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GRASSROOTS ECO-SOCIAL INNOVATIONS DRIVING INCLUSIVE CIRCULAR ECONOMY

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ABSTRACT

The paper discusses research results on waste governance and circular economy, conducted with waste picker cooperatives in the metropolitan region of São Paulo, Brazil. Two cases have been selected, from a pool of 21 waste picker organizations, to video document their grassroots eco-social innovations that have improved local waste management and the lives of the cooperative members. The videos support knowledge sharing with key actors in waste governance and the circular economy. Social grassroots innovation theory focuses on livelihood opportunities beyond the formal labour market, pursuing social inclusion by creating meaningful work for individuals who were considered left out and in vulnerable situations. Transitioning to sustainability necessarily goes beyond socio-technical innovations but rather integrates eco-social perspectives. After first introducing grassroots innovation theory and the concept of eco-social innovations the paper describes the empirical frame and presents two cases where organized waste pickers were successful in operationalizing innovations that address the circular economy and contribute to sustainability transitions. Key findings highlighted are cooperative governance, long-term partnership building, improved productivity and increased income.

1. INTRODUCTION

In the global South the informal (Coletto & Bisshop, 2017) and the organized waste picker sector (Kaza, Yao, Bhada-Tata & VanWoerden, 2018) constitute the main motor that feeds the recycling chain. In this part of the world hundreds of thousands of workers collect, classify and sell diverse recyclable materials, salvaged from everyday garbage flows to provide for the recycling industry, which depends on this work (Gutberlet, Carenzo, Kain & Azevedo, 2017). Waste pickers organize in many different forms, e.g., cooperatives, associations, networks, unions, federations or other community based organizations (Gutberlet, 2015). While they significantly contribute to material recovery, their working conditions in most cases remain precarious and their income at the poverty line or below (Dias, 2016; Morais, Corder, Golev, Lawson and Ali, 2022).

There are experiences of waste picker organizations that stand out and can be framed as grassroots innovations. Often these innovations are not recognized as such by other key actos in this field, who may see waste pickers as work force but not as developers of technologies. These experiences encompass technological, organizational or structural changes made by the group which have resulted in different accomplishments, facilitating their work, increasing the income, reducing occupational risks, improving the organization and management of their group, enhancing human relations or reducing conflicts within the cooperative, just to mention some. Grassroots innovation theory (Hossain, 2016; Seyfang & Smith, 2007, Smith, Fressoli, Abrol, Around & Ely, 2017) helps explain the community-based process of developing and nurturing successful experiences. The key bottleneck is always whether and how these practices can be replicated and amplified, increasing their beneficial impact.

The key objective of the research presented in this paper was to digitally capture grassroots innovation among Waste Picker Organizations (WPOs), in order to tackle a gap in knowledge sharing and mobilization. The research builds on long-term community engagement with WPOs in Brazil and specifically on the results accomplished for the Brazilian case study under the Recycling Network and Waste Governance project. Since 2018 this project has applied a mixed methods study with WPOs in five different countries (Argentina, Brazil, Kenya, Nicaragua and Tanzania), generating data sets on diverse social science attributes and processes regarding WPOs in these locations. In Brazil, 21 representatives of WPOs were surveyed and interviewed in 2018, to learn about their innovation experiences. While many WPOs had some novelties and improvements to report, only few of them were able to demonstrate resil-

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ience and continuing sustainability of the innovation; which served as one of the selection criteria for participating in the documentary. Two experiences were selected, based on their outstanding scope, durability, replicability and results demonstrated over several years. A professional film maker, was involved in the production of these innovation videos (produced in Portuguese with with subtitles in English, Spanish and Swahili) showcasing grassroots social innovation and serving the purpose of mobilizing knowledge among key waste actors and inspiring other waste pickers worldwide to adapt and multiply these experiences.

Circular economy is one of the key foci in this research, based on ideas that have emerged during interviews and the survey application with WPOs. Given the current climate and environmental crisis and for a sustainable present and future, it is imperative that the circular economy becomes the new dominant regime (rules, physical structures, governance format) which shapes planning, design, production and waste management. Circular economy is defined by the Ellen MacArthur Foundation (n.d.) as driven by design and based on three key principles: elimination of waste, circularity and regeneration. The present research argues for social valorization of waste and waste workers as a key element in circularity and underscores the necessity to expand the existing framework for the circular economy, contemplating the social dimension. It is essential to include all key actors in the co-production of the circular economy and in the re-definition of the waste regime (building on the concept of waste regime by Gille, 2012). Given the prominent participation in material recovery and diversion, waste pickers are among the key stakeholders in the waste regime. Waste pickers constitute links between resource discard and recovery. They are key grassroots actors of the circular economy (Barford & Ahmad, 2021; Sousa Dutra, Yamane & Siman, 2018; Gutberlet & Carenzo, 2020). Particularly when organized, these collectives have the potential to become powerful entrepreneurs in the waste management sector, moving the transition towards sustainability (Gutberlet et al., 2016; Damásio, 2008). How can these organizations be strengthened, their actors be empowered and the work flows improved, resulting in higher income for the workers, safer working conditions, more secure livelihoods and a cleaner environment where less materials are wasted? These are some of the questions asked throughout the article. To transition towards sustainability the focus can not only be on social and technical innovations but must include ecological perspectives. In the context of social work, Stamm, Hirvilammi, Matthies and Närhi define eco-social innovations as "social innovations with a clear and consistent ecological approach that are improving both social and ecological sustainability" (2017, p. 202). Grassroots eco-social innovations are important in public policy making, which goes beyond sectoral and embraces eco-social policy making (Wallimann, 2013).

In the following section grassroots innovation theory will be introduced, under consideration of transition studies, to support the discussion on WPOs driving the circular economy. Then a description of the research methodology and research tools will be given, followed by the discussion of main research results. The final section briefly highlights some of the conclusions of this research.

2. GRASSROOTS INNOVATION THEORY

Social innovation theory broadly describes those innovations that offer livelihood opportunities beyond the mainstream labour market, targeting social inclusion for individuals in precarious situations (O'Riordan, 2013). Grassroots efforts and the involvement of new agencies are central in driving social innovations and in challenging existing top-down paradigms. As such social innovations have the potential to endorse social sustainability, based on terms of equity and justice (Parra, 2013).

Grassroots innovations (GIs) are bottom-up, small-scale and evolve as social experiments based on the knowledge, experiences and skills of communities, networks and individuals who lie outside the formal institutions of education and research to solve local problems (Reinsberger et al., 2015). Thus, they may often emerge from the margins such as the peripheries and communities. Innovations can result in new technologies, values, institutions and specific forms of organization or governance (Seyfang & Haxeltine, 2012). According to Seyfang and Longhurst (2016), GIs distinguish themselves from mainstream innovations at least in the following manners: (a) they are initiated by a social need, (b) they are driven by ethical commitment instead of purely profit seeking, (c) the niche where they develop embodies the local values and culture contexts, (d) they are created in collective ownership structures (e.g., cooperatives, networks, voluntary associations, community organizations), (e) they dependent on voluntary contributions, grants, or mutual exchange, and (f) operate in a social and solidarity contexts (summarized by Hossain & Anees-ur-Rehman, 2016, p. 975).

GIs tend to respond to local challenges considering the interests of the communities, and the results can directly benefit individuals, groups or even society at large (Grabs, Langen, Maschkowski & Schapke, 2016). Examples of GIs include alternative energy projects (Smith et al., 2017), food production and networks (Smith, 2006, Kirwan, Ilbery, Maye & Carey 2013), local material recycling (Carenzo, Goodluck, Gutberlet, Kain, Oloko, Pérez Reinosa, Zapata & Zapata Campos, 2022), repair movements (Zapata Campos & Zapata, 2017), community-based water and sanitation (Smith, Fressoli & Thomas, 2014) or alternative banking (Zapata Campos, Carenzo, Kain, Oloko, Reynosa, Zapata, 2021). GIs promote new forms of organization, and systems of provision (Seyfang, 2010).

GIs start small and develop in niches, outside of the dominant system and often under extremely deprived circumstances (the terms regime and niche are used here in association with the socio-technical transition literature, see e.g., Geels, 2005). Mutual trust between grassroots actors is vital in the collective development of any GI and if well disseminated, in an accessible language, they are able to trigger wider societal transformations. These niche experiences are often captured by the social and solidarity economy (Gutberlet & Carenzo, 2020; Gutberlet, Besen & Morais, 2020), which highlights the network formation, capacity building, cooperative values, collective learning and the empowering aspects of grassroots actors involved in innovation processes. Successful niches can influence a

regime by replicating innovations, installing multiple small innovations, scaling up and growing to attract and include a wider public and eventually turn a niche innovation into the mainstream (Hoppe, Graf, Warbroek, Lammers & Lepping, 2015). Research has shown how these initiatives operate dynamically in developing and recombining resources, rationales and relations to create and maintain social innovations that drive change (Zapata Campos & Zapata, 2017). Carenzo (2020) demonstrates how waste pickers are also central in the design and manufacturing of their own technological devices, going beyond the traditional work in collecting and separating recyclable materials.

Matthies, Stamm, Hirvilammi and Närhi have complemented the discussion by emphasizing sustainability outcomes and by introducing the concept of eco-social innovations, refering to *"grassroots level social innovations that combine ecological and social goal setting"* (2019, p.2). This enhanced perspective of GIs will be applied in the development of this research.

Societal systems are complex and adaptive and in order to understand, prepare and influence for change, it is important to know how transitions work. Transition literature has investigated in detail the different paths and processes under which transition happens, highlighting the close link between structures (encompassing the formal, physical, legal and economic aspects in society restricting and enabling practices), cultures (cognitive, discursive, normative and ideological aspects) and practices (routines, habits, procedures and protocols) (de Haan & Rotmans, 2011). Transitions can be thought of as sequences of patterns that occur under specific conditions, generating so called transition paths. De Haan and Rotmans provide a comprehensive definition of a transition "as [being] a fundamental change in the structures, cultures and practices of a societal system, profoundly altering the way it functions" (2011, p. 92). Further, the authors claim that *"[a] societal transition is the process through which a different constellation becomes the dominant one, shifting the functioning of the whole societal system, ….a regime change"* (Ibid, 2011, p. 93).

In order to gain visibility and to allow bottom-up initiatives to become upscaled, they require support from regulatory, political and industrial perspectives (Hess, 2013). Consequently, their success also depends on the partnerships with government, universities, NGOs, informal networks, social movements and other different actors, as well as their visions and leadership that support these grassroots (Feola & Nunes, 2014). Hargreaves, Hielscher, Seyfang and Smith (2013) point out that intermediaries such as NGOs or universities can become important support mechanisms that help document innovative practices, disseminate the created knowledge and promote the transfer of the innovations to other localities.

Grassroots actors frame their innovations differently (a) as the emergence of new ideas and solutions (ingenuity framing), (b) as the empowerment of local communities (empowerment framing), or (c) as a form of addressing structural problems and questioning conventional innovation (structural framing) (Smith et al., 2017). Often these frameworks are applied concomitantly. The relevance of GIs is recognized as driving force substituting existing unsustainable cultural and economic paradigms and values (Matthies et al., 2019; Seyfang & Haxeltine, 2012).

3. RESEARCH METHOD

The study is empirically informed by the Recycling Networks & Waste Governance international research projects, involving a large multidisciplinary team of international researchers and students that examine waste governance and grassroots innovations developed by WPOs and networks in different parts of the world. In 2018, the multinational research team conducted surveys with more than 100 waste picker organizations (WPOs) in Argentina, Brazil, Kenya, Nicaragua and Tanzania, examining the history and characteristics of these initiatives, their governance structures, funding and equipment situations, types of work conducted, characteristics of the workers and the working conditions, network relations, and general challenges and innovations of WPOs (Kain, Zapata, de Azevedo, ,Carenzo, Charles, Gutberlet, Reynosa and Zapats Campos, 2022). The study also included 100 in-depth interviews with a selection of WPO members, with key informants in local governments and with other waste governance actors. The researchers took an ethnographic and participatory approach to the data collection. The author of this paper is responsible for the fieldwork and analysis of the data collected in the metropolitan region of São Paulo in Brazil. At two international workshops, one held in Kenya (2018) and another in Tanzania (2019), the findings were analyzed and discussed by the team of researchers and several WPO representatives from the countries involved as well as by Kenyan and Tanzanian municipal officers and politicians working with environmental and waste management. The purpose of these workshops was to co-create knowledge and to conceptualize solutions and policy recommendations (for results on these workshops see: Azevedo et al., 2018 and Goodluck et al., 2019).

The survey prepared for the Recycling Networks & Waste Governance project was applied by the author and one research assistant in Brazil, between October and November in 2018, to 21 waste picker organizations. We started with those WPOs to which the author already had established contacts from previous research projects and then used snowballing to include more WPOs in the region. In addition, 7 waste picker networks and a representative from the National Waste Pickers Movement (MNCR) were also interviewed following the same key topics and interview questions posed to the 21 groups, in addition to questions that focused specifically on the context of networks and social movements.

All information collected via participant observations, survey and interviews were tabulated into Excel spreadsheets and analysed using qualitative, thematic content analysis to identify key themes and unique experiences. The results from the thematica analysis bring to light the waste pickers' perspectives.

In a follow-up project, in partnership with Argentina, Brazil, Kenya, Sweden and Tanzania and funded by Formas (Swedish Research Council for Sustainable Development),

WPOs were chosen for further in-depth study in each of these countries. The two Brazilian WPOs chosen were invited to participate in the production of the documentary, with the purpose of capturing and disseminating the unique innovative experiences. All videos showcase the contribution of waste pickers to the circular economy and to waste management at large. We take an arts-informed research frame building on exploration and experimentation of new ways of collecting data and disseminating results. It is *"a mode and form of qualitative research in the social sciences that is influenced by, but not based in, the arts broadly conceived"* (Cole & Knowles, 2008, p. 59). The key purpose is to increase and facilitate the understanding of whatever human phenomena or condition needs to be communicated, by using complementary empirical tools and processes which will then allow to reach diverse audiences. These authors describe how for them *"trying to get closer and closer to human experience and to communicate it in a way that seemed truer to its original form and to those who may be involved"*, was the motivator to push the boundaries of conventional scholarship (Ibid., p. 58).

Documentary filmmaking is our selected tool for knowledge mobilization and to make scholarship more visible and accessible (Cole & Knowles, 2008). Documentary and ethnographic film making has made its way into academia as additional form of scholarly publication, but also to make research results more accessible to the general public, practitioners and specifically to decision and policy makers (Petrarca & Hughes, 2014). As part of participatory and community-based research epistemologies it is essential to make our work available to a wider public and to seek out different formats of communication (Amauchi et al., 2021), beyond academia (Eisner, 1997).

For the video production in Brazil a young professional film maker was involved and together with members from the two cooperatives a story board was developed and key interviewees were defined for the film. These preparatory conversations happened online through WhatsApp and over Zoom meetings. Fieldwork was delayed until the beginning of 2022, due to the Coronavirus pandemic. Finally, in February 2022, we were able to conduct the filming in-person. The research has received ethical approval from the University of Victoria's research ethics board and followed the requirements for informed consent, specifically regarding the captured images and film (Protocol Number: 21-0261). After finalizing the filming process, several hours of material were edited by the filmmaker into a short clip of less than 10 minutes. The clips were sent to the two cooperatives for viewing, asking for feedback, which was then incorporated into the final version, approved by the two WPOs. Since then, the clips have been uploaded (see: https://www.cbrl.uvic.ca/videos), disseminated among research participants and organizations on list serves targeting waste pickers in Brazil and shown during public events. Future public viewings in association with discussions are being planned.

In the following section the results of the interviews and surveys conducted since 2018 on GIs will be presented. The key findings are portrayed in the two videos cited above.

4. RESULTS

The two WPOs selected as case studies are Avemare and Coopercaps, both located in the metropolitan region of São Paulo, Brazil. The cooperative Avemare illustrates outstanding internal governance and partnership development experiences, while Coopercaps (São Paulo), has innovated in design and manufacturing of their own technological processes as well as in socio-productive inclusion.

4.1 Avemare: Governance and partnership

With the closure of the controlled landfill in Santana de Parnaíba, waste pickers started to organize and in 2000, the local government provided the space and some basic equipment for the waste pickers to organize as association. In 2007, this original group constituted a recycling cooperative, called Avemare. Since then, the cooperative received support from different partners (Fundação Alfaville, IPESA, FUNASA, Instituto Ecoar and from some industries (Hurshley, CEMPRE, ABIPEC, TETRAPAK) primarily for capacity building and the acquisition of equipment. In 2013, supported by the NGO ECOAR and the waste picker network Rede Verde Sustentável, Avemare began negotiations with the local government for a service contract to perform the municipal collection of recyclables. In 2014, they signed a contract for service provision and were paid 220 R$ (60 US$) for every ton of separated recyclable materials and they also received an additional 10% (based on the monthly total of commercialized materials) for maintenance expenses (e.g., electrical and water bills, roof maintenance, etc.). Since 2020, they have signed a collaboration agreement with the city (Termo de Colaboração), in which the cooperative in partnership with the city has established goals that need to be reached in order for resources to be transferred to the cooperative. This includes targets in terms of quantity of materials recovered, reduction of materials sent to the landfill (rejeito), as well as targets focused on environmental education (e.g., elaboration of information pamphlets distributed to the community, increased number of households participating in the recycling program, etc.). Major attention is given to sustainability transition parameters, such as expanding the collection and recovery of recyclables for the circular economy and concomitantly reducing the fraction that is send to the landfill.

The average monthly income per member in 2018 was between 1,200 and 1,300 R$ (320 – 350US$), while in the beginning of 2022 it was at 2,300 R$ (456 US$). Avemare covers approximately 50% of the city area (in 2018 it was only 30%) with door-to-door household collection. They use trucks for the material collection from households, schools, restaurants, hotels, residential condominiums, commercial businesses and government buildings. They further collect electronic waste from businesses and industries. Currently, Avemare has 82 members, of which 43 are women (7 of 8 members of the board of directors are women). Most members are relatively young, between 18 and 40 years old. Today they collect 400 tons every month and sell 320 tons of materials per month (in 2018 it was between 350 and 400 tons/month). Currently the cooperative has 4 presses, 1 balance, 1 glass crusher, 1 PET crusher,

1 fork-lift, 1 bobcat, as well as 2 moving conveyor belts of 25 meters for sorting. The cooperative owns 5 trucks and shares additional 3 trucks with the recycling network (Rede Verde Sustentável). The many capacity building activities the members have participated in, as well as the recognition by the local government and consequent higher income of the waste pickers were instrumental in promoting the innovation to invest in the livelihoods of its members and in participatory waste governance.

One of the main goals of Avemare is to promote social inclusion and to contribute to urban sustainability, considering equity and justice, by offering low barrier jobs and by providing door-to-door resource recovery. Avemare has defined human development for its members as a key target and they have prioritized human development actions for cooperative members and their families. Achieving this goal begins by providing fresh and healthy, nutritious food to the members; *"so at least once a day the people eat well"*, says Ionara, the coop leader. The cooperative has a clean and spacious refectory and a cook that prepares healthy meals.

Avemare engages in social work and provides specific support to individuals (e.g., child support, social assistance, financial support, conflict resolution, etc.). General assemblies or extraordinary meetings are conducted over the month, to address gender specific issues or to tackle internal conflicts. If a member has a problem, they first try to solve it within the cooperative, as highlighterd by Ionara: *"we are kind of a mother, a psychologist…. Sometimes the person only wants a hug, a friend's shoulder to release, or ask for advice, and the cooperative is welcoming about it ...". "Our biggest result is when we see lifes transformed within the work of the cooperative"* (Ionara). The cooperative has recovered several individuals who were involved in drug trafficking and are now 'clean' and working as regular members. Further, during the door-to-door collection waste pickers engage in community education and also participate in environmental education programs, involving schools and pre-schools. Avemare maintains a 2nd hand shop (Bazar), where they place reusable or repaired items (e.g., electronics) for low cost to members.

Avemare has built a strong partnership with the city hall, where they are now seen as more than just service providers but rather as partners in waste management and in tackling several of the Sustainable Development Goals (SDGs). A government occupational health and security agent works on a regular basis with the cooperative, making sure that medical exams and routine check-ups are done by the members. They also help schedule medical exams through the government's social assistance and health promotion secretariats. The city runs educational campaigns in partnership with Avemare, to improve recycling rates and to increase the cleanliness of the city.

Capacity building takes time and participants usually have to leave their 'comfort zone' in order to apply the learned lessons (e.g., change work behavior and work equipment to comply with occupational risk prevention measures). However, there is still a lack of knowledge and awareness among many cooperative members related to the necessity to innovate (e.g., members are unaware of relevant legislation and regulations that influence selective waste collection and recycling). *"Both, environmentally speaking and in regards to the transformation of people we seek to improve even more, until today"* (Ionara). Avemare seeks to establish partnerships with different stakeholders (business, government, university, NGOs) for capacity building to increase their level of knowledge.

According to the leadership and confirmed by individual members, the high level of satisfaction of members has resulted in low membership rotation, an issue other WPOs often face. The cooperative claims to have effectively integrated several members who were ex-prisoners, ex-drug addicts or had suffered from extreme poverty and to have contributed to reduced levels of conflicts among members, overall improving the work environment. These innovations in social development particularly target those in society that have been historically marginalized and stigmatized. Avemare admits new autonomous waste pickers wanting to join the cooperative. Often individuals who can not find another job, have addiction or other health problems and the cooperative can help address these issues. Some of the waste pickers who today have a strong voice within the cooperative, in the past were also most vulnerable.

Avemare is part of the National Waste Pickers Movement (MNCR) and a member of the network Rede Verde Sustentável and participates in regular meetings with these organizations. Avemare actively helps other cooperatives who are not yet or newly established to address their challenges. The leadership recognizes that they also had learned from other peers and now they want to give the same support to other WPOs. Avemare has adapted a 'remuneration by production system' which is a form of fair pay according to the work conducted. This system was first experienced by Cooper Viva Bem, another waste picker cooperative in São Paulo, who has tought Avemare the implementation of this system. Avemare sees it as their mandate to help diminish disparities among the WPOs in the region ("nivelar os grupos"), whose working conditions and outcomes are still quite unequal. There are many very small groups that have no infrastructure and no bargaining power. These groups benefit from partnerships and peer learning with well-established WPOs. Finally, the leadership of Avemare mentioned repeatedly how important participation and transparency were for the successful management of the cooperative.

4.2 Coopercaps: Networking, technical innovations and social inclusion

The seed of the cooperative Coopercaps was planted in 2001, when a group of eight autonomous waste pickers in Interlagos, the south of the city of São Paulo, agreed to work collaboratively instead of on their own. In 2003 the cooperative was legally created and since then has been continuously expanded their activities. Over the time they have developed partnerships with different NGOs and government agencies. Central Unica dos Trabalhadores, the main national trade union and the largest union in Latin America, early on provided capacity building on cooperatives and, in addition, the local city administration offered

a space for them to work, support with transportation and basic food items for cooperative members.

Since then, many other partners support the cooperative, including the NGO called GAIA SOCIAL as well as some industries (BRASKEM, PEPSIKO, the Brazilian Association of the PET Industry - ABIPEC). The Brazilian Beverage Association (ABRABE) has helped in the formalization of the group, and nowadays conducts the inspection of all required documents to guarantee the health of the workers.

Today a total of 347 members (of which approximately half are women) are working in five units that compose Coopercaps. These units include the initial cooperative space with manual separation (Unit Matriz), two additional manual separation units (Socorro and Paraisópolis) and two mechanized plants implemented by the city of São Paulo (Unit Carolina de Jesus and Unit Ponte Pequena) The three manual separation plants together process approximately 250 tons/day; material that comes from household collection, residential condominiums, schools, businesses and public buildings. Since 2018, Coopercaps has continuously expanded, from 128 members to 347 members today. The average income in 2018 was 1,750 R$ (427US$) and is now around 2,604 R$ (517.-US$)

Coopercaps is a leading member of Rede Sul, a network of 13 WPOs, covering the south of the metropolitan area and the city of Campinas. Rede Sul integrates approximately 800 waste pickers. The network was formalized in 2012 for collective commercialization, allowing the members to sell directly to the industry and to thus avoid middlemen or scrap dealers. It is noteworthy to mention that Rede Sul has currently formed another overarching network called CONATREC (Confederação Nacional de Cooperativas de Trabalho e Produção de Recicláveis), which integrates the two networks of WPOs in the larger region (FEPACOORE - Federação Paulista de Cooperativas de Reciclagem and FEBRACOM - Federação das Cooperativas de Catadores de Materiais Recicláveis) - see Fugure 1 - and has partnered in 2021 with ANCAT (Associação Nacional dos Catadores e Catadoras de Materiais Recicláveis), the other nationwide association of WPOs. These networks allow for negotiation with policy makers and industries and have the potential to promote structural change and sustainability transitions.

The regional network Rede Sul allows for collective sales among its members and also supports their voice in policy decisions. Rede Sul provides capacity building and expertise on increasing and maintaining quality standards in material separation, crucial for selling to the industry. Waste pickers have differentiated skills, since they can quickly tell apart PAD and PEAD plastics among other materials, while automotized separation can not. In addition, the network supports associated cooperatives on administrative and legal issues and seeks funding for infrastructure and equipment in order to benefit its members.

Coopercaps is taking the lead in strengthening this network and also engages in the research of alternative solutions for materials that reach the cooperative but are not recyclable. In partnership with research institutes (University of São Paulo, USP) Coopercaps searches for solutions for those materials. According to Pablo, *"our innovation at this point, is just this research done about the materials to know what can be and what can't be done with them"*. In 2018, e.g., a new milk container made of mixed materials, was showing up on the cooperative's separation belt, which

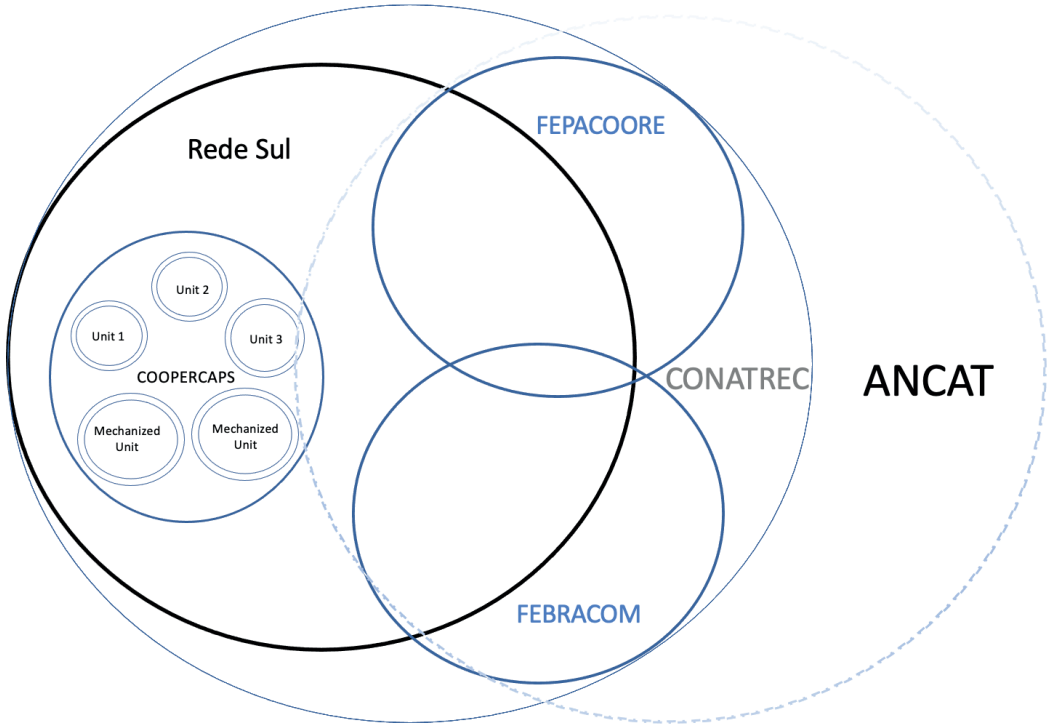

FIGURE 1: Multilevel Waste Picker Organizations in the state of São Paulo.

was separated but had no market and was thus piling up in the yard. During our visit in 2022, we were informed that after conducting a study they had found a niche for these packaging materials. According to the cooperative leader, approximately 20% of rejected materials, mostly dirty or organic materials and pieces that are too small to capture as recyclable, are considered rejected materials and are send to the landfill. However, at the automatized separation plant this figure is significantly higher.

Coopercaps also has a mandate to support social inclusion, by providing low barrier jobs to individuals with difficulties to become employed, such as immigrants, refugees, expats, ex-prisoners or drug addicts.

It's social change [neh], the change that happens in a person's life when he succeeds. I'll give you a clear example of that. We have a support network, … a recovery house called Fraternidade, located in Parelheiros. We went there, and there are about 10 people inside that will be hired by Coopercaps to work in here. One of the men is called Anderson, …he has an interesting life story. He was a drug user, he went to Cracolandia, [uh]... taken out of there by this priest, he went through the recovery house, he went through his period of treatment, which is 6 months, he stayed for another 3 months, and then what did he do? He was hired by Coopercaps. …. Now, Anderson has already rented a little house for him to live. So, I would say Anderson is our clearest example of social transformation that we have here today in the cooperative (Pablo).

Furthermore, one of Coopercaps' units (Unit Socorro) has been specifically proactive in including LGBTQ+ individuals and has created awareness about the vulnerability of these groups. Unit Ponte Pequena has received several refugees from Sudan and Unit Matriz has specialized in receiving and supporting particularly elderly and handicapped waste pickers.

5. DISCUSSION

The two examples for GIs presented in this paper, reiterate the observations made by Geels (2012) that learning occurs over time, in various dimensions and that early visions and ideas turn into more lasting outcomes. Both cooperatives started out between 2000 and 2003 with a group of informal waste pickers, who had a vision of collectively improving their livelihoods. Both cooperatives engaged early in building partnerships, involving the local government and NGOs, that allowed them to grow. These results are not easy to achieve. Resistance and overcoming obstacles as well as manouvering power dynamics and imbalances shape the aims and scope of the waste pickers' innovations (see also Carenzo, 2021).

Avemare has been strong in negotiating with the local government, over different legislations, consistently improving the situation for the cooperative. Coopercaps, in particular, has expanded its multilevel networking capacity and collaborations also with other waste picker organizations and with businesses, particularly since the Coronavirus pandemic in 2000. Coopercaps is a strong partner in the discussion of the role of WPOs in reverse logistics and the circular economy. Feola and Nunes (2014) have also observed that a strong vision and leadership, as well as the engagement in partnerships with different local formal and informal actors is crucial for the success of transition towards more sustainable systems. The two experiences underline the importance of continuity and persistence. The gains these groups could achieve over the past 20 years are built on perseverance and dedication, dialogue and negotiation skills in the definition for better working conditions and fair remuneration of the services provided by the waste picker cooperatives, and also demonstrate the "informal" experimental praxis of trial and error, involving a peer based practical pedagogy towards social innovations (Carenzo, 2020).

Being able to access appropriate funding or microcredits is necessary to stimulate local innovations (Hoppe et al., 2015). The two cases have also relied on funding opportunities supplied by previous federal governments, specifically by the Social and Solidarity Secretariate between 2003 and 2016, under president Lula and president Dilma Rousseff (Gutberlet, Besen & Morais, 2020). More recently, particularly due to lack of support and even the dismantling of existing support mechanisms (funding, policies) by the government of ex-president Bolsonaro, some of the leaders among WPOs (Coopercaps) had narrowed the dialogue and negotiations with industry partners, reiterating their key role within the circular economy, similar to what has been discussed by Barford and Ahmad (2021) as an example for a socially restorative circular economy.

The success of Avemare is linked to the internal governance structure with high levels of participation and transparency, the management structure based on fairness and inclusion, as well as the human values directed towards the recovery of the citizenship of its members. Avemare particularly builds on democratic decision-making among cooperative members and on continuous conflict resolution efforts done by the cooperative administrative board. The monthly general assembly, extraordinary meetings and individual conferences offer a space for members to become informed, to speak up, to share ideas and to solve problems. Conflict situations occur frequently among large numbers of co-workers. However, dealing with these conflicts in a democratic, transparent and neutral perspective is not easy. In both cases peer-to-peer knowledge dissemination (Feola & Nunes, 2014) is being practiced continuously, among members and among different WPOs and networks. Combining formal and informal science is imperative for GI to develop and consolidate (Gupta, 2012). Over the years, particularly Coopercaps who is at the forefront of Rede Sul and a key founder for CONATREC, has dedicated time and energy to peer learning and the dissemination of peer learning. One of its leaders (Carioca) has been a continuous driving force, bridging knowledge gaps in different cooperatives and networks, solving specific administrative, organizational or technical problems in different cooperatives.

An important preparation for WPOs to thrive has come from capacity building and peer learning about cooperatives (cooperativismo), strongly supported and implemented by the larger networks such as the national waste pickers movement (MNCR) and regional networks such as Rede

Verde Sustentável and Rede Sul. MNCR applies a method called from waste picker to waste picker, in the dissemination of knowledge, which is peer-to-peer learning, valuing the knowledge and experiences waste pickers bring and that is being disseminated. They have produced didactic materials for this grassroots educational process. Fruits from this process are the strong identity waste pickers nurture with the values and objectives of cooperatives. Many of the organized waste pickers and particularly the leaders are proud of being part of a collective and are struggling to constantly improve their livelihoods, their working conditions and the impacts of their work. Since the mid 2000s, waste pickers have emerged as a collective of organizations, called networks (Cooperativa de 2o Grau) generating innovative solutions for many pressing challenges (Feola & Nunes, 2014). Waste picker leaders have identified new opportunities that have arisen with growing awareness of the environmental and social impacts related to inappropriate handling of waste, particularly by engaging in environmental education in their communities, giving talks at schools or at businesses (Gutberlet, Sorroche, Martins Baeder, Zapata & Zapata Campos, 2021).

The two examples in this article highlight the transformative power of WPOs and their potential to make unprecedented contributions to the transition to sustainability (Leach, Rokstrom, Raskin, Scoones, Stirling, Smith & Olsson, 2012) and to thus tackle some of the United Nations Sustainable Development Goals (SDGs) (Gutberlet, 2021; Hajer, et alli., 2015). Some scholars in grassroots innovation theory have observed that transitions to sustainability in general tend to depend on particular conditions. De Haan and Rotmans (2011) e.g., understand these as (a) cultural (normative, ideological aspects) and structural tensions (problems with the physical, infrastructural, economical, formal and legal aspects); (b) a degree of internal inconsistencies (the dominant way is unable to provide the societal needs); and (c) pressures from inside or outside of the regime. The authors also speak of a multi-pattern approach, where "[t]ransitions can be considered sequences of patterns that occur under certain conditions, producing transition paths" (De Haan & Rotmans, 2011, p. 100).

The GIs described here showcase two innovation paths which have allowed the two groups to shift over time from a marginal to a more entrepreneurial organization as they seek to emerge from a niche to a regime as has been theorized by Martin and Upham (2016). The two cases presented highlight the need for recognition of the social valorization of waste workers along the waste value chain. WPO include individuals that have fallen through the cracks, were long-term unemployed, drug dependent or live in poverty. The circular economy framework should also capture these social dimensions of waste.

New GIs can challenge incumbent regimes, by first introducing alternative practices in marginal 'niches', demonstrating that the innovation might better serve the priorities of communities and local leaders (Boyer, 2014). The two cases have shown how these groups have undergone processes of transition, following the sequential pattern previously highlighted (De Haan & Rotmans, 2011), with empowerment, re-constellation, adaptation and finally becoming materially and cognitively installed and shifting the regime to accommodate the innovation.

Over the years, despite changing local governments, Avemare has been able to solidify and expand its participation in the city's selective waste collection; introducing grassroots knowledge on waste management and building on diverse local partnerships. They have been able to tackle the United Nations Sustainable Development Goals, particularly by providing decent low barrier jobs and improving working conditions (goal number 8) and pay (goal number 1 and 10), enhancing human development of its members (goal number 2, 3 and 5) and contributing to a cleaner environment (goal number 11, 12 and 13). The transparent and bonding relationship between Avemare and the local government has allowed them to become recognized for their contibutions to sustainable development.

The final version of the video was shared through social media with all participants and related social networks. Particularly Coopercaps, who has recently inaugurated a new educational space at their main location Unit 1, has expressed interest in using the videos for training and pedagogical purposes. Both groups want to work with the videos to widen their public support and to demonstrate their specific roles in the city's waste management systems. Specifically, the local government in Santana de Parnaiba has already used the documentary for dissimination. The film was first publicly screened during a workshop in April 2022, to an audience of waste pickers and supporters (NGOs and universities) in São Paulo. Next steps will include widening the scope of dissemination within different regions in Brazil and internationally (in countries that speak Spanish, English and Swahili) and by introducing the documentary as educational tool and as source during debates on inclusive circular economy.

6. FINAL CONSIDERATIONS

The research results reveal how WPOs contribute to the socio-productive inclusion of workers who have been stigmatized and excluded, providing a livelihood for individuals that were homeless, abused, substance dependent and living in poverty and without work. Both cooperatives have a policy of including and supporting vulnerable individuals, addressing their personal challenges and recovering their citizenship (Gutberlet, 2008). The documentaries highlight some of the eco-social innovations of cooperatives and the resulting environmental benefits. Coopercaps has developed new techniques to maximize resource recovery, by finding opportunities for materials that were considered unrecyclable or didn't have a market. In partnership with the city, Avemare engages in environmental education at the household level, targeting better separation at the source and the reduction of rejected materials. Both examles contribute to less waste being send to the landfill and more materials entering the circular economy, thus diminishing the pressure for natural resource extraction.

The novel practices discussed in this article have emerged from a marginal 'niche' context. These eco-social and socio-technical innovations are being disseminated through existing networks of WPOs and of their allies,

reaching the progressive mainstream (e.g., the city hall in Santana de Parnaiba, recycling industry partners, university partnerships). In some countries, such as Argentina, Brazil or Colombia waste pickers are part of a larger social movement involved in transferring knowledge (and GIs) for the implementation of sustainable practices (e.g., increasing material recovery and diversion into the circular economy, building more awareness in the community about socio-environmental dimensions of separate waste collection and recycling or struggling for social inclusion and remuneration of recycling services). Waste picker leaders are aware about their role in the circular economy and are proud of the differentiated knowledge and skills they posess on waste diversion and in material-product chains for material transformation, design, recycling and reuse (Carenzo, 2020).

Avemare is a case where innovations have been scaled-up and translated into changes in the structure (institutional) and practice (routines, procedures and protocols at the municipal and cooperative level). Similarly, Coopercaps has proven their capacity and skills in managing the recyclable fraction of waste for part of the megacity São Paulo, increasing diversion rates. Diverse changes in practice and technical GIs have contributed to increase the value of materials (by finding markets for materials that did not have a value) and to share the new knowledge with other cooperatives via networks and waste pickers' social movements. These processes are shaped by situated power dynamics and, of course, don't happen without tensions, stresses and conflicts. The long-term value shifts and the consolidation of the GI towards a transition to greater recognition of the role of waste pickers in the circular economy, can make up for the many obstacles and setbacks these WPOs encounter along their transition path. As Hoppe and co-authors (2015), suggest, successful niches can further influence a regime by the replication of the innovation, by installing multiple small innovations, scaling them up and growing to attract more participants and eventually turn a niche innovation into a mainstream system. According to the waste pickers' perspectives, these innovation videos should contribute towards replicating and upscaling the specific learnings, making the experiences available to the mainstream. The documentaries inform policy makers about the role change from waste pickers as workers in the recycling system, to waste pickers as developers of new technologies and social innovations in work practices and governance.

The circular economy framework requires a revision in order to accommodate the social valorization within the value chain of waste, recognizing the diverse eco-social contributions of waste pickers in the waste system. Undoubtedly, new challenges will arise in waste management and for waste picker organizations. How can waste pickers' contributions, as demonstrated in the GI examples provided in this article, be rightfully included in an updated circular economy framework? How do GIs in solid waste management impact the official and mainstream actors within the circular economy? These and other questions need to be answered to be able to evaluate the resilience, adaptability and sustainability of these innovations but also to find solutions for the persistent hurdles and the bottlenecks of GI transitions.

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