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# Cooperative urban mining in Brazil: Collective practices in selective household waste collection and recycling

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ABSTRACT

Solid waste is a major urban challenge worldwide and reclaiming the resources embedded in waste streams, involving organized recyclers, is a smart response to it. Informal and organized recyclers, mostly in the global south, already act as important urban miners in resource recovery. The paper describes the complex operations of recycling cooperatives and draws attention to their economic, environmental, and social contributions. A detailed discussion based on empirical data from the recycling network COOPCENT-ABC in metropolitan São Paulo, Brazil, contextualizes this form of urban mining. The analysis is situated within Social and Solidarity Economy (SSE) and Ecological Economy (EE) theory. Current challenges related to planning, public policy, and the implementation of cooperative recycling are analysed on the level of individual recyclers, cooperatives, municipalities and internationally. There are still many hurdles for the informal, organized recycling sector to become recognized as a key player in efficient material separation and to up-scale these activities for an effective contribution to the SSE and EE. Policies need to be in place to guarantee fair and safe work relations. There is a win–win situation where communities and the environment will benefit from organized urban mining.

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## 1. Introduction: Production, consumption, recycling

The objective of this article is to analyse informal and organized recyclers under the lens of urban mining, fulfilling an important task of recovering resources and redirecting these into productive cycles. Based on experiences from long-term participatory and action-oriented research the main argument is that these workers, although socially and economically excluded and often stigmatized by the wider society, are performing an important environmental service to the community. A case study from Brazil demonstrates that with increased levels of organization this sector is conquering new political spaces, achieving increased recognition by local governments. Given the critical environmental concerns including climate change and resources depletion, it is of paramount importance to address waste issues, at its roots and to find appropriate solutions to address related challenges.

Theories of sustainability (Rockström et al., 2009), decent work (ILO, 2013), life cycle thinking (Jørgensen et al., 2008; Wenzel et al., 1997) and urban metabolism (Gandy, 2004; Wolman, 1965) are covered under the two main analytical pillars applied in this paper: ecological economy (Erickson, 1999; Faber et al., 1996; Gowdy and Erickson, 2005; Söderbaum, 2000) and social and solidarity economy (Lemaitre and Helmsing, 2012; Moulaert and Nussbaumer, 2005; Neamtam, 2005; Restakis, 2006). The author will adopt the theoretical lens of social/solidarity economy (SSE) and ecological economy (EE) as interpretative concepts to support the debate on fundamental changes in how we treat waste and those who work in resource recovery. Both, ecological and social/-solidarity economy draw the attention to innovative forms of economic interaction, where people and the environment matter, transcending profit generation, efficiency orientation, and paternalistic practice (Moulaert and Ailenei, 2005).

The paper argues that organized informal recyclers recover materials from solid waste streams for reuse and recycling, contributing thus to urban sustainability a concept extensively discussed within ecological economy (Costanza et al., 1991; Pezzey, 1992). SSE develops the policies and theories that can support collective frameworks, as those trailed by the members of recycling cooperatives. SSE is based on values of solidarity, cooperation and reciprocity and seeks non-capitalistic economic relations and forms of organization to transform hierarchical and authoritarian models and operations (Moulaert and Nussbaumer, 2005; Moulaert and Ailenei, 2005). Here the concept of social justice – standing for social innovation by (re)introducing justice issues into production, allocation and service systems – is vital in promoting decent work conditions in recycling cooperatives. Decent work

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means "*. . . productive work for women and men in conditions of freedom, equity, security and human dignity. Decent work involves opportunities for work that is productive and delivers a fair income; provides security in the workplace and social protection for workers and their families; offers better prospects for personal development and encourages social integration; gives people the freedom to express their concerns, to organize and to participate in decisions that affect their lives; and guarantees equal opportunities and equal treatment for all*" (ILO, 2007, p. VI).

The generation of solid waste has become one of the most pressing universal urban problems and is especially visible in cities in the global south. Uncontrolled waste disposal; lack of municipal solid waste (MSW) collection in informal settlements; roadsides, rivers and drainages contaminated with refuse; streams and channels blocked with junk; or inappropriately disposed toxic wastes are common situations found in many cities in the global south (Gutberlet, 2014; Lacoste and Chalmin, 2006; Medina, 2007; Rouse, 2006). However, increasingly solid waste is being recognized as a resource with the potential to maintain livelihoods and to generate profits (Gutberlet, 2013). Urban growth, in tandem with the expansion of discard and consumption oriented lifestyles, has created ubiquitous, multifaceted solid waste problems. Current solutions (landfilling, incinerating, recycling) are expensive and not free from producing environmental hazards. Reduction and avoidance of waste generation as well as resource recovery for reuse and recycling are still incipient and highly insufficient.

Worldwide we generate more than 4 billion tons of solid waste every year, of which almost half (1.6–2.0 billion tons) is MSW. The global value of the waste industry is estimated at US$ 433 billion annually. Yet, globally most of the MSW (70%) is still taken to sanitary landfills and dumpsites, 11% is incinerated and only approximately 19% is recycled or treated by Mechanical and Biological Treatment, which also includes composting and anaerobic digestion. Surprisingly more than half of the world's population does not have regular garbage collection and controlled disposal (ISWA, 2012, p. 5). Informal sector recycling is common in cities in the global south. It contributes substantially to waste management and resource recovery, feeding the supply chain of the recycling industry with new resources for production. However, the organization of informal workers and their integration in formal solid waste management (formalized co-production; see: Bovaird, 2007) are not yet widespread in the global south. In Brazil, for example, there is a tendency for municipalities with experience in selective waste collection to contract recycling cooperatives for the service of collecting recyclables at the household level. Approximately half of the municipalities with selective waste collection already work with cooperatives (CEMPRE, 2014).

Urban mining is the process of reclaiming materials and components from products, buildings, and discarded waste, also defined as "*the systematic reuse of anthropogenic materials from urban areas*" (Brunner, 2011, p. 339). The overall goals of urban mining are resource conservation and environmental protection, as well as generating economic benefits. Cities hold large stocks of materials, contained in buildings, infrastructure, landfills, and also in each household. These materials represent stocks of potential resources that can be reclaimed, at the end of the product lifetime. In this article, the concept of urban mining is applied to the resource recovery activity of informal and organized recyclers who reclaim the resources from MSW. Under appropriate working conditions (as discussed under social and solidarity economy) this activity contributes to urban sustainability. Approximately 1% of the urban population in the global south works in the recycling sector. Urban mining is used within the larger connotation of material recycling schemes of waste materials, particularly referring to household waste, which is rich in organic matter, paper, cardboard, metals, plastics, and glass, and which also includes construction debris, scrap iron, cooking oil, fabrics and leather, electronic and electric waste.

Material resources remain a major pillar in economic activities. Raw materials are used in building and processing, transforming them into new products and consumer goods. Resource recovery and recycling have become a necessity, given the scarcities, finiteness, and the price fluctuations for natural resources, as well as the costs of environmental impacts from resource extraction, mining, transportation, and industrial processing. The fact that our planet's life support systems are being profoundly changed by humanity is now commonly acknowledged and reaffirmed by a growing number of scholars who suggest that we have entered a new geological epoch – the *Anthropocene* (Dalby, 2007). The scale and speed of human transformation, particularly since the 1950s, has been unprecedented and is wearing down the Earth's resilience (Rockström et al., 2009). The growing amounts of waste discarded everywhere near human agglomerations and even in remote areas or distant oceans, is the visible tip of the iceberg representing the critical problem humans have created worldwide.

Reduction (and avoidance), reuse and resource recovery are concrete forms to diminish waste and prevent natural resource extraction. The informal and organized recycling sector contributes towards these purposes. The paper applies concepts from social and solidarity economy (SSE) and ecological economy (EE) to analyse the key benefits and challenges in a selective waste collection and recycling involving cooperatives. The recycling network COOPCENT-ABC, in the metropolitan region of São Paulo, exemplifies the social, environmental and economic contributions and barriers yet to overcome in this form of urban mining. Finally, the paper argues that organized recyclers are an important link in the resource recovery chain, avoiding the deposit of recyclable materials into landfills.

## 2. The global role and contribution of organized recycling

The recycling cooperative sector fits under the umbrella of social and solidarity economy (SSE) and the ecological economy (EE) as similar guiding principles are pursued and primarily bottom-up, grassroots, community-based initiatives are involved. SSE is founded on the values of solidarity, autonomy, and citizenship. In cooperatives, reciprocity is expressed through a mutualistic approach, where the cooperative is collectively owned by its members for their and the wider community's benefit (Ninacs, 2002). EE is based on the principles of responsibility, precaution, adaptive management, and participation. The focus is on the integration of ecological, social and economic goals, seeking for sustainable governance (Costanza, 1989). Reciprocity and the social link to economy, produces a hybrid spectrum of market-inserted, redistributive, and non-monetary economies, often operating within the conventional and market driven economy (Moulaert and Ailenei, 2005). As the article departs from the understanding that informal and organized recyclers perform an activity that benefits the environment and local communities, this current section provides insights with data on the contribution in terms of reclaiming resources from the solid waste stream and reintroducing these materials into recycling operations.

The International Solid Waste Association recognizes that informal and micro-enterprise recycling, reuse, and repair systems achieve significant recycling rates, with 20–30% in low-income countries. This activity saves local authorities around 20% or more of what they would otherwise spend additionally on waste management, representing many millions of dollars every year in large cities (ISWA, 2012). In Santa Cruz, Bolivia, the informal waste

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collectors service 37% of the population (Medina, 2010). In Delhi, India only 34% of the city's refuse is recycled, 27% of which is performed by informal collection services (UN-HABITAT, 2010). A study comparing informal with formal sector recycling in six different cities in the global south points out the overwhelmingly larger contribution of informal recycling to resource recovery (CWG and GIZ, 2011). In Cairo, for example, informal workers recover 30% while the formal sector recovers 13%. In Lima the comparison is 19 to 0.3% and in Pune it is 22 to 0%. In these cities the net cost for household waste collection is only Euro 2/ton, which is Euro 13/ton less than the expenses of the formal sector (CWG and GIZ, 2011, p. 17). In these six cities, informal recyclers save the authorities a total of 39 million Euros, every year.

The work of recyclers, whether informal or organized, is mostly unrecognized, nevertheless, there is no doubt that without them, more resources would be lost and cities would have to deal with even more waste on a daily basis. Informal and organized recyclers perform such a substantial favour to the economy that cities like Bangkok, Jakarta, Kanpur, Karachi, and Manila save more than US$ 23 million annually through the recyclers' work (Medina, 2010, p. 7). These savings are attributable to reduced waste management costs and to less spending on imports due to the availability of recyclable resources.

In Brazil, only approximately 18% of all municipalities have formal selective waste collection programs. Most recovered material is retrieved through informal recyclers. Data from 2008 demonstrates that out of the almost 10 million tons of scrap metal recycled every year, only 0.7% is collected by formal recycling programs. Of the 4 million tons of recycled paper/year, 7.5% stem from formal selective waste collection programs. For plastics, the number is 962,000 tons/year recycled and 17.7% provided by formal recycling programs. Finally, of the almost 500,000 tons of glass recycled every year, only 10.4% are provided by formal recycling programs (IPEA, 2012). Under current recycling rates Brazil already saves approximately R$ 1.4 to R$ 3.3 billion/year (US$ half a billion to US$ 1.1 billion/year), most of which is generated by informal and unorganized recyclers. If all recyclable materials, still send to landfills and dumps, were recovered, the Brazilian society would safe around R$ 8 billion (US$ 2.7 billion) every year (IPEA, 2010, p. 7).[1]

It is estimated that the informal recycling sector is around 20 million worldwide, almost 50% of the labour force involved in waste management (ISWA, 2012). Currently, there are about 1000 organizations of recyclers (cooperatives, unions and associations) throughout Latin America (Terraza and Sturzenegger, 2010). In countries like Brazil and Colombia, recyclers have organized as a national social movement in support of their struggle to improve working conditions and service remuneration. Co-operative recycling creates social capital (Coleman, 1988; Pretty and Ward, 2001) by incorporating people into meaningful work. Research claims that these activities are beneficial to formal municipal waste and resource management, as mentioned earlier and that it provides a livelihood to around 1% of the urban population in the global south (Gutberlet, 2013, 2012, 2008; Scheinberg et al., 2010; Wilson et al., 2012).

Despite the relatively small number of organized recycling groups in Latin America, their organization is expanding and their numbers are rising. In Brazil, for example, the organization of informal recyclers is growing and an increasing number of municipalities are becoming involved in selective solid waste collection schemes with recycling cooperatives (CEMPRE, 2014). Worldwide, but largely in Latin American countries (Brazil, Chile, Argentina, Ecuador, Uruguay, Venezuela) the federal government actively supports the organization of informal recyclers and has created structures, legislation and funding measures to support SSE initiatives (Caruana and Srnec, 2013). Specifically the organized cooperative recycling sector benefits from these provisions (Poirier, 2006; Gutberlet, 2009; Lemaitre and Helmsing, 2012). In some cases governments and non-governmental organizations provide training and capacity building for members of recycling cooperatives, integrating them in door-to-door selective waste collection. These experiences contribute to building leadership, to empowering the recyclers, and to opening avenues for social development. Cooperative members learn how to participate in collective decision-making and leaders more often negotiate with local governments on inclusive waste management contracts.

Recyclers are able to work safer, more efficiently, and get better value for their work when they are organized in cooperatives, associations or social enterprises. Over the past years several networks have been set up in Brazil, based on the institutional support of the solidarity economy in the country (Singer, 2003). Participants have a saying in decision-making processes within their cooperatives, in stakeholder meetings to negotiate with government or business and during public events (Gutberlet, 2009). These practices also create human capital and build citizenship, opening new ways for social development (Coleman, 1988). Organized recycling works with those who otherwise have reduced opportunities to work (due to physical or mental illness, long term unemployment, lack of formal education or professional training) and could become a burden to society. These local sources of social capital are important, as they provide a community with livelihood options, capacities and networks of support, particularly during periods of change or difficulties (Ostrom and Ahn, 2003).

The recyclers contribute to resource recovery, which creates environmental benefits and reduces the waste of resources. The gains can further be translated into the reduction of greenhouse gases (GHGs) and the mitigation of climate change (King and Gutberlet, 2013). Part of the contribution happens through recovering what would otherwise end up in landfills, generating detrimental gases and leachate. The activity also reduces energy expenditures during the product cycle, because for most materials, recycling is less energy intense than producing new items from virgin materials (King and Gutberlet, 2013). Salvaging materials considered to be 'waste' prevents further strain on the environment that is related to natural resources extraction. In energy-intensive industries, the recovery of basic materials such as aluminium, steel, paper, and iron results in large energy savings. Aluminium recycling, for example, can save up to 95% of the energy costs required in the production of virgin materials. Steel recycling can yield a 40–75% savings in the amount of energy required for its production (UNEP, 2008). The recycling of packaging containing metal products, and the re-smelting of used metal packages such as beverage cans, also contributes to these environmental gains.

Nevertheless, there are also environmental impacts from informal sector recycling. When conducted in an unorganized fashion the activity can add to littering, besides creating health impacts to the recyclers themselves, to their families or community members. Informal recovery of valuable materials from electronic waste, for example, can generate serious health and environmental impacts (Lepawsky and McNabb, 2010). By integrating the recyclers into formal groups, these impacts can be mitigated. The International Solid Waste Association (ISWA) "*identifies a major opportunity for win–win solutions – building recycling rates, protecting and developing people's livelihoods, addressing the negative aspects of current informal recycling on health and the environment, and reducing costs to the city of managing its wastes – if the informal sector can be included more successfully within an integrated and sustainable waste management system*" (ISWA, 2012, p. 7).

[1] Exchange rate 0.3375 (using nominal rate).

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## 3. Cooperative urban mining and the solidarity economy

### 3.1. Scope and nature of recycling cooperatives in Brazil

In Brazil, informal recyclers are known as *catadores* and *catadoras* or *carrinheiros*, which means collectors or cart pushers, and *carroceiros* when using horse pulled carts. Estimates vary from 500,000 (Besen, 2008) to 800,000 (MNCR, 2012). Part of the *catadores* is organized in approximately 600 associations or cooperatives throughout Brazil, some of them linked through networks (IPEA, 2012). As for the rest of the world, in Brazil most of the recyclers are also still informal, work under deplorable occupational health conditions, are often stigmatized by part of society and are very poor. The latest study from IPEA (2013) reports the existence of 692 recycling enterprises, most of which (80%) are operating since 2001, with a total of 21,164 workers, of which 39% are women. 28% of these enterprises are cooperatives and 34% are associations (IPEA, 2013, p. 27).

There are many different ways of getting involved in urban mining in Brazil; from workers operating as individuals, and scavenging at landfills (officially banned since August 2014), open dumps, or in the streets, being employed by middlemen for the collection and separation of materials, to working collectively in cooperatives and associations. The organized groups sometimes perform door-to-door collection of source-separated materials from households, industries and offices. Mostly, middlemen buy the material from the recyclers. When organized in cooperative networks, with several groups pooling together their materials, they are able to sell directly to the industry. Some cooperatives further add value to the recyclable materials through upstream activities, such as compacting, shredding and transforming the materials, and sometimes creating new products (for example: string and washing line from PET plastic bottles, recycled paper goods or roof tiles and furniture from Tetra Pak packaging) (Gutberlet, 2012).

The majority of the informal recyclers works during the day but some also collect at night. Materials are collected, categorically sorted (by plastic type, glass colour, paper or cardboard type, metals), and sold to middlemen or to the recycling industry. The level of organization, the availability of space and infrastructure assisting the work process (presses, forklifts, tables, computers, etc.), as well as administrative and business skills vary greatly among the groups, as does the number of co-operative members; which all affects their output. Mostly because the pay in this sector is still very low, recycling co-operatives have a high turnover in members, which challenges the sustainability of their operations and for which reason human development and capacity building activities in the cooperative need to be continuous.

The organized recyclers reclaim different forms of materials, ranging from plastics, paper and cardboard, metals, wood, cooking oil and other oils, WEEE products, other specific packaging and rarely organic waste. The recovery rate per recycler or per co-operative depends on different factors, including the quality of source separation, mode of transportation, local topography, extension of the serviced neighbourhood, quality and existence of equipment (for example: sorting belts, presses, fork lifters, electronic balances, trucks, electric hand pushed carts) and level of professional training of the workers. While autonomous recyclers often work shifts of 12-h/day, pushing on average 200 kg/day at a distance of 20 km/day, in the cooperative, the workday is usually limited to 8 h/day (Conceição, 2005). There is great heterogeneity among the cooperatives, reflected by the variation in the physical productivity, fluctuating between 606 kg/catador to 1608 kg/catador of material separated and sold, per month (IPEA, 2010, p. 8). The same study also highlights large price variations at which the recyclers sell their material. For example, scrap metal prices can vary from R$ 0.07 to R$ 0.93/kilo.

### 3.2. Social and solidarity economy in Brazil

Interestingly, the Brazilian government has taken important steps to integrating civil society in the regulation and promotion of 'popular solidarity economy', supported by several national governing bodies. The Brazilian Forum of Solidarity Economy (*Fórum Brasileiro de Economia Solidária*, *FBES*) is present in all 27 states of the country and on the local level through local forums. FBES plays an important role in the dissemination of information and promoting the dialogue among key actors and stakeholders. In 2003, the federal government created the National Secretariat of Solidarity Economy (*Secretaria Nacional de Economia Solidária*, *SENAES*), which reports to the Ministry of Work and Employment. The working plan of SENAES is based on a platform defined by the actors themselves. Together with FBES they have organized 8 working groups to promote Solidarity Economy in Brazil: communication, geographical survey, legal framework, public policies, production, commercialization and consumption, international relations, solidarity funds and training (Caruana and Srnec, 2013). In addition, the National Conference of Solidarity Economy, which is a tripartite government body (*one third of the participation corresponds to the government and the federal banks, one third to the movements and entities of civil society and the last third to the workers of solidary ventures* (Caruana and Srnec, 2013, p. 722) has contributed to the design of specific bills to support social and solidarity economy (SSE).

Brazil has adapted a *dual approach* to SSE, which translates into separate policies and regulations for the cooperative and mutual movement from the rest of the SSE organizations. FBES is active in promoting legislative changes to the legal framework for the cooperative sector. These specific policies date from the period of the military dictatorship and do not encompass yet all the specificities of SSE. Until recently, the law of cooperatives supported mostly large cooperatives (primarily from the agroindustry sector). For that reason only 8% of the businesses listed under solidarity economy are cooperatives (Poirier, 2006). There are currently approximately 20,000 solidarity economy enterprises in Brazil, comprising almost 1.7 million people, countrywide (Utting et al., 2014).

In 2010, the Brazilian government established the national solid waste policy (Law No. 12,305, 07/2010) with an Inter-ministerial Committee on solid waste and a Steering Committee for the implementation of reverse logistics. This and other supportive legislation has opened new avenues for the inclusion of recycling co-operatives in selective waste collection and represents a landmark for inclusive waste management. This law also proposes shared responsibility for the product life cycle and the reduction of negative human and environmental health impacts throughout the life of products.

The federal government, through SENAES has made available different credit lines for infrastructure upgrades in recycling cooperatives. Some municipalities support the catadores by granting space for the sorting and stocking operation, infrastructure, transportation, or by providing training and capacity development. In particular cases, policies are in place to safeguard this support. The city of Diadema, for example, remunerates the recyclers for the service of collecting and recycling household waste (decree no. 5.984/2005). Paying the service of selective waste collection is still a pioneering situation in Brazil and in other countries in the global south, where the service of the recyclers is mostly unrecognized and undervalued by local governments. In Brazil, other cities, including São Paulo, Ourinhos, Londrina, or Mauá, are

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currently following the proposal of paying the recyclers for their services. The following section describes the research methodology and then explores the case study COOPCENT-ABC for assets and barriers in cooperative recycling initiatives entrenched in the SSE and the EE. What are some of the key challenges and what measures are required to allow recycling cooperatives to improve their working conditions and outcomes and thus contribute to more sustainable and resilient cities. These are prime questions, given the growing demands on the social economy to fulfil social and public services.

## 4. COOPCENT-ABC: A case study of urban mining

The current research applies a multifaceted analysis using social/solidarity economy and ecological economy as theoretical framework (Costanza et al., 1991; Moulaert and Nussbaumer, 2005; Moulaert and Ailenei, 2005), situated in the context of everyday experiences of *catadores* in the metropolitan region of São Paulo, Brazil. The research is framed as a case study supported with a literature review. The empirical study draws on participatory epistemology (Brandão, 1981; Cahill, 2007; Kidd and Kral, 2005; Thiollent, 2005), to understand what it means to be a worker in informal selective waste collection, to appreciate their work and service contribution. The research is grounded in long term participatory and action oriented intervention of the author, as part of a multidisciplinary and international research team under the *Participatory Sustainable Waste Management* (PSWM) project, a research collaboration between the University of São Paulo and the University of Victoria, in partnership with recycling cooperatives, local governments and NGOs (Gutberlet, 2013). The specific case study outlined here involved participatory observation, discussions with key informants, one group interview (involving two recyclers and two technical administrators of COOPCENT) and document/academic literature reviews, conducted by the author between 2013 and 2014, during a prolonged research stay in São Paulo. The group interview took approximately 2 h and was conducted at the premises of COOPCENT-ABC. The interview was taped and later transcribed for data analysis. The content of the interview data and the author's diary entries from discussions, meetings, field visits and observations were compiled and analysed based on basic categories guided by the key research questions with the focus on understanding the workers and the work operations of the *catadores*, under the interpretative concept applied to the study. The data analysis provided fresh and praxis oriented views to the research questions. The analysis of all texts using basic coding helped to systematically extract meanings from the data, in order to get to the interpretations and recommendations presented ahead.

### 4.1. The cooperative network COOPCENT-ABC

Since the creation of COOPCENT-ABC, in January 2008, the author has accompanied their developments over visits, informal conversations, email correspondence, Skype meetings and interviews. The author has also given specific workshops to the recyclers and participated in related seminars whenever possible. This network is considered a second-degree cooperative, uniting currently twelve organized groups (mostly cooperatives) who carry out selective collection, separation and commercialization of recyclable materials in seven municipalities in the greater ABC region of São Paulo. The objective of the network is to improve the performance of its affiliates through democratic management, economic efficiency, and excellence in the recycling process, assuring safe and sustainable economic development conditions for recyclers in the region. Today the network has around 200 affiliated *catadores*. COOPCENT-ABC is committed to improving employment and income conditions, as well as the formal recognition of the recyclers. The estimated number of informal and unorganized recyclers in the larger ABC region is 1200. This number includes the municipalities of Santo André (with 54 organized catadores) and São Caetano (zero organized catadores), which are not yet part of the network. Currently COOPCENT-ABC is involved in a capacity development project, funded by SENAES, aspiring to include another 600 *catadores*, by 2017.

The network contributes to the design of public waste management policies that practice the social inclusion of informal recyclers. COOPCENT-ABC defends "*the principles of authentic cooperativism and solidarity economy. Participatory and democratic self-management (autogestão) is a key characteristic to ensure gender equity and the dignity of all recyclers. With the improvement and the promotion of the recycling chain the network tackles social and economic inequities, deriving from the effect of the current development model based primarily on economic growth and the concentration of income at the expense of social inequities and environmental degradation, which affects current and future generations*" (COOPCENT-ABC, 2014). This declaration is in line with the definition of social economy organizations as being: "*those organizations whose members are animated by the principle of reciprocity for the pursuit of mutual economic or social goals, often through the social control of capital*" (Restakis, 2006, p. 12). *Autogestão* is a key principle valued by the recyclers as autonomous management; a reason why often they argue against becoming city employees providing waste management services. The four defining principles for the SSE, as outlined by Ninacs (2002, p. 5), are corresponding guiding values for COOPCENT-ABC.

(I) primary goal of service to members or the community rather than accumulating profit;
(II) autonomous management (as distinguished from public programs);
(III) democratic decision-making process; and
(IV) primacy of persons and work over capital and redistribution of profits.

There are still many hurdles to overcome for the work of the recyclers to be fairly remunerated and for the working conditions to improve significantly. COOPCENT-ABC facilitates collective commercialization among the members, which means avoiding middlemen and selling directly to the industry, thus increasing their income. So far, they sell the following materials together: different types of paper (white paper, mixed paper, cardboard, newspapers and magazines), different types of plastics (PET, PEAD, separated by cleanliness and colour) and Tetra Pak beverage packaging (containing different layers of plastic and aluminium). The amount of aluminium cans collected by the cooperatives is very small and thus this material is sold directly by each group whenever they have a reasonable amount to be cashed in with middlemen. To practice collective commercialization is complex and requires a high degree of organization. Therefore the cooperatives sell collectively only those materials for which they can collect a sufficient quantity in a reasonable time. In 2013, COOPCENT-ABC sold together approximately 1,586 tons of recyclable materials, in the value of R$ 600,000 (approximately US$ 251,398) (Table 1). In addition, COOPCENT-ABC also transforms PET plastic bottles into washing line. One 1 litre PET bottle produces 10 meters of washing line, which is today sold for the price of R$ 2.50 (US$ 0.84). This project is modest due to difficulties in the marketing of the product, specifically scaling-up to meeting the amount demanded by larger supermarkets, remains difficult and until now the product is sold mainly in local stores, at fairs, markets, or during specific events.

The logistics for collective commercialization is challenging and requires access to communication means (computer, telephone,

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**Table 1**
COOPCENT collectively commercialized materials in 2013.

| Materials | kg | R$ |
|---|---|---|
| Plastics | 3919 | 5070 |
| Newspaper | 3956 | 1134 |
| Mixed paper | 140,328 | 34,633 |
| White paper | 89,243 | 37,451 |
| Cardboard | 1,100,092 | 460,887 |
| PET bottles | 23,193 | 41,586 |
| PET oil packaging | 2118 | 1483 |
| Magazines | 2246 | 629 |
| Tetra Pak | 74,299 | 25,584 |
| Total | 1,439,394 | 608,456 |

Fax machine) and specific infrastructure (trucks, storage space), as well as well-articulated organizational structures within the groups. Transportation costs and truck maintenance are high and can become an impediment for collective commercialization. The fee of 5% from the sales value of each group, paid to COOPCENT-ABC, does not yet cover the maintenance expenses of the network and additional funding for the operations is required.

As it stands today, most recyclers of COOPCENT-ABC still earn less than a minimum salary and in 2013 the hourly wage fluctuated between R$ 2 and R$ 4 (between US$ 0.67 and US$ 1.35); resulting in an average monthly income between R$ 336 and R$ 672 (approximately US$ 113 to US$ 227). The low income of the recyclers poses a major livelihood obstacle and basically keeps this population in poverty. With better-paid opportunities of employment, recyclers leave the cooperative, resulting in a high turnover rate of the workers. The pay reveals the low material prices (except for aluminium) and the disregard of the environmental service provided by the recyclers. In addition, a well-equipped cooperative usually has a more efficient material separation, compacting and bailing, resulting in higher productivity. The economic vulnerability of the recyclers needs to be tackled to make the current economies more humane. "*It is also the arena where the redress of economic and social disparity through the practice of reciprocity and the alignment of economic means to social ends has the most potential for lasting reform*" (Restakis, 2006, p. 15). This and other persisting challenges for cooperative recycling are discussed in the following sections differentiated by scale:

- individual,
- group,
- municipality,
- national, international, global

### 4.2. Individual level challenges in cooperative recycling

On the individual level, skills, professional preparedness and work ethics of the recyclers have been identified as essential to increase efficiency and improve working conditions (e.g. accurate bookkeeping, efficient material separation and baling, networking, and decision making for collective commercialization). Most recyclers have lived in lifelong exclusion (often with no or little formal education) under oppressive conditions (at work and/or at home), a fact that adds layers of complexities to the recovery of their citizenship, as discussed in Paulo Freire's 'Pedagogy of the Oppressed' (Freire, 1970), revisited in current perspectives by Schenck (2002), Beisiegel (1989) and Beisiegel and Moraes (2009). These authors reiterate the unpacking of oppressive conditions shaping the behaviour of the invisible professionals. The illiterate person becomes uprooted, distanced from the formal, predominant culture (da Costa, 2004). Illiteracy prevents the individual from understanding the laws and regulations, which situate the person's place in the world. This alienation produces traumas and psychological symptoms, difficult to overcome (da Costa, 2004). Paulo Freire's discourse on 'conscientization' addresses this condition and ways to overcome. The cooperative space provides opportunities for the recyclers to learn and elaborate on multiple forms in which reciprocity can be lived. In the SSE reciprocity is described as realizing mutuality, solidarity and engaging for the benefit of the broader community (Costanza, 1989). These aspects clearly come out in everyday work processes, interactions and dialogues, expressed by the recyclers in the collective environment of the cooperative.

### 4.3. Group level challenges in cooperative recycling

Group challenges include the quality and availability of equipment involved in the collection, separation, compacting, and transportation of recyclable materials. Work organization and proper use of the space of the sorting centre are equally crucial, as well as efficient planning of the material collection and (collective) commercialization, which can make a difference in productivity and thus reflect in income variations. Prices for recyclables are determined by demand and the control of the world market, thus subject to fluctuations (sometimes based on the world market). In addition, buyers pay different prices; influenced by the quantity and quality of the materials, (e.g. cleanliness in the separation) and by transportation costs (see Table 2).

Source: COOPCENT-ABC (2013) Balanço geral dos grupos 18.10.2013. Diadema: Coopcent-ABC.

The quality of the source-separated materials also depends on the level of information available at the household. In addition, the collection form also affects the quality of the materials. For example, some cities (e.g. São Paulo) use compacting trucks, which damage the material, by squashing and breaking materials (specially glass). Furthermore, resource losses also happen at the sorting centre, particularly when the conveyor belt is moving too quickly, or when the number of recyclers is too small to maximize the recovery rate. At the cooperative, COOPERCATA in Mauá, the recovery rate is quite high with 91.6% of the material entering the cooperative being separated and sold. In this case, the cooperative (22 workers) receives on average, 32 tons of material/month, of which only 8.4% (2653 kg/month) is sent to the landfill. In many other groups the discard of unsorted or un-sortable material is still significantly higher, fluctuating between 10% and 40% in the region.

Collective commercialization provides higher prices, however, sometimes groups still sell on their own, due to different circumstances, lack of sufficient quantity, unfavourable logistics due to the geographic location of the group, and for other reasons. The following Fig. 1 provides an example for price differences between individual and collective commercialization of PET plastic and mixed paper sales.

The availability and quality of equipment varies significantly among the cooperatives, allowing some groups to process more or less material. The number of recyclers working per group and their turn over also impacts on the productivity of the group. Very small groups (7–10 workers) are often less well-equipped and less effective than larger groups (20–30 workers). Table 3 distinguishes the groups according to their average number of members in 2013. As can be observed in Fig. 2, commercialization varies over the year according to: quantity of materials collected and sorted, material demand by the industry, price development, availability of sufficient recyclers, and other factors.

When comparing the total commercialization rate in kg and R$ for the previous years, we see an overall trend of increase with growing volumes and increased diversity in materials sold collectively, attesting the increased skills acquired by the groups in successfully performing the commercialization transactions collectively (Fig. 3).

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**Table 2**
Price variations for selected materials during 2013.

| Material | R$/kg |
|---|---|
| Newspaper | 0.16–0.35 |
| Mixed paper | 0.10–0.28 |
| White paper | 0.10–0.53 |
| Cardboard | 0.32–0.52 |
| PET bottles | 1.80 |
| PET oil packaging | 0.70 |
| PEAD | 0.60–1.50 |
| PEAD coloured | 0.90–1.30 |
| PEAD white | 0.70–0.90 |
| PP coloured | 0.70–1.30 |
| PP | 0.50–0.80 |
| Tetra Pak | 0.23–0.37 |

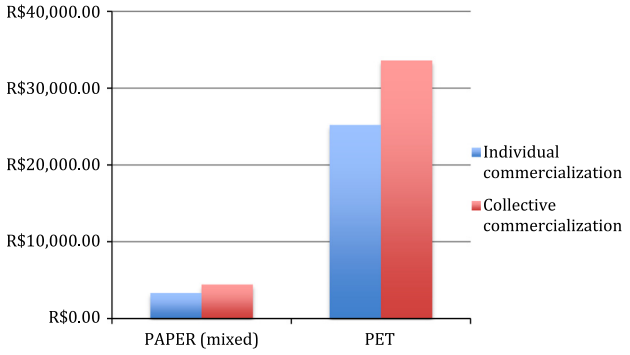


**Fig. 1.** Individual and collective commercialization in August 2013.

**Table 3**
Average number of cooperative members in 2013.

| Municipality | Group | Coop members |
|---|---|---|
| São Bernardo do Campo | *Raio de Luz* | 40 |
| | *Reluz* | 35 |
| Diadema | *Cooperlimpa* | 20 |
| | *Nova Pop* | 12 |
| | *Chico Mendes* | 7 |
| Mauá | *Coopercata* | 23 |
| Ribeirão Pires | *Cooperpires* | 17 |

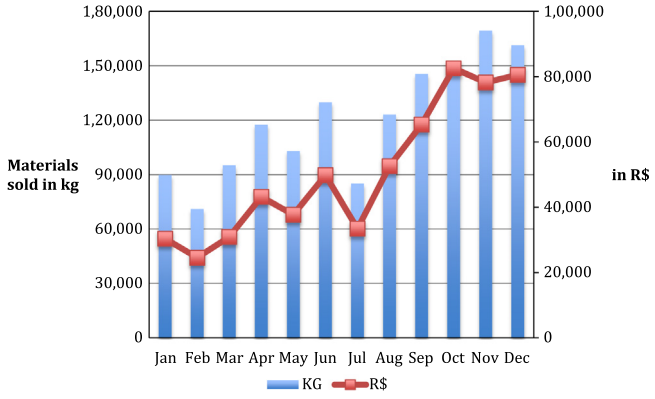


**Fig. 2.** COOPCENT commercialization of paper and plastic in 2013.

### 4.4. Municipal level challenges in cooperative recycling

The municipal level of intervention comes to play with fair remuneration of the service performed by the recyclers. Their income can be increased through formal recognition of organized recycling. In Brazil the activity of collecting recyclables is officially

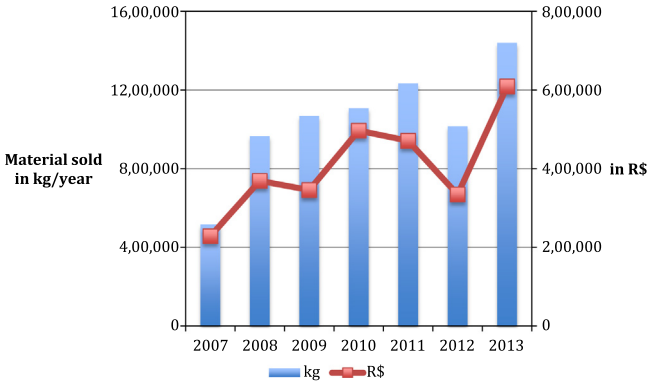


**Fig. 3.** COOPCENT commercialization of paper and plastic since 2007.

recognized since 2002 as a professional category: 'collector of recyclable materials' (*catador*), under Code 5192-05. Nevertheless, most cities are unaware of this fact and do not yet pay the recyclers for the service. The remuneration of the recyclers needs to be anchored in public policy, independent from the four-year government cycles. In the city of Diadema part of the recyclers is organized in a local association (*Pacto Ambiental*) an element in the city's waste management program (*Programa Vida Limpa*). They are paid by the city for the quantity of material recovered. In 2004, the local government instituted Law 2336, which defines separate collection of recyclables as part of integrated solid waste management and an instrument to generate income and social inclusion. The law further recognizes *catadores* as agents of urban cleaning and establishes the remuneration of their services. The *National Sanitation Policy* (Federal law 11,445/07), instituted in 2007, allows the city to waive competitive bidding for contracting of collection, processing and marketing of recyclable/reusable materials from MSW, in areas with selective waste collection carried out by associations or cooperatives, formed exclusively by individuals from low-income households. The law now simplifies remuneration arrangements as made in Diadema, allowing the local government to partner with organizations of legally established *catadores*. Further the federal solid waste management law no. 12.305, finalized in July 2010, represents a key milestone on the municipal level for the inclusion of catadores. Despite the existence of this supportive institutional frame in Brazil, very few cities are actively engaged in inclusive waste management. Public policies alone are not sufficient to implement the necessary shift towards inclusive solid waste management. Business and communities need to also be involved as stakeholders. "*The social economy came to mean an enlargement of classical economics to take into account the actual social conditions that accompany and indeed underlie the creation and distribution of wealth, and to situate economic behaviour within the wider compass of social relation for the pursuit of mutual economic or social goals, often through the social control of capital*" (Restakis, 2006, p. 5). The state has the ability to play an important role in promoting SSE and EE, resulting in employment generation, social welfare, social inclusion, occupational health, and even climate change mitigation, among others. In order to institute a municipal agency with a focus on inclusive SWM, several political and technical difficulties still remain. It will require the persistence of the organized recyclers and their advocates to change and drive the local government's attention towards the opportunities and challenges in cooperative recycling.

### 4.5. Global level challenges in cooperative recycling

Global level challenges include national and international policies to reduce packaging, to enforce product lifetime liability and to

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promote reuse and recycling (King et al., 2006). Products and their wrapping need to travel less, become more biodegradable, reusable and recyclable, and those materials that cannot be recovered or require environmentally harmful processes during recycling, should be banned, based on principles of EE (Daly and Farley, 2004). Smaller return loops, with repair and reconditioning should always come before remanufacturing, according to the hierarchy of secondary market production processes, which is based on the typically required work content, the performance obtained, and the value of the warranty a product normally carries (King et al., 2006).

In addition, developments of new recyclable materials, low impact recycling processes, and responsible consumption need to be fostered (Marchand and Walker, 2007). Solid waste travels internationally, transferring environmental and social impacts to regions that did not generate the waste (Lepawsky and McNabb, 2010). Trade in international waste is a growing business. Kellenberg (2012) suggests the idea of waste havens, based on these countries' low environmental regulations, receiving waste flows for recycling or discard in an unsafe manner, creating environmental problems. Challenges related to international waste shipping are particularly visible in the context of international flows of electronic waste and toxic residues. The Basel Convention is an instrument intended to prevent irregular export of hazardous wastes (Alter, 1997). Some important gaps and key loopholes still exist in this treaty, responsible for the continuity of irregular transport of hazardous waste. For example, the original treaty allowed transboundary movements of hazardous waste for reuse or recycling, which led to some exporters just re-naming materials for disposal as materials to become recycled. Since then amendments to the original Convention have been elaborated but are not yet ratified by enough countries to become legally binding (Ban Amendment). International regulations need to account for a growing complexity of issues involving solid waste (Lepawsky and McNabb, 2010).

Measures to avoid the negative impacts from irregular (international) solid waste flows and to transform consumption towards more reuse and recycling must go beyond public policies. On the national and international level legal instruments are also not enough to guarantee the successful implementation of participatory solid waste management programs. Education and particularly environmental education of the wider public and measures for capacity building and training specifically of informal and organized recyclers on a large scale must be a given. These actions and educational measures are important for existing legal frameworks to operate effectively.

Finally, from a general perspective the work of the recyclers contributes towards global environmental sustainability by reducing GHG emissions and energy spending as demonstrated by King and Gutberlet (2013). The activity has the potential to change the path of current dominant growth-oriented economics towards 'd e-materialization' and 'uneconomic growth' (Daly, 2007), by demonstrating the gains of circular economy. Recovering recyclable resources from households and local business and educating the population for more effective source separation are strategies that work in favour of the principles of ecological economy. The recyclers have a role to play in applying 'transformative literacy' (Schneidewind, 2013) making way for needed social change, for example as environmental stewards performing door-to-door collection, engaging with schools and communities.

## 5. Final considerations

Cooperative recycling as a form of organized urban mining generates an obvious, short to long term, win–win situation for communities, governments, urban miners/recyclers, and the environment. Experiences, primarily from the global south, demonstrate these opportunities and multiple benefits. At the same time there are multifarious challenges and difficulties related to cooperative recycling that need to be overcome. The most successful cases are those where local governments are committed to including organized urban miners from the informal and organized sector in their formal selective waste collection programs, remunerating them fairly for this service. Public policies supporting the social and solidarity economy of solid waste and participatory approaches to waste management are crucial to guarantee the success of the programs and to safeguard on-going support, which goes beyond party politics.

The article has introduced experiences of organized recycling groups in Brazil and has highlighted the specific case of the COOPCENT-ABC network, which coordinates collective commercialization of recyclable materials for a pool of cooperatives in metropolitan São Paulo. Different challenges arising from everyday praxis on the individual, group, municipal, national and global level, were discussed, requiring key milestones to improve the results in organized urban mining and to increase material recovery rates. The activity clearly fits the key principles set for the social and solidarity economy (Poirier, 2006; Caruana and Srnec, 2013) and for the ecological economy (Costanza, 1991) and is therefore in a position of spearheading social transformation. Nevertheless, the daily experience of the recyclers is still instigated by political power struggles, economic exclusion, and, often social stigmatization.

Interventions on the individual level involve access to formal education, skill development and capacity building as essential steps for effective resource recovery and value adding to the work of the recyclers. Particularly, for the inclusion of informal unorganized recyclers into cooperatives or associations, long term education and human development work is essential. Know-how on the intrinsic properties of materials, and how to most effectively separate these elements to avoid material losses, will become necessary as the cooperative recycling sector becomes increasingly involved in solid waste co-management, also covering materials which are not yet regularly collected. On the group level, appropriate technology and infrastructure facilitating the work from collection, separation, transformation to commercialization, as well as knowledge about better logistics and administration, are fundamental to increase the effectiveness and quality of their work.

Brunner (2011) urges to develop new knowledge to overcome the present state of recycling and to achieve true urban mining, where materials are recovered more effectively, taking valuable but also hazardous substances into account throughout their life cycle. Handling hazardous materials still remains challenging, particularly when involving the informal recycling sector in the global south. In Brazil, for example, the federal law 787, of 1997 – rules on the program for the prevention of contamination by toxic waste, to be promoted by manufacturers of fluorescent lamps, mercury vapour, sodium vapour and mixed light and other matters (Zanta and Ferreira, 2003). During the recovery of products that contain these materials recyclers are potentially exposed to health hazards. Some of the products (for example fluorescent lamps) are currently being discussed under the reverse logistics debate involving government, industry, and recyclers, to establish save procedures for collection and recycling. Despite a preventive legislation in place, there remain numerous occupational and environmental health challenges related to the everyday practices of collection and recycling (Zanta and Ferreira, 2003). The application of this knowledge will help reduce the waste of resources at the production end, but also at the recovery stage. Brunner claims "*the information necessary for decisions about urban mining comprises all relevant flows and stocks of a particular substance, from production to utilization and disposal at the end of the lifetime. In particular, data about use*

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*during the product lifetime are important (location, flows and stocks, density, speciation, partner elements, dissipative losses)*" (2011, p. 340).

The compilation of a new knowledge base that is accessible to those who work with recyclable material, including the organized cooperative sector, has been identified as important but challenging. We need the development of new appropriate technologies to aid the resource recovery process and to make it more humane (e.g. by introducing electric push carts, versus hand pushed or animal powered carts). Innovative design for urban mining should also contemplate social aspects and be concerned with the generation of new employment opportunities. There are plenty of possibilities to support resource recovery with a dignified work process, respecting the autonomy of the recyclers and building their capacity. The national, international, and global level of intervention can stimulate these developments and prevent the waste of resources in production and consumption through regulatory measures, laws and funding priorities, as proposed by EE (see for example Welzer and Wiegandt, 2014). Public policies are required to safeguard appropriate developments in this field. Product design that facilitates resource recovery and reuse should become a prerequisite in production and needs to be enforced through adequate laws, regulations and funding. Products that generate a critical left over should not be produced nor consumed at first place. Consumer responsibility, coupled with producer accountability in considering material and component selection to avoid the generation of waste and specifically of problematic materials that could end up in landfills or incinerators by default, is a fundamental requirement towards greater sustainability. Public policies as discussed for Brazil with the solidarity economy on the federal level or the remuneration policy on the municipal level are examples that can be transferred to other similar contexts in countries and cities in the global south.

The article has challenged the notion that informal recycling is only local and happens disconnected. Yet, the scale of cooperative recycling is still modest and there are many practical hurdles to overcome. The most basic difficulty relates to the social and economic exclusion of the informal sector workers. The lack of political will to include recyclers in official waste management programmes, as manifested by many local governments, is often hard to change. The low level of remuneration for door-to-door selective waste collection and the lack of financial resources to expand the infrastructure remain persistent problems. In addition, the corporate sector relentlessly seeks to expand 'waste-to-energy' (WtoE) technology, despite the internationally reported long-term lock-in effects of governments committing to this technology (Corvellec et al., 2013). In Brazil, there is only one pilot WtoE plant in operation but some municipalities have shown interest in acquiring this technology. These developments are widely contested by the recyclers' movement and environmental grassroots initiatives. The wider population is learning about the disadvantages and inappropriateness of this technology (e.g. high humidity and organic content of MSW common in many global south countries), the elevated costs involved, the health risks from air pollution, among others. The recycling cooperatives are important contributors towards urban sustainability, by reducing the city's solid waste burden. Nevertheless, the effectiveness and significance of their contribution depends on resource availability, including access to the recyclables contained in MSW, as well as access to fair remuneration for the service provision. If the city spends its budget on expensive and inappropriate SWM solutions, little funding will remain to upgrade resource recovery for reuse and material recycling. From an ecological economy lens resources are to be recovered and GHG emissions and energy spendings are to be reduced in order to address the recent critical planetary impacts, including climate change. Cooperative recycling is a transitional pathway promoting social change, which fits social/-solidarity economy and the vital environmental aspects of ecological economy. It is essential for future research to further develop strategies and policies for maximizing the potential of informal and organized recyclers to become recognized as urban miners and drivers for zero waste.

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