Aalto University
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Living off garbage: Waste picker institutions in Brazil through the lens of Elinor Ostrom's principles for governance of common-pool resources.

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Master's thesis

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Abstract of master's thesis

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Abstract

In many cities of the developing world, an active informal waste sector, made up of millions of people, make a living from the recovery and recycling of resources found in waste. They are often the major suppliers of secondary materials to industry and in some places they achieve significant recycling rates. The living and working conditions of informal recyclers are, however, often extremely difficult. Also, informal recycling, notably of waste electrical and electronic equipment (WEEE), is characterized by highly pollutant processes, without compliance to environmental, safety and health standards. Calls have been made for the integration of informal sector recycling into mainstream waste management, for the millions of jobs it creates to the urban poor, the potential to improve working conditions and for the need to address unsound environmental practices. Integration requires a level of organizing and a common venue is the establishment of associations or cooperatives of waste pickers. Brazil is known for its initiatives of waste picker integration, and is home to over a thousand organizations of waste pickers, often characterized by the principles of self-management and collective decision-making.

In this thesis, waste picker institutions in Brazil are examined through the lens of common-pool resource (CPR) theory, and in particular, Elinor Ostrom's core design principles for the efficacy of groups (E.Ostrom, Nobel Prize in Economic Sciences 2009). It is set against the emerging background of waste as a resource, specifically waste as a common-pool resource. The research adopts a descriptive, multiple-case study approach, in which Ostrom's principles are applied to two institutions of waste pickers with the aims of verifying to which extent they characterize these institutions and if their presence (or absence) is related to their institutional performance. Multiple sources of data were used: primary data through field visits, observations and interviews, and secondary data from the body of literature.

Results suggest a strong relationship between the degree to which the principles are present at these institutions and the results they achieve in terms of income level, recycling rates and the mix of services they offer. In light of these findings, the design principles could be used by waste picker institutions to evaluate performance and to highlight modes of improvement. At a theoretical level, findings strengthen the case for generalization of the principles across groups outside the traditionally studied natural CPRs. This study contributes to the conceptualization of waste as resource and, in particular, as a common-pool resource. As such, it is relevant to the understanding of the incentive structure underlying materials recovery from waste and to resource efficiency. It joins the growing body of research on the urban commons.

Keywords common-pool resource, design principles, waste, informal recycling sector, waste pickers, institutions, secondary raw materials

To my parents.

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ABBREVIATIONS

ABRELPE - Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais

ASMAC – Associação dos Catadores Autônomos de Materiais Recicláveis de Contagem

ASMARE - Associação dos Catadores de Papel, Papelao e Material Reaproveitável de Belo Horizonte

CBO - Classificação Brasileira de Ocupações

CEMPRE – Compromisso Empresarial para Reciclagem

COOPERT – Cooperativa de Reciclagem e Trabalho Ltda.

CPR - Common-Pool Resource

EAP - East Asia and Pacific

EEE - Electrical and Electronic Equipment

IBGE - Instituto Brasileiro de Geografia e Estatística

ILO - International Labour Organization

IMF - International Monetary Fund

INSEA - Instituto Nenuca de Desenvolvimento Sustentável

IPEA - Instituto de Pesquisa Econômica Aplicada

ISMW - Integrated Sustainable Waste Management

MBO - Membership-based Organization

MNCR - Movimento Nacional dos Catadores de Materiais Recicláveis

MSW - Municipal Solid Waste

MSWM - Municipal Solid Waste Management

OECD - Organisation for Economic Co-operation and Development

SLU - Superintendência de Limpeza Urbana

SSE - Social and Solidarity Economy

WEEE - Waste Electrical and Electronic Equipment

1 INTRODUCTION

The world has never generated such amounts of waste before. The current 1.3 billion tonnes/year is expected to increase to 2.2 billion t/year by 2025 (Hoornweg & Bhada-Tata 2012, 7-8). Growth in waste generation is a global trend for low- and middle-income countries (Hoornweg, Bhada-Tata & Kennedy 2014). Waste management systems in these countries are struggling with lack of capacities to address the problem and serious health and environmental damages occur from the inappropriate and inefficient handling of waste (UNEP 2015; Hoornweg & Bhada-Tata 2012). Concerns over the use of finite natural resources, on the one hand, and mounts of waste produced on the other, call for action aimed at preventing the generation of waste, and promoting reuse and recycling, as laid down by the waste hierarchy (ibid.). Recycling is a strategic component of resource efficiency, acting to recover materials in waste streams, and re-insert them back into the economy (OECD 2015).

Waste management systems of low- and middle-income countries are largely characterized by insufficient waste collection, no formal recycling strategies and infrastructure in place, and inappropriate disposal of waste (UNEP 2015; Hoornweg & Bhada-Tata 2012; Nzeadibe & Anyadike 2012; Sharholy, Ahmad, Mahmood & Trivedi 2008; Zhang, Tan & Gersberg 2010). In spite of these deficiencies, considerable recycling exists (Chi, Streicher-Porte, Wang & Reuter 2011; Scheinberg, Spies, Simpson & Mol 2011; Wilson, Araba, Chinwah & Cheeseman 2009; Zhang & Wen 2014; Fahmi & Sutton 2006). That is made possible by the presence of an active informal waste sector, whose millions of waste pickers worldwide make a living from the collection and sales of recyclable materials (Medina 2008; Wilson et al. 2009; Scheinberg et al. 2011). In some cities, these informal waste workers achieve significant rates of recycling and are often the major or only suppliers of recyclables to industry (Chi et al. 2011; Fahmi & Sutton 2006; Zhang & Wen 2014; Wilson et al. 2009; Scheinberg et al. 2011). Informal recycling is characterized, however, by terrible working conditions and the presence of child labor (Gerdes & Gunsilius 2010; ILO 2014), poverty, social exclusion and lack of recognition by local authorities (Chirkamane 2012), serious negative environmental and public health externalities caused by the crude and pollutant methods of recycling and the absence of

environmental controls (Chi et al. 2011; Yu, Williams, Ju & Yang 2010; ILO 2014; World Bank 2012). Several studies point to the need to integrate informal waste workers to mainstream solid waste management systems (ILO 2014; World Bank 2012; Medina 2008; Scheinberg et al. 2011; Wilson et al. 2009; Gerdes & Gunsilius 2010; Fahmi & Sutton 2006; Raghupathy, Krüger, Chaturvedi, Arora & Henzler 2010). The integration of the informal recycling sector is desirable for the millions of jobs it generates to the urban poor, the potential to improve their living and working conditions, and the contributions this sector makes to materials recovery in developing countries (Medina 2008; ILO 2014; Gerdes & Gunsilius 2010; Scheinberg et al. 2011; Wilson et al. 2009). Also, integration has the potential to improve recycling processes practices by the informal sector in terms of compliance with environmental and health standards, something of enormous concern in the recycling of electrical and electronic equipment (e-waste) (World Bank 2012; Chi et al. 2011; Wang, Huisman, Meskers, Schluep, Stevels & Hagelüken 2012; Raghupathy et al. 2010). Organizing waste pickers and other waste workers into cooperatives or associations have been recommended to bring about their integration (ILO 2014; Gerdes & Gunsilius 2010; Medina 2008; Raghupathy et al. 2010).

In Brazil, waste pickers have achieved considerable recognition by government authorities and at policy level (Dias 2011a; Dias 2011b; IPEA 2013) and today there are over 1.170 organizations of waste pickers in Brazil (CEMPRE 2013, 30). The Brazilian experience has shown, however, that considerable differences exist amongst cooperatives in terms of efficiency in recyclables recovery and commercialization (IPEA 2010). Productivity matters because it affects the revenues of these organizations (IPEA 2010) and, consequently, the incomes they can generate. Aspects related to management and efficiency in cooperatives and associations of recyclers in Brazil emerge in literature as important and challenging factors (Gutberlet 2015; Rutkowski 2008; Dias 2011a; Oliveira & Lima 2012; Tirado-Soto & Zamberlan 2013). Efficiency has been studied, for instance in Oliveira & Lima (2012), whose work focuses on the interplay between efficiency and solidarity. Rutkowski (2008) contextualizes waste picker cooperatives and associations within the social and solidarity economy (SSE), and applies a viewpoint from production engineering to sustainability challenges of these enterprises. Tirado-Soto and Zamberlan (2013) study networks of waste picker organizations and present a method for their creation and structuring; economic viability and self-management factors are discussed at the level of networks. Gutberlet (2015) positions waste picker organizations within the

contexts of SSE and urban mining, and describes the work of cooperatives in the state of Sao Paulo, with particular emphasis on their operations at a network level. Issues that affect productivity and income are discussed (ibid.).

This Master's thesis analyses waste picker organizations through the lens of Elinor Ostrom's theory on self-governed institutions (Ostrom 1990; Nobel Prize in Economics 2009). In particular, it applies Ostrom's Design Principles of robust institutions (Ostrom 1990) to the context of self-governed institutions of waste pickers in Brazil. A number of recent studies characterize waste as a common-pool resource (Lane 2011; Cavé 2014; Negrão 2014; Zapata & Zapata Campos 2015). An application of the principles to a community of waste pickers in Managua was conducted by Zapata & Zapata Campos (2015). The application of the principles are, however, not restricted to groups in the management of common-pool resources, as Wilson, Ostrom and Cox (2013) demonstrate, and could therefore be applied to organizations of waste pickers even in the absence of the framing of waste as a common-pool resource. The argument for the generalizability of the principles is presented in their article entitled 'Generalizing the core design principles for the efficacy of groups', (Wilson, Ostrom &Cox 2013).

This study has several aims. On a theoretical level, it aims to contribute to this emerging body of research on waste as an urban commons, and to the diversity of applications of the design principles to self-governed institutions outside the realm of natural and renewable resources. On what concerns the unit of analysis, this study aims at contributing to the discussion on methods to improve the efficacy of waste picker organizations, acknowledging the vast potential for effective integration of waste pickers in MSWM in developing countries, with decent incomes and working conditions, and high performance in materials recycling, all crucial dimensions of sustainable development. The next sections elaborate on the research problem and provide guidance over the structure of this thesis. These are followed by an overview of Brazil today.

1.1 Research Problem

Extensive research on self-governed institutions in the context of common-pool resources (CPRs) revealed that robust institutions that have persisted over time are characterized by seven principles and an additional eighth principle in larger cases (Ostrom 1990, 88-102). Wilson, Ostrom & Cox (2013) refer to the principles as the core design principles for the efficacy of groups'. And they are: (1) Clearly defined boundaries; (2) Congruence between

appropriation and provision rules and local conditions; (3) Collective-choice arrangements; (4) Monitoring; (5) Graduated sanctions; (6) Conflict-resolution mechanisms; (7) Minimal recognition of rights to organize; (8) Nested enterprises (for CPRs that are part of larger systems) (Ostrom 1990, 90). As shown by Ostrom (1990), a high presence of the principles was associated with robust institutional performance and resource sustainability, whereas their presence to lesser extents resulted in fragility or even failure (Ostrom 1990, 180).

This thesis applies the design principles to two cases of self-organized and self-governed institutions of waste pickers in Brazil. Such application in the context of Brazilian waste picker organizations was not found elsewhere in the literature reviewed. The aim is to verify whether a connection exists between the presence of the principles and the results achieved by the organizations, as determined by income generated, overall productivity of recyclables, and the mixes of services the organizations deliver. The latter is also indicative of performance, since in order to be included in service provision to municipalities (e.g. collection of selected waste), they must be first perceived as reliable and capable partners. Thus, the following questions are asked:

1. To which extent are the Core Design Principles for the Efficacy of Groups present in these institutions?
2. Is there a relationship between the extent to which the Principles are employed and the performance of the institutions in terms of income level generated, recyclables recovered, and progress in the mix of services they provide?
3. What contributions can this approach bring to waste pickers organizations and to theory?

1.2 Thesis Structure

The first chapter of this thesis introduces the study, its research questions and offers a brief overview of Brazil, where the study takes place. In literature review, the first part elaborates on the waste problem, with special focus on municipal waste management in developing countries and, in particular, on its informal actors. That is followed by the specific case of Brazil. It then proceeds with a discussion on waste as a resource, its framing as an urban commons and the presentation of Ostrom's theory with which the thesis' unit of analysis will be analyzed. A chapter on methodology is next, followed by a presentation of the study's findings, results and concluding remarks. On a practical note,

this thesis relies on several sources written in Portuguese, to which I provided unofficial translation.

1.3 Brazil: An Overview

Brazil is a country of approximately 205.346.780 (IBGEb n.d.), and it occupies the largest share of South America. Brazilians have achieved remarkable milestones since the beginning of this century, including lifting over 26 million people out of poverty and reductions in inequality, registering a fall of six percent in the Gini Coefficient in 2013 (World Bank n.d.). Brazil's GDP growth rate displayed optimistic levels from 2004-2011 (with the exception of 2009, when it retracted), reaching over 7% growth in 2010 (IMF n.d.). Growth was still moderate in 2013 (ibid.), but a crushing crisis was already on the way. Petrobras, the Brazilian state oil company, became the center of what has been considered the largest corruption scheme in the history of the country, involving its own executives, major Brazilian companies, and a vast number of politicians primarily from the PT – Partido dos Trabalhadores – the party of President Dilma Rousseff and of former President Lula. At the time of this writing, stocks from Petrobras are trading for about US$1,00 (one dollar) (Cruz & Leite 2016). With Brazilian fiscal condition deteriorating, credit-ratings firms such as S&P have downgraded it to what is referred as 'junk territory' (Kiernan & Trevisani 2015).

Now the economic crisis became real. Inflation is out of control again, hitting the 10% mark in 2015, for the first time in 12 years (Biller & Malinowski 2015). Unemployment is on the rise, projected to hit 10% during 2016 (Exame 2015b), and the currency – the Brazilian Real – on a free fall, devaluated to all-time lows since its creation, bordering R$ 4.07 per USD in September 2015 (Sambo, Orr & Godoy 2015). In addition to economic recession, Brazilians have faced an unprecedented energy crisis, the Samarco mining environmental disaster, and the insurgence of the Zika virus. The political sphere is unstable and seems unable. The latest projection of the IMF (International Monetary Fund) for Brazil's 2016 is a retraction of 3.5% of the country's Gross Domestic Product and no growth in sight for 2017 (Veja 2016).

In the midst of a political crisis, economic turmoil, instability, public health concerns and a crisis of confidence, there are still the quietly growing volumes of waste generated in Brazil every day: waste generation continues to register positive growth, with 2.9% more

waste generated in 2014 relative to 2013, which is higher than the growth rate of Brazilian population for the same period (<1%) (ABRELPE 2014, 41). In volume, total waste generated reached 215.297 tonnes/day in 2014 (ibid.). Meanwhile, recycling rates in Brazil are very low – an estimated 8.5% of total waste generated in a year (calculated from data at CEMPRE 2013, 30), but what there is of recycling is almost entirely attributable to the local informal sector (IPEA 2013, 19). Brazil has, however, passed a legislative framework in 2010 (Presidência da República, Lei no.12.305/2010) on the management of solid waste, which, amongst other things, explicitly recognizes the informal recycling sector as a legitimate stakeholder in MSWM. According to Dias (2011c), 'Brazil has been at the forefront of efforts to organize waste pickers and to improve their situation and livelihood'. This study offers an overview of where waste picker organizations are at present and of the challenges they face in terms of their internal governance and management structures. Brazil's experience with organizing and integrating waste pickers may lead to valuable insights on ways forward.

2 LITERATURE REVIEW

This chapter begins with the waste problem and how it is handled in developing countries. It proceeds with a description of the informal waste sector at a global level, and narrows down to the Brazilian case. The last chapter focuses on common-pool resource theory and on Elinor Ostrom's design principles of robust institutions, in preparation for the application of the principles to institutions of waste pickers in Brazil.

2.1 Cities & Waste: a world perspective

World population reached 7.3 billion people in 2015 (UN 2015), of which 82 per cent are living in developing countries (UN-Habitat 2012, 79). Rapid and massive urban population growth has put a strain on the already limited resources available to low- and middle-income countries to develop the necessary infrastructure to accommodate this new reality, putting at stake the benefits associated with cities (UN-Habitat 2012; World Bank 2013). High levels of urbanization and economic development are associated with increasing levels in waste generation (Hoornweg & Bhada-Tata 2012 & Hoornweg, Bhada-Tata & Kennedy 2014). Although considerable variation exists amongst countries in the relationship between waste generation and GDP, it has been found that countries with the largest populations – including Brazil, India, China and Indonesia – exhibit a strong relation between these two variables, so that when income per capita increases, waste generation increases (Hoornweg, Bhada-Tata & Kennedy 2014, 120-121).

Waste management is one of the major challenges developing countries' cities currently face (Sharholy, Ahmad, Mahmood & Trivedi 2008; Ezeah & Roberts 2014; Marshall & Farahbakhsh 2013; Hoornweg & Bhada-Tata 2012). Municipal Solid Waste (MSW), defined as residential (e.g. households), industrial (e.g. manufacturing), commercial (e.g. shops, restaurants, office buildings), institutional (e.g. government buildings, schools), construction and demolition waste, and municipal services wastes (e.g. street sweeping, recreational areas) (Hoornweg & Bhada-Tata 2012, 7), amount to approximately 1.3 billion tonnes per year, and is expected to reach 2.2 billion tonnes per year by 2025 (ibid., 8). China has become the world's top generator of MSW (Hoornweg, Lam & Chaudhry 2005, 5).

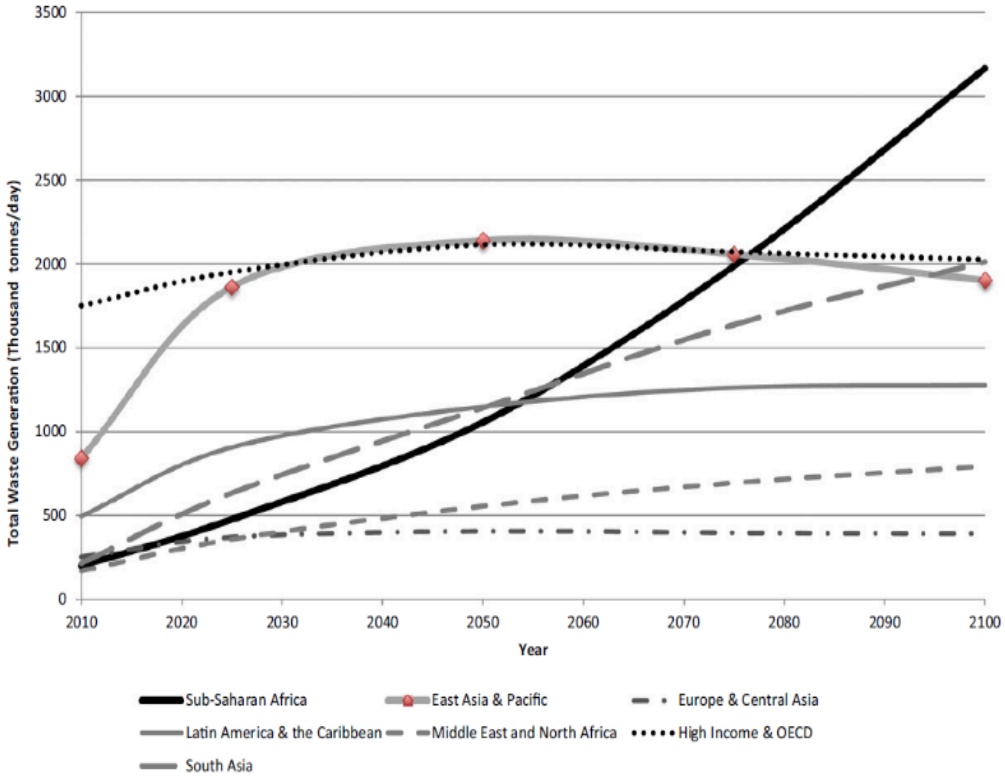

Figure 1 – Waste generation by region, 2010-2100 under the "business-as-usual" forecast (thousand tonnes/day). Hoornweg et al. 2013, in Hoornweg, Bhada-Tata & Kennedy 2014, 124.

The major part of the increase in MSW will happen in developing countries (Hoornweg, Bhada-Tata & Kennedy 2014). OECD countries are currently the world's largest waste generators, but they will be soon overtaken by the East Asia and Pacific (EAP) region (ibid., 125). In fact, after 2050 a decline in waste generation is expected in OECD member countries, whereas Africa's waste generation is projected to shoot upwards, driven by urbanization and economic growth, and will surpass the EAP countries still this century (ibid.), as illustrated by Figure 1, above.

Waste is dangerous if not efficiently collected and if inappropriately disposed of: it can lead to serious public health and environmental hazards (UNEP 2015; Hoornweg & Bhada-Tata 2012). Trends in the growth of waste in low- and middle-income countries, together with the extreme risks to human health and the environment, point to the urgent need for improvements in waste management in these countries. This study focuses on the specific case of municipal solid waste (MSW), defined earlier in this section. In the following section, municipal solid waste management will be briefly discussed, with an emphasis on the context of developing countries.

2.2 What do we do with so much garbage? Municipal Solid Waste Management in a Nutshell

Waste volumes and the prospects of scarcity of primary raw materials are some of the tough challenges we face (Cossu & Williams 2015, 1). Concepts such as the circular economy, zero waste, and eco-design, as well as processes such as recycling, materials recovery and urban mining are becoming mainstream (ibid.). An important concept guiding the EU's policy and legislation concerning waste management is the waste hierarchy, illustrated by an upside-down pyramid-shaped figure (UNEP 2015, 31). It ranks waste management options from most preferred at the top to least preferred at the bottom, in terms of environmental aspects (EC 2008). Waste prevention and minimization rank highest, followed by reuse, recycling and recovery (e.g. waste-to-energy); landfill lies at the bottom, followed by controlled disposal (UNEP 2015, 31). Another important concept in waste management is that of Integrated Sustainable Waste Management (ISWM): it encompasses three spheres deemed necessary if an enduring system is to be achieved, namely *physical elements* (e.g. collection, recycling, recovery, disposal), *stakeholders* (e.g. municipalities, waste generators, and service providers both formal and informal), and *strategic aspects* (e.g. political, institutional and financial aspects) (UNEP 2015, 29-30; Van de Klundert &Anschütz 2001).

Waste and its management are highly context dependent, exhibiting variations in a number of elements such as waste composition, collection coverage, cost structures of waste management systems and budget spending (Hoornweg & Bhada-Tata 2012). Countries also differ markedly in the proportions of municipal waste that is recycled, incinerated and disposed off. The major fraction of waste worldwide goes to landfills[1] (ibid., 22). In developing countries, the problem is worsened by the fact that landfills often lack controls – such landfills are notorious for methane emissions - and there is high incidence of open dumps as common method of disposal (Hoornweg & Bhada-Tata 2012). These practices are highly pollutant and also harmful to those in contact with it, such as waste pickers who scavenge for livelihood and people living nearby (Hoornweg & Bhada-Tata 2012; UNEP 2015). The incineration of waste (high temperature waste treatment) can generate heat and electricity and new and modern incinerators are able to meet high standards of

[1] Landfills are where waste is disposed off and they exist in different types, from minimally controlled, highly pollutant ones, to landfills with tighter environmental controls, referred to as sanitary landfills (Hoornweg & Bhada-Tata 2012, 29).

environmental protection (UNEP 2015, 76). But incineration plants are expensive to establish and to maintain, reasons why they are largely absent from the context of developing countries (Hoornweg & Bhada-Tata 2012). Recycling is associated with a reduction of pressure on landfills, on virgin stocks, and on water and energy; moreover, it is strategic in addressing resource scarcity (OECD 2015). Recycling rates in Europe are high for instance in Germany (69%) and Belgium (57%), but below 30% in Spain and Portugal; the EU average is 32% (EEA 2015). Reliable data on low- and middle-income countries' recycling rates are noted as difficult to find (Wilson, Araba, Chinwah & Cheeseman 2009), but there are estimates that considerable recycling exists in some developing countries, attributed mostly to the existing informal recycling sector (Wilson et al. 2009; Scheinberg, Spies, Simpson & Mol 2011). Rates vary significantly depending on countries and cities, and can be as high as 20-50% (Wilson et al. 2009, 632).

The fastest growing waste stream is that of waste electrical and electronic equipment (WEEE), or e-waste (ILO 2014; World Bank 2012). The combination of production of electrical and electronic equipment (EEE), the growing consumption of these goods notably in developing countries, and the short time-span in which these products are substituted for newer ones, have been driving the e-waste levels to unprecedented heights (ILO 2014, 11). Asia is the world's largest producer of e-waste (Baldé, Wang, Kuehr & Huisman 2015, 22; 25). In Brazil, it has been reported that the total number of mobile phones has surpassed the country's total population (World Bank 2012, 12). The e-waste reuse and recycling market is vibrant in some parts of the developing world, and largely dominated by an informal sector, whose practices in the dismantling and recycling of materials from e-waste are notoriously harmful for human health and the environment (ILO 2014; Chi, Streicher-Porte, Wang & Reuter 2011). EEE contain both valuable components (e.g. gold, silver, steel, copper) and hazardous components (e.g. lead, mercury, cadmium) (EC 2003; Tsydenova & Bengtsson 2011; cited in Wang, Huisman, Meskers, Schluep, Stevels & Hagelüken 2012, 2134). The growth of e-waste in developing countries has lead to changes in the patterns of waste trade (Lepawsky 2015) and Yu, Williams, Ju & Yang (2010) refer to the large and growing volumes of domestically generated e-waste as a major contributor to informal sector recycling.

The challenges developing countries face in what concerns waste management are significant, aggravated by the limited resources available to tackle the problems. The

following subsection discusses experiences of municipal solid waste management systems in developing countries.

2.2.1 Municipal Solid Waste management in developing countries

The town of Noida, in the periphery of Delhi was supposed to be a haven to Indian families seeking a distance from the congestions of megacities like Delhi, but found itself in a waste crisis, as recounted by Schindler and Kishore (2015). In Noida, notwithstanding the gap opened by the local government's failure to provide adequate solid waste management, formal sector enterprises initiatives had been shy because of the lack of legal disposal facilities to where collected waste could be directed (ibid.). This gap was filled by the informal sector, who collected waste at a fee, but who (1) had a preference for recyclable wastes and thus neglected the "non-valuable" fraction of the wastes, and (2) quickly dumped the fraction of collected waste deemed not valuable in open spaces; public health crisis emerged from inappropriate waste collection and disposal (ibid.). Municipal solid waste management in India in general is characterized by inadequate collection and shortage of treatment and disposal options for its growing volumes of waste, with open dumps a common destination (Sharholy, Ahmad, Mahmood & Trivedi 2008). The city of Delhi itself is in a reportedly 'state of crisis' due to the waste challenge (Schindler, Demaria & Pandit 2012).

China's MSWM is a challenge of very large proportions. Almost all collected MSW in China is disposed of in landfills, the majority of which are uncontrolled (Zhang, Tan & Gersberg 2010, 1627). The e-waste stream alone poses an enormous public health and environmental challenge to China (Chi et al. 2011). Their huge quantities of WEEE generated from domestic consumption, imports and production scraps from China's industrial processes (Chi et al. 2011, 733-734) are proccessed by informal sector waste workers at low pay and in the absence of any health and environmental standards, fueled by demand from China's large reuse and secondary materials markets (Chi et al. 2011).

As the discussion above shows, the provision of MSWM services in developing countries is very problematic. The interplay of particular variables, such as rapid urbanization, inequality, economic growth, and governance and institutional shortcomings (Marshall & Farahbakhsh 2013) – that is, context-dependent factors - has prompted a number of researchers to argue that transposing systems that function successfully in developed

economies to developing countries' contexts can result in under-performance; other solutions that account for local conditions should be devised (Marshall & Farahbakhsh 2013; Scheinberg et al. 2011). Baud, Grafakos, Hordijk and Post (2001, 5) identify four groups of actors in solid waste management systems of developing countries: the public sector (e.g. local authorities), the private sector (e.g. large and small registered enterprises), the small-scale, non-recognized private sector (e.g. waste pickers), and the local community (e.g. NGOs; CBOs). A variety of alliances can be formed by the combination of these actors, with distinct results to the sustainable development of cities (Baud et al. 2001). The next section takes a deeper look at a major protagonist in waste management in developing countries: the informal sector.

2.3 Informal sector participation in the waste market

There are at least 15 million people worldwide – or roughly 1% of the urban population - whose livelihoods depend on waste picking (Medina 2008, 1). Waste pickers come from a variety of vulnerable backgrounds and have in common the need to make a living from recovering materials in waste (ibid.). Studies point to the terrible conditions under which informal recyclers work (Gerdes & Gunsilius 2010; ILO 2014; Chikarmane 2012). Gerdes and Gunsilius (2010, 6) describe that in addition to the exposure to toxic and contaminated materials in waste, waste pickers are vulnerable to harassment from officials and to exploitation by traders; they are not covered by legal, social or health care benefits and there is high incidence of child labor in informal waste picking activities. Working with e-waste recycling in informality, for instance, means to be exposed to toxic substances that can potentially cause neurological disorders and cancer (World Bank 2012; ILO 2014).

According to Chaturvedi, Arora & Saluja (2015, 7), '[w]aste management provides low entry-cost opportunities to the urban poor', in which they can earn incomes from the value of discarded materials without the need to make large investments. The recycling value chain is made up of both informal and formal actors (ILO 2014). The majority of informal waste workers work at the bottom of the recycling value chain where income is lowest (ibid.). According to Medina (2008, 1), at the top are recycling industries and these do not buy directly from individual waste pickers but, instead, deal with intermediary actors capable of meeting the requirements of large volumes of materials with a degree of processing such as sorting, baling, and crushing. The activities of volume accumulation and further processing yield higher profits but are out of reach for individual waste pickers

as these demand access to capital and infrastructure investment (ILO 2014, 23-24). Meanwhile, waste pickers often work individually and sell recovered recyclables in small amounts to middlemen with no chance to bargain for better prices (ILO 2014, 23-24).

Recyclables can be recovered in a number of ways and from a variety of sources. Itinerant waste buyers collect recyclables from households and businesses often at a purchase fee for the materials; street pickers collect already discarded materials (e.g. materials in waiting for formal collection), while others collect from dumps (Scheinberg et al. 2011, 193-194). Informal recyclers are a major supplier of recyclables to industry, with substantial recycling rates in a number of cities worldwide (Scheinberg et al. 2011; Wilson et al. 2009). The *Zabaleen* of Cairo, for example, are reported to have created 'one of the world's most efficient resource recovery systems' (Fahmi & Sutton 2006, 820), characterized by sizeable and sophisticated networks, which run across the informal and formal sections of the value chain, coupled with an efficient, self-devised collection system, and an 80-85% recycling rate of the amount of waste they collect (Gerdes & Gunsilius 2010, 7-8). Their system was challenged, however, when local authorities pursued contracts with large waste management firms (Fahmi & Sutton 2006).

China, the largest consumer of PET bottles in the world (Zhang & Wen 2014, 988), achieves impressive recycling rates of post-consumer PET, performed almost entirely by an informal sector (Zhang & Wen 2014). Formal initiatives are few and incipient (ibid.). The great majority of post-consumer PET materials remains within the informal sector due to the cost competitiveness of the sector: they can pay higher prices for collected materials than the formal sector recyclers, whose formality incurs additional operating costs such as environmentally sound processes (Zhang & Wen 2014, 995). This results in shortage of supply to formal sector enterprises (ibid.). Consequently, over 90% of all post-consumer PET bottles in Beijing undergo the informal sector's recycling processes characterized by the absence of environmental controls (ibid., 997). Similar patterns are found in the e-waste sector. Formal sector enterprises' attempts to enter the e-waste recycling market have been met with a shortage of e-waste supply due to the informal sector's collection schemes (Chi et al. 2011). These involve efficient networks for accessing sources of e-waste (e.g. households) and competitive prices paid for discarded electronics, against which the formal sector is unable to compete as a result of its larger costs with work, health and environmental standards (ibid.).

Incomes of waste pickers vary. In Cairo, waste pickers were reported to earn an average of €4.30 per day, or roughly € 100 per month; the number for waste pickers in Lima is €5.40 per day or about €135 per month (Scheinberg et al. 2011, 195). Pune's organized waste pickers earn on average Rs.72.000 pear year or US$ 1.296 (Chirkamane 2012, 10), which is about US$108 per month. A study conducted by Scheinberg et al. (2011, 193), found that informal recycling yields income comparable or above national minimum wages. Notwithstanding the contributions of informal sector recyclers to recycling rates and solid waste management in developing countries' cities, and the jobs and incomes their activities create for vulnerable groups in urban areas worldwide, official recognition and appreciation for their work are reportedly challenging to achieve (Wilson et al. 2009; Medina 2008; Nzeadibe & Anyadike 2012). The preference of public authorities for formal sector actors, notably large enterprises, is documented in a number of studies (Baud et al. 2001; Chaturvedi, Arora & Saluja 2015; Fahmi & Sutton 2006; Schindler, Demaria & Pandit 2012). In Delhi, where privatization of waste management activities has been restricted to formal private actors, the exclusion of the informal sector from MSWM strategies resulted in competition and conflicts between the formal and informal sectors over access to waste (Schindler, Demaria & Pandit 2012). Instead of hostility and exclusion, a contrasting position has been advocated in several recent studies and reports. These have pointed to need to include and integrate the informal waste sector into mainstream municipal waste management systems (World Bank 2012; ILO 2014; Medina 2008; Wilson et al. 2009; Scheinberg et al. 2011; Gerdes & Gunsilius 2010; Raghupathy et al. 2015; Fahmi & Sutton 2006; Chi et al. 2011). The arguments for integration are the subject of the next section.

2.3.1 Informal sector integration in solid waste management systems

Engaging all relevant stakeholders is essential for the achievement of desired goals in a system, as demonstrated by Chaturvedi, Arora & Saluja (2015). The authors discuss the conflicts over waste in the city of Delhi, where the informal sector was excluded from the privatization process, and warn that '…conflict has the potential to thwart any effective implementation of public-private partnerships initiated by local government' (ibid., 14). Partnerships where the formal and informal sectors cooperate by focusing on their respective expertise (e.g. informal sector's expertise in collection and segregation, and the formal sector's in advanced technological solutions) could result in benefits for both (Chaturvedi, Arora & Saluja 2015). Integration and cooperation between the sectors are

also argued in Wilson et al. (2009), Scheinberg et al. (2011) and Raghupathy et al. (2010). The integration of the informal sector in the context of e-waste reuse and recycling is further addressed in a philosophy entitled 'Best-of-2-worlds' (Bo2W), put forward by StEP (Solving the E-waste problem) and the (United Nations University), and discussed in detail in a study by Wang, Huisman, Meskers, Schluep, Stevels and Hagelüken (2012). Bo2W proposes a geographical distribution of activities along the recycling value chain based on the competitive advantages of developed and developing countries and which takes into account the environmental damages currently taking place in recycling of e-waste in developing countries, as well as the economic realities of these countries which pose impediments to the development of local high-end installations for recycling (ibid.). In this model, the first stages of the e-waste recycling value chain would benefit from the expertise and labor intensive processes of the informal sector (e.g. collection and manual dismantling) while being a source of employment for the urban poor (ibid.). The latter stages of the chain require high technology and strict environmental, health and safety controls, presently available in high-income countries (ibid., 2144). Materials would flow from developing countries for further processing in state-of the-art facilities in developed countries, with an appropriate compensation scheme in place (Wang et al. 2012; 2143).

It is widely noted that the path to integration involves a level of organizing of informal recyclers (Raghupathy et al. 2010; ILO 2014; Gerdes & Gunsilius 2010; Medina 2008). Social and solidarity economy (SSE[2]) enterprises, notably cooperatives, have been widely used forms of organizing of informal workers and serve as vehicles to their formalization (ILO 2014, 25). Organizing has numerous advantages, and they include the formation of an entity which can claim recognition by authorities and which can enter contracts with other stakeholders (e.g. industrial actors), and the possibility for direct negotiations with actors higher up in the recycling value chain through which they can obtain better prices and, as a consequence, secure higher incomes (Medina 2008; ILO 2014). By acting collectively, informal recyclers can put together their individual volumes of recyclables and form larger bundles, skip intermediaries, and sell directly to buyers higher up in the chain with strengthened bargaining position (ILO 2014, 26). Furthermore, organizing enables for better working conditions such as limited working hours, coordination of

[2] According to ILO (2009 in ILO 2014, 25), SSE is 'a concept designating organizations, in particular cooperatives, mutual benefit societies, associations, foundations and social enterprises, which have the specific feature of producing goods, services and knowledge while pursuing both economic and social aims and fostering solidarity'.

activities, and the provision of supportive services such as childcare (ibid.). Organizing in cooperatives can potentially enable informal recyclers to become regular service providers (e.g. collection) and suppliers of recyclables to industry (Gerdes & Gunsilius 2010, 15; 27). Being a reliable service provider is crucial to their competitiveness (ibid., 29).

There are cases in which informal recyclers have organized and have become part of their city's mainstream waste management schemes. In the city of Pune, India, waste pickers and itinerant waste buyers succeeded to organize into a cooperative, known as SWaCH (Solid Waste Collection Handling) (Chikarmane 2012). The cooperative is fully owned by its members and is responsible for the collection of waste from over 340.000 households (Chikarmane 2012, 8). According to Medina (2007, 113), the city of Medellín, in Colombia, is home to Cooperativa Recuperar, a cooperative of waste pickers with over 1.000 members and whose income amounts to 1.5 times the minimum salary. Through the cooperative, members are entitled to safety nets such as accident and life insurance, and the organization has been able to enter contracts with municipalities for the collection, transportation and disposal of waste (ibid.).

Medina (2007, 113) stated that Brazil is home to 'the most dynamic waste picker cooperative movement in the world today'. The Brazilian experience with inclusion and integration of waste pickers into mainstream MSWM is the theme of the next chapter.

2.4 Waste management, recycling & self-organized institutions of waste pickers in Brazil

Solid waste management in Brazil has been under the guidance of the National Policy for Solid Residues (Política Nacional de Resíduos Sólidos –PNRS), made law in 2010 (see Presidência da República, Lei no. 12.305/2010). A key feature of this legislation is its recognition of waste pickers as stakeholders in waste management and its call for the integration of their organizations into waste management schemes (see Articles 7th/XII; 8th/IV; and 18th/II). Dumps are no longer allowed in Brazil (see Art. 54) but they still exist, and 17,4% of the 195.233 tonnes of urban solid waste collected per day in year 2014 were disposed of in dumps (ABRELPE 2014, 40; 43). The remaining 24.2% and 58.4% were disposed in controlled landfills and sanitary landfills, respectively (ibid., 43).

Waste collection covers on average over 90 per cent of Brazilian territory (ibid. 40), but *selective collection* – the collection system of recyclable materials previously segregated at source (such as metals, paper and plastics) (CEMPRE 2014, 5) is practiced in only 14 per cent of municipalities (CEMPRE 2013, 21). Selective collection is carried out by the door-to-door collection of source-segregated waste, and also through the collection of deposited recyclables in containers in fixed locations (CEMPRE 2014, 11-12). In Brazil, MSWM is the responsibility of municipalities, but these often hire private sector enterprises to undertake activities, such as the collection of waste (IPEA 2013, 17). Selective collection is considerably more expensive than conventional collection, reaching US$212 per ton in 2012, a value 4.5 times the costs of conventional collection (CEMPRE 2013, 24). The results it achieves, however, are very modest: selective collection represents only 2.4 per cent of the total waste collected conventionally (IPEA 2010, 23). The overall recycling rate in Brazil is low: about 8.5 per cent[3] (estimated from CEMPRE 2013, 30). Recycling in Brazil is heavily dependent on waste pickers, whose activities amount to 90 per cent of the total of materials recycled in the country (IPEA 2013, 19). The largest share of materials recovery is attributed to middlemen often reliant on the services of informal waste pickers acting outside the cooperative model – 22.7 per cent of the total recyclable (inorganic) fraction; the corresponding value for cooperatives was 2.329 t/day, or 4.2 per cent (CEMPRE 2013, 37-39). Together they make for 26.9% recovery rate of the recyclable fraction of waste (ibid.).

Estimates on how many waste pickers exist in Brazil vary. One study cites between 400.000 and 600.000 waste pickers (IPEA 2011, cited in IPEA 2013, 44). A study by CEMPRE (2013, 37) cites 800.000 waste pickers, of which about 30.390 belong to organizations such as cooperatives or associations (ibid., 30). The next sections analyze these organizations in more detail.

2.4.1 Waste picker cooperatives and associations in the Brazilian context

In Brazil today, a few categories of waste pickers can be identified. Dias (2011c) points to three different categories, namely the unorganized or autonomous informal recycler, who works individually in the collection of recyclables from streets and dumps; the organized waste picker who is inserted in a cooperative or association; and the waste picker who

[3] The percentage recycled of the total inorganic (dry) waste fraction is estimated at 26.9%. Inorganic fraction comprises 31.9% of total waste generated, estimated at 173.703 t/day in year 2012 (CEMPRE 2013, 30).

works under contractual agreement with junk yards, industries or the public sector and is entitled to benefits associated with formal employment. A study by IPEA[4] (2013) - Institute for Applied Economic Research – elaborates on the current situation of waste pickers in Brazil. The profile of Brazilian recyclers is described as heterogeneous (IPEA 2013, 8). Some *catadores*[5] are engaged in waste picking since childhood, while others enter waste picking activities due to unemployment (ibid.). Some informal recyclers work individually and others work collectively, for instance in cooperatives (ibid.).

Collective action has been a way found by the *catadores* to improve their bargaining position vis-à-vis authorities and other actors of the recycling value chain (IPEA 2013, 19). In Brazil, organizing has happened largely in the form of associations or cooperatives of waste pickers (ibid., 20). Organized recyclers, however, constitute only about four per cent of the total amount of waste pickers in the country (CEMPRE 2013, 30; 37). Reasons for this include a preference by waste pickers to work individually, without a boss and with flexibility of working hours (IPEA 2013, 21). Waste picker organizations are discussed in more detail, next.

A historical perspective

The first cooperative of waste pickers in Brazil was COOPAMARE, established in 1989 in Sao Paulo (IPEA 2013, 23). ASMARE – Associação dos Catadores de Papel, Papelao e Material Reaproveitável de Belo Horizonte – was established in 1990, in Belo Horizonte (ibid.). The situation of waste pickers at the time of ASMARE's establishment had the elements of poverty, low self-esteem, exploitation by middlemen who paid unfair prices for materials, social exclusion and constant clashes with authorities (Dias 2002). Their practice of sorting waste on the streets and leaving behind the scattered portion not recovered lead to recurrent conflicts with the local municipal cleansing agency (Dias 2002). Crucial to the organizing of recyclers in Belo Horizonte was the interference of the Pastoral de Rua, an NGO initiative from the Catholic Church (Dias 2002). The NGO actors engaged street waste pickers in group activities that, amongst other things, were aimed at building citizenship, creating awareness of the importance of their work, and especially at building mutual trust (Dias 2002, 56-58; 74-75). The result was the establishment, in 1990, of ASMARE. Following its establishment, significant developments at the level of

[4] IPEA - Instituto de Pesquisa Econômica Aplicada
[5] *Catadores* is the portuguese term for *waste pickers.*

recognition, policy and partnerships with the municipality were achieved, as recounted by Dias (2002). ASMARE was met by public willingness to effectively integrate them into the city's waste management system, becoming a partner in the municipality's recycling scheme that unfolded (Dias 2002).

Waste pickers in Brazil achieved a series of important victories in terms of policy and governmental support (IPEA 2013). Their work category, *catador de material reciclável* or "collector/waste picker of recyclables", has been included at the Brazilian Occupational Classification code (Classificação Brasileira de Ocupações – CBO) (IPEA 2013, 33). In 2007, legislation was passed determining that cooperatives and associations of waste pickers could be hired by municipalities for selective collection services without the usual process of bidding (ibid.). As previously mentioned, the Federal Law no. 12.305/2010 on the management of solid waste in the country explicitly recognizes waste pickers as stakeholders and promotes their inclusion in municipal solid waste management systems (see Presidência da República, Lei no. 12.305/2010). Waste pickers in Brazil have succeeded to create a national-level representative movement called the Movimento Nacional dos Catadores de Materiais Recicláveis (MNCR) or the National Movement of Waste Pickers (see www.mncr.org.br) which has since articulated for the rights and demands of waste pickers (MNCR 2011). In addition to recognition and support by the Federal government, states in Brazil have their own particular programs and incentives. The state of Minas Gerais, where ASMARE is located, passed in 2011, a state-level legislation (Estado de Minas Gerais, Lei no. 19.823/2011) for the concession of the *Bolsa Reciclagem*, a financial incentive for cooperatives and associations of waste pickers in the state, based on quantities of recyclables commercialized (ibid.; Agencia Minas Gerais 2015).

There are currently about 1.175 associations/cooperatives of waste pickers in Brazil (CEMPRE 2013, 30). They differ on a number of aspects (IPEA 2013) and some examples of how they operate are given below, in the next section.

The institutions and how they operate

Some waste picker organizations work in partnership with the local government. ASMARE's case is illustrative. In Belo Horizonte, a city of about 2.375.151 people (IBGEa n.d.), the public cleansing authority, SLU (Superintendência de Limpeza Urbana),

oversees all waste management services, including the selective collection of recyclables, covering 34 neighborhoods (or about 376.000 people) through a door-to-door collection scheme (SLUa n.d.). Collected recyclables are then donated to the cooperatives or associations of waste pickers in the city (ibid.). Only 4.5 per cent of all waste generated in the city per year is recycled (ibid.). There are currently seven organizations of waste pickers in Belo Horizonte who receive materials collected by the municipality as well as financial support such as rent subsidies for their warehouses (SLUb n.d.). ASMARE is one of them. It functions as a membership-based organization (MBO) and provides its individual waste picker associates with sorting space, purchases their materials, and has a fixed crew who processes the materials acquired from associates for sale to the next actors in the value chain; the resulting income is shared amongst them (Dias 2011a). Materials are supplied both by associates engaged in individual collection of materials (who get paid based on own production) and by the city's selective collection scheme (ibid.). ASMARE is managed by its own members and is considered in a state of semi-formality (ibid.). It was established by only 10 waste pickers (Dias 2002, 59) and its growth reached over 300 members (IPEA 2013, 23).

Since ASMARE's establishment, hundreds of other associations and cooperatives were established in different states and cities of Brazil. Their organizing also took on the next level, to the creation of networks of member-coops/associations. For instance, the Cataunidos network – Rede de Economia Popular e Solidária Cataunidos – comprises currently 33 organizations in the state of Minas Gerais (INSEA 2014). Cataunidos was established in 2006 with the aims of enhancing capacity of commercialization through gains in scale, and promoting the exchange of experiences and practices amongst its member-coop./associations (IPEA 2013, 23-24). The principle of *autogestão*, or self-management, is a central feature in recyclers' cooperatives and associations, and one advocated by their national movement (MNCR 2008; Gurberlet 2015). The model of self-management and collective decision-making structures, in which members participate and decide on all aspects of the organization, is characteristic of recyclers' cooperatives and associations in Brazil (Gutberlet 2009; Gutberlet 2015; Rutkowski 2008; Oliveira & Lima 2012). Waste picker organizations in Brazil are often contextualized within the Social and Solidarity Economy (SSE), whose enterprises have attributes which differ from the traditional models of the firm and of the state (Gutberlet 2015; Gutberlet 2009; Rutkowski 2008; Rutkowski & Rutkowski 2015; Oliveira & Lima 2012).

According to IPEA (2013, 28), organizations of waste pickers are highly heterogeneous, and differ in terms of equipment and infrastructure, access to credit, know-how, history, criteria used to accept new members, work divisions, management, and partnerships. Furthermore, the study states that all these factors have direct impacts in productivity, income, working conditions, and on the level of satisfaction of the waste pickers with the organizations to which they belong (ibid.). The studies by Rutkowski (2008) and Oliveira and Lima (2012) describe aspects of the internal management and operations of some of these organizations. In Rutkowski (2008), for instance, two organizations are analyzed and the study revealed wide differences in items such as attitude regarding absences (strict rules on absence and lateness with application of penalties vs. high rate of absence), criteria for admitting new members (peer evaluation and attention to efficiency vs. no defined criteria), technology employed (conveyor belt vs. manual sorting), degree of work division (clear work division in advance vs. no prior work division), and income levels (R$700/month vs. R$300/month) (Rutkowski 2008, 107-128). Gutberlet (2015) describes aspects of the operations of a set of cooperatives of waste pickers located in the state of Sao Paulo, which are part of a network that advances joint commercialization of their recyclables. According to the author, the cooperatives suffer from very low income levels – average monthly income between R$336 and R$672[6] - and this leads to high rate of turnover of members (ibid., 27). Challenges which impact productivity and incomes are identified, including access to equipment and infrastructure and work organization (ibid., 27). Self-management is mentioned as a challenge to the networks of organizations of waste pickers, in a study by Tirado-Soto and Zamberlan (2013). The same study also refers to the different levels of efficiency in member organizations of networks as an obstacle to the effective standardization of production for joint commercialization (ibid., 1006).

Efficiency of waste picker organizations is addressed in a study by IPEA (2010), which elaborates on a program for payment of urban environmental services to waste pickers. The study found considerable variations in productivity: the average productivity of the very low efficiency group was 256 kg/wp[7]/month of recyclables, whereas the number for

[6] These values in 01/2016 exchange rate 1USD = R$ 4.09 are USD 82 and USD 164.
[7] The term 'wp' is an abbreviation of 'waste picker'.

the high efficiency group was 2.292 kg/wp/month (IPEA 2010, 40)[8]. Results showed that 60 per cent of the cooperatives belonged to the low and very-low efficiency groups (ibid.). Moreover, coops/associations obtain different prices for the sales of same materials, as a result of differences in issues of economy of scale, degree of organization, and networks with other actors along the recycling chain (IPEA 2010, 38). Differences in individual productivity and in prices obtained in sales result in different levels of revenues generated, as demonstrated in IPEA (2010, 39). The study recommends that cooperatives and associations be classified according to efficiency levels, upon which financial compensation for environmental services would be based (IPEA 2010).

Some associations and cooperatives have been hired by municipalities to perform the collection of inorganic waste from residencies and businesses, in a model where the city remunerates them for the service and they increase incomes further by the processing and sales of collected recyclables (Rutkowski & Rutkowski 2015). Rutkowski and Rutkowski (2015) cite increases in incomes of waste pickers as a result.

Where they are today: challenges and opportunities

Several external challenges emerge in literature. Gutberlet (2015, 27) points to impacts on the quality of materials as a result of source-separation and collection methods. Competition with other actors over access to recyclables in waste emerges as a pressing challenge (Dias 2011a; Demajorovic, Besen & Rathsam 2004). WtE plants are also mentioned as a challenge in connection with recyclers' access to waste materials (Gutberlet 2015, 30). Internally, access to equipment and infrastructure is cited as a challenge (Dias 2011a; Gutberlet 2015). Aspects related to management and efficiency in cooperatives and associations of recyclers in Brazil emerge in literature as important and challenging factors to the organizations (Dias 2011a; Gutberlet 2015; Rutkowski 2008; Oliveira & Lima 2012; Tirado-Soto & Zamberlan 2013). According to Dias (2011a), 'the MBOs need to improve their work performance regarding reliable collection and efficient sorting'. Furthermore, low efficiency by individual cooperatives also affects the performance of networks of cooperatives, an strategic scheme argued as means to achieve joint commercialization of recyclables, higher prices paid for products, and higher incomes (Tirado-Soto & Zamberlan 2013).

[8] The study analyzed data collected from 71 coops/associations (3.503 waste pickers) by Damásio (2006; 2007; 2009, cited in IPEA 2010, 40)

While some coops/associations are characterized by very low incomes, low productivity and less involvement in additional partnership opportunities, others have succeeded in achieving higher incomes and also in securing contracts for the provision of collection services for municipalities, through which they also access recyclables for their own commercialization. Such opportunities for a larger mix of business activities exist, but not all organizations have been able to take part in them.

2.5 Garbage. A resource?

This study applies Ostrom's design principles of robust institutions to selected case studies, in an effort to understand the features of these institutions that contribute to the differences in results achieved. This section begins with a short review of the notion of waste as a resource, and its characterization as a common-pool resource. Next, a discussion is presented on Elinor Ostrom's Nobel Prize winning theory of self-governed institutions in the management of CPRs (Ostrom 1990; Nobel Prize in Economics 2009). A chapter on methodology will follow and, finally, data collected will be presented and analyzed.

According to Butti (2012, 1621), waste 'creates legal problems at both its "birth" and "death". To fully develop a market for trade of recyclables, arriving at definitions of when waste ends and products begin is essential (OECD 2015, 92-93). At the moment, there is no such standardized definitions at an international level (e.g. something can be considered hazardous in one country but non-hazardous in another) (ibid.), though some progress is being made with regards to the end-of-waste criteria (UNEP 2015, 137; 142). In this section, an overview of interesting trends in the direction of waste as a resource and, in particular, of waste as a common-pool resource is provided. Some academic writing already exists in this regard, and the present study is positioned against this background.

2.5.1 Rethinking waste

Cao, a migrant from a poor rural province in China, lives in Shanghai and survives on recovering materials from the city's waste streams and re-directing them to recycling (Waldmeir 2015). Waldmeir (2015) refers to Shanghai's 'army of people who make a living as part of the unofficial – but highly efficient – recycling industry'. Cao earns on average only 10,34 British pounds per day but it is enough to cover for her living costs and also her son's who is in university (ibid.). On the other side of the world, in Belo

Horizonte, Brazil, Dona Geralda, one of the founding members of ASMARE and whose survival from recyclables started at age 8, tells in an interview that '…to me, garbage is work, income and raw material. Through garbage, I raised my nine kids. And I also help raise my nine grandkids' (in Melo 2009).

In addition to the *use* of waste as a resource by so many people around the world, current trends point in this direction from the standpoint of finiteness and shortages of natural resources. According to Bonifazi and Cossu (2013), 'attention is currently moving from the limited and fixed stocks of raw materials to the increasing anthropogenic stocks of materials' (ibid., 497). Anthropogenic stocks refer to 'the amount of material in society that has been extracted, processed, put into use, currently providing service, or discarded or dissipated over time' (OECD 2015, 97). The sustainable supply of materials over time is said to depend on both, natural (virgin) stocks and anthropogenic (man-made) stocks (ibid.). Anthropogenic stocks such as WEEE, plastics and cardboards, represent 'Urban Mining resources' (Bonifazi & Cossu 2013, 497). The concept of Urban Mining sees that 'stocked materials may represent significant source of resources, with concentrations of elements often comparable to or exceeding natural stocks' (Cossu & Williams 2015, 1). Dijkema, Reuter and Verhoef (2000, 634) propose a new paradigm in which 'waste is only a temporary attribute of a resource' (ibid., 638). Park and Chertow (2014, 47) refer to a "resource-based paradigm", where, rather than automatically considering discarded materials as wastes, they are first regarded as 'potential resources until determined otherwise' (ibid.). The resource-based paradigm stands in contrast to the waste-based paradigm (Park & Chertow 2014). Their differences can be seen from Table 1, below.

Table 1 – Resource-based paradigm (Park & Chertow 2014, 47).

Resource-based paradigm versus waste-based paradigm

	Waste-based paradigm	Resource-based paradigm
Underlying thoughts	Waste can cause harm to public health and safety until shown otherwise	Waste is a potential resource until shown otherwise
Main strategy	Safe disposal and containment	Environmentally sound processing and reuse
Language and taxonomy	Waste	Secondary materials
Operationalized metric for waste	None	Reuse potential

'Wastes as resources' begs the question: what type of resource or good is it? The nature of a good, that is, its attributes, is a determining factor of the incentives structure that shape its provision and allocation (Ostrom 1990; Ostrom 2003; Ostrom 2005). Conflicts and competition over access to waste have been a recurrent theme in literature reviewed for this thesis, with different actors at different levels contesting for the resources found in waste. Looking at waste from the viewpoint of resources can offer valuable insights to the dynamics around it: the actors, the incentives, the disputes, and ultimately, the effective management of the potential resources it contains. In the following section a short discussion on resource types is presented, accompanied by arguments of waste as a common-pool resource.

2.5.2 If waste were a resource, what resource would it be? An introduction to resource types

In economics, goods and services are frequently classified according to two attributes, namely subtractability (or rivalry) of use or consumption, and the difficulty of excluding potential beneficiaries (Ostrom 2005, 23-26; Ostrom 2003). According to Ostrom (2005, 23), '[s]ubtractability refers to the extent to which one individual's use subtracts from the availability of a good or service for consumption by others'. 'Exclusion relates to the difficulty of restricting those who benefit from the provision of a good or service', that is, it is very costly or even impossible to exclude those who do not contribute to the provision of the good from consuming it (ibid.). From these two attributes, four basic types of goods emerge: private goods, public goods, toll goods (or club goods) and common-pool resources (ibid., 24). Normally goods are characterized by a degree of these attributes as in a continuum, from low to high (ibid.). The broad categories are shown at Table 2, below, with corresponding examples.

Table 2. Four types of goods. Source: Adapted from E.Ostrom 2005, 24, in Ostrom 2009 Nobel Prize Lecture

		Subtractability of Use	
		HIGH	**LOW**
Difficulty of Excluding Potential Beneficiaries	**HIGH**	**Common-pool resources:** groundwater basins, lakes, irrigation systems, fisheries, forests, etc.	**Public goods:** peace and security of a community, national defense, knowledge, fire protection, weather forecasts, etc.
	LOW	**Private goods**: food, clothing, automobiles, etc.	**Toll goods:** theaters, private clubs, daycare centers

The two attributes have direct effect on the incentives individuals face regarding provision, allocation and consumption of those goods and services (Ostrom 2003; Ostrom 2005; Ostrom 2009; Ostrom & Ostrom 1999). *Private goods*, such as a loaf of bread, are characterized by both *no* jointness of consumption (i.e. high subtractability of use) and feasible exclusion of potential users (Ostrom & Ostrom 1999, 76-78). *Public goods*, on the other hand, are characterized by difficulties in exclusion and low subtractability, meaning that once provided, the consumption or use by one person does not subtract from the availability of the good to others, and excluding anyone is impossible or very costly (Ostrom 2005, 23; Ostrom & Ostrom 1999). One of the implications of this distinction is that in the case of private goods, those who do not pay can be excluded from consumption, whereas with public goods there is great difficulty in excluding from consumption someone who does not pay (Ostrom & Ostrom 1999, 80). As a result, market mechanisms can be used in the provision of private goods, where incentives are set so that those who invest can profit from their investments through quid pro quo exchanges, but that is not the case for public goods, where consumption is possible regardless of payment or contribution (Ostrom 2005, 24). According to Ostrom (ibid.), 'excludability problems can thus lead to the problem of free-riding, which in turn leads to underinvestment in capital and its maintenance'.

Although in the case of public goods a person's consumption of a good does not subtract from its availability to others, there is one type of good – *common-pool resource* – which, similarly to public goods, is characterized by difficult or costly exclusion of non-contributors, but unlike public goods one person's consumption diminishes the availability of the good to others (Ostrom 1990; Ostrom 2003). In the case of a common-pool resource such as a fishery, one person's catch is no longer there for the other fisher to catch (Ostrom 1990, 31-32).

A common-pool resource (CPR) is defined by Ostrom (1990, 30) as 'a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use'. A characteristic of CPRs is that while the resource *system* can be used by many, the resource *units 'are not subject to joint use or appropriation'* (ibid., 31, emphasis in original). When it is too costly to exclude potential appropriators from accessing the resource, problems of free riding emerge (ibid.). As Ostrom (1990) demonstrates, CPRs exist in large numbers, all over the

world, and in a diversity of forms: forests, fisheries, grazing areas, irrigation channels, and groundwater basins are some examples. Subtractability and its resulting reduction in available resource units also means that overuse leads to congestion (e.g. bridge), and overharvesting leads to the potential destruction of the resource system (e.g. forests, fisheries). A famous article by Hardin (1968) speaks precisely of the "Tragedy of Commons", in which CPRs are predicted to suffer from over-exploitation due to unrestricted appropriation of subtractable resources. The "commons dilemma" (Ostrom 1990, 13) will be discussed in more detail in the next sections.

2.5.3 Garbage as an "urban commons"

Common-pool resources are not restricted to natural resources alone: it can also be a man-made common-pool resource (Ostrom 1990, 30). In fact, the field of commons research has expanded into other realms than the traditionally studied area of natural resources and irrigation systems, and that includes the urban commons (Hess 2006, cited in Digital Library of the Commons n.d.), such as city commons, parking, urban greenspace and waste management (Digital Library of the Commons n.d.). When it comes to urban commons, Kornberger and Borch (2015) propose that what urban commons means is yet to be fully understood, and that both Hardin's (1968) and Ostrom's (1990) stances on the commons present limitations when applied to the city. One such limitations, they argue, lies with the applicability of the attribute of subtractability to the context of the urban commons: consumption or use in the urban commons is argued as having the effect of producing the commons rather than contributing to its depletion (Kornberger and Borch 2015).

Waste as a commons features scarcely in literature on common-pool resources, as far as the review for this thesis was able to uncover, but some works do exist. Zapata and Zapata Campos (2015, 103) refer to the waste at La Chureca dump, in Managua, as a common-pool resource. The authors describe the waste commons as a finite albeit abundant resource, one growing in volumes and with regular flows, as opposed to traditional commons such as irrigation reservoirs which can empty in the absence of sufficient rainfall, and argue that '[t]his commons does not need regulation in the same way as do reservoirs, meadows, or fisheries…' (ibid., 98). Access to waste, however, became problematic once municipal waste collection crews began intercepting valuable waste materials prior to their disposal at the dump, leading to reductions in the waste pickers' incomes (ibid., 99-101). Conflicts erupted at La Chureca and waste pickers joined forces in

protest (ibid.). Zapata and Zapata Campos (2015) describe the process of self-organization of waste pickers at La Chureca with an application of Ostrom's design principles of CPR institutions. Negrao (2014) discusses the possibility of urban waste as a commons. He argues that the transition in waste management from a sanitarian paradigm to a sustainability paradigm meant a transition from waste being perceived as an annoyance to something of value. New actors emerged in this context, along with the old actors (e.g. waste pickers) interested in the economic possibilities attached to waste, leading to competing approaches and disputes around its appropriation (ibid.). It is also in this context, he argues, that waste could be analyzed from the perspective of an institutional resource (ibid.).

Cavé (2014) makes reference to the dual nature of waste: one part is "rubbish" and the other part is "resource" (Cavé 2014, 814). The rubbish, which nobody wants, has to be paid for by its generators to have it removed; the valuables, which many want, is subject to competition and even conflicts amongst actors involved, all of whom want the valuable recyclables (Cavé 2014). These conflicts, Cavé explains, are 'actually appropriation conflicts in a sector where property rights are not clearly defined' (2014, 818). The author concludes that the urban solid waste deposit '*de facto* constitutes an impure public good, or, more precisely, a common good' (Cavé 2014, 819). Rivalry over waste is identified in empirical settings, attributed to the economic possibilities found in the dry, recyclable materials; difficulties of exclusion is also characteristic, with valuable waste materials being continuously intercepted by a number of actors (e.g. waste pickers, itinerant buyers, municipal collection crew) (ibid., 818-819). The notion of "waste commons" is not restricted to developing countries alone, as demonstrated by Lane (2011) in her study on south eastern suburbs of Melbourne, Australia. The study reveals tensions in the unregulated waste commons, where the activities of the formal sector companies, contracted to collect hard rubbish, clash with recovery activities from informal '"professional recyclers"' (ibid., 403). In fact, competition for valuables exists amongst scavengers themselves (ibid., 403). Lane argues that 'Melbourne's hard rubbish collections form a kind of informal waste commons…' (ibid., 398).

This thesis is positioned against the background of these empirical findings and recent conceptualizations of waste as a common-pool resource (Cavé 2014; Lane 2011; Negrao 2014; Zapata & Zapata Campos 2015). In particular, it maintains the approach to waste as

a CPR characterized by the attributes of subtractability (or rivalry) and difficulty of excluding potential beneficiaries, as specifically noted by Cavé (2014). In spite of the amounts of waste increasingly generated, competition is fierce for the valuable resources in waste, to the point where income reductions have been reported amongst waste pickers as a result of interceptions of recyclables by other actors (see Demajorovic, Besen, & Rathsam 2004; Zapata & Zapata Campos 2015) and formal enterprises have faced a shortage of recyclables due to competition with informal sector recycling (see Chi et al. 2011; Zhang & Wen 2014; Raghupathy et al. 2010, Lane 2011). In sum: valuable waste recovered by one actor becomes unavailable to the other actor, and potential appropriators are very hard to exclude from accessing recyclables. That is, waste is an urban common-pool resource.

2.6 Common-pool resource governance: market, state & self-organized institutions

This section starts with an overview of the conventional theory on common-pool resources. It is followed by a discussion on Ostrom's theory on CPR management and self-organized institutions (Ostrom 1990). Her research challenged conventional theory and, in 2009, Elinor Ostrom was awarded the Nobel Prize in Economics, 'for her analysis of economic governance, especially the commons' (Nobel Prize 2009). Her research on common-pool resources and their institutions produced eight design principles associated with robust and long-enduring institutions (Ostrom 1990, 90-102). The design principles will be applied in this thesis to two institutions of waste pickers in Brazil. They are discussed in length in section 2.7.

2.6.1 Either Market or State: the conventional modeling of the 'Commons Dilemma'

As the extensive literature on common-pool resources will attest, these types of resources exist all around the world, in both natural and man-made forms, and have been the subject of gloomy predictions on their future, due to their jointness of use and subtractable characteristics, with the resulting vulnerability to social dilemmas (Ostrom 1990). Social dilemmas are 'characterized by a situation where everyone is tempted to take one action but all will be better off if all (or most of them) take another action' (Ostrom, 2005, 79). The absence of rules to regulate appropriation of valuable resource units in CPR systems - a condition called *open access* - set incentives for the unrestricted harvesting of resource units from the system by appropriators; possible outcomes include congestion, overuse and also the destruction of the resource itself (Ostrom 2005, 80). Three influential models have

formed the basis for the argument that commons must be governed by either the state or the market, or else it is doomed to failure (Ostrom 1990, 2-7). The first model described here is the famous 'Tragedy of the Commons", by Garrett Hardin (1968).

Hardin (1968, 1244) explains the logic behind the tragic fate of common-pool resources using the example of a 'pasture open to all', shared by herdsmen, where it is in the interest of each herdsman to maximize the amount of cattle he keeps on the commons. While gains from the selling of cattle are private, the cost of putting one more cattle to graze on the commons is shared by all who use it (ibid.). The rational herdsman understands that the best course of action is to add another animal to his herd (ibid.). Since he is not the only herdsman arriving at this conclusion, the result is that all rational herdsmen increase the number of animals at the commons, bringing tragedy upon this shared but finite resource (ibid.). A commons must cease to be a shared resource, open to all, or else it is doomed (Hardin 1968). The remedy, according to Hardin (1968) is either private property or some other form of coercive force.

The underlying structure of The "Tragedy of the Commons" is one of a Prisoner's Dilemma game (Ostrom 1990, 3-5). The Prisoner's Dilemma game is a widely studied game in the social sciences (Straffin 1993, 73). Game theory, according to Harsanyi (1994, 136), 'is a theory of *strategic interaction*... it is a theory of *rational* behavior in social situations in which each player has to choose his moves on the basis of what he thinks the other players' *countermoves* are likely to be' (emphasis in original)[9]. The Prisoner's Dilemma game unfolds as follows: two prisoners face arrest for a jointly committed crime and are interrogated in separate rooms (Straffin 1993, 73-74). If one of them confesses the crime whereas the other does not, the confessor will get a reward and the other will have a heavy sentence bestowed upon him; if both confess, both will receive a light sentence; if neither confesses, both will be set free (ibid.). Clearly, the best option is that neither confesses. They are not, however, able to communicate and coordinate their strategies, so that 'confess' becomes the dominant strategy[10] for both, as demonstrated by the payoff matrix in appendix 1 (ibid.). That is, 'each prisoner is better off confessing, no matter what

[9] A game is made of at least two players (e.g. individual; corporation; nation), a number of possible strategies each player can choose from (i.e. their possible courses of action), outcomes resulting from the choices of strategies of each player, and payoffs associated to each possible outcome (Straffin 1993, 3).

[10] A dominant strategy is defined as the optimal strategy for a player no matter the choice of strategies by the other player (Pindyck & Rubinfeld 2009, 482).

he believes the other prisoner will do' (Straffin 1993, 73). The result of this non-cooperation is that the outcome achieved is Pareto inferior, that is, there is another outcome which would result in higher payoffs to both players, or one that would yield to one player the same payoff but to the other player a higher payoff[11] (Straffin 1993, 68). Applying this logic to Hardin's model, the herders' best outcome would come from both choosing to cooperate, in which case they each send the same amount of animals to the pasture without exceeding the pasture's capacity (Ostrom 1990, 3-4). But if only one limits his number of animals while the other sends as many as he wants, the "defector" earns higher profits while the "sucker" obtains the worst possible payoff (ibid., 4). In the absence of communication and a binding contract (that is, a noncooperative game[12] setting), 'each chooses his dominant strategy, which is to defect', resulting in a Pareto inferior outcome, that is, in overgrazing (Ostrom 1990, 4).

A third model that supports the idea that collective action is doomed to fail unless enforced by external agents is Mancur Olson's 'The Logic of Collective Action'. As he stated:

> …unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interests.*
> (Olson 1965, 2; emphasis in original).

Collective action produces a collective good, and as such, is available for consumption to all members of the group once provided, regardless of contributions (ibid., 34-36). Ostrom (1990, 6) explains that the essence of these models lies in the free-rider problem: the possibility of enjoying benefits without contributing to the joint effort that provides them lead to suboptimal outcomes and even to the failure in producing the collective goods. That is to say, that by pursuing one's own individual rational best strategy, all end up worse off (ibid.). The notion of the tragic fate of the commons informed much of the policy debate around common-pool resources, notably in natural resource commons; the prescription was one of centralized control and regulation, or privatization (Ostrom 1990, 8-13). State regulation and privatization, as it turned out, had shortcomings of their own. Cases abound of centralized administrations incapable of regulating resources, with devastating results to resource systems (see Ostrom 1990, 23). Privatization of commons poses challenges regarding the costs of excluding non-owners from access, the difficulties in privatizing

[11] 'An outcome is *Pareto optimal* if there is no such other outcome' (Straffin 1993, 68 emphasis in original)
[12] Nooncooperative game: 'Game in which negotiation and enforcement of binding contracts are not possible' (Pindyck & Rubinfeld 2009, 480).

fugitive resources (e.g. fish and water) (Ostrom 1990, 13; 22), and the important question of equity when compared to common property (Tucker 1999). What is clear is that when thinking of solutions to commons dilemmas, there seems to be no obvious right answer.

2.6.2 Evidence from the commons: what conventional theory could not explain

Tragedy in CPRs was in fact observed empirically in a number of settings (Ostrom 1990). Basurto and Ostrom (2009, 255) state that 'overharvesting frequently occurs when resource users are totally anonymous, do not have a foundation of trust and reciprocity, cannot communicate, and have no established rules'. Thus, under certain conditions, Hardin's model is capable of useful predictions. What does not follow, however, is that tragic results are generalizable across all settings, that is, Hardin's model cannot explain empirical evidence documenting instances when appropriators do devise institutions in the absence of either state authority or privatization, capable of producing long-enduring results in resource sustainability over time and in the institutional models devised (Ostrom 1990; Ostrom 2005; Basurto & Ostrom 2009).

2.6.3 Introducing Elinor Ostrom: the building of a new theory of CPRs

> A large number of field studies have found that local groups of resource users, sometimes by themselves and sometimes with the assistance of external actors, have managed to create viable institutional arrangements for coping with common-pool resource problems. These empirical studies document successful self-organized resource governance systems in diverse sectors in many parts of the world. (Ostrom 2005, 221).

The systematic study of in-depth case studies on common-pool resource governance and institutions undertaken by Elinor Ostrom and her colleagues produced substantial empirical evidence on the existence of institutions devised by local communities of users of CPR systems 'resembling neither the state nor the market' (Ostrom 1990, 1) which, in addition to solving the problem of institutional supply, succeeded also in addressing the problems of commitment to the rules devised and of monitoring each others' conformance to the rules (ibid., 45). Up until then, collective action was presumably achieved only through the actions of an external entity – the firm or the state – in which contractual agreements with an entrepreneur or coercive methods by a government accompanied by the effective monitoring of rule conformance, would lead to rules being followed (Ostrom 1990, 40-42). Self-organization was, however, found to occur in real settings, and a number of attributes related to resources and appropriators were identified as conducive to

self-organization, both of which affect the calculation of benefits and costs of organizing (Ostrom 2005, 244-250).

2.6.4 Self-organized institutions & the governance of CPRs: evidence from the field

> Institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights). Throughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange. Together with the standard constraints of economics they define the choice set... Institutions provide the incentive structure of an economy…
>
> (North 1991, 97)

Ostrom's classic work on the commons, 'Governing the Commons: the Evolution of Institutions for Collective Action' (1990) recounts several cases in which groups of principals succeeded in devising institutions to jointly manage CPRs which were characterized by both long-endurance of the institutions devised and sustainability of the resource systems. One such case took place in Japan, as documented by Margaret McKean (1986, cited in Ostrom 1990, 65-69). McKean (1986) describes three villages that relied on lands used in common for several products and uses, such as game, fodder and wood for construction and fuel. All three villages had developed rules to regulate the use of the commons (ibid.). For instance, there were rules about which products could be obtained and how much of each could be taken, controls for how much had to be kept in nature to ensure regeneration, and who could access the commons and what harvesting tools were allowed (ibid.). There were also rules regulating the distribution of the harvested products (ibid.). Entrance to the commons was strictly regulated (ibid.).

There were also rules concerning provision services to the commons. Villagers had duties around its maintenance, which also included 'patrolling the commons to enforce the rules of use and apprehend violators…' (ibid., 5). Rule breaking was subjected to penalties, ranging from the payment of fines to being excluded from rights to the commons and even banned from accessing the commons altogether (ibid.). Amounts harvested and contributions of labor were strictly controlled to ensure compliance (ibid.). Those villages were far from the *open access* or *unowned* property conditions (McKean 1986, 1) described by Hardin's ill-fated grazing pastures, where herders added animals at will (Hardin 1968). Users of the commons were represented at assembly, where decisions were made concerning when the commons would be open, harvest dates, rules and to resolve conflicts (ibid.). That eligible villagers were represented in assembly was important to

secure legitimacy of the rules devised amongst those expected to follow them (ibid., 8). Villagers were reportedly allowed considerable autonomy in the management of the commons by local authorities (ibid., 7). According to McKean (1986, 571 cited in Ostrom 1990, 69), the villages' rule systems endured over time, without external coercive impositions. Ostrom (1990, 180) categorized these Japanese villages as of robust institutional performance. Similar patterns were found in other types of CPRs in different parts of the world, as can be seen in Ostrom (1990), demonstrating that some individuals succeed to devise systems of cooperation aimed at increasing their joint returns while preserving the shared resource over time (Ostrom 1990). The next section briefly discusses cooperation, and some conditions under which it can happen.

2.6.5 Re-thinking collective action: cooperation and traditional assumptions of conventional theory

In his classic book *'The Evolution of Cooperation'*, Robert Axelrod describes experiments conducted with subjects on iterated Prisoner's Dilemma conditions, in the form of computer tournaments ,with interesting results: the most successful strategy – the one that obtained the highest payoffs – was one of conditional cooperation called TIT FOR TAT. TIT FOR TAT is a strategy in which the player cooperates on the first move and then does whatever the other player did on the previous move: TIT FOR TAT will defect immediately after the other player's defection, and similarly, it will cooperate once following the other player's cooperation (Axelrod 1984, 13; 31). Axelrod (1984, 10) explains that when the Prisoner Dilemma game is played only once, players choose their dominant choice, i.e. defection, as discussed earlier, resulting in less than optimal joint outcomes, and that the same is predicted to happen when the game is played a known finite number of times. But if the conditions are such that the game is played an indefinite number of times, cooperation can emerge (ibid., 10-11), that is, repeated interactions with no end in sight may help bring about cooperation. Axelrod concludes that 'under suitable conditions, cooperation can indeed emerge in a world of egoists without central authority' (ibid., 20).

Communication was also found to greatly influence the prospects of cooperation. Ostrom (2002) describes a series of common-pool resource laboratory experiments conducted to test the role of communication on results achieved by subjects. Experiments revealed that where subjects were allowed to communicate, significantly higher joint outcomes were

achieved when compared to a baseline experiment in which subjects were not allowed to communicate and where results were consistent with the gloomy predictions of conventional theory (ibid., 1319-1321). That comes in contrast to the assumption in the Prisoner's Dilemma game in which communication would be nothing more than cheap-talk since agreements cannot be enforced unless external agents are called to guarantee enforcement (Ostrom 2002, 1320). Another challenged assumption is that CPRs imply open access, or in Hardin's words, '…a pasture open to all… (Hardin 1968, 1244). Open access resources are those to which 'whomever can gain access' (Ostrom 2009, 249), and where 'rent dissipation is likely to be endemic' (Ostrom 1990, 48). Field evidence, however, demonstrates that there are CPRs characterized by a 'well-defined group of appropriators'(ibid.). Open access is not the same as *common property,* although it is frequently confused with it (Ostrom 2009, 249). Common property refers to a type of property regime: 'a formal or informal property regime that allocates a bundle of rights to a group' and these rights 'may include ownership, management, use, exclusion, access of a shared resource.' (Hess 2006, in Digital Library of the Commons). One other prevailing assumption was that appropriators are unable to change the situation or coordinate strategies, something field evidence and CPR experiments squarely challenge (Ostrom 1990; Ostrom 2002; Basurto & Ostrom 2009). In sum: ample evidence exists of situations where the prevailing assumptions of conventional theory of CPR do not hold, and where different outcomes other than the tragic results predicted by Hardin and the other models described, are achieved (Ostrom 1990; Ostrom 2002; Ostrom 2005; Wade 1987).

2.7 The Design Principles of Robust Institutions

Where CPR users succeed to organize, there is the question of long-term endurance of the self-governed enterprises they devise (Ostrom 2005, 254). Self-organized institutions of CPR appropriators were found to exhibit varying degrees of performance, with some cases of success and robustness with regards to the resource systems' sustainability over time and the endurance of the institutions devised, and with other cases considered fragile or failures (Ostrom 1990). In analyzing those cases, Ostrom (1990, 90) identified seven design principles that characterize all the robust CPR institutions, with an additional eighth principle in larger, more complex cases. They are shown in Table 3, below. Ostrom defines "design principle" as 'an essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use' (Ostrom 1990, 90).

Table 3. Design Principles of Robust Institutions. (Ostrom 1990, 90).

Design Principles Illustrated by Long-enduring CPR Institutions

1. Clearly defined boundaries - Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.
2. Congruence between appropriation and provision rules and local conditions - Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.
3. Collective-choice arrangements - Most individuals affected by the operational rules can participate in modifying the operational rules.
4. Monitoring - Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.
5. Graduated sanctions - Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
6. Conflict-resolution mechanisms - Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
7. Minimal recognition of rights to organize - The rights of appropriators to devise their own institutions are not challenged by external government authorities.

For CPRs that are part of larger systems:

8. Nested Enterprises - Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

The principles, while present in robust institutions, were also found to be absent in the cases of failure, and present only in part in fragile cases (Ostrom 1990, 179-181).

2.7.1 Design Principle 1. Clearly defined boundaries

Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.

Ostrom (1990, 91) states that unless access is restricted to those who contribute their efforts to the resource, "outsiders" can potentially enjoy the benefits without contributing. That is, it addresses the free-rider problem (Ostrom 2005, 260). As Tucker (1999, 4) explains, access rights and resource boundaries 'must hold for users and outsiders to recognize legitimate group members, the area to which users have rights, and the perimeter that users protect from incursions'. Such restrictions come in contrast to the open access resource condition discussed earlier.

2.7.2 Design Principle 2. Congruence between appropriation and provision rules and local conditions

Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.

This principle addresses issues concerning the appropriation of resource units from the resource and the distributional rules of benefits and costs: according to Ostrom (2005, 263), '[w]hen the rules related to the distribution of benefits are made broadly consistent

with the distribution of costs, participants are more willing to pitch in to keep a resource well-maintained and sustainable'.

2.7.3 Design Principle 3. Collective-Choice Arrangements

Most individuals affected by the operational rules can participate in modifying the operational rules.

This principles refers to the crafting and modifying of rules regulating the resource regime by those directly affected by it, and who are better able to tailor the rules to the specific conditions in ways that they consider fair (Ostrom 2005, 263).

2.7.4 Design Principle 4. Monitoring

Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.

Effective monitoring is essential for the survival of the resource system (Ostrom 2005, 265). The way monitoring is conducted vary from system to system. In some cases, the monitors are the appropriators themselves and monitoring occurs in a rotation system; in other cases, resources are pooled and monitors are hired (ibid.). Monitoring assures conditional cooperators that conformance is being checked and they are not being taken advantage of (ibid.).

2.7.5 Design Principle 5. Graduated sanctions

Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.

Rule infractions are subjected to graduated sanctions, ranging from minor fines to an eventual banishment (Ostrom 1990, 98). Monitoring and sanctioning non-compliance of rules increases confidence in those who comply that one is not being a sucker (ibid., 97).

2.7.6 Design Principle 6. Conflict-resolution mechanisms

Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.

Accessible, low-cost conflict resolution mechanisms ensure that conflicts stemming from the misinterpretation of rules, errors or non-compliance are dealt with effectively (Ostrom 1990, 100-101).

2.7.7 Design Principle 7. Minimal recognition of rights to organize

The rights of appropriators to devise their own institutions are not challenged by external government authorities.

The effectiveness and long-time endurance of a self-devised system is affected by whether local authorities recognize the legitimacy of their rules and their enforcement of rules

(Ostrom 1990, 101). When local authorities perceive themselves as the only ones who should be devising rules and enforcing them, appropriators' institutions are at risk in the long-run (ibid.).

2.7.8 Design Principle 8. Nested Enterprises

Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

This principle is relevant for larger CPR systems, and refers to governance activities being organized in multiple layers of nested enterprises (Ostrom 2005, 269). Taking irrigation canals as an example, problems appropriators face in particular canals are different from the problems pertaining to greater parts of the system which affect the entire system (Ostrom 1990, 102).

The design principles, according to Ostrom (2005, 257), are not blueprints, but rather descriptions of 'broad structural similarities among those self organized systems that have been able to adapt and learn so as to be robust to the many social, economic, and ecological disturbances that occur over time'. The following section discusses success, failure and fragility in terms of the principles, and describes examples of failure.

2.7.9 Success, Failure & Fragility in self-organized institutions

Commons institutions have not only succeeded; cases of failure abound, as Ostrom (1990) demonstrates. The case of the Bodrum fishery in Turkey, studied by Berkes (1986, cited in Ostrom 1990, 144-145), is illustrative. Bodrum was characterized by unrestricted access to the fishery; that led to rent dissipation where '…the revenues from the fleet as a whole were less than the costs of fishing in the area' (ibid.). Conflicts amongst appropriators could not be resolved (ibid., 145). The different groups of appropriators (e.g. small-scale fishermen, large-scale trawlers, semiprofessional fishers, and others) compete for fish (ibid.). Ostrom (1990, 179) concludes that Bodrum is not characterized by any of the principles. Another fishery in Turkey, the Alanya fishery, where institutions were devised, is considered 'fragile', for although rules were devised to resolve appropriation problems (e.g. identification and assignment of fishing locations to fishers, under a rotation system), and mutual monitoring and sanctioning existed, access was not limited, opening for the possibility for crowding and rent dissipation in the future; collective-choice arenas are still rather informal and should become regular to be able to adjust rules effectively in face of changes in the landscape (Ostrom 1990, 19-20; 179-181). The failure cases described in

‘Governing the Commons’ are characterized by no more than three of the principles; the fragile cases are intermediate, in that ‘[e]nough of the principles are in use to enable appropriators to solve some of their immediate CPR problems, but one would be hesitant to predict institutional endurance…’ (ibid., 179-181). Robust cases are characterized by all the principles (ibid., 179-180).

2.7.10 Generalizing the Core Design Principles

Cox, Arnold and Villamayor Tomás (2010) analyzed a large body of empirical literature that evaluated the design principles ever since their introduction, and put together the major criticisms to the principles, as well as a set of modifications they considered relevant. The most important empirical critique they identified was the incompleteness of the principles, meaning, the principles alone cannot fully explain performance of the institutions (ibid.). External variables, such as market-related issues, can also potentially affect performance (ibid.). The authors agree with such critique, but state that, rather than undermine the principles, it points to additional matters to be considered (ibid.). Another point raised is whether the principles are applicable to larger-scale systems (ibid.). The conclusions the authors arrive at, however, are that the principles are ‘robust to empirical testing’ and that they constitute a ‘sound basis for future research…’ (ibid.).

An article written by Wilson, Ostrom and Cox (2013), entitled ‘*Generalizing the core design principles for the efficacy of groups’*, builds the argument for the generalization of the principles based on foundational evolutionary principles and on evidence of their applicability to a wider range of groups. The authors cite, for example, case studies in the field of education and conclude that ‘the core design principles appear to be as relevant for the context of education as for the management of common-pool resources’ (Wilson, Ostrom & Cox 2013, 28). The principles, they argue, ‘are relevant to nearly any situation where people must cooperate and coordinate to achieve shared goals’, and that they can be used ‘as a practical guide for increasing the efficacy of groups’ together with local tailoring for their implementation (ibid., 22).

The principles are notably difficult to implement in practice (ibid., 27). As demonstrated by Ostrom (1990), and argued by Wilson, Ostrom and Cox (2013, 27), the principles were found to be present or absent in CPR groups in varying degrees, and with corresponding variation in the performance of their institutions. Some cases were of outright institutional

failure, with perverse outcomes to the groups involved (Ostrom 1990). Wilson, Ostrom and Cox (2013, 27) note that even in the cases where they were adopted, the process involved experimentation – trial and error – to arrive at the principles. What is very noteworthy is that the principles find implementations of different sorts, that is, there is a difference between the principles and their implementations: the principles are found in a diversity of forms, according to the particular contexts, resources and needs of the groups that employ them (Ostrom 1990; Wilson, Ostrom & Cox 2013, 26). Take monitoring: groups employ a variety of monitoring schemes, so that the prescription of what is the 'optimal' monitoring scheme for all groups is impossible to arrive at, but there is a common underlying thread which is that most groups require monitoring (Wilson, Ostrom & Cox 2013, 26). The relevance of accounting for local contexts and circumstances could not have been more emphasized by Ostrom (1990). In view of this development in the scope of application of the principles, this study turns to its own empirical findings, in which institutions of waste pickers located in Brazil are analyzed through the prism of the design principles.

3 METHODOLOGY

3.1 Research Design: Case Study Research

In this research, the case study method is used. Case study research is particularly useful when one wants to understand complex social phenomena (Yin 2014, 4). A case study is 'an empirical inquiry', in which contemporary phenomenon is studied 'in depth and within its real-world context' (Yin 2014, 16). Case studies have played a pivotal role in the development of CPR theory; they served as a rich empirical basis, from which significant findings on common-pool resources and self-governed institutions emerged, including the design principles (see Ostrom 1990).

Yin (2012) distinguishes between three types of case studies, namely exploratory, descriptive and explanatory. The chosen approach in this thesis is that of a descriptive case study. A descriptive case study is 'a case study whose purpose is to describe a phenomenon (the "case") in its real-world context (Yin 2014, 238). According to Scholtz and Tietje (2002, 12), in a descriptive case study, a theory or model is used to direct data collection and case description, in contrast to an exploratory study. Yin (2012, 27) states that '[r]eliance on theoretical concepts to guide design and data collection remains one of the most important strategies for doing successful case studies'. This present study relies heavily on Ostrom's theory of CPRs. The design principles were particularly important when delineating the boundaries of the study and the key themes to be incorporated in the data collection phase and in composing the description.

This is a multiple-case design study, in which two institutions of waste pickers are analyzed in-depth. In addition to the two cases, one interview was conducted with a founding member of a famous waste picker institution, and two visits were made to public events on the streets of Belo Horizonte city to observe waste pickers in action. A multiple-case design is associated with more powerful analytic conclusions when compared to a single-case design (Yin 2014, 64). As pointed by Yin (2014, 57), a multiple-case study can be very demanding in terms of resources and time. When deciding on how many cases to incorporate in the analysis, attention was given to the available resources for this thesis and, especially, to time resources. Two cases were chosen for the research: ASMAC, an association of waste pickers in the city of Contagem, at the outskirts of Belo Horizonte, and COOPERT, a cooperative of waste pickers located in the city of Itaúna, about two

hours away from Belo Horizonte. COOPERT was chosen due to reference in literature about their efficiency and higher income levels (see Rutkowski 2008). ASMAC was selected based on its numbers in productivity and income, both lower than COOPERT's (Rutkowski 2008, 25), and on its accessible location. ASMAC is made of three separate units with different modus operandi. The focus of this study was narrowed down to the unit that receives recyclable materials collected by the city's selective collection program, and where associates interact to achieve common objectives (other units consist of associate waste pickers who earn based on how much materials they individually collect). The units of analysis in this present case study are the institutional mechanisms and performance of the two self-devised institutions of waste pickers.

3.2 Data Collection

This is a qualitative study. Qualitative research is difficult to define, but Yin (2011, 7-9) cites five features of this type of study: it studies the meaning of people's lives in real-world conditions, it is able to capture the perspectives of the participants of the study, encompasses contextual conditions (e.g. social, institutional), seeks to explain human behavior and real-world events through existing or emerging concepts, and it 'strives to collect, integrate, and present data from a variety of sources of evidence as part of any given study'. This thesis relies heavily on primary data, that is, data collected by the researcher him/herself (Eriksson & Kovalainen 2008, 77). Secondary data, that is, already existing empirical data (ibid.), are also used, and care was taken in choosing them, notably when it came to web sources. A variety of sources of evidence can be used in case study including documentation, interviews, direct observations, physical artifacts, photographs, and others (Yin 2014, 105). According to Yin (2014, 105), these are 'highly complementary, and a good case study will therefore want to rely on as many sources as possible'. Here, some *documentation* is used (formal studies; media articles) and a couple of *physical artifacts* were collected (two brochures, shown in Appendices 4 and 5), but the bulk of the descriptions comes from several *interviews*, *direct observation* and *photos*, collected in field study. Fieldwork is 'a common mode of data collection in a case study, whereby interviews, documentary evidence, and direct observations all are gathered in the real-world setting of the case being studied (Yin 2014, 239). Access to field sites was generously granted, resulting in several visits and many hours in which interviews and direct observations were made. Fieldwork took place during the period of May-July 2014. The visits were set apart from one another by at least one week to allow for enough time

for data and theory interaction. During the thesis work, I kept a research notebook for scribbling and brainstorming on themes, questions, ideas, theory and data.

Careful attention was paid to ethical considerations concerning participants in the field research. Firstly, permission was asked from the coordinator of ASMAC and from the administrative manager of COOPERT to carry out the visits, the interviews with members, take photos of the facilities and 'hang around' for hours to collect observations. Photographs of people were only taken if permission was granted. All involved were informed about the purpose of the study and I remained open to any other questions that they might have. It was made explicitly clear that participation in the study was voluntary, that participants were free to choose whether to answer or not to the questions posed, and that they could quit participating at any time. Some members were eager to participate while others spoke less or occasionally, and there were others who did not participate. The interviews were recorded when explicitly permitted, and it was permitted at COOPERT in all interviews (permission was asked from all participants in the group and individual interviews, and also from management); audio recording was permitted at the joint interview with Itaúna's solid waste manager and COOPERT's administrative manager, at the interview with the director of selective waste collection of the city of Contagem (where ASMAC is located), and at the interview with ASMARE's founding member, Dona Geralda. At ASMAC, although member participants agreed to the use of the recorder, the coordinator was uncomfortable with it, and therefore its use was not insisted upon and all interviews were recorded in the form of field notes. Although anonymity was not asked by any participant and neither by the management of the cooperative/association, in this study only the participants in managerial positions and the government officials will have their names displayed; the other participants are referred to in the text by letters in order to protect their identities.

Interview is 'one of the most important sources of case study evidence' (Yin 2014, 110). Several interviews were conducted with different stakeholders in this study, as can be seen from the data collection table, in Appendix 2. In both cases, ASMAC and COOPERT, members of the association/cooperative were interviewed, as well as government representatives in charge of waste management services in their respective cities. Three visits were made to ASMAC, in which nine interviews were conducted (six individual interviews and three in pairs), including one with ASMAC's coordinator. The durations of

the interviews varied, as can be see from the table, with six shorter interviews (avg. 25 min each) and three longer ones (avg. 1h each). At COOPERT, two visits were made in which four interviews were conducted: a joint interview with the city's solid waste manager and the cooperative's administrative manager, an individual interview with the administrative manager of COOPERT, and two group interviews with members at the sorting facility. Interviews lasted, on average, about 1h and 15 minutes. At ASMARE, Dona Geralda, one of its founding members, was interviewed. During the second visit made to street events at the time of the World Cup festivities (two events were visited), informal conversations took place with members of the ASMARE crew who were there collecting recyclables.

Interviews were the qualitative type of guided, semi-structured, open-ended interviews (Eriksson & Kovalainen 2008, 82-83). Open-ended questions encourage speech and usually yield more detailed responses (ibid.). A guided, semi-structured interview has a pre-prepared outline of topics, issues, or themes that ensures systematic collection of material, but while still preserving a conversational tone (ibid., 82). This type of interview was preferred so that the relevant themes could be addressed in the designated time and in systematic manner across participants. Yet, considerable attention was paid to the emergence of new themes during the interviews since very limited information on the work, internal management structure and institutional aspects is available in secondary sources. The broad themes followed directly from the design principles, and more specific subcategories of themes - informed by both the principles and the CPR case studies read – guided the interview through the important points. In building the interview guide, some aspects of the Business Model Canvas, by Osterwalder and Pigneur (2010), were included in general terms, notably cost structure, revenues, key partners and key activities. Also, in addition to the interviews, several shorter, informal conversations occurred which were also important sources of data.

Direct observations were made both more formally, in which particular themes guided the observations, and less formally for instance when interviews were being conducted (see Yin 2014, 113). Field notes were taken throughout the work in the field, and especially at ASMAC, where interviews were documented in notes. The advices on writing field notes in Hammersley and Atkinson (2007) proved very valuable, such as matching phases of observation with periods of writing notes: I took short breaks from the action in the field whenever possible for the purpose of writing notes, and then went back to action. Once a

day of fieldwork was over, memos were written detailing the visit. With practice, my skills in taking field notes improved, so that in addition to writing more efficiently, I became more attentive to the interesting details and nuances of the environment I was in.

As fieldwork proceeded, participants got to know me better, and expressed concerns about the meager sandwiches I gobbled down at lunch so as not to waste any time during field visits, very kindly offering me lunch. One participant did ask me whether I was a worker for the government, to which I replied in detail that I was not, and explained where I come from, what I do and what I study. After that, we resumed talks and she became a very important source of information.

Some challenges occurred during data collection. My own limited skills as a researcher was obviously one. I put great effort at preparing for each field visit and the constant interplay of theory and data was fundamental in helping me evaluate the data collected after each visit, and identify what I thought was missing, what was not clear, or what interesting unanticipated themes emerged and how to take them forward. Still, there were surprises. Since the interviews with members of the association/cooperative were conducted while they were at work – I was careful to interfere as minimally as possible in their work duties – what this meant in the case of COOPERT was that group interviews took place right by the conveyor belt. The conveyor belt is where the waste is spread for sorting; it is incredibly noisy, with piles of waste being pushed down a funnel-shaped pathway. The noise affected some parts of the recorded interviews. Interviews were interrupted a couple of times when rats appeared in the midst of the waste on the belt, and hysteria erupted, with the sorters jumping down from the suspended structure where the belt is located, above the ground (quite a jump). I too jumped down when I was told the rats can attack and bite.

Learning about the volumes of recyclables effectively commercialized and the economic performance of organizations of waste pickers was challenging because the availability of up-to-date quantitative data on specific organizations is limited. Data was found on total recycled by organizations of waste pickers in Brazil (see CEMPRE 2013) and also for differences in productivity and revenues amongst organizations (see IPEA 2010), but those studies made no references to particular organizations. Furthermore, quantitative data when available sometimes differed from one another. Unfortunately this seems to be a

problem way beyond this present study. Challenges pertaining to data have been noted elsewhere, in a number of studies on waste recycling (see Wilson et al. 2009; Hoornweg & Bhada-Tata 2012). Wilson et al. (2009, 631), for instance, note that 'all quantitative data on waste management in developing country cities has until recently been both scarce and unreliable, perhaps even more so for data on recycling rates'.

The data collection process was characterized by a constant interplay of theory and data, in which they informed each other, as highlighted in Ostrom (1990, xvi) and Eisenhardt (1989). Such interplay proved fundamental to my own learning curve and for the development of this study as a whole.

3.3 Data Analysis

To begin organizing the data, all handwritten field notes and memos were typed to computer documents, and all interviews were transcribed verbatim in their original Portuguese – a process that took several days to accomplish but which was crucial to coding and data analysis. After transcription, data were coded. Coding 'means that features, instances, issues and themes in empirical data are classified and given a specific label, a **code**' (Eriksson & Kovalainen 2008, 128, emphasis in original). CPR theory and the design principles formed the basis of the coding themes (see ibid., 128-129), and themes can be seen in Appendix 3. A process of within-case analysis began, in which each case was analyzed individually, and a rich description of each was composed (ibid., 130). After each case was described, the design principles were applied to the cases. This step was followed by cross-case analysis. Eriksson and Kovalainen (2008, 130, emphasis in original) explain that in multiple case studies the within-case analysis is followed by a '**cross-case analysis**, which entails some kind of comparison of the cases in search for similarities and differences across cases and in contrast to theory'. The multiple sources utilized enabled for data triangulation, a process in which the different sources of data (interviews, documents, observations) converge 'to determine the consistency of the findings' (Yin 2014, 238; 120-121).

3.4 Validity, Reliability & Generalizability

According to Eriksson and Kovalainen (2008, 291), three concepts – validity, reliability and generalizability – provide a basic framework for the evaluation of research in social sciences. Validity refers 'to the extent to which conclusions drawn in research give an

accurate description or explanation of what happened' (Eriksson & Kovalainen 2008, 292). Triangulation is a common procedure for establishing validity (ibid.). In this study, multiple sources of evidence were used and data was cross-checked to verify if they led to the same findings (Eriksson & Kovalainen 2008, 292; Yin 2014, 120-121).

Reliability is concerned with 'the extent to which a measure, procedure or instrument yields the same result on repeated trials' (Eriksson & Kovalainen 2008, 292). In this study, the choices of cases, the methods for data collection and analysis, a description of theory and tools used in the development of themes that guided data collection, and the references used have been all well documented, so that I can conclude that if other researcher repeats this process again, he/she will arrive at similar findings.

Generalizability, according to Eriksson and Kovalainen (2008, 293), 'deals with issues of whether the research results can be extended in one way or another into a wider context'. Qualitative research, in contrast to quantitative research, is 'particularistic', which makes it difficult when it comes to generalize findings to 'some broader set of conditions' (Yin 2011, 98). In case studies, analytical generalization, rather than statistical generalization, is often the manner in which generalization occurs, in which '[t]he study's findings should demonstrate whether and how the empirical results supported or challenged theory…' (Yin 2011, 101). This study aims at the analytical generalization of results.

4 FINDINGS

In this section I report the findings of the fieldwork I conducted. The descriptions below are based on the data acquired through interviews, observations and photographs.
They begin with a snapshot of waste pickers working at a busy spot of a large Brazilian city – Belo Horizonte – during World Cup celebrations events, and with a glimpse of probably the most famous association of waste pickers in Brazil, ASMARE. It is followed by detailed descriptions of the two organizations that constitute the center of the analysis of this work: COOPERT, in the city of Itaúna, and ASMAC, in the city of Contagem, both located in the state of Minas Gerais, Brazil (see map in Figure 2, below). All the interviews were conducted in Portuguese; the descriptions and quotes, below, have been unofficially translated by me.

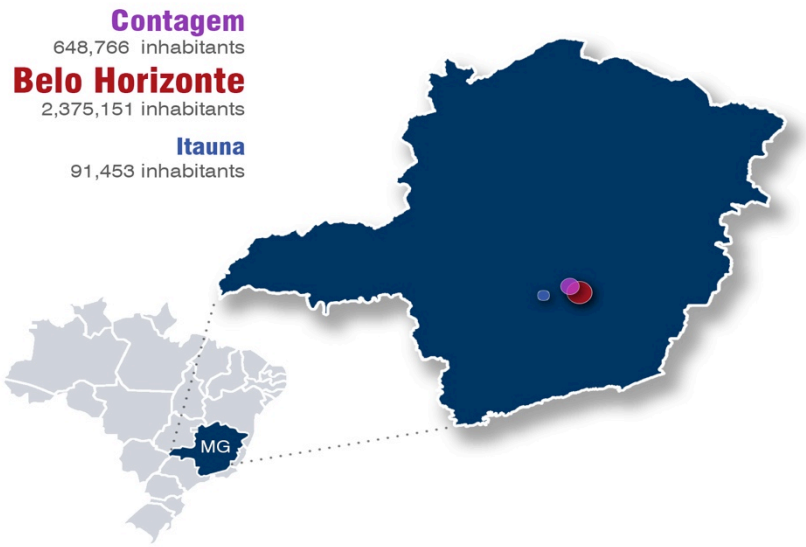

Figure 2. Contagem, Itaúna and Belo Horizonte on the map. Minas Gerais State, Brazil. Source: R. Perrupato-Stahl, C. Data on population numbers: IBGE (n.d.).

4.1 'Catadores' in action: a stint at the 2014 World Cup Celebrations

Brazil was host to the World Cup in year 2014. I visited two occasions of public gatherings at a busy spot in Belo Horizonte city, where hundreds of people were out to watch Brazil play. Waste pickers, on the other hand, were out there to work: such events meant an abundance of PET bottles and, especially, the valuable beverage cans. I spent a couple of hours in each event, watching how they work.

There were men and women of all ages collecting waste, and occasionally mothers with children were spotted. Some waste pickers were walking past the crowds collecting from the ground and emptying garbage bins. Others were seen pushing carts, some heavily loaded with recyclables. There were bags all over the streets at fixed spots, tied up around light poles and trees, to where materials were deposited by people and by pickers (see Figure 3, below). The owners of the bags were not standing right next to them, which led me to wonder how it is that they are left there, seemingly unattended, with so much valuable materials inside. A group of people with a scale were spotted: apparently trade happens at the spot.

A team of ASMARE's waste pickers was there. They had parked a cart on a street corner and were there in both my two visits, at the same spot (see Figure 3). One girl stood by the cart, guarding the materials, she said, while a group of others collected recyclables from around. She explained to me about the question of the unattended bags I was wondering about. She said the owners were nearby, keeping a watch. She explained the waste pickers can request help from the police in case someone tries to take their stuff: 'we say who it was and the police helps us to solve it'. 'The police?', I ask: 'Aha, here people have a lot of respect for the *catadores*, they know the work that we do', she replied. I asked about how they claim a spot for their bags, and she said it is whoever arrives there first. Do others respect one's spot, I asked, to which she replied 'Yes they do. They have to'.

Figure 3: Waste pickers in action at World Cup 2014 festivities in streets of Belo Horizonte. ASMARE team on the right. Source: R. Perrupato-Stahl, C.

When I told them I study Sustainability and am interested in their work, one of them said: 'this here [the materials] is all about sustainability'.

4.2 A glimpse at ASMARE

Dona Geralda, a founding member of ASMARE (pictured on the left in Figure 4, below) began to make a living from waste picking at age 8.

Figure 4. Dona Geralda at ASMARE's headquarters.Source: R. Perrupato-Stahl, C.

In speaking of the times prior to ASMARE's establishment, she said:

> We had no vision of anything, we had no self-esteem. First the Pastoral worked with us the self-esteem, then citizenship, then work. Then that's it: nobody holds anymore… Then we began to unite, then because I began to stay a lot at the meetings and believe in the change, then I stayed in, I am until today, 24 years, in the management.

ASMARE today has two units, one comprising autonomous waste pickers who are associates, and another who works in the sorting and commercialization of waste materials delivered to them by the city's selective collection program. In the first model, individual waste pickers associates collect materials and bring them to the association for sorting (they each are assigned a sorting box and sort materials themselves). Materials are purchased by the association at a price better than what the middlemen pay, Dona Geralda explains, and waste pickers earn based on their own individual production. The association has a fixed team who works at the receiving, weighting, pressing, baling and commercializing the materials. At the other unit, a group of about 50 waste pickers sort the materials received free of charge from the city and prepare them for commercialization. ASMARE then sells the recyclables forward, circumventing one level of intermediaries in

the recycling value chain. The number of associates taking both units together totals 180 members. There are several advantages in being part of the association. Dona Geralda cited the Bolsa Reciclagem (cash payment for environmental services paid for by the government of Minas Gerais), the guidance individuals have access to when they are members, and the possibility of putting their children at a daycare in partnership with the city's government that takes children from waste pickers and also from other disadvantaged communities.

In terms of production, ASMARE currently produces 250-300 tonnes of recyclables per month, she says, and member incomes vary from one minimum salary to two salaries, two and a half salaries per month[13]. At the unit where members work as a group on the materials brought by the municipality incomes fluctuate from approximately R$ 400 to R$ 500 per week, and can also be as low as R$ 200 to R$ 300 per week (thus, R$ 800 - R$ 2.000 per month). At this facility, in contrast with the free agency of the individual picker associate who comes and goes according to his/her will, members must abide to certain work rules. For example, if a member does not come to work, he/she does not earn the day's value. Dona Geralda said the association has created a service, the 'sustainable event', in which waste pickers associates come to business events and collect materials, at an effort to increase their incomes.

In addition to supplying ASMARE with materials from the collection program, the municipality also pays the association's rents, water and electricity. ASMARE suffers, however, with poor infrastructure, Dona Geralda says. She states that they do not have the conditions to undertake large investments at infrastructure that could improve their outcomes, such as in trucks to reach out to donors and access more materials. At ASMARE, associates also elect the administration and any member can become a candidate. Although the individual pickers work on their own rhythm and schedules, there are some rules which every member has to comply, such as no drinking, no drug use and respect in the facilities. ASMARE has social responsibility in mind, she says, to take in people who are excluded from the labor market.

In terms of access to waste, Dona Geralda explained that the individual catadores have 'historical spots', with reference to their usual spots for collection, such as businesses.

[13] Minimum salary in Brasil in 2014: R$ 724 (Portal Brasil 2013), or US$ 177; two salaries totals US$ 354.

Access to valuable waste depends on who is your donor, she says. For instance, if you get materials from banks – white, heavy paper – it is better than collecting waste from streets, which comes mixed. To get such a spot, she says, it is about history: 'they have many years, it's historic [ties], right, it's many years'. She said there is not really any fighting, each one has his/her donor.

On networks, Dona Geralda says their aim is to promote joint commercialization and add value, circumventing other actors along the recycling value chain. She also pointed to the important work of capacity building of the associations at the level of the network. On the future of the *catador* she states that:

> The future of the catador… is that if they don't run after, really, the future is to later be without nothing. Because us… what was left to us is the garbage, you know, for us to make a living from, right? And now, because it has a certain value, every one is eyeing it up.

4.3 COOPERT, Itauna – Minas Gerais

COOPERT – Cooperativa de Reciclagem e Trabalho Ltda. – is located in the city of Itaúna, Minas Gerais, Brazil, about two hours away from the state's capital, Belo Horizonte. Its profile, operations and interesting institutional arrangements are discussed, below.

4.3.1 Profile

COOPERT was founded in 1998, in the city of Itaúna, by a group of unemployed individuals and a group of waste pickers. When a local metal company terminated its activities, large numbers of people lost their jobs; a group of former metal workers had the idea to work with materials recovery from waste. Márcia – COOPERT's administrative manager, founding member and former waste picker from the times of the open-air dump – recounts that 'since they [the former metal workers] didn't have the experience to handle garbage, they went to the dump and made a proposal to the group that was there'. Márcia tells that those who stuck to the idea approached the municipality with a proposal and, after many discussions and meetings, convinced it to take a chance on their project. They also got support from ASMARE, who was already operating since 1990, and from the NGO INSEA[14]. With time, the composition of members changed so that currently, only a

[14] Earlier it was the Pastoral de Rua, the charity organization from the Catholic Church, which later created the INSEA NGO.

handful of members are from the metal worker and waste picker background. The majority of members today have diverse backgrounds (e.g. unemployed; former supermarket worker). The cooperative today is a registered enterprise.

4.3.2 Partnership with the local government

According to Márcia, from the beginning, the local government provides the cooperative with the working space, electricity and water. It also provides for the collection of rejects – materials not recoverable or which were not recovered during sorting – and their transportation for disposal at landfill. Sérgio Cunha, the solid waste manager of the city of Itaúna, describes the relationship between the municipality and COOPERT as 'professional' and refers to the cooperative as a 'partner' and service provider. According to both, Sérgio and Márcia, changes in administration brought changes to the depth of cooperation between the cooperative and the municipality, which affected COOPERT's operations. Sergio speaks of selective collection as a priority for the current administration and that there is both willingness from local public authorities and professionalism by COOPERT which he refers to as 'the most organized cooperative he knows of'. The current administration has hired COOPERT, since 2013, as the service provider for selective collection of dry waste in the city. Thus, nowadays, COOPERT has two core businesses: it provides the service of collection of dry waste to the city, and it sorts and commercializes recyclables. Before, collection was performed by the municipality itself, and the collected materials delivered to the cooperative. The cooperative is equipped with four trucks of its own – donated to them by Banco do Brasil – and now they are trying to acquire a fifth truck, paid for by the cooperative, Márcia says. Sérgio explains that the municipal government does not interfere with the internal affairs of the cooperative and states that 'I, for example, I want to implement something to the collection… I have to negotiate with them, I don't come and say "look, we are going to do this"'.

Itaúna's selective collection program, in which residents separate their waste into 'wet' and 'dry', covers 100% of the city, and finds high adherence by the population: 75-80% participation rate, according to Sergio. Residents place bags with dry waste in front of their homes for the collection to pick them up. The program suffered a setback, he explains, in the period of end of 2009-2012, when wet and dry waste were being collected together in the same truck, mixing them up, something which affected the motivation of the population to segregate waste once they realized it was all getting mixed during the

collection stage. He says that 'the work of COOPERT gives credibility for the individual to want to segregate [waste]'.

Márcia states that their expenses, ranging from those with collection (e.g. driver, trucks, gas, tires) to machinery (e.g. scales and pressing machines) have to be paid for by the cooperative itself. The resulting expenses with the collection service they now provide to the city are very large, she says, and profits were not as high as they expected. Income did increase but as Márcia puts it, so did the responsibilities. She explains that the municipality helped them with their expenses at the beginning of the cooperative, but ever since they built a structure they pay for the costs themselves, with the exception of expenses with the working space, electricity and water, which the municipality stills covers. At the time of this research, a new facility for COOPERT was being built by the municipality in partnership with other government institutions, with a conveyor belt twice as long as the current 9-meter long belt (the cooperative, as will be seen in the next section, has a conveyor belt at the center of its production).

4.3.3 Governance & Collective decision-making

Ever since its foundation, COOPERT is governed and managed by its members, in a system called *autogestão,* or self-management. Today, COOPERT has 70 members, 26 of which are engaged in the collection service it provides to the city. At COOPERT all decisions are made collectively. Proposals are voted for in assembly, a minute is written and all present put their signatures. For example, if a person wants to become a member of the cooperative, all current members vote on whether to accept him/her to the cooperative or not. All members vote, every two years, on the administration board, composed of three members – a president, a financial manager and a administrative member – and their three vice-representatives who take over when the active member is absent. And all members vote on a fiscal counsel, every year, composed by three active members and three substitutes. The role of the counsel is to oversee the revenues, expenses and payment calculations, check absences of members, and, as one member cited 'to supervise the directorship'. According to another member, H., the fiscal counsel

> …supervises the group…all the responsibility here of the group are his. If someone is absent he has to look and see what to do… if I do something wrong here she can call me and take me to the office, she has the responsibility to take me. Suppose I did something, but then you don't want to take me, but she can come here, call me and take me.

Anybody who is a member is eligible to become a candidate to these positions. In the case of the fiscal counsel, only one out of the six elected members (three active and three substitutes) can continue in the position for another year; all the others must be changed, thus allowing for other members to participate. In addition to yearly assemblies, smaller scale meetings are carried out whenever needed. Being present at assembly is considered an obligation members have, and as such no extra pay (in the form of extra hours) is awarded for showing up at assembly meetings.

4.3.4 Remuneration

In terms of income, according to Márcia, once all expenses are deducted from revenues, the remaining portion is divided amongst members in equal parts, with the same hour-value to everyone. About equal shares, Márcia explains that there are times when people, sometimes newcomers, confuse the cooperative's model with that of a private firm:

> COOPERT has always functioned like this, it will be 16 years… so it's everyone with equal shares. For example when comes the idea that the director has to earn more, we fight, say "no, it's not like this, that from the beginning it's like this [equal shares] and so it will continue like this"

According to Márcia, income at COOPERT ranges from R$ 2.200 – R$ 2.400 and even R$ 2.600[15] per month. Márcia explained that ever since its structuring, the cooperative has always made good earnings: even before becoming the city's service providers they already earned about R$ 2.080[16] per month. At group interviews, the item 'salary' was one often mentioned when participants were asked about the benefits of being part of the cooperative. One group member, E., said she makes about R$ 1.400, R$ 1.500 after the deductions with social security and with what they refer as 'discounts' which consists of a mix of costs – e.g. lunch boxes, transportation, cooking gas – that seem to come off their salary through the cooperative. Another member, H., said that salary level depends on the person and that herself she makes about R$ 1.200 'free' after all the deductions. She also said they earn the Bolsa Reciclagem[17] every three months, the value of which fluctuates (e.g. as low as R$ 400 to higher sums as R$ 800). Márcia noted that there are people from

[15] That amounts to US$ 538 - US$ 597 and US$ 636, respectively (USD 1 = R$ 4,09 exchange rate January 2016).
[16] US$ 508 (1US$ = R$ 4,09).
[17] Cash payment for environmental services paid for to registered waste pickers by the government of Minas Gerais.

the general public who react negatively to their salary level, which can be three times higher than the country's minimum salary:

> Like, *catador*, collector… a *gari*[18] earn R$ 2.600? …we here inside… many people don't see us… they see when we appear on the news… then they see the waste picker earn R$ 2.600… they think it's absurd. They think the waste picker doesn't have to have a home, doesn't have to have a house, doesn't have to have his/her car, doesn't' have to walk around well-dressed… we, *catadores,* have to change this view from society.

Remuneration is on a monthly basis, in two installments: one advance payment toward the end of the month and the payment itself within the first 10 days of the new month. A pre-established fund ensures there is enough liquidity to cover the advance payment. The cooperative requires that all its members pay for social security. Hours-worked are calculated individually in order to account for lateness and absences, which impact on the salary received. As Márcia states:

> Everyone is [earns] for hours worked, equal shares. Directorship, Fiscal Counsel, members [working] down there, those making the bales, those pressing, the cleaner, the gatekeeper, the collector who is [working] on the street, the driver… all earn the same value… all the same hour-value.

Márcia states that all associations should work with a monthly-based remuneration scheme: 'how are you going to administer a money which you must spend all… you don't build anything... you distribute money every week!'.

4.3.5 Access to waste & Commercialization

According to Sérgio, the amount of dry waste that flows to COOPERT for recycling is between 550 and 650 tonnes/month, of which about 420 tonnes are commercialized; the remaining amount – about 200 tonnes of rejects – is transported for disposal at landfill, he explains. He noted that the current infrastructure of COOPERT is not sufficient to handle the volume of waste that arrives. The city of Itaúna collects about 1.800 tonnes of waste per month in total, or about 70 tonnes per day, as stated by Sérgio. Márcia clarified that the amount of rejects is enormous and that the waste that arrives for recycling also contains materials that the market does not demand anymore, such as certain types of plastics. Sérgio pointed to a diaper in the midst of the waste that was there, which is not recoverable. Márcia said that two trucks full of rejects leave the facility daily for landfill disposal. According to Márcia, the total amount commercialized by the cooperative per month, that is, excluding the amount of rejects, is around 150, 160, 170 tonnes/month, and

[18] A term used to refer to professionals working at waste management activities.

that the quantity of waste arriving including rejects is around 400 tonnes. For the analysis in this study, the amounts quoted by Márcia were chosen, since she is charge of commercialization at the cooperative and as such has access to up-to-date data on this aspect. Variations in production occur, as explained by Márcia, depending on the mix of materials that arrive for recycling. Márcia points, for instance, to the problem of middlemen and informal waste pickers skimming off the valuables materials from waste, resulting in a mix containing less valuable items such as plastics and paper. She explains that when they notice quantities falling, for instance of plastics, of scrap, they ask collectors how they are collecting: 'then the fiscal says "ah, today they made the *bandeira*[19]", and then we say "ah, so that's why the material is not arriving"…'. When making the *bandeira,* someone else may pass and grab the piled up waste, leading to loss of materials to COOPERT. Plastics, for instance, is a highly valued material according to Márcia, and income is pulled down if plastics are diminished from the mix.

The major sources of waste for COOPERT are the selective collection program and the donations by so-called 'large generators' or large companies that either bring the materials to the cooperative or have them picked up. They also purchase recyclable materials from local autonomous waste pickers through a project they run, the ASCARUNA association of autonomous waste pickers. COOPERT provides them with a space to have coffee and shower, pays for the maintenance costs (rent, electricity and water) and purchases their materials at a better price than the ones paid by middlemen. Márcia notes that unorganized waste pickers find it difficult to adapt to the disciplined environment of the cooperative, as they are used to having no schedule, no wake up time, and they work at will, in some cases to maintain addiction.

To conquer market share, one must have both volume and quality material, Márcia explains. She says that they must comply with market standards and as such they must sell clean, good quality materials, and pressed, in order to earn value for materials. Small volumes of materials not pressed, as the autonomous pickers sell, amount to significantly lower earnings. She says the strength of COOPERT is that it is able to sell these large

[19] *Bandeira* is a term used to describe a method of collection in which collectors pull materials from streets to a spot, piling them up in mounts to be then thrown in the truck, in an effort to speed up the collection process.

quantities, pressed, which result in higher earnings. That is the advantage of organizing, she says:

> The waste picker, he has to organize. That's why they must organize and create association and cooperative. Because alone they don't manage… The middlemen, he manages because he puts his employees and goes on buying. And for him to manage he has to make an enormous demand [for materials]… he has to procure materials all over cities, otherwise he doesn't have a market share.

The autonomous pickers sell their small quantities to middlemen, who then acquire volume, press and sell forward to others who accumulate even larger volumes to sell to industry. Competition for waste is one issue the cooperative struggles with. According to Sérgio and Márcia, there are the so-called *copergatas* or fake cooperatives of waste pickers where they are labeled cooperatives but actually have the internal structure of a private enterprise. There are also the middlemen and the informal waste pickers who also compete for the valuables in waste. Márcia mentioned the case of a middleman with a pick-up-truck who came and collected the waste COOPERT's crew had gathered at a picking up spot or *bandeira* – a system for faster collection in which waste bags are first gathered from around the streets into piles at a certain place from which it is collected to the trucks. COOPERT's crew protested, she recounted, and said 'we had so much work to pick up [the materials] from street to street!', upon which the middleman mocked and pushed a crew member onto the floor. As Márcia said,

> Money, it's money by the doorstep, understand? He takes the money by the doorstep. And more, the collectors [COOPERT's] take… because of logistics… they sometimes take [the material from] a street and pull it here… to speed up the process, then a truck that passed there saw it was there, they go and take it…

She adds that 'the waste is mine when it is inside my house'… and that 'after it is out in the street it does not belong to anyone, it belongs to whoever takes it…'. Sérgio states that the activities of informal pickers cause problems to the municipality because of their scattering of waste around in search for valuable items, causing residents to complain. He also said that

> The work we are having, like… I think it is one of the most difficult that I have encountered so far, is to convince the people to put the waste to be collected as close as possible to the time [scheduled] for the truck to pass.

Márcia explained that, while the law includes the waste pickers in waste management, it does not secure the waste pickers' access to waste materials:

> …there is no law that says "that material over there belongs to the *catador* and cannot be touched", because garbage, once on the street, after it leaves my house, does not belong to me anymore...

In addition to challenges concerning access to waste, the issue of mechanization of the process of sorting waste emerged in our conversations. Márcia said that this is something members worry about. She says the cooperative must look into other areas to guarantee the market for its members and for those of the future. According to Sérgio, one member had the idea of working with compost of organic waste. Sérgio spoke also of a proposal of handing over the collection of the organic fraction also to COOPERT. Márcia touched on the dynamic nature of the business, where also materials change: some plastics are biodegradable; some materials recyclable today may not have a market in the future. 'Today', she says, 'the market is adapting, so recycling has to adapt as well… with new products'.

4.3.6 How they operate

Once materials arrive at COOPERT, they are placed onto a pile of waste on the ground, from where they are pushed down a funnel-shaped apparatus, landing on to the conveyor belt, as shown by the scheme, below (Figure 5). The belt is located on a suspended structure above the ground and below the section that contains the pile of garbage. A member, normally a man, works by the outlet of the funnel, to facilitate the way out of the waste on to the belt. Several members work by the belt, organized along its both sides and all the way to its extremity, just before its end, at which point the uncollected waste that passed through the belt falls down to the ground, to be then picked up by the rejects truck that takes it to the disposal at landfill. Along the belt are pre-defined positions in accordance to the type of material to be fished out in a particular order. For example, in the position by the funnel's outlet, the sorter must open the bags containing waste materials and spread the waste onto the belt; another position is responsible for retrieving paper materials, and yet another for retrieving PET bottles. The ones at the very end of the belt are supposed to rescue whatever of value that passes, before it all falls down to the reject pile, and is therefore considered a position of greater pressure. As one member stated, 'that last one, that last one… she has to be able to catch everything that passed from here…'. Members rotate the positions daily. All interviewed expressed that they know their positions already in advance. The belt works so that it moves at a steady speed, and one member at its beginning is in control of a button to stop it, which she does every now and

then when needed. Materials recovered are placed inside funnel-shaped apparatuses located next to every position, and from there they fall to bags attached to the structure of the sorting facility. The bags are then removed by other members, who will take them to be weighted and pressed. The work pace is intense and members seemed highly skillful at their tasks. But not all materials can be retrieved, as one member puts it: 'unfortunately it goes down, there is no way around it'. Yet another says '…we don't succeed to win the demand and recover everything… it's too much stuff'. One other member, at an informal conversation away from the belt, expressed frustration at the amount of materials that is not recovered, something she said, had to do with less dedicated members who let materials go.

While at the belt, we had the visit of rats, twice unannounced and uninvited, causing a moment of hysteria, with most of us jumping to the ground (including myself, after being informed that they can attack). They show up, every now and then. One member stood out alone and brave with a broom, driving the visitors away. On my first visit to the sorting facility, there were seven women working at sorting and one man by the funnel outlet. Members interviewed said there were three of them missing, one on leave of absence, the other on vacation and the third was busy participating on an administrative function. On my second visit, there were 11 women and one man working at sorting, and members referred to the belt being at full capacity, with extra workers. Teams work in two shifts, one from 6h to 14h and the other from 14h to 22h. Teams alternate between the two shifts on a weekly basis, and although there is a table marking which team is in which shift, according to Márcia everyone knows his schedule.

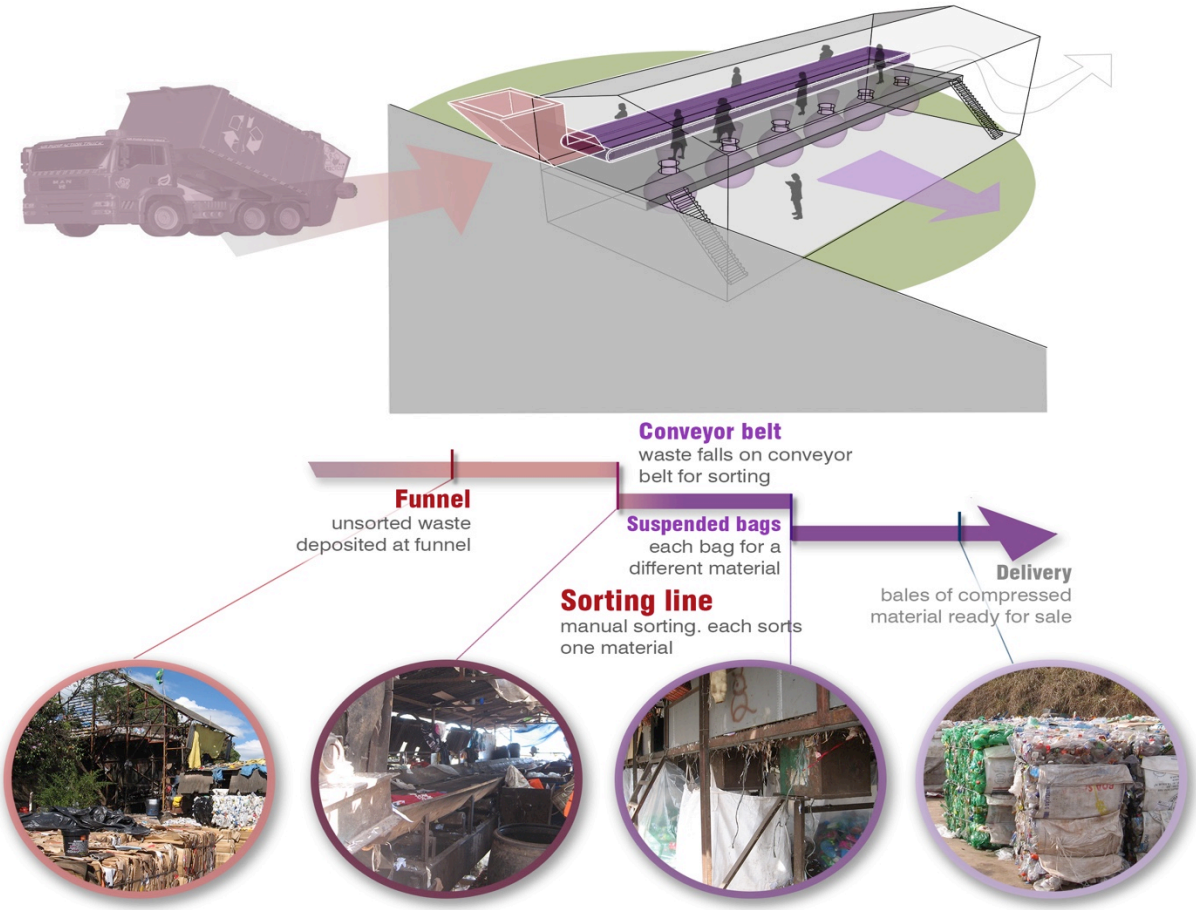

Figure 5. Scheme of COOPERT's Production. Photos from field visit (Source: R. Perrupato-Stahl, C.)

4.3.7 Work division & Work rules

At the cooperative, work division is clear. According to Márcia, there is a team engaged in waste collection, a team for sorting, a team for pressing, one for processing fine materials, cleaning, etc. Everyone has a fixed position at the cooperative, with certain exceptions, such as when someone gets pregnant and is then assigned to less demanding work, such as shredding paper. According to Márcia, everything is according to a pre-established plan, by the rule. Even when there is an event the cooperative is part of, they designate how many people are going because the work cannot stop; their salary depends on the work, she says. The weighting of materials, for example, is supervised by the administration, in this case meaning Márcia herself. Part of her function as administrative manager is to carry out commercialization, prepare receipts and work with the finance manager checking if payments were received - if not she has to contact the payer; she verifies production and sells production. If Márcia is not around to carry out her functions, another person from the administration will be in charge; she notes that everyone there is trustworthy.

Extra hours are not allowed unless explicitly authorized by the administration. They are permitted only under certain conditions. Márcia explained that at one point in time during an administration, extra hours were permitted and members accumulated hours; a mess ensured: 'there was nobody to work!', she exclaimed. She recounted how one person began to sell her extra hours of work so that she would come to work for others while they stayed home. Márcia says 'it becomes a mess; that cannot be'. Plus, she added: 'it doesn't give productivity'. I asked her how a problem such as this one gets fixed, and she replied that 'we saw ourselves that it was absurd, we called an assembly and cut it' and that 'the people voted, said it was too much really, and agreed, wrote a minute and it's over'.

When I asked members what they thought their obligations to the cooperative were, one member, B., replied that 'you have the obligation to administer an enterprise; follow the schedules, do what you can to improve…'. He noted that 'the rhythm here is more strict than… at a company'. When I asked what to expect from one another, he answered 'from one another? Service. We expect from one another that everyone works the same, or make the effort, right?'.

At COOPERT, absence, lateness or leaving work early without justification and without prior notice are not tolerated. The rules governing these matters were explained in detail by Márcia, and also by other members interviewed, who all seemed very well informed on them. If one is to arrive late or must leave early it is allowed but it must be announced at least one day in advance; if announcement comes on the same day, the member needs to bring a proof of urgency (e.g. a doctor's certificate). The idea is that the team must be able to plan the work. Every member has 30 minutes per month that he/she can get late. This means that if on one day he arrives 10 minutes late, and then on a second day he arrives 20 minutes late, his 30 minutes allowance are over, and after that, any minute late means he/she cannot enter a day's work anymore. The punishment for the offense is two days without pay. The second day without pay means that the member does have to show up to work but he/she does not receive payment for the days' work. They have at the cooperative an arrival and departure control card system, which registers check-in and check-out. Thus it becomes possible to verify exactly the hours worked. Márcia said members monitor one another, that there is a clock by the belt and everyone has got a clock and they can check whether people arrive on time or not. If, however, announcement of lateness is given in advance, then a member can get late and still be permitted to work, but the time out is

discounted from his/her pay. Minutes are accounted for, and summed up by the administration and the fiscal counsel. Note that announcement of lateness is not accepted over the phone: it must be done in person. I asked one member if you could not just make a phone call and say that you will be a couple of hours late, but he replied: 'No, you'd better come here! For example, you are in the car and the car broke down somewhere, you must leave it there and come here'. He said 'it's very strict'. Three members explained to me the 30-minute lateness allowance:

> B. 'If you get to thirty-one, you can be sure, you are not coming in, and so you miss the [work] day… then you will miss two days, right C.? Then you must come here the next day [and work] for free because that day you are working, you lost it'.
> A. 'There is the hour-card[20]!'
> C. 'There is the hour-card'.
> A. 'And there are people checking it'.

B. states that the level of absences is low, and that 'people here know that if they are absent they are the ones who lose the most'. Missing work without justification receives the punishment of loss of two days of work, and if unjustified absences continue, the member is called for a talk, a verbal warning. If the reason is health, he/she must bring a doctor's certificate. B says that '…if there weren't these rules a lot of people would behave carelessly, would be absent a lot, would not be committed to the work'.

Members are entitled to paid vacation and to unpaid leave of absence. Vacation is distributed along the year because, according to Márcia, it is not possible for members to take a whole month straight of vacation, or else production will suffer. Thus, members take one week at a time, every three months, throughout the year. There is a planned rotation system with the each member's vacation turn. Leave of absence is possible at a member's request, but it is unpaid. Member A. said that when they get very tired or they want to travel, they can request a leave of absence; paid vacation, she said, is not enough to rest someone who has been working at the cooperative for several years. There are strict rules regulating the vacation system. For instance, it is not allowed to put together a leave of absence and a vacation time sequentially. Márcia says that '…we self-regulate ourselves so we don't incur losses'.

[20] *Bater-ponto* in portuguese stands for the system of check-in and check-out control where the person registers arrival/departure with a personal card on a machine.

4.3.8 Monitoring & Sanctions

Mutual monitoring occurs at different levels. For instance, Márcia tells how the members who prepare the bales can tell, by the quantity of bales they make in a day, whether production was good or bad. Márcia says that they say 'look, production today was not good' or 'ah, production today was good'. She explained that production does fluctuate:

> Sometimes the collection that comes doesn't have a lot of material, sometimes the people working at the belt are not with good will, there are days that they are not very good… sometimes the person who is working at the PET [bottles] is getting the production stuck, asks [the belt] to stop too many times… or even paper itself. Sometimes whoever is at the button [at the beginning of the belt] isn't putting the appropriate amount of waste for the belt to work well… everything, everything fluctuates.

Members vary in the way they prefer to monitor, but what seemed clear from the answers at interview, is that monitoring does occur and that they themselves consider it important, as seen from the dialogue below, when I ask if they demand from one another:

> B. Yes we do.
> A. …there are days that we are tired, there are days we feel pain, but all the time we don't accept...
> C. We demand from one another.
> A. There are people who don't accept it [the demand].

One other member prefers to complain to the directorship rather than straightforwardly to the colleague:

> E. Many people here are respectful to one another, because here is the deal, if I have my way of working, another person doesn't have, right? …All this has to be respected, right? But we demand, we demand, we pass forward to the directors for them to be demanding… Here we don't demand otherwise they… they think we are bossing them around… because it's hard.

Two other members elaborate on mutual monitoring and free riding:

> D. …sometimes I wish I could leave, disrespect the rules… we are dead tired here… J. doesn't let me go home, right J.? …if I stop for a little bit then my partner says "put the hands on the garbage!", right J.? But that's it, I have to work, she doesn't have to work for me, I have to do my part.
> F. …here it has to be like this, really, it's one pulling the other, otherwise… there are the *sugadores* [the ones who suck].

When conflicts between members occur, they sometimes handle it between themselves but also have the possibility to take it to the administration. According to one member of the fiscal counsel, feedback from the administration is sometimes not openly received by some

members as they state the administration is not working there with them to see exactly what is happening. Conflicts exist, as one member puts it 'sometimes we… deviate from the statute, [have] some fights. But later everything comes back under control'. When asked if issues can be brought to the attention of the administration when necessary, one member states that 'yes we can, we can. And we usually… we communicate first with the person, right? We give a warning, we talk… I think at a certain point we have to sometimes have to go [to the administration]'.

They do have a system of sanctions in place, should rule infractions occur. Marcia explained how it works: for example, if someone misses a day of work without prior notice and without justification, he/she is called for a talk. Issues are discussed and a verbal notification is given. If the problem persists, there is a written notice. If it does not resolve, there is suspension (e.g. five days off work), and finally, if infractions continue, the member will be requested to leave. When someone leaves, he/she has the right to issue a letter within 30 days and request to come back. If the assembly votes in favor, he/she can come back, but if the problem persists, he/she will have to leave permanently. To exclude someone from the cooperative the assembly does not have to vote because the existing statute already determines the conditions under which someone can be excluded. If that occurs, the assembly only needs to formalize the exclusion. They had only one case in which a person was excluded and voted to be accepted back, but because offenses continued, he/she was eventually excluded permanently.

4.3.9 Admission rules

There are also rules for admitting new members to the cooperative. According to Márcia, admission depends on vacancy. Potential new comers are submitted to a trial period, in which current members train and evaluate their performance; all members vote on whether to admit the person as a member or not. According to some members, relatives of current members are not allowed to enter:

> B. Relatives are not allowed to join.
> A.Today family members cannot join anymore.
> B. It's a rule… So that there is not so much *panela* [group], right, the family… then comes the whole family and you have that group.

4.3.10 Rules & Rule-making

I asked about how they arrived at such rules. Márcia answered that, ever since their beginnings they function as a cooperative. She described the process of arriving at rules as a day-to-day process, of 'cracking the head', looking at what worked and what didn't, without giving up. She mentioned that the cooperative suffered three fires, and that even then, they kept working. On one occasion, they had to wait a couple of months until the facility was fixed up for use again. During that time, they requested from the town that they kept bringing them the waste materials collected from the city because they could continue their work. She tells they worked through the piles of waste, as if in the times of the open-air dump, spending long hours working, and that in the end they actually made more money than they had before the fire.

Márcia cites vacation rules as very important, so that they get some rest. She cites their statute as an essential tool which has to exist. She expressed great caution about modifying existing rules: when there is change of administration, she explains, there is the risk that the new one wants to modify rules which actually work. Rules that work, she says, should be preserved. New ideas must be incorporated but what works well must continue. The statute created by COOPERT has become a model to other organizations, according to Márcia. Unfortunately, I did not have a chance to see it. But, as members refer to it, it can be inferred that it contains a series of fundamental rules regarding the management of the cooperative, and also the consequences of breaking those rules. In thinking of rules, members state for instance that:

> E. The rules here, I think they are right… For example, if I want to be absent, I can, but I will make a leave of absence, understand? I can make a leave of absence, I can stay home, understand?... So this is very important, because, for example, if I have something to do, then I won't give an excuse… I will get a leave of absence… and I won't cause damage… So, it's very important.
>
> D. If we didn't have these rules, then it would not be working properly… If three of those who are here are absent, production is not the same, because then it becomes more difficult to work… If people are absent it's more difficult to work and we get more tired. So there has to have these rules so that we always have more people to work…

On which rules are most important, one member says:

> H. All. Because… all, because you have to have, we have commitment. You can't be absent, you can't… you feel bad, you went home, no. You feel bad you must go see a doctor and get a certificate, a declaration, so you have to have commitment. And a lot of

> cooperatives that I know don't have this. So like, things work here because of the commitment we have to have with the cooperative.

4.3.11 Challenges & Opportunities

According to Márcia, there are many organizations in fragile conditions, in terms both of infrastructure and management. She says that some associations don't think they can reach the same results as COOPERT, 'they think we don't tire, we don't rest, we don't take vacation, that we only think about work…' She states that other organizations say that they cannot receive on a monthly basis as COOPERT does, and that in some places they even receive on a daily basis. That's an issue she criticizes: 'if they don't organize themselves they will not succeed; everything produced will be consumed on the same day? This… does not lead to growth, no'. Another problem has to do with the amounts of materials other organizations have access to, which can be quite little, according to Márcia. She says COOPERT has enough volume of plastics, paper, tetrapak, etc., to send forward, but some organizations do not have that. This is why, she says, they must work in networks, to put their volumes together and commercialize together. COOPERT is part of a large network of associations/cooperatives of waste pickers, called Cataunidos. A recent news release stated that Cataunidos are now comprised of 33 member-organizations, from all over Minas Gerais state, and that 15 of them are starting joint commercialization (INSEA 2014). Márcia says that another advantage of being part of a network has to do with the exchange of experiences they can share with one another.

Several challenges were cited by members of COOPERT in terms of what the future holds for them. Mechanization was cited by both Márcia and some of the members interviewed. Márcia hypothesized that with mechanized sorting, perhaps they will have to work less hours and have better quality of life while maintaining their jobs. She thinks they must adapt and develop, create jobs and also revenues for the municipality. In group interviews, in addition to mechanization, incineration and competition of waste were challenges discussed. A couple of members cited their movement against incineration, in which protests are carried out.

Overall, members seemed positive about the cooperative. In terms of the advantages of being part of the cooperative, salary was an item often cited. A couple of members referred

to self-management as a favourite feature, and social aspects such as friendship was cited by some as yet another benefit from being there.

4.3.12 Their results

Here, a brief summary is presented of some of COOPERT's results, in terms of income, recovery rates, and the mix of services it can offer and profit from. Its members earn what they themselves consider, an advantageous salary; it is also so relative to Brazil's minimum salary, which is currently R$ 880 (Exame 2015a), compared to COOPERT's R$ 2.200 - R$ 2.600 monthly salary. Recovery rate, as stated by Márcia, ranges between 150-170 tonnes/month. One can speculate that this number is likely to change when COOPERT's new facility begins its operations, where a conveyor belt twice as long is likely to impact positively the amounts recovered. COOPERT's partnership with the municipality for the selective collection of the dry waste generated by the city has secured COOPERT a contract, which led to income increase and more people being members of the cooperative. The cooperative also has ideas of possible future services that could someday materialize, such as becoming the city's service provider also for the collection of organic waste and the idea of a compost process.

4.4 ASMAC, Contagem – Minas Gerais

ASMAC - Associação dos Catadores Autônomos de Materiais Recicláveis de Contagem - is located in the city of Contagem, state of Minas Gerais, just at the outskirts of Belo Horizonte, the state's capital. The association is described, below.

4.4.1 Profile

ASMAC is comprised of three separate units: the Novo Riacho unit, the CEASA unit, and the Perobas unit. The first two units are older, dating from the early 2000s, with a model of individual waste pickers associates who collect their own waste and earn based on their individual productions. The third unit, ASMAC Perobas, occupies a facility belonging to the local government, located at the city's sanitary landfill. It is comprised of a group of 25 members predominantly women – 24 women and one man – of varying ages and backgrounds. Some of the members have been at ASMAC since its establishment, such as E., D. and C., all former autonomous waste pickers. Other members, such as B., used to work different jobs (e.g. making food for sale; working for family homes), and G. worked at a snack shop prior joining ASMAC. Several associates, at least 4, are members of the

same family, something one member noted she does not like because when there is a problem, she says, one covers up for the other. ASMAC Perobas' core business is to sort, bale and commercialize the recyclables it receives free of charge from the Contagem city's selective collection program and from business donors. In addition to the partnership with the municipality, ASMAC receives support from INSEA, the NGO that also supports other organizations of waste pickers. This unit was established in year 2011, and is the focus of this study.

4.4.2 Partnership with the local government

According to Natalie Rates, the director of the city's selective collection program, the municipality's partnership with ASMAC precedes the implementation of selective collection in the city: ASMAC has been a beneficiary of subsidies from the local government since 2001. The government provides two of the units – Novo Riacho and ASMAC Perobas – with the space (in the case of Novo Riacho the municipality pays the rent of their facility), water, electricity and technical assistance. The facility of ASMAC Perobas is ceded to them by the government at no cost to the association. The unit at CEASA – a large wholesaler of a diversity of products and host to a unit of ASMAC – receives funding from CEASA itself.

Natalie explained that according to the new legislation on solid waste management in Brazil, the *catadores* must be included in waste management, but that municipalities differ as to how they integrate them into the process. Several municipalities have opted for hiring the waste pickers at a salary, she says, while others choose to collect the waste and donate it to establishments run by the waste pickers themselves. The latter strategy is the one adopted by the city of Contagem. In ASMAC's case, the sorting and commercialization of materials are carried out by the waste pickers independently from the government. The challenge this model poses to the municipality, according to Natalie, is that, in addition to operating the selective collection in the city, it also receives constant demands for support by ASMAC. She states that, even though they are an independent organization, with their own rules and coordination, they continuously request for more support from the municipality. Unfortunately, she says, the municipality cannot do everything. The selective collection program has three trucks to collect materials, with two assistants and a driver, working six days per week. One member of the association joins the collection crew and the choice of who joins pertain to the association itself. According to an associate, A., they

go on the door-to-door collection to educate residents on selective collection. Natalie, also touched on this point, explaining that this way the population establishes a connection with the question of donating the materials to the waste picker. Member A. said the reactions of the public are mixed, with some people receiving them well, while others not: she recounts an episode of one resident who handed the bag with waste to her saying, unfriendly, 'here's your garbage'. She told me, with conviction, that 'this is not garbage! It's recyclable material!' and that herself and others make a living out of it.

There are currently two organizations in Contagem, ASMAC and COPERCATA, both supported by the municipality. Natalie says that her team is trying to balance the existing gaps in income of the organizations and even within ASMAC itself: the unit of Novo Riacho, for instance, achieves only half the salary of the group of Perobas, she notes. At the Novo Riacho unit, the waste pickers have to collect materials themselves, resulting in differences in production, with some able to collect more than others. At ASMAC Perobas, they receive materials from the municipal collection and process them collectively; they are more able to accommodate differences such as, for instance, if a member is older and cannot work as fast, she says. I brought up a recurrent theme of the group at Perobas, which are the frequent complaints by its members of some people working more than others. Natalie states that their model is not one of a firm but one of a social enterprise, of inclusion and income generation, but that the group still has difficulties to grasp this; even though they work collectively, she says, they are very individualistic. The municipality has a couple of programs in partnership with other government institutions aimed at strengthening the associations. One of them will work the entrepreneurial dimension, she explains, by, for instance, training them on how to commercialize as a group, the advantages of it, and some technical aspects of running an enterprise. The experience they have had is that programs more focused on the social side found resistance from group, she says. The question of how to work as a collective is one that needs to be addressed with them with the help of a professional, Natalie notes, and that she herself works on optimizing the selective collection program, and does not have the qualifications necessary to work on the social dimension with the group.

In the case of autonomous waste pickers, she explains that they are not yet ready for working as a group. The goal is the inclusion of waste pickers in a formalized process, also in order for them to have the benefits of training programs and cash payments for their

environmental services (Bolsa Reciclagem), only available to the formalized picker, she says. One of the functions of a solidarity selective collection program is to commercialize in groups, Natalie explains, and to receive as a collective, but that some autonomous pickers are still resistant to this concept:

> But we have a big problem which is that the informal [pickers], they like to work autonomously, to not have a schedule, to not have rules, they like to receive daily because they collect a little bit [of materials], commercialize it, because the majority of the informal waste pickers have some kind of addiction… they don't achieve this routine to work on schedule, because the girls [at ASMAC], they have a schedule.

4.4.3 Access to waste & Commercialization

At ASMAC, materials come mainly from the selective collection program and from donors (e.g. businesses). The program, ran by the municipality, collects dry waste from several sources: households, schools, public institutions, residential compounds, businesses and commercial corridors. Natalie states that the population is very committed to the system, with over 90% of adherence in the areas covered by the program (only a part of the city is covered at the moment). But there is a lack of infrastructure and the level of implementation of the scheme is still low; had these been better, the collection would, as she says, 'explode'.

A major problem with selective collection is that it costs significantly more than conventional collection. Natalie says that costs remain an impediment to the expansion of the program: selective collection is nine times more expensive than conventional collection, she says. One reason is that conventional collection is significantly faster than selective collection, since the crew does not have to stop and knock at residences to receive materials personally – residents do not place the materials outside. This rather inconvenient system is due to the competition for waste: Natalie recounts an episode during collection when residents, accustomed to the schedule, began to place the waste outside their homes for collection. But one van passed by and collected all the waste before the municipal trucks arrived. When the truck came, there was nothing to collect anymore. As she puts it,

> The waste placed outside… it's public, right? So we cannot even say "you can't do that", the waste is public… but then the municipality has spent with the mobilization, implementation, with the truck going there… when they saw that the material, that people had already grasped the idea, already segregated the materials correctly, then the separated material is…

According to Natalie, there is a lot of competition for waste:

> With the middlemen, with the informal waste picker, a lot [of competition]… The people from the scrap shops, a lot of competition. Because they began to realize the value it has. Before… it was about the beverage cans… paper is valuable, white paper has [value], PET bottles have [value]…

She explains that, at a busy commercial corridor with loads of materials, they needed to have more trucks to pass more often because people do not wait several days until the truck comes by to pick materials up; they donate it to someone else who comes earlier. In addition to costs with collection itself, the municipality has costs with its implementation, which demands resources to inform and educate the population on the program, and to monitor the process for some time. The municipality also has to financially support the waste picker organizations (e.g. electricity, water, rent, technical assistance). Natalie explained that when change in administration occurred, it took some time until the new administration understood how the partnership between municipality and ASMAC functioned, and why the association still could not maintain itself even though the city already provided them with the space and the materials collected. Ultimately, the partnership was renewed but until the issue was resolved the *catadores* went on protests.

The facility of Perobas was initially planned for 110 waste pickers to work in two shifts of 55 persons each. At the moment, they have only 25 members but Natalie explains that the volume of materials that arrives there daily – about three tonnes per day – falls very short from the planned 12 tonnes per day. Thus, much has to be done still to meet the goal of 12 tonnes/day and then enable for more people to join the association. The current recycling rate of the city of Contagem is 1.3%. Natalie provided me data on the monthly production of the cooperatives in Contagem for year 2013 and beginning of 2014. ASMAC's total production in 2013 (including all its units) amounted to 1.628 t/y. ASMAC Perobas, in particular, exhibited an average monthly commercialization volume in year 2013 of 64,7 tonnes, and of 77,3 tonnes per month for the first quarter of 2014.

4.4.4 Governance & Collective decision-making

The coordinator of ASMAC, Dona Ercy, is responsible for all three units and, according to her, there is a finance manager as well, who was working at another of ASMAC's units. ASMAC's model is also based on *autogestão*, or self-management, with collective decision-making. Its members vote in assembly to elect the coordinator and the vice-coordinator every two years. If a person wants to join the association, it has to be voted in

assembly. According to F., in general elections all units come together in assembly to vote. Everything decided in assembly is written on a minute: 'If someone says something and later says she never said it, it's all in the minute', says F.. She adds that there is no fiscal counsel at the ASMAC Perobas but that there was going to be elections in the middle of the year for general coordination positions and also for a counsel). Dona Ercy said that ASMAC has got a statute with the association's rules but I did not have a chance to see it during fieldwork.

One aspect not straightforwardly clear was who was the vice-coordinator, an important detail since Dona Ercy is in charge of all units of ASMAC and, at least during fieldwork, she was not always present at the Perobas facility. Some mentioned I., while others referred to H. as the one who 'takes over' when the coordinator is absent. Turns out, both statements are correct: I. is the official vice-coodinator, but the one who *de facto* coordinates when Dona Ercy is not around is H.. According to B., 'I. has no active voice. If Dona Ercy is not here and there must be weighting of materials, I. doesn't do it and things don't move forward. In practice, it's H. who takes over when Dona Ercy is not here'.

4.4.5 Remuneration

Remuneration at ASMAC Perobas occurs on a weekly basis. According to ASMAC's coordinator, all members earn the same value of the day worked, but they do not earn anything for the days of work they miss. As members later clarified to me in interviews, it works so that every day there is a production and those working on a given day earn equal shares based on that day's value of production. If someone is absent, he or she will miss the value of the day's share. That is, unless the absentee has got extra hours on the house to make up for the absence. If that is so, then he/she still earns the value of the day's share even though he/she has not showed up to work (to earn a full day's pay, one must have eight hours on the house).

Income level at Perobas ranges between R$ 1.400, R$ 1.500[21] per month, according to Natalie (that makes about R$ 350 per week). She points that their income level is higher than what the autonomous waste pickers at Novo Riacho make, which is about R$ 600, R$

[21] US$ 367 (1USD = R$ 4,09 exchange rate January 2016), or US$ 85 per week.

700[22] per month, and also higher than the national average. There are times in which they earn as high as R$ 2.000, or about R$ 400, R$ 500 per week, she says. On top of their salary, Natalia explains, they are also entitled to receive the Bolsa Reciclagem, the cash transfer by the government of Minas Gerais as payment for their environmental services, and that amounts to roughly R$ 800, R$ 1.000[23] every three months. Current earnings, according to Dona Ercy, are neighboring a salary and a half, which sums up to about R$1.100[24]; at the least, she says, they earn R$ 200 – R$ 250 per week. Members complained about income level and about staying short of the potential they have there to earn more. One member, B., stated that there were weeks they earned even R$ 600 but that her last pay amounted to as low as R$ 197. One other member, G., who joined the association recently, cited values of R$ 250, R$ 190, not more than that, she says. That makes for between R$ 820 – R$ 1.100 monthly salary, or US$ 200 – US$ 270[25].

A number of factors are said to affect income. For instance, during one my visits to ASMAC, H., the *de facto* vice-coordinator, complained about the bags to the director of selective collection, who was there on a visit. The *ecobags*, as it turns out, are bags distributed by the municipality to households for the segregation of dry waste. They were getting old after a couple of years in use and needed to be replaced. What the group finds hard to understand, explains Natalie, is that the acquisition of new bags must go through the bureaucratic process of the municipality which includes a bidding process by suppliers and, once a supplier is chosen, it is given a time to deliver the bags. Thus, while the bags are on their way, it has taken time, and it has affected collection, resulting in less materials collected. Another aspect which affects production and income has to do with the number of associates who come to work. Dona Ercy notes that, while at other units of ASMAC waste pickers earn based on their own individual efforts, there at Perobas, they depend on one another. On the day of my first visit, Dona Ercy readily noted that many people were absent. She explained that there, it's the collective effort that generates income, and that they could be sorting a lot more material: at least four members had not come to work, which meant a whole container without sorting on that day. Absences emerged as a serious problem and a root of conflicts in the organization, as will be discussed in the next section.

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[22] US$ 147; US$ 171

[23] About US$ 440.

[24] US$ 269 per month or US$ 55 per week.

[25] Exchange rate US$ 1 = R$ 4,09, of January 2016.

Yet another factor is the adminission of new members to the association. B. connected the admission of two more members with the lowering of income: '[Income] got worse, weakened, because two more people got in. This week we earned only R$ 197. We made a plan and then something else happens'. Below, is a graph constructed on the basis of the data for year 2013 and the first quarter of 2014 provided by the selective collection director. The monthly volumes commercialized and average selling prices per kg of recyclables were provided. Average incomes were estimated for the periods mentioned. These are rough estimates of income levels because there was no data on their expenses – note that the government subsidizes all the major costs – and because the overall average price of materials may not exactly reflect ASMAC's mix of materials (materials, like PET bottles, paper and metals are priced differently). Finally, every member earns based on his/her days worked, and that can vary. With all this in mind, the graph is useful in providing an idea of commercialization and income levels at the association.

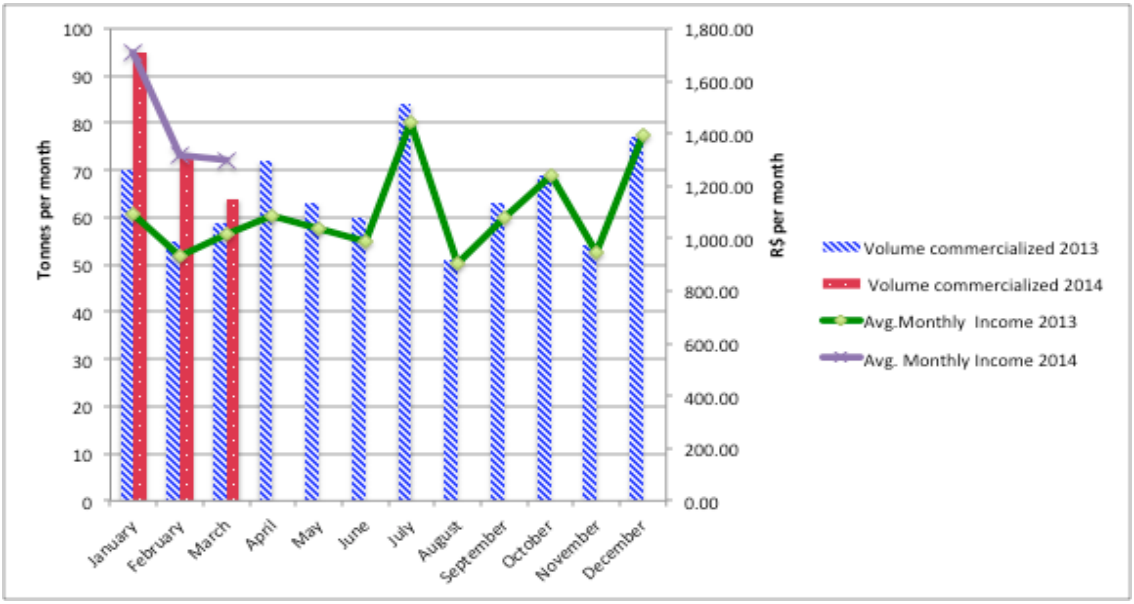


Figure 6. Commercialization and income levels at ASMAC Perobas.
Based on data obtained from Natalie Rates, director of the selective collection program of the city of Contagem. Calculations: avg. monthly income = total volume commercialized per month x average sales price of materials for the month, divided by 25 members. Estimated from the monthly avg. sales price and monthly volumes commercialized provided in data.

4.4.6 How they operate

At ASMAC, materials arriving from collection are deposited in large containers – there are 12 containers altogether at the association. According to one member, B., there are also members who sort materials outside the association, for instance at a shopping mall in Contagem, and the material is then brought to the association for commercialization. Sorting is manual and occurs without a conveyor belt. Sorters work in groups from two to four (and occasionally also individually, as I observed), retrieving materials from the containers and directing them to different bags positioned all around them, containing different types of materials, all the way until the container is emptied. I saw them working mostly standing. The sorted materials are weighted, pressed, and baled to be commercialized. A scheme for ASMAC's facility and production can be found below, in Figure 7.

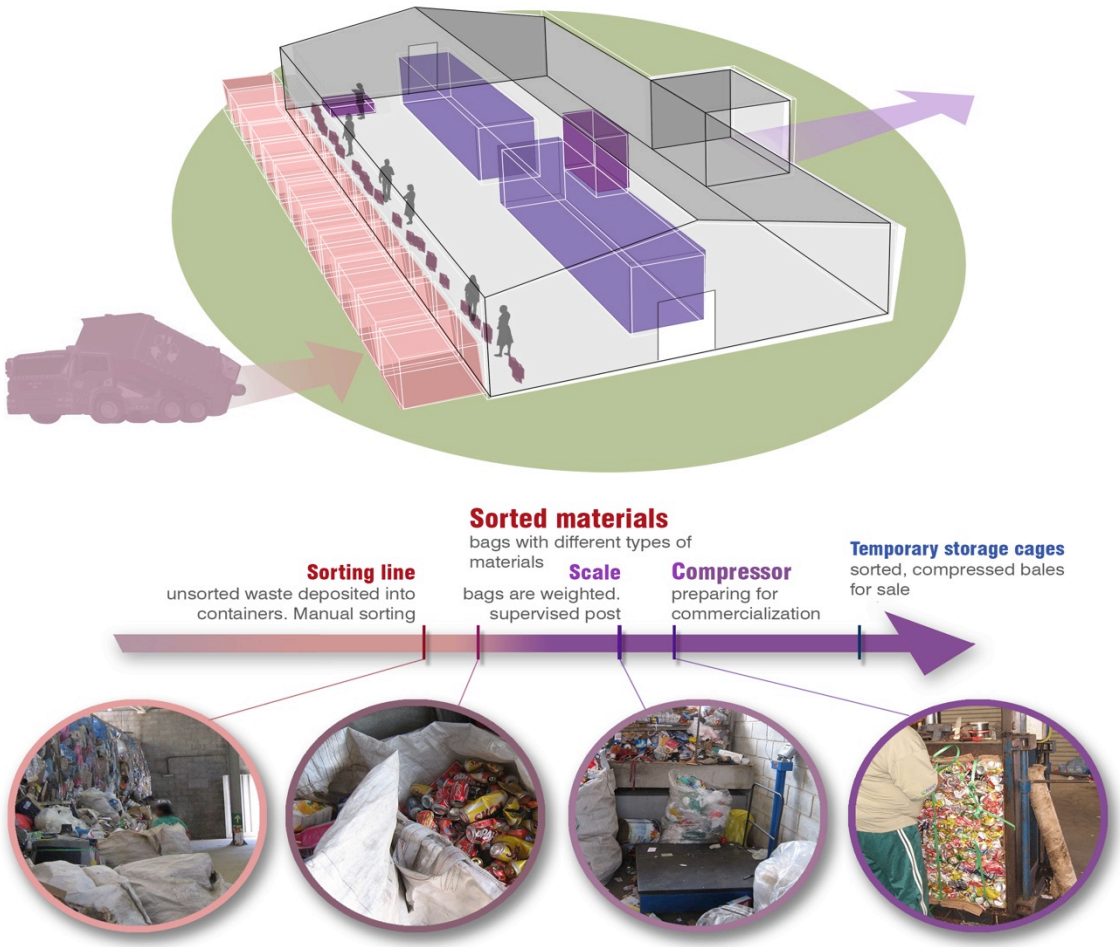


Figure 7. Scheme of ASMAC's production. Photos from field visit (Source: R. Perrupato-Stahl, C.)

4.4.7 Work division & Work rules

Work division is decided daily. A., a member, explained that their activities consist of sorting, weighting, pressing, and going out to door-to-door collection with the municipality's crew on a rotation system. According to ASMAC's coordinator, Dona Ercy, everyday the work to be done is checked and, based on the amount of members present on each day and on the quantity of work, work is divided. The actual assignment of containers for sorting is done through a lottery system. One member said that the containers have mixed levels of difficulty, thus the lottery resolves who goes where. I had the chance to observe the lottery procedure on an early morning. All those present were gathered and names were drawn from a metal tin, assigning names to containers. In all my visits I noted most containers were considerably full of mixed waste to be sorted. The lottery system is also used to decide on who will join the municipality's crew on the selective collection program (one or two members join them on every one of the six days collection takes place). One member, A., explained that before there was a specific team designated to accompany the collectors, but others also wanted to participate, since residents occasionally give away items they don't want anymore, she says. Thus, in order to avoid conflicts, the group decided that everyone should participate. Lottery also decides on the two members who will be doing the cleaning chores of the premises for a given week. Whoever was already chosen for the chores, does not enter the lottery. The whole process of dividing work took quite a while, at least half an hour, during which time there was no production in the premises.

The impression I got from observations is that the work process is not very well defined. Dona Ercy was seen giving orders around about what needed to be done while occasional shouts were heard of members asking for help with tasks. For instance, while talking with a member, the *de facto* coordinator was seen demanding that someone go help with a task, prompting A. to comment: 'see, there are things that have no way'. She added that cleaning, for instance, sometimes is not well done, that others not always do their share. At one point, during my third visit, I noticed that work practically stopped. One member, who was explaining to me about the types of materials, commented with frustration: 'some work, others stop. If the others stop, I will also stop. Here it's like this. If [they] work, I work. If [they] stop, I also stop'. That attitude resonated with other members as well. As E. stated, 'sometimes, by three o'clock, if everyone stops, I won't be working for others. We

can only leave at 4:30h, but we stay there… but this isn't everyday'. B. said that 'to improve income here people must have work hour. In the morning everyone is more upbeat but in the afternoon…'.

Morcegagem – or not working when you should be working - was cited by the coordinator and by others as a major problem at work. In an interview with two members, the issue was vigorously discussed. We talked while they worked on sorting in one container, when others were away still on their lunch break. C. says:

> We came to work still at lunch hour. But many people don't care. They think that because there is a lunch hour they can buy time. I think if two or three have come to the containers, everyone else should come. The collective should come, because, otherwise, we earn from this here [containers].

D. adds that 'there are many people who fiddle around here. We should be earning 600 bucks or more. We have a lot of material here'. They argue further, and C. asks me:

> Would you like someone to earn your money in your place? The money is here [in the container]. Sometimes you earn little because the collective doesn't show interest at the work. … The right thing here, with the collective, would be to empty six containers per day. Seven people are absent in a day here, sometimes even more. How do you want to achieve a good number? The collective here chats, answers the phone, all the time. Phone here should be allowed only at lunchtime. To work and earn is very good, but to work for others?

According to C., things only improve when they threaten to discount the day. She said that a system of individual production does not work there; if each one works for her own production there will be more problems, she says. D. states that with a production target 'then money would show up'. She said they could earn more, 'there is material, the containers are all full'. C. comments that 'look! It's already time to be back. Where? Are they back?' 'Here', D. says, 'if people in general had more responsibility, we would be making some 500 a week'. She said they get paid on Thursdays, and by Wednesday, the last day to weight materials, 'when Wednesday comes and they see that weighting [quantity] is weak, they go nuts, go nuts'. F. says she does not agree with the system of equal pay and would rather it be based on individual production. When discussing the possibility of production target she said that if it worked it would be great: 'the bats which only like to *morcegar* would be here until eight o'clock at night'.

A recurrent theme on my third visit was about who was to be sent to the Big Shopping – the shopping mall in Contagem where the association has got members sorting materials on site. One person who normally goes, could not make it on a certain day and another had to be sent as a substitute. Arguments began early in the morning and lasted throughout the day. The group suggested B. to go. But B. was unhappy with how matters were being handled: '…I, who have been there [at the shopping mall], the group gets together and says "you go, B., you will have to go", they want to boss around. [They] don't ask if we want'. And adds that, 'if it were the coordinator, the boss, that would come and explain, but the colleagues, who don't even ask if I want to go, want to boss around'. She says further that

> I could even go, but [they] have to know how to talk to me, pay the bus ticket… The newer members [are] the bossiest… this one here [pointing to E.] even cries by the container. I don't cry, I scold.

E. corrected that 'now I started to scold'.

Absence emerged as a major source of conflict. It also appears to be a persistent problem. On my first visit to ASMAC, the coordinator commented that several people had not come to work. On my second visit, there was significant commotion over the issue. One member, D., exclaimed in frustration: 'seven at once!' H. said that absences affect production but that it doesn't help to talk to absentees. The rate of absence was one of the two themes discussed in a meeting the coordinator held with members, and which I had the chance to observe. Most members gathered together for the meeting. The first topic addressed was the problem with the scale: the scale for weighting materials was somewhat defective and the group had to decide collectively if to stop weighting materials until the problem was resolved. Their salary is calculated based on the day's production quantity and type of materials. Henceforth, postponing the weighting would lead to postponing the payment, as they discussed. One associate, C., stated that, to her, they should stop weighting materials; she said she does not mind to be without money, that nothing moves forward in that organization and that they are all 'a group of suckers'. Associates were brainstorming on possible solutions. The issue that the government demands three different offers by three suppliers before it can make a purchase was raised. The problem was temporarily resolved with a scale the coordinator borrowed from someone, but the issue of purchase of a new scale was not resolved; it appeared they intended to address it with the municipality. Discussion shifted to the second major topic, that of absences. One associate

stated that absences have to be announced way in advance, with a week's notice. Dona Ercy explained that in the case of emergency, that will not work. She suggested that whenever people had to miss work that they tried to do it by leaving work earlier because in the morning production is greater. Ultimately, no concrete measures to address absences were established in the meeting.

Lateness and leaving work early are additional issues. According to B., there is a notebook where everyone has to write down the time they arrived and the time they left the association, and sign. She says 'there is cheating, there are people who leave at 12h for example, then come back and say that left at 16h'. F. says that not everyone respects arrival and leaving hours.

One issue that seems to complicate matters at work regarding absences is their policy of *horas na casa*, or hours on the house, a system in which it is possible to accumulate extra hours and then claim them, apparently without coordinating claims, resulting in many people missing work on a same day. There seems to be several ways in which members can accumulate extra hours. A couple of examples are when a member accompanies the collection truck on Saturdays and earns a day of work, and the hours earned by associates who participate at assemblies. B. said that she does not miss any of the meetings and earns hours; E. said that 'Before, I missed [assembly] because I didn't know that we earned hours. Now I really don't miss it'. What happens is that when members are absent but have hours on the house, they receive payment for the workday even though they did not participate in production. Those who come and work on the day's production must divide their pay with the absentees. On absences, H. explained 'if you have hours you don't lose, if you don't have hours you lose the day. The value varies'. The only rule on absences seems to be that if a member misses work and does not have extra hours accumulated to cover for the absence, she does not earn for that day. With extra hours, absences are covered and there is no penalty.

The remuneration scheme, which is based on the production achieved per day of work, was confusing at first because while I got the information that income was based on the value of the day worked, I also got the explanation that materials are not weighted everyday: 'when there is no weighting [during the week] and accumulates all on Wednesday, then it becomes heavy', said B.. Wednesday is the last day of weighting before pay-day. I had the

chance to observe how materials are weighted, and it turned out to be that materials should *ideally* be weighted everyday, but in practice that does not happen because the coordinator requires that she is herself present in the weighting of materials, and she is not at the premises all the time. Bags with materials to be weighted were arranged in bundles along the corridor. B. filled me in on how it works:

> Everything I did yesterday over there [points to container] I know everything I did over there. Here, here is container 5, I know everything I do here. The others also know. That dark bag over there I know it was I who did it yesterday. We know, [we] know the way we tie it, I know.

The coordinator was not at the association when weighting took place but had given the permission for it to be carried out because, according to one member, there was a trusted member at the association on that day. One member said 'there is trouble if we weight [materials] without her authorization. She is only allowing it because K. is here'. Several members were mobilized to weight materials. Heavy bags had to be pulled from the corridor to the scale, which they did in groups. One member held a notebook in which the weight of materials was written down. There did not seem to be any other identification tool matching a bag to its day of production other than the claim by someone that she made that bag and when. There seemed to be materials all the way from the past week's Thursday, Friday, and the present week's Monday and Tuesday. Weighting proceeded with complaints popping up frequently about the need for more people to help with pulling the bags and with back-and-forth shouts of who made a particular bag and when:

> Is this from Friday?
> Friday or yesterday?
> This is from Friday. I'm sure. I made it.

And:

> That one is from which day?
> I don't know!
> Ah, we put it on Thursday, Friday, it's the same.
> It's from yesterday!

Although confusing at sight and time-consuming, there did not seem to be major conflicts on the identification process; there was questioning of to which day bags belonged to, but often someone claimed to know it and the process continued. Occasionally, though, there was real confusion:

> Guys, this mixed here is from which day?
> You can put yesterday.

I asked K. whether it was not better to weight every day, and she replied: 'that's what I'm saying, the right thing is to weight material every day, but the coordinator is not here

everyday. It's for the trust'. I asked whether this system did not lead to confusion and one member answered that 'confusion happens, last week we had big confusion'. The whole procedure took quite a long time, over 40 minutes, during which the majority of members were mobilized in the task of weighting.

4.4.8 Monitoring & Sanctions

During the interview with B. and E., the pair noticed one member, J., who was leaving. B. whispered to E., 'is J. leaving?', and they both looked at what time it was and one of them wrote it down. I asked if they feel the need to monitor and the reply was positive, with one noting that '[we] must monitor, we observe here…' B. asked me in the beginning of our conversations whether I worked for the government, to which I replied in detail that I did not, and explained where I come from, what I do and what I study. Thereafter she became a very important source of information. According to F., there are people marking the hours, such as H. and I., and also A.. She says this is in everyone's interest. H. said 'I check the absences, lateness, it's my work. Nothing goes unaccounted for'. H. is the *de facto* vice-coordinator. A. states that 'without rules it's very difficult, there are people who don't respect the rules, it's very difficult here'.

The coordinator said she has to have a strong hand, direct and demand from members. She said complaints are often taken to her, rather than to one another, and that she calls on everyone for meetings to discuss the problems. Physical fights are forbidden, she says, and issues must be put at meetings. These are held as often as necessary, she says. F. says she prefers not to demand directly from others because she says that it leads to fights; she prefers to send matters to the coordinator. Dona Ercy stated that they first address problems with verbal warnings. Then, if not resolved, they resort to written warnings and finally, if problems continue they can expel members but she says it has not gotten to that point. C. put it this way: 'do we fight amongst ourselves? Yes we do. But we fight for good cause, because we want improvement'.

4.4.9 Admission rules

New members are admitted through voting by current members. There is an experimental period, according to Dona Ercy, and if the prospective candidate does not adapt, he/she has to leave. New members are taken based on the quantity of materials. She said there can be

resistance to the admission of new members since it can impact income level. One member, B., explained that

> Every time someone new enters, [income] breaks a bit. We keep on looking, if it works out, stays. Everyone observes if [he/she] is working or *morcegando*[26]. Then, [in the] day of meeting we can say if not working. We vote if she stays.

There are many members there without a course, B. says, but that whoever has been there for longer teaches the others. One member, F., who was sorting materials alone in one container, said she knows all types of plastics:

> If you don't know, there is no way to sort. It leads to problems because one [type] is expensive and the other is cheaper. That's why people must take a course. Some of it [materials] is garbage.

4.4.10 Challenges & Opportunities

The director of the selective collection program discussed several challenges to the program and to the association. Costs are a big problem: selective collection is very costly to the municipality and this affects its expansion to other areas of the city. Competition for waste also undermines the program since the municipality is the one who incurs the expenses of setting up the program and its infra-structure while the agent who appropriates the material in its place contributed with nothing. On whether ASMAC could provide the service of selective collection to the city, Natalie states:

> No, no. They even wanted to do it. But they don't even succeed to do the management of the facility yet. They haven't taken on the expenses of the facility. You saw them talk about the scale today… the presser… should be acquired by the association itself. The equipment would be theirs, not an equipment that the municipality cedes to them.

She said further, that

> It's a question of consciousness, of self-management, to understand that in the beginning it will be a bit more complicated because income will fall by a bit but that it will be… it will give them the autonomy forever. They are not yet thinking at this level, they are still at the question of dependence, of the obligation of the municipality… Not that it isn't the obligation of the municipality to implement, but it is not the obligation of the municipality to maintain the organizations in the manner we do here…

The municipality, she explains, could opt, for instance to take into account all the expenses it has with the selective collection program and devise a system in which waste pickers are

[26] 'Morcegando' comes from the term 'morcegar', which they frequently use when refering to the behavior of not working when they should be working; fiddling around; free-riding.

hired at a salary to sort the materials. The model adopted at Contagem, however, is one of inclusion and integration, she explains; it is not only an environmental project but also a program of inclusion. If it were only environmental, she says, they would focus the resources on collection of materials. I asked her what they at ASMAC expect from the municipality, to which she replied: 'they expect everything from the municipality. Everything of donations, everything which could improve for them, they expect, and they demand it, always, always…'

Dona Ercy had said in our interview that income at the level they achieve at ASMAC Perobas is an advantage for people with no schooling. Income level was cited by G. as what attracted her to the association - she used to earn only the minimum salary at her previous job. B. cited another aspect she appreciated at the association: the chance to travel. She said she has travelled to see other waste picker organizations in different locations and that 'we take our news, I take things from my organization, I come back with proposals from there…'. Older members of ASMAC, such as C. and D., pointed that their conditions have markedly improved with the organization. E., who has also been at ASMAC from its beginnings and who is older and not allowed to participate on the door-to-door scheme due to health reasons, says that today she cannot handle the waste picker's cart anymore and considers the system at Perobas better for her. A. says she loves her job and that sometimes she does not see the time passing. C., who began to pick waste still in her childhood, says that, through recycling, today she has her own car and that next, she dreams to buy a home.

4.4.11 Their results

This section sums up the major results of ASMAC Perobas, in terms of income, recovery rates, and the mix of services it can offer and profit from. Income levels vary considerably. Members go from sometimes earning just above the country's minimum salary to a salary and a half. Income has in the past reportedly peaked to around R$ 2.000. These fluctuations show up in Figure 6. But at the time of this research, complaints were frequent about income level, which reached a low point of approximately R$ 190 per week. Some members pointed to the association's falling short of its earnings potential, something frequently attributed to the lack of commitment by members. Other factors emerged that affect production, namely the delays of the ecobags for residents, and the problem with the

defective scale. They have not yet been able to become a service provider for collection services to the city.

5 RESULTS: WASTE PICKER INSTITUTIONS IN LIGHT OF OSTROM'S DESIGN PRINCIPLES

In this chapter, data is examined through the lens of theory. Ostrom's eight design principles will be applied to the two case studies described above. With the research questions in mind, discussion takes place on the degree to which the principles characterize the cases, and whether there might be a relationship between the presence of the principles and their institutional performance. The eighth principle, *Nested Enterprises*, is only briefly covered. The lesser emphasis is a result of limited resources to collect enough data to enable a deeper analysis.

5.1 Design Principle 1. Clearly defined boundaries

The first principle concerns boundaries, both at the level of the CPR boundaries and at the level of who has rights to withdraw units from it (Ostrom 1990, 90). One way to look at the boundaries of the waste commons analyzed here is by looking at city borders, based on the legal responsibility of each municipality to take care of its own waste. The city of Itaúna, for instance, has a selective collection program in place which covers its own area; that translates into the area COOPERT's services and collects materials from. The waste ASMAC receives from the city is also in accordance with Contagem's collection scheme. But city borders delineate only the responsibility and appropriation of waste by the municipalities – other actors, such as waste pickers and middlemen, can enter different cities' waste commons and appropriate of waste materials. Legislation calls for the inclusion of waste pickers in waste management but, as COOPERT's administrative manager noted, does not guarantee to them the ownership of waste: others actors can and do appropriate of waste, also under the conditions of when the municipality has spent with the implementation and infrastructure of a program for collection, as was recounted by Contagem's director of selective collection. That is, resource boundaries are highly penetrable to different actors and exclusion is difficult. At this level of analysis a number of potential appropriators can be identified, including individual waste pickers, organizations of waste pickers, the municipality which collects dry waste through its programs, and the many middlemen and other intermediaries, all of whom appropriate waste materials from the commons. Unrestricted appropriation as is the case here configures open access and can potentially lead to rent dissipation. In fact, COOPERT's administrative manager did speak about competition for waste and of their income level

being reduced due to the interception of valuable recyclables by others. An in-depth analysis of the waste commons, its participants, and the incentives structure underlying it is, however, beyond the scope of this study. The focus of this study is the waste picker institutions.

Both COOPERT and ASMAC have rules concerning the admission of new members, including when to admit new members and an experimental period in which candidates are evaluated. Current members vote on admission and the majority decides whether the new person enters. Concerns over a candidate's productivity were evident in both organizations. A balance must be found between the number of members an institution has and the quantity of recyclables it can access, or the result can be lower incomes to all. Rent dissipation, according to Ostrom (1990, 48), is when 'the marginal returns from an appropriation process are smaller than the marginal costs of appropriation'. Both organizations appear to be in full control over who can enter and become member. They are, however, affected by issues related to the overall access to waste: income suffers at COOPERT when other actors appropriate of waste materials it piled up to collect, and at ASMAC only 25 of the planned 110 (or 23%) are members of the organization, something largely attributed to the insufficient quantity of materials. Appropriate access to waste materials is a problem and potential threat for the future of these organizations. Thus, design principle 1 cannot be regarded as strongly present in the institutions.

5.2 Design Principle 2. Congruence between appropriation and provision rules and local conditions

Design principle 2 concerns the '[p]roportional equivalence between benefits and costs', so that 'the rules-in-use allocate benefits proportional to inputs that are required' and that these be tailored to local conditions (Ostrom 2005, 262). The open access condition that characterizes the waste commons at the macro level leads to problems regarding appropriation and provision: appropriation at the macro level is characterized by difficulties of exclusion of potential beneficiaries who may not have contributed to the provision of the commons. Such conditions pose serious challenges to collection programs and, consequently, to the access to waste materials by organizations of waste pickers. In the case of COOPERT, its costs with collection are reportedly significant and materials are sometimes intercepted by other actors who have not contributed with the costs and labor of gathering the materials from streets. ASMAC Perobas does not incur the costs of collection

themselves, but are impacted by the viability and access to waste materials by the municipality's program.

At the level of the institutions studied, members work together in the sorting and commercialization of the recyclables, and the benefits achieved through their collective action is shared amongst all members, equally. Costs are also shared, since when a member does not give his/her best effort, the result is shared with everyone else. There are several benefits associated with membership (e.g. friendship; access to training programs). This analysis focuses on the income aspect. At COOPERT, strict rules are in place with the aim of securing commitment and all members' contributions to making their earnings. For example, the strict absence and lateness/leaving-early rules work to ensure that members show up to work and that there are enough people to create production. Such rules resonated with members, as demonstrated in the previous chapter, in that they openly pointed to the relevance of the rules and the connection to results achieved. The benefit in terms of income is clear since earnings are superior than other numbers encountered in literature and at ASMAC itself, as well as in relation to the national minimum wage. Work division at COOPERT is clear, which helps to know one's responsibility and also gets the work moving faster: from my observations, members were quick to assume their tasks. I conclude that design principle 2 is very much present at COOPERT.

In contrast, at ASMAC, this principle seems rather weak. While at COOPERT work division is clear, at ASMAC work is based on what there is to do and who is present on a given day. The high rate of absences has the double effect of hurting production and creating conflicts amongst members. There did not seem to be any rules in place to secure desired contributions, such as rules to regulate absences. And, if there were, they were either ineffective or not followed. The scheme of extra hours was at the core of this problem because it enabled for members accumulate hours and then spend them by not showing up to work in an uncoordinated manner, while later benefiting with a share of the production achieved by others who came to work. At ASMAC, one's income does not necessarily reflect one's contribution to the work, and this was made clear by the frequent comments on free-riding and on having to work for others. The way some members found to cope with the imbalance between benefits and costs was to stop working when they saw others were had stopped. This obviously leads to outcomes that nobody wants.

As discussed in the beginning of this section, boundary challenges, difficulties of exclusion and the lack of appropriation/provision rules at the level of the waste commons can impact the long-term sustainability of the institutions even when, at the internal level, the principle is strong, as is the case of COOPERT. COOPERT at present is characterized by a strong presence of design principle 2 but may face difficulties in the future if competition for waste increases and unrestricted access continues at the macro level. The stint at the World Cup events revealed that some rules exist in the appropriation of waste by waste pickers even in circumstances where they do not know each other and where bags full of valuable recyclables stand at fixed points without *de jure* property rights. Dona Geralda's comments on the 'historical spots' also point to interesting arrangements already in use by some actors in the waste commons. Further studies are necessary to understand fully who are the participants and how appropriation and provision happens at the macro level.

5.3 Design Principle 3. Collective-choice arrangements

This principle has to do with the degree to which the rules to be followed were crafted or modified by those meant to follow the rules (Ostrom 1990, 93). When individuals affected by the rules are also those who can make and modify them, chances are that the rules have a better fit with the local circumstances and find greater legitimacy with appropriators (Ostrom 1990, 93; Ostrom 2005, 263-265). Both institutions are based on the principle of *autogestão*, or self-management, in which the organization is run by its members, in a system of collective decision-making. Members have equal voting power to decide on matters raging from whether to allow a new person to enter, to which members will be in charge of administration activities, and to the choice of the operational rules that will regulate the day-to-day work. Local authorities in both cases do not interfere with the internal matters of the organizations nor do they enforce the internal rules crafted by members. Waste pickers design their own regulatory schemes and are the ones responsible for enforcing them. Thus, both ASMAC and COOPERT have the autonomy to create their own rules, pointing to a strong presence of design principle 3. Still, as noted by Ostrom (1990, 93), one thing is to have rules, quite another is to follow them: '[a]ctually following rules ex post, when strong temptations arise, is the significant accomplishment'. We then turn to the next design principle: monitoring.

5.4 Design principle 4. Monitoring

Ostrom (2005, 265) states that '[f]ew long-surviving resource regimes rely primarily on endogenous levels of trust and reciprocity among appropriators to keep rule breaking levels down'. The effect of monitoring rule compliance is not restricted only to catching offenders: it also assures conditional cooperators that conformance to rules is being verified and that they are not being suckers (ibid.). Furthermore, monitoring is associated with the sustainability of resource systems (ibid., 265-266). Monitoring is identified in both waste picker institutions analyzed in this study and is conducted not by external actors but by members of the organizations themselves. At COOPERT, the fiscal counsel is responsible for officially monitoring the group and reporting problems to the administration. The counsel, composed by three active members and three substitutes, also supervises data on production, commercialization, absences, and payment calculations. As one member pointed out in the interview, the counsel supervises the administration. The mechanism at COOPERT, to verify arrival and leaving times with the registration card enables for a precise checking on hours worked. There is also an informal type of monitoring, in which members watch one another's behavior and work effort. The resulting observation may be accompanied by a direct comment on the other's behavior, or, as some prefer, it may be taken to the administration for them to resolve the problem. That is because monitoring fellow members is not always well received and may incur personal costs to the monitor. Participants in interviews made it clear that they do demand from one another and that they 'pull' each other up at work. Design principle 4 is very much present at COOPERT.

At ASMAC, a specific position of monitor, in kind with the fiscal counsel, was not identified, and according to one member, there is no fiscal counsel at that unit. The vice-coordinator was said to monitor absences and work time, but it was the *de facto* vice-coordinator that was most often seen actively monitoring others. Mutual monitoring is very much practiced. Members seemed very skeptical of each others' contributions to the collective effort and often expressed frustration at free-riding and at having to work for others. At one instance, two members being interviewed actively watched a fellow associate leave the premises early, and wrote down the time she left in order to later check if she had written it correctly at the notebook. The method of documenting arrival and leaving times are by one's own writing at a notebook, which, according to these members,

is not always written with accuracy. Similarly to COOPERT, there are those who prefer to report violations to the administration and avoid direct confrontations with fellow associates. Design principle 4 is strong at the organization, but, although there is monitoring at ASMAC, it seemed to still fall short of generating changes of behavior in members. The high rates of absences, for instance, were monitored – members seemed to know how many people were absent – but that did not seem to stop people from being absent. With this thought in mind, the next principle, of graduated sanctions, is analyzed.

5.5 Design Principle 5. Graduated sanctions

> A real threat to the continuance of self-organized regime occurs, however, if some participants break rules repeatedly. The capability to escalate sanctions enables such a regime to warn members that if they do not conform, they will have to pay ever higher sanctions and may eventually be forced to leave the community. (Ostrom 2005, 267).

At COOPERT sanctions were mentioned in connection to rule violations. For example, if the 30-minute monthly lateness allowance is spent, and a member arrives late without prior notification and without a proof of emergency, he/she loses two days-worth of work, meaning that he/she must come to work but will not receive any payment for it. Verbal warnings are given when rule infractions occur, followed by more serious penalties in case the problem persists. Finally, members can be expelled from the cooperative without the need for votes in assembly, because the statute already allows for it to happen depending on the type of offense. Members interviewed seemed very well aware of the rules and of what happens if they are broken, leading to a comment by a member that the cooperative is stricter than private firms. Design principle 5 appears strong at COOPERT.

At ASMAC, graduated sanctions to address rule violations were described by the coordinator as first a verbal warning, second a written warning and, finally, being expelled from the organization. Sanctions, however, did not seem to address recurrent problems members complained about, such as the frequency and incoordination of absences and the free riding behavior by some. Rather, the opposite of sanctioning seem to be in place: due to the system of extra hours and its accumulation, together with the lack of sanctions on unannounced absences, it is possible for members to miss work and still receive a share of what others produced on that day. The frequency of complaints by participants on some members fiddling around instead of working also points to the direction of the wrong incentives in place. Finally, members conveyed to me a general sense of disbelief in the system – that things just do not work the way they should there. Design principle 5, on

graduated sanctions is very weak at ASMAC. As such, it does not support monitoring efforts as it should to encourage compliance and cooperation.

5.6 Design Principle 6. Conflict-resolution mechanisms

According to Ostrom (1990, 90), this principle means that '[a]ppropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials'. Conflicts do take place in both organizations. At COOPERT, conflicts were not observed during field study but members did, however, speak of fights, and that they ultimately resolve them. Conflict resolution mechanisms were described as informal conversations between members and meetings with the presence of the administration when necessary. These appear to have a positive effect on resolving conflicts, based on how members refer to conflicts as existing but which get resolved. In relation to the local government, the partnership between COOPERT and the municipality appeared to achieve results they both appreciate, which is indicative of their cooperation and suggests they find mechanisms to resolve their differences. These findings point to effective conflict resolution mechanisms. At ASMAC, the environment was tenser, and frustration was explicitly verbalized by members, notably in discussions over absences and over aspects of work division. Members can request meetings to address conflicts and I had the chance to be an observer at a meeting in which the problem of frequent absences was discussed, but to which no solution was arrived at. The issue then turns to the effectiveness of the existing mechanisms to address the conflicts at hand. Their relationship with the city's selective collection team appeared strained, suggesting also that the mechanisms in place to address differences is falling short of resolving them. I therefore conclude that ASMAC's conflict resolution mechanisms are weak. In general, for both organizations, more research would be necessary to understand how existing mechanisms work, their strengths and their shortcomings.

5.7 Design Principle 7. Minimal recognition of rights to organize

This principle refers to the level of autonomy groups of appropriators have to devise their own institutions without having their arrangements challenged by external government authorities (Ostrom 1990, 90). When authorities do not recognize the legitimacy of the institutional arrangements created by appropriators they may not be able to sustain their institutions (ibid., 101). This principle is present in both institutions studied here. The

governments of Itauna and Contagem do not interfere with the internal arrangements of the waste picker organizations studied, and actually support them financially. The institutions are governed by waste pickers themselves, in accordance with their principle of self-management.

5.8 Design Principle 8. Nested enterprises

In larger, more complex systems, there are different levels of organization, with specific rules pertaining to each (Ostrom 1990, 101-102). COOPERT and ASMAC are both part of the same network of waste pickers, the Cataunidos network. The specific activities of the network and how these relate to the member organizations were not studied in depth. But the importance of a network scheme to waste picker organizations was discussed in this thesis to some extent. As noted by COOPERT's administrative manager, Márcia, this level of organization enables for the joint commercialization of recyclables and for the exchange of experiences, both essential components for their competitiveness and growth. What can be said at this point is that they are organized in nested enterprises, that networks are very important to the development of their organizations, and that more research is recommended to understand how the network works.

6 DISCUSSION & CONCLUSIONS

In this chapter, I discuss the findings of this study and present its conclusions. This is followed by a section on limitations of the study and suggestions for future research.

6.1 Discussion & concluding remarks

The first research question of this thesis is '*To which extent are the Core Design Principles for the Efficacy of Groups present in these institutions?*'As the analysis in the previous section demonstrated, Ostrom's core design principles for the efficacy of groups are found to be present to different extents in the self-devised institutions of waste pickers studied in this thesis. A summary of the principles, of their application and a resulting diagnosis of the extent to which they are present (or absent) are shown in Table 4, below. According to Ostrom (1990, 179), long-enduring, robust institutions are characterized by all the principles, whereas a maximum of three were found to characterize 'cases in which CPR appropriators were clearly unable to solve the problems they faced', configuring a failed institutional performance (Ostrom 179-180). Fragility stands in the middle between robust performance and failure:

> Enough of the principles are in use to enable appropriators to solve some of their immediate CPR problems, but one would be hesitant to predict institutional endurance unless further institutional development occurs and the arrangements come closer to meeting the full set of design principles. (Ostrom 1990, 181)

In examining the extent to which the institutions are characterized by the design principles, the measures 'strong' and 'weak' were used. 'Strong' means the principle applies to the institution, while 'weak' means the principle does not fully apply but is not absent either. Had a principle not characterized an institution at all, the term 'absent' would have been used.

Table 4. Application of Design Principles & Institutional Performance.

Ostrom's Design Principles		**ASMAC**		**COOPERT**	
(Ostrom 1990; Ostrom 2005)		**Description**	**Diagnosis**	**Description**	**Diagnosis**
1	**Clearly defined boundaries** - at the level of resource boundaries and of users boundaries	Clear boundaries in terms of who can become a member; decisions on membership controlled by all current members; prospective candidates are thoroughly evaluated and submitted to a voting system. Resource boundaries: open access	Weak	Clear boundaries in terms of who can become a member; decisions on membership controlled by all current members; prospective candidates are thoroughly evaluated and submitted to a voting system. Resource boundaries: open access	Weak
2	**Congruence between appropriation and provision rules and local conditions** - proportional equivalence between benefits and costs	Benefits in terms of income fell short of the potential of the institution; complaints over free-riding were widespread; high rate of absence and lack of mutual trust on the amount of individual effort dedicated to joint objectives	Weak	Benefits in terms of income are highly valued by members and were accompanied by strict work rules that ensure contribution to productivity and commitment to the collective effort	Strong

Ostrom's Design Principles		ASMAC		COOPERT	
(Ostrom 1990; Ostrom 2005)		Description	Diagnosis	Description	Diagnosis
3	**Collective-choice arrangements** - individuals affected by rules participate in the making and modifying of rules	Rules were made and modified by members themselves	Strong	Rules were made and modified by members themselves	Strong
4	**Monitoring** - rule compliance is monitored by individuals accountable to appropriators, or by appropriators themselves	*De facto* vice-coordinator engaged in monitoring absences and hours worked; vigorous mutual monitoring strengthens monitoring - members informally engaged in verifying hours worked by others; mutual monitoring on effort; system of registration of work time is a notebook and its effectiveness was questioned by members	Strong	Formal monitoring scheme with a designated team of elected supervisors responsible for monitoring members and supervising administrative tasks; mechanism of hour-card to control arrival/leaving enables for precise and unbiased calculations of work time. Presence of mutual monitoring on effort strenghtens monitoring	Strong
5	**Graduated sanctions** - appropriators who violate operational rules are likely to be assessed graduated sanctions	Graduated sanctions exist but their effectiveness is questionable; behaviors members complain about (e.g. absences; free-riding) appear persistent and recurrent; existing sactions are either not implemented in practice or are not enough to bring about desired results.	Weak	Graduated sanctions exist; rule-breaking is followed by penalties that are enforceable given the monitoring tecniques in place; rule followers seemed very informed about them; members appeared reassured the system works to bring about compliance and comitment.	Strong
6	**Conflict-resolution mechanisms** - appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.	Conflict resolution mechanisms exist in the form of meetings with the presence of the coordinator; effectiveness, however, is an issue due to the persistence of at least some conflicts which seemed to greatly frustrate members; in relation to the local government, relationship appears strained; mechanisms to address their points of divergence do not seem effective.	Weak	Conflict resolution mechanisms exist in the form of informal conversations, meetings and with presence of the administration if necessary; they appear effective; in relation to the local government, it appears their partnership achieves results that they both appreciate, indicating that there is more cooperation than conflicts.	Strong
7	**Minimal recognition of rights to organize** - the rights of appropriators to devise their own institutions are not challenged by external government authorities.	Local authorities do not interfere with the internal arrangements of the institution, allowing for ASMAC members to actively manage their institution. Subsidies are provided by the municipality in the form of collection and delivery of materials for recycling at no cost for the association, space, water, electricity, technical assistance and capacity building courses.	Strong	Local authorities do not interfere with the internal arrangements of the institution, allowing for COOPERT members to actively manage their institution; subsidies are provided in the form of space, water and electricity; new facility for COOPERT being built by municipality in partnership with other government actors.	Strong
8	**Nested enterprises** - appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.	ASMAC is part of CATAUNIDOS, a network of waste pickers organizations set to promote joint commercialization and the exchange of experiences; more information is needed on how the network works, its responsibilities, rules, and benefits to the organizations.	n.a. Requires more research	COOPERT is part of CATAUNIDOS, a network of waste pickers organizations set to promote joint commercialization and the exchange of experiences; more information is needed on how the network works, its responsibilities, rules, and benefits to the organizations.	n.a. Requires more research
Institutional Performance		**FRAGILE**		**ROBUST**	

COOPERT is characterized by almost all the principles in strong form, the only exception being design principle 1: although COOPERT has full control of who enters the organization as a new member, the institution is affected negatively by the fact that, at the macro level, the resource system configures open access. Potential beneficiaries are hard to

exclude and unrestricted access coupled with the subtractability feature (e.g. the post-consumer PET bottle collected by one waste picker is not available for collection by another) can in the future lead to rent dissipation. Open access may in the future threaten the sustainability of the waste picker institutions if more appropriators compete for the resource. At this point in time, however, COOPERT does have the contract for municipal collection and is able to access a sufficient portion of the resource flow to maintain its institutional performance high. Moreover, COOPERT is characterized by a strong presence of all other principles. I therefore conclude that COOPERT shows a robust institutional performance. ASMAC, on the other hand, is characterized by only three principles in strong form, namely collective-choice arrangements, monitoring and minimal recognition of rights to organize. Although no principle was entirely absent, the remaining four design principles were present only in weak form. ASMAC is considered a fragile institution, one in which appropriators are able to solve some of their problems but the institution remains at risk of not surviving in the long-term (see Ostrom 1990, 179).

The second question of this study is '*Is there a relationship between the extent to which the Principles are employed and the performance of the institutions in terms of income level generated, recyclables recovered, and progress in the mix of services they provide?'* Table 5, below, gives a snapshot of the results of the institutions in terms of income level, recycling rates, and mix of services they can offer.

Table 5. Snapshot of results

	Members	Business model	Members engaged in sorting and commercialization related activities	Avg. Volume of recyclables commercialized (tonnes/month)	Avg. Productivity per capita (tonnes/month/person) in sorting and commercialization related activities	Average income (R$/month /person)	Source of materials	Institutional performance
ASMAC Perobas	25	Sorting & commercialization	25	67,3	2,69	967,50	Municipality's collection; donations from businesses	Fragile
COOPERT	70	Collection, sorting & commercialization	44*	160	3,64	2 400,00	Coopert's own collection (service provided to municipality); donations from businesses; autonomous waste pickers	Robust

*Number derived from total members (70) minus number of members engaged in collection services only (26) = 44 members engaged in sorting and commercialization related activities. This distinction enables for more precise comparison with ASMAC,whose members are engaged in sorting and commercialization activities only. The goal is to understand productivity levels in these particular activities.

*Avg. Productivity per capita calculation: Avg. Volume of recyclables commercialized/members engaged in sorting and commercialization related activities.

*ASMAC's average income calculated based on range R$ 200-250 for recent incomes, and COOPERT's based on range R$2.200-2.600.

In terms of income, COOPERT displays significantly higher average income per month per person than ASMAC. Their income level is also high for Brazil's standards (the current minimum salary is R$ 880 (Exame 2015a)). Moreover, COOPERT's members expressed appreciation for the income level at the cooperative. At ASMAC, members income level received criticism. Even though it is still high by the nation's standards – and values occasionally fluctuate upwards, as can be seen on the graph on Figure 6 – members expressed discontent for the income received and frustration at the group's lack of commitment which, some argued, prevented them from reaching higher levels of productivity and income. In terms of recycling rates, COOPERT displays higher productivity per person – 3,64 tonnes/month/person, compared to ASMAC's 2,69 tonnes/month/person. That is not to say that ASMAC's relative production is too low: only a more comprehensive comparison involving other organizations could really tell about relative productivity levels. Their number, if put against the study on efficiency by IPEA (2010, 40) falls under the category of high productivity which displays an average productivity per waste picker of 2,29 tonnes/w.p./month. It does not follow, however, that in absolute terms productivity should not be improved. More production means higher income, greater possibilities to admit more members and create more jobs, and higher payments received for environmental contributions. It can also have positive effects in strengthening their business and increasing competitiveness in the uncertain environment of waste management. The third factor examined here is their service mix. This is particularly important because it reflects the capability of the institution to be a regular, reliable services provider (see Gerdes & Gunsilius 2010). The competitiveness of waste picker enterprises relates to their capacity to regularly supply materials to industry and to be reliable services providers (Gerdes & Gunsilius 2010). COOPERT has a contract with the municipality in which it is responsible for the entire collection of the city's dry waste. The service generated 26 new jobs at the cooperative and increased their income level. ASMAC has not yet been able to take on activities like this. As explained by the director of the Contagem's selective collection program, they do not have the capacity to supply collection services when they cannot even manage their own business yet or cover its own expenses.

The conclusion regarding the relationship between the design principles and the performance of the institutions is that there appears to be a strong relationship between the

degree to which the principles are present in these institutions of waste pickers and the results they achieve.

The final research question asks '*What contributions can this approach bring to waste picker organizations and to theory?*'. The results of this research show that Ostrom's core design principles for the efficacy of groups are applicable to institutions of waste pickers and are related to their institutional performance. It contributes to the work of waste picker organizations by showing how the relationship between the principles and performance works. In light of these findings, the design principles could be used by waste picker institutions to evaluate performance and to make a diagnosis of what to improve in order to enhance institutional performance and improve their results. As mentioned by Dona Geralda, ASMARE's founding member, the future of the *catador* is uncertain because waste is now regarded as valuable by many others. Understanding how the principles work and how they shape incentives may be useful to boost capacity building and strengthen waste picker institutions so they can best tackle the challenges they have ahead.

At a theoretical level, the findings of this study corroborate with other findings in CPR theory, in which the presence or absence of the design principles in institutions is associated with their robustness and the results they are able to obtain. Findings also support the proposition put forward by Wilson, Ostrom and Cox (2013) that the design principles are applicable to groups beyond the traditionally studied groups of natural resource commons. In this way, this study strengthens the case for the generalizability of the principles across groups. This study also contributes to the conceptualization of waste as resource, more specifically, of waste as a common-pool resource, and to the growing body of research on urban commons.

CPR theory may prove very useful in the field of waste management, notably in developing countries where waste is perceived as a resource by a number of actors and where property rights over waste may be either not defined or to difficult to enforce. Ostrom cautioned, however, against the notion of panacea-type solutions, that is, 'recommendations that a single governance-system blueprint (e.g. government ownership, privatization, community property) should be applied to all environmental problems' (Ostrom, Janssen & Anderies 2007, 15176). Rather than advocating 'cure-all' solutions, a diagnostic approach to the commons is recommended, where both shared attributes across

CPRs as well as particular, contextual factors are taken into account (Ostrom, Janssen & Anderies 2007; Basurto & Ostrom 2009). Thus, in evaluating the way forward with regards to waste, it is important that attention be given to a diversity of possible solutions that together can bring about efficient waste and resource management in developing countries. As discussed in Baud, Grafakos, Hordijk and Post (2001), partnerships in solid waste management differ in terms of their contributions to sustainable development, and the results of alliances must be evaluated in this regard.

6.2 Limitations of the study and recommendations for future research

This is a qualitative case study, covering only two cases. It is therefore limited in terms of its generalizability. Also, with regards to the cases analyzed, time and financial constraints prevented a more in-depth, complete research from being accomplished. There are aspects that could not be covered given the limited time spent in the field such as data at the network level and a more profound research of the principles themselves. More research is recommended also beyond the principles because factors other than the ones covered by them can potentially affect performance, an issue raised in Cox, Arnold and Villamayor Tomás (2010). Henceforth, additional research on what factors affect efficiency, and on the degree to which the principles are present in organizations of waste pickers will further contribute to the understanding of efficiency in their settings and on what is the way forward in improving it. It is also essential that research be conducted at the level of the waste commons: participants (e.g. municipality, waste pickers, middlemen, other appropriators of waste materials such as incineration plants), incentives structure, the question of boundaries and open access, appropriation and provision rules, all must be understood in order for waste as a resource to be managed efficiently and with the best possible results in terms of the environment, shared prosperity, and energy and materials efficiency, all crucial dimensions of sustainable development.

7 REFERENCES

ABRELPE (Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais) (2014). *Panorama dos Resíduos Sólidos no Brasil 2014.* Available at: http://www.abrelpe.org.br/Panorama/panorama2014.pdf In Portuguese. (accessed 9 December 2015).

Agência Minas Gerais (2015). *Governo coloca Bolsa Reciclagem em dia e projeta ampliação dos incentivos*. Media release 29 October. Available at: http://www.agenciaminas.mg.gov.br/noticia/governo-coloca-bolsa-reciclagem-em-dia-e-projeta-ampliacao-dos-incentivos In Portuguese. (accessed 20 January 2016).

Axelrod, R. (1984). *The Evolution of Cooperation*. New York, NY: Basic Books.

Baldé, C.P.; Wang, F.; Kuehr, R. & Huisman, J. (2015). *The global e-waste monitor – 2014*, United Nations University, IAS – SCYCLE, Bonn, Germany. Available at: http://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf (accessed 10 January 2016).

Basurto, X. & Ostrom , E. (2009). 'The core challenges of moving beyond Garrett Hardin'. *Journal of Natural Resources Policy Research,* **1**, No. 3, 255-259. Doi: 10.1080/19390450903040447.

Baud, I.; Grafakos, S.; Hordijk, M. & Post, J. (2001). 'Quality of Life and Alliances in Solid Waste Management. Contributions to Urban Sustainable Development'. *Cities,* **18**, No. 1, 3–12. Available at: http://www.iacenter.ir/uploads/Quality_of_Life_and_Alliances_in.pdf (accessed 21 December 2015).

Biller, D. & Malinowski, M. (2015) 'Brazil's inflation surpasses 10% for first time in 12 years'. *Bloomberg Business.* 19 November. Available at: http://www.bloomberg.com/news/articles/2015-11-19/brazil-consumer-inflation-exceeds-10-for-first-time-in-12-years (accessed 13 January 2016).

Bonifazi, G. & Cossu, R. (2013). 'The Urban Mining concept'. *Waste Management*, **33**, 497–498. http://dx.doi.org/10.1016/j.wasman.2013.01.010

Butti, L. (2012). 'Birth and death of waste'. *Waste Management,* **32**, 1621–1622. http://dx.doi.org/10.1016/j.wasman.2012.05.030

Cavé, J. (2014). 'Who owns urban waste? Appropriation conflicts in emerging countries'. *Waste Management & Research*, **32**, No.9, 813-821. Doi: 10.1177/0734242X14540978

CEMPRE (Compromisso Empresarial para Reciclagem) (2013). *CEMPRE Review 2013*. Sao Paulo. Available at: http://cempre.org.br/artigo-publicacao/artigos In Portuguese. (accessed 29 October 2015).

CEMPRE (Compromisso Empresarial para Reciclagem) (2014). *Guia da Coleta Seletiva de Lixo*. 2nd Edition. Sao Paulo. Available at: http://cempre.org.br/artigo-publicacao/artigos In Portuguese. (accessed 29 October 2015).

Chaturvedi, A.; Arora, R. & Saluja, M.S. (2015). 'Private sector and waste management in Delhi: A political economy perspective'. *Institute of Development Studies* (*IDS). IDS Bulletin,* **46** Number 3 May 2015, 7-16.

Chi, X; Streicher-Porte, M.; Wang, M.Y.L. & Reuter, M.A. (2011). 'Informal electronic waste recycling: A sector review with special focus on China'. *Waste Management,* **31,** 731–742.

doi:10.1016/j.wasman.2010.11.006

Chikarmane, P. (2012). 'Integrating waste pickers into municipal solid waste management in Pune, India'. *WIEGO Policy Brief (Urban Policies) No. 8. July 2012*. Women in Informal Employment: Globalizing and Organizing (WIEGO). Available at: http://wiego.org/sites/wiego.org/files/publications/files/Chikarmane_WIEGO_PB8.pdf (accessed 15 December 2015).

Cossu, R. & Williams, I.D. (2015). 'Urban mining: concepts, terminology, challenges'. *Waste Management*, **45**, 1–3. http://dx.doi.org/10.1016/j.wasman.2015.09.040

Cox, M.; Arnold, G. & Villamayor Tomás, S. (2010). 'A review of design principles for community-based natural resource management'. *Ecology and Society* **15**(4): 38. Available at: www.ecologyandsociety.org/vol15/iss4/art38/ES-2010-3704.pdf (accessed 13 February 2016).

Cruz, N.H. & Leite, J. (2016). 'Petrobras near $1, stocks at decade low: Brazil's rout in charts'. *Bloomberg Business*. 26 January. Available at: http://www.bloomberg.com/news/articles/2016-01-26/petrobras-near-1-stocks-at-decade-low-brazil-s-rout-in-charts (accessed 27 January 2016).

Demajorovic, J.; Besen, G.R. & Rathsam, A.A. (2004). 'Gestao compartilhada dos resíduos sólidos – novos atores e conflitos'. In *Congresso Brasileiro de Ciência e Tecnologia em Resíduos e Desenvolvimento Sustentável*. Florianópolis 2004. Available at: https://www.ipen.br/biblioteca/cd/ictr/2004/ARQUIVOS%20PDF/06/06-094.pdf In Portuguese. (accessed 25 January 2016).

Dias, S. (2002). *Construindo a Cidadania: Avancos e Limites do Projeto de Coleta Seletiva em Parceria com a ASMARE.* Master's Thesis. Instituto de Geociências, UFMG (Universidade Federal de Minas Gerais). Belo Horizonte. Available at: http://www.inclusivecities.org/wp-content/uploads/2012/07/Dias_Construindo_a_Cidadania.pdf In Portuguese. (accessed 26 May 2015).

Dias, S. (2011a). 'Integrating informal workers into selective waste collection: The case of Belo Horizonte, Brazil'. *WIEGO Policy Brief (Urban Policies) No. 4.* May 2011. Women in Informal Employment: Globalizing and Organizing (WIEGO). Available at: http://wiego.org/sites/wiego.org/files/publications/files/Dias_WIEGO_PB4.pdf In Portuguese. (accessed 1 December 2015).

Dias, S. (2011b). 'Recycling in Belo Horizonte, Brazil – An overview of inclusive programming'. *WIEGO Policy Brief (Urban Policies) No. 3.* May 2011. Women in Informal Employment: Globalizing and Organizing (WIEGO). Available at: http://wiego.org/sites/wiego.org/files/publications/files/Dias_WIEGO_PB3.pdf In Portuguese. (accessed 1 December 2015).

Dias, S. (2011c). 'Statistics on waste pickers in Brazil'. *WIEGO Statistical Brief No. 2.* May 2011. Women in Informal Employment: Globalizing and Organizing (WIEGO). Available at: http://wiego.org/sites/wiego.org/files/publications/files/Dias_WIEGO_SB2.pdf In Portuguese. (accessed 15 December 2015).

Digital Library of the Commons (n.d.). 'Research on the Commons, Common-Pool Resources, and Common Property'. *Indiana University. (n.d.)*. Available at: https://dlc.dlib.indiana.edu/dlc/contentguidelines (accessed 1 February 2016).

Dijkema, G.P.J.; Reuter, M.A. & Verhoef, E.V. (2000). 'A new paradigm for waste management'. *Waste Management,* **20**, 633-638.

EC (European Commission) (2008). DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT and of the COUNCIL of 19 November 2008 on Waste and Repealing Certain Directives 312, pp. 3-30 . Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0098&from=EN (accessed 20 November 2015).

EEA (European Environment Agency) (2015). *How much of our municipal waste do we recycle?* 12 March. Available at: http://www.eea.europa.eu/media/infographics/recycling-rates-in-europe-1/view (accessed 9 January 2016).

Eisenhardt, K.M. (1989). 'Building theories from case study research'. *The Academy of Management Review*, **14**, No. 4, 532-550.

Eriksson, P. & Kovalainen, A. (2008). *Qualitative Methods in Business Research*. London: Sage Publications.

Estado de Minas Gerais (2011). *Lei no. 19.823, de 22 de novembro de 2011*. Available at: http://www.siam.mg.gov.br/sla/download.pdf?idNorma=19694 (accessed 20 January 2016).

Exame (2015a). 'Salário mínimo vai para R$880 em 2016'. *Exame*. 29 December. Available at: http://exame.abril.com.br/economia/noticias/salario-minimo-vai-para In Portuguese (accessed 21 January 2016).

Exame (2015b). 'Taxa de desemprego no Brasil deve atingir 10% em 2016'. *Exame*, 15 November. Available at: http://exame.abril.com.br/economia/noticias/taxa-de-desemprego-no-brasil-deve-atingir-10-em-2016 (accessed 13 January 2016).

Ezeah, C. & Roberts, C.L. (2014). 'Waste governance agenda in Nigerian cities: A comparative analysis'. *Habitat International,* **41**, 121e128. http://dx.doi.org/10.1016/j.habitatint.2013.07.007

Fahmi, W.S. & Sutton, K. (2006). 'Cairo's Zabaleen garbage recyclers: Multi-nationals' takeover and state relocation plans'. *Habitat International,* **30**, 809–837. doi:10.1016/j.habitatint.2005.09.006

Gerdes, P. & Gunsilius, E. (2010). *The Waste Experts: Enabling Conditions for Informal Sector Integration in Solid Waste Management. Lessons learned from Brazil, Egypt and India.* Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH. Eschborn, March 2010. Available at: http://www.giz.de/de/downloads/gtz2010-waste-experts-conditions-is-integration.pdf (accessed 17 October 2015).

Gutberlet, J. (2009). 'Solidarity economy and recycling co-ops in Sao Paulo: micro-credit to alleviate poverty'. *Development in Practice*, **19**, No. 6, 737-751. Published by: Taylor & Francis, Ltd. On behalf of Oxfam GB. doi: 10.1080/09614520903026892

Gutberlet, J. (2015). 'Cooperative urban mining in Brazil: collective practices in selective household waste collection and recycling'. *Waste Management,* **45**, 22–31. http://dx.doi.org/10.1016/j.wasman.2015.06.023

Hammersley, M. & Atkinson, P. (2007). *Ethnography: Principles in Practice*. 3rd edition. Routledge. Taylor and Francis e-library, 2007.

Hardin, G. (1968). 'The tragedy of the commons'. Science, **162**, 1243-1248.

Harsanyi, J.C. (1994). 'Games with Incomplete Information'. *Nobel Lecture, December 9, 1994.* Available at http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1994/harsanyi-lecture.pdf (accessed 13 September 2015).

Hoornweg, D. & Bhada-Tata, P. (2012). *What a Waste: A Global Review of Solid Waste Management.* The World Bank, Urban Development Series Knowledge Papers, No. 15. Available at: http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf (accessed 13 October 2015).

Hoornweg, D.; Bhada-Tata, P. & Kennedy, C. (2014). 'Peak Waste. When is it likely to occur?' *Journal of Industrial Ecology,* **19**, No.1, 117-128. doi: 10.1111/jiec.12165

Hoornweg, D.; Lam, P. & Chaudhry, M. (2005). *Waste Management in China: Issues and Recommendations.* The World Bank, working paper No. 9. Available at: http://siteresources.worldbank.org/INTEAPREGTOPURBDEV/Resources/China-Waste-Management1.pdf (accessed 9 November 2015).

IBGEa (Instituto Brasileiro de Geografia e Estatística) (n.d.). *Cidades*. Available at: http://cidades.ibge.gov.br/painel/painel.php?codmun=310620 (accessed 20 January 2016).

IBGEb (Instituto Brasileiro de Geografia e Estatística) (n.d.) *Projeção da População do Brasil e das Unidades da Federação.* Available at: http://www.ibge.gov.br/apps/populacao/projecao/ (accessed 13 January 2016).

IBGEc (Instituto Brasileiro de Geografia e Estatística) (n.d.) *Cidades*. Available at: http://www.cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=313380 (accessed 22 February 2016).

IBGEd (Instituto Brasileiro de Geografia e Estatistica) (n.d.) *Cidades*. Available at: http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=311860&search=||infogr%E1ficos:-informa%E7%F5es-completas (accessed 22 February 2016).

ILO (International Labour Organization) (2014). *Tackling Informality in e-waste Management: The Potential of Cooperative Enterprises.* Sectoral Activities Department (SECTOR), Cooperatives Unit (COOP). Geneva. Available at: Available online at: ILO http://www.ilo.org/public/libdoc/ilo/2014/114B09_165_engl.pdf (accessed 27 October 2015).

IMF (International Monetary Fund) (n.d.). *Data and Statistics*. Available at: http://www.imf.org (accessed 13 January 2016).

INSEA (Instituto Nenuca de Desenvolvimento Sustentável) (2014). *Cataunidos começa a comercialização em rede.* 31 July. Available at: http://www.insea.org.br/cataunidos-comeca-a-comercializacao-em-rede/# In Portuguese. (accessed 21 January 2016).

IPEA (Instituto de Pesquisa Econômica Aplicada) (2010). *Pesquisa sobre Pagamento por Serviços Ambientais Urbanos para Gestao de Resíduos Sólidos. Relatório de Pesquisa*. Diretoria de Estudos e Políticas Regionais, Urbanas e Ambientais (Dirur). Brasília, 2010. Available at: http://www.ipea.gov.br/portal/images/stories/PDFs/100514_relatpsau.pdf In Portuguese. (accessed 12 December 2015).

IPEA (Instituto de Pesquisa Econômica Aplicada) (2013). *Situação Social das Catadoras e dos Catadores de Material Reciclável e Reutilizável – Brazil.* Brasília, 2013. Available at: http://www.ipea.gov.br/portal/images/stories/PDFs/situacao_social/131219_relatorio_situacaosocial_mat_reciclavel_brasil.pdf In Portuguese (accessed 9 December 2015).

Kiernan, P. & Trevisani, P. (2015). 'S&P cuts Brazil's debt rating to junk. Drop to BB+ based on challenges to the government's efforts to balance budget'. *The Wall Street Journal.* 9 September. Available at: http://www.wsj.com/articles/s-p-drops-brazil-debt-rating-one-notch-to-junk-

1441838102 (accessed 13 January 2016).

Kornberger, M. & Borch, C. (2015). 'Introduction: Urban Commons'. In Borch, C. & Kornberger, M. (Eds.), *Urban Commons: Rethinking the City.* (pp. 1-21). Abingdon: Routledge.

Lane, R. (2011). 'The waste commons in an emerging resource recovery waste regime: contesting property and value in Melbourne's hard rubbish collections'. *Geographical Research*, 49, No. 4, 395-407. Doi: 10.1111/j.1745-5871.2011.00704.x

Lepawsky, J. (2015). 'The changing geography of global trade in electronic discards: time to rethink the e-waste problem'. *The Geographical Journal,* **181**, No. 2, 147–159. doi: 10.1111/geoj.12077

Marshall, R.E. & Farahbakhsh, K. (2013). 'Systems approaches to integrated solid waste management in developing countries'. *Waste Management,* **33**, 988–1003. http://dx.doi.org/10.1016/j.wasman.2012.12.023

McKean, M. (1986). *Success on the Commons: A Comparative Examination of Institutions for Common Property Resource Management*. Digital Library of the Commons, Indiana University. Available at: http://dlc.dlib.indiana.edu/dlc/handle/10535/5349 (accessed 13 June 2015).

Medina, M. (2007). 'Waste picker cooperatives in developing countries'. In Chen, M.; Jhabvala, R.; Kanbur, R. & Richards, C. (Eds). *Membership-Based Organizations of the Poor.* Available at: *https://books.google.com.br/books?id=gs-TAgAAQBAJ&pg=PT117&dq=martin+medina++waste+pickers&hl=en&sa=X&redir_esc=y#v=onepage&q=martin%20medina%20%20waste%20pickers&f=false* (accessed 24 January 2016). Abingdon, Oxon: Routledge.

Medina, M. (2008). 'The informal recycling sector in developing countries. Organizing waste pickers to enhance their impact'. Gridlines. October 2008, No. 44. Public-Private Infrastructure Advisory Facility (PPIAF). World Bank. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/10586/472210BRI0Box31ing1sectors01PUBLIC1.pdf?sequence=1 (accessed 13 October 2015).

Melo, C. (2009). 'Viver é preciso. Reciclar, mais ainda. Maria das Graças Marçal, a Dona Geralda da Asmare: uma vida inteira reciclada, a comecar pelo proprio nome'. *Revista Ecologico*. 09 September. Available at: http://www.revistaecologico.com.br/materia.php?id=11&secao=132&mat=135 In Portuguese. (accessed 23 January 2016).

MNCR (Movimento Nacional dos Catadores de Materiais Recicláveis) (2008). *Principios e objetivos do MNCR.* 1 January. Available at: http://www.mncr.org.br/sobre-o-mncr/principios-e-objetivos In Portuguese. (accessed 20 January 2016).

MNCR (Movimento Nacional dos Catadores de Materiais Recicláveis) (2011). *História do MNCR*. 19 March. Available at: http://www.mncr.org.br/sobre-o-mncr/sua-historia In Portuguese. (accessed 27.1.2016).

Negrão, M.P. (2014). 'Urban solid waste are commons? A case study in Rio de Janeiro region, Brazil'. *Prepared for delivery at the Workshop on the Ostrom Workshop (WOW5) Conference.* Indiana University, Bloomington: June 18-21. Available at: http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/9390/WG9_Pires%20Negrao.pdf?sequence=1&isAllowed=y (accessed 26 May 2015).

Nobel Prize (2009). 'Elinor Ostrom – Facts'. *The Sveriges Riksbank Prize in Economic Sciences in*

Memory of Alfred Nobel 2009. Available at: http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/ostrom-facts.html (accessed 3 February 2016).

North, D.C. (1991). 'Institutions'. *The Journal of Economic Perspectives*, **5**, No.1, 97-112.

Nzeadibe, T.C. & Anyadike, R.N.C. (2012). 'Social participation in city governance and urban livelihoods: Constraints to the informal recycling economy in Aba, Nigeria'. *City, Culture and Society,* **3**, 313–325. http://dx.doi.org/10.1016/j.ccs.2012.10.001

OECD (2015), *Material Resources, Productivity and the Environment.* OECD Green Growth Studies, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264190504-en Available at: http://www.oecd.org/env/waste/material-resources-productivity-and-the-environment-9789264190504-en.htm (accessed 26 January 2016).

Oliveira, F.G. & Lima, F.P.A. (2012). 'Eficiência e Solidariedade nas Associações de Catadores de Materiais Recicláveis'. *Working Paper da WIEGO (Políticas Urbanas), No. 22*. February 2012. Women in Informal Employment: Globalizing and Organizing (WIEGO). Available at: http://www.inclusivecities.org/wp-content/uploads/2012/07/Goulart_WIEGO_WP22_pt.pdf In Portuguese. (accessed 21 January 2016).

Olson, M. (1965). *The Logic of Collective Action. Public Goods and the Theory of Groups*. Harvard University Press.

Osterwalder, A. & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers and Challengers*. New Jersey: John Wiley and Sons.

Ostrom, E. (1990). *Governing the Commons. The Evolution of Institutions for Collective Action. Cambridge University Press*. Cambridge.

Ostrom, E. (2002). 'Common-pool resources and institutions: toward a revised theory'. In Gardner, B. & Rausser, G. (Eds.), *Handbook of Agricultural Economics*. Vol. 2. Chapter 24 (pp.1315-1339). Elsevier Science B.V.

Ostrom, E. (2003). 'How types of goods and property rights jointly affect collective action'. *Journal of Theoretical Politics*, **15**, No. 3, 239-270.

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton, NY: Princeton University Press.

Ostrom, E. (2009). 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems*'*. *Nobel Prize*. Nobel Prize Lecture 2009. 8 December. Available at: http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/ostrom_lecture.pdf (accessed 6 March 2016).

Ostrom, E.; Janssen, M.A. & Anderies, J.M. (2007). 'Going beyond panaceas'. *PNAS*, **104**, No. 39, 15176-15178. Doi: 10.1073/pnas.0701886104

Ostrom, V. & Ostrom E. (1999). 'Public goods and public choices'. In McGinnis, M.D. (Ed.), *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis.* Ann Arbor: The University of Michigan Press.

Park, J.Y. & Chertow, M.R. (2014). 'Establishing and testing the "reuse potential" indicator for managing wastes as resources'. *Journal of Environmental Management*, **137**, 45-53. http://dx.doi.org/10.1016/j.jenvman.2013.11.053

Pindyck, R.S. & Rubinfeld, D.L. (2009). *Microeconomics*. 7th edition. Upper Saddle River, NY:

Pearson Education Inc.

Portal Brasil (2013). 'Valor do salário mínimo vai para R$ 724 em 2014'. *Portal Brasil*. 23 December. Available at: http://www.brasil.gov.br/economia-e-emprego/2013/12/valor-do-salario-minimo-vai-para-r-724-em-2014 In Portuguese. (accessed 15 February 2016).

Presidência da República (2010). *Lei no. 12.305, de 2 de agosto de 2010*. Available at: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm In Portuguese (accessed 20 January 2016).

Raghupathy, L.; Krüger, C.; Chaturvedi, A.; Arora, R. & Henzler, M.P. (2010). 'E-Waste Recycling In India – Bridging The Gap Between The Informal And Formal Sector'. Available at: http://www.iswa.org/uploads/tx_iswaknowledgebase/Krueger.pdf (accessed 1 December 2015).

Rutkowski, J.E. (2008). *Sustentabilidade de Empreendimentos Econômicos Solidários – uma Abordagem na Engenharia de Produção*. PhD. Thesis. COPPE/UFRJ (Universidade Federal do Rio de Janeiro. Rio de Janeiro, September 2008.

Rutkowski, J.E. & Rutkowski, E.W. (2015). 'Expanding worldwide urban solid waste recycling: The Brazilian social technology in waste pickers inclusion'. *Waste Management & Research,* **33**, 1084–1093 . doi:10.1177/0734242X15607424

Sambo, P.; Orr, E. & Godoy, D. (2015). 'Brazilian Real drops to record low against U.S. Dollar'. *Bloomberg Business*. 22 September. Available at: http://www.bloomberg.com/news/articles/2015-09-22/brazil-s-currency-tumbles-to-record-on-pessimism-over-budget (accessed 13 January 2016).

Scheinberg, A.; Spies, S.; Simpson, M.H. & Mol, A.P.J. (2011). 'Assessing urban recycling in low- and middle-income countries: Building on modernised mixtures'. *Habitat International,* **35**, 188-198. doi:10.1016/j.habitatint.2010.08.004

Schindler, S. & Kishore, B. (2015). 'Why Delhi cannot plan its 'new towns': The case of solid waste management in Noida'. *Geoforum,* **60**, 33–42. http://dx.doi.org/10.1016/j.geoforum.2015.01.008

Schindler, S.; Demaria, F. & Pandit, S. (2012). 'Delhi's Waste Conflict'. Economic & Political Weekly (EPW), XLVII, No. 42, 18-21. Available at: http://www.jnu.ac.in/sss/cssp/Delhis_Waste_Conflict.pdf (accessed 9 December 2015).

Scholz, R.W. & Tietje, O. (Eds.). (2002). *Embedded Case Study Methods.* Thousand Oaks, CA: SAGE Publications, Inc. doi: http://dx.doi.org/10.4135/9781412984027

Sharholy, M.; Ahmad, K.; Mahmood, G. & Trivedi, R.C. (2008). 'Municipal solid waste management in Indian cities – A review'. *Waste Management,* **28**, 459–467. doi:10.1016/j.wasman.2007.02.008

SLUa (Superintendência de Limpeza Urbana) (n.d.). *Coleta Seletiva em BH*. Media release (n.d.). Prefeitura de Belo Horizonte. Available at: http://portalpbh.pbh.gov.br/pbh/ecp/comunidade.do?evento=portlet&pIdPlc=ecpTaxonomiaMenuPortal&app=slu&tax=34900&lang=pt_BR&pg=5600&taxp=0& In Portuguese. (accessed 15 December 2015).

SLUb (Superintendência de Limpeza Urbana) (n.d.). *Cooperativas-Associações. Catadores e trabalhadores com materiais recicláveis.* Media release (n.d.) Prefeitura de Belo Horizonte. Available at:

http://portalpbh.pbh.gov.br/pbh/ecp/comunidade.do?evento=portlet&pIdPlc=ecpTaxonomiaMenuPortal&app=slu&tax=34902&lang=pt_BR&pg=5600&taxp=0& In Portuguese. (accessed 15 December 2015).

Straffin, P.D. (1993). *Game Theory and Strategy*. 5th printing. Washington, DC: The Mathematical Association of America.

Tirado-Soto, M.M. & Zamberlan, F.L. (2013). 'Networks of recyclable material waste-picker's cooperatives: An alternative for the solid waste management in the city of Rio de Janeiro'. *Waste Management,* **33,** 1004–1012. http://dx.doi.org/10.1016/j.wasman.2012.09.025

Tucker, C. (1999). 'Common property design principles and development in a Honduran community'. *PRAXIS: The Fletcher Journal of Development Studies*, **XIV**, 1-22. Available at: http://fletcher.tufts.edu/praxis/archives/~/media/fletcher/microsites/praxis/xv/tucker.pdf (accessed 25 May 2015).

UN (United Nations) (2015). Data query, total population. Department of Economic and Social Affairs, Population Division. Available at: http://esa.un.org/unpd/wpp/DataQuery/ (accessed 28 December 2015).

UN-Habitat (United Nations Human Settlements Programme) (2012). *State of the World's Cities Report 2012/2013: Prosperity of Cities.* Nairobi, Kenya. Available at: https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=745&menu=1515 (accessed 28 October 2015).

UNEP (United Nations Environment Programme) (2015). *Global Waste Management Outlook*. Available at: http://unep.org/ietc/ourwork/wastemanagement/GWMO (accessed 16 November 2015).

Van de Klundert, A. & Anschütz, J. (2001). *Integrated Sustainable Waste Management – The Concept. Tools for Decision Makers. Experiences from the Urban Waste Expertise Programme (1995-2001).* Series ed.: Scheinberg, A. Available at: http://www.waste.nl/sites/waste.nl/files/product/files/tools_iswm_concept_eng1.pdf (accessed 8 January 2016).

Veja (2016). 'Brasil vai encolher 3.5% em 2016 e não vai crescer em 2017, diz FMI'. *Veja*. 19 January. Available at: http://veja.abril.com.br/noticia/economia/fmi-preve-retracao-de-35-dda-economia-brasileira-em-2016 In Portuguese. (accessed 19 January 2016)
Wade, R. (1987). 'The management of common property resources: collective action as an alternative to privatization or state regulation. *Cambridge Journal of Economics*, **11**, 95-106.

Waldmeir, P. (2015). 'China's rural migrants: life as a trashpicker in a Shanghai hole'. *Financial Times*. 19 June. Available at: http://www.ft.com/cms/s/2/cd19caea-101c-11e5-bd70-00144feabdc0.html#slide0 (accessed 28 June 2015).

Wang, F.; Huisman, J.; Meskers, C.E.M.; Schluep, M.; Stevels, A. & Hagelüken, C. (2012). 'The Best-of-2-Worlds philosophy: Developing local dismantling and global infrastructure network for sustainable e-waste treatment in emerging economies'. *Waste Management,* **32**, 2134–2146. http://dx.doi.org/10.1016/j.wasman.2012.03.029

Wilson, D.C.; Araba, A.O.; Chinwah, K.; Cheeseman, C.R. (2009). 'Building recycling rates through the informal sector '. *Waste Management,* **29**, 629–635. doi:10.1016/j.wasman.2008.06.016

Wilson, D.S., Ostrom, E. & Cox, M.E. (2013). 'Generalizing the core design principles for the

efficacy of groups'. *Journal of Economic Behavior & Organization* **90S**, S21–S32 . http://dx.doi.org/10.1016/j.jebo.2012.12.010

World Bank (2012). *Wasting No Opportunity. The Case for Managing Brazil's Electronic Waste. Project Report April 2012.* InfoDev/The World Bank. Washington DC. Available at: http://www.infodev.org/articles/wasting-no-opportunity-case-managing-brazils-electronic-waste (accessed 6 December 2015).

World Bank (2013). *Harnessing Urbanization to End Poverty and Boost Prosperity in Africa. An Action Agenda for Transformation.* The World Bank. Africa Region Sustainable Development. Washington DC, 2013. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2013/10/21/000442464_20131021121716/Rendered/PDF/815460WP0Afric00Box379851B00PUBLIC0.pdf (accessed 26 October 2015).

World Bank (n.d.). *Brazil, Overview*. Available at: http://www.worldbank.org/en/country/brazil/overview (accessed 13 January 2016).

Yin, R.K. (2011). *Qualitative Research from Start to Finish*. New York, NY: The Guilford Press.

Yin, R.K. (2012). *Applications of Case Study Research*. 3rd edition. Thousand Oaks, CA: Sage Publications.

Yin, R.K. (2014). *Case Study Research: Design and Methods*. 5th edition. Thousand Oaks, CA: Sage Publications.

Yu, J.; Williams, E.; Ju, M. & Yang, Y. (2010). 'Forecasting Global Generation of Obsolete Personal Computers'. *Environmental Science & Technology,* **44***,* 3232–3237. doi: 10.1021/es903350q

Zapata, P. & Zapata Campos, M.J. (2015). 'Producing, Appropriating, and Recreating the Myth of the Urban Commons'. In Borch, C. & Kornberger, M. (Eds.), *Urban Commons: Rethinking the City.* (pp. 92-108). Chapter 4. Abingdon: Routledge.

Zhang, D.Q.; Tan, S.K. & Gersberg, R.M. (2010). 'Municipal solid waste management in China: Status, problems and challenges'. *Journal of Environmental Management,* **91**, 1623-1633. doi:10.1016/j.jenvman.2010.03.012

Zhang, H. & Wen, Z. (2014). 'The consumption and recycling collection system of PET bottles: A case study of Beijing, China'. *Waste Management,* **34,** 987–998. http://dx.doi.org/10.1016/j.wasman.2013.07.015

8 APPENDIX

Appendix 1 – The Prisoner's Dilemma Game

Table 6. The general form of Prisoner's Dilemma (adapted from Straffin 1993, 73 and Rapoport & Chammah 1970, cited in Straffin 1993, 74).

		Player 2: Cooperate	Player 2: Defect
Player 1	Cooperate	**(R, R)** (0, 0)	**(S, T)** (-2, 1)
	Defect	**(T, S)** (1, -2)	**(U, U)** (-1, -1)

C: cooperate
D: defect
R: reward for cooperation
S: sucker payoff
T: temptation payoff
U: uncooperative payoff

Conditions: $T > R > U > S$ and $R \geq (S + T) / 2$

Appendix 2 - Field visits table

Table 7. Field visits. Source: Rocha Perrupato-Stahl, Carla.

ASMAC-Galpao Perobas - Contagem, Minas Gerais

VISITS	3	HOURS	11h
INTERVIEWS	9	individual: 6 / group (in pairs): 3	
Total number of participants:	12		

INTERVIEWS

Interviewee	Position	Duration	Type of Interview
Dona Ercy	General coordinator	1h	individual
4 short individual interviews	Member associates	average duration: 22 min	individual
1 long individual interview	Member associate	40 min	individual
2 short group interviews	Member associates	average duration: 30 min	group
1 long group interview	Member associates	1h 30 min	group

Municipal Office for the Environment, Contagem (Secretaria Municipal do Meio Ambiente, Contagem)

VISIT	1	HOURS	1h 15min
INTERVIEWS	1	(individual: 1 / group: 0)	

Interviewee	Position	Duration	Type of Interview
Natalie Rates	Director of Selective Collection Programme	1h 15min	individual

ASMARE - Belo Horizonte, Minas Gerais

VISITS	1	HOURS	35 min
INTERVIEWS	1	(individual: 1 / group: 0)	

Interviewee	Position	Duration	Type of Interview
Dona Geralda	Asmare's founding member and coordinator	35 min	individual

COOPERT - Itaúna, Minas Gerais

VISITS	2	HOURS	9h 30min
INTERVIEWS	4	(individual: 1 / group: 3)	
Total number of participants:	8		

INTERVIEWS

Interviewee	Position	Duration	Type of Interview
Sérgio Cunha Márcia	City's solid waste manager Coopert's administrative manager	1h 25min	group
2 Group interviews at sorting facility	Seven total active participants*	average duration: 1h 10min each	group
Márcia	Coopert's administrative manager	1h 9min	individual
Lecture by Sérgio Cunha, Itaúna city's solid waste manager, at an event on the Environment week, 3.6.2014 in Itaúna (aprox. 1 hour).			

*There were more than seven participants in total, as the interviews took place by the conveyor belt where when full had 11 people working. But (A) participation was more active by those nearby where I was and (B) some participated only occasionally and some not at all.

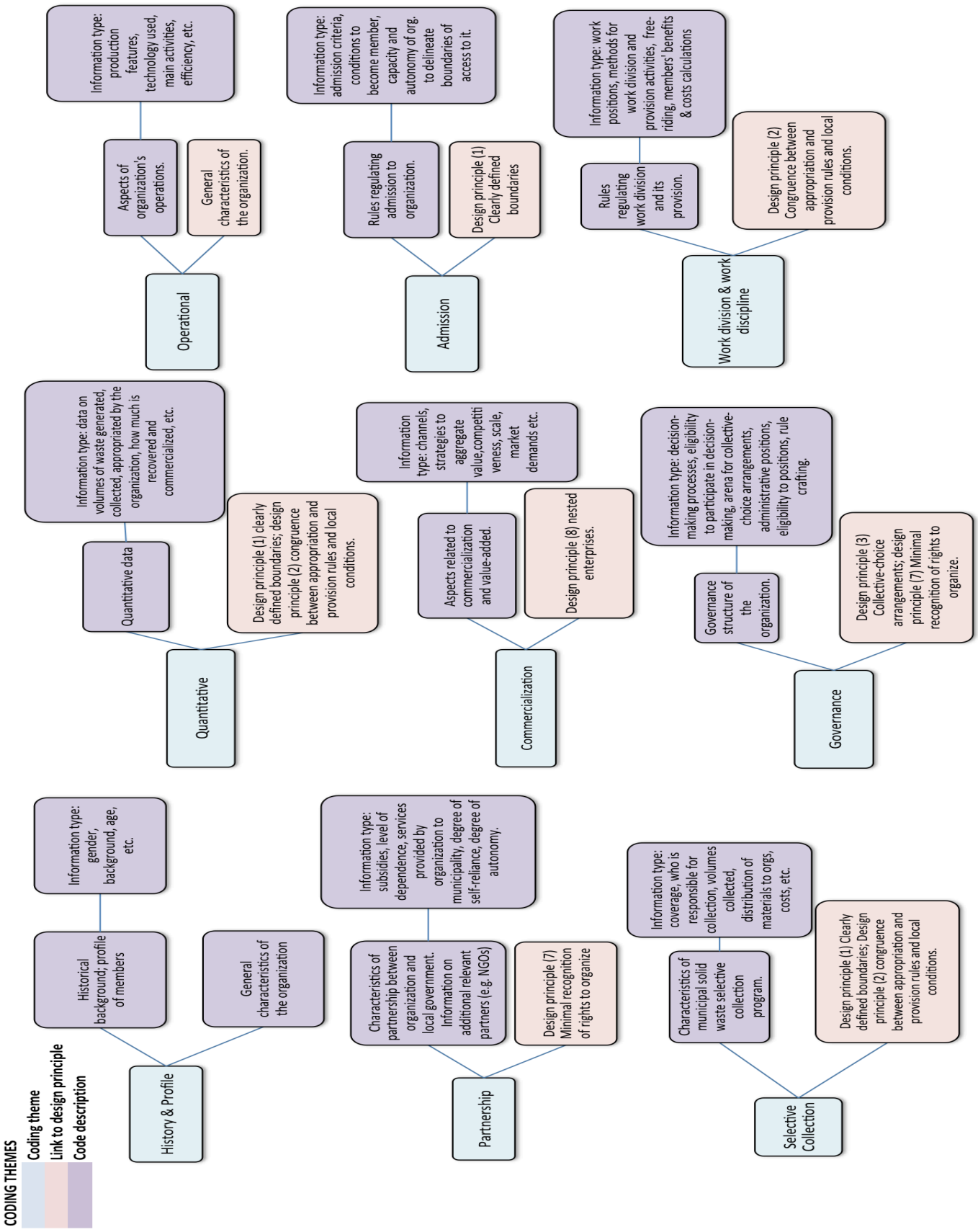
WORLD CUP 2014 - Waste Pickers in Action - Belo Horizonte, Minas Gerais

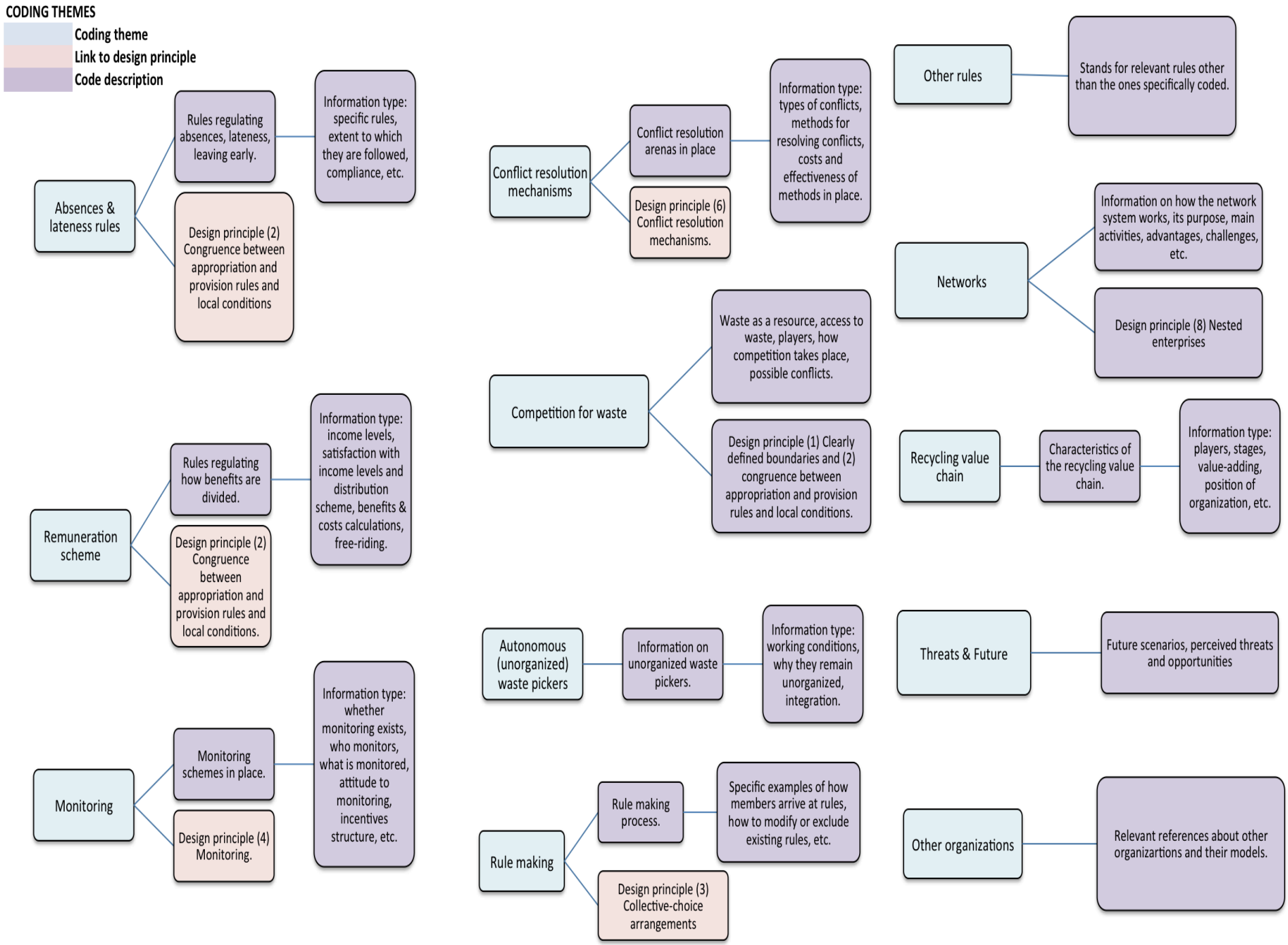
VISITS		HOURS	
	2 events	1st event	16:30h-18:20h & 21:15h-22:15h
		2nd event	17:30h-18:50h & 22:30h-23h

LOCATION: Savassi, public gathering as part of World Cup games festivities

INTERVIEWS: Short conversations with members of ASMARE, who were there collecting recyclables.

Appendix 3 – Coding Themes




CODING THEMES
Coding theme
Link to design principle
Code description
Absences & lateness rules
Rules regulating absences, lateness, leaving early.
Information type: specific rules, extent to which they are followed, compliance, etc.
Design principle (2) Congruence between appropriation and provision rules and local conditions
Remuneration scheme
Rules regulating how benefits are divided.
Information type: income levels, satisfaction with income levels and distribution scheme, benefits & costs calculations, free-riding.
Design principle (2) Congruence between appropriation and provision rules and local conditions.
Monitoring
Monitoring schemes in place.
Information type: whether monitoring exists, who monitors, what is monitored, attitude to monitoring, incentives structure, etc.
Design principle (4) Monitoring.
Conflict resolution mechanisms
Conflict resolution arenas in place
Information type: types of conflicts, methods for resolving conflicts, costs and effectiveness of methods in place.
Design principle (6) Conflict resolution mechanisms.
Competition for waste
Waste as a resource, access to waste, players, how competition takes place, possible conflicts.
Design principle (1) Clearly defined boundaries and (2) congruence between appropriation and provision rules and local conditions.
Autonomous (unorganized) waste pickers
Information on unorganized waste pickers.
Information type: working conditions, why they remain unorganized, integration.
Rule making
Rule making process.
Specific examples of how members arrive at rules, how to modify or exclude existing rules, etc.
Design principle (3) Collective-choice arrangements
Other rules
Stands for relevant rules other than the ones specifically coded.
Networks
Information on how the network system works, its purpose, main activities, advantages, challenges, etc.
Design principle (8) Nested enterprises
Recycling value chain
Characteristics of the recycling value chain.
Information type: players, stages, value-adding, position of organization, etc.
Threats & Future
Future scenarios, perceived threats and opportunities
Other organizations
Relevant references about other organizartions and their models.

Appendix 4 – Brochure of Catadores at World Cup 2014

Appendix 5 – Informative guide on the rights of Catadores

Appendix 6 – ASMAC's Headquarters

Figure 8: Overview of ASMAC's facility. Containers with materials on the right. Source: R. Perrupato-Stahl, C. (2014)

Figure 9. Compressor at ASMAC. Source: R. Perrupato-Stahl, C. (2014)

Appendix 7 – COOPERT's Headquarters

Figure 10. Outside view of COOPERT's sorting facility. Conveyor belt beneath the roof. Source: R. Perrupato-Stahl, C. (2014)

Figure 11. COOPERT: underneath the structure of the conveyor belt. Bags positioned to receive sorted items. Source: R. Perrupato-Stahl, C. (2014)

Figure 12. COOPERT. Inside the sorting facility. Conveyor belt. Source: R. Perrupato-Stahl, C. (2014).