Towards an inclusive municipal solid waste management system: A case study from Xalapa, Veracruz, Mexico

Andrés González Acosta
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Abstract: The city of Xalapa, like many Mexican cities, does not count with any sort of official recycling program. Resource recovery relies on the work performed by the informal recycling sector and often, such work is neglected by the local government. In line with this, the aim of this study is to evaluate if a participatory resource management is a more suitable option than the current approach; so that the informal recycling sector can be included into the formal waste management system. In order to do so, this study employed a case study method using qualitative data; during the month of field work in Xalapa, semi-structured interviews and observation were the techniques used for collecting data. Concepts such as informal economy, participatory resource management, network theory and waste management were employed to analyze the organization and operation of the formal and informal waste management systems.

Drawn from the results and analysis, it was presented that the informal recycling sector in Xalapa is composed of 5 different types of actors. Some of these actors are organized, while others work independently. The study revealed that their income is related to their capability of accessing to infrastructure and resources. This access to infrastructure and resources takes the form of a secondary materials trade hierarchy where the income of an actor depends on their ability to add value to their recovered materials. Additionally, organized actors tend to be less prone to manipulation and exploitation.

Furthermore, it was deemed relevant to look at the current policies and regulations as well as to the action plans proposed by the local government for alleviating the solid waste crisis in Xalapa. It was identified that to consider a participatory resource management approach, several barriers need to be overcome; these barriers lie within the governance and social spectrum. However, despite the identified barriers, the current waste management system has opportunities for creating a more inclusive and socially just municipal solid waste management system.

Keywords: Sustainable development, municipal solid waste management, Xalapa, informal recycling sector, participatory resource management

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Summary: A proper municipal waste management system is a challenge to many cities from the global South. In countries like Mexico, most cities lack formal recycling schemes. However, there is an informal resource recovery system comprised of different set of actors, whom mainly recover: plastic, metal, cardboard, paper and aluminium cans; some follow a hierarchical organization while others work independently. In the city of Xalapa, the local government, in spite of recognizing the labor these informal recyclers do, does not acknowledge their work as essential or official. Therefore, these actors receive no support from the local government; their working conditions are usually precarious and dangerous.

The informal recycling sector functions in parallel with the formal municipal solid waste management system. In fact, some actors from the Public Sanitation Department (the authority in charge of waste management in the city) are also engaged in informal resource recovery activities; what is more, these actors recover more materials than any other group.

The aim of this study was to evaluate if and how can participatory resource management can be a more suitable alternative to the current waste management system. In order to do so, an understanding of how the formal waste management system and the informal resource recovery was necessary. To this end, the study employed a case study method; and semi-structured interviews and observations were the techniques used to gather data. It has been presented that the informal recycling sector in Xalapa is composed of 5 different actors. Some of these actors are organized, while others work independently. The study revealed that their income is related to their capability of accessing to infrastructure and resources. This access to infrastructure and resources takes the form of a secondary materials trade hierarchy; where the income of an actor depends on their ability to add value to their recovered materials. Additionally, unorganized actors can be more susceptible to manipulation and exploitation than organized actors.

It was necessary to look at the current policies and regulations; as well as to the action plans proposed by the local government for solving the waste crisis from the city of Xalapa. It was identified that the suggested action plans proposed by the local government lack: inclusive policies, incentive mechanisms to encourage citizens recycle and recognition of the labor performed by informal recyclers. It was recognized that to consider a participatory resource management approach, several barriers need to be overcome; these barriers lie within the governance and social spectrum. However, despite the identified barriers, the current waste management system has opportunities for creating a more inclusive and socially just municipal solid waste management system.

Keywords: Informal recycling sector, sustainable development, municipal solid waste management, participatory resource management, Mexico

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1. Introduction

1.1. Problem statement

Changes in lifestyle and different consumption patterns cause important consequences in generation and characterization of waste stream (GTZ and Ambiental, 2003). Rapid urbanization and increasing global consumption are driving unprecedented levels of waste generation in low and middle income countries (United Nations Human Settlements Programme, 2010). Cities, especially in the global South, are experiencing population growth and rapid urbanization. This unplanned growth, mixed with governments with limited capacity, is causing a series of problems, one of them being a lack of proper municipal solid waste management (MSWM) (Medina, 2005).

Recognizing this challenge, cities try to improve waste collection by upgrading and increasing their waste collection fleet, as well as by privatization efforts, yet, they fail at providing a reliable service to the population (Medina, 2007b).

An appropriate solid waste management is one of the main challenges faced by local governments all over Mexico (Jiménez Martínez, 2015, p.36). In 1997 in Mexico, around 29 million tons of municipal solid wastes (MSW) were generated, and in the year 2012 around 42 million tons of MSW were reported, an increment of 44% for the 15 years period (Rodriguez, Castrejon-Godinez, Ortíz Hernandez and Sanchez-Salinas, 2015). It is estimated that 90% of the total waste generated is collected (El Medio Ambiente en México 2013-2014, 2014); the rest is illegally dumped or else, burned (ibid).

In the case of Xalapa, the unplanned growth that the city has been experiencing for the last 30 years has yielded creation of squatter settlements in the fringes of the urban area (Departamento del Medio Ambiente y Recursos Naturales, 2016). In such settlements and in many low-income areas, roads are unpaved and very steep thus making the access of MSW collection service difficult. In these areas, informal refuse collectors provide the service of picking up garbage, and retrieving recyclables contained in it, for a fee (Gutberlet, 2008b; Medina, 2005). Moreover, given that the municipality does not count with any recycling programs, the informal recycling sector provides this service (in chapter 2 the informal recycling sector will be presented). Public policy towards informal recycling sector is classified into four categories: repression, neglect, collusion and stimulation (Medina, 2007b).

In addition, several studies (Gutberlet, 2008a; Medina, 2007a; Scheinberg, Spies, Simpson and Mol, 2011; Velis et al., 2012; Wilson, Velis and Cheeseman, 2006) among others, have shown that these informal recycling services have positive effects on the environment, reduce the costs of waste management systems and provide income opportunities for a large number of people (Gerdes and Gunsilius, 2010). This makes the informal sector a key factor in order to have a functioning solid waste management. A more inclusive approach for the integration of the informal sector into the municipal solid waste management system will be the area of interest of this project.

The municipality of Xalapa, Mexico, faced with an increase of waste generation and a MSWM system unable to cope with it, has proposed in its Municipal Development Plan 2014-2017 a set of actions in order to improve the service (more in chapter 5). The proposed action plan announced by the municipality of Xalapa lacks action guidelines referring to the informal recycling sector. Therefore, this project proposes that instead of the action plan proposed by the local government, a participatory resource management for waste management approach would be a more suitable proposal in order to include all the actors involved in the system, formal and informal. But, in order to consider such alternative, an understanding of how the MSWM system works including the informal recycling sector work is needed. However, it is also relevant to look at the policy...
governing waste management as well as to identify the stakeholders involved in the system for getting insight on what are their opinions from the current MSWM.

This project relies on the work done by Gutherlet (2008) on participatory resource management for waste management. “Participatory resource management is based on the idea that all stakeholders who have an interest in a resource should take part in the resource’s management” (Hare, Letcher and Jakeman, 2007). In other words, participation goals include a desire to encourage social learning; to increase the democratic legitimization of management decisions; and to increase project effectiveness (Hare, Letcher and Jakeman, 2007).

Additionally, every day, more and more policy makers are realizing that the design of waste management systems is much more than a technical issue (Hornsby, Ripa, Vassillo and Ulgiati, 2017, p.158). Several studies have shown that participatory methods for waste management can provide the means for involving all stakeholders and creating more enduring solutions Municipal solid waste management in Mexico calls for urgent action. Local municipalities have the burden of providing sound environmental, economic, and socially acceptable MSWM services to society (El Medio Ambiente en México 2013-2014, 2014).

1.2. Objective
The objective of this project is to evaluate if a participatory resource management is a more suitable alternative for the municipality of Xalapa than the action plan they propose.

1.3. Research question
The study addresses the following research question:

Main research question

- Can a participatory resource management approach be applied to Xalapa’s municipal solid waste management system in order to include the informal recycling sector?

Sub questions

- How does the current municipal solid waste management work? Who are its main stakeholders?
- How does the informal recycling sector works? Who are its stakeholders? How are they organized?
- Are there any interactions among the formal and informal sectors? If so, how do they function?
- What are the problems/challenges (perceived by the actors) in each sector?
- What are the barriers and opportunities for participatory resource management to provide solutions to the problems identified in the WM sector?

1.4. Limitations
This study is restricted to the municipality of Xalapa in the state of Veracruz, Mexico. Moreover, this study only looks at household waste; leaving aside hazardous and dangerous waste. Due to data collected during the fieldwork, more attention will be placed on certain informal recycling sector actors, namely pepenadores and carreteneros. However, it is recognized that informal recycling sector in Xalapa is comprised of more actors, which are briefly described in the report.
1.5. Organization and content of the project
This thesis is organized into 7 chapters. Chapter 1 deals with introduction to the topic as well as with stating the research question and sub-questions that will guide the rest of the paper; objectives and limitations are also presented. Chapter 2 is about the background of the study area including geography, governance, infrastructure and current municipal solid waste management practices in Xalapa. The concept of informal recycling sector is also introduced in this chapter. Chapter 3 deals with the theoretical framework and describes the different concepts and theories on informal economy, integrated sustainable waste management, networks, sustainable development and participatory resource management. Chapter 4 is about the method and techniques used in order to generate and gather data. Chapter 5 presents the results from the fieldwork done in Xalapa. The fieldwork was comprised of semi-structured interviews and observations, with a focus on local government authorities and the informal recycling sector. Chapter 6 sets to analyze and discuss the results based on the theoretical framework from chapter 3. Chapter 7 presents the conclusions from the study and ends with suggestions for further studies.
2. Background

2.1. Municipal solid waste management in the global South

One of the major challenges facing cities in the Global South is the improper disposal of waste. Waste is a global issue. If not properly dealt with, waste poses a threat to public health and the environment (Wilson et al., 2015a). It is a growing issue linked directly to the way society produces and consumes, it involves everyone (Wilson et al., 2015a). A proper waste management is essential for any society and indeed, a human need (ibid).

Municipal solid waste management constitutes a serious problem in many global South cities (Medina, 2007a). Most cities do not collect the totality of wastes generated, and of the wastes collected, only a fraction receives proper treatment and disposal (Medina, 2005). Together, the insufficient collection and inappropriate management of solid wastes represent a source of water, land, and air pollution and pose risks to human health and the environment (Medina, 2007a). In the UN-HABITAT’s report, *Solid Waste Management in the World’s Cities*, Bharati Chauturvedi refers to waste as one of the biggest challenges of the urban world (Gutberlet, 2015; United Nations Human Settlements Programme, 2010). Just as Gutberlet (Gutberlet, 2012) points out, finding socially, economically and environmentally adequate, long-term solutions to the serious solid waste predicaments has become an increasing and ubiquitous concern for local governments, environmentalists, academics and the community at large.

Many municipalities in the global South often consider the informal recycling sector as a liability rather than as an asset for improving their MSWM system and resource recovery rates (United Nations Human Settlements Programme, 2010).

2.2. Informal recycling sector

The recovery of materials from waste to be reused or recycled has been carried out for millennia, and probably throughout the whole of human history (Downs and Medina, 2000). Recycling of municipal solid wastes in developing countries relies largely on the informal recovery of materials from waste carried out by the informal recycling sector (Medina, 2000). In contemporary societies, informal recycling activities reduce the amount of wastes that need to be collected, transported and disposed of, and extend the life of dumps and landfills (Downs and Medina, 2000). According to Medina (2007b, p. 8), “most studies report that waste pickers constitute disadvantaged and vulnerable segments of the population. Due to their daily contact with garbage, waste pickers face multiple hazards and problems”. Mexico City’s waste pickers, for example, have a life expectancy of 37 years while for the rest of the residents is of 67 years (Nuñez Espinoza, 2016). In the context of Xalapa, despite the evident contributions made by the informal recycling sector in matter of resource recovery, official recognition is lacking. Public policy towards them is that of neglect (BID-ICES, 2014).

The informal sector is characterized by “small-scale, labor-intensive, largely unregulated and unregistered low-technology manufacturing or provision of services” (Wilson, Velis and Cheeseman, 2006). Furthermore, informal sector entrepreneurs or enterprises do not pay taxes, have no trading license and are not included in social welfare or government insurance schemes (ibid). Moreover, the informal sector lacks job security, minimum wage income, or any political power for negotiation (Lomnitz, 1978).

In the context of municipal solid waste management, the informal recycling sector refers to the waste recycling activities of scavengers, household collectors, waste picker, and in the case of Mexico, individuals involved in municipal waste collection services. These terms are used to describe those involved in the extraction of recyclables and reusable materials from mixed waste.
(Ezeah, Fazakerley and Roberts, 2013). These activities epitomize the informal sector as this is labor-intensive, low-technology, low-paid, unrecorded and unregulated work, often completed by individuals or family groups (Wilson, Velis and Cheeseman, 2006).

(Ezeah, Fazakerley and Roberts, 2013) states that in most cities with informal, municipal waste collection and disposal systems, at least six categories of informal waste recycling are known to exist. The existing informal waste recyclers are: household waste collector, street pickers, itinerant buyers, municipal waste collection crew, dumpsite pickers and middle men (or informal recycling centers). A more detailed description of each category will be given in chapter 5. Figure 1 illustrates the recyclables flow retrieved by the informal sector in a Mexican city.

![Flow of recyclable materials by informal sector in a Mexican city](image)

**Figure 1** Flow of recyclable materials by informal sector in a Mexican city (Ojeda-Benitez, Armijo-de-Vega and Ramírez-Barreto, 2002)

### 2.2.1. Socio-economic, health, and environmental impact of the informal recycling sector

Apart from providing a complementary service to the current MSWM system, the informal recycling sector brings social, economic and environmental benefits (Ezeah, Fazakerley and Roberts, 2013; Gutberlet, 2008b; Medina, 2007b; Ojeda-Benitez, Armijo-de-Vega and Ramírez-Barreto, 2002; Wilson, Velis and Cheeseman, 2006). According to (Wamsler, 2000) some of the benefits provided by the informal sector, which most of citizens are unaware of, include:

- **Environmental benefits**, extend the operating years from the sanitary landfills and diminish the pressure on extraction of more “virgin” natural resources as they provide material inputs for recycling; social benefits, creation of jobs for an important number of marginalized and urban poor citizens; economic benefits, create significant amount of savings to the municipality, and society, as they make that less waste ends up at the sanitary landfill hence, contributing to a reduction of the negative environmental impacts caused by municipal solid wastes. (2000, p. 2)
2.2.2. Trade hierarchy in informal recycling

The income and working conditions from the informal recycling sector is highly dependent on their organization. Generally, the less organized these sector is, the less possibilities of adding value to the secondary raw materials they collect, and the more vulnerable they are to exploitation from middlemen (Wilson, Velis and Cheeseman, 2006). Normally, materials collected by this sector are traded local, having as end-users local or regional industries including craftsmen and artisans. This trade often involves a chain of intermediate dealers between informal recycling sector and end-users and may include both formal and informal sector activities (Medina, 2007b).

Actors involved in this recycling trade network are structured in a hierarchy (Figure 2). When a secondary material is traded, the higher it is traded, the higher added value it possesses. Wilson et al. explains that “informal recyclers tend to occupy the base of the secondary materials trade hierarchy and this significantly reduces their potential income” (2006, p. 800).

![Trade hierarchy of informal recycling sector](image)

**Figure 2** Trade hierarchy of informal recycling sector (Wilson, Velis and Cheeseman, 2006)

2.3. Study area

2.3.1. City of Xalapa

The municipality of Xalapa is the capital city of the state of Veracruz in Mexico. It has 457,614 inhabitants according to the latest census (INEGI, 2010). The metropolitan area encompasses the municipalities of Xalapa, Banderilla, Coatepec, Emiliano Zapata, Jilotepec, Rafael Lucio and Tlanelhuayocan. Figure 3 shows Mexico with the state of Veracruz highlighted in green, while Figure 4 illustrates the city of Xalapa.
Figure 3 Map of Mexico. State of Veracruz highlighted in green (INEGI, 2010)

Figure 4 City of Xalapa, capital city from Veracruz (INEGI, 2010)
2.3.2. Urbanization
Xalapa has a very irregular topography. It is full of slopes and narrow streets. During the last 30 years, the municipality of Xalapa has suffered from rapid and unplanned urbanization. This has led to a variety of squatters settlements at the peripheral areas of the city at the north-east and south-east border of the city (Departamento del Medio Ambiente y Recursos Naturales, 2016). One of the problems with these unregulated housing areas is that, besides difficult access, they are located in areas prone to floods and mudslides (ibid).

According to local authority 3 from Ministry of environment, (interview with Local authority 3, 2017), during the last three decades, the urban area has grown seven times while the total population has only doubled. This means that in the periphery of the city there are many unplanned neighborhoods as well as unpaved roads. These informal neighborhoods with its unpaved roads hinder the collection services of the municipal solid waste management system.

2.3.3. Governance
It is out of this project’s scope to give in detail the several laws governing solid waste management at a national and local level, so I will limit myself to provide a general overview of these.

In Mexico, the federal government is in charge of creating the legal and institutional frameworks for the adequate management of municipal solid wastes. Such framework is provided by the Ley General del Equilibrio Ecológico y la Protección al Ambiente (General Law for the Protection of the Environment and Ecological Equilibrium) and by the Ley para la Prevención y Gestión Integral de los Residuos (Prevention and Integrated Waste Management Law) (BID-ICES, 2014). Some scholar argue that part of the waste crisis Mexican cities are facing is due to inadequate legislation regarding waste treatment (Armijo de Vega, Ojeda-Benitez and Ramirez-Barreto, 2003; Castillo Berthier, 2003).

At the state level, each state government has an Ecological Equilibrium and Environment Protection Law and an Integrated Solid Waste Management and Prevention Law in which the general guidelines for good governance and regulations for a proper waste management at a local level are described (Armijo de Vega, Ojeda-Benitez and Ramirez-Barreto, 2003). Besides this, the 115° article from the United Mexicans States Constitution establishes that the municipalities are in charge of providing: collection, transfer, treatment and final disposal services. Table 1 illustrates the institutional framework regarding municipal solid wastes.

<table>
<thead>
<tr>
<th>Institutional framework for an integrated solid waste management in Mexico</th>
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<tbody>
<tr>
<td><strong>Ministry of Natural Resources and Environment</strong></td>
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<td><strong>State governments</strong></td>
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<tr>
<td><strong>Local governments</strong></td>
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At the local level, Xalapa has a Municipal Services Regulation (Reglamento de Servicio Municipales Xalapa) issued on September 2008 (Gobierno del Estado, 2008). This regulation:
Establishes the strategy for public waste collection;
- Defines the obligations that inhabitants of the municipality have with the Public Sanitation Department services;
- Establishes the strategy for municipal solid waste collection; recycling and installation of recycling centers; sanitary landfills or any other final disposal system; and,
- Regulate composting of municipal solid waste.

There is very little emphasis upon source reduction, recycling or reuse. Furthermore, there is a lack of any kind of program to inform the population about important aspects of sustainable waste management; as well as environmental education for the general public (Armijo de Vega, Ojeda-Benitez and Ramírez-Barreto, 2003).

In 2014 the municipality of Xalapa, published a Plan Integral para el Mejoramiento del Servicio de Limpia Pública (Public Cleaning Improvement Integrated Plan) as a way of showing its commitment and political will to provide a better service to the city. But such Program failed in its approach of not recognizing the need and importance for waste prevention guidelines and in its integrated solid waste management system (BID-ICES, 2014). In chapter 5 a summary of this plan will be presented as well as the action plan proposed by the Iniciativa de Ciudad Emergentes y Sostenibles (Emergent and Sustainable Cities Initiative, ESCI henceforth) a program by the Inter-American Development Bank.

2.4. Municipal solid waste management in Xalapa

2.4.1. Current municipal solid waste management practices in Xalapa

The main strategies for municipal solid waste management in Mexico tend to be: collection, storage, transport, treatment and final disposal (Rodriguez et al., 2015). With efforts mainly focused on collection and final disposal, in sanitary landfills and in open landfills (Martínez Sepúlveda et al., 2016).

In the city of Xalapa the municipal solid waste management system is provided by the local government, while the sanitary landfill is owned and operated by a private company. Therefore, the municipality of Xalapa pays for each ton of waste disposed at the landfill.

Every year each household pays a tax called “impuesto de limpia publica” which basically is a tax for waste collection services. It is through this tax that Public Sanitation Department gets funds. This department is in charge of the operation of the municipal solid waste management system.

There are approximately five hundred employees working at the department, 30% of them work in street sweeping while the rest works in municipal waste collection service. The department has around 60 waste collection trucks; however there are usually, at any given time, 13 trucks idle, awaiting some kind of mechanical service (Plan de acción municipal Xalapa, 2014).

Xalapa’s municipal solid waste management system consists mainly of four phases: street sweeping, collection, transfer from households to the sanitary landfill and its proper disposal; informal resource recovery (recovered material: aluminum cans, paper, cardboard, plastic bottles, and metals) activities are present in the first three phases (Ojeda-Benitez, Armijo-de-Vega and Ramírez-Barreto, 2002).

For collection purposes, the city is divided into 450 city zones. There are two collection shifts, morning shift with 50 collection routes and evening shift with 25 collection routes with a collection frequency of 2-5 days per week and a total of 60 waste collection trucks. According to public sanitation worker 1, former director of Public Sanitation Department, the collection crew has
collection coverage of 92% of the total population (Interview with Public sanitation worker 1, 2017). This means that municipal solid waste collection provides services to 410 out of 450 city zones. The remaining 40 city zones are served by informal refuse collectors; in Mexico they are called carretoneros (ibid).

All waste collected by the municipal waste collection crew, and by the informal recycling sector, is sent to the sanitary landfill. According to INEGI (2014) a daily average 335 tons of waste are sent daily. Most of the waste that ends up at the sanitary landfill has been previously separated and contains small quantities of recyclable material. Segregation of waste is performed, on one hand, by municipal waste collection crew, on the other by pepenadores and carretoneros. However, it is important to note that the municipality doesn’t count with any type of formal resource recovery, or recycling programs; attempts have been done to inform citizens about the importance of separation of waste through campaigns but have failed to have a real impact (interview with public sanitation worker 1, 2017). Pepenadores are the people that rummage through the household waste in search of recyclables to sell, in English the term is waste pickers; while, carretoneros are the people that offer door-to-door refuse collection in areas where municipal waste collection services do not reach. These concepts will be further detailed in chapter five.

From all the waste collected, approximately 25% is recovered (interview with Public Sanitation worker 2, 2017). It is hard to say with accuracy what is the real percentage of recovery given that there are no reliable records of such activity. (BID-ICES, 2014)

It is not only the municipality of Xalapa that uses the sanitary landfill as the final step in their MSWM system. The surrounding municipalities of Coatepec, Emiliano Zapata and Tlalnelhuayocan also use it as their final step in their MSWM system. This gives a total of 490 tons of waste disposed into the sanitary landfill on a daily basis (Plan de acción municipal Xalapa, 2014).

2.4.2. Characterization of the waste sent to the sanitary landfill from the municipality of Xalapa

In order to assess the best possible MSWM system and utilization of resources, it is necessary to know the types of waste being generated on the city (Buenrostro, Bocco and Bernache, 2001; Ojeda-Benitez and Beraud-Lozano, 2003; United Nations Department of Economic and Social Affairs, 2011). This is called characterization of waste.

Wastes generated in low- and middle- income cities have a large proportion of organic waste, whereas wastes in high-income cities are more diversified with relatively larger shares of plastic and paper (UNDESA, 2011). For the case of Xalapa, as we shall see, a large proportion of waste remains organic (see Figure 5).
Figure 5 Composition of waste stream in the city of Xalapa, before disposal at sanitary landfill (own construction with data from Reintech, 2013)

This percentages show the quantity of waste present at the municipal waste collection trucks before disposal, without the presence of recyclables. As it can be seen, organic waste is the main component of the waste disposed at the sanitary landfill. The presence of cardboard (9%) could be because of remaining pieces that were not properly separated by municipal waste collection crew.
3. Theoretical framework

3.1. Defining Waste
The Ministry of Natural Resources and Environment (SEMARNAT, by its acronym in Spanish) defines waste as “material or product (in solid, liquid or gas state) whose owner or holder discards into containers and that such material is susceptible to valuation or that it abides either certain treatment or final disposal as required by this law (SEMARNAT 2014 in DOF, 2014). According to their characteristics they are classified into three categories: municipal solid waste (MSW), special and hazardous waste.

As for municipal solid waste, each country and organization have different definitions. Therefore, in this work I will follow the definition used in (United Nations Human Settlements Programme, 2010). The UN Habitat defines municipal solid waste as: “waste generated by households, and wastes of a similar nature generated by commercial and industrial premises, by institutions such as schools, hospitals, care homes and prisons, and from public spaces such as streets, markets, slaughter house, public toilets, bus stops, parks, and gardens”. Further, they continue, some establishments are likely to produce both municipal and non-municipal waste, i.e. manufacturing industry. Because these type of industry generates solid waste from offices and canteens, and industrial wastes from manufacturing processes. Some industrial wastes are hazardous, thus requiring special management.

3.1.2. Resource management instead of waste management
Resource management is one of three main physical elements from an integrated sustainable waste management (more in section 3.2). Resource management represents a collection of public and private, formal and informal activities that result in diverting materials from disposal and recovering them in order to return them to productive use (United Nations Human Settlements Programme, 2010).

Resource recovery can become a social and economic development instrument, offering direct opportunities for communities embedded in waste prevention, reduction, re-use and recycling (Gutberlet, 2012). There is a need to move away from waste management to resource management. As stated in the United Nations Environment Programme and Nepal (United Nations Environment Programme and Nepal, 2001) report “the increasing volumes of waste being generated would not be a problem if waste was viewed as resource and managed properly”. The goal is to move the fundamental thinking away from ‘waste disposal’ to ‘waste management’ and from ‘waste’ to ‘resources’ (Wilson et al., 2015a).

3.1.3. Concept of waste hierarchy
The waste management hierarchy serves as an entry strategy for waste reduction practices. It is a prioritizing waste management guide in order to achieve the best overall environmental outcome (Wilson et al., 2015a). The higher an activity is in the waste hierarchy, the more resources and greenhouse gas gains are to be made. “The general priority of the waste hierarchy is: prevention, minimization, reuse, recycling, other recovery including energy recovery and final disposal” (ibid, p. 277). Figure 6 illustrates the waste hierarchy.
3.2. Integrated sustainable waste management

Integrated Sustainable Waste Management (ISWM) is a systems approach that recognizes three important dimensions, which all need to be addressed when developing or changing a solid waste management system for an ISWM system to work well and to work sustainably (Wilson et al., 2015b). These three dimensions are: public health, environment and resource management.

Apart from these three dimensions, an ISWM system has three interrelated requirements under the framework of ‘good governance’. There is a need for the system to: be inclusive, represent the full spectrum of recognized and unrecognized stakeholders; be financially sustainable, solid waste management consists of a variety of activities, including reduction, reuse, recycling, and composting; and, rest on a base of sound institutions and pro-active policies, strong and transparent institutional framework is essential to good governance in solid waste (United Nations Human Settlements Programme, 2010).

The term integrated waste management has been widely used, often referring only to integration across the physical (infrastructure) elements. The concept of integrated sustainable waste management, on the other hand, brings together all three dimensions and is gradually becoming the norm in discussions of solid waste management (Wilson et al., 2015a). Nevertheless, as (Wilson, Araba, Chinwah and Cheeseman, 2009) points out, in order to improve waste management, there is no model that fits all.

3.3.1. Municipal solid waste management

The primary target of MSWM is to protect the health of the population, promote environmental quality, develop sustainability, and provide support to economic productivity. (Troschinetz and Mihelec, 2009)

In the case of Mexico, Mexican municipalities’ concentrated efforts of waste management are within collection, transfer and disposal activities (Jiménez Martínez, 2015). Furthermore, there is little emphasis on 3Rs strategies (Buenrostro and Bocco, 2003). The municipality of Xalapa aims towards an integrated municipal solid waste management system (Plan de acción municipal Xalapa, 2014).
3.3. Sustainable development
Historically, health and safety have been the major concerns in waste management. These still apply wastes must be managed in a way that minimizes risk to human health. Today, society demands more than this as waste management must also be sustainable (McDougall, White, Franke and Hindle, 2001).

The United Nations endorses sustainable development as the philosophy that should guide nations in the conduct of their commercial and industrial activities. Since waste management activities are a subset of the overall industrial undertakings of society, it is important that they should also be governed by this philosophy (Tammemagi, 1999). The United Nations’ (World Commission On Environment and Development, 1987) in its report ‘Our Common Future’ defines sustainable development as: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

The concept of sustainable development can be viewed as the integration of economic, social, and environmental systems (Tammemagi, 1999). It underlines the importance of protecting the natural resources and the environment. Economic and social wellbeing cannot be improved by measures that destroy the environment (Wilson, 2007). Therefore, sustainable waste management practices according to (McDougall et al., 2001) must be:

- Economically affordable
- Socially acceptable
- Environmentally effective

As explained in Global Waste Management Outlook 2015 “waste management is a crosscutting issue impacting on many aspects of society and the economy. It has strong linkages to a range of other global challenges such as health, climate change, poverty reduction good and resource security and sustainable production and consumption. The political case for action is significantly strengthened when waste management is viewed as an entry point to address a range of sustainable development issues, many of which are difficult to tackle.” (Wilson et al., 2015a).

3.3.1. Sustainable development goals and the link with solid waste management
The impacts of waste management have effects on local and national scales (United Nations Human Settlements Programme, 2010). By engaging in this issue, local governments have the opportunity of moving forward on their local agenda towards a more sustainable city/society.

Solid waste management is a crosscutting issue that affects and impacts various areas of sustainable development in each of the three sustainability domains: environment, economy and society (Rodić and Wilson, 2017). According to Rodić and Wilson the affected “areas include living conditions, sanitation, public health, marine and terrestrial ecosystems, access to decent jobs, as well as the sustainable use of natural resources” (2017, p.1). In addition, out of the 17 sustainable development goals (SDGs) of the 2030 Agenda for Sustainable Development at least 12 and their pertinent target have direct link to SWM. These are:

Goal 1- No poverty; Goal 3 – Good health and well-being; Goal 6 – Clean water and sanitation; Goal 7 – Affordable and clean energy; Goal 8 – Decent work and economic growth; Goal 11 – Sustainable cities and communities; Goal 12 – Ensure sustainable consumption and production patterns; Goal 13 – Climate action by mitigating greenhouse gas emissions (GHG); Goal 14 – Life
below water; Goal 15 – Life on land; and Goal 17 – Global partnership for sustainable development by addressing the needs of the developing countries through non-discriminatory international funds (Elagroudy, Warith and El Zayat, 2016).

In essence, Rodić and Wilson explain that, the main driving forces for the implementation of SDGs into SWM activities are: public health, environment concerns, resource value, climate change and inclusivity (2017).

3.4. Participatory resource management

MSWM solutions in Mexican municipalities are usually driven by a top-down approach, wherein actors have little to no input in the solutions proposed by the competent local authorities. Therefore, participatory approaches can provide an alternative for taking all stakeholders into consideration.

One of the most profound challenges faced by modern society is how to include the full spectrum of existing rationalities in the development and subsequent implementation of public policy (Hansen, Nielsen, Sriskandarajah and Gunnarsson, 2016). The authors emphasize that “only through a more participative approach than today is this possible, an approach that can only ensure better inclusion and integration of the existing value, experiences and various types of knowledge in society, but also detect and define desirable futures as a response to the eco-political crises of contemporary society” (ibid, p. 124).

True public participation in policy-making is more than just consultation. It requires transparent democratic, processes, forums for deliberation and genuine participation of different stakeholders (Gutberlet, 2008a). Participatory methods offer the necessary tools in order for this to happen (ibid).

(Kooiman, 2003) in Governing as governance defines co-management as “a shared responsibility between government agencies and users for the well-being of the resource, such as preventing depletion or illness” (2003, p N). In other words, as Gutberlet explains,

“It means finding a shared understanding between government and community-initiated regulations. It is participatory rather than hierarchical; decentralized instead of centralized; and the process happens through active participation of the different parties in public policy making rather than just consultation” (2008).

Kooiman asserts that it is expected that by involving users of the resource directly in its governance, the knowledge on which this is based is more adequate than would otherwise be possible (2003, p. 103). This means that, “governing measures taken in this way will mean that users involved: willingly accept the regulations as appropriate and consistent with their persisting values’ and world views” (Kooiman 2003, p. 104).

Participatory waste management is an approach to guarantee more durable decision-making and contributes to the construction of more sustainable communities (Sekher, 2001). Several scholars (i.e. Gutberlet, 2008; (Medina, 2005; Rouse, 2006)) remark that participatory resource management involving the informal recycling sector as stakeholders is an effective of tackling crucial challenges in waste management. New policies are required that address the waste of energy and natural resources and the increased generation of garbage in our disposable society (Gutberlet, 2008). “Strategies that on one hand promote integrated selective collection, separation and recycling and on the other hand generate income for the urban poor will be the most suitable (ibid, p 11)”.

3.5. Informal economy

The informal economy comprises, -‘all forms of ‘informal employment’– that is, employment without labor or social protection – both inside and outside informal enterprises, including both
self-employment in small unregistered enterprises and wage employment in unprotected jobs’ (Chen, 2007). Economic relations –of production, distribution and employment –tend to fall at some point on a continuum between ‘formal’ relations (i.e., regulated and protected) at one pole and pure ‘informal’ relations (i.e., unregulated and unprotected) at the other, with many categories in between (Chen, 2007). In fact, economic relations are often dynamically linked between the formal and informal (ibid).

For the case of Mexico, the inadequate audits, excess of regulations and administrative processes, and, above all, neoliberal economic policies undertaken by former administrations, during the 80s, has made the informal economy, alongside migration to the US, a livelihood alternative towards a government incapable of providing jobs to a rising population (Ramales Osorio and Díaz Toledo, 2005).

This informal economy gives rise to networks of reciprocity and patron-client relations which have been shown to play an important role within disadvantage sectors of society, urban poor, in articulating their members to the formal market system and in creating informal social security systems to survive (Lomnitz, 1978). Lourenco-Lindell, (2002 in Adama, 2012) sees the role of these social networks as vital coping mechanism for the urban poor.

3.6. Network theory

Social networks refer to informal organizational arrangements based on social ties Meagher (2005 cited in Adama, 2012, p.452). Furthermore, Wasserman and Faust note the following principles as key components in any social network: actors and their actions are viewed as interdependent; relational ties (linkages) between actors are channels for transfer or “flow” of resources (either material or nonmaterial); network models conceptualize structure (social, economic, political, and so forth) as lasting patterns of relations among actors (1994). Urban social networks are derived from relations of ethnicity, friendship, family, or from a variety of associational activities, this relations can be based on family and kinship or on professional ties (ibid).

Chaskin et al. (in Gutberlet, 2008, p. 80) emphasize “the role (for good or ill) that social structure - the concrete networks of relations among individuals and institutions that define the shape of social interaction – plays in providing access to information, opportunity, and support. It is through these relationships, and the associational action they make possible, that social capital operates”. Thus, encouraging and facilitating the creation of social networks, can therefore be a pro-active form of capacity building, aiming at expanding social capital (Gutberlet, 2008). Social capital is defined as “the relationships and networks developed and drawn upon by the urban poor to survive and improve their livelihoods” (Adama, 2012, p. 452).

(Adama, 2012) points out “studies show that collective organizing is a major avenue through which informal actors acquire social capital and engage with the state”. Networks are platforms to communicate and exchange experiences, which can be used as discussion forums to help improve occupational safety and increase income generation (Gutberlet, 2008b, p.12). Networks compromise a wide variety of actors, including government and non-governmental organizations (Scott, 2000).

Network theory thus provides a framework for understanding and exploring social relationships involved in recovery of materials by the informal recycling sector. Paying attention to such relationships can provide insight into undisclosed social norms, power relations and hierarchies (Gutberlet, 2008b). As Lourenço-Lindell (2002 in Adama, 2012) points out “social networks contain hierarchies and power relations that shape participants’ access to resources and assistance”.
4. Method
This project used a case study methodology with a mix of techniques for gathering data. Next, the method and techniques are explained.

4.1. Case study
(Thomas, 2011) explains, “a case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in ‘real’ life context”. (Woodside, 2010) further states, that “case study research is an inquiry that focuses on describing, understanding, predicting, and/or controlling the individual (i.e., process, animal, person, household, organization, group, industry, culture, or nationality)”.

Furthermore, (Gerring, 2007) emphasizes that an additional implication of the term “case study” is “that the unit(s) under special focus is not perfectly representative of the population, or is at least questionable. Unit of homogeneity across the sample and the population is not assured”. For this study, this implication is of importance and should be noted. It is of importance because due to the informality of waste picking it would be very time consuming and exhausting to interview everyone involved in this activity and difficult to select a representative sample; therefore, most informal recycling actors approached worked in the same geographical area of the city. This produces that actors interviewed are not representative of the whole population of the informal recycling sector.

4.2. Data collection techniques
This study uses qualitative techniques to collect data. These techniques are semi-structured interviews, observations and literature review. However, because this topic is yet not widely researched in Mexico and even so less in the region of Xalapa, it was necessary to widen the scope of the literature review. Therefore, literature reviewed includes experiences and insights from Latin America, Africa and Asia. These techniques were sufficient in providing the necessary data for responding the main research question and sub-questions.

For identifying stakeholders involved in the MSWM system, a snowballing technique was used in order to locate possible stakeholders. Snowball sampling can be simply defined as a technique for finding research subjects (Atkinson and Flint, 2001); where “one subject gives the researcher the name of another subject, who in turn gives the name of another subject, and so on” (ibid, p. 2). Additionally, this technique was useful given that no studies have been done in Xalapa that identify the actors involved in the system; therefore the available information was somewhat limited.

4.2.1. Semi-structured interviews
Semi-structured interviews were used as one of the main techniques for collection of data. Semi-structured interviews offer sufficient flexibility to approach different respondents differently while still covering the same areas of data collection (KBM, 2008). As (DiCicco-Bloom and Crabtree, 2006)note, “for this sort of interviews the interviewer has to collect information personally from the sources concerned. He has to be on the spot and has to meet people from whom data have to be collected” (2006, p. 315). This type of interview was used for gaining insight on how the current waste management system works as well as for how the informal recycling sector works.

The questions were designed to get in-depth information about their work and everyday life. Each interview was recorded unless, as it happened, the interviewee was not comfortable with that idea. Either case, note taking was used during the interviews. Question guidelines for the semi-structured interviews are included in the annex. Prior to the beginning of the interview, or when approaching the people on the streets, a necessary first step was to give an explanation of my intentions and an
overview of the research and why the interest on him/her. This was particularly important when approaching individuals on the streets or at their “base camps” because they would be suspicious of my presence there.

4.2.2. Observation
This technique was also used as a source of data. (Kothari, 2004) points out that, “observation becomes a scientific tool and a method for data collection for the researcher, when it serves a formulated research purpose. Observation generates insights and a better understanding of the phenomenon under study (KBM, 2008). Furthermore, Kothari explains that in the context of social sciences in particular, we can often talk about participant or non-participant types of observation. This distinction depends upon the observer’s sharing or not sharing the life of the group he is observing (2008).

For this study non-participant observation was performed. This was because the informal recyclers were always on the move; going from street to street in search of recyclables or collecting household waste. Therefore, my involvement in their daily activities would have just slowed them down. And because their earnings depend, for the case of pepenadores, on their ability to go through as many plastic bags as they can; my presence would have made them earn less money. An example of this happened when interviewing pepenadores on the streets; they needed to be quick while rummaging for recyclables because if not the collection crew, which could be just one street away from them, would take all the trash, leaving them without any material to sell. So most of the cases I would just follow them while they performed their activities.

4.3. Research ethics
For anonymity reasons, interviewees that agreed on disclosing their identity, their name has remained unchanged; however for those actors that did not want their name to be disclose, they will be categorized as follows: local authority 1, 2…; and, public sanitation department worker 1, 2… Anonymity consists in cutting away personal information in order to eliminate the connection between interviews or questionnaires answers and a certain individual (Swedish Research Council, 2011).

4.4. Problems encountered

Building trust

An important factor when conducting fieldwork is trust among the people you will be conducting the research upon. Trust is something that is gained over time. It was an issue for me because I was only there for one month, so my time was very limited in order to properly gain the trust needed for getting full disclosures on the livelihoods of the people interviewed. According to Gutberlet, trust is essential when working with informal recyclers; building trust with actors takes time, it is something that you do not gain overnight (Gutberlet, 2008b).

Furthermore, it was even more difficult to establish the necessary trust because there are no NGOs or civil associations working with this topic in Xalapa. This meant that I was on my own. Luckily I met people willing to help me with my research and they would put me in contact with people knowledgeable or with experience on the topic.

Difficulties with interviews

When approaching the corresponding actors for asking for interviews, a recurrent observation was noted. Some of the actors that I was about to approach did not want to be interviewed. They would suggest that I should go and talk with their representative or they would just decline the interview.
This happened, for example, once when I was in front of the city hall and, by chance, there was a manifestation from an informal recycling group, called “carretoneros”. I saw this as a great opportunity but once the manifestation was over, I approached them and was asking if they could explain what was happening. They would gladly explain but once I wanted to know about them and their organization, they would tell me to go and speak with their leader. It turned out that this leader was the leader from the labor union they belong to.
5. Results

5.1. Current solid waste management practices
This section will present the existing practices of storage, collection, transport, disposal and street sweeping in practice in the study area. With the intention of presenting and giving context in which the informal recycling sector operates.

As already mentioned above, the Public Sanitation Department is the authority in charge of providing MSWM services. Next, an explanation of each phase will be presented.

5.1.1. Household storage
The first step in the municipal solid waste management system from the city of Xalapa is collection of waste at the household level. Usually, household trash is put into plastic bags. Given that the municipality does not provide plastic bins for storage and further collection of trash bags, they are placed outside household’s doorstep, street sidewalks, or street corners. Any household that takes out its trash before or after the waste collection truck passes, will get fined.

Based on my observations and interviews, this storage and collection practice comes with some issues. In some areas of the city, usually low income areas but not exclusively, piles of plastic bags can be seen on streets. In some cases, when the collection truck doesn’t goes by, these piles just keep growing and growing, reaching alarming problems for people living in those areas. Figure 7 illustrates an example of one of these streets, hours before the collection crew arrives.

Figure 7 Bags of waste piled up in a street from a low income area
Sorting of waste

Based on interviews conducted with the city councillor of public cleaning services, and with the informal sector, they all seemed to agree on that households seldom separate waste. Independently from the socio-economic status of the neighborhoods, people are used to not recycling or separating their waste. Local authority explains that this has to do with the lack of participation and interest citizens have with matters of the local government. This opinion is also shared by the former director of public sanitation department.

5.1.2. Waste collection, transport and disposal

Waste collection and transport

The Public Sanitation Department is in charge of collection, transport and disposal of waste. The sanitary landfill is concessioned to a private company. The company is in charge of the proper operation and management of the sanitary landfill.

Waste collection crews have predefined routes. There are 75 collection routes, 50 in the morning and 25 in the evening. The frequency of the service varies from two to five times per week, depending on the amount of waste generated by households alongside that route. Waste collection crew is organized and operates as follows: Each collection route corresponds to a collection truck; while this is how it was organized in reality there are at least 15 waste collection trucks in maintenance, all the time. This is because the road to the sanitary landfill is unpaved, rough and usually full of bumps. Hence, some collection trucks have to cover more than one route. Each collection truck has one driver, two workers in charge of collecting the waste and two informal workers working inside the truck. Only the driver and the two workers belong to the public cleaning services department. Informal workers are usually related to the driver some way or another.

When they are on duty, one of the workers in charge of collection runs alongside the street ringing a bell, letting know people to take their trash out for collection. Households place their waste on the streets sidewalks; most of household’s don’t separate the recyclables.

As they progress on their route, the informal workers inside the truck start to separate recyclables from non-recyclables. These workers are usually referred to as from la plancha and the activity of separating recyclables while on duty is referred to as la pre-pena. Figure 8 illustrates this activity. Once they have finished their route, they stop either there or near to the sanitary landfill. They stay idle for about 30 to 60 minutes while the informal workers finish sorting the materials. Once they have finished they go to waste dealers or informal recycling centers to sell all the material selected.

The most common materials include plastic bottles (PET) and other forms of plastic, aluminum cans, paper, cardboard, and metals such as copper, steel and iron. Once they have sold the materials, they go to the sanitary landfill to dispose the waste. Sometimes, instead of going to a waste dealer with the waste collection truck, while the informal workers finish the pre-pena, they use that time for transferring the recovered material to a pick-up truck. This activity is illustrated in Figure 9.

One of the questions for interviewees was if they were aware of any scavenging activities at the sanitary landfill, everyone’s answer was no, there are none. Everyone asked appeared to agree on the answer, there are no scavengers on the landfill because it is a private company and they do not allow any scavenging activities in the premises. Besides, most of the waste sent to the sanitary landfill contains little recyclables as most of it has been separated either by the waste collection crew or by pepenadores and carretoneros.
Figure 8 Informal workers separating material while truck is idle

Figure 9 Informal workers separating recyclables and transferring them into a pick-up for its subsequent sale
Street sweeping

The Public Sanitation Department also provides a street sweeping service. This street sweeping is performed mainly at the city center and important streets around it. People involved in this activity are counting with the extra income that separation of recyclables offers. Recovery of recyclables is performed while they are cleaning the streets.

Disposal

Disposal of waste is done at the sanitary landfill. Most of the waste sent there contains almost no recyclable materials. This is because the informal recycling sector has already retrieved all, or almost all, valuable resources that the local industry, by local I mean at regional level, requires.

The sanitary landfill is located 2km away from the nearest population area, or at least it used to be like that, and only 6.5km from the City Hall of Xalapa, located in the city center. Figure 10 shows the location of the sanitary landfill and from the city hall. The black circle indicates where the sanitary landfill is.

![Figure 10 Distance between city hall and sanitary landfill](image)

There are contradictory statements regarding the operation of the landfill. Some interviewees said that the operation and management of the sanitary landfill was appropriate, even exemplar. While
others said that its inefficient management is creating environmental problems for residents living nearby.

5.1.3. Work safety measurements and training for waste collection personnel
Based on observations, it was seen that waste collection workers do not use any protection. In one of the interviews with a former driver, Public sanitation worker 2, he told me that there have been accidents where one of the informal workers falls off the collection truck, sometimes ending in deaths. Their superior instructs them to wear helmet and gloves but they are reluctant to do so. They argue that it is because they cannot handle waste the way they do without wearing gloves.

When asking them about training related to environmental education or work safety they responded that they do not get any training. Local authority 1 from the Ministry of Environment and Natural Resources pointed out that workers at the Department of public cleaning require urgent training; some of them drink while at work, while others show irresponsible conducts but because they belong to labor unions, they are protected and face minor consequences.

5.1.4. Resource recovery
Based on interviews, all resource recovery activities are carried out by both the municipal street sweepers, and waste collection crew as well as by the informal recycling sector. Neither local government nor the company running the sanitary landfill has any resource recovery initiatives. According to local authority 2, approximately 100 tons of materials are recovered on a daily basis by the informal recycling sector and municipal waste collection workers.

5.2. Organization of municipal solid waste management system
It was described, above, how the current municipal solid waste management system in Xalapa works. There it was explained that the main activities from the MSWM system are: collection, street sweeping, transport, and disposal. In each of the activities, there are activities involving informal recycling. Next, the organization of the Public Sanitation Department is presented.

Organization

Everyone working at the Public Sanitation Department is a member of a labor union, Figure 11 illustrates their organization. There are seven different labor unions present at the department. Among those seven unions there is one that holds the majority of workers, and it is called Solidaridad Urbana (Urban Solidarity). This labor union is a major stakeholder and some local government authorities see these labor unions as one of the obstacles for improving the municipal solid waste management service; as expressed by local authority 3.
We can see the power that these labor unions hold, especially Urban Solidarity as it belongs to a national labor union. This means that this labor union holds support at a regional and national level.

5.3. Action plan

Next, the proposals whose objectives are to improve the MSWM system of Xalapa are introduced. First, is the Public Cleaning Improvement Integrated Plan (plan integral para el mejoramiento del servicio de limpia pública) presented in the Municipal Development Plan 2014-2017 (Plan de Desarrollo Municipal 2014-2017) where 20 action guidelines are proposed in order to improve the MSWM system; then, is the action plan proposed by the Emergent and Sustainable Cities Initiative (ESCI), a program developed by the Inter-American Development Bank.

In 2014 Xalapa’s municipality announced its Municipal Development Plan 2014-2017. In that document they presented an action plan for improving public cleaning services, The Public Cleaning Improvement Integrated Plan. This plan consisted of 20 action plan guidelines divided in four overarching categories. These categories are: Infrastructure improvements, Administrative improvements, Human resources, and Public awareness. Figure 12 presents a summary of the aforementioned plan.
The same year that the municipality announced their municipal development plan 2014-2017, the city of Xalapa became part of the ESCI. In this program, subsequently a publication of an action plan was made, an external organization assessed the whole city from an environmental, social and economic point of view; several topics were discussed such as water distribution and sanitation, municipal solid waste management, and urban sustainability. In their analysis of the current MSWM system, the municipality’s Public Cleaning Improvement Integrated Plan was criticized because of its lack of focus regarding citizen participation; reduction at source; education and training; shared responsibility; and sustainable development (BID-ICES, 2014).

Instead, in the action plan developed by the ESCI program, action guidelines are proposed in order to move towards and integrated municipal solid waste management system. Next, a summary of the proposed action guidelines is presented, which from my point of view are relevant to the informal recycling sector.
Relevant points

- In order to move towards an integrated municipal solid waste management it is necessary to adopt an institutional framework that focus on the characterization of waste; in order to tailor solutions to the needs of the city, based on what the cities consumes.

- Re-design of the collection process: redesign of collection routes and asses the possibility of proposing separate collection. Ways in which to improve and formalize the informal recycling sector should also be taken into consideration. These actions should come together with an economic analysis that takes into consideration different public and private options of finance. Moreover, this redesigning should be accompanied with institutional strengthening actions in order to improve the organization at the Public Sanitation Department as well as in the local government.

- Creation of a network of clean collection points scattered around the city. In these collection points, citizens can voluntarily discard their old/unused/broken electrical appliances. In these collection points jobs could be given to the informal recycling sector.

- Different proposals for alternatives to the current sanitary landfill. Considering utilization of biogas or creating of compost given that 30% to 40% of the waste stream that ends up at the sanitary landfill is organic matter.

- When considering the new location for the next sanitary landfill, the possibility of building a transfer station should be taken into account.

5.4. Actors involved in recovery of resources

The informal recycling sector in Xalapa is characterized mainly by five actors: municipal waste collection crew, informal waste pickers, in Mexico called *pepenadores*, informal refuse collection service, in Mexico called *carretoneros*, waste dealers, referred to as middlemen, and street sweepers. Next, I will present the informal recycling sector actors and explain how they are organized, how they work and if there are any interactions between them. Each informal recycling actor is briefly described. Then, more in-depth information will be provided.

- Municipal waste collection crew – materials are recovered and segregated from vehicles transporting MSW to disposal sites. Collection crew later sells the material to waste dealers and divide the income amongst them. Even though they belong to the public sanitation department, their recover activity is considered informal.

- *Pepenadores* – street pickers or waste pickers that recover materials from rummaging through plastic bags in search of recyclables all over the urban area.

- *Carretoneros* – This informal sector provides waste collection services to low-income areas where the waste collection truck cannot access. This involves individuals going from door-to-door, in a predefined route, collecting waste using a cart pulled by a horse or donkey. Usually households provide a fee in exchange of their services. After collection, materials deemed valuable are segregated, cleaned, washed, dried and classified. The remaining residual waste is sent to the sanitary landfill.

- Middlemen (waste dealers) - There are primary and secondary dealers. This group plays an important role in the recycling of materials (Wilson, Velis and Cheeseman, 2006). Industry demands an adequate volume of quality materials from their supplies and will not buy
materials from individual scavengers. As a result, middlemen purchase items from all informal recycling actors and then sell them to small industry, traders, large scale enterprises and/or exporters who finally sell their recyclables to the manufacturing industry.

- Municipal street sweepers – Materials are recovered from streets or sidewalks where street sweepers operate. Street sweeping services are usually confined within the city center and surrounding areas.

**Municipal waste collection crew**

As mentioned above, the waste collection crew is involved in the recovery of materials. In fact, they are the ones that recover most of the materials. This is because they have the means to transport considerable amounts of recovered materials. Figure 13 shows the type of rags and bags municipal waste collection crew use in order to separate recyclables from general waste.

**Figure 13** Bags used by the municipal waste collection crew to separate recyclables from mix waste

**Pepenadores**

Based on interviews and observations it was found that most of the people recurring to scavenging do so because they have no other option. From all 8 pepenadores interviewed, most of them were above 65 years old. They have no health insurance, in some cases their pension is not enough to cover basic services, even less for buying enough food for the whole month for him/her and their family. Facing such conditions, they had to look for extra means of income. The problem is that they have no education and because of their age, no one wants to hire them, hence, their only option was to become material recoverers.
Pepenadores can be found all over the city. Although some stay outside the city center, some have heard stories about fellow pepenadores getting into trouble with authorities or with the collection crew. All pepenadores interviewed affirmed that they work independently, not organized in any way, and all of them work either on their own or with family members. None of them have any relation with the formal waste system. Figure 14 shows pepenadores in a street from Xalapa moments before the collection crew arrives.

Figure 14 Pepenadores collecting materials in a corner street before the collection crew arrives

Pepenadores recover less material than carretoneros or the collection crew. For gathering materials, they use rags or bags; for transporting some use a wheelbarrow while others use dolly cart. They collect: cardboard, paper, plastic bottles, and aluminum cans. They no longer recover glass, they told me, because it is scarcely paid, it is not worth the trouble. Some of them sell their recovered materials that same day, while others wait until they have collected a considerable amount of material. This depends on if him/her has the means of transporting volumes of recyclables or if they only have push carts, which have a limited carrying capacity.

An example of this is Celedonio Garcia, a pepenador that works as such two days a week. This is because the neighborhood where he lives, it is in these two days when people take out their trash to be collected by the municipal waste crew. Before recovering materials, he used to work in construction. But, given his age, 60+, he was laid off and since then has not found any job. Now, he has been working recovering materials for about one year and a half. In the neighborhood area, the waste collection truck comes every Wednesday and Thursday, hence those are the days he goes out to recover materials. Once he has recovered a certain amount of materials, he contacts someone, that has a pick-up truck, and for a fee this person will transport Celedonio’s material to the closest middle men. A problem he constantly faces is that more than half of his earnings are spent on the transportation fee. He is also unaware if the price he is getting is a fair one or not.

Some pepenadores, when interviewed, showed excitement and willingness for improving their work and livelihoods conditions, whereas others where skeptic about my intentions. A woman, whose
name I did not get, showed very skeptic when I approached her. She could not understand why someone would be willing to help them, the poor, without getting any profit.

**Carretoneros**

Carretoneros offer refuse service. They operate in areas that are of difficult access for the formal collection trucks as shown in Figure 15. Instead of ringing a bell, like the formal waste collection crew, they have an air pump attached to a honk which they play to announce that they have arrived to the neighborhood/street. They collect people’s garbage for a fee, $10 Mexican pesos per household (around 5 kr). In addition, depending on the relation that carretoneros foster with households, they sometimes get clothes donations.

Once they have covered their “routes” or until the motorbike is full, they return to their base. This base is their transfer station. Once back in their base, they start to separate the refuse collected into recyclables, or with value for them, and waste destined for disposal. All waste destined for disposal is loaded in a truck which then will go to the sanitary landfill. They are exempt of the fee paid for disposing at the sanitary landfill. This is because they have made a deal with the municipality in which they do not pay for the waste disposed.

![Figure 15 Typology of streets where carretoneros operate](image)

**Figure 15** Typology of streets where carretoneros operate

Carretoneros are in the same labor union as the majority from the public cleaning services department. It was the leader from this labor union the one that made the deal with the municipality about the zero fees for the waste disposed at the sanitary landfill by carretoneros. This leader is also their representative when they have problems with authorities or for raising their voice or protesting.

An example of their leader representing them is presented next. Carretoneros were protesting, in front of the city hall, demanding that the deal they made with the Major be respected. They had
been involved in a program where their horses or mules were going to be changed for motorbikes. City officials were concerned about the treatment they were giving to the animals, so, they decided to step in and help. They were offering these motorbikes to the carretoneros so that they no longer mistreat the animals they were using for pulling the wagons full of trash bags. They were protesting because some police had stopped one of them and was facing fines and even jail time for using his mule. So they all went downtown to the city hall to protest and there, their leader was representing them. Figure 16 shows this protest. Figure 17 shows the motorbikes provided by the municipality.

Figure 16 Carretoneros in front of the city hall

Figure 17 Motorbike provided by the municipality
There are formal and informal recycling centers. Most of the recovered material by the informal recycling sector is sold to informal recycling centers. The majority of them can be found on the way to the sanitary landfill. Figure 19 and Figure 20 illustrate informal recycling centers. The middle men/informal recycling center I approached refused to be interviewed, only one worker from an informal recycling center accepted to be interviewed.

Based on the interview and observations, informal recycling centers are engaged in buying and selling of mostly material brought by the informal sector, workers from the collection crew and households. Some of these informal recycling centers sell directly to industry, in case they handle certain amounts of material. Otherwise, they sell to a bigger recycling center, which in this case are the ones selling to the industry. It was pointed out by Local authority that there is even organized crime involved in informal recycling centers.
These recycling centers are always changing their buy/sell prices; therefore, pepenadores, carretoneros, and municipal waste collection crew are always looking for the establishment offering the best price.

*Street sweepers*

Street sweepers recover mainly aluminum cans and plastic bottles. As this is what they usually find during their working hours.
The next illustration (Figure 21) serves as a visual guide; it sums up the actors presence in the system.

**Figure 21** Summary of informal recycling actors

### 5.4.2. Interaction among actors

Based on interviews, there is a hierarchy in the current waste collection system. This hierarchy is mostly present within the collection trucks. From the five people working daily on the collection trucks – driver, two people picking up the waste, and two people on la plancha – the driver has the highest rank (Figure 22 illustrates the hierarchy). He decides who will be working in la plancha. Most of the time, the people working in la plancha have some kind of kinship relationship with the driver. All earnings from the materials are divided equally among informal workers and collection workers while drivers usually earn 5% more.
Based on observations and interviews, it was noted that there is an embedded hierarchy present within the formal and informal sector. Pepenadores don’t have any relationship with any group, if any it is one based in competition. This is because the waste collection crew perceives pepenadores as competition. Between carretoneros and the waste collection crew there is a relationship, neither good nor bad, but no relationship between carretoneros and pepenadores.

Regardless of relationship or no relationship, interaction or no interaction, there is an existing hierarchy that even though some groups do not have interactions between other groups, the hierarchy is still present. Figure 23 presents this hierarchy.

Public sanitation worker 1, former administrative employee from Public Sanitation Department, suggests that inside Public Sanitation Department there is a subculture. It is within this context that this social hierarchy is expressed and followed.
5.4.3. Waste flow through the different actors

Figure 24 Schematic showing the different actors involved in the handling of waste and further recovery of resources (own construction)

The generation, transport and final disposal practices of Xalapa’s solid waste are described through Figure 24. It also illustrates the existing interactions among actors involved in waste generation, collection, transport, final disposal and resource recovery.

The ‘production of municipal solid waste’ column in Figure 24 refers to waste producing sources; ‘collection’ column refers to the formal municipal solid waste collection providers as well as to the informal refuse collection, in other words, carretoneros house-to-house collection service. The ‘resource recovery/sorting of waste’ column refers to actions performed after the different actors have collected waste. These actors are referred to as the informal recycling sector; even though municipal waste collection crew and street sweepers belong to Public Sanitation Department, their resource recovery activity is considered informal. The ‘transport’ column refers to the ways in which these actors transport the waste towards the sanitary landfill. For the case of municipal waste collection crew ‘resource recovery’ and ‘transport’ activities are highly linked; because they perform resource recovery activities while transporting the waste. ‘Disposal’ column is the final phase from the MSWM system. The column ‘recyclables buy/sell’ refers to the stage where the materials salvaged are then sold to primary or secondary, formal or informal middlemen. The
‘transformation’ column refers to the industry that buys all the recyclables recovered by informal recycling sector. This material is manufactured into new objects which then people buy and the cycle starts again. The type of line indicates the flows of recyclables, showing the different relations between actors involved in recovery of materials.

5.5. Organization of the different actors in the informal recycling sector

5.5.1. Street sweepers
Public Sanitation Department is in charge of organizing and setting up the routes that street sweepers work on. Approximately 30% of the workforce from the department works as a street sweeper. Almost all women working at the department are in this section.

5.5.2. Municipal waste collection crew
Approximately 70% of the workforce from the Public Sanitation Department works as municipal waste collection personnel. Municipal waste collection workers are divided into squads of five people: a driver, two waste collectors and two informal workers separating recyclables.

5.5.3. Pepenadores
Pepenadores work independently. Nevertheless, they do have contact with other pepenadores but they do not work together or cooperate, as expressed by Isidro a pepenador working in one of the main streets of the city.

5.5.4. Carretoneros
Based on interviews from several carretoneros and city officials, it was found that there are approximately 100 carretoneros. They are divided into groups, and each group has its own base and a leader. Their bases are usually in the areas where they operate and are usually out of sight. This base is their meeting point and they use it as their transfer station. Each group is composed of around 8 to 20 people. In each group there are “experienced” and “newcomers”. Newcomers are simply referred to as assistants or chalanes in Spanish. Assistants earn less than the rest.

They have a hierarchical organization with a president, treasurer and secretary on top. Among everyone they choose a president, secretary and treasurer. They hold meetings every other Sunday, to inform about problems and discuss certain topics. Their president, secretary, treasurer, and group leaders are all appointed by them, according to a person’s number of years in the job. When I asked carretoneros for more information about their president, secretary and treasurer they all seemed to ignore the question, so was not able to get any more information on them. I am unaware of the duties and responsibilities from the president, treasurer, and secretary as well as from the group leaders.

Carretoneros labor union
The carretoneros have been members of the Urban Solidarity labor union since 1990. One of the reasons they joined was because they were being mistreated by the authorities and by the formal sector. Since they joined the union, the treatment received by authorities has improved as well as by the Public Sanitation Department workers. The union labor leader represents them legally and he is their spokesman, always speaking, when needed, with city officials (see Figure 25). As with any other labor union, a monthly fee has to be paid to the union in exchange of their services.
5.5. Middle men / informal recycling centers
From the little information obtained from the only interview with the person working in an informal recycling center, it was found that there are primary and secondary waste dealers that buy materials from the informal and municipal waste collection workers. A primary waste dealer means that they have the machinery necessary for shredding or compacting and cleaning of materials, and that they handle a minimum volume of materials. Normally these recycling centers are the ones supplying the industry with recyclable material.

5.6. Stakeholders
In this section I will introduce the main stakeholders that, from my point of view and based on interviews, are involved in the recovery of materials and whose voice and opinion should be heard and taken into account.

Pepenadores
Even though pepenadores are an important stakeholder group and very present in the recovery of materials, they have no say in the local government or in the Public Sanitation Department. Instead, they are seen as a liability for improving the solid waste management system.

Carretoneros
On the other hand, there is a mutual understanding between carretoneros and the Public Sanitation Department. The government acknowledges the service they provide as necessary but they fail to recognize them as a legitimate stakeholder in the municipal solid waste management system.

Carretoneros expressed their opinions regarding how they felt about the government officials and almost all of them showed discontent. Carretoneros are not happy with the decision from the municipality to change their horse-drawn wagons for motorbikes. This is because most of them were left without a motorbike in the meantime, as the municipality ran out of money and don’t have enough for buying the rest of the motorbikes.

Municipal waste collection crew
Even though municipal waste collection workers are well aware of all the technical and operational aspects of waste collection, as well as of all the problems, they are left out of any decision for improving the system.

Labor union
A key stakeholder is the labor union which happens to be involved in both the formal and informal sector. Some actors interviewed see the labor union as an obstacle which hinders any actions taken in order to improve the formal waste management system. One of them even suggested that this
labor union should be disintegrated; only through this action would the formal sector improve. In the meantime, the fact is that the labor union is a key, and powerful, stakeholder that even though it has no legal means, it holds the support from all the workers from the department of public cleaning services.

Government

As long as the local government does not recognize the work done by the informal sector as paramount for the proper working of the current MSWM system, discussions on integration or different proposal will not be considered. Hence, it is indispensable that local government officials begin recognizing this fact and propose ways in which to include them in the MSWM. This means that local government authorities hold an important position as a stakeholder.

Civil society

During interviews with city officials, it was pointed out that citizens are scarcely involved in recycling practices. Furthermore, they expressed that citizens need to be better informed regarding not only recycling but the overarching topics environmental education, climate change, and waste. Therefore, efforts aiming at involving citizens in problems affecting society are imperative. This is when participatory methods are relevant.

Middle men

The current model involves pepenadores; carretoneros; waste collection crew and street sweepers to all sell their materials to middlemen. Even though it is not a “monopsonistic market (markets where there is only one buyer, as opposed to a monopoly, where there is only one seller)” as described by (Medina, 2007b), middlemen control the prices of recyclables and usually buy very cheap and sell at higher prices.

Industry

The industry involved in the manufacture of new products utilizing recyclables is not involved in the recovery of recyclables from mix waste.

5.7. Problems/challenges perceived by actors involved in the recovery of materials

5.7.1. Municipal solid waste management system

Problems and challenges perceived by collection crew actors:

Several workers asserted that one of the problems that they have to deal with, on a daily basis, is the mess that pepenadores pickers make. This is because pepenadores rummage from plastic bag to plastic bag looking for recyclables. In the doing, some, not all, rip off the bags, spreading the garbage onto the ground. These pepenadores would just leave the trash in the streets, moving to the next plastic bag or container. This trash on the streets creates also problems to the residents living in the area nearby. The spilled trash attracts stray dogs making the problem even bigger, as the dogs rip off more bags getting more trash on the streets. And if it happens to be raining, as it often is, the trash clogs the sewers creating even more problems. Therefore, the waste collection crew expressed their discontent towards pepenadores and disapproves their practices. The biggest complaint they have towards them is that they spill the garbage.
The waste collection crew also expressed some discontent towards carretoneros. This is because carretoneros are no longer operating only in the areas of difficult access for the collection crew; they have expanded their operation area, interfering with routes from the collection crew, although not into the city center, as they are prohibited from entering there.

*Problems and challenges perceived by other actors*

Veronica Avila, former director from the department of public cleaning services, argues that another problem faced by the MSWM system is the so called “imported waste”. She refers to this waste as all the waste produced by people commuting to Xalapa either for work or leisure. She calculates that there are approximately 270,000 people commuting to Xalapa every day. This creates an influx of waste that the system is unable to cope with, thus, exacerbating the waste crisis in Xalapa.

It is not only the so called imported waste that makes the system unable to cope with the waste. On top of it, another problem, she adds, is the waste some carretoneros drop off by the already staggering mountain of bags in some streets where they operate. If it happens that the motorbike from some carretoneros is already full, they would unload some bags into the nearest collection point, where they know that the waste collection crew will pass, so that they can continue collecting household waste, and fees. This makes that collection trucks can’t cope with the amount of trash that needs to be collected, in some cases the collection crew comes back for the uncollected trash, other times, leave it there and collect it days after.

5.7.2. Pepenadores

Based on interviews, pepenadores face economic uncertainty every day. That’s what worries most of them. They feel dissent towards local government. As they have been deceived more than once by the local government, by making promises about improving their working and living conditions, yet once they are in power, they forget about them.

5.7.3. Carretoneros

All carretoneros with whom I spoke with are well aware about the benefits provided to the city and to the MSWM system from their refuse activities. They would like to see more cooperation between the local government and them. They also said that more dialogue with the local government would benefit everyone involved in this activity.

While interviewing different carretoneros, they all showed discontent with their change of horse/mule to motorbike. On one hand, the issue is that motorbikes are not as all terrain as an animal, they can’t go through a street full of mud, for example. On the other is that up to that day, not everyone had received a motorbike. Only 15 out of 100 had motorbikes, this meant that only 15 could work while the other 85 people had to look for another means of transport for doing the job, mainly renting pick-up trucks, as shown in figure 18. They were upset with this because their daily costs had risen; they now had to pay a fee for using the pick-up truck. Furthermore, they were upset with the local government because on top of the lack of motorbikes, they were not able to provide the refuse service using their former pushcart pulled by an animal; because if they did, they would get a huge fine and some jail time.

5.7.4. Local government representatives

Some of the problems and challenges perceive by local government representatives are on one hand the informal recycling sector, on the other hand, the lack of citizen participation in matters of governmental matters.
Local authority 3 remarks that, better working agreements between local government and carretoneros are needed. At the moment they have no agreements, the only program going on is the replacement of horse with motorbikes, as already mentioned above. According to him, labor unions represent a major obstacle for improving the formal MSWM system. This is because labor unions in Mexico no longer stand up for the rights of the workers rather, they look for their own interests. The same is happening in Xalapa. He also stresses the importance of waste segregation at household level and active participation of citizens.

Another problem is that waste collection crews take longer time to complete the routes and sometimes they don’t get to finish all of them, which clearly is a big problem. This is because once a collection crew has finished its route they tend to stay idle somewhere in order to finish separating the waste and organizing it, they must to finish the pre-pena activity. Once they have finished organizing it, they get on their way to the sanitary landfill and just outside the entrance they make another stop. This time for selling all the material recovered. Most of the buyers of recyclable materials and scrap metals are settled near the landfill.

Some respondents expressed that the activity of the pre-pena is very time consuming.

Local authority 2, from municipal city hall, points out that as long as the labor unions exist, better relationships need to be fostered. A better relationship would not only benefit the local government but would improve working conditions from waste collection crew members. Some local government representatives see the informal recycling sector as a threat towards the MSWM system.

Local authority 4 from the Ministry of Environment and Natural Resources says that, for him the biggest problem in the current MSWM system is the disposal at the sanitary landfill. Challenges faced within waste collection process: many collecting units do not get maintenance; the road to the sanitary landfill is unpaved, full of bumps, hence why many waste collection trucks are always in need of maintenance; while doing the “pre-pena” a lot of time is wasted; waste collection routes must be updated; staff needs training; labor union represents some challenges.

5.8. Solutions proposed by actors

5.8.1. Public Sanitation Department

Municipal waste collection crew

Based on interviews with workers from the formal sector it was found that most of them believe that increasing the budget of the department of public cleaning services would solve most of the problems.

Public sanitation worker 2, a former waste collection truck driver and now manager thinks that with an increase in budget, the department would be able to solve most of the collection problems. With more trucks, waste collection service would be available everywhere in the city. He further notes that now a days many waste collection trucks need maintenance but because there is no budget, they are just idle, waiting to be repaired. He also thinks that proper training and building of responsibility are also necessary.

Other actors

Public sanitation worker 4, chief inspector from the department of public cleaning services suggests that what is needed is a transfer station. By having one, transfer times would be greatly reduced and waste collection trucks could cover more collection routes. He also points out that more staff and
waste collection trucks are needed as well. By doing so, waste collection crew will be able to cope with the uncollected waste.

Public sanitation worker 3, management from Public Sanitation Department, says that what is needed for the improvement of the MSWM system is more budget. Allocation of budget should go towards acquisition of more waste collection and compactor trucks and increase staff. By doing so, the area covered by waste collection services would increase to 100%, he affirms.

5.8.2. Pepenadores
Based on interviews, some pepenadores pointed out willingness to form groups in order to handle more quantities of recyclables with the hope of bypassing middlemen and getting better deals. They mentioned that they are aware that middle men or waste dealers are the ones making more profit from the materials.

5.8.3. Carretoneros
All carretoneros with whom I spoke with are well aware about the benefits provided to the city and to the MSWM system from their refuse activities. They would like to see more cooperation between the local government and themselves.

5.8.4. Local government representatives
Local authority 3 suggests that some of the problems faced by the current MSWM system could be overcome with involvement of citizens. Involvement of citizens is indispensable for creating supportive networks that will have the opportunity of affecting positively the role scavenger’s play, he affirms. A processing plant, he suggests, would really benefit the city. The municipality should manage it and create inclusive opportunities for the urban poor, by the creation of public-private partnerships.

Local authority 2 proposes that a processing center would greatly benefit the city and the MSWM system. This way everyone involved in la plancha would be at the processing plant separating recyclables. He also remarks that a local education plan is needed for showing the citizens the importance of waste segregation.

Local authority 4 states the need for a transfer station, as well as increasing waste compactor truck fleet. With a transfer station, he reassures, the operation times would drastically decline thus permitting more coverage of routes, increasing overall municipal solid waste collection.
6. Analysis and discussion

In this chapter the results obtained during the fieldwork and presented in the previous chapter will be analyzed using the theories presented in chapter three.

6.1. Weak municipal solid waste management system and policies towards resource recovery

The MSWM system from the municipality of Xalapa still represents a challenge, and its proper service is an unresolved issue from past and present administrations (Jiménez Martínez, 2015). According to Castro and Pérez, this is the result of a centralized and hierarchical model whose responsibilities are lacking and functions are inefficient (Castro and Pérez, 2016). A characteristic of the current system is the total lack of citizen participation and the incapability of the local government to cope with an ever-increasing demand of MSW services.

The current system is facing several problems: a growing urban population, increasing the total amount of solid waste generation; a growing urban area, both squatter settlements and legal developments, in which some cases the municipal solid waste collection service can’t provide service; demand of more and better infrastructure from Public Sanitation Department; a sanitary landfill with a life expectancy of only one more year (from 2017); as well as a lack of strategies towards an integrated sustainable waste management (Bernache Pérez, 2015).

Shortsighted local governments

A serious problem afflicting local governments, which has direct repercussion to MSWM systems, in Mexico is the existence of weak institutional bodies (Jiménez Martínez, 2015). This translates into a lack of continuity of public programs and actions between past and current administrations. Every time a new local government enters the office, all current programs – municipal waste management, recycling initiatives, education, community building – are ditched and new ones are proposed and implemented by the new government (Castro and Pérez, 2016). It doesn’t matter if these programs were showing successful results; they are discontinued and replaced by another set of actions. Local governments fail at recognizing that sustainable development is not achieved overnight, it requires medium and long term planning (Bernache Pérez, 2015).

Policy towards resource recovery

As mentioned in chapter two, the Municipal Services Regulation is the document which regulates municipal solid waste management services in Xalapa, among other public services. In 2014, the local government through its Municipal Development Program 2014-2017, presented a set of action guidelines and policy work that the current administration will follow. In this development program, there is very little emphasis in resource recovery actions as well as in waste prevention, reuse and recycle strategies, the so called waste hierarchy (see figure 6) (Wilson et al., 2015a). It does mention that from 2014 onwards municipal solid waste should be separated in organic and inorganic. It also adds that organic waste collected by the municipal collection crew should be turned into compost.

Up to this date, municipal solid waste is not separated and no organic waste is turned into compost. Even though organic waste is a major component of the waste disposed at the sanitary landfill, recovery programs are lacking. If the municipality created a program where the organic waste is used and turned into compost, or any other action, it would cut the amount of waste being disposed by almost half.
Poor communication

Former director of Public Sanitation Department and other local authorities underline the poor communication and organization within the Public Sanitation Department. This is evident in relation to the waste collection routes performed daily by the waste collection crew. As some people said that these routes are modified every day, according to demand and even sometimes several waste collection trucks would pass by the same route thinking that no truck has passed by yet.

Time consuming municipal waste collection practices

Current municipal waste collection practices are very time consuming. On one hand, waste trucks usually travel at least 15km a day; from the Public Sanitation Department (it is both, offices and the base for waste trucks) to waste collection route, then to the sanitary landfill and for selling the recyclables, and then back to the base. It is very time consuming as well as expensive. According to Daniel Fe, Public Sanitation Department spends, only in diesel and gasoline, $8,555,585 Mexican pesos/year (approximately 4million kr/year). While on the other hand, the prepena as well as the increase in collection times due to pepenadores activities, makes the current collection and disposal practices very time consuming. This is the reason why some local authorities believe that the construction of a transfer station is the answer to the waste problem. The reason for a transfer station is that instead of the waste collection trucks going directly to the sanitary landfill; they go to a transfer station, which could be built in a strategic location closer to the city than the sanitary landfill is. This way, transfer distances are decreased as well as transfer times.

6.2. Weak strategy plan proposed by the local government and action plan proposed in ESCI program

Public Cleaning Improvement Integrated Plan

As mentioned above, in 2014 the municipality issued a Municipal Development Plan 2014-2017. Confronted with a waste crisis, that same year they published their Public Cleaning Improvement Integrated Action. In it, 20 strategic action plans for improving the MSWM system were presented. Its action plans were divided into 4 sub-topics: infrastructure, administrative, human resources, and public awareness.

Among other deficiencies, the action plan failed at providing recommendations and action guidelines regarding: waste prevention and minimization; informing the general public on the importance of recycling, sustainable development and climate change; initiate social participation programs; the informal recycling sector and its integration to the MSWM system.

The lack of waste prevention strategies can be explained because waste treatment is fundamentally comprised of end-of pipe solutions, such as collection, landfill, incineration and recycling (Zacho and Mosgaard, 2016). This is especially true for Xalapa’s MSWM system, where all efforts are directed towards collection, both street sweeping and collection trucks, and disposal; placing no priority to 3Rs strategy.

Scholars such as (Gutberlet, 2008a; Medina, 2008; Wilson, Rodic and Velis, 2013) stress the importance of active participation from society in matters of local government issues such as solid waste management. Having an informed and participative society means providing individuals with the right to democratically construct their present and future (Gutberlet, 2008b). Unfortunately, civil participation in Xalapa is very low. Several interviewees, including carretoneros, recognized the fact that households seldom separate their waste, although there are some communities where they do have recycling and separation programs.
It is unreasonable for a city to succeed in overcoming the waste predicaments affecting everyone when they fail to recognize the importance of an informed and active society, the importance of waste prevention and minimization, and the integration of the informal recycling sector to the current MSWM system.

**Emergent and sustainable cities initiative action plan**

The strategic action plan proposed by the ESCI program for Xalapa is better suited to the needs of the municipality of Xalapa. Moreover, they propose that the institutional framework, regarding the MSWM at a local and regional level, should be modified to include strategies for waste prevention, reduction and recycling. Nevertheless, they overlook the informal recycling sector and only mention that the activities performed by pepenadores should be formalized and regulated. The other informal recycling sector actors are not even mentioned (mainly carretoneros and, regarding the activities from municipal waste collection crew, not a word).

Furthermore, mechanisms for engaging all stakeholders involved in MSWM system are not specified, neither do they identify all local stakeholders involved in the system. (Wilson, Rodic and Velis, 2013) asserts that, the actions undertaken from the local government in isolation will never be enough. Therefore, it is as much responsibility of the local government as it is from all stakeholders involved in the system to actively participate in their own role and responsibilities, within the system.

While the proposal focuses, mainly, in changing the institutional framework regulating MSWM and in improving the physical elements of the system, collection, disposal and recycling. It falls short in including the full spectrum of good governance aspects. These governance aspects are: proactive policies, inclusivity and financial sustainability (Wilson, Rodic and Velis, 2013). Furthermore, the authors suggest that for a solid waste management system to be successful it has to address both the physical (technical) elements as well as the good governance aspects (ibid).

Additionally, moving towards the goal of sustainability requires fundamental changes in human behavior and attitudes. Progress in this direction is thus critically dependent on education and public awareness (United Nations Educational, Scientific and Cultural Organization (UNESCO), 1997). Public awareness, public participation and environmental education initiatives are essential for creating an environmental culture where people generate and consume less as well as separates and recycles more (Bernache Pérez, 2015). Yet, such initiatives are absent from the proposal.

None of the proposals touch upon integration of informal recyclers into the formal MSWM system. Even though the proposal from the ESCI program takes a more holistic approach, still fails at recognizing the role informal recyclers provide to the city.

**6.3. Informal waste recyclers**

Pepenadores working and living conditions are in line with what Medina suggests; they survive in a hostile physical and social environment, facing discrimination, harassment and scarcity on a daily basis (2007a). Pepenadores, like José Hernandez, expressed that some days he doesn’t find enough materials to sell, this means that he has no money to buy food for that night; he lives one day at a time. One of his daily struggles is the fact that middlemen or informal recycling centers always give unfair valuation of recyclables. This happens because, as explained in the previous chapter, some informal recyclers meddle with the recyclables they recover; so, middlemen knowing their practices do the same with the scale used.

José Hernandez was not the only pepenador to complain about low prices paid by the informal recycling centers/middlemen, most pepenadores interviewed expressed the same concern. Low
income can be explained due to their low position in the trade hierarchy for recycled materials (see figure 2) (Wilson, Velis and Cheeseman, 2006). According to (Medina, 2008), opportunities arise for the exploitation and / or political control of the scavengers, since they must sell their pickings to a middleman, who in turn sells to industry. Given that industry demands for a minimum amount, they often do not buy from individual scavengers. Therefore, scavengers have no other option than to sell to middlemen, in spite of the low valuation of their materials.

Figure 26 shows the secondary materials added value in the city of Xalapa. Pepenadores as José Hernandez are at the bottom of the so-called secondary materials added value chain. Individual pepenadores tend to occupy the bottom of the secondary materials added value chain due to their limited capacity for recovering, processing or storing materials (Wilson et al., 2006).

![Diagram showing the added value chain from industry to street sweepers](image)

**Figure 26** Lowest to highest added value from informal recycling sector

However, organization also plays an important role in the position of actors across the added value chain hierarchy. As a general rule, “the less organized the informal recycling sector is, the less the people involved are capable of adding value to the materials they collect, and the more vulnerable they are to the exploitation from intermediate dealers” (Wilson, Velis and Cheeseman, 2006, p.800). Pepenadores will remain the most vulnerable unless they get access to technology. That is why scholar such as (Gutberlet, 2012; Medina, 2007b; Wilson, Velis and Cheeseman, 2006; Wilson and Velis, 2015) suggest that a very effective way for pepenadores to upgrade their ability to add value to collected materials is through training and organization.

The socio-economic and socio-demographic characteristics of scavengers differ from location to location (Ezeah, Fazakerley and Roberts, 2013). In the case of Xalapa, even though it’s a heterogeneous group of people, there is a marked presence of elderly people who have lost their job and have no possibility of being employed somewhere else. As pointed out by Medina, pepenadores constitute disadvantaged and vulnerable segments of the population (2008). Local authority 3 (interview with Local authority 3, 2017) pointed out that the number of people recurring to this activity is on the rise. He adds that apart from the local unemployed population, in recent years, migrants on their way to the US make a stop in Xalapa and get involved in this activity for a while.

For carretoneros, their situation is similar to pepenadores but not quite the same. The fact that the Public Sanitation Department and other local authorities acknowledge that they cannot cope with the demand for MSWM services makes carretoneros work necessary, and up to a certain point wanted. As long as carretoneros don’t interfere with the municipal waste collection crew and they...
stay away from the city center ring, their work is permitted. Nevertheless, even though the local government acknowledges their work and the various benefits carretoneros make to the city. The local government fails at providing them with any kind of retribution for their work. The only retribution is that their activities are somewhat allowed.

In addition, carretoneros have fostered certain kind of relation with households they visit. When they engage in house to house collection, apart from the fee that every household gives, some of them also give them clothes, as a donation gesture. This gesture seems to relate with the amount of time a certain carretonero has visited certain household. Moreover, carretoneros seem to be accepted by local residents unlike pepenadores that, sometimes, are seen as thieves. The criminalization of pepenadores by locals is a common phenomenon (Adama, 2012).

Contrary to pepenadores, carretoneros are organized; they even belong to a labor union. The fact that they are organized, and their job somewhat recognized, gives them more political strength.

**Policies towards the informal recycling sector**

There are no national guidelines or policies that regulate or mention the activities of pepenadores or carretoneros. Therefore, local governments are in charge of this task. For the case of Xalapa, the Municipal Services Regulation is the governing document concerning municipal public services (Gobierno del Estado, 2008). There are two articles relevant for this discussion, article 57 and 88. Article 57 states that carretoneros services are allowed only in areas where municipal waste collection service is unable to access. Operating carretoneros must register at the Public Sanitation Department so that local authorities can regulate their activities. Article 88 states that scavenger activities of any kind performed by unauthorized people, is forbidden.

For the case of Public Sanitation Department workers, article 63 from Municipal Services Regulation states that, resource recovery activities can be performed by the own local government, private industry, private people, or by Public Sanitation Department workers, as long as they are authorized by the department.

Articles 64 and 65 from Municipal Services Regulation deal with the requirements to establish a formal recycling center or a recycling industry. The problem is that in Xalapa there are few formal recycling centers; most of them operate as illegal; meaning that these centers do not pay taxes and do not have any sort of records. This translate into unreliable or nonexistent data regarding resource recovery activities, a huge problem in Mexico (Bernache Pérez, 2015).

The Municipal Development Plan barely touches upon resource recovery strategies, as for informal recycling actors, only carretoneros activities are considered. It only mentions that their activities should be regulated and they should be registered.

Such an action plan shows the poor commitment by the current local government towards improving the working and living conditions of this sector. This exemplifies the usual attitude taken from local governments towards this sector, as pointed out by (Buenrostro and Bocco, 2003; Medina, 2005; Nuñez Espinoza, 2016).

An example of this attitude is the recent program the government undertook to help carretoneros. In an attempt to improve the working conditions of carretoneros, the local government decided to exchange their carts pulled by horses for motorbikes. Instead of helping them with offering: better sanitation and working conditions, safety gear, insurance, salary. The only thing the government did was to prohibit carts pulled by horses or donkeys from circulating in the streets. It is a clear example of politicians will, just as Medina (2005) points out, attitudes towards carretoneros or/and pepenadores are of neglect or prohibition.
6.4. Hierarchy within informal recycling actors (Vulnerability among informal recyclers)

The informal recycling system consists of different actors, each involved at different levels and each with different possibilities of influencing the system. Within the system there are different networks; some of them interacting with others while others are isolated. Within these networks there are sets of actors organized, forming sub-groups or ‘cliques’, which follow hierarchical organization; while others work independently or in small groups varying between 2-4 people. A ‘clique’ or ‘sub-group’ according to Scott (2000, p. 19) is “people’s informal social relations tie them into cohesive sub-grouping that have their own norms, values and sub-culture”. Following this concept, carretoneros and municipal waste collection crew each form cliques. In addition, carretoneros and municipal waste collection workers form two non-overlapping groups (Figure 27); however because both belong to the same labor union there is a membership overlap (all carretoneros and some waste collection crew are members of Urban Solidarity labor union, as described in the previous chapter) (see Figure 28). According to network theory: where groups or cliques overlap, conflict between them is less likely than when groups do not overlap (Hanneman and Riddle, 2005). For the case of pepenadores unless they work with someone else, no clique can be formed; the smallest clique is composed of two actors.

Additionally, within these networks a social hierarchy takes form with waste collection crew members on top (see Figure 23). Regardless of the lack of interaction between some actors (pepenadores and carretoneros) everyone seems to comply with such hierarchy. A possible explanation to this phenomenon is because each comply to the own norms of the clique they belong
to. Just as what Public sanitation worker 1 mentioned, that inside Public Sanitation Department there is a sub-culture.

Moreover, it is because of actor’s access to technology that this hierarchy seems to stand and prevail. Municipal waste collection crew occupies the first two positions in the hierarchy, with the driver on top (see Figure 22). This is because, in comparison with the rest of informal recyclers (carretoneros, pepenadores and street sweepers), they have access to more infrastructure (waste truck) and resources (huge amounts of mixed waste) than the rest of the actors do. Municipal waste collection crew has access to technology that pepenadores do not have. Access to technology can provide an advantage over other actors that do not have access to the same technology. That is why, when pepenadores want to sell their recovered materials, they have to pay someone to transport them; over half of their earnings are spent in transport costs. The fact that they have less access to technology, in this case infrastructure and resources, is one of the reasons why pepenadores are at the bottom of the hierarchy; making them a more vulnerable group than the rest of the informal recycling actors. However, access to technology alone will not prove to be the solution. Access to technology alongside good governance policies, on the contrary, can provide the sort of solutions needed for the informal recycling sector to improve their livelihoods (Rodić and Wilson, 2017; Wilson, Rodic and Velis, 2013).

Furthermore, most of informal waste workers do not have basic education; this, contributes to making them believe that in fact they must comply with this hierarchy and that they are unhygienic, a symbol of backwardness, a nuisance, a squalor (Medina, 2007b).

The aforementioned hierarchy is apparent within Public Sanitation Department, specifically among municipal waste collection workers. According to this hierarchy, drivers are on top, then, assistants, subsequently comes informal workers. Usually between drivers and possible informal workers exists a form of relationship; acquaintance, kinship, friend of a friend. Therefore, most of the times these informal workers riding along with municipal waste collection crew are there thanks to the driver and their relationship. This is what Lomnitz (1988) names reciprocity within members of a network. Informal exchange of services and goods within a formal social system develops in response to scarcity (ibid, p. 43). In this case, on one hand, unemployment leads drivers to offer their kin or acquaintances the chance of riding along for the recovery of materials; while on the other, access to technology is what enables drivers to offer this opportunity in the first place.

6.5. Relation between formal and informal waste management system

Often the attitudes and perceptions from local authorities and the formal waste management towards the informal recyclers tend to be negative. They are stigmatized for their activity and they suffer under strong societal prejudices (Gutberlet, 2008b, p.6). In spite of the fact that informal recyclers are providing a service that the own government has failed at fully providing.

The relation between the formal waste management and local government with carretoneros is neutral. The Public Sanitation Department allows their activities as long as: they only operate in areas where the formal waste management system is unable to enter, that they don’t use animals to pull their carts and that they don’t interfere with the formal waste management system. Since the Municipal Services Regulation (Gobierno del Estado, 2008) was revised in 2008, article 57 states that carretoneros activities are permitted as long as they operate within areas where municipal waste collection services are unable to reach; and carretoneros must register to the Public Sanitation Department.
As mentioned above, carretoneros and the majority of municipal waste collection workers are members of the same labor union. In other words, as suggested before, these two set of actors have a membership overlap. Where groups overlap, “mobilization and diffusion of ideas, information, resources, etc., may spread rapidly across the entire network; where the groups don’t overlap, ideas may occur in one group and not diffuse to the other” (Hanneman and Riddle, 2005, p.171). To the level of mobilization and diffuse of ideas, information, or resources it is known as ‘reachability’ (ibid). Even though carretoneros and waste collection workers have high level of ‘reachability’ zero initiatives have been proposed to work together from both groups. According to Public sanitation worker 1 (interview with Public sanitation worker 1, 2017) this has to do with the hierarchy embedded in this network. However, according to her, there is slim chance of collaboration if their earnings from the sale of recyclables are not compromised. In order for such collaboration to emerge, the labor union should be involved in this discussion.

For the case of pepenadores, the relation between them and the formal waste management sector as well as with the local government is that of prohibition. In fact, article 88 from Municipal Services Regulation forbids any kind of waste picking activities; including the prepena activity performed by the municipal waste collection crew and street sweepers. Further, municipal waste collection crew sees pepenadores as nuisance and interference. However, this is because municipal waste collection crew perceives pepenadores as competition, given that both of them recover materials from the same source.

As expressed by (Gutberlet, 2010) the prevailing view of waste and waste recovery has to change. Such view would imply a shift towards recognizing recyclers as environmental service providers, instead of perceiving them as a nuisance and treating them with aversion (ibid, p. 172). This is in line with what Wilson et al suggests as a first step when convincing municipal authorities and politicians to move from their policies of repression and neglect to one of support and integration. The first step is for those in authority to recognize the economic, social, and environmental benefits that result from informal recycling (ibid, p. 805). In the case of the municipal authorities in Xalapa, they recognize that it is because of this people that recycling exists at all. However, they fail to recognize the rest of the benefits that result from the informal recycling sector as well as the risks of their profession. Furthermore, neither the action plan presented by the municipal government nor the one presented by the ESCI consider such benefits; even less do they propose mechanism for their integration to the current MSWM system.

6.6. Analysis of current situation
The current local government is in need of new alternatives to municipal waste management. The problem with solid waste is exacerbated due to several reasons including: a weak institutional framework, with little emphasis on resource recovery and waste prevention; a lack of an environmental culture which permeates every sector of the population; and, local authorities with scant interest in helping the urban poor.

What is more troubling is the type of solutions proposed by local authorities and by some stakeholders. The solutions proposed by local authorities including local authority 2, local authority 1 from Ministry of environment and natural resources, Public sanitation worker 3 assistant to the director of Public Sanitation Department, Public sanitation worker 4, as well as Public sanitation worker 2. They all believe that more budget, more infrastructure, and more personnel will solve the waste problems afflicting the city.

These solutions resemble to what (Medina, 2007b) refers to as conventional solutions. These solutions tend to be: centralized and un-diversified; top-down approaches without any, or with little, community participation; capital-intensive; only considering the formal sector, ignoring the
existence and possible contribution of the informal recycling sector. Conventional solutions consider waste as a disposal problem rather than as a resource management (ibid), often with unsuccessful solutions in global South countries. Inasmuch as those approaches focus in end-of-pipe solutions. These conventional solutions proposed by local authorities are reflected in both the Municipal Development plan and its further Public Cleaning Integrated Improvement Plan.

Furthermore, some of the actors mentioned above, think that what is needed is state-of-the-art compactor trucks will help solve the problems from the MSWM system. While the truth is that, according to Medina (2008) technology commonly used in global North countries often fails in global South cities; compaction of wastes, in these cities, is often unnecessary because the refuse has a high proportion of organic matter. In fact, Public Sanitation Department recently bought state-of-the-art compactor trucks as well as non-compactor. According to some interviews, personnel of the department would intentionally temper with the trucks so that the compactor mechanism would stop working; this way they could still perform the plancha.

In addition to end-of-pipe type solutions proposed by local authorities, the current MSWM system faces another problem. There are great differences between policy and practice as suggested by (Buenrostro and Bocco, 2003). On one hand, according to Municipal Services Regulation, any type of waste picking activities are forbidden, including the prepensa performed by municipal waste collection crew; and no persons should be allowed to ride inside the compartment where waste is transported. When in fact, what actually happens is the opposite; the Public Sanitation Department with the permission of the local government allows such activities. And this is only one of many examples that illustrate the situation in Mexico; there is a great difference between intention and reality. Buenrostro and Bocco argue that is the result of poor administrative organization between departments as well as unqualified people assuming a role that they simply can’t fulfill (2003).

Moreover, in 2016 the municipality of Xalapa revealed, recently approved by the local government, a Climate Change Action Plan (Programa de Acción Climática Municipal, in Spanish), in which sets the guidelines for fighting climate change on a municipal level. The aforementioned program does include guidelines aiming at: environmental education campaigns, recycling including reduction and reuse, among others (Plan de Acción Climática, 2016). However, the action plan doesn’t consider the informal recycling sector for achieving these goals.

6.7. Barriers and opportunities for participatory resource management to provide solutions to the problems identified in the WM sector

In order to consider a participatory resource management for waste management it is necessary to explore the barriers and opportunities that the current MSWM system possesses. The identified barriers span from civil society to local authorities responsible for MSWM system. For the case of opportunities, among several others, the fact that the municipality wants to “catch up” with sustainable development practices provides a window for opportunity.

Barriers for a participatory resource management approach

Poor policies designed to promote and encourage separation of waste at source, as well as selective waste collection, and recycling. Selective waste collection is not stipulated in Municipal Services Regulation, although, according to Municipal Development Plan 2014-2017 waste should be separated into organic and inorganic. As Gutterlet (2015) suggests, selective collection and recycling has to be anchored in public policy, assuring governmental support and remuneration for the service of recovering resources from garbage. This suggests that regulations and policy co-opt by local government is still far from desirable.
Apart from existing regulation and policy towards resource recovery, local government does not consider the informal recycling sector as an asset. Partly, this has to do with the attitudes and perceptions that outsiders have towards people working directly with garbage. This in fact, is one of the greatest problems identified by (Wilson, Velis and Cheeseman, 2006). According to the authors, one of the greatest challenges is to shift the perception and attitudes, particularly of local officials and also of the general public, towards those involved in informal recycling (ibid, p. 805).

Several scholars and practitioners (Fahmi and Sutton, 2006; Gutberlet, 2015; Medina, 2008; Wilson, Velis and Cheeseman, 2006), to name a few, have confirmed that NGO involvement in discussions with the informal recycling sector is essential. Unfortunately, in Xalapa there are no NGOs or civil associations that work with this sector. However, this doesn’t mean there are no organizations working in this topic. For example, in Mexico City there are several international NGOs such as WIEGO (Woman in Informal Employment: Globalizing and Organizing), that have been doing an enormous work towards this sector throughout Latin America.

Moreover, scarce citizen participation is the prevalent attitude towards matters of citizen responsibility, as already mentioned. In fact, most individuals are failing to minimize their waste generation, to reorient their consumption habits and lifestyles, and to initiate/participate in public discussion of waste and the social, economic, and ecological implications of it (Gutberlet, 2015, p.234). That is why much effort needs to be placed into informing and raising awareness on waste, environmental education and sustainable development (Wilson et al., 2015a).

Another challenge perceived by some actors, mostly within the formal sector and local government, is the presence of labor unions within the MSWM system. The problem with these unions is that their leaders stopped fighting for the rights of their members; instead they look for what is best for them. For the case of the labor unions in Xalapa, they are seen as an obstacle for improving the MSWM system. Nevertheless, the fact is that they are in a position of power (see Figure 11), and are followed by their members. As long as they exist, local authorities as well as any other initiative will have to learn how to deal with labor unions.

Public Sanitation Department workers would have difficulties working with pepenadores, given that they are seen as competition. Public Sanitation Department workers would never agree on working with pepenadores, and if forced to work together it could translate into hostile relations. Therefore, before any attempt of integration of the informal recycling sector into the formal waste management system, consultation and deliberation with all stakeholders is needed.

Opportunities for a participatory resource management approach

The municipality of Xalapa has showed its commitment with actions and policy aiming at a sustainable development on a local level by joining the ESCI (emergent and sustainable cities initiative) as well as by presenting, and, further approval, the Climate Change Action Plan. Even though those documents do not include policies or strategic lines that build upon the existing informal recycling sector; they, show certain engagement on behalf of the local government to start proposing policies under the lens of sustainable development.

With the support of existing NGOs, informal recyclers could get assistance to organize themselves and to add value to their recycled material before selling them on, to move up the hierarchy shown in Figure 2 (Wilson, Velis and Cheeseman, 2006). One way of achieving this is to assist pepenadores and carretoneros to form cooperatives. Pepenadores and carretoneros organized in cooperatives can bypass the middlemen; in turn better prices can be negotiated between them and industry. (Medina, 2000) further notes that the timing in which the coop is formed can contribute to
its success. A window of opportunity appears during changes of administration, at the local level order.

A drawback that pepenadores face is that most of them work on their own, and that every day their number rises, therefore organizing them could be a challenge. However, some pepenadores interviewed showed, at first skepticism, willingness to finds ways to add more value to their recyclables; one way of achieving this is by creation of cooperatives, as mentioned above. The key is organization (Medina, 2008; Wilson, Velis and Cheeseman, 2006). Organizing provides an avenue for political action that can lead to transformative changes not only at local level, but at national level as well (Dias, 2016).

Given that carretoneros and the majority of Public Sanitation Department workers belong to the same labor union, represented by the same leader; this could lead to better relationships and cooperation. For this to happen, this would be needed: discussion, round tables, full engagement of both parties, and decisions taken based on information.

Some of the solutions proposed by local authorities can initiate a transition toward adequate and work safety infrastructure. A processing station, solution proposed by several, could be a good starting point in order for politicians and representatives to see the potential that the informal recycling sector provides.
7. Conclusion

The municipal solid waste management system of Xalapa is characterized by the presence of informal recycling actors who deal with all the recovery of resources. Resource recovery activities occur at the street sweeping, collection and transport phases. This resource recovery system runs in parallel with the formal municipal waste collection one; and it is because of the inefficiencies from the latter that the informal recycling sector remains.

The informal recycling actors present in Xalapa are: pepenadores, carretoneros, street sweepers, municipal waste collection crew and primary and secondary waste dealers. It was discussed that depending on their capacity to add value to the waste recovered and if organized or not, they tend to occupy certain position in the secondary materials trade hierarchy. Wherein, the lower an actor’s position in this hierarchy the more vulnerable to exploitation and manipulation from middlemen or local government.

Neither the action plan proposed by the local government nor the strategic plan put forth by the ESCI program recognizes the informal recycling sector as a legitimate stakeholder. Moreover, current actions towards improving waste management are represented by inadequate policies that on one hand, lack incentives for recycling as well as place little emphasis on prevention and 3Rs strategies; while on the other, hinder opportunities for informal recycler for improving their livelihoods by ignoring the benefits brought by these actors.

It is suggested that citizen’s involvement, inclusive policies and bottom-up proposal are pre-requisites and necessary for the creation of new municipal solid waste management systems that can cope with the urgent needs of the city. If participatory resource management is to be considered as an alternative to the current waste management plan, several barriers need to be recognized as well as overcome. Most of these barriers lie within the governance and social spectrum. Some of the governance barriers are: poor policy towards resource recovery and recycling as well as waste prevention; in the case of the social barriers, the most relevant are: the lack of environmental education and scarce citizen participation. Recognition of the services and benefits provided by the informal recycling sector is a critical first step. However, the existing governance system does have some opportunities that can be beneficial to move towards a more inclusive, socially acceptable and sustainable MSWM system. The fact that competent local authorities have released a climate change action plan; as well as having participated in the emergent and sustainable initiative cities program, shows commitment, on behalf of authorities, in the search of more just and socially acceptable solutions.
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Andrés
9. References


10. Annex

Semi-structured interview guide

Semi-structured interview for city officials involved in municipal solid waste management program

- Name
- Could you describe briefly how does the formal waste management work?
- Who are the main agents responsible for its proper working?
- How is the plan of action decided?
- What is done with all the trash collected?
- Is there any recycling done? If so, where do the materials go and who buys it?
- Is there any interaction with private companies?
- Do you know about any informal recyclers activities?
- Is there any interaction between formal and informal sector? How?
- Do you know if they are organized in any way? Labor union or cooperatives?
- *if yes, what is your opinion on such organization?
- Does the informal sector interfere with the formal sector?
- Do you think that working with the informal sector can benefit the collection/recycling process?
- Is there any program that educates the people working on the waste management system on environmental education, impact, and/or recycling?
- If so, how does it work? Why not?
- How do you think that the current waste management system can be improved?

Semi-structured interview for formal waste management workers

- How long have you been involved in this activity?
- Explain briefly how does it work
- Who tells you which route to go?
- Are you organized in any way? If so, how?
Do people separate their waste?
Do you separate the materials you pick up?
How do you separate the materials?
Do you sell it afterwards? To whom? And by how much
Do you have any interaction with the industry sector?
Do you have any interaction with the informal sector?
If so, how does it work?
Do you get any training, or any information, on environmental education?
Would you be interested in working together with the informal sector?

Semi-structured interview for informal recycling sector

How and why did you start recovering materials?
How long have you been in this activity?
Do you work alone?
If not, who do you work with? Family or small cooperatives?
Are you organized in some way?
If so, how are you organized? And, how does it work? Do you have representatives?
Who do you sell to the materials that you salvage?
Do you get to choose who you sell them to?
How do you determine its monetary value?
Where do you usually work?
Do you work always on the same place or you rotate between different landfills?
Do you use any protection for working?
Do you work with the formal sector?
Do you have dialogues with the government officials?
How is your relationship, if any, with them?
Do you feel that citizens respect you? How do they treat you?
What do you think about your profession?
What are the challenges you face in your everyday job?
Semi-structured interview for NGOs

- How is your organization involved with the informal sector?
- Do you work in direct contact with them? Or through a representative?
- How are you helping them?
- Are you also working with the government?
- Are you also working with the formal recycling sector?
- Do you know if the informal sector is organized in some way? Perhaps labor unions or cooperatives?