There is recognition that waste needs to be regarded more as a resource and its management needs to be environmentally effective, economically affordable, and socially acceptable (Yousuf, 2014). Developed countries utilize curbside recycling programs to collect and sort recyclable products; while, in developing countries recyclers perform recycling work under poor conditions, putting their health and security in risk. In cities located in developing countries, several thousands of people depend on recycling; so far, recyclers play an important role in MSWM. Millennium Development Goals focus on poverty reduction, waste strategies and the improvement of recycling rates in developing countries; one of the major challenges is how to work better with the informal sector. Recycling

generates economic, social and environmental benefits, such as: jobs are created, poverty is reduced, raw material costs for industry are lowered, pollution is reduced, resources are conserved and the environment is protected (Wilson, Velis and Cheeseman, 2006)

According to RCO (2000), a study conducted in Ontario, Canada on recycling programs serving residents of multi-units building showed that these are less convenient than recycling programs serving single households. Conversely, in Santiago de Cali, Colombia municipal authorities created a plan of waste management known as Plan de Gestion Integral de Residuos Solidos (PGIRS from the Spanish acronym) and established the Recycling Program by local law. The MFRP was implemented in 2006 in multi-family dwellings of socioeconomic strata between 2 to 6. In the following chapters, I will present a case study using a framework to assess the economic, environmental and social aspects of the MFRP in Santiago de Cali. The results cover the main characteristics of the program; its goals and barriers met by the local authorities; and the participation of recyclers in the program.



## **Chapter 3**

### **Methodology**

This section outlines the research methodology used to explore Cali's integrated municipal solid waste program. The nature of this research is descriptive and, to some degree, explanatory and normative. This research is considered a case study because it explores the potential of ISWM in one city in a developing country, Colombia. As defined by Creswell (2009) "case studies are a strategy of inquiry in which the researcher explores in depth a program, event, activity, process" (p.13); so, this case study explores specifically the Multifamily Recycling Program (MFRP) in the urban area of Cali.

Researchers collect detail information using a variety of data collection procedures. This case study employs qualitative and quantitative research. The main information was collected by reviewing the literature. Data was also obtained from official documents collected during visits and from observations during the research phase in public and private institutions. Primary data was mainly collected by semi-structured interviews and semi-structure questionnaires.

The municipality of Santiago de Cali was selected as a case study for several reasons: the municipality's solid waste management has been facing difficult pressures due to rapid urbanization, industrialization, and population growth; and, the ISWM that has been operating since 2006. The researcher's familiarity with, and accessibility to the study area were also taken into consideration in selecting this study area.

#### **3.1 Data Collection Methods**

The data collection methods used in this study includes: review of documentary materials, questionnaires, interviews, and field observations. The documentary materials were collected from various sources, for instance, government institutions, private firms and newspapers. Structured questionnaires were administered to households, condo managers, and recyclers. Semi-structured interviews were conducted with various respondents, such as government officials, private sector employees, and representatives of professional recyclers, manager of the recyclers' professional association, and members of a non-governmental agency. Observations were also undertaken in many places relevant to the study, for example, the disposal site in each selected condo, community and public areas. The data collected from this city focused on the following:

- The current situation of the city in relation to the MFRP

- Attitudes of people involved in the process of implementation, development and evaluation of the program of the MFRP
- Environmental education associated with the MFRP

### **3.2 Literature Review**

The information collected concerning MSWM was based on a literature review of journal articles and academic publications, government documents (official and unpublished materials), international organizations' reports, newspaper articles, and on-line public material of the private waste collection companies operating in Cali. A literature review of research on waste management legislation was then carried out, taking into consideration the current regulations at the national and municipal levels, such as fundamental laws, legislative decrees, municipal ordinances, and statutes. The major content of the literature review provides the basis for understanding the waste management system in Colombia and Santiago de Cali, and more specifically, the MFRP.

### **3.3 Ethical considerations and ethics review**

The cultural context and customs of the interviewees were respected, and government regulations were also adhered to during the conduct of the fieldwork in Santiago de Cali. Research instruments were developed in consultation with the Ethics Review Committee of the University of Waterloo, Graduate Studies Office. The questionnaires (Appendix A-1), and interview questions (Appendix A-2) were reviewed, and approved by the University of Waterloo, Social Research Ethics Review Board before being used in the field. Thus, the study collected no unwarranted information.

The confidentiality of data was also maintained, by preserving the anonymity of the participants unless they offered their consent. Respondents' identities were protected through a clause in the participant consent form. As seen in Appendix A-3, every participant filled out a consent form, and if the participant did not wish to answer any questions, or give certain information such as the name or place of employment, they were not obliged to. On the consent form, the interviewees also were asked about several options, i.e., if they permitted the use of a tape recorder, or if the information that they were providing could be directly quoted, and if they were giving permission to have their name attached to the statement. Finally, after agreeing to participate in to the study, the interviewees were offered the option of obtaining the results upon completion of the study.

### 3.4 Sampling

In this case study, interviews were mainly of stakeholders in the municipality of Santiago de Cali. Representatives from government departments and institutions, private waste management firms, one non-government organization, and private businesses were purposely selected. The key was to collect research data through communication with people who work in the waste management field, planning departments, environment, municipality and community. Respondents actively involved in the MFRP in the city were identified using the snowball sampling method (Newman, 2007). The initial step in this stage was to identify the first potential informants: people with good knowledge of the local MFRP. The process began with the Conservation Authority (CVC): people in charge of the control of the program of waste management. They, in turn, suggested that the researcher contact additional people, including committee members, specifically those working on activities which comply with the duties imposed by the national government to address matters covered by Sentence T-291<sup>6</sup> related to recycler legislation for local waste management.

Representative samples from households were identified through a stratified sampling. Income, waste collection and transportation service provided by the four private waste collection companies, and the type of dwelling (condominiums only) were the variables used. The city has a household socioeconomic stratification that allows the collection of fees for the provision of public services according to the income of the population<sup>7</sup>. Six levels of social economic classification or strata have been established by

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<sup>6</sup> Sentence T-291 See appendix D.6

<sup>7</sup> According to the National Department of Statistics, DANE, in Colombia the socioeconomic stratification is the mechanism that allows classification of the population into different strata or groups of people with similar social and economic characteristics, through examination of the physical characteristics of their housing, environment immediately and urban or rural context of the same. This classification is established based socioeconomic stratification of two principles: solidarity and redistribution of income. These principles respond to the need to design policies that lead to equitable access of the population to basic social services, as well as public utilities. For this reason, this tool targeting spending is used to collect household utilities with differential rates by stratum and for allocating grants and contributions. Thus, those with more financial power pay more for utilities and contribute to lower strata households can pay their fees.

[http://www.cali.gov.co/publicaciones/que\\_es\\_la\\_estratificacion\\_pub](http://www.cali.gov.co/publicaciones/que_es_la_estratificacion_pub)

municipal planners, with one equalling the lowest and six being the highest. Participants were chosen randomly from the following three groups who form a representative sample of each of the six levels of stratification: high- income class (strata 5, 6), middle- income class (strata 3-4), and low-income class (2). Only strata 2 last form this because there are no condo owners in strata 1<sup>8</sup> (Rincon, Maldonado & Echeverry, 2006). The survey of these three groups related to waste management, and specifically, on how waste recycling and source separation was conducted to provide coverage to all areas and socioeconomic strata in the city.

**Table 3.1 Summary of Survey Collected in Cali**

Group	Valid	Declined	Total Attempted	Response rate %
Condo managers	25	12	37	67.6
Residents: (Owners ,tenants)	50	10	60	83.3
Recyclers	25	2	27	92.6
<b>Total</b>	<b>100</b>	<b>24</b>	<b>124</b>	

The goal was to obtain a good representation of the whole population. The first group was composed of managers of condominiums: 25 valid copies of the survey resulted, while 12 tries were declined. The second group was formed by residents of apartments or condo buildings belonging to selected condominiums: 50 valid copies of the survey resulted, while 10 tries were declined. The third group was made up of

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Cali following this methodology, has classified the homes in the urban area according to socioeconomic (SE) stratification, assigning a code number from 1 to 6, with 1 representing a dwelling occupied by a family with low income and 6 indicating those with high income. [www.cali.gov.co/publico2/documento/2015/planeacion/InformeGestionMunicipal2014.pdf](http://www.cali.gov.co/publico2/documento/2015/planeacion/InformeGestionMunicipal2014.pdf).

<sup>8</sup> In Cali, in recent years the creation of multi-family homes or condos for socioeconomic (SE) strata 4, 5 and 6 has become the urbanistic trend. 25% of the population live in condos distributed between SE 2, 3, 4, 5 and 6. SE 5, indicates the highest number, followed by 6, 4 and 3 respectively. (Rincon , Maldonado and Echeverry, 2006)

recyclers: 25 valid copies of the survey resulted, with 2 refusals (Table 3.1).

Other factors considered in the selection of participants were:

- The system for the collection, sweeping and disposal of residues generated in urban areas of the city is divided into four areas (North, South, West and East). Each waste management company (ESP in Spanish) operates an area. This study considers resident participants from the four areas.
- The urban area of the city has several types of condominium development: horizontal residential (houses up to three levels), vertical residential (blocks up to five levels or floors), or multi-family buildings (buildings over five floors). This study considers a gated condo community<sup>9</sup> of single houses, town houses or apartments buildings, which have been carefully chosen from a group of condominiums that are working with the MFRP.

**Table 3.2 Number of residents and managers surveyed by socioeconomic strata**

NUMBER OF PARTICIPANTS	SOCIOECONOMIC STRATA (SE)					TOTAL
	2	3	4	5	6	
RESIDENTS	4	10	13	13	10	50
MANAGERS	1	5	7	7	5	25

Source: Author

The fieldwork was conducted in the month of March 2013 in several condominiums in the urban zone of Santiago de Cali. Interviews and surveys were conducted with each of the managers and residents of each condo selected. Their participation was voluntary. For security reasons, contact was first made with the manager of each condo to set up an appointment. He/she was then given a letter of invitation (37 letters), but only 25 condominiums accept to participate in this research. Subsequently condo manager (he/she) decided whether to participate, allow the interview and answer the questionnaire. He/she also shared the information received from the surveyor with people (tenants and /or owners) who could

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<sup>9</sup> In Cali, condo developments include single houses, town-houses, apartments all are either gated communities or feature a controlled access point.

participate in answering the survey. The group of condos selected to participate was chosen from the group of condominiums that had participated in the pilot program that included a survey conducted by the Municipal Planning Department in 2006. In total, 100 surveys were conducted in selected condos. In addition, 25 questionnaires were answered by informal recyclers, 25 by condo managers and 50 by residents (owners/tenants of apartments or houses in condo communities) and distributed in different socio-economic level neighbourhoods (Table 3.2). The majority of the surveys were conducted in socioeconomic groups 4 and 5 because most apartments and houses in condominium developments are built for them as was reported by Maldonado and Echeverry (2006). As was mention before, in Cali, groups with lower socioeconomic status (1 and 2) predominate in the single house buildings and were therefore included less frequently in the survey.<sup>10</sup>

### 3.5 Qualitative interviews

Qualitative interviews were conducted with persons well informed about different aspects of the waste management system in the city: persons involved in multifamily recycling in the urban area, and persons working in waste management in the city. According to Yin, 2003 interviews are one of the most important sources of case study information. In this study interviews were conducted with key informants who were identified using the city staff directory and snowball sampling. Personal interviews were scheduled with persons belonging to municipal planning staff; waste collection companies (ESP in Spanish); the Ministry of Environment or conservation authority in the city and the region (DAGMA and CVC, respectively); recyclers' cooperatives, intermediate dealers and a NGO.

The interviews were conducted by Clara Paya (the author) orally in Spanish, audio recorded, and then translated into English. Each interview took from 20-25 minutes. Once the interviews were fully transcribed, the data gathered was ready for analysis. Table 3.3 includes the types of questions asked, following the framework of ISWM.

**Table 3.3 Framework for questions and interviews**

Characteristics	Interviewed	Questions
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<sup>10</sup> In 2012, Cali had a total of 587.520 residences, but there is no accurate information about the number of condos (apartments and houses in condo communities) within the city. In 2014 urban population estimated is 2.308.086 with a density of 190.92 persons per hectare (DANE, 2014)

What are the characteristics of the multifamily recycling program (MRP) in the framework of ISWM		
Economic Affordability	Householders Recyclers Waste service companies	What economic benefits do householders of this program receive? Economically, has the recycler benefited from this program? Is the MFRP financially self-sufficient?
Environmental Effectiveness	Householders Recyclers Waste service companies	How does the MFRP mitigate environmental harm? What environmental benefits have been achieved for the city and its inhabitants?
Social Acceptability Education	Householders	What is the level of householder' participation in the dissemination of the program?
	Recyclers	What is the level of recycler' participation in the educational program?
	Private sector	What is the level of participation of the four waste management companies in the dissemination of the program? Is the educational program effective?
Social Acceptability Participation	Householders	What is the level of householders and condo managers' participation in the program? What percentage increase has the program had in its first four years?
	Recyclers	Are recyclers accepted within the condos?
	Private sector	What is the level of businesses participation in the program?

Source: Author

An interesting phenomenon occurred during the interviews with respondents, especially with government officers in Santiago de Cali and recyclers. Although this study is exploratory, attempts were made to gather quantitative evidence. At the preliminary stage of data collection, questions in the survey were designed based on a framework that follows the three pillars of sustainability: environmental, economic, and social aspects. This approach was employed in order to ease subsequent data processing and analysis but, after interviews with three government officers, the use of this framework had to be abandoned because of the discomfort that the quantitative questions caused respondents. The questions were working poorly because the respondents did not feel comfortable in answering certain inquiries; for instance, government employees refused to say anything about results or problems, and recyclers would

not discuss prices. Recognizing this situation, questions were transformed from framework questions to open ones. This format was more acceptable and successful. Respondents seemed more enthusiastic when the nature of the conversation was more exploratory in nature. However, the main difficulty of this kind of conversation was in following the flow of a discussion as planned by the researcher, because respondents could jump from one topic to another.

**Table 3.4 Information of interview participants**

<b>Institution</b>	<b>Interviewee Name</b>	<b>Position</b>	<b>Interview Date</b>
Environmental Authority –CVC	Ana Cristina Perilla	Biologist, Environmental Management Specialist	March 6,2013
Environmental Authority - CVC environmental management- regional southwestern)	Adriana Patricia Ramirez	Coordinator group of strengthening the environmental education and Civic Culture-	March 20,2013
Municipal Environmental Authority – DAGMA	Diego Fernando Benavides	Solid Waste Coordinator	March 21,2013
NGO Fundacion Carvajal	Aura Aydee Garcia	Project Coordinator	March 20,2013
Association of Recyclers of Cali ARC	Santo Espólito Murillo	Legal represent, Manager	March 21,2013
Waste Management Company: Ciudad Limpia	Catherine Arteaga	Communication	March 12,2013
Waste management company: Promoambiental Valle	Paola Cordoba	Coordinator of Community Relations	March 19,2013
Small business Tecnisolidos	Alexander Ortiz	Legal represent, Manager	March 20,2013

Source: Author



Qualitative information was obtained through observation and the information obtained by the interviews. All interviewees granted the request for audio recording during the interview. The details of participants interviewed are shown in Table 3.4

### **3.6 Survey: Quantitative questionnaires**

A survey was constructed, validated and applied to 100 randomly chosen persons. The objective was to identify characteristics of the MFRP and assess the willingness of residents to participate in the program proposed by the municipality; and to determine whether residents accepted recycler as staff inside the condominiums. The selection of participants was based primarily on their willingness to answer the questionnaires. The sample included men and women over 18 years who live in condominiums representing the several socioeconomic strata.

The survey was carried out with respondents who knew about of the Integrated Waste Management Program-Recycling in Condominiums of the urban zone in Santiago de Cali (MFRP) and was done with three groups of respondents:

- Condo managers
- Residents: owners and tenants of apartments/houses within selected condos
- Recyclers

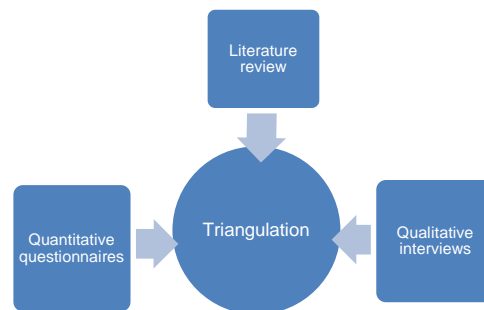
Three different questionnaires were designed, although they had some questions in common, in order to obtain more-detailed information about the field of expertise of the participant. The sample questionnaires are provided in Appendix A. Some surveys were conducted orally, face to face by the researcher in Spanish, to increase the rate of participation in responding to the questionnaire, especially with the group of recyclers, who were often harder to involve in answering the questionnaires. The questionnaires comprised about twenty questions, which followed framework (Table 3.2). The questions required either a numerical response or choosing one or more multiple response options. The questionnaire also included questions pertaining to the individual, such as gender, age, education (level of schooling) and work experience in recycling. For the house characteristics, questions about ownership of residence, socioeconomic dwelling stratum, number of adult and number of children residents were also included. The end of the questionnaire included a blank space for reviews, ideas, comments, or opinions concerning source collection and recycling programs.

### 3.7 Coding

For ethical reasons, the surveys completed were given an identifying number. A table was subsequently created that listed the code and its location. After creation of the participant reference table, data were aggregated according to the randomly assigned number. Responses from the surveys were coded, and all of the different codes were weighted equally, to correspond to the stratified random sampling.

### 3.8 Triangulation

Triangulation is a way of assuring the validity of research through using a variety of methods to collect data on the same topic. Golashanif (2003) argues that “triangulation is typically a strategy (test) for improving the validity and reliability of research or evaluation of findings” p.603. Moreover, triangulation may include multiple methods of data collection and data analysis, but does not suggest a fix method for all the researches. The methods chosen in triangulation to test the validity and reliability of a study depend on the criterion of the research. This case study used a survey (quantitative method), an interview (qualitative method), and documentary analyses (literature review and review of relevant municipal waste management documents provided by persons interviewed). This combination of techniques provided the triangulation analysis, creating a more focused result, Figure 3.1.



**Figure 3.1 Triangulation used in the research**

Source: Author

### **3.9 Limitations**

The following limitations could have affected the quality of the research results and conclusions:

- The time allotted for the surveys was short, and thus the number carried out was restricted given that the city has grown considerably, especially in condominium development
- Safety concerns and limited mobility in the city prevented the interviewer reaching as many people as originally planned, especially those in socioeconomic strata 2
- The major number of interviews of recyclers was achieved with people belonging to the Cali Recyclers Association – ARC; independent recyclers found working in the streets were reluctant to answer without being rewarded financially, and only very few of them thus agreed to answer the questionnaire
- Collecting accurate data during the interviews was difficult because of the privacy desired by the companies.

## Chapter 4

### Characteristics of Case Study

This chapter provides contextual information through a brief description of Colombia and the study area, the municipality of Santiago de Cali, including general information such as geographic, demographic, administrative and economic details. Waste management in Colombia and specifically in Santiago de Cali is explored with consideration of the economic, environmental and social aspects. The current Colombian environmental legislation related to waste management and recycling programs is also considered.

#### 4.1 Municipality of Santiago de Cali

The city of Santiago of Cali, more often called Cali, capital of the Department of Valle del Cauca, is the third city in economic importance to Colombia. Cali is located in the south-west of Colombia<sup>11</sup>, and has a warm climate, with temperatures averaging 24.3 °C and an annual precipitation of 1588mm ([www.cali.gov.co](http://www.cali.gov.co)). According to National Statistics Department (DANE, 2014), Cali has the third largest population of Colombia, with an estimated urban concentration for 2014 of 2,308.086, and a density of 190.92 persons per hectare. The territory of the Santiago of Cali has a total extension of 560.3 km<sup>2</sup>, with 120.9 km<sup>2</sup> of urban area (Alcaldia de Santiago de Cali, Planeacion Municipal, 2006). For administrative purposes, the city's urban area has been divided into communes, which are in turn divided into neighbourhoods and new developments<sup>12</sup>. In 2014, there were in total 22 communes, 249 neighbourhoods and 91 new developments ([www.comunas-de-cali.svg](http://www.comunas-de-cali.svg)).

Cali has good coverage of public services in the urban area; for example, in 2010, 85.5% of homes had drinking water service, and 100% had access to sources of water, with consumption per capita of 118.4 lts /person/day, 90.5% of homes had electric energy authorized service (Alcaldia de Santiago de Cali, Departamento Administrativo de Planeacion, Cali en Cifras, 2011).

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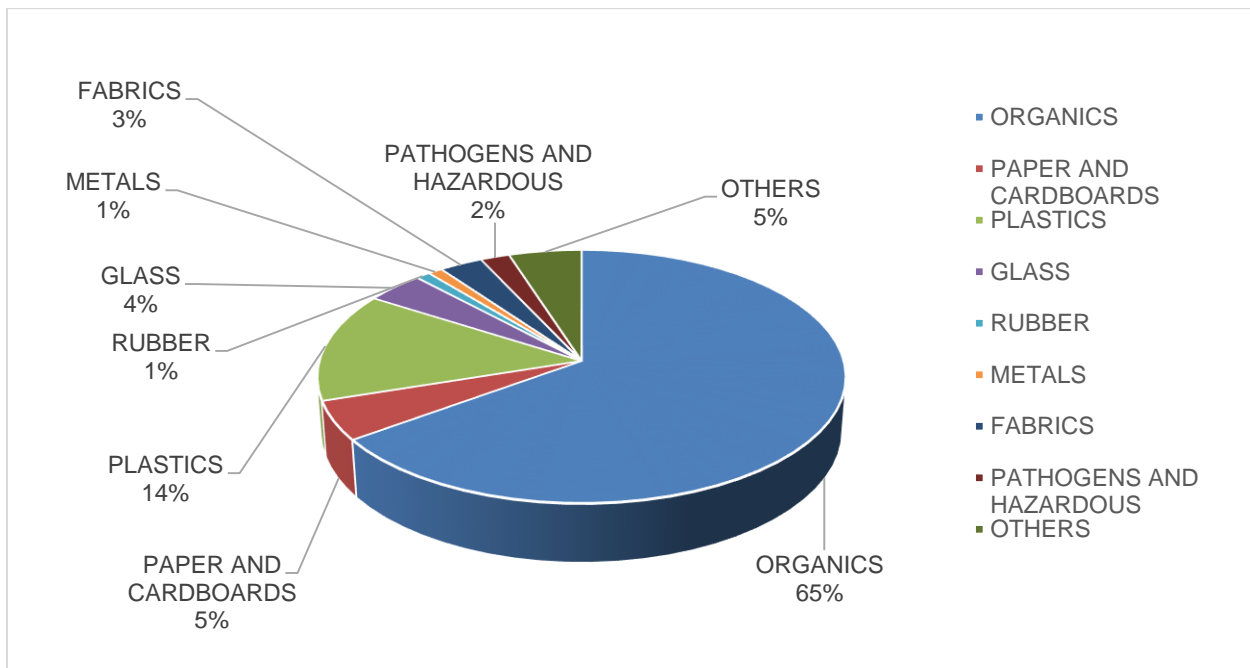
<sup>11</sup> Colombia is a developing country located in the North- West corner of South America (Figure 4.1). Colombia in 2005 presented a population of 42,888,594 inhabitants and the projection to 2015 is a population total of 48,143,196 inhabitants (DANE, 2014).

<sup>12</sup> Developments are expansions or new project of neighborhoods that do not have yet approved by local government as neighborhood.

## 4.2 Waste characteristics and waste management in Colombia

The Colombia production of solid waste is equivalent to a daily production average by inhabitant of 0.6 kg/person/day, but there are variations according to a city's size. For example, Bogota, the capital city, has an average of 0.95 kg/person/day; cities such as Medellin or Cali have 0.81 kg/person/day, and cities with a total population of less than 500.000 inhabitants have 0.31 kg/per/day (Alcaldia de Santiago de Cali, 2009).

As reported by the Ministerio de Ambiente, Vivienda y Desarrollo Territorial (MAVDT, 2008) Colombian Ministry of Environment, Housing and Development (in English) the composition of waste in Colombia is 65% organic, 14% plastics, 5% paper and cardboard, 4% glass, 1% metals and, 1% rubbers (Figure 4.1). From the total waste generated in Colombia, only 13% is recycled, of which 7% is recuperated by scavengers and/or informal cooperatives, and the remaining 6% by direct agreements between trade and industry (Alcaldia de Santiago de Cali, 2009).



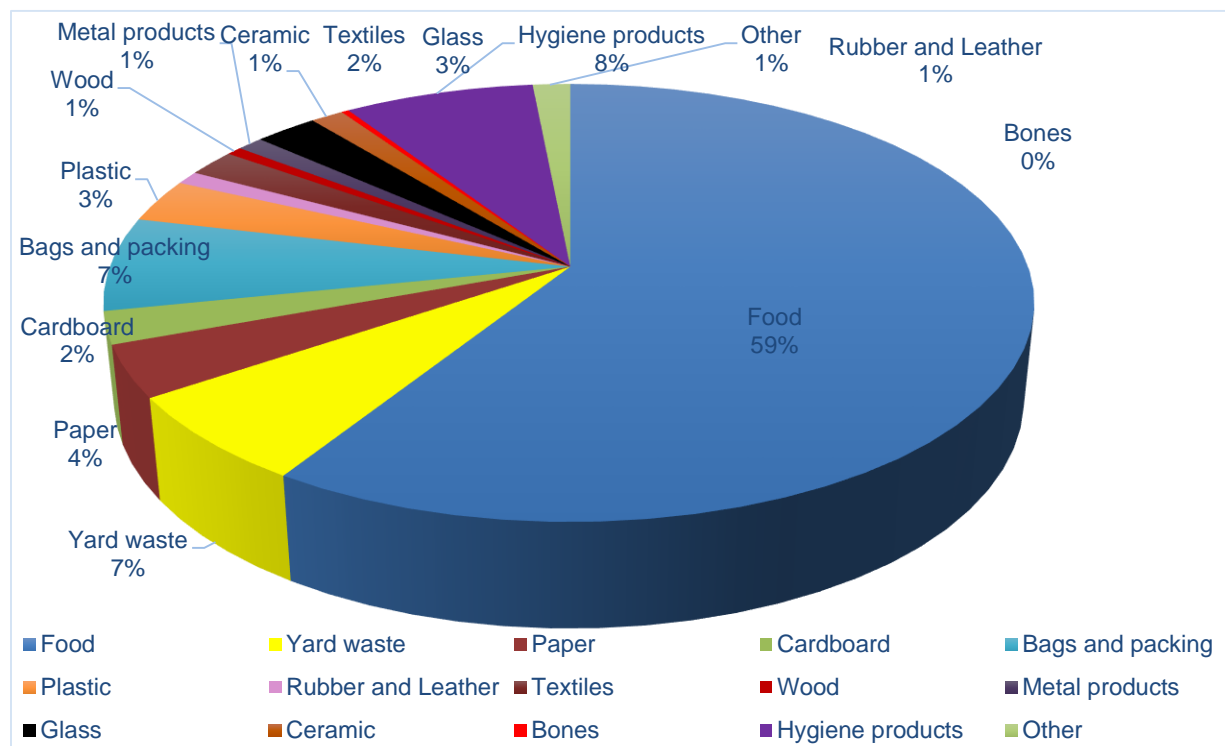
**Figure 4.1 Solid waste composition in Colombia**

Source: MAVDT, 2008

In Colombia, the institutional reforms implemented after the 1991 National Constitution and Law 142 of 1994 have generated advances in the solid waste service, strengthening the move towards decentralization and allowing public and private companies to provide this service

instead of the municipalities. More than 20 years after these reforms, an evaluation done by the Ministerio de Vivienda (the Ministry of Housing in English) and the World Bank (2014) showed that most Colombian municipalities reported positive results in term of coverage, efficiency and sustainability in public waste service. It also concluded that the final disposition of waste is associated with the rate of waste generation and the amount submitted by the generator to the public waste collection service.

The waste composition of the municipality of Santiago de Cali consists principally of organic waste: food waste is the greater percentage (59%) component, followed by hygiene products (8%), bags and packing (7%), yard waste (7%), paper (4%), plastic (3%), glass (3%), textile (2%), and cardboard (2 %) (Figure 4.2). In 2006, residential waste generation in Cali was 395,159 ton /year (Alcaldia de Santiago de Cali, 2006).



**Figure 4.2 Physical composition of residential solid waste-Santiago de Cali (Percentage)**

Source: Alcaldia de Santiago de Cali, Departamento Administrativo de Planeacion Municipal, 2006

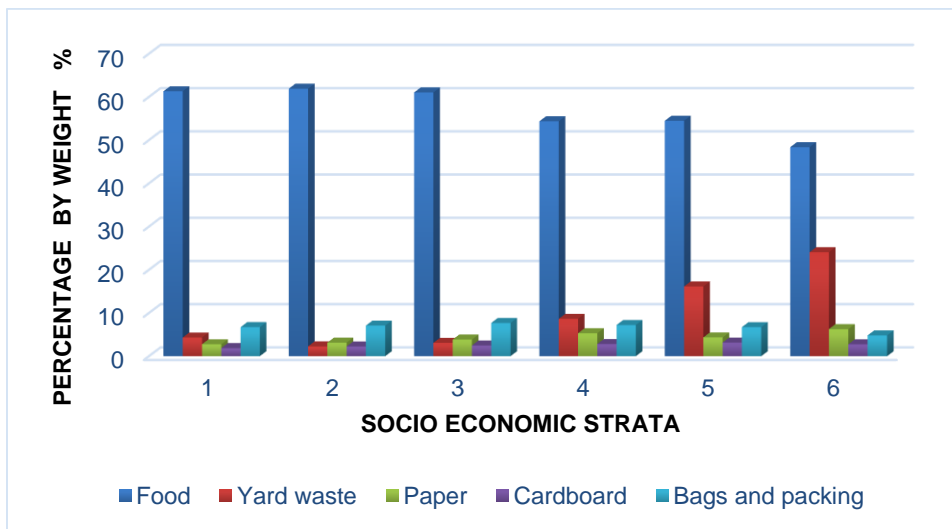
Santiago de Cali (2006) reported a variation in waste generation per person/day by socioeconomic strata as follows: a high level (SE- 6) is 0.77 kg/person/day; a medium level (SE- 3) is 0.37 kg/person/day; and a low level (SE-1) is 0.34 kg/person/day (Table 4.1). Figure 4.3

shows, as the main waste component in all SE strata is food. Lower strata (1, 2 and 3) generates in average (60%) while the upper strata (5, 6) generates in average (51%). Furthermore, Marmolejo et al. (2010) found an association between socioeconomic status and the generation of solid waste in Cali, concluding that the higher income sectors generate more solid waste compared to low economic ones.

**Table 4.1 Per capita waste generation in Santiago de Cali**

Socioeconomic Strata	Generation per capita (kg/ person /day)	Interval of 95% of trust
1	0.34	0.32 – 0.35
2	0.36	0.34 – 0.38
3	0.37	0.35 – 0.39
4	0.49	0.44 – 0.55
5	0.60	0.49 – 0.70
6	0.77	0.64 – 0.90
<b>Average</b>	<b>0.39</b>	

Source: Alcaldia de Santiago de Cali - Planeacion Municipal, 2006



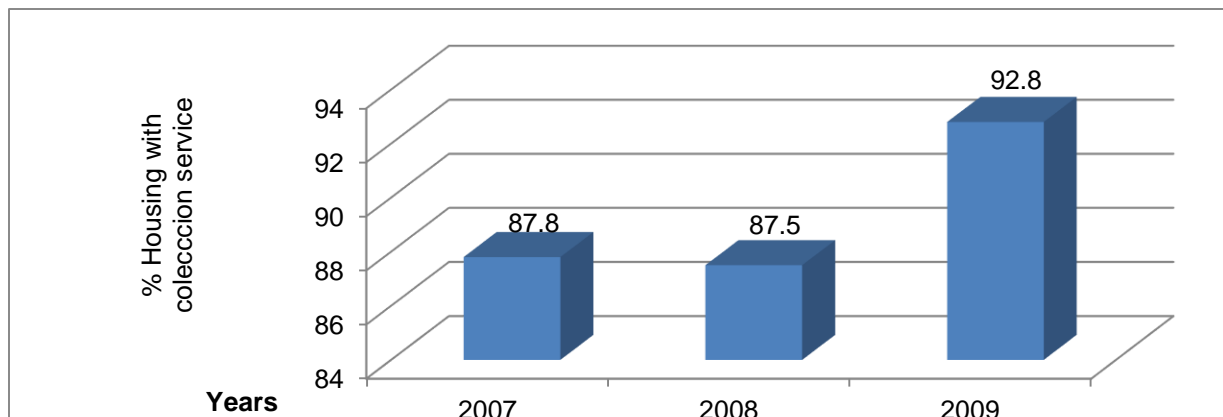
**Figure 4.3 Physical composition of residential solid waste (percentage by weight) by socioeconomic strata in the urban area of Cali**

Source: Author content from Marmolejo et al. (2010)

Alcaldia de Santiago de Cali (2006 a) reported that waste composition by socioeconomic strata the highest percentage is food, lower SE strata (1,2 and 3) average 60% and, medium

and high SE strata (4, 5,6) reported an average (50%) in their waste composition followed by yard waste (24%) in SE6. Figure 4.3

In relation to the waste collection service, Clean and Clean Air -CCA (2012) reported that in the urban area, the coverage of waste collection and sweeping has improved in the city, reaching 99%. In 2012, Cali generated 1,860 tons/day of solid waste, but this decreased in 2013 to 1,513 tons/day (Alcaldia de Santiago de Cali, 2012). Figure 4.4 shows the percentage of housing with waste collection service, from the years 2007 to 2009 in the city.



**Figure 4.4 Percentage of housing with waste collection service in recent years Santiago de Cali**

Source: Alcaldia de Santiago de Cali, 2012

Majority of waste is sent to the Yotoco landfill, via a transfer station located in Palmaseca outside of Cali. In Cali formal and informal recyclers collect recyclables products around 3258 persons work in recycling in the urban area (Alcaldia de Santiago de Cali, 2006 b)

#### **4.3. Legal waste management frameworks national and local**

In 1991, the National Constitution recognized that everyone has the constitutional collective right to enjoy a healthy environment, and it now states that the environment is a common heritage and that resources should be protected as a right of all citizens (Rolled & Grijalva, 2001). One of the essential aspects of change in this constitution is the update of policies on the environment to respond to the need for sustainable development. Section 4.1.2 of this constitution defined that the process of economic and social development of the country will be guided by the universal principles and sustainable development goals contained in Agenda 21, the Declaration of Rio de Janeiro, signed on June of 1992, article 3rd on the Environment and Development.



**Table 4.2 Chronological history of the main legal standards related to solid waste Norms and policies on Waste management in Colombia**

<b>Norm Name</b>	<b>Level</b>	<b>Relation to the solid waste management</b>
Act 2811 de 1974	National	Protection of environmental resources. National Code of Renewable Natural Resources and Environmental Protection
Law 9 de 1979 (Rules)	National	Technical regulations and environmental issues that encourage recycling processes and minimize solid waste generation
Law 99 de 1993 Colombian Environmental Policy	National	Creation of Ministry of Environment, National Environmental System-SINA in the following descending order of rank <ul style="list-style-type: none"> <li>• Ministry of Environment</li> <li>• Regional Autonomous Corporations</li> <li>• Departments, Districts or municipalities</li> </ul>
Law 142 de 1994	National	Regulation of the Domiciliary Public Services
Act 605 de 1996	National - Ministry of Economic Development	Regulation of Law 142 of 1994 in relation to the public cleaning service. The storage and presentation of waste (disposable and returnable containers), the establishment of collection routes, garbage truck characteristics and the next steps for the implementation of sweeping and cleaning of public areas.
Law 9 de 1999	National	Regulating all aspects of healthcare provision that may affect individual or collective health of the community for the public good.
Act 1713 de 2002	National	National policy for managing solid waste, based on the integrated management and provision of sanitation services in a planned way. This act created the Policy for Integrated Solid Waste Management, ISWM
Resolution 1045 de 2003	National	Methodology for the preparation of ISWM: The technical guidance and financial (costs) for installation of the ISWM

Source: author Content drawn from Aluna, 2011; Alcaldia de Santiago de Cali, 2009

In Colombia, Law 142 of 1994 established the system of public services, and Act 632 of 2000 modified the previous act and set out guidelines for municipal garbage collection. Among the actions being carried out to create public awareness among is proper management, with instruction about domestic, industrial, commercial solid waste initiatives. Since 1998, the national government, through the Ministry of Environment, Housing and Territorial Development, has been developing the National Policy for Solid Waste (Plan Nacional de Residuos Sólidos-PNRS). Decree 1713 of 2002 specifies a plan for solid waste management, Plan de Gestión Integral de Residuos Sólidos (PGIRS), for each municipality. The PGIRS is a requirement for municipalities each of whom must formulate a locally appropriate plan and prioritize actions to address problems with solid waste in an organized and systematic manner. The plan must

consist of the following: provide for garbage collection and transportation, sweeping cleaning, washing and pruning of trees in public areas, transfer, treatment, utilization and disposal of waste. The formulation of the plan should be led by the mayor of each city or town, and promote participation of different actors. The national environmental policy requires implementation of a plan in each municipality, for both hazardous and non-hazardous wastes. The preparation of PGIRS is based on resolution 1045 of 2003, which aims to promote processes to encourage minimization, use, recovery, treatment and disposal of controlled residues.

Partly due to the lack of accountability of those who produce waste, and the materials recovered and recycled, the Ministry of Environment, Housing and Territorial Development, by Law 1258 of December 2008, introduced the idea of an Environmental Summons. With this power, the National Police and other officials who control society can punish violations in cleansing and solid waste collection. The Act defines a number of offenses related to unlawful waste disposal; it prevents the curbside removal, complete or partial, of the recyclable contents of garbage bags (<http://www.mineducacion.gov.co/cvn/1665/article-187615.html>) retrieved March 17, 2013. According to Rubio (2009), the action is defined as pedagogical; however, in its essence it is merely punitive. Table 4.2 summarizes the norms and policies related to waste management in force in Colombia.

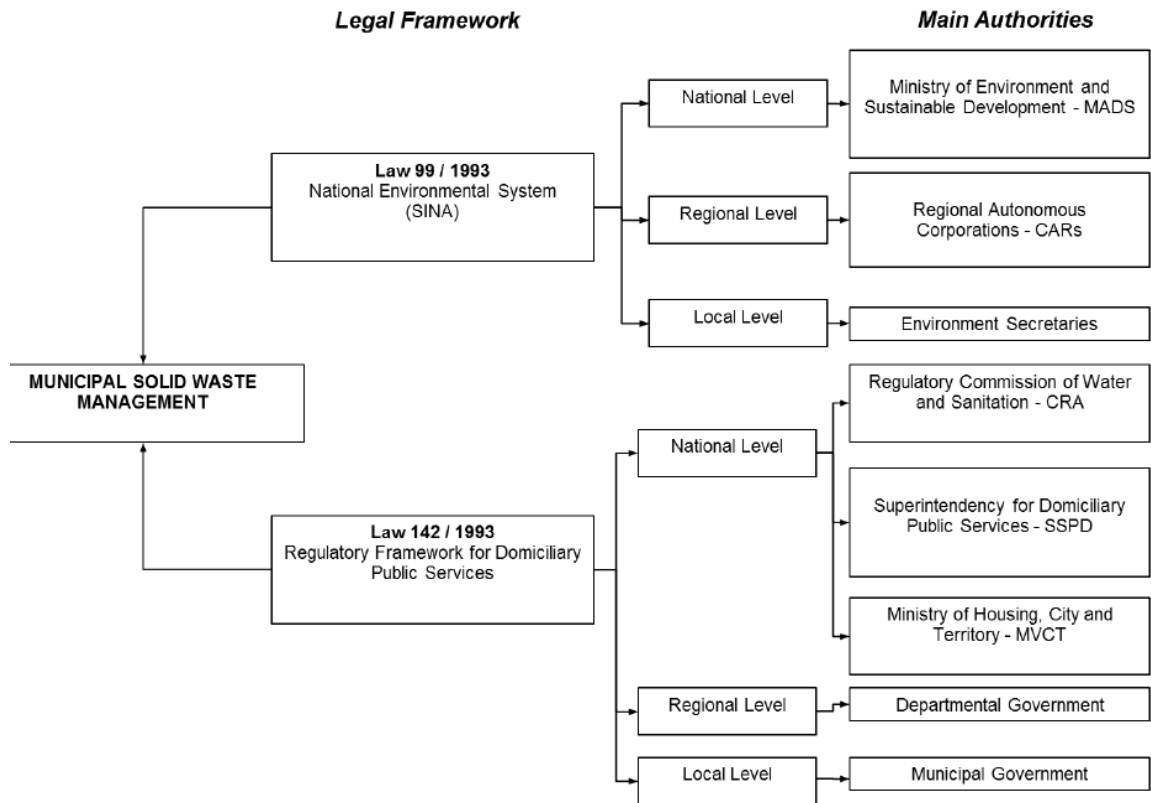
#### **4.4. Governmental responsibilities related to waste management**

In Colombia, as indicated in Article 31 of the National Constitution, waste collection service is public and the responsibility for an effective waste management plan in the country has several levels. The national government, represented by the president and the Ministry of Environment and Sustainable Development, has a relative minor role in the solid waste management of each municipality. Generally, it has a considerable influence on policy marking and sets the legal framework at a national level. The regional administration, which is represented by the Governor through the Secretary of Environment, is responsible for technical, financial, administrative support, and for controlling activity finances. It acts as a coordinating body between the nation and a municipality, promoting clean production systems and programs for sustainable development. The local level is represented by the Mayor<sup>13</sup>, who must ensure

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<sup>13</sup> Each Mayor in Colombia is elected by popular vote for a four-year period. His/her main functions are administering the resources of the municipality, ensuring the welfare and interests of its citizens, and also boosting local policies to improve quality of life programs such as: health, housing, security, education, road infrastructure and public order.

the effective provision of public services (waste collection and final disposition), directly or through a third party. In cities with a population of over two million, there is an entity called the Departamento Administrativo de Gestion del Medio Ambiente – DAGMA. Acting as technical director for the management of the environment in the municipality. Dagma is responsible for environmental policy and actions for enforcing the rules. Figure 4.5 summarizes the main laws and main authorities in Colombia.

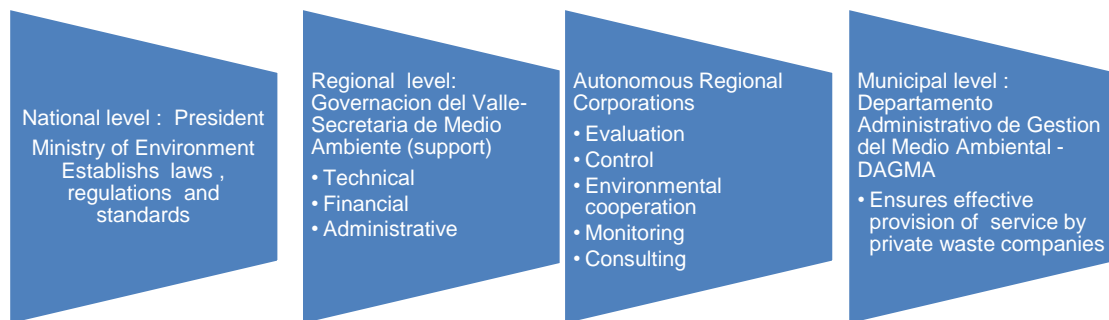


**Figure 4.5 Colombia Legal Framework**

Source: [http://waste.ccac-knowledge.net/sites/default/files/files/city\\_profiles/City%20Profile\\_Cali.pdf](http://waste.ccac-knowledge.net/sites/default/files/files/city_profiles/City%20Profile_Cali.pdf)

In Cali, there are two environmental authorities: The Regional Autonomous Corporation of Valle del Cauca (CVC), which is responsible for evaluating, controlling, monitoring, and consulting the national government in established laws, regulations and standards for the waste management, and the Dagma, which works as the local environmental authority. The several

levels of authority in Colombia related to waste management and their functions are summarized in Figure 4.6



**Figure 4.6 Colombian waste management, level of authority and functions**

Source: author content drawn from Alcaldia de Santiago de Cali, 2009

#### **4.5 The informal recycling sector in Colombia and Cali**

Overall, Colombia is a highly urbanized country whose formal economy does not generate enough employment, thereby forcing people to seek income opportunities in the informal sector. Scavengers have existed for at least one hundred years in Colombia. In the 1940s and 1950s, they became more visible on the streets of Bogota, Cali, Medellin and other cities, searching for and buying from homes items such as metals, bottles, jars, etc. In the 1980s, recyclers were affected by the closure of several dumps by government laws, resulting in the displacement of many families that supported themselves by recycling in those dumps. No scavenging activities were allowed at the new landfills (Medina, 2010).

Birkbeck (1978) argues that in Cali garbage picking is the oldest component of the recuperative system. For more of five decades recuperation has been undertaken by them. The recuperation of products began to expand around 1963 when at a national and local level the development of large-scale industries, promoted the selection of raw materials to be used in industrial processing. According to information gathered from documents, newspapers and websites, in Santiago de Cali 3205 recyclers have undertaken their work for years in the context of the informal economy. Before the close of the final disposal site Navarro, around 600 scavengers or informal recyclers worked daily on that site. The Navarro landfill's closure brings the eviction of all families and individuals who were pursuing recycling, these persons lost their "work areas". The Navarro recyclers began to exercise their duties in the urban area of Cali. As a response to this situation, the Navarro recyclers advocated blocking the entrance to the waste disposal site a few days before it closed. They later carried out the "peaceful take over" of La

Ermita church in Cali's downtown, sued Emsirva, CVC, DAGMA, city's Mayor as the representatives of the Municipality of Cali, for the right to work and imposed a Colombian tutela demanding the quick solutions to their problems (Newspaper El Pais, 2008). Since then, in 2009 the situation in Cali has been changing, with the national government supporting legitimate scavenging in the country as a legal activity. Persons doing it are now officially called recyclers<sup>14</sup>. The Colombian constitutional court, via Sentence T-291 recognizes recyclers as waste entrepreneurs, which force the municipality to work in the creation and implementation of a public policy, where recyclers of the entire city (around 3200) are included in the collection system of recyclables. The Government started a plan to help them and their families through training, housing initiatives and, social program for their families. However, the laws in Colombia, such as Law 511 of 2006 in Cali, that prohibited scavenging activities at dumpsites and landfills, forced scavengers to work at streets. This law was not particularly effective and few goals were achieved, until 2009 when the government resolved the tutela<sup>15</sup> (legal action) filed by the recyclers and issued sentences T-291 and T-411 of 2009 (See more details about Sentence T-291 on Appendix D). Additionally, Decree 2981 of 2013 states that it is the responsibility of the municipalities, in accordance with PIGRS, to implement selected routes for recyclable waste with the participation of recyclers (Alcaldia de Santiago de Cali, 2009)

#### **4.6 Multifamily residential buildings (Condominius) in Colombia and Cali**

Contemporary cities tend to grow with the development of residential buildings and groups of contained housing or multifamily units. The great cities have changed their urbanistic landscape, replacing detached house neighbourhoods with multi-residential buildings, thus increasing population density. In Colombia the concept of condominiums refers to gated communities or residential enclosures. These condominiums are configured as islets or isolated areas of the city's roads, fenced with secure access to a main road, and have inside parking,

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<sup>14</sup> Recyclers is the term used in this thesis for waste pickers or scavengers

<sup>15</sup> The Colombian Tutela: It is an accessible tool for fast enforcement of fundamental rights found in the National Constitution. This was established in the 1991 Constitution as an action to provide for the "immediate protection" of one's fundamental constitutional rights, when any of these are violated or threatened by the action or omission of any public authority (See more information in appendix D)

pedestrian networks, social and green areas of various sizes according to the economic strata of users (Maldonado and Rincon, 2006).

Pergolis and Moreno (1998) reported that in Colombia the phenomenon of confinement has been growing as a response to insecurity. Many people feel the need to live with others like them (in the same social and economic conditions). Thus, peers are isolated in different closed housing areas established according to their socioeconomic strata. Additionally, the expansion of the residential buildings in Colombia is associated with the regulation of the property horizontal<sup>16</sup> and with the creation of UPAC (purchasing constant power unit - Unidad de Poder Adquisitivo Constante - in Spanish) in the year 1972. According to the Departamento Administrativo Nacional de Estadísticas - DANE in Colombia approximately 65% of the urban population live in apartments and condominiums.

In Santiago de Cali, in the 1970s, the construction of gated communities (condominiums) began to proliferate in response not only to problems of insecurity, but also to changes of everyday life. Gated communities became the functional and economical solutions for all families of different socioeconomic strata to the problems of housing shortages. With such communities containing secure houses and large apartment buildings, urban fragmentation intensified and the model became more popular in urban development, generating the city's current oversupply of housing (Maldonado, M & Rincon, M. 2006). Currently there are condominiums comprised of houses or apartments (single houses, townhouses, apartments in buildings under to 5 floors, and apartments in large buildings with more than five floors). Each condominium is organized and has a committee constitute by owners elected annually by vote. Its function is to ensure the maintenance and organization of the condominium. The committee is in charge of hiring an administrator to perform the tasks of finance and monitoring. They are also responsible to hire the staff to maintain the cleanliness of condominium. Each owner pays one monthly fee for management and maintenance.

Moreno and Rincon (2009) studied the reasons expressed by residents for choosing multifamily housing in the city of Cali and found that the main causes of this phenomenon are linked to the urbanization and modernization of the city or the process of globalization and urban residential segregation. They reported that the city had 1,478 condominiums in 2006, housing

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<sup>16</sup> Property horizontal is the legal term used in Colombia for an apartment in a high rise

nearly 25% of the total population in the urban area of the city. According to the existing socioeconomic classification in Cali, Moreno and Rincon reported that socioeconomic strata five had the highest number of residents, followed by strata six, four and three. The southern sector sees the biggest trends in condominium construction, especially for four, five and six. Strata two and three are associated with reduction of the costs of housing and public services due to government subsidies. In summary, the factors involved in the transformation of Santiago de Cali are diverse:

- changes in the conception of the modern city project,
- intensive land use
- increase in the value of land per square meter
- advances in industrial production, engineering and construction materials
- increased insecurity and the need to reduce exposures to the same
- evolution of family forms

In 2001, Colombia enacted law 675 regulating the planning of horizontal property and in 2002, national government issued Decree 1713 of The Commission on Regulation of Water and Sanitation <sup>17</sup>(CRA in Spanish), and through Resolution No.233 of October 2002 CRA was responsible for regulating rates for waste management service. It also defined the regulations of "Multiuser waste management services for residences" with the objective of promoting the reduction, separation at source and use of waste produced by this type housing. Multiusers are all users grouped dwelling units, residential centers, condominiums or similar under the horizontal property administration or concentrated in commercial or similar facilities, characterized in that they have put out in a specify place their solid waste to the person providing the service and that requested the capacity of their waste to this measurement. The person providing the service will bill each property individually, only if the condominium is registered as a multiuser in full compliance with the regulation is issued to this purpose. By national law each condo should have an adequate storage room for keep the waste and recyclable products in labeled containers. Each waste storage room must comply with the technical construction as coating material for the walls, odor control and ventilation, cleaning

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<sup>17</sup> The CRA is a Colombian governmental institution intended to regulate and improve the sustainability of drinking water and basic sanitation (waste management) services, warranting the provision of quality services at reasonable rates and broad coverage.

and fumigation. Verification in compliance with these standards and the supervision of these rooms is in charge of the municipal health secretary.



## Chapter 5

### Interview and questionnaire results: A description of the current waste management system in Santiago de Cali

#### 5.1 Interview results

Personal interviews were conducted with representatives of regional and local environmental authorities, the Municipal Planning Department, the Fundacion Carvajal-NGO, Cali's recyclers association, private waste collection companies, and a recycling businessman. The information obtained was classified and summarized following the framework on environmental, social and economic aspects.

##### 5.1.1 Main characteristic of Cali's multifamily recycling program

In Cali, currently the population is served by curbside waste collection. The waste, collected three times per week, includes residual waste after recyclables have been separated by residents within the house (separation at the source) or by recyclers before collection. The waste collection service in the city is divided into four areas and is provided by four private waste-management companies. Table 5.1 shows the current waste service companies and their respective work areas. Collection of waste from institutional and industrial buildings also relies on container services, and collection is done along special routes, such as the hospital route, which provides special service for hazardous waste generated in hospitals, clinics and laboratories.

**Table 5.1 Waste service companies' distribution of coverage zones**

Waste service company	Collection areas
Promoambiental Cali	Residential communes 2, 4, 5, 6, 7 and 8 additionally made services of collection and transportation of waste generated by big producers and special services and hospital route.
Empresa Metropolitana de Aseo-Cali, EMAS	Residential Communes: 11,12,13,14,15 and 21
Promoambiental Valle	Residential communes 10,16,17,18 and 22
Ciudad Limpia	Residential Communes: 1,3,9,19 and 20 (Downtown) Services: waste collection, Street sweep, transportation and handling of debris

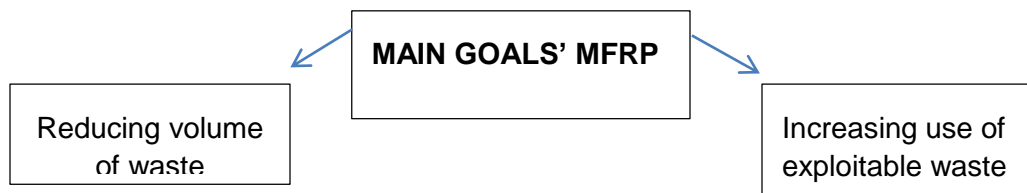
Source: Alcaldia de Santiago de Cali, 2012

The garbage collected by the four operators is transported daily to the transfer station (TS) La Caucana. In this TS, the garbage is sorted and compacted to be delivered for final

disposition to the landfill Coloma- El Guabal at Yotoco. The owner and operator of this landfill and the TS is Interaseo del Valle S.A, a private company that received in 2008 a concession from the municipality for the operation of the landfill for a period of 20 years. Each waste management company pays Interaseo del Valle-S. A a fee by the ton for disposal in the landfill.

According to the CVC representatives, Cali has an advanced country Integral Plan of Solid Waste Management<sup>18</sup> : the Plan de Gestion Integral de Residuos Solidos- PGIRS”, signed in December 2004, for development over a period of 15 years (2004-2019). The PGIRS, which works to find social, economic and environmental solutions that benefit all citizens and future generations, has as its main goals the preservation of the environment, the implementation of clean technologies in waste management, and the economic support for closing of the Navarro landfill, as its capacity had been exceeded.

Solid waste management in the city follows the national laws which have been defined in harmony with guidelines stated worldwide by international agreements such as the Rio and Johannesburg summits. The hierarchy of goals is comprised of prevention, minimization, reuse, recycling, recovering and finally disposition.



**Figure 5.1 Cali's PGIR's main goals**

Source: Author, Content drawn from Interviews,2013; Alcaldia de Santiago de Cali, 2008

Law 0475 of 2004, and has as its primary goals of diverting, reducing the volume of waste and increasing the use of exploitable waste (Figure 5.1). Other considerations mentioned in the

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<sup>18</sup> The Plan de Gestion Integral de residuos Solidos- PGIRS, a municipal policy, has a primary goal to divert waste, with reduction of the negative impacts on the environment and human health, as well as to promote the value and use of waste and the acquisition of new technologies. Citizens are encouraged to develop recycling strategies that will increase the proportion of materials incorporated into productive cycles, with the participation of the community and encouragement of inter-sectorial work (Alcaldia de Santiago de Cali, PGIRS, Manual Conjuntos Residenciales, 2008)

interviews about the goals proposed in the program are: 1) the responsibility of each resident to use waste bags and, 2) environmental projects as the priority of elementary and secondary schools.

### **Economic Aspects**

According to representatives of Municipal Planning, CVC and Dagma, the cost of waste collection and transportation in the city has increased, as well as service fees. They commented that Cali has one of the most expensive collection service fees in Colombia. This collection service fee to each home covers street sweeping, garbage collection, transportation, transfer, and final disposal. Additionally, expenditures on waste management have varied in the last ten years due to changes in the management of the transfer station facility and transportation to the sanitary landfill Yotoco; which, as mentioned, is located 45 km from Cali. These new processes are now included in the system, making the service more expensive. The costs are distributed among all users; however, they pay according to their income-level. For instance, with the increases, the waste collection fee for an apartment located in socioeconomic strata SE- 3, which is not eligible for subsidies rose 57.14%: from \$7000 Colombian pesos in 2011 to \$ 11000 in 2012. As a consequence, municipal interest has grown in reducing the quantity of garbage generated and transported.

The waste collection service fee is regulated through a national law issued in 1994 (Law 142 Regimen de Servicios Publicos Domiciliarios <sup>19</sup> ). This law determines which groups are to be targeted for charges including owners of any business activity, industries, shops, and households. This law specifies that adjustment to a service fee be conducted based on economic changes and the need to increase service to the public.

Since 2005, Cali introduced for multifamily residences (multiusers) a multi-user pricing system, known as Pay AS Your Throw (PAYT) or Pay By Use (PBU). This voluntary economic incentive is aimed at reducing solid waste generation. The key in this system is that collectors will deal with groups of households, instead of individual households. The rate for collection

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<sup>19</sup> Law 142 Regimen de Servicios Publicos Domiciliarios: In Colombia this law organizes the socioeconomic stratification as an indicator that regulates the charging of fees for public services (electric power, public water supply, garbage collection and household gas). Stratification has been designed to facilitate the application of differential tariffs for different users of domiciliary public services and help the population with fewer resources (Rosero, L.2004. p. 54).

service is calculated based on a predetermined fixed cost plus a variable cost that corresponds to the density and volume of waste generated (Emsirva, 2005)

In conversation, with Ciudad Limpia staff they reported that the service fees collected from the users are sufficient to cover all the costs of the city's urban solid waste management program. Empresas Municipales de Cali office (a government owned water and electricity Corporation) collects the waste collection fee. Recipients of Emcali's service who use electricity also pay waste removal fees at the same location that they pay their electricity bill. According to waste collection companies' representatives, this scheme has been satisfactory.

### **Social Aspect**

The PGIRS' Cali articulates different actions leading to the implementation of a policy to ensure the community understands' the value of waste minimization and recycling activities. Active participation of the community is encouraged to improve quality of life, ensure environmental improvement of the city, and increase the socially organized participation of informal recyclers (scavengers). The motto included in the Official Municipal Plan is "Towards living a dignified life" [Para vivir la vida dignamente – in Spanish]. Moreover, the PGIRS promotes initiatives to ensure that this generation and following ones have a decent living without affecting the environment.

Interviews with key people working in waste environment field show that in Cali the PGIRS' implementation and development changed after judgment T-291 in 2009. The Municipality of Cali in coordination with the Waste Management Companies, the Regional Autonomous Corporation (CVC), and the Administrative Department of the Environment (DAGMA) have worked to link the petitioners (recyclers) with alternative employment and livelihood as:

1. Temporary work solutions to ensure survival,
2. Business solutions to ensure survival and
3. Peripheral solutions to allow subsistence

#### **5.1.2. How well does the MFRP meet the criteria of environment effectiveness, social acceptability, and economic affordability the three pillars of ISWM?**

##### **Environmental effectiveness**

The effectiveness of a waste management program is based on the support of law at the national, regional and local levels and should be led by governmental and environmental

institutions. In Cali, the PGIRS and the MFRP have the support of the government through the implementation of laws that have created the program and established the participation of governmental entities, the community and private sector.

At the regional level, the CVC is the environmental authority, which assumes responsibility for the implementation of policies, plans, programs and projects on environment and renewable natural resources. Likewise, the CVC in accordance with Law 99 of 1993 may promote and develop works and programs for water management, land improvement and complementary services that enable and intensify land use and ensure higher productivity. All of these activities are aimed at promoting sustainable development. CVC is in charge of controlling and monitoring the closure of the Navarro landfill and preventing contamination of water, air and soil generated by leachate at the landfill (Personal interview, CVC representatives, March 2003).

At the local level, DAGMA is the environmental authority, responsible for monitoring and providing technical assistance to the MFRP. DAGMA, however is a non-operating entity, acting only as overseer. The Dagma' representative interviewed emphasized that DAGMA as a local environmental institution has little or no responsibility for administering solid waste practices in the city. However, it has overseen the clean-up and eradication of illegal dumps and maintains control to prevent new open dumps from being created within the city. In addition, all government institutions have worked on linking students to environmental projects whose priority is to improve environmental conditions and reduce environmental impacts, as well as to educate the young on environmental responsibility.

An interview at Ciudad Limpia (Waste Collection Service Company) on March 2013 revealed that, in Cali the four waste service companies are hired by the Mayor to collect and haul solid waste, and to clean the roads. They also promote the MFRP's educational campaign in condos that participate in the program. Additionally, each waste collection service company is responsible for keeping users informed about collection times, and how to present their waste for proper collection. Citizens have participated in cleaning campaigns promoted by the Mayor and in educative recycler's fairs.

At the household level a representative of Municipal Planning commented that in Cali there is a responsibility for each person to handle the garbage generated at home. Moreover, according to the PGIRS, residents should sort, separate and present their waste in plastic bags.

The plan promotes the separation of recyclables and organic waste in order to prevent contamination of recyclables. The results of the implementation of the MFRP in Cali have shown that the simplest program established tend to work best, and that the best results have been obtained using only two colors of bags: blue for paper and cardboard, and green for organic waste. Nevertheless, the issue of sensitizing people to recycling has been difficult because as some people commented "I don't like to recycle because waste is mixed in the truck collector". Still, the municipal government is working on raising awareness in the population by showing the social, economic and environmental benefits that recycling provides (Personal interview, Departamento de Municipal Planning's representative, March 2013). CVC in collaboration with the municipality of Cali Municipal Planning has conducted a campaign to educate the community on the benefits of separation at source (Personal interview, CVC's representative, March 2013)

### **Social acceptability**

People interviewed at CVC, Dagma and the Municipal Planning Department agreed that the government has recognized the labour of recyclers as positive and are working to motivate the community to support the work of recyclers inside of condos. In Cali, law has changed the term of "recyclers" to "environmental reclaimers" (Recuperadores ambientales - in Spanish). The national government has also declared one day to be the National Day of Recyclers, in order to dignify the profession.

As mentioned before the judgment T-291 changed the PIGRS and the social focus, by making, the work of recyclers a priory. The local authorities worked together to find a solution to social conflict created by the closure of the Navarro landfill. The Fundacion Carvajal-ONG was hired by CVC to work with recyclers and their families to improve their social conditions. The first step was a census of recyclers and their families, which collected demographic, social, and economic information. Subsequently, priorities were established, and recyclers and their families were trained in several aspects such as leadership and conflict resolution between recyclers, parents and couples relationships.

The interview with the Fundacion Carvajal reported that 1700 recyclers have participated in the training conducted by the Fundacion and the Servicio Nacional de Aprendizaje (SENA – a public national college). These recyclers received training for three years and were certificated as technicians in recycling activities. They also learned accounting strengthen their grasp of aspects such as purchasing and management software in order to efficiently self-manage their

recycling businesses. As well as, they were trained in the preparation of business plans, work proposals, budgets, and government paper work.

### **Economic affordability**

The social conflict with recyclers (scavengers) generated by the closure of the Navarro landfill was resolved by the Constitutional Court, which recognized their fundamental rights and the status of their recycling businesses in judgment T-291 in 2009. The Mayor of the city, Dr. Rodrigo Guerrero Velasco (2010-2015), has worked specifically with the Navarro recyclers group, whose members have benefited from a national law and Tutela <sup>20</sup>: guardianship requiring the Mayor to ensure the right to work for this group of people. There is currently a committee comprising representatives of the entities involved in environmental and solid waste management in the city. They are responsible for compliance with the requirements made by the national government. The main objective of this committee is to define a selected route for recovering products in the urban area of the city that integrated recyclers as permanent workers (Personal Interview, CVC's representative, 2013)

The CVC has been working jointly with other entities such as municipal planning, DAGMA and the NGO Fundacion Carvajal in the Integrated Waste Management Program (Plan de Gestion Integral de Residuos Solidos (PGIRS)-in Spanish) and more specifically in providing solutions to the tasks required to meet the demand filed by recyclers in Cali (Judgment T-291). Related to the permanent work of recyclers in the new selective routes, persons interviewed declared that:

“Recyclers are the right people for recycling activities in the city. They have been trained and certified as recycling professionals”. However, it has been difficult to integrate recyclers inside the condos. Both the municipality and public entities are working to create a new law that will oblige people to deliver recyclable products to recyclers working within the condos (Personal Interview, CVC's representative, 2013)

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<sup>20</sup> See Appendix D for details about the Colombian Tutela and statements of judgment T-291

Currently a national law, 1259 (2008), bans recycling activity on streets and at the landfill area, but in Cali this law was modified by a 2011 amendment 1259 and Decree 1713 (2008) to allowing temporary recycling in streets (Personal Interview, CVC's representative, March 2013)

On the other hand, according to information provided by one local authority, implementing the MFRP and achieving source separation program and recycling in with participation of recyclers working as staff within condominiums has been very difficult. The majority of condos have a conflict of interest with government goals, as they want to use recyclable products for their own benefit. Moreover, the authority emphasized that there is no law requiring condos to deliver their recyclable material to recyclers or permitting recyclers to work within condos (Personal interview, Department de Planeacion Municipal, March 2013)

The Association of Recyclers Cali (ARC) stated that, currently, recyclers are working on several fronts to achieve compliance with the provisions of the law. Those members interviewed also affirmed that, at present, the recyclers are organized. They have created associations to work with recycling organizations, which are generating economic benefits to recyclers and great benefits to the environment and the city. Example of these associations in Cali are: Suframe, Redecol, Arena and Ecofuturo. The ARC's motto is "We are telling the community that recyclers want to be part of a solution; we are organized and we hope that people in condominiums will believe in us and allow recyclers to work inside of condos on recycling activities" (Santo Espolito Murillo, Manager-ARC). Unfortunately, there are few condominiums in the city who have contracted recyclers as part of their staff.

Judgment T-291 made it a priority for entities such as CVC, Dagma, and Municipal Planning to help recyclers become entrepreneurs. Thus, the CVC invested 815 million Colombian pesos in educating recyclers in technical and business skills. CVC also financially assisted recyclers so as to address their tax debt with the government, and facilitated them with seed capital. This investment was necessary because the state entities for which they offered their services are slow to pay, and they needed money to survive and to fulfillment their contracts.

Another important economic aspect mentioned by Fundacion Carvajal-NGO, concerned the recyclers hired for full-time work. They had problems following schedules and with a monthly salary, because when they are used to work recycling they did not require follow a work schedule and received dairy money from selling the recyclable material recovered. In their new



works, recyclers as formal workers were required to follow a schedule work and receive a monthly paid. This led to conflicts because they could not manage their household finances. Fundacion Carvajal helped this group of recyclers to create a cooperative in order to solve these issues. The cooperative was responsible for facilitating credit to recyclers. Members can now acquire major groceries and toiletries and pledge to pay monthly when they received a payment. Additionally, new jobs were created in the cooperative for other recyclers or members of their families.

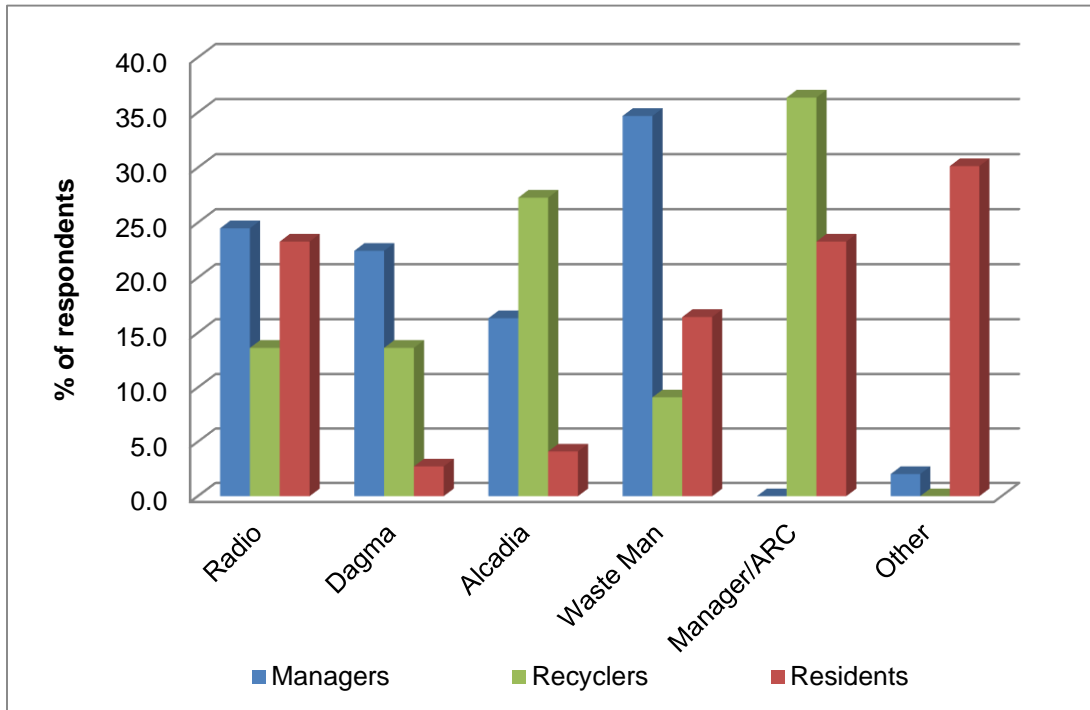
Interviews with waste-service company representatives show that they also are participating in the development of the MFRP in the city; for example, Ciudad Limpia (a waste service company) has generated employment for many Navarro's recyclers who lost their means of earning a living. These persons work for Ciudad Limpia full time cleaning roads and receive a monthly salary, health benefits and a pension plan.

Related to stores that recyclers sell recyclables, a Municipal Planning representative mentioned in the interview that the legalization of these stores has been difficult because they need to meet legal and institutional requirements. The majority of such stores are located within areas where they create conflicts between neighbours or they are not allowed because they are in residential areas as defined by Cali's land-use plan.

## **5.2 Questionnaire Results**

The following sections present an overview of the survey data on the Multifamily Recycling Program (MFRP) collected from residents, condo managers and recyclers, as main actors or participants in the program.

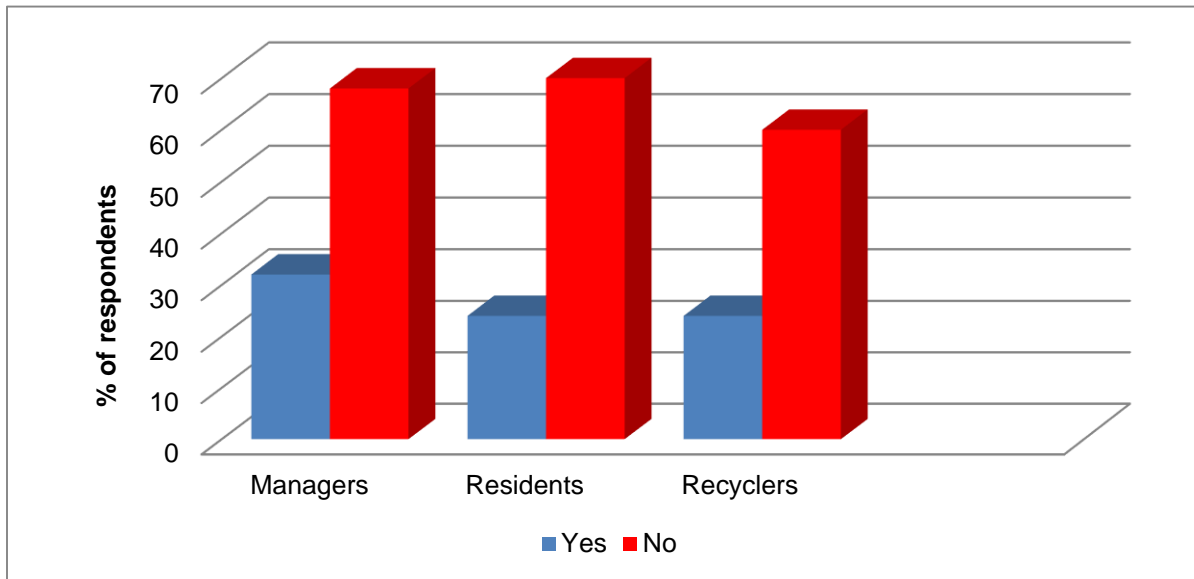
### 5.2.1 Characteristic of the MFRP



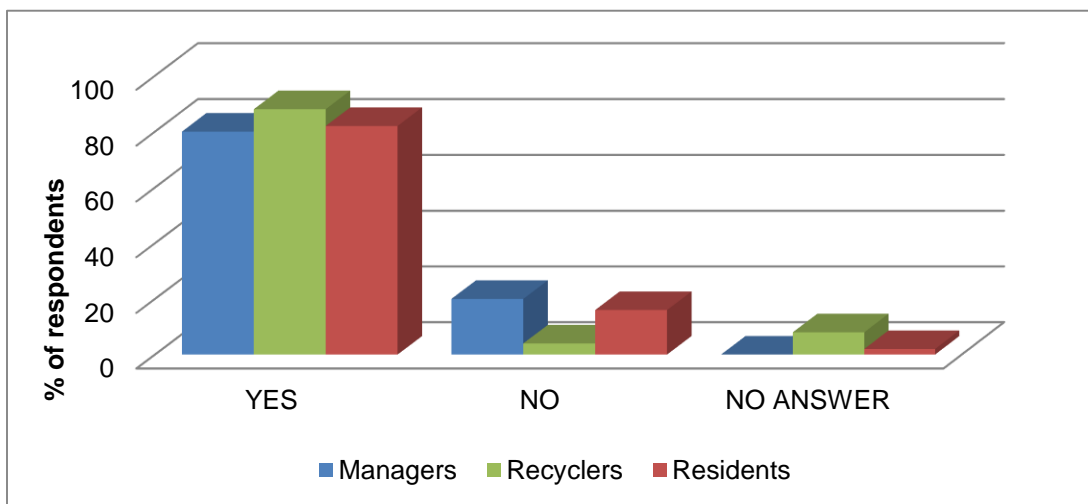
**Figure 5.2 Results from surveys of managers, recyclers and residents about advertising of MFRP**

Results from surveys of manager, recyclers and residents show that condo managers clearly recognize the work being done by the waste service companies: 34 % of the managers know about MFRP from the waste services companies; while, 31.3% of the recyclers and 30.1% of the residents know about it from friends (Figure 5.2). The most surprising result was that so few respondents identified Municipal Planning as a source of program information, although this governmental entity advertises extensively on radio and television: 16% of the managers and 4% of the residents know about the MFRP from information received from Municipal Planning. On the other hand, 24% of the managers and 23.3% of the residents know about the MFRP from advertisements. Not unexpectedly, recyclers tended to know that their association (ARC) had provided information about the program: 25% of the recyclers know about the MFRP from ARC.

Managers, residents and recyclers were asked about the success of MFRP's publicity in the condo communities. They agreed that the MFRP publicity has had little success in the condo communities. The majority of participants answered "NO" to this question (68% of the managers, 70% of the residents and 60% of the recyclers) (Figure 5.3).

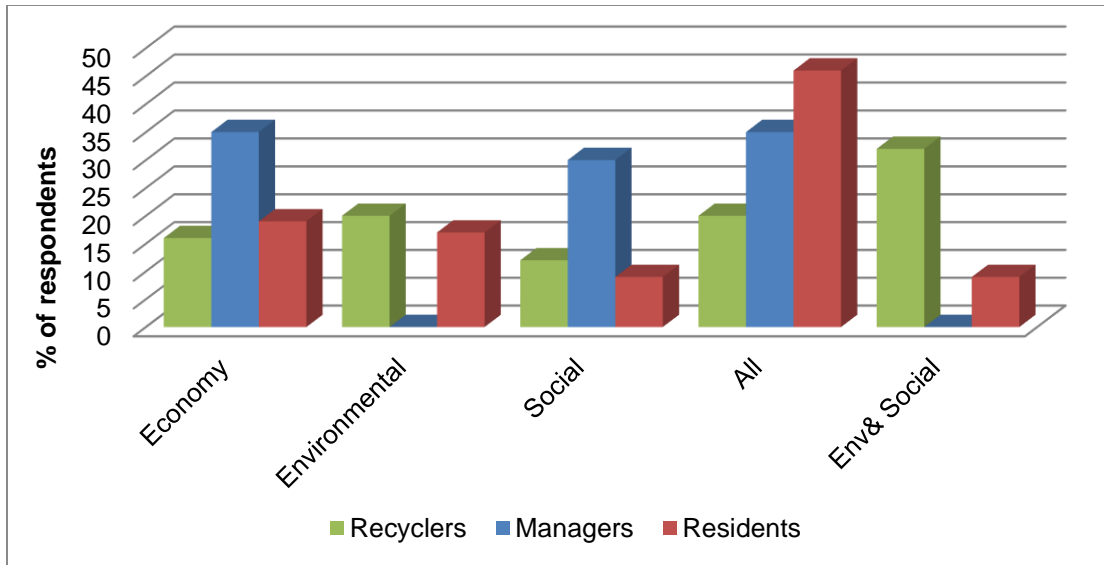


**Figure 5.3 Effect of the MFRP's advertising on condo communities**

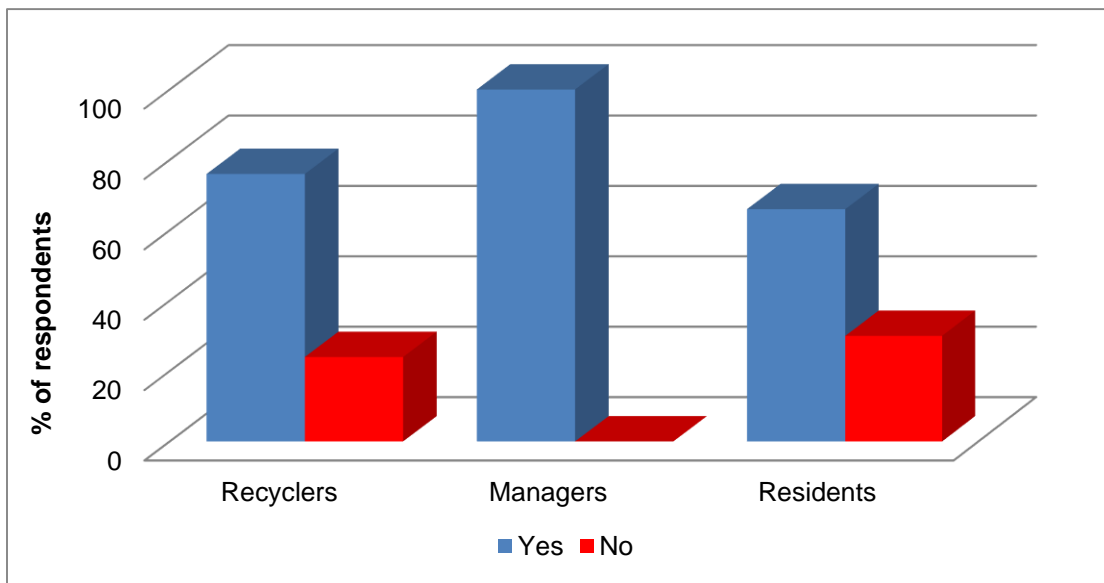


**Figure 5.4 Knowledge of participants about benefits that the MFRP could generate in Cali**

When asked whether they thought the MFRP had benefits for the community, a high percentage of survey respondents answered yes: 88% of recyclers, 82% of residents and 80% of managers (Figure 5.4). Respondents were also asked to indicate what benefits the MFRP could generate for the community, choosing from the following alternatives: economic, environmental and social benefits. 46% of residents and 35% of managers agreed that the MFRP generate all benefits suggested (economic, environmental and social), while 32% of recyclers responded that it generates social and environment benefits (Figure 5.5).



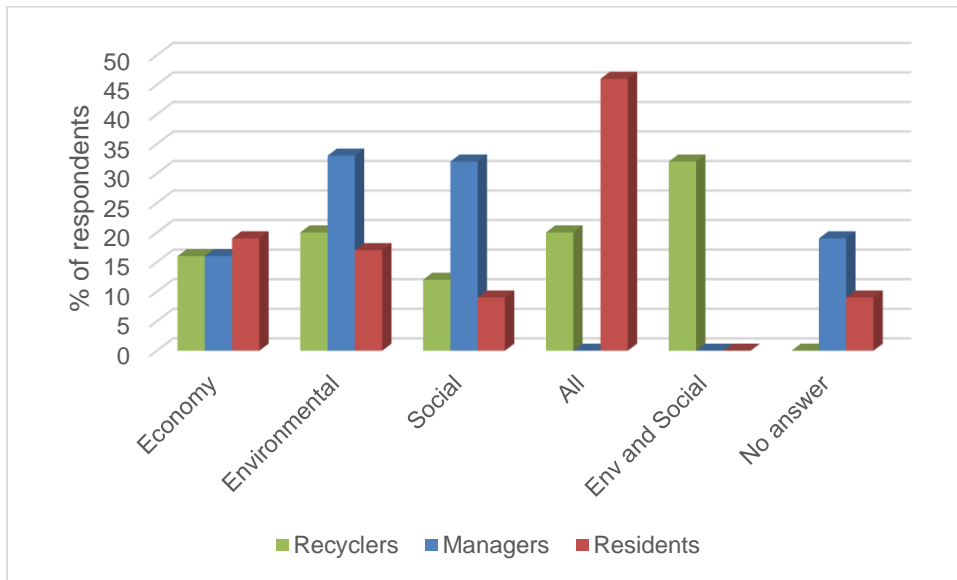
**Figure 5.5 Opinion about kind of benefits that the MFRP could generate**



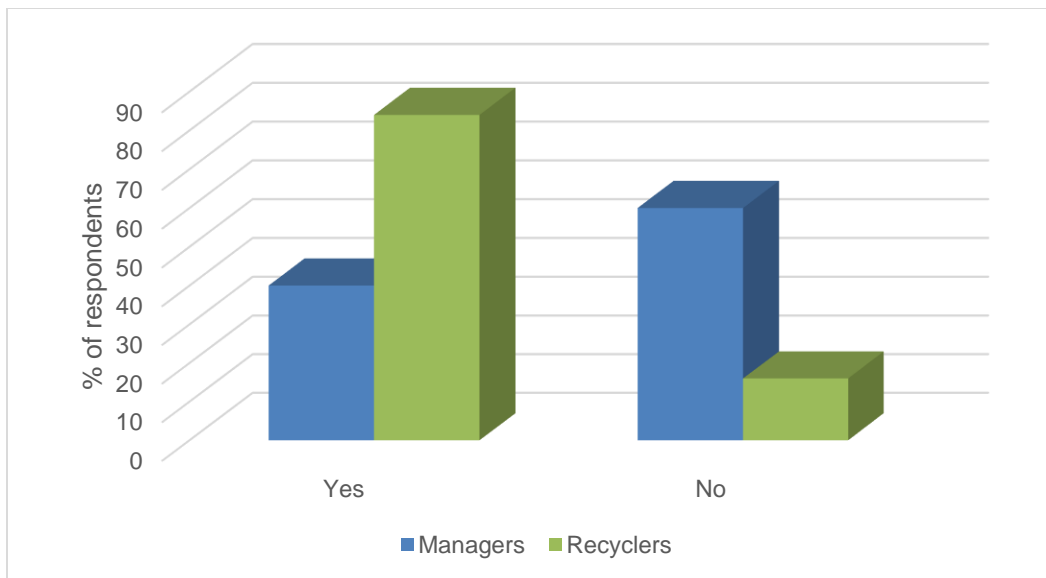
**Figure 5.6 Percentage of respondents receiving benefits from the MFRP in Cali**

Participants also reported about the benefits received from the MFRP, choosing from the following alternatives: economic, environmental and social benefits: 100% of managers, 76 of recyclers and 66% residents had received benefits from the MFRP (Figure 5.5). The previous information was supplemented by the question about the kind of benefits received by them from the MFRP: 46% of resident participants answered they had received all benefits (social, environmental and economic), while 32% of recyclers chose environmental and social benefits and 33% of managers answered they had received only environmental benefits. In contrast few

recycler participants had received environmental benefits (12% only), and a small number (9%) of residents recognized that they had received only social benefits from the MFRP (Figure 5.6).



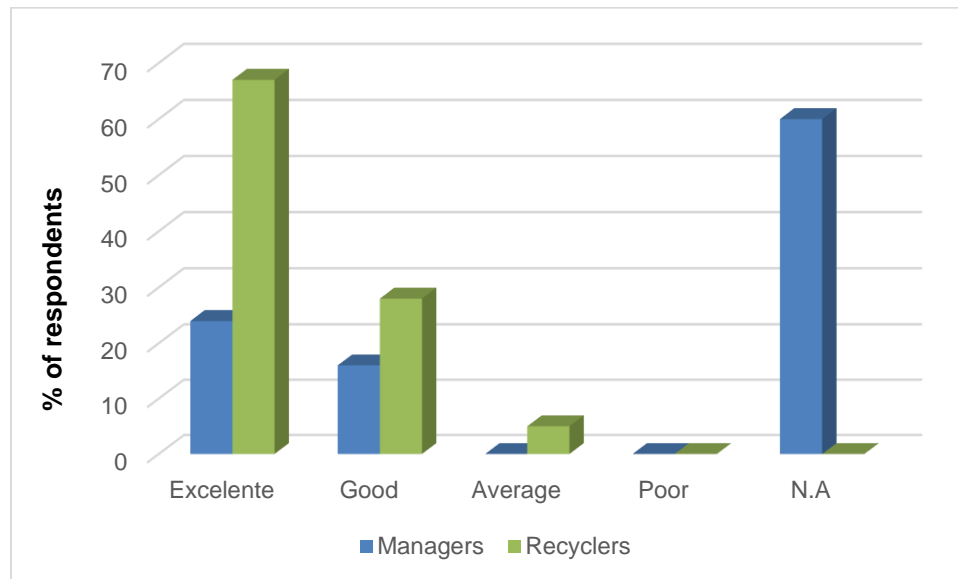
**Figure 5.7 Benefits received by respondents from the MFRP in Cali**



**Figure 5.8 Training received by managers and recyclers**

People interviewed reported that the Fundacion Carvajal-NGO and the waste management companies trained recyclers and managers in aspects related to MFRP and

recycling. Of all participants, 84% who were recyclers, and 40%, who were managers reported that they had received training (Figure 5.8). The rating of this training shows that the majority (67%) of recyclers believe that it was excellent, whereas only 24% of managers rated the training as excellent. The majority of managers (60%) did not answer this question (Figure 5.9).

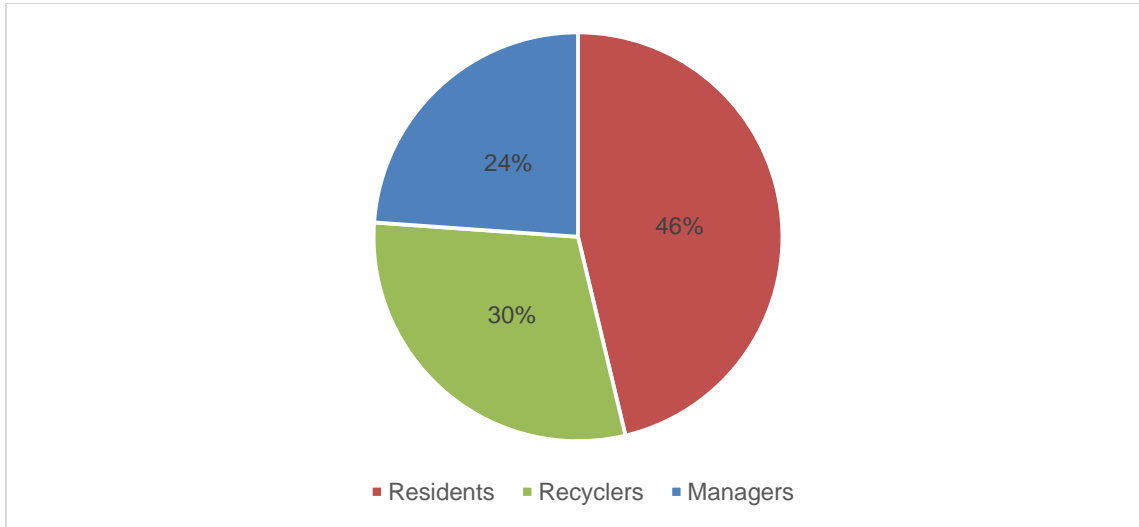


**Figure 5.9 Rating of training received about MFRP by managers and recyclers**

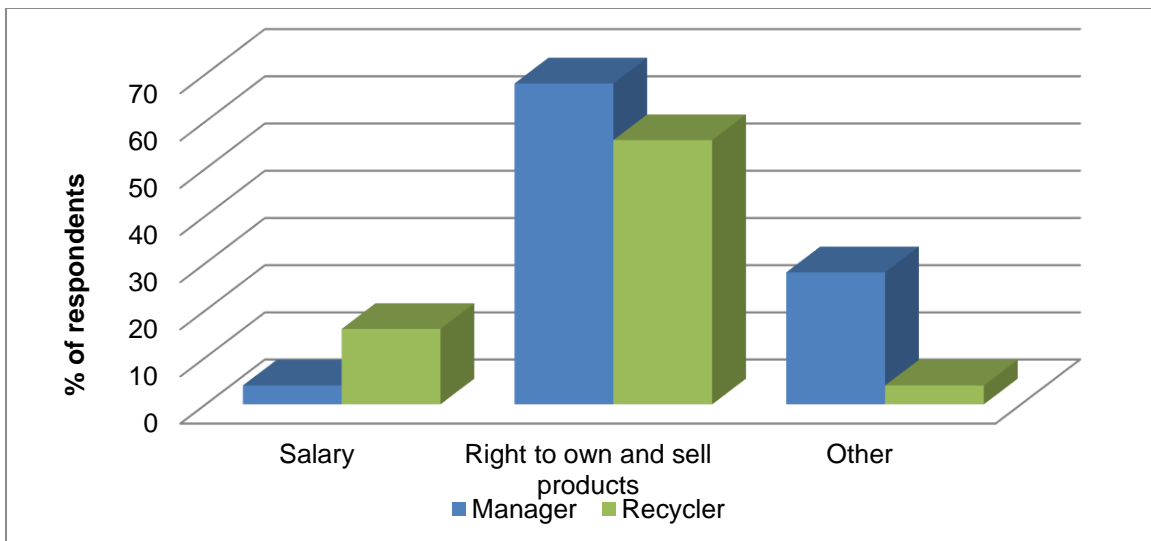
### 5.2.2 Economic Aspects

When participants answered questions about the economic benefit that they received from the MFRP: 31% of residents, 20% of recyclers and 16% of managers agreed they had received economic benefits. For instance, several recyclers were hired by the mayor and waste service companies to clean public areas and cut trees. Condo managers and residents also, reported that they had received economic benefits by selling recyclables products recovered within condo. This profit is used for social activities of residents (Figure 5.10). Recyclers and managers were questioned about what economic benefit was received by recyclers working within condos. From the following alternatives, participants were asked to select one option: a) A salary b) Receives the recovered items and sells them for financial gain, and c) Other. The majority of participants (68% of managers and 56% of recyclers) agreed that informal recyclers working independently in condos have only the right to own and sell the products they collect for their financial gain. Few participants (4% of managers and 16% of recyclers) answered that recyclers received a monthly salary or are hired by each condo's administration. A small number

of recycler (4%) and (28 %) of managers answered that recyclers receive “other” economic benefit from their services, but they did not give a specific answer about the type of payment that recyclers receive (Figure 5.11).



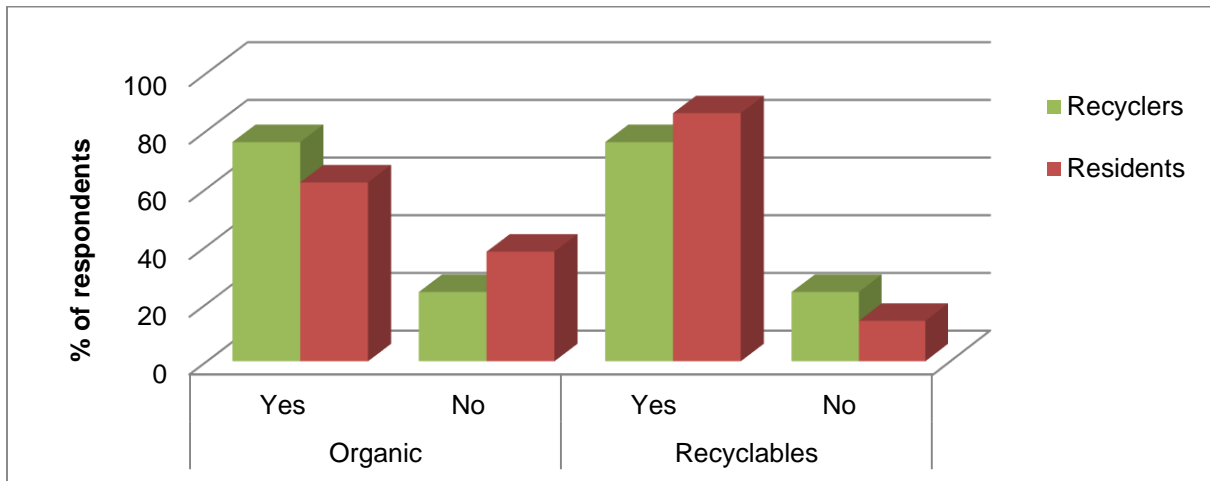
**Figure 5.10 Economic benefits that participants received from MFRP**



**Figure 5.11 Kind of economic benefits received by recyclers working within condos in Cali**

### 5.2.3 Environmental Aspects

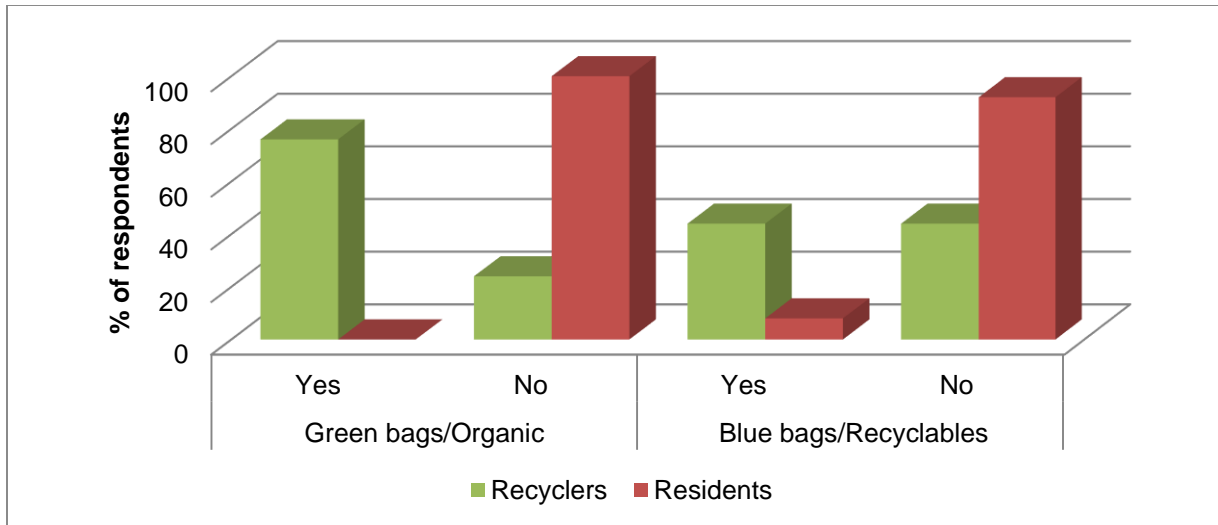
Recyclers and residents were asked about the kind of bags were being used to dispose of the organic waste at home. The answers show that the majority of recyclers and residents agreed that people prefer grocery bags: 76% of recyclers and 62% residents agreed that organic waste is disposed of in grocery bags. When participants were asked about the kind of bag used to dispose of recyclable products at home: 86% of residents and 76% of recyclers answered that residents prefer grocery bags (Figure 5.12). When recyclers and residents were asked about the use of the coloured bags (blue and green) sold as part of the MFRP, 76 % of recyclers believe that people are using green bags to dispose of organic waste and 100% of residents answered that they are not using the green bags. In contrast, 92% of residents answered that they are not using blue bags to dispose of recyclable products, and 44% of recyclers believe that people are using the blue bag (Figure 5.13).



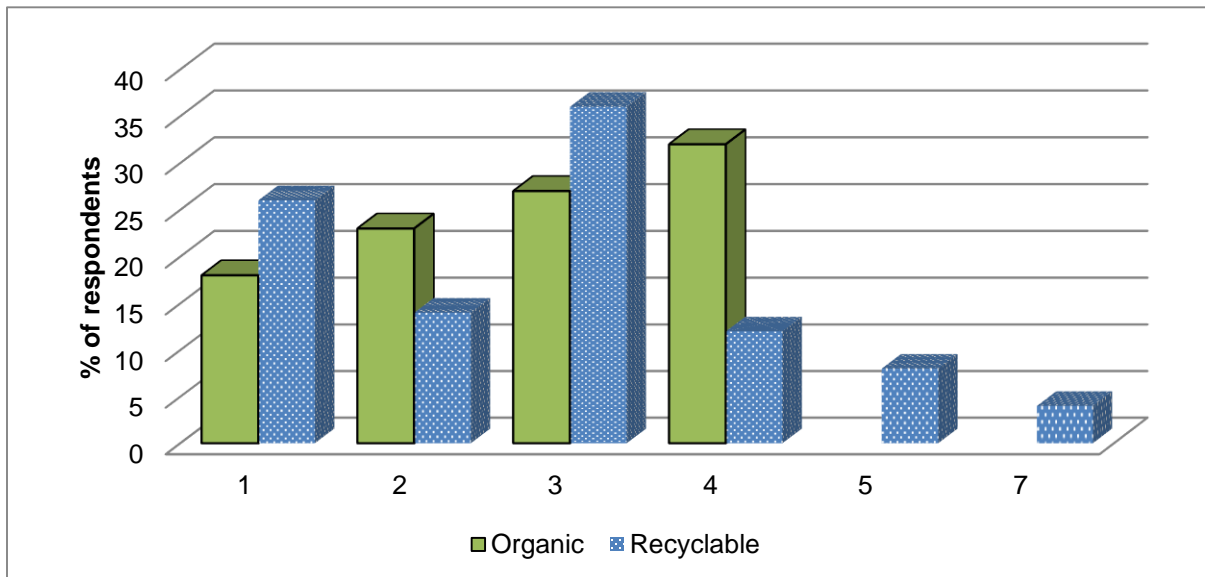
**Figure 5.12 Information about the use of grocery bags to dispose of waste in Cali**

In the questionnaire, respondents were asked how many bags of organic waste they did put out for disposal on average per week. To help respondents estimate their waste generation in terms of number of bags and size, and so unify their answer, examples of the bags sizes were shown to respondents. Survey results showed that 36% of residents reported generating three bags/week of recyclable products, and 32% of residents generated four bags/week of organic waste (Figure 5.14). Statistical analysis reported the mode as 5 bags /week.





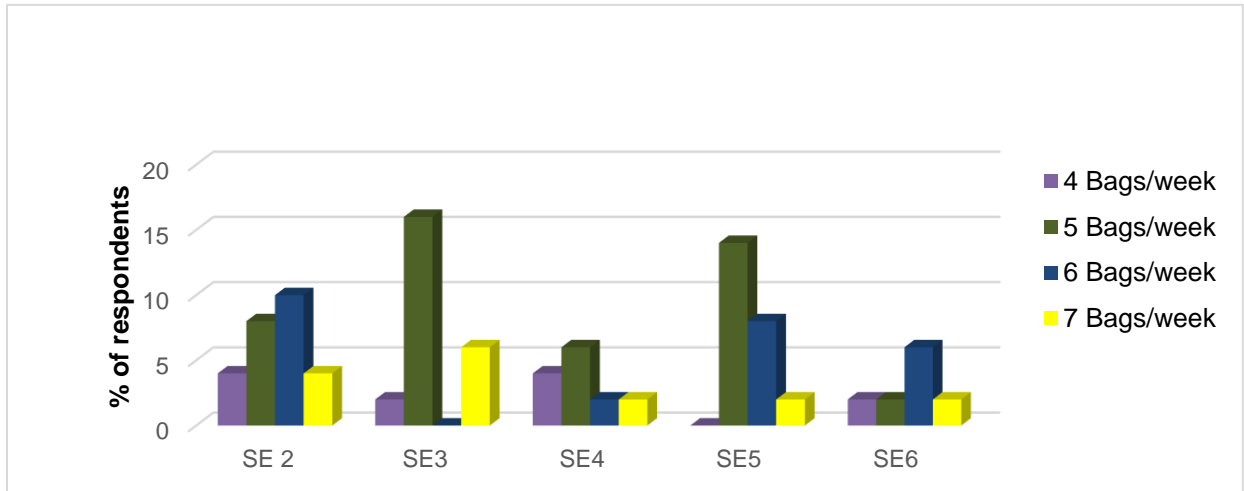
**Figure 5.13 Use of colored bags (Percentage)**



**Figure 5.14 Average of number of bags disposed of weekly by residents surveyed**

In terms of how waste generation increases with income, the analysis is performed taking into account the number of organic bags disposed of weekly by socio economic strata. As mentioned in 4.5.1, in Cali, there is a socioeconomic classification into six groups (Low level = 1 and high level= 6).The results show that 10% of the residents in SE 2 dispose of 6 bags/week; 16% of the residents in SE 3 dispose of 5 bags/week; 6% of the residents in SE 4 dispose of 5 bags/week; 14% of the residents in SE 5 dispose of 5 bags/week, and 6% of the residents in SE 6 dispose of 6-bags/ week (Figure 5.15). This data is summarized in Table 5.2 .This information

was also analysed statistically, the results of the statistical tests (Appendix F) indicate that the number of bags disposed of weekly is not dependent by SE strata [ $p= 1.33E-09 <0.005$ ].



**Figure 5.15 Percentage of bags disposed weekly, classification by SE strata**

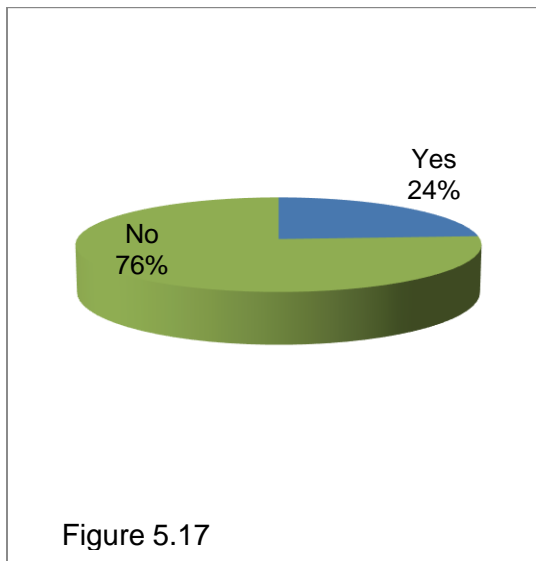
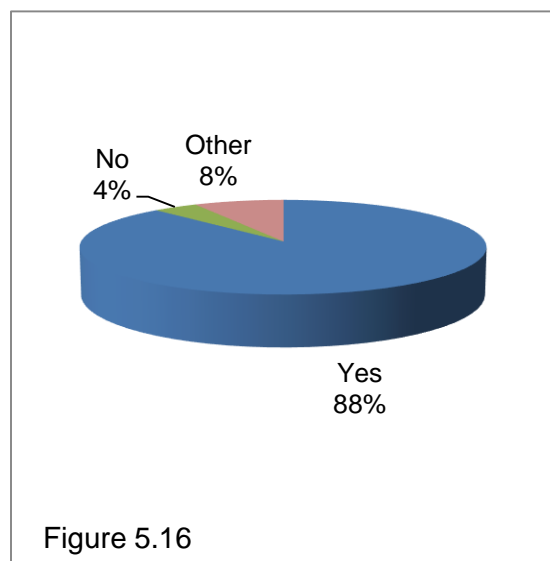
**Table 5.2 Average of number of bags dispose of weekly classification by SE strata**

Socioeconomic Strata	Average of # bag/week	
	Organic	Recyclable
2	6	3
3	5	4
4	5	2
5	5	2
6	6	2
MEAN	5	2

Managers were asked if there is an adequate room inside of each condo for storing waste and recyclable products. 88% of condos surveyed have a room for storing organic waste and recyclable products; 4% did not have a room; and, 8% gave other answers. For example, “it is in the process of remediation/ being built”, or “there is not space available for it” (Figure 5.16). It is important to note that all condominiums in Cali by law 675, 2001 must have adequate

room to store their garbage (organic and recyclable), and they should abide by this law of condominiums about the features of this room<sup>21</sup>.

Information about the use in condominiums of labeled cans (green or blue labels used for organic waste and recyclable waste cans respectively) was obtained from condo managers: 76% answered “No”, and 24% are using this identification on the condo garbage cans (Figure 5.17).



**Figure 5.16 Adequacy of room inside condos for sorting and storing recyclable and organic waste**

**Figure 5.17 Use in condos of labeled cans for disposal of organic waste and recyclable products**

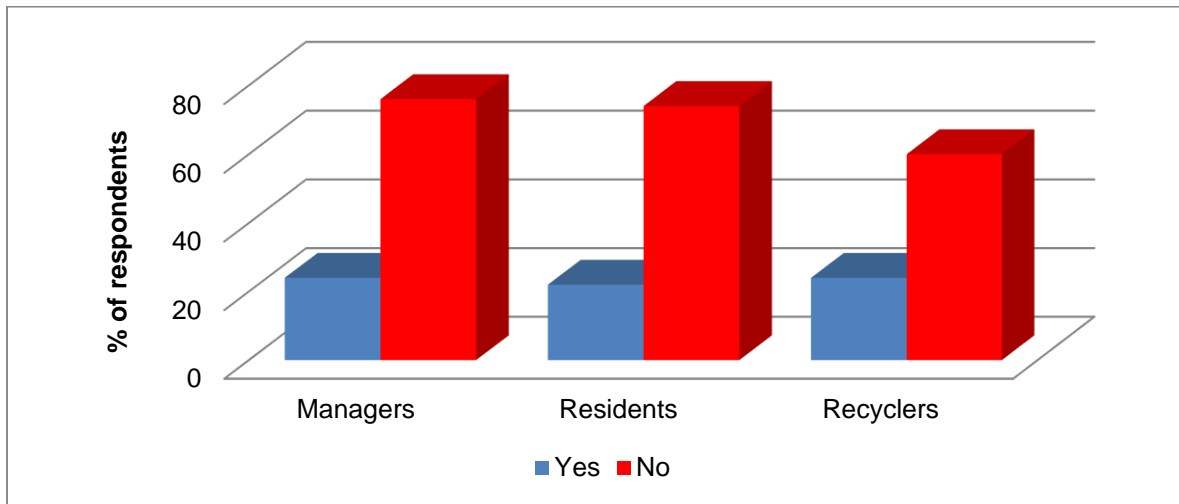
#### 5.2.4. Social Aspects

Characteristics related to education, gender and number of persons living in the household were investigated but were not found to be significantly correlated with waste generation. The question about the acceptability of recyclers as staff within condos was posed to managers, residents and recyclers. The majority of participants (76% of managers, 74% of

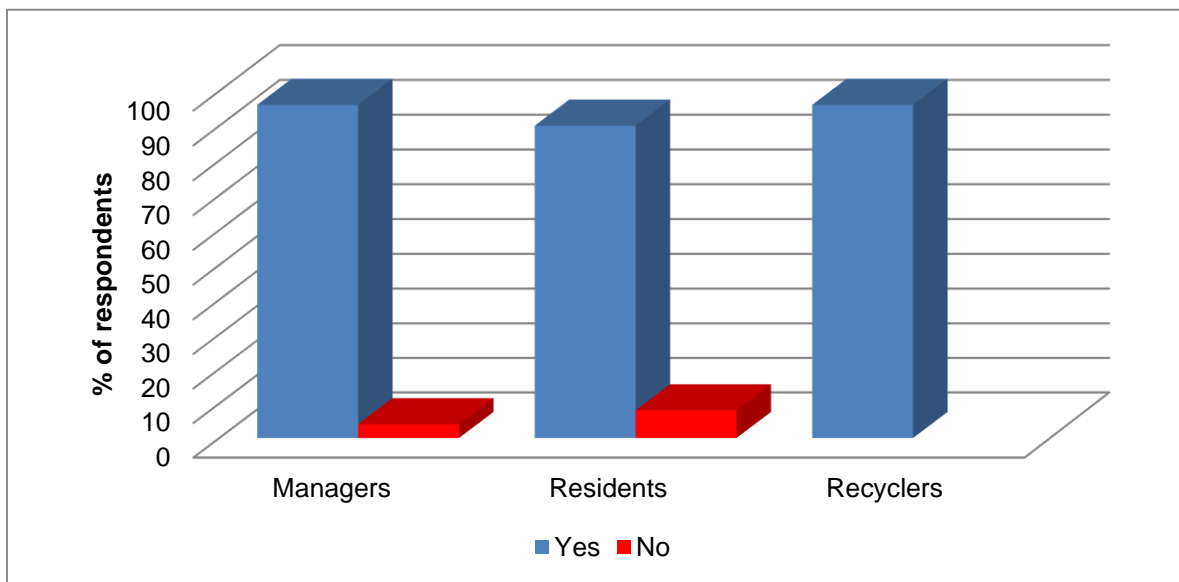
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<sup>21</sup> By law 675, 2001 (Horizontal Property law), each condo should have an adequate room to store the waste generated within the condo (organic and recyclable). This room should meet the characteristics specified in this law. Public Health Office is in charge of overseeing and certifying this room.

residents, and 60% of recyclers) believe that recyclers are not accepted within condos as staff/workers receiving a salary and benefits (Figure 5.18).



**Figure 5.18 Acceptability of recyclers as staff or workers within condos in Cali**



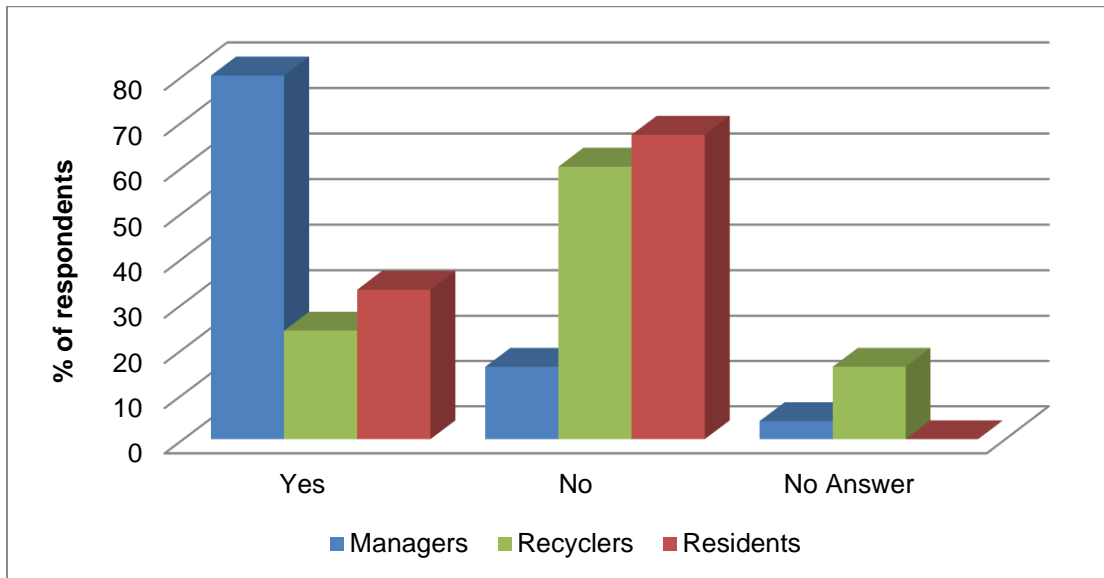
**Figure 5.19 Security provided for recyclers by the adequate use of protective equipment**

Another social aspect of interest assessed in the MFRP is related to the security that the program generates for recyclers using protective equipment including uniforms, gloves and helmets to execute their jobs. 96% of managers and recyclers and 90% of residents answered that the use of protective equipment makes secure the recycling work. Managers and residents commented that the use of uniform by recyclers working in condominiums facilitates the work

they perform, because greater confidence is generated to allow access to the condo (Figure 5.19).

### 5.2.5 Technical Aspects

Managers, residents and recyclers were questioned about the MFRP's effectiveness: 80% of managers believe that it is effective, while 60% of recyclers and 67 % of residents consider that the MFRP is not effective (Figure 5.20).



**Figure 5.20 Effectiveness of the MFRP in Cali**

An opinion about what could be improved in the MFRP was asked of all participants: 30% of managers consider that reduced fees would be better, while 31% of residents and 28% of recyclers agreed that reduced odour in the storage room would be healthier and improve the MFRP (Figure 5.21).

Managers, residents and recyclers were also asked who they would tell about a complaint or suggestion about the MFRP in the condos: 31% of managers answered municipal planning, 26% of residents prefer to tell to the condo manager, and 46% of recyclers prefer to go to their political representative (Figure 5.22).

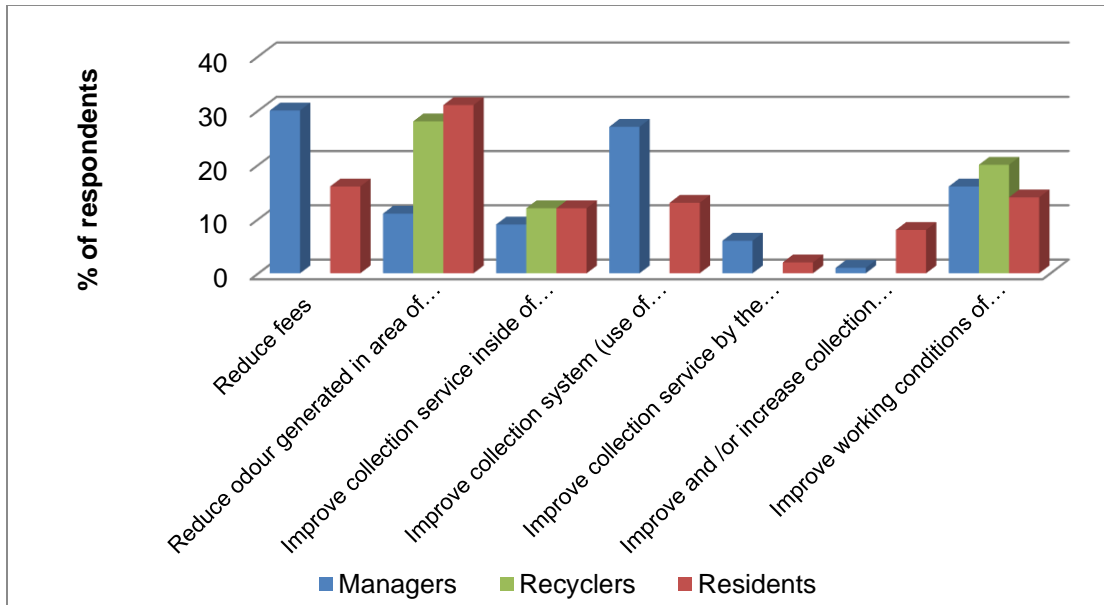


Figure 5.21 Opinion about how can be improve the MFRP

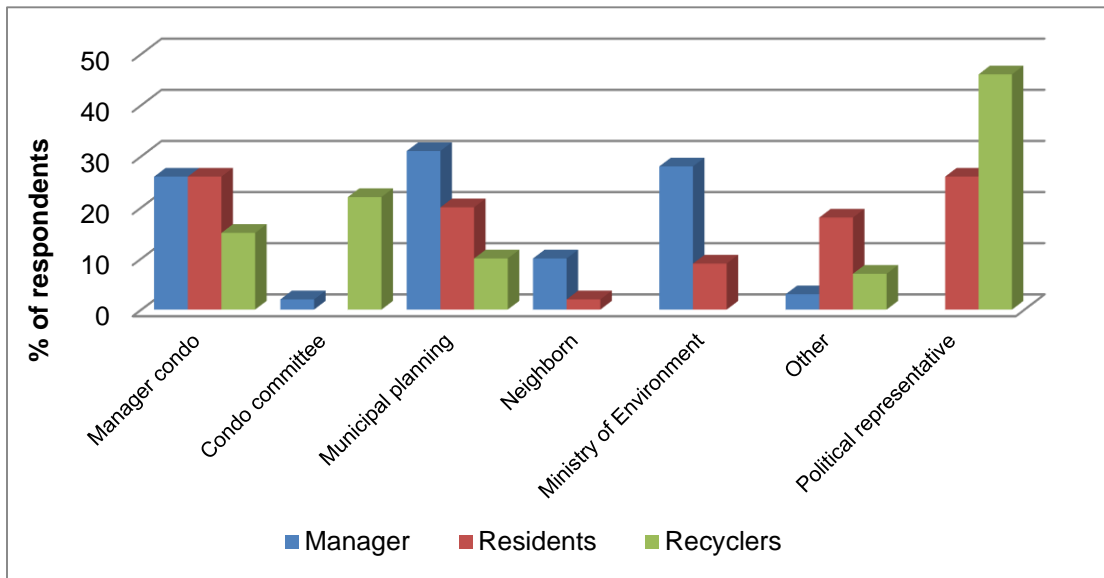


Figure 5.22 Suggested recipients of claims related to the MFRP

## Chapter 6

### Discussion

This chapter discusses the findings about the Multifamily Recycling Program (MFRP) in the municipality of Santiago de Cali, Colombia; it explores the results of interviews and surveys in consideration of the information obtained from the literature review to answer the main question outlined in Chapter 1: Is the MFRP successful from an Integrated Solid Waste Management (ISWM) framework? The discussion is organized into the following sections:

1. Assessment according to ISWM: To conclude if the waste recycling program in Santiago de Cali is effective from an ISWM framework, it was assessed according to the principles of social acceptability, environmental effectiveness, economic affordability and effective management.
2. The path to improvement: Interview and survey results showed the main shortcomings found in MFRP in Cali, which could be addressed to make improvements to the program.
3. Application to other developing areas: Can the MFRP be used as a model and be applied to other cities in Colombia or other developing countries? Ways in which developing countries can overcome barriers to MFRP are suggested.

#### 6.1. Assessment according ISWM

An effective integrated waste management system is one that meet the principles of sustainability. According to PAHO (2005) “ an integrated solid waste management encompasses a structured and interrelated set of policy actions, operational, financial, planning, administrative, social, educational, monitoring, supervision and assessment for the management of waste from its generation to final disposal; in order to obtain environmental benefits, economic optimization of its management and its social acceptance, responding to needs and circumstances of each locality and region” In IDRC-CRDI (2005) p.16.

This case study utilized an ISWM framework as an assessment tool; a methodology also used by Mader, J (2011) in a case study for assessing a waste collection system in Aguas Calientes, Mexico. The ISWM framework was created to analyze the information obtained in the surveys, as shown in Table 3.4. This framework is based on the guidelines suggested by IDRC-CRDI (2005) in order to follow an effective integrated waste system in Latin America.

For ease of use, analysis of the questionnaires, responses have been divided into sections following the framework of ISWM (social, economic and environmental aspects). Most of the indicators measures in this study had percentage results, and the major percentage in the results is used as a positive/negative aspect in the evaluation of the MFRP. Once the evaluation of each principle is complete, the evaluator assesses overall whether or not the MFRP meet the principles of sustainability.

### **6.1.1 Social aspects**

Currently, developing countries are concerned with meeting their Millennium Development goals on poverty reduction, and waste strategies for improving recycling, with the focus on how best to work with the informal sector to improve their livelihoods, working conditions and efficiency in recycling (United Nations Organization [UNO], 2007)

Srivastava et al., 2005 stated that “a waste management program that ignores the social aspect is doomed to failure” p. 531. Cali has a well-defined and implemented integrated waste management plan [Plan de Gestion Integral de Residuos Solidos-PGIRS in Spanish] (section 4.2.6). The PGIRS follows the parameters established by national law that seeks to comply with the agreements signed in the Millennium Development program, in which main goals (MDGs) have been focusing on reducing the poverty and improving recycling rates (Alcaldia de Santiago de Cali, 2008).

The literature reported that an important part of the social aspects in a waste management initiative is the situation and role of the informal sector. Vogler (1984) states that the recycler “is perhaps the most notable feature in Third World in developing countries” (in Holmes, 1984, p.244). According to UN-Habit, (2010) recyclers should be considered and included in the planning process in any urban area. Smith (1997) argues that recyclers can be an important component within waste management systems, but they need a supportive framework. Moreover, Cointreau, 1984 presented a project guide for environmental management of urban solid wastes in developing countries. Her major argument is that public management improvements in developing countries by the government should facilitate the informal sector (scavengers) in their recycling and hand picking activities rather than exclude them. Wilson et al. (2006) stated that one of the major challengers in solid waste management in developing countries is how best to work with the informal sector to improve their livelihoods, working conditions and efficiency of recycling. The MFRP' Cali seeks to create financial and social benefits to the recyclers according to indicated in Sentence T-291. The Municipal



Planning Department in 2006 reported that in Cali approximately 3,258 persons work on recycling activities. Currently, in Cali there are two groups of recyclers: registered recyclers, trained and associated in any cooperative or association as the ARC and on the other hand, recyclers working in the streets who do not belong to any association and work occasionally. This last group of recyclers do not wear any protective clothing, the equipment used by them are their wagons and two or more bags for storing the recovered products (see pictures). Moreover, they are not included in any social program. In Cali there are a largest number of recyclers who work independently do so because recycling is considered an easy job; this number is increasing every day due to the number of people that arrive to Colombian big cities displaced from the fields by guerilla and violence problems (Personal interview March 2013, Fundacion Carvajal-NGO). The national government has made great efforts to protect this group of people. For instance, by national law scavenger' work is recognized as professional labour, and derogatory names have been replaced by name of "environmental recyclers". The national government by law 2695 of 2000 has established that March 1<sup>st</sup> of each year is the National Recyclers day. In Cali, governmental entities engage with the MFRP have helped recyclers with training in recycling activities and assisted with social programs for their families in order to improve their social conditions. In Colombia by 1045 of 2003, the national government established the participation of recyclers in the elaboration of the integrated plan de solid waste –PGIRS

Another social aspect considered in this thesis was the participation of the community in the MFRP. The success of a recycling program is also dependent upon the willingness of residents, businesses, etc. to comply with the necessary aspects of the program—whether it be sorting glass by color, and leaving it in separate containers for curbside collection. Any recycling operations depends on the goodwill, cooperation, and ecological spirit of its residents to participate on a regular activity. Srivastava et al. (2005) reported that a strategy for effective community participation in MSWM is the strength of the role of youth, housewives and senior citizens. They suggest that environmental education needs to be imparted into the community by increasing community participation in MSWM through awareness raising and training activities using information, education and communication materials. For motivation of community participation local, community-based individuals or groups should be utilized as spokespersons for recycling intervention. The Youth on the Move- group at Columbia Villa (U.S) is a good example cited by them. An accompanying issue is how to motivate residents to participate in these recycling programs. Tracey et al. (1994) argue that ideally all volunteer

programs are most desirable; but, when the amount of effort involved is either extensive or on going, it is difficult to recruit sufficient participants, and they recommended the use of education ‘Police’ in school. According to DAGMA’s representative, environmental education in schools and high schools is being implemented in Cali. This study also found that educational campaigns have been promoted by governmental and private entities such as the CVC and the Chamber of Commerce of Cali. Together they have created the “Zero Waste campaign” which is aimed at motivating citizens to participate in the 3R programs (recycle, reuse and reduce). Furthermore, the Community environmental management system [Sistema de Gestion Ambiental Comunitario –SIGAG in Spanish] in 2014 implemented a pilot program in commune #17 (located at south of the city with inhabitants of SE 5). This pilot program is using community leaders to increase community participation in the PGIRS. In the pilot program 50 environmental promoters (two per district) work for each community. They are young volunteer leaders who want to participate in this program to improve environmental conditions in their neighbourhoods. Another group "Spokesmen in Action – Voceros en Accion in Spanish, a group of young people who since 2009 have been working voluntarily to create civility in the city. Examples of their actions is to motivate people to collect garbage in public areas and to clean green areas (Alcaldia de Santiago de Cali, 2014).

In Cali, the community in general can also get involved in the MFRP by submitting projects, proposals and addressing complaints to the municipality (Personal interview, Municipal Planning, March 2013). This is an important finding considering that the city had started its first step to encourage participation of the community in order to find quick solutions to problems and barriers encountered in achieving their goals. It is interesting to note, that in this study survey responses to the question “who can you tell about complaints and suggestions about of the MFRP” show that managers prefer to go with municipal planning while residents prefer to go with the condo manager, and recyclers prefer to go with the political representative. These results indicate that the political aspects in Cali play an important role in the development of recycling programs. The MFRP has support and acceptance from national, regional, and local governmental levels, NGOs, the community, private organizations and business. All of these stakeholders have been of great importance in carrying out and achieving the MFRP’s goals.

The success of a recycling program is also dependent upon the willingness of residents, businesses, etc. This means that any recycling actions depend on the goodwill, cooperation, and ecological spirit of all stakeholders to participate on a regular basis and with an altruistic behaviour. Hopper and Nielsen, 1991 confirmed that recycling behaviour is influenced by social

norms, personal norms, and an awareness of consequences. One characteristic found in the Cali community is its altruistic behaviour. Cali citizens possess this attribute: they want to build a beautiful city. Condominiums in Cali are characterized by their good organization; each condo has a manager and a committee who propose actions to benefit the interests of all residents. In general, the community in Cali is working for the benefit of all, which is of great value to take the program forward. As was mentioned before, one example of this altruistic behaviour is shown in Commune # 17 whose motto is “CALI BIOAGRADABLE- entre todos lo hacemos posible” [In Spanish] which translates to CALI BIO-AGREEABLE, between all we making possible” (See Flyer Appendix F).

Oskamp et al., 1991 and Katzev et al., 1993 agreed that peer participation is an important determinant of recycling behaviour. In Cali, this argument is well supported with the active participation within condos and communes on recycling, the motto “between all we making possible” shows that there is in Cali a strong wish to work in community, which benefits the program. This case study also, shows that most residents knew about the program from friends, confirming the importance of peer participation in recycling behaviour. People are motivated to recycle when having friends and neighbours who recycle.

Income and education of participants in the MFRP were also analyzed in this case study. Katzev et al. (1993) suggested that income level and education are positively associated with the level of participation in a recycling program. Howenstine (1993) supports the position that the potential for participation in waste reduction and other environmental activities exists in almost every demographic group if the resource needs, capabilities, and concerns are understood. Eliminating the obstacles and increasing awareness through public education programs can accomplish improvements in behavioural patterns. In Cali, a previous survey conducted by the Municipal Planning Department in 2006 reported that income and education are associated with recycling habits, and with the success of the program. Furthermore, that persons belonging to the upper socioeconomic strata (6) had better recycling habits because they had better education (Alcaldia de Santiago de Cali, 2009). However, I found that the MFRP is working well in all socioeconomic strata (2 to 6); there is not a relationship with the socioeconomic strata. The level of education of participants is high in managers and residents (76% of managers, 48% residents have university education). On the other hand, the majority of recyclers had not finished elementary education, which made it difficult for Fundacion Carvajal to train them to become recycling entrepreneurs, as it was imposed by the sentence T-291 (Personal interview, Fundacion Carvajal, March 2013). Moreover, the Alcaldia de Santiago de Cali (2009) reported,

“the education and organization of recyclers in Cali is low, which makes that their job generate stigmatization by the community about the activities performed” (Municipio de Santiago de Cali, 2009 p.80).

One positive point assessing the MFRP is the fact that recyclers were properly trained. Srivastava et al. (2005) suggested that the educational portion of a recycling program is crucial to expand awareness. In Cali, The CVC through the Fundacion Carvajal-NGO, trained and certificated recyclers as recycling technicians, or if they chose, they could enter in other technical programs such as electrical services, pruning and cutting trees, and accounting. This educative process ran for three years. People with a low level of education were motivated to get their basic level of education (elementary) in order to participate in the recycling training and certificate program. The choice of the program or training was carried out by each recycler, according to their capabilities and aspirations that each person had to overcome to get a better job (Personal Interview, Fundacion Carvajal, March, 2013). The survey results showed that the recyclers' training was effective: 80% of the recyclers surveyed have received this training and 70 % ranked it as excellent. Fundacion Carvajal also worked with the families of recyclers. This social work carried out with recyclers' family included workshops on topics of parenting, cohabitation, interfamily violence and leadership. The main objective was to help parents develop a better relationship between the recyclers (Personal interview, Fundacion Carvajal's representative, March, 2013).

Suttibak and Nitivattananon (2008) assessed the factors influencing the performance of solid waste recycling programs and suggested that the perception of administrator awareness of SWM problems and source separation are associated with successful recycling programs. Additionally, Flintoff (1984) notes that attention should be focused on the training of middle and top management individuals in solid waste management techniques. In Cali, managers also have been trained in the MFRP; however, their participation in this training was low: 60% of the managers surveyed had not received training, and only 20% of the managers surveyed ranked it excellent. This high percentage of managers not be trained in the MFRP could be considered a factor that has reduced the MFRP's in meeting its goals. This study found that managers are an important part of the development of the MFRP. Managers should be trained and motivate to participate actively as leaders in condos. Managers are the main disseminators of the program and may spread information related to the MFRP though social activities in each condo. The MFRP has defined specific functions for managers working in condos in Cali, these functions are summarized in Table 6.1.

**Table 6.1 Functions of condo managers in the MFRP**

<b>Characteristics</b>	<b>Participants</b>	<b>Objectives</b>	<b>Description Activities</b>
Administrative	Manager Condominium-Council	To determine the management and distribution of resources of the MFRP within condo	Identify the number of people and materials necessary for the implementation of the program in condos.
Technical and logistical	Manager	To define construction or adaptation of: recycling storage room [URA * or CCA]  Elaboration of the map with localization of storage room, bins in public areas  Evaluation of recycling rooms	Diagnostic: Waste produced weekly: Production per capita PPC characterization and weight  Number of dwellings, residents, employees, visitants  Location of social areas, chutes and internal collection route, recycling rooms  Verification of dimensions and characteristics according to Law 1140 of 2003; number of containers; chutes  Number of people employees (Cleaning staff, recyclers)
Informative and Educational	Manager	To define strategies of information, communication and education.  Objective : define strategies to strengthen favourable attitudes and practices for solid waste management source separation, 3Rs	Dissemination of information related to the topic of recycling: on billboards, brochures or meetings (adequate to the budget).  Encouragement of community activities in the community where people receive information related to the topic of the recycling program (dance, theater, singing)

Source: Author, Content drawn from Alcaldia de Santiago de Cali, PGIRS, Manual de Conjuntos Residenciales, 2008

Table 6.2 summarises the factors of participation identified in the research that motivate residents in Cali for participate in recycling programs, and identified from the literature review the factor of participation found in other developing countries.

**Table 6.2 Factors of participation in recycle found in literature review**

<b>Factor of participation in supporting recycling</b>	<b>Support from this Thesis</b>	<b>Developing Country Literature</b>
--------------------------------------------------------	---------------------------------	--------------------------------------

Altruistic behaviour	Participation of residents in condos increases when the profits from recycling are used for community activities.	Jacob and Bailey, 1982 Srivastava et al., 2005
Effect of incentives	There are no economic incentives for residents to promote recycling	De Young, 1990
Manager as leader in each condo	The use of leaders to prompt residents to participate in the MFRP could have a big impact on recycling behaviour Degree to which managers support the program	Hopper and Nielsen, 1991 Katzev et al., 1993
Knowledge and motivational factors Training of actors	Participants have a good knowledge about the MFRP and its benefits; CVC hired the Fundacion Carvajal to train recyclers and managers; residents are trained by the waste service company	Flintoff, 1984 Srivastava et al., 2005
Friends and neighbours	Peer participation is an important determinant of recycling behaviour. Most of the residents received information about the MFRP from friends and neighbours	Oskamp et al., 1991 Katzev et al., 1993
Income level	Income level and education, are positively associate at level of participation	Katzev et al., 1993
Cleanliness	Positive association with cleanliness, such as: the mere physical appearance of the containers can encourage usage	Katzev et al., 1993
Publicizing the MFRP	Municipal planners have used brochures, magnets, flyers, public events in order to inform the community about the program	Srivastava et al., 2005

Source: Conten from: Jacob and Bailey, 1982; Katzev et al., 1993; Srivastava et al.2005; Oskamp et al., 1991; De Young ,1990; and Flintoff ,1984.

From the results of this study, MFRP in Cali is socially acceptable. The municipality guarantees equal service is given in each neighbourhood to improve social acceptability of recycling activities. There are municipally initiated public engagement events about the MFRP in Cali, and adequate training programs for recyclers. The recyclers are an essential component in the MFRP. They have been motivated to participate in the program, such as Fundacion Carvajal had undertaken several social activities with recyclers and their families. Recyclers have received social benefits and their work has been recognized in the society. However, local authorities should be encouraged to improve the training of managers and residents in order to accomplish the acceptance of recyclers as staff in condos. Table 6.3 summarizes the information obtained about the social acceptability of the MFRP.

**Table 6.3 Social acceptability assessment of the MFRP in Cali**

Indicator	Description	Impact on social acceptability
Participation in the MFRP	People want to see Cali as a clean city, which motivate citizens to participate in the source separation within dwellings	Positive
Level of public involvement in waste related to decisions	Publically initiated: Individuals and groups can submit projects and proposal Environmental committee: entities responsible for the implementation of the MFRP in the city have created the environmental committee to determine best practices related to the recycling program citywide with the integration of waste pickers as an essential part of the program, generating employment solutions for most of them	Positive Positive
The existence/level of participation of recyclers in the MFRP	About 70% of condos managers respondents answered that recyclers are not welcome to work as part of staff in condos	Negative
Recyclers and national government	The national government recognizes the activity of recycle as an formal work By law national government create a national day for recycles and recycle day	Positive Positive
Recyclers and local government	The PGIRS recognizes the recyclers as important part of recycle chain Municipal Planning Department have conducted a census of recyclers and their families Environmental authorities CVC and Fundacion Carvajal have trained recyclers and their families (84% of the recyclers surveyed respondent that they have received training)	Positive Positive Positive
Safety and use of protective equipment	Effective training of recyclers in the use of safety equipment for improve their recycling work There is social security for recyclers and their families Few recyclers wearing protective equipment in their work ( mask and gloves)	Positive Positive Negative
Working conditions and compensation for recyclers employed as part of staff in condos or in service collection companies	Labour laws govern approved work hours, holiday and compensation for injuries, minimum salary	Positive
Strengthening of recyclers association	The ARC was strengthened with local government support through leadership training and better living who received recyclers	Positive
<b>Overall</b>	The MFRP in Cali is socially acceptable, less acceptable is the inclusion of recyclers as part of the staff of condominiums and not use of protective equipment for recycling activities	

### **6.1.2 Environmental effectiveness**

The indicators of environmental effectiveness measured in this thesis include the public knowledge about environmental benefits generated for the MFRP; source separation inside apartments/houses using coloured bags; resource recovery rates; the collection service in general; and the methods of final waste disposal. Results indicated that participants have a good knowledge about the benefits that the MFRP generates; the majority of recyclers (72%) and residents (63%) agreed that this program is generating environmental benefits. These observations are a positive achievement of the program. In addition, if more people are concerned with the environment additional people could be motivated to participate in the program.

Binyousuf (2004) argues that, due to the depletion of natural resources and the increase of pollution level in the environment, the 3Rs principle has started gaining more attention in recent years in developing countries. Kinnamman and Takeuchi (2014) found that environmental concerns are significant and that a greater awareness of the natural environment encourages a stronger predisposition toward recycling. Oteng-Ababio et al. (2014) suggested that increasing knowledge about the adverse consequences of continuous depletion of the natural resources in today's consumerist society has forced many local authorities to rethink and embrace the concept of recycling as a comprehensive method of resource use. Tracy et al. (1994) suggested that participation in a successful recycling program is associated with higher levels of motivation to recycle. "A successful program motivates residents to recycle rather than vice versa" p.17. For instance, one successful recycling program is working in Ontario since the 1960s recycling has really come a long way "Acceptable materials have increased over time, the frequency of collection has increased, and the size of our Blue Boxes have gotten bigger. Recycling really does make a difference - make it a daily habit" (Halton Region, 2014).

According to Hostovsky (2006) waste management planning started in the 1970's when American planners began to place emphasis on alternative waste management approaches, which were based on the 3 Rs (recycle, recover and reuse). In Cali, the MFRP also promotes the 3Rs principle and motivates citizens to separate at source within condos. Furthermore, in Cali the MFRP proposes to make the separation at the source by householders (inside of apartments or houses), using coloured bags (green and blue) for organic and recyclable waste. The survey results show that householder participants of the program are separating recyclable products; they know about the coloured bags, but they prefer to use the recycling shopping bags (86% of residents) because they are free. This study found that, Cali householders tend to



separate items such as newspaper, bottles, papers and cardboard; that recyclers have worked separating those items from the regular garbage for the last six decades; and that the separation of waste is executed within each condo in containers for each kind of waste (organic and recyclables), (see pictures- Appendix C). Consequently, the planners of the program should find new alternatives to motivate residents to participate in the MFRP. Oskam et al. (1991) found that recycling would require relatively little effort on any one participant if householders were given boxes for recycling items, if these boxes were picked up with the regular garbage, and if a wide variety of items were accepted for recycling. Moreover, Derksen and Gartreill (1993) cited several authors who have shown that when containers are nearby and easy to use, people are more likely to recycle.

In Cali, recycling containers could therefore be introduced at the source separation stage in each apartment or house within condos in order to increase and facilitate the separation of recyclable products and prevent their contamination. The majority of condos in Cali have a storage room for waste and recyclable products, which facilitate and benefit the process of separation. Nevertheless, few condominiums (24%) are using labeled bins, although they are included in the program as mandatory. This information confirms managers' mismanagement of program and ratifies the need of training for them in the MFRP. Additionally, in the visit to the participants' condos, the author confirmed the effective cleaning in the storage rooms and the existence of bins collection in pairs in common areas (See pictures- Appendix C). These activities are considered an effective response to the MFRP.

It is important to note that four private companies perform the waste collection service in Cali. They are serving 95% of the city and 5 % is conducted by ten small private companies. The collection frequency in all city is three times a week for all users (Personal interview, Ciudad Limpia- Waste Service Company' representative, March 2013). Residents and condo managers surveyed rated this service as efficient. In the survey no one complained about the service schedule, thus confirming that the privatization of the service in Cali was a positive decision for handling conflicts in the city. However, there are inadequate actions carried out by recyclers who work in the streets and use inappropriate sites (under bridges, green areas) for sorting of recycled products. As they leave garbage lying on the streets, thus generating sources of contamination affecting the immediate environment and the coexistence between neighbours. This problem could be solved and improved if residents make proper separation of recyclables and carefully following the recommendations given in the program MFRP in order to facilitate the recyclers' work. Source separation, also helps in reducing the risks posed by

contaminated waste to recyclers' health as well as, ensuring the cleanliness of products earmarked for recycling and reuse.

“A key factor in implementing resource recovery is the existence of national legislation which establishes it as a priority activity” (Clark and Gillean, 1981. p.11). In Colombia, the national government established law 1713 (2002) and law 1505 (2003) which make as mandatory the formulation, implementation and monitoring of the comprehensive plan of integrated solid waste management. Under the laws, each municipality should submit a plan that includes an assessment of the waste management situation, inversion lines that will increase waste collection service quality and specifies the sanitary landfill as a unique solution to final disposition (Ministry of Environment, Housing and Development, 2008). Cali has a PGIRS adopted by Municipal Decree 0475 (2004) the waste management plan for a period of 2004 to 2019.

Troschinetz and Mihelci (2009) found that government policy provides the regulations needed to formulate a MSWM plan; administrators create the plan and they are required to frequently update information and look it for direction of their responsibilities, through permanent monitoring of the plan. In Cali there is a Management Plan (PGIRS from the Spanish acronym). It was adopted by municipal Decree 0475 of 2004 and reviewed and evaluated and adjusted over the year 2008 and 2009. In 2009 the evaluation of the PGIRS in Cali showed that MFRP is a successful program (Alcaldia de Santiago de Cali, 2009). Results also show that encouraging all stakeholders to participate in the program may bring best results; however, updated information after that time is poor. Monitoring the types and quantities of waste recovered by householders and salvaged from landfills is needed in order to indicate to MFRP planners which waste could be more useful than others could. Currently in Cali, the Department of Municipal Planning does not have accurate information about the recycling products recovered in the city and salvaged from landfills.

Oskamp et al. (1991) argues that a systematic, well-advertised program could create a new community norm favouring recycling. Planning an effective system in Cali, must therefore consider the habits and attitudes of householders who dispose of the items retrieved, and the project planners must link householders' activities into an overall resource recovery project. Moreover, program success may require changes in behaviour at home, such as avoiding throwaway habits and getting involved in source separation. This can be achieved through public education programs and strengthening publicity, since 66% on average of households

surveyed indicated that they need more information on recycling and rated access to publicity as low. The MFRP's publicity should focus on demonstrating to householders the benefits that the MFRP generates as well as stressing the benefits of the diversion program (3R).

In Cali, although the national government has taken into account the needs of the recyclers by approving Sentence T-291, controversial law 1259 (2008) and Decree 1713 (2008) which contain an anti-scavenging clause that emphasizes the fact that recyclable materials become city property once they are placed outside for collection; thus it cannot be collected or "stolen" by private parties. This ordinance specifies penalties for violations of the anti-scavenging provision. There is, an unspecified penalty for failure to separate recyclable products from refuse, because the objective is implementing a norm promoting the adequate management of solid waste through education. This law was modified by the law 1466 of 2011 which outlines the protection of recyclers and their right to work on these scavenging activities. This law will be in effect until the selective route is properly operating, at which time the decree 1713 will come back into effect. This decree prohibits recyclables from being taken by private parties or individuals at curbside and will only be allowed to recyclers working in the program of selected route. To complement the MFRP, the environmental committee is also studying the execution of a recycling program using curbside collection for single dwellings called Selective route. This curbside-recycling program started as a pilot program in 2003 and its main purpose, in addition to the environmental benefits it generates, is the integration of Navarro's recyclers as full time workers along the selected route.

In relation to the final disposal of waste in Cali, the four private service waste collection companies collect daily the garbage generated by users and waste collected is sent to two transfer stations. One transfer station located outside of Cali is dedicated to handling mixed waste, and a second located within an urban area receives only debris and construction materials. The organic waste is taken to the transfer station where it is compacted and then transported in higher capacity equipment to an engineered sanitary landfill, called the Colomba - Guabal, located 45 km from Cali in the Township of Yotoco. This landfill approved by the Ministry of Environment is working on reducing fossil fuel emissions and in mitigating air, soil and water pollution, which rise from the decomposing waste. Two international companies were hired to develop the study and execute projects to prevent contamination of the air, water and soil in both landfills. For the Colomba-Guabal landfill, mitigate almost all of the landfill's GHG emissions and reduce dependence on fossil fuels for the energy-from-waste [EFW] facility, which will be built when the landfill produces sufficient amount of biogas. For the former Navarro

landfill located in the urban area of Cali, which was closed by CVC on June 2008, Emsirva and the city' Mayor must ensure proper handling that includes proper recovery of the land, and all necessary measures to prevent the pollution of air, soil, and groundwater for a period of up to 30 years after its closure (See more information in Appendix D). Environmental authorities have permanent control of these two landfills and municipal authorities have a special interest in solving all the environmental issues.

The environmental effectiveness of the MFRP and the waste management system in Cali performed better than expected. The recycling activity in Cali dates from many years ago, but the recent implementation of a recycling system in the city and corresponding recycling education programs have increased the recovery rate and reduced possible contamination of recyclables. The city needs to publicize the program more and must show that it generates a double win: environmental and economic benefits for condo participants; reduction of the garbage disposed of by condos, thus reduction of fees. The planning program should concentrate on restructuring activities such as the source separation within condos, and promote recycling activities with inclusion of recyclers. Table 6.4 summarizes the environmental effectiveness of the MFRP in Cali.

**Table 6.4 Environmental effectiveness of the MFRP in Cali**

<b>Indicator</b>	<b>Measurement/Status</b>	<b>Impact on environment</b>
Knowledge about environmental benefits generated by the MFRP	98% of participants surveyed have answered that they have knowledge about environmental benefits generated by the MFRP in Cali	Positive
Environmental education to recyclers	High positive participation of recyclers to gain knowledge about recycling. Some are now certificated by College/ SENA (Servicio Nacional de Aprendizaje)	Positive
Environmental education to managers	Few managers surveyed answered that they have received training in recycling and the MFRP	Poor
Publicity about environmental benefits and the MFRP	Environmental campaigns to increase the participation and motivation of citizens to implement source reduction at home TV-advertisements show how people can participate in recycling and use green and blue cans for organic and recyclable waste, respectively.	Positive
Method of final disposal in the city	Regional landfill: El Guabal landfill is working since 2008 with leachate treatment and gas collection Closure of former Navarro landfill, gas collection and treatment, leachate treatment	Positive
Transfer Stations (TSs)	Use of TSs, help reduce gas emissions and cost of gas. In the urban area of Cali, two TSs help to reduce the number of truck fleets to the landfill and generate less contamination	Positive

Store room inside condos	By national law, condominiums should have an adequate storage room for garbage and recyclable products with specific conditions. In Cali the majority of condos surveyed have an clean and adequate room for storing waste and recyclables, preventing pollution and the proliferation of rodents and insects	Positive
Use of labeled cans in condos	By law, condos should use labeled cans in common and social areas, and in storage rooms for final disposition of garbage, to prevent contamination of recyclable resources and facilitate the work of recyclers	Positive
<b>Overall Assessment</b>	<b>The MFRP in Cali is environmentally effective.</b>	

**6.1.3 Economic affordability**

Indicators of economic affordability measured in this thesis are the accessibility of the waste collection service to all community members (subsidy according to socioeconomic classification in paying the garbage collection service), the Pay As You Throw (PAYT) program, government investment and economic benefits that the MFRP generates to recyclers.

According to Rajamanika et al. (2014), public sectors in many countries are unable to deliver waste management services effectively, resulting in uncollected waste on roadsides and in other places. Currently, in Cali, this issue has been resolved through privatizing the collection service throughout four companies that provide service to all neighbourhoods and areas of the city. The fees for this collection service are subsidized for residents in the lower socioeconomic strata (1 and 2); by law the upper strata (5 and 6) subsidize the poorest. The four private companies work collecting waste, cleaning the streets and public areas in the entire city and they have reported that they are economically sustainable. However, in the last ten years the waste collection service was increased. The export of waste to the new landfill located in the municipality of Yotoco and creating transfer stations in the city, added new charges to the cost of service, making it one of the most expensive in Colombia. Schubeler (1996) states that fee collection performance in developing countries is often poor and suggests that improvement can often be achieved by attaching solid waste fees to the billing for another service, for example water supply. In Cali, the collection of bills is realized in conjunction with the recovery of fees for water services in the city by EMCALI, allowing for easy retrieval of the money. Thus, all people pay for garbage collection and receive an egalitarian service. The government regulates the fees for public services, and private companies follow these regulations. However, the current regulation does not promote economic incentives to reduce the volume of waste generated or to promote recycling.

Ferrara and Missios (2005) found in their study executed in Canada that user fees on garbage collection have significant impacts on recycling levels of all materials except toxic chemicals, and mandatory recycling programs on particular items have significant effects on recycling of almost all materials. They also showed that limits on the amount of garbage that can be placed at the curb, providing free units and user fee systems; however, generally have a negligible or detrimental impact on recycling rates.

De Young (1990) suggested that efforts to promote waste reduction and recycling behaviour should focus on non-monetary incentives. In Colombia, the government allows multiusers the right to obtain accurate measurement of the waste from waste services companies. They can also voluntarily request the registering of condos in a PAYT system, filing the application form and complying with the requirements of the law. The results reported from interviews show that in Cali the PAYT has had minimal acceptance so far. The requirements demanded are often difficult or awkward to meet. As mentioned in Chapter 2 section 2.13 international experience shows that PAYT in multifamily buildings is not successful (Skumantz, 2008). In contrast, international experiences in single residences show that such programs of generating payment are effective in terms of optimizing landfill space, improving efficiency in collection and transport routes, reducing waste generation, and increasing recycling levels (Kutzmark, 1995; Canterbury, 1998). Based on national experience in Colombia, as was mentioned before, the PAYT program is working effectively in Medellin and Bogota, which have reported a decrease in collection by waste collection services of about 50% (Ramirez, 2006). PAYT in Cali could be improved if multiusers are motivated to participate and if municipal planning and waste service companies strengthen their publicity and education campaigns.

Another important economic fact to mention is that the formation of scavenger cooperatives attempts to skirt the middlemen and thus gain higher prices the cooperative members. Medina (2000) argued that higher prices for cooperative members, in turn, translate into a higher income and a better standard of living for the recyclers. In Cali, the MFRP program has economically benefited recyclers, giving them financial advice about their business. Currently the recyclers are legally authorized and certified to exercise their craft. Recyclers are trained to manage their finances. Moreover, the creation of a cooperative to supply food helped their associates to have an adequate management of their monthly income, while new jobs were created. The private sector has also lent great economic support. For instance, Bavaria Brewery, a company that helped the association of recyclers of Cali- ARC buy a truck to transport recycled materials (see picture). The product prices are negotiated with the ARC. The

association purchases from associate partners recyclable products recovered daily for them to be selected, packaged and sold to large companies such as Bavaria Brewery, and Cristaleria Peldar (glass factory). Bickberck (1978) described the work of Navarro' recyclers as a "factory" and recyclers as "self-employed proletarians". This means that recyclers working as self-employed may be in a position to decide when they work or when they not work. However, with the MFRP recyclers hired by government and waste service companies need to follow rules, they must meet a schedule, but they receive monthly payments and social benefits (health protection and pension plan).

Institutions and entities involved in the enforcement of Judgment T-291 have managed and executed resources in their operational plans to achieve the goal of including recyclers. For example, in 2012 CVC invested U.S dollars \$300,000 in an environmental surcharge tax for socialization and training recyclers and their families (Ramirez interview, 2013). Cali's local government and the waste services companies have also participated by giving jobs to the recyclers as part of the solution to the problem. Several recyclers have been hired as staff to sweep roads, clean public green areas, and prune trees and trees according to the training received by recyclers in the program (Benavidez and Arteaga interviews, 2013). Condominiums can also be actively involved in the job creation process by providing the raw materials for recyclers. Most condominiums in Cali recycle, but they do not allow the recyclers work within their condos; because, they sell directly recyclable products to middlemen and use the profits received from selling for the benefit of each condo. This activity has caused much controversy within the municipality, because one of the MFRP's goals is the inclusion of recyclers within condos as staff, so as to generate economic benefits for people whose livelihoods depend on this activity. The survey results indicate that an average 70% of participants (residents, managers and recyclers surveyed) agreed that recyclers are not accepted within condos as staff or workers with a salary and benefits. Otherwise, the recent efforts made by Municipal Planning and CVC which also stress a relationship between government planning decisions, employment and the prospect of long term economic stability for recyclers may be lost. To solve this problem local authorities developing the MFRP are studying the possibility of establishing a law requiring residents to separate their recyclables for delivery to recyclers. In other countries, good examples of public investment in recycling program exist, for example in Ontario, Canada where municipalities fund 50% or more of household Blue Box costs with the manufacturers of paper and packaging funding the rest. Each year municipalities and manufacturers (called stewards) meet to negotiate the relevant costs (Bennett, 2014).

This thesis research found that, in Cali, municipal and environmental entities have been working together following the requests made in Judgment T-291. They hoped to achieve compliance with the goals set by the PGIRS, especially to solve the problem of the Navarro recyclers. If the purpose is to create employment opportunities for recyclers, more emphasis should be given to the establishment of new cottage industries for the processing and recycling of solid waste into useful products. This could help to create more foreign exchange through the export of locally recycled products. Vogler (1984) refers to the situation in developing countries in general: “The many gaps in the industrial structure offer large-scale opportunities for creation of small industries, with subsequent employment resulting, and this is probably the most important feature as well as being that which has been least appreciated by planners and governments” (In Holmes, 1984. p.266). Table 6.5 outlines the economic affordability of the MFRP in Cali.

**Table 6.5 Economic affordability assessment of the MFRP**

<b>Indicator</b>	<b>Measurement/Status</b>	<b>Impact on environment</b>
Fees accessible to community	The city has rates set by the national government, which considers socioeconomic stratification when generating fees for collection of garbage Users may be subsidized; for example, the lower strata (1 and 2) receive economic benefits from the high strata (5 and 6) to get an affordable rate for all socioeconomic levels of the city. Thus all users are serviced avoiding the proliferation of open dumps or pollution of water sources by improper disposal of trash	Positive
Fees and environment	Expenditures on waste management has been increased due to the waste transportation to the new landfill and setting up transfer stations, as consequence municipal interest has grown in reducing the quantity of garbage generated and transported	Positive
Pay As You Throw (PAYT) program	Condos in Cali can apply to be served as multiuser and have a fee for the collection of garbage collection and disposal system by PAYT	Positive
Pay As You Throw (PAYT) program Participation	The condos' participation in the PAYT in Cali is very low, This participation is voluntary and the condo must meet many requirements imposed by law to be accepted as a participant in the program	Poor
<b>Overall Assessment</b>	<b>The MFRP' Cali is economically affordable</b>	

#### **6.1.4 Technical aspects**

The MFRP has a well-defined plan that follows all seven steps mention before in section 2.7 that are analyzed in detail with the data collected from the MFRP and PGIRS in Cali.



1. Develop baseline data: In Cali, characterization and quantification of waste from various sources and future projections were done in 2006.
2. Collect information and analyze to it develop baseline data on the current waste management systems: The information collected and analyzed was used for development the MFRP.
3. Create goals for ISWM in agreement with local stakeholders: this study found that the program has not defined a specific goal and a period by which meet it.
4. Identify concerns of ISWM (financial, technical, environmental, and social) of concern to local stakeholders: National and local authorities identified the main problems affecting the waste collection service, and proceeded to the closure of Emsirva. The privatization of the collection and the hiring of four private companies managed to solve this problem achieving an efficient service covering 98% of the city.
5. Develop an ISWM plan: There is an ISWM plan known as Plan de Gestion Integral de Residuos Solidos-PGIRS, which follows the principles of sustainability.
6. Develop an implementation strategy for ISWM: The PGIRS's strategy is work in several areas
7. Develop a monitoring and feedback system for ISWM: The city has a general monitoring system of the PGIRS, but there is no a specific head monitoring the MFRP's progress. Unfortunately, the existing monitoring information was not provided at the time of the interviews (March, 2013).

The survey results show that distribution of the MFRP's publicity material is poor: about 70% of the residents, 68% of the managers, and 60% of the recyclers answered that the MFRP's advertising is not accessible to all condo communities. Additional information could be given on the planning and implementation of specific projects such as the source separation within dwellings and the integration of recyclers in condos. Information given may imply that a resource recovery program targeted at householders requires lifestyles changes. In Ontario, Canada, for example, numerous pamphlets were distributed on recycling and messages sent via newspapers and television commercials about changing throwaway habits and supporting the Blue Box recycling program. Currently, over 95% of Ontarians have access to curbside recycling, and nearly 90% feel that the Blue Box Program is the main driver of their recycling habits (Halton Region, 2012).

In Cali, the participation of residents in the MFRP has been encouraged by the local government through Municipal Planning, which distributed documents and educative materials about recycling and source separation, such as brochures, Rubik's cubes, fridge magnets (see pictures). Moreover, the educational campaigns are carried out by different sectors, for example the waste service companies and community associations. These educational campaigns in the city promote the recycling; the motto used is "SEPARATE FOR RECYCLING." Examining the information distribution used in Cali is important to the application of this recommendation. This case study shows that most managers (34%) knew about the MFRP from waste service companies (WSC); the majority of residents (30.1%) knew about this program from friends, and most recyclers (31.3%) reported from the ARC as source. Hopper and Nielsen (1991) found that "the use of local block leaders to encourage community members to participate in a recycling programs had the biggest impact on recycling behaviour; while, verbal prompts and written information had the weakest effect" (p.435).

In this study, it was surprising that only 24% of managers and 23% of residents knew about the commercials on TV by Municipal Planning that promoted recycling. In contrast, several authors have indicated that there is a potential for the use of media and TV commercials to intensify the awareness of resource recovery. For example, in 1985 Hickman's study revealed that the newspapers were very instrumental in relaying information about recycling, and in 1989 Shurland's study reported that information on resource recovery in Trinidad is usually given via newspaper because it may be cheaper. However, the use of TV was preferred by respondents to a survey conducted to learn about the details of promoting recycling. This weakness in the program may be attributed to the fact that the MFRP has not been actively raising awareness on recycling through print media and the radio among all condo communities.

In this assessment, the MFRP in Cali is considered generally acceptable from an ISWM framework, weaknesses areas were identified and suggestion were given to improve them. The assessment was made rationally- intuitively based on considerations of all results (interviews, surveys and observations). The MFRP was evaluated by only one person the researcher, based on response from several stakeholders, but due to low number of participants the conclusions found in this assessment cannot be generalized.

## **6.2 Shortcomings related to Cali's MFRP**

Various shortcomings of MSWM in Santiago de Cali, and particularly in the MFRP, have been identified. Addressing these shortcomings could help the city meet the goals proposed by

the program. The main shortcomings faced in the city with regard to its solid waste management system can be classified in the following four categories:

### **6.2.1 Institutional elements**

Despite the local government having self-evaluated its performance in accomplishing and following-up on PGIRS in 2010, the same shortcomings named in the evaluation were still encountered four years later. In order to implement and develop the program, environmental authorities (CVC and DAGMA) and the Municipal Planning Department have undertaken several activities, particularly to comply with the orders of judgment T-291. However, the main shortcoming found in the program is that there is no control mechanism of coordination between the entities responsible for implementing the program, between the different sub divisions within of these entities, and between entities and the waste services companies. This lack of coordination and cooperation affects not only technical interventions, but also the success of the program. This weakness can be solved with the creation of a head in the municipality to be responsible for coordinating the program, leading the participation between different institutions, and monitoring problems and achievements of the program. He or she would also lead in engaging the community and the private sector, with specific tasks and goals to achieve within a definite time period.

The ongoing political changes in institutions lead to lack of continuity in programs, affecting the intended goals. One of the most critical conflicts associated with Cali and Colombia in general is the lack of political commitment that should endeavour to define and give stability and continuity to the local plan (PGIRS) as a management tool of great importance for improving environmental conditions and quality of life for the community. Moreover, the lack of management has caused changes in political structure, thus enforce discontinuity between the different plans at several levels. Even when laws and policies exist, the city does not have an adequate system of control and monitoring on these types of program. Government institutions should be restructured for maximum cooperation and coordination for program success. This should be a key component in any planning strategy in Cali. Therefore, there should be proper communication links between community and environmental groups, the government, industries, and private companies for the whole program to work.

Even when laws and policies exist, the city does not have an adequate system to control and monitor these types of programs; for example, the city has not been successful in the

implementation of the Pay As You Throw (PAYT) program as few condos participate in this program due in part to changes the condos were required to make.

### **6.2.2 Socioeconomic factors**

People in condos are doing source separation, but the economic benefit generated by selling recyclable products has stirred controversy in several condos. Most condos want to sell the materials themselves and use the profits for their own benefits. Moreover, they do not allow recyclers to work inside the condos, affecting the progress of the program. Currently, the city bylaws do not oblige to condos to hire recyclers to work as staff or/and allow them to work inside the recycling rooms, otherwise to supply them with the recyclable products collected inside of condos, which has affected the program's progress.

### **6.2.3 Technical factors**

Lack of proper publicity is another factor affecting the success of the program. People need to be informed about the program, to know about its goals and benefits. TV commercials have been used, but wider publicity is needed to involve all stakeholders.

## **6.3. Application to other developing areas**

This section highlights the main points of success found in the MFRP that can be replicated in other cities with conditions similar to Cali's in condominium waste management and the implementation of a recycling system with separation at source.

- The implementation of a successful program of recycling and waste management should be backed by a law at the national, regional and local levels and should be led by governmental and environmental institutions .By national law, each condo should have an adequate storage room for storing waste and recyclable products in labeled containers
- The ability of issue sanctions or warnings for improper separation, and financial circumstances involving collection and tipping fees are considered important for develop mandatory recycling programs
- Citizens are more likely to participate effectively in collective efforts when they have been party to the policy decisions. The creation of committees with participation of all stakeholders is a good decision.
- The use of colored bags improves the source separation within dwellings; however, cities that provide free bins to householders have more recycling success.

- Financial support is essential to reaching all the goals foreseen.
- Collection services by the private sector is a good alternative. It solves the problems of mismanagement and inefficiency often encountered when waste management service is performed by government-run companies.
- The program of recycling must be supported by an excellent advertising campaign, which should start in schools and must include the participation of all stakeholders. Extensive education should stress the benefits of recycling and the participation of recyclers as important part of the recycling chain. Public education and marketing strategies that are part of a community effort can result in more recycling achievement.
- Creation of recyclers cooperatives and associations, have showed that economic benefits can be improve for recyclers and their families.
- The training to recyclers and managers is a positive aspect helping to development of the program.
- Every city must create in residents a sense of ownership and responsibility for cleaning culture to encourage participation in the program.

## **Chapter 7**

### **Conclusions**

This study aimed to answer the following main question: How well does the multifamily recycling program in Cali, Colombia corresponds to the ISWM framework?

In Colombia, the Ministry of Environment, through Decree 1505 of 2003, implemented the Plan de Gestion Integral de Residuos Solidos (PGIRS), which determined that each municipality should create a PGIRS and implement it in a specific time. Each PGIR should have specific goals and should be permanently monitored. Through Municipal Decree 0475, on August 31, 2004, Cali created its own plan for the 2004-2019: the PGIRS' Cali, which was established on a sustainability policy (with economic, social and environment aspects). The Multifamily Recycling Program (MFRP) as part of the PGIRS in Cali has as defined goal to encourage source separation and recycling within dwellings to contribute to the longer life of the landfill areas and the conservation of natural resources, as well as to generate employ to recyclers and economic benefits from the sale of recycled materials.

This waste management program had the participation of various interest groups or stakeholders: the government (National and municipal), the private sector (companies that buy and sell recyclable products), ONGs, the association of recyclers of Cali (A.R.C), managers and residents of condos, and citizens in general.

To highlight the social aspects of the MFRP, this study found the social insertion of recyclers through the national recognition of this activity and the creation of a national recycling day on March 1<sup>st</sup> of each year, as well as the training of recyclers and their families. In Colombia, the recyclers at the national and local level have created and organized associations and cooperatives. These work for improving economic and social conditions of their associates. In Cali, municipal entities and environmental authorities have been working to improve the recognition of recyclers as an important link in the recycling chain. In order to improve the social conditions of recyclers and their families, municipal and environmental entities have developed a plan with the participation of the Fundacion Carvajal-ONG and private companies. This plan includes training of recyclers to encourage recycling in a better way, leadership, financial support, as well as training in parenting and better living for their families.

As for the economic aspects, the city hired four private companies that cover all areas of the city. Users pay monthly fees for collection of waste in the city. Each dwelling should pay by the service according to its owners' socioeconomic strata. That is strata 1 and 2 pay less, and strata 4, 5, and 6 pay more to subsidize the lower strata. Only stratum 3 pays the real tariff. The collection of this fee is by EMCALI through the energy and water bill, making the monthly collection more effective. In the survey, few participants claim that fees for waste collection should be reduced. In general, a good point, is that people in Cali accept paying for a good service because they like to see a clean city. Cali has also established a Pay As You Throw (PAYT) program, which was proposed to all condos so the city receives economic and environmental benefits such as reduction of waste to dispose of and extended life of the sanitary landfill Coloma-EI Guabal. Dwellings also have reduction of fees for transport to the landfill, and a reduction of greenhouse gases. This survey found that PAYT is running slowing because it is a voluntary program. Condos owners must meet with many requirements to get approval from the waste service company. For example, each condo must ask to change to this regimen of weigh and pay for their waste disposal; undertake weighing of the waste generate; and, must prepare an integrated plan for waste management following the norms established by planner in the city.

In reference to socioeconomic aspects, it is important to highlight the work underway by the government entities committed to solving the Navarro recyclers by judgment T-291 in resolving most of the issues generated by the Navarro landfill's closure. The creation of a selected route for recyclable products in the urban area, and including the Navarro recyclers as part of its staff may be a model program to replicate in other cities in Colombia and other developing countries. In Cali, the chain of recycling and its waste industry is well developed and working well on several fronts, and it is generating employment for many families. The partnership among private companies and the A.R.C has helped to improve recycling and the use of recovered products as raw materials, thus gaining economic benefit for recyclers and industry.

Environmentally as consequence of increase of waste service due to expenditures on waste management, municipal interest has grown in reducing the quantity of waste generated and transported in the city of Cali. The MFRP established source separation within condos which provides major environmental benefits that include reduction of the waste send to the landfill as well as avoid the contamination of recyclables products. The implementation of the use of coloured bags for source separation was evaluated within condo participants. People in

condos are sorting recyclable products within dwellings; but, they prefer to reuse shopping bags for disposal of both organic and recyclable products.

The conclusions that provided the assessment of the MFRP are not generalizable due to the low amount of participants that partook in the survey; however, this information provides a good understanding into the waste management that Cali has developed.

## **7.2 Recommendations**

After analysis of the data and relevant information obtained through the interviews, survey results, and literature review, several recommendations are listed that would improve Cali's MFRP and make this program a model to be followed by other cities with similar characteristics:

- Establish a national goal for waste reduction. The actual percentage reduction that is chosen is not important for planners and local governments. It is not considered as main goal to achieve; however, it must be high enough to actually attract positive action.
- Local authorities need to expand the advertising of the MFRP in different media. It is vital to begin a campaign in schools with children and youth. Awareness of recycling and concern for the environment should be inculcated from an early age in all economic strata.
- Local authorities need to work closely with private sector companies and Non-Government Organizations (NGOs) in order to encourage effective participation in the program. Funding is an important aspect of any waste management programme, especially in a developing country. The business community should be a significant source of supplementary funding.
- Economic incentives that benefit recycling in condominiums should be promoted. For instance, a tax break could be given to condos that allow recyclers work within them, and another for those that promote the separation in source of household waste to facilitate sorting and sale, simplifying the reclamation of certain materials and products.
- Incentives could also be used to promote the use of recycled products. The design and use of many products need to be changed to be less harmful to environment. For instance, packing material needs to be reduced, as do plastic bags. The MFRP in condominiums suggests the use of green and blue plastic bags to promote source



separation of organic and recycle products; labeled bins inside of houses and apartments should replace them.

- An intensive program supported by the private sector, ONG, government and stakeholders should consider the use of these plastic bins.
- Creation of economic benefits for condos that participate in the PAYT program will help to improve their participation.
- Environmental awareness must be stimulated, as well as domestic habits that promote a culture of recycling in all sectors with the help of civic organizations and teaching institutions. Waste management and other environment issues should become one of the core programmes in the educational system, as it is young people who will influence the future.
- Dialogue and consultation with, and training of condo managers are needed. They are the key to achieving program success by encouraging participation in the recycling program for each condo. They must be program promoters and implementers; with their help the program should improve in efficiency and participation.
- Local authorities are planning to implement a selected route for collection of recyclables in condos and single dwellings. Collecting on different days for recyclables and organic waste is a good option that promotes the separation at source and generates benefits to recyclers by facilitating their daily work. A well-planned schedule of collection and adequate publicity by several means such as the Internet and flyers can ensure success in the program.
- Composting of all compostable material should be encourage. This could become a significant source of employment. In addition, it would cut down on the volume of waste for disposal and produce a useful nutrient that can displace costly artificial fertilizer use.

### **7.3 Research contributions/ Significance**

This research provides valuable lessons about the potential, problems, and opportunities in promoting and implementing ISWM. The lessons learned are also important for other municipal governments in Colombia, and for other governments in developing countries facing similar problems and situations in terms of planning and management of municipal solid wastes. Moreover, this study makes a contribution to the city of Santiago of Cali and other cities of developing countries that implement a multifamily recycling program in order to increase habits of recycling and increase diversion of recyclable materials from landfill sites such programs will generate social, economic and environmental benefits.

The study results are potentially useful for municipal solid waste decision makers because the current program is a good example of planning waste management activities related to local policies/regulations, community participation, encouragement and organization of informal recyclers. This example could stimulate the interest of waste management professionals in other cities in using this kind of program as a model.

#### **7.4 Future Research**

Challenges are still present in implementing planning and management strategies to improve waste management in Santiago de Cali. Further research is needed to extend the results of this study and to continue exploring the application of the program of source separation in various contexts. One issue that requires closer scrutiny is the development of selective recycling collection routes that have been implemented in the city. (At present the city has a pilot of selective recycling collection). The development of this program in the city cannot be achieved simply by policies. The problem should be surveyed with a detailed census and a case study with analysis of financial and other forces, e.g., the market demand for recycled products, participation rates, the competition of the informal sector, and government's attitude towards waste services. More in-depth research is needed to closely investigate different cases; identify their strengths, weaknesses, opportunities, and threats; and summarize the key elements for viable and reliable selective collection routes.

Future research should investigate and explore effective and viable forms of source separation. The location of the recycling station is an important factor in the study and the public attitudes towards source separation in general (the use of colour-coded bins inside of apartments and houses would encourage the separation of recyclable products if green and blue bins were supplied to the households).

Another challenging issue that needs to be addressed concerns public-private partnerships in the MSWM in Cali. Both the development of the waste industry and the promotion of waste-diversion programs require collaborative efforts. However, government leadership changes every four years and often too government focus and interest in the MFRP. Different agents may have different concerns, interests, and objectives. What mechanism is best and who will be able to mediate these various concerns, interests, and objectives deserve investigation.

Finally, research about composting is important in developing countries where the major percentage in waste composition is organic, so implementing composting programs that include recyclers as workers can be an excellent solution to environmental, economic and social issues that affecting developing countries.

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## Appendix A

### A.1 Ethics Materials

Ethics Clearance ORE # 18661

Dear Researcher:

The recommended revisions/additional information requested in the ethics review of your ORE application:

Title: An integrated system of waste management in a developing country, case study: Santiago de Cali- Colombia

ORE #: 18661

Faculty Supervisor: Murray Haight ([mehaight@uwaterloo.ca](mailto:mehaight@uwaterloo.ca))

Student Investigator: Clara Paya ([clarapaya@rogers.com](mailto:clarapaya@rogers.com))

have been reviewed and are considered acceptable. As a result, your application now has received full ethics clearance.

A signed copy of the Notification of Full Ethics Clearance will be sent to the Principal Investigator or Faculty Supervisor in the case of student research.

\*\*\*\*\*

Note 1: This ethics clearance from the Office of Research Ethics (ORE) is valid for one year from the date shown on the certificate and is renewable annually, for four consecutive years. Renewal is through completion and ethics clearance of the Annual Progress Report for Continuing Research (ORE Form 105). A new ORE Form 101 application must be submitted for a project continuing beyond five years.

Note 2: This project must be conducted according to the application description and revised materials for which ethics clearance has been granted. All subsequent modifications to the project also must receive prior ethics clearance (i.e., Request for Ethics Clearance of a Modification, ORE Form 104) through the Office of Research Ethics and must not begin until notification has been received by the investigators.

Note 3: Researchers must submit a Progress Report on Continuing Human Research Projects (ORE Form 105) annually for all ongoing research projects or on the completion of the project. The Office of Research Ethics sends the ORE Form 105 for a project to the Principal Investigator or Faculty Supervisor for completion. If ethics clearance of an ongoing project is not renewed and consequently expires, the Office of Research Ethics may be obliged to notify Research Finance for their action in accordance with university and funding agency regulations.

Note 4: Any unanticipated event involving a participant that adversely affected the participant(s) must be reported immediately (i.e., within 1 business day of becoming aware of the event) to the ORE using ORE Form 106.

Best wishes for success with this study.

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Susanne Santi, M. Math.,  
Senior Manager  
Office of Research Ethics  
NH 1027  
519.888.4567 x 37163  
[ssanti@uwaterloo.ca](mailto:ssanti@uwaterloo.ca)

## A.2 Covert letter

Dear respondent,

I am doing a survey to find out what people think about the multifamily recycling program (source collection and recycling in condos). I would be grateful if the person who usually looks after garbage in your household would take a few minutes now to complete this questionnaire.

This survey is part of a student project at the University of Waterloo, ON, Canada Faculty of Environment, Planning Department. Your responses will be kept completely confidential and will be used only in this research. If you have any questions regarding this survey please feel free to contact Clara Paya at 226-240-703, [clarapaya@rogers.com](mailto:clarapaya@rogers.com) or Professor Murray Height at \_\_\_\_\_

I WILL BE BACK TOMORROW TO PICK UP THE COMPLETED QUESTIONNAIRE.

Thank you for your help.

Sincerely,

Clara Paya

Graduate Student

## A.3 Questionnaires

### A.3.1 Household questionnaire

Multifamily Recycling Program

Condo Name \_\_\_\_\_ Address \_\_\_\_\_

Thank you for taking the time to complete this questionnaire. Be assured that your individual responses will be kept completely confidential. First, we would like to know general information about yourself

.Do you rent or own your home?

1. Rent  2. Own

Including yourself, how many people usually live in your home/apartment?

How many adults? \_\_\_\_\_

How many children? \_\_\_\_\_

Please indicate your age group

- |                                            |                                     |                                     |
|--------------------------------------------|-------------------------------------|-------------------------------------|
| 1. <input type="checkbox"/> Under 18 years | 2. <input type="checkbox"/> 18 -25  | 5. <input type="checkbox"/> 45 – 54 |
| 3. <input type="checkbox"/> 25 - 34        | 4. <input type="checkbox"/> 35 – 44 | 6. <input type="checkbox"/> over 65 |

What is your highest completed level of schooling?

1. Elementary school  ; 2. Secondary school  ; 3. College;  4. University

Are you male or female?

1. Male  2. Female

We would like to know a little about you and your condo so we can see how others like you feel about of multifamily recycling program. Your answers will be kept completely confidential

1. Do you know about the multifamily recycling program in the city?

Yes \_\_\_\_\_ No \_\_\_\_\_

If your answer is Yes please continue with the following questions:

2. How did learn about this project?

Radio/TV \_\_\_\_\_ Friends \_\_\_\_\_ Community group \_\_\_\_\_ Manager Condo \_\_\_\_\_

Municipality \_\_\_\_\_ Ministry of Environment \_\_\_\_\_ Company of waste management \_\_\_\_\_

3. Do you know about of the benefits that multifamily recycling program generate?

Yes \_\_\_\_\_ No \_\_\_\_\_



4. Which of the following benefits do you know this program creates or would create for the community?
- |                   |           |          |
|-------------------|-----------|----------|
| Economic .....    | Yes _____ | No _____ |
| Environment ..... | Yes _____ | No _____ |
| Social .....      | Yes _____ | No _____ |
5. Are you receiving any benefit from the multifamily recycling program?  
Yes \_\_\_\_\_ No \_\_\_\_\_
6. Which of the benefits of questions # 4 are you receiving? \_\_\_\_\_
7. Do you know about the use of green and blue bags for dispose of garbage in your condo?  
Yes \_\_\_\_\_ No \_\_\_\_\_
8. Do you use green bags for dispose of the garbage in your home? (Check one)  
  
[ ] 1. Yes [ ] 2. No
9. Do you use blue bags for dispose of the recyclable products in your home? (Check one)  
  
[ ] 1. Yes [ ] 2. No
10. Do you reuse grocery bags for dispose of the waste or recyclable products?  
  
[ ] 1. Yes [ ] 2. No
11. Would you say that you reuse grocery bags often, sometimes or hardly ever? (Check one)  
  
[ ] 1. Often [ ] 2. Sometimes [ ] 3. Hardly ever
12. How many average size (green) or (blue) bags of garbage approximately do you put out for collection each week? Green \_\_\_\_\_ bags ; Blue \_\_\_\_\_ bags (number of bags)
13. How many average size (black or grocery) bags of recyclable products approximately do you put out for collection each week? \_\_\_\_\_ bags (number of bags)
14. About how many average size (black or grocery) bags of waste do you put out for collection each week? \_\_\_\_\_ bags (number of bags)
15. If you are now trying to reduce the amount of garbage you put out for collection, how much difference would you say this program of recycling in your condo has made on the amount of garbage you put each week? (Check one)  
  
[ ] 1. No difference; [ ] 2. Some difference (Less than 1 bag per week)  
  
[ ] 3. Big difference (More than 1 bag per week)
16. In your opinion the multifamily recycling program in condos in the city is effectively working? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
17. In your opinion the multifamily recycling program is generating security to recyclers using protective equipment as uniform, gloves and helmet to do their jobs?  
(Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
18. In your opinion the multifamily recycling program is accessible to all condo communities

(Check one) Yes \_\_\_\_\_ No \_\_\_\_\_

19. What do you think could be improved about the multifamily recycling program?

- a) Reduced fees
- b) Reduce the odour generated in area of sort and collection
- c) Improve the service of collection inside of the condo (frequency, cans)
- d) Improve the system of collection (use of green and blue bags at home/apartment)
- e) Improve the service of collection by the EPS
- f) Better and /or more equipment of collection
- g) Informal recycler's work

20. If you have a complaint or suggestion about the recycling program in your condo, who would you talk to?

- a) My local political representative
- b) Condo Manager
- c) Condo Committee
- d) The Planning Department
- e) My neighbourhood
- f) The environment authority
- g) Other
- h) No one

If you have any further ideas, comments, or opinions concerning source collection and recycling programs, please write them in the space provide below and on the back of this page if more space is needed

### A.3.2 Informal recycler questionnaire

Thank you for taking the time to complete this questionnaire. Be assured that your individual responses will be kept completely confidential. First, we would like to know general information about yourself

How long have you been working as a recycler? \_\_\_\_\_

Including yourself, how many people usually work /recycle in this condo?

How many adults? \_\_\_\_\_

How many children? \_\_\_\_\_

Please indicate your age group

1 [ ] Under 18 years                      2.[ ] 18 -25                      3 [ ] 25 – 34

4. [ ] 35 – 44    5. [ ] 45 – 54                      6. [ ] over 65

What is your highest completed level of schooling?

[ ] 1. Elementary school    [ ] 2. Secondary school    [ ] 3. None

Are you female or male?

[ ] 1. Female                      [ ] 2. Male

We would like to know a little about you and your work so we can see how others like you feel about of multifamily recycling program. Your answers will be kept completely confidential

1. Do you know about the multifamily recycling program in the city?  
Yes \_\_\_\_\_ No \_\_\_\_\_

If your answer is Yes please continue with the following questions:

2. How do you know about this project?

Radio/TV \_\_\_\_\_ Friends \_\_\_\_\_ Community group \_\_\_\_\_ Manager Condo \_\_\_\_\_

Municipality \_\_\_\_\_ Ministry of Environment \_\_\_\_\_ Company of waste management \_\_\_\_\_

3. Do you know about of the benefits that multifamily recycling program generate?  
Yes \_\_\_\_ No \_\_\_\_

4. Which of the following benefits do you know this program is generate or would generate for the community?

Economic .....Yes \_\_\_\_\_ No \_\_\_\_\_  
Environment ..... Yes \_\_\_\_\_ No \_\_\_\_\_  
Social .....Yes \_\_\_\_\_ No \_\_\_\_\_

5. Are you receiving any benefit from the multifamily recycling program?  
Yes \_\_\_\_\_ No \_\_\_\_\_
6. Which of the benefits of questions # 4 are you receiving? \_\_\_\_\_
7. Have you received training to participate or work in the multifamily recycling program in condos? (Check one) Yes \_\_\_\_ No\_\_\_\_
8. How do you rate this training?  
a) Excellent b) Good c) Regular d) Bad
9. Do you know about the use of green and blue bags for dispose off garbage in condos?  
Yes \_\_\_\_\_ No \_\_\_\_\_
10. Do you know if householders are using blue bags for dispose off the recyclable products at home? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
11. Do you know if householders prefer to use reuse grocery bags for dispose off the waste or recyclable products? Yes \_\_\_\_\_ No \_\_\_\_\_
12. If you opinion, how much difference would you say this program of recycling in condominiums has made on the amount of garbage you recycled each week? (Check one)

[ ] 1. No difference [ ] 2. Some difference [ ] 3. Big difference

13. In your opinion the multifamily recycling program in condominiums in the city is effectively working? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
14. In your opinion the multifamily recycling program in condominiums has helped to improve working conditions of informal recyclers? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
15. In your opinion the multifamily recycling program is safe and accessible to the community? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
16. What do you think could be improved about the multifamily recycling program?

- a) Improve working conditions of informal recyclers
- b) Reduce the odour generate in area of sort and collection
- c) Improve the service of collection inside of the condo (frequency, cans)
- d) Improve the system of collection (use of green and blue bags at home/apartment)
- e) Improve the service of collection by the EPS
- f) Better and /or more equipment of collection

18. If you have a complaint or suggestion about the recycling program in any condo, who would you tell?

- a) My local political representative
- b) Condo Manager
- c) Condo Committee
- d) The Planning Department
- e) My neighbourhood
- f) The environment authority
- g) Other
- h) No one

If you have any further ideas, comments, or opinions concerning source collection and recycling programs, please write them in the space provide below and on the back of this page if more space is needed.

### A.3.3 Condo's manager questionnaire

Condo Name: \_\_\_\_\_ Address \_\_\_\_\_

Numbers of houses/apartments: \_\_\_\_\_ Strata level: \_\_\_\_\_

Thank you for taking the time to complete this questionnaire. Be assured that your individual responses will be kept completely confidential. First, we would like to know general information about yourself

How long have you been the manager of this condo/building? \_\_\_\_\_

What is your highest completed level of schooling?

1. Elementary school     2. Secondary school     3. College     4. University

Are you female or male?

1. Female     2. Male

We would like to know a little about you and this condo so we can see how others like you feel about of multifamily recycling program. Your answers will be kept completely confidential

1. Do you know about the multifamily recycling program in the city?  
Yes \_\_\_\_\_ No \_\_\_\_\_

If your answer is Yes please continue with the following questions:

2. How do you know about this project?  
Radio/TV \_\_\_\_\_ Friends \_\_\_\_\_ Community group \_\_\_\_\_ Municipality \_\_\_\_\_  
Ministry of Environment \_\_\_\_\_ Company of waste management \_\_\_\_\_
3. Have you received training for the implementation of the multifamily recycling program in condos? (Check one)    Yes \_\_\_\_\_    No \_\_\_\_\_
4. How do you rate this training?  
a) Excellent    b) Good    c) Regular    d) Bad
5. Do you know about of the benefits that multifamily recycling program generate?  
Yes \_\_\_\_\_    No \_\_\_\_\_
6. Which of the following benefits do you know this program is generate or would generate for the community?
- |                   |           |          |
|-------------------|-----------|----------|
| Economic .....    | Yes _____ | No _____ |
| Environment ..... | Yes _____ | No _____ |
| Social .....      | Yes _____ | No _____ |
7. Is this condo/building participating in the multifamily recycling program? (Check one)  
Yes \_\_\_\_\_    No \_\_\_\_\_

If your answer is Yes please continue with the following questions:

8. Is this condo/building receiving any benefit from the multifamily recycling program? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
9. Which of the benefits of questions # 6 is it receiving? \_\_\_\_\_
10. Has this condo received any financial aid to implement the recycling program? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
11. How this condo store waste?  
 a. Bucket                      b) Plastic container                      c) Other
12. How this condo store recyclable items collected and sorted?  
 a) Bucket                      b) Plastic container                      c) Other
13. Is there an adequate room for the process of sorter and storage of recyclables and waste in this condo? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
14. Is this condo using labeled green/ blue cans for dispose of garbage/recyclables respectively? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
15. Do you know if householders in this condo are using green bags for dispose of their garbage (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
16. Do you know if householders in this condo are using blue bags for dispose of the recyclable products at home? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
17. Do you know if householders prefer to reuse grocery bags for dispose of the waste or recyclable products? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
18. Approximately how many green cans of garbage are produced in this condo each week? \_\_\_\_\_ cans ( number of cans)
19. About how many average sizes blue cans of recyclable products are being collected in this condo each week? \_\_\_\_\_ cans ( number of cans)
20. About how many average homes are using blue bags for recyclable products at home each week? \_\_\_\_\_ (number of houses/apartments)
21. About how many average homes are using black or grocery bags for garbage at home each week? \_\_\_\_\_ ( number of houses/apartments)
22. If this condo is now trying to reduce the amount of garbage that put out for collection, how much difference would you say this program of recycling has made on the amount of garbage that it put out each week? (Check one)
- [ ] 1. No difference    [ ] 2. Some difference (Less than 1 can per week)
- [ ] 3. Big difference (More than 1 can per week)
23. In your opinion the multifamily recycling program in condos in the city is effectively working? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_
24. In your opinion the multifamily recycling program is safe and accessible to the community? (Check one) Yes \_\_\_\_\_ No \_\_\_\_\_

25. What do you think could be improved about the multifamily recycling program?

- a) Reduced fees
- b) Improve the educational campaign
- c) Improve the participation of householders in the program
- d) Improve the system of collection (use of green and blue bags at home/apartment)
- e) Improve the service of collection by the waste management company- EPS
- f) Better and /or more equipment of collection
- g) Informal recycler's work

26. If you have a complaint or suggestion about the recycling program in your condo, who would you tell?

- a) My local political representative
- b) Waste Management Company-EPS
- c) Condo Committee
- d) The municipality- Mayor
- e) The environment authority
- f) The Planning Department
- g) No one
- h) Other

27. How do you rate the participation of the waste manage company – EPS in the multifamily recycling program of this condo?

- a) Excellent
- b) Good
- c) Regular
- d) Bad

28. How do you rate the fees for the service of collection of waste?

- a) High
- b) Good
- d) Low

29. Have you found reduction in the service payment garbage collection after implementing the recycling program in this condo? (Check one)

Yes \_\_\_\_\_ No \_\_\_\_\_

30. If you answered **Yes** in 29, what percentage fell payment of this service?

- a) 5-10% \_\_\_\_\_
- b) 10- 20 % \_\_\_\_\_
- c) 20- 30 % \_\_\_\_\_
- d) 30-40% \_\_\_\_\_
- e) 40- 50% \_\_\_\_\_
- f) > 50% \_\_\_\_\_

31. How do you rate the work (sorter and collection of recyclable items) of the informal recyclers in this condo?

- a) Excellent
- b) Good
- c) Regular
- d) Bad

32. What economic benefit receives the informal recycler that works for this condo?



- a) A salary
- b) Receives the recovered items and sell them for financial gain
- c) Other

If you have any further ideas, comments, or opinions concerning source collection and recycling programs, please write them in the space provide below and on the back of this page if more space is needed.

Thank you for your time.

#### **A.4. Verbal consent script for interview**

I agree to participate in an interview being conducted by Clara Paya under the supervision of Professor Murray Haight of the School of Planning in the Faculty of Environment, University of Waterloo, Canada. I have made this decision based on the information I have received and the additional details that I have requested.

As a participant in this study, I realize that I will be asked to take part in a twenty minute interview and that I may decline answering any of the questions, if I so choose. All information which I provide will be held in confidence and I will not be identified by name in the thesis, report or publication. I understand that I may withdraw this consent at any time by asking that the interview be stopped. I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that quotes from the interview may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous. In addition, I allow to be photographed and that my photographs can be used in this thesis or any thesis or publication that comes of this research.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

I acknowledge that this project has been reviewed by and received ethics clearance through the Office of Research Ethics at the University Waterloo and that I may contact this office if I have any comments or concerns about my participation in this study. Also, I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at 1- (519) 888-4567 ext. 36005 Waterloo, Canada.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

YES  NO

I agree to have my interview audio recorded.

YES  NO

I allow to be photographed and that my photographs can be used in this thesis or any thesis or publication that comes of this research  YES  NO

**Appendix B**  
**Codification of survey**

**Table B.1 Code used to classified surveys**

Classification	Sequence Number	SE strata
Manager = M	1, 2, 3 .....	2, 3, 4, 5, 6
Tenant= T	1, 2, 3, 4.....	2, 3, 4, 5, 6
Recycler = R	1, 2, 3, 4.....	S=street, A=association

## Appendix C

### Pictures



Picture 1 Informal Recycler



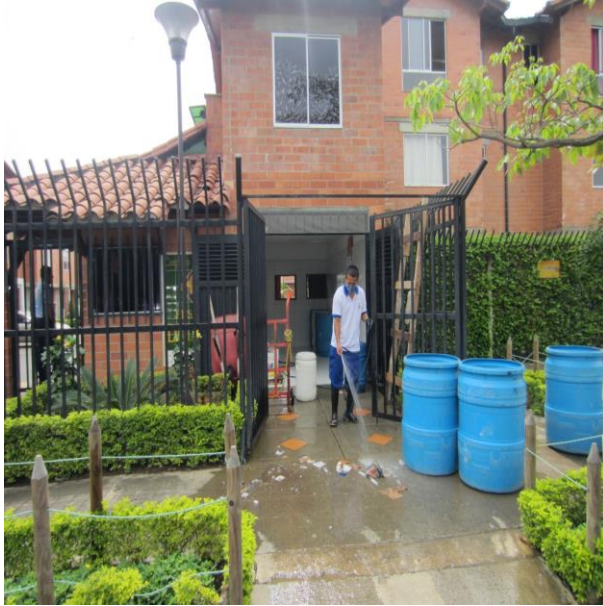
Picture 2 Carretilero



Picture 3 Waste storage room within condo



Picture 4 Shut within condo



Picture 5 Cleaning waste storage room



Picture 6 Outdoor trash cart



Picture 7 Recycling bin



Picture 8 Recycle center –Duos



Picture 9 and 10 Storage room SE 3



Picture 11 Sign in shut area

Picture 12 Shut door



Picture 13 and 14 Signs: Indicate where and how residents should deposit their waste



Picture 15 and 16 Recycling cardboards and plastics within condo



Picture 17 Outside yard waste deposit in condo Picture 18 Outdoor waste receptables



Picture 19 Waste collection day

Picture 20 Recycler sorting in cursibe waste



Pictures 21 and 22 Trucks waste collection



Picture 23 ARC : use of safety tools

Picture 24 ARC- Area office



Picture 27 ARC' Weighing Area

Picture 28 ARC' storage





Picture 29 Recyclers wearing their uniforms Picture 30 Truck donated by Bavaria-Brewery

### DIDACTICS TOOLS



Fridge magnetic



Mural wallpaper

The PGIRS of Cali, has adopted an animated cartoon that recreates the teachings of PGIRS among children in the municipality. "Santi" as it is known, uses a suit with the distinctive colors of the flag of Santiago de Cali. He looks on his chest the distinctive logo of the Comprehensive Plan Solid Waste Management -PGIRS". Through him residents are being educated to distinguish the value of waste and received recommendations to follow to make a proper management of waste generated. "Santi" strives to teach us our duty to reduce the amount of waste that we generate, to separate them in the same place in which they are generated such as: at home, at work, in meeting and fun places, and in public spaces.



Didactics mural wallpapers use in condo: The MFRP in Cali defined using two colors to differentiate the presentation of dry recyclables from organic wet waste

### RUBICK'S CUBE



## Appendix D

### **D.1 The Integrated Solid Waste Management Program in Santiago de Cali (ISWM): Plan de Gestion Integral de Residuos Solidos –PGIRS [in Spanish]**

The Integrated Solid Waste Management Program in Santiago de Cali (ISWM) was created by the municipal government through a specific law (Agreement 0475 de 2004) known as Plan de Gestion Integral de Residuos Solidos- PGIRS( from the Spanish acronym). It is a municipal policy and has a primary goal to divert waste, with reduction of the negative impacts on the environment and human health, as well as to promote the value and use of waste and the acquisition of new technologies; citizens are encouraged to develop recycling strategies that will increase the proportion of materials incorporated into productive cycles, with the participation of the community and encouragement of inter-sectorial work (Alcaldia de Santiago de Cali, PGIRS, Manual Conjuntos Residenciales, 2008).

The main aspects and strategies found in the PGIRS' Cali are summarized as:

- The waste hierarchy includes: reduce, reuse, recycle, recovery and disposal
- Promote technical cooperation between the public entities avoiding the duplication of efforts
- Closure of former Navarro Landfill following the current legislation
- The municipality is committed to the installation of the transferences centres and work should be directed to successfully implement the use of the solid waste recycler's organizations (Case T-291) and the reduction of waste to be deposited at the site of final disposal at the Guabal landfill, located in the municipality of Yotoco.
- Building transference centres to optimise transportation costs, reduce the volume of waste disposal increasing the recovering of recyclable material to optimise transportation costs, reduce the volume of waste disposal increasing the recovering of recyclable material
- Organization of informal sector by the promotion of cooperative associations with the private sector
- The promotion of sustainable consumption,
- Citizen integration and participation in the implementation of the municipal plan through environmental campaigns.

**Table D.1.2 Statements T-291 and T-411 of 2009**

<b>Responsible Entity</b>	<b>Association</b>	<b>Actions or Measures</b>	<b>Beneficiaries</b>
Mayor,  Social Welfare, Secretaries of Education and Health	Health  Education  Social Security	Ensure the full enjoyment of their constitutional rights to health, education and food, access to education for minor children, inclusion in social programs of feeding, housing, recreation, job training and sports	Cali's recyclers and their Families
Mayor, Emsirva ESP, Ministry of Environment: CVC and DAGMA	Economic	Provide temporary work or temporal labor solutions to guarantee subsistence; business solutions and solutions to peripheral subsistence	Plaintiffs of Tutela Action
Emsirva -ESP, Mayor, CVC	Economic	Design, adopt and implement a policy of effective inclusion for Cali's recyclers in the waste related formal economy: collection programs, development and commercialization of waste and strengthening the quality of their entrepreneurial and organizational forms of solidarity	Cali's recyclers
Municipal Planning	Planning	Update census of recyclers and their families ( including streets recyclers and Navarro's recyclers)	
Ministry of Environment : Dagma, CVC	Planning	Create and promote a contest to motivate caring and citizenship, in order to initiate participation in activities such as: a) source separation b) transfer of ownership of recyclable waste to organized recyclers until the city starts the operation of selected routes	Citizens
Mayor,  Emsirva  ESP	Social   Planning	Create action committee(s) for the inclusion of recyclers in the formal economy of waste management in the city  Plan should have actions taken and advanced, and outcome indicators that show the status of the process.	a representative of: DANSOCIAL, DAGMA,CVC, FEREDURCO,UP FRAME, ANR, Regional human rights defender, CIVISOL

Source: Author, Content drawn from T-291 and T-411 of Santiago de Cali, 2009

## D.2 The former landfill: El Basuro de Navarro

El Basuro de Navarro is the original landfill of Santiago de Cali. Navarro landfill started operations as a dump in 1959 and continued until 2008 with a hill approximately of 52 meters vertical. The site encompasses 35 hectares (ha), distributed into three sections: the former, the transitory and the expansion landfill.

The Navarro Landfill in Cali received more than 1500 tons of waste daily from three municipalities: Cali (42324 tons/month), Yumbo (1173 tons/ month) and Jamundi (896 tons/ month). Figure D 2.1 shows the former landfill's localization in the urban area of Santiago de Cali.



Figure D 2.1 **Satellite image of Cali's landfill** - Localization in the urban area

Source: Google maps 2011

In 2001 a landslide occurred in the southern sector of the landfill due to the pressure of leachate by which CVC forced to close the old landfill and continue the provision in the transitional landfill beside to the old landfill. During the period of 1998-2001 Serviambientales S.A operates the landfill and built gas drainage, leachate and rainwater, reducing outstanding slope to provide stability to the waste deposited. A social plan also was created by Serviambientales S.A to benefit recyclers and their families who had worked recovering recyclables products for more of 20 years in the landfill. The social plan included a walk in clinic

for health care waste pickers and their families, a school for the children of recyclers and a better work area with two conveyor belts. Unfortunately, the entire social plan was deteriorating because of internal conflict of recyclers. As well as, the conveyor belts due to the high-energy costs for its operation and finally were abandoned.

In 2006 CVC closed the landfill because reached its maxima capacity. However, in this time the city does not ready a new landfill to dispose of the garbage. EMSIRVA started to deposit the waste in the expansion area a small landfill of 0.9 hectares equipped to work with an impermeable layer at the bottom, gas pipes and leachate collection with a treatment pond. In this expansion area the city of Cali dispose of its waste until 2008, when its closure was an order issued by the Autonomous Regional Corporation CVC (regional environmental authority) dated June 4, 2008. The city began to export the waste to the new landfill in Yotoco, on June 25 2008. In the Navarro landfill the municipality has the obligation to carry out all actions to control the impacts that may occur on this site and should continue its management for 30 years after the closing. The private company Carbon BW was hired to build the leachate plant for Navarro's lixiviates.

The Navarro landfill closure bring the eviction of all families and individuals (686 recyclers) who were pursuing recycling task and began to exercise their duties in urban areas generating a social problem.

**Table D.2.2 Summary of the Main Characteristics of the Navarro Landfill**

Total site area	
Area designated for waste filling	40 ha
• Original landfill area	16 ha
• Transitory area	16 ha
• Expansion area	0.9 ha
Estimate capacity of waste at closure	19.6 Millions tones
Infrastructure	Control building Pre-treatment of leachate: Evaporation pounds ( Seven) Roads Storm water channels Gas extraction system

Source: Author content from Clean Development Mechanism, 2010



Figure: D.2.2. Characteristics of the three periods of build of the Navarro Open dump and landfill

Source: Newspaper El Pais, 2008.

<http://historico.elpais.com.co/paionline/calionline/notas/Febrero102008/cali01.html>

### D.3 The new landfill: Colomba - El Guabal

The Colomba –El Guabal landfill is located to nine kilometers from the urban area of the municipality of Yotoco, Valle del Cauca and 45 km from the downtown Cali. The total area is 4000 hectares of which 356 are the useful area of the landfill and an active area of 63.7 ha, which only twenty hectares are receiving refuse.

From June 2008, the owner and operator Interaseo del Valle S.A received a concession from the municipality for the operation for a period of 20 years (Clean Development Mechanism, 2010). The landfill has environmental license Number 0740-0377 issued by CV C August 9, 2007 (Aluna, 2010)

The landfill will be able to receive 2000 tons of garbage daily from eight municipalities of Department of Valle del Cauca: Yotoco, Santiago de Cali, Yumbo, Candelaria, Jamundi, Florida, La Cumbre, Dagua, and four municipalities of Department of Cauca: Caloto, Padilla, Villarica and Corinto. Currently, the landfill is receiving 1800 ton/day, operates 24 hours, and received on average 230 truckloads per day. The project will have a lifetime of thirty-one years, during this period it may receive 19,487,769 tonnes of waste; it is estimated that in 2035 Cali will produce 3,685 tons/day.

The construction of the landfill has been divided in to several phases; the first phase included three vases for a period of 31 years (13 for the first vase, three for the second and

fifteen for the third). Figure 4.18 shows the stage of construction in the landfill and Figure 4.19 displays an overview of landfill El Guabal in the municipality of Yotoco, Valle del Cauca. Each cell in the Guabal landfill is covered daily with earthy materials and synthetic coverage which ensures that finds no presence of vultures and animals. The treatment plant leachate generated in the landfill the Guabal consists of two storage pools where leachate recirculation is performed. Zone A operates in an area of 12.3 hectares and manages a flow rate of 1.7 liters per second. It is estimated that when a flow of 8 m<sup>3</sup>/seg generated at the end of the plant should be operating properly. Chimneys located in each cell capture the gases generated in the process of degradation of organic matter (Aluna, 2010). Figure D.2 and D.3 show landfill Coloma localization and a panoramic of the landfill.



**Figure D.2 New Landfill Colomba -El Guabal-Yotoco**



**Figure D.3 Panoramic new landfill**

Source: CDM- El Guabal Landfill, 2006

#### **D.4 Compaction and transfers stations**

The use of Transfers Stations (TS) is a factor that has gained strength in recent years, as urban centers grow and disposal sites are increasingly distant. Transfer stations are dedicated to management, material recovery, and solid waste; Solid wastes from collection trucks are stored for a short period of time compacted into large containers for delivery to the landfill. In Colombia by Article 11 of Decree 1713 de 2002 the ministry of economic



development and the ministry of environment included transfer stations of solid residues prior to final disposal as one of the components and activities in the public service of waste and as part of the PGIRS (Varon,K.; Orejuela,J. ;Velazquez, M. 2012)

In Cali, after the closure of the former landfill Navarro and the opening of the new landfill located 45 km from Cali, the city built in April 2009 a transfer station (TS) called The Caucana located in the town of Palmaseca (Municipality of Palmira).



#### **D.5 Sentence T-291**

In response to the recycler's demands, the Constitutional Court issued Decision T-291 and T-411 in 2009, which ordered the following: [Quoted here in its entirety]

- EMSIRVA ESP, or companies that develop the same functions in the future, Cali's mayor and CVC will design, adopt and implement effective inclusion policies for recyclers in Cali's collection programs, waste utilization and marketing to strengthen their quality of entrepreneurs and organizational forms of solidarity
- Cali's mayor through his Ministries of Education, Health and Welfare, will take the necessary measures to ensure that the Navarro recyclers surveyed in 2003 and 2006,

obtain licenses or special identification for the enjoyment of their constitutional rights to health, education, decent housing and food, checking for in each case the affiliation or connection to the social security system in health, access to education for minor children, and their inclusion in social programs.

- The Municipal Planning Department of Cali will perform a census of Navarro's recyclers, and include all those initially surveyed and listed in the databases of cooperatives and other organizations EATs that worked in Navarro. Likewise, it will design and conduct a census of street recyclers in the city of Cali, so that the information collected can move forward the process of including them in the formal economy of the waste.
- DAGMA and CVC will create and promote, with the participation of civil society organizations that join in their efforts, citizenship and solidarity campaigns aimed at encouraging citizens of Santiago de Cali
  - a. Begin the process of separate the waste inside of the apartment or house (source separation)
  - b. Initiate waste selected routes operating in the city.

#### **D.6 The PAYT system in Colombia**

One of the essential aspects of change in the constitution made in Colombia in 1991 is the modernization of policies on the environment, which were updated to respond to the concept of sustainable development. During the phases of creation, implementation, execution and control of new environmental regulations, state intervention was necessary. Preventive and corrective policies have been designed to ensure environmental protection and proper use of natural resources. Preventive policies are characterized by the creation of instruments designed to prevent pollution and environmental damage (Escobar & Lopez 2008, p.177). Although these mechanisms (direct restrictions and incentives) are complementary, economic incentives have gained more space in environmental regulation because they are considered more efficient.

In Colombia, the current pricing structure of the waste management service is based on the system of freedom to regulate<sup>22</sup>. This means that the persons providing waste management service set their rates following holistically calculation methodologies issued by the Committee

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<sup>22</sup> Law 142 of 1994, Article 14 defines the regime of liberty regulated as follows: "Rate Regime whereby the respective regulatory commission shall establish the criteria and methodology under the companies which public utilities may determine or modify the maximum prices for the services offered to the user or consumer"

on Water and Sanitation [Comision de Agua Potable y Saneamiento Basico (CRA) in Spanish]. According to socioeconomic status, users can be subsidized or paid solidarity contributions. In the event that the profits of the user contributions are insufficient to cover the amount of subsidies, the municipality must pay this difference<sup>23</sup>. The current price regulation does not include economic incentives to reduce volume of solid waste produced, collected and disposed of; the multi-user tariff option (PAYT) is the exception. This option seeks to reduce the generation of solid waste through reduction and /or source separation (Uribe and Dominguez, 2005). Law 142 of 1994 established the right of the public to obtain from waste management companies accurate measurement of the waste they have put out for disposal so they will not be overcharged. This measurement is the main variable in the price charged that a subscriber or user. Based on this forecast, Decree 1713 of 2002 defined the term “multiuser”<sup>24</sup>, as pertaining to groups of users who combine their waste for disposal, for instance, in one garbage collection area/condo and included explicit obligations for the CRA regarding the design of incentives to pursue separation at the source (Uribe & Dominguez, 2005). Furthermore, the CRA issued Resolution 233 of 2002, which established that the fee would be reduced under the option of a multiuser tariff if the volume of solid waste produced is less than that estimated by the current methodology.

The multi-user pricing is an alternative option for users of sanitation services that are bundled to obtain a major rate of this service. The waste produced in co-ownership (condos) are measured by the service organization and based on this measurement the fee is charged to each user, resulting in a significant decrease in the cost of the fare. Since this is a voluntary option, it must be requested by submitting a written request to the company that provides cleaning service that caters to the corresponding communication area. The communication must

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<sup>23</sup> Artículo 89 of Law 142 de 1994.

<sup>24</sup> In Colombia, the multi-service waste management defined by Decree 1713 of 2002 defined as multiuser all users grouped dwelling units, residential centers, condominiums or similar under the horizontal property administration or concentrated in commercial or similar facilities, characterized in that they have put out in a specify place their solid waste to the person providing the service and that SWR: requested the capacity of their waste to this measurement. The person providing the service will bill each property individually, in full compliance with the regulation is issued to this purpose

meet certain requirements. By having access to this tariff option they are obtained different economic, environmental and social benefits. Once users are requiring the service EPS undergoing the respective appraisals, process consisting of several visits by officials of the EPS in which perform different weightings in order to determine the amount of waste by setting the weight and volume of the same, where you should have, and explains how it should be the presentation of the waste produced by the condominium. There are evaluations in the cities of Medellin and Bogota where reported decrease in the collection of the cleaning service of about 50% (Ramirez, T. 2006)

Economic incentives have been used to increase the sorter waste ratio<sup>25</sup> (SWR) and to reduce the amount of unsorted waste produced. Pay-as-you-throw (PAYT) or peer-unit pricing system is an economic incentive since it links the fee paid by the user to the amount of residual (unsorted) waste actually produced. The variable part of the PAYT is usually calculate based on weight or volume of the unsorted waste produced.

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<sup>25</sup> SWR is the amount of sorted waste compared with the total amount of waste produced. Because sorted waste is potentially recyclable, some authors use the term recycling ratio instead of sorted waste ratio