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FULL PAPER

Environmental Justice and Circular Economy: Analyzing Justice for Waste Pickers in Upcoming Circular Economy in Fortaleza, Brazil

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Abstract
Sustainable development (SD) presents three pillars: environment, equality, and economy. Many scholars agree that circular economy (CE) currently displays a social gap, as most studies so far focus mostly on economic aspects and, occasionally, environmental too. Although some developed countries and especially the EU heavily promote it, there is little possibility of developing countries accepting CE unless it can fill what it is lacking. This study suggests the use of Schlosberg's tripartite environmental justice (EJ) perspective to complete the concept of CE, bringing it closer to that of SD. Due to their significant contribution to both circularity and the environment, and, likewise, due to their poor social conditions, this paper focuses on the social group of WPs, mainly in Brazil. After conducting 19 semi-structured interviews, EJ was applied to the case of the Ecopoints in Fortaleza (northeastern Brazil) and each element—recognition, distribution, and participation—detected conflicts, such as underappreciation, continuously reduced access to recyclables, distrust, and miscommunication. If CE is successful in LMCs, it will heavily rely on WPs. The analysis suggests that it is necessary to recognize their contributions in order to value their work and consequently, promote their social inclusion.

Keywords Environmental justice · Advanced circular economy · Waste pickers · Brazil · Fortaleza

Introduction: Overview of the Circular Economy

This article focuses on the understudied role of waste pickers (WPs) in a circular economy (CE), namely by using an environmental justice (EJ) perspective to fill the social gap of a

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potential CE in Fortaleza, Brazil. A circular economy is based on three principles, according to the Ellen MacArthur Foundation [1, 2]: preservation and enhancement of natural capital, longer circulation of products and materials, and designing out waste. However, as mentioned by Camacho-Otero [3], most CE scholars focus on production, tackling topics such as business models or waste management (WM). CE studies often suggest the implementation of the 3Rs or of the ReSOLVE framework developed by the EMF [1].[1] Nevertheless, because CE is a mix of schools, it encompasses a range of other issues, such as clean energy, supply chains, waste, product safety, virtual services, environmental limits, and restoration. Many of these topics relate to sustainable development (SD) and the sustainable development goals (SDGs) [4], which the United Nations established to tackle many of the ongoing environmental, social, and economic encountered worldwide, most significantly "reducing poverty," the first of the 17 goals. The SDGs can be considered the current priorities of the world—many of which involve social issues—which CE should also integrate with.

Kirchherr [5] suggests that CE should aim to achieve SD, but both Murray et al. [6] and Geissdoerfer et al. [7], for example, agree that CE "does not integrate other dimensions of SD, especially the social one. These missing dimensions could be added to the concept of the Circular Economy" [8]. A recent study systematically reviewed some of the topics examined thus far under the guise of CE [9], and though a wide range was covered—including social networks, local communities, sharing economy—most of these studies were limited to very narrow aspects, especially employment [9], and more than half were geographically limited to China. Although such limitations are justifiable by the difficulty of interdisciplinary research and holistic approaches, the literature is unanimous in a key issue: CE does overlook the social dimension as a whole [5, 8, 10, 11], especially the issues related to SDGs 8 (inclusive and sustained economic growth) and 10 (reduce inequalities), therefore, perpetuates the North x South quarrel.

If, on the one hand, CE lacks studies of its social impacts, on the other hand, the EMF definition itself employs the word "industrial," which suggests that CE's main concern is the production side. Moreau et al. [11] argue for a more social CE, citing, for example, Polanyi [12], when reasoning that economy is both tied and deeply woven into society: It is not purely self-regulating, since it depends on the institutions and social relations where the economy is inserted, and that it is inevitably inseparable from its surroundings. Contrasting with this notion is Elkington's triple-bottom line design, which summarizes the SD ideals of balancing economy, environment, and human societies. Neither recommend improving economic aspects without simultaneously looking at the whole panorama. Excluding the social aspects seems counter-productive, as the World Commission on Environment and Development [13] argued, especially under Polanyi's design. The instability of societies with deep social issues may lead to escalated conflicts such as civil wars [14], a consequence that may befall a circular society that does not tackle its social issues.

The social gap in low and middle-income countries (LMCs) poses more of an issue compared to high-income countries (HICs), as the first can count on far less resources to tackle the challenges than the more privileged group [15, 16]. Social difficulties lead to problems such as poverty, unemployment, and under-employment in LMCs, and many other issues that are targeted by the SDGs, such as reducing inequalities and promoting responsible consumption and production. Another difficulty in LMCs is the high number of WPs, mostly driven by the lack of better opportunities. Despite their contributions—such as cleaning the

[1] ReSOLVE stands for regenerate, share, optimize, loop, virtualize, and exchange.

environment, improving household welfare, and returning some materials to production cycles—WPs are considered a social problem, since many are prisoners to cycles of poverty. They are but one example of social exclusion.

CE lacks social dimensions to address the present needs of neglected social groups and of developing economies, which could position CE as a weak sustainability concept, such as green economy [17], or simply as an economy strategy [9]. In this sense, Gutberlet et al. [18] proposed the amended circular economy (ACE), a framework of social/solidarity economy and ecological economy. Indeed, technical courses offered to WPs in Brazil seem to advise using social solidarity among the associations, perhaps as a direct result of Gutberlet's working with the WPs of São Paulo for over 10 years. However, as the leader of the waste picker alliance of Ceará (REDE) commented in an interview for the present study, "this social economy thing only works internally," but externally it had no real strength against their struggles, such as the debate regarding the Ecopoints, a policy in the city of Fortaleza, capital of the state of Ceará. From a CE perspective, the Ecopoints program is somewhat positively weighed as it brings back materials into production cycles, albeit for downcycling. However, further analysis under a social lens points to this initiative as a source of much discussion, especially from the point of view of WP associations.

Considering conflicts such as the one above, it is necessary to use a critical perspective capable of examining, among other elements, power relations and injustices among social groups—both of which can cause social stagnation and unsustainability—in order to diagnose and improve what is necessary. EJ particularly excels in this area, especially when studying marginalized groups, such as WPs in LMCs. In many developing countries, WPs play an important role for both public health and the environment due to their removing litter from the streets and contributing to recycling [19]. This service is generally unrecognized or undercompensated, and is often conducted informally and individually, resulting in low wages and weak social protection. Perhaps these low economic values are a consequence of the automatic relationship to "dirty," "smelly," and undesirable waste [20]. Even when recognized as formal labor, this activity rarely provides enough payment for a comfortable living standard, though there are many successful stories too. This overall scenario of neglect and exclusion is what EJ is equipped to analyze.

This paper demonstrates the viability of EJ to bridge the social gap of CE. EJ plays a key role in analyzing social injustices against excluded groups, such as waste pickers. The EJ perspective is therefore essential to redesign circular economy for LMCs, as it can identify overlooked groups, the cause of their exclusion, and include them in the proposal of new paradigms. Considering mainstream CE is neither a valid implementation of SD nor its extension due to CE's characteristic lack of social considerations, which are essential to SD [21], this study aims to employ the EJ perspective to fill in this gap under the auspices of the SDGs—mainly, though not limited to goals 8, 10, and 12, respectively: decent work and inclusive sustainable growth, reduced inequalities, and responsible consumption and production. Subsequently, fulfilling this gap should thus improve the implementation of CE in LMCs, namely in Brazil. The South-American country has one of the highest number of waste picker associations in the world [22, 23], and according to WIEGO [24], is the only country to systematically collect data on these informal workers, demonstrating its significance in studying social impacts of CE. Additionally, CE is a field still somewhat rare in academic works in the biggest South-American country [25]; consequently, a future translated version of this paper will contribute to increasing that database.

The next section (the "Literature Review" section) elaborates on Schlosberg's tripartite EJ, the perspective applied in this study. It is followed by the "Methodology and Method" section, which explains the methodology and the rationality employed in this study. The "Results: Evaluating Under the Proposed Environmental Justice Perspective" section presents the findings of the interviews, followed by the "Discussion" section, which analyzes the data obtained in the "Results: Evaluating Under the Proposed Environmental Justice Perspective" section. Lastly, the "Conclusion and Recommendations" section presents the conclusion and suggestions.

Literature Review

The distribution of natural resources or of their value is undoubtedly unequal [26], causing social inequalities. EJ excels in such cases, offering a lens to analyze social disparities. In this sense, Middleton states that EJ "is strongest in evaluating fairness in decision-making, and explaining why (in)justices may have occurred," [27] and "the crux of environmental justice often focuses on the environmental burden and lack of access to decision-making of economically, socially and politically marginalized communities" [27]. Thus, EJ is a valid candidate to investigate the feasibility of CE in developing regions, including a social determinant.

EJ is increasingly linked to the SD principle, despite SD being another concept that lacks a universal definition [28, 29]. Regarding this association, Haughton observes that "finding the common ground between EJ and sustainability requires 'acknowledging the interdependency of social justice, economic well-being and environmental stewardship'. The social dimension is critical since the unjust society is unlikely to be sustainable in environmental or economic terms" [28, 30]. A society that does not concern itself with its social issues is doomed to conflicts and ruin, therein lying the importance of social research and the spreading of ideas such as SD and EJ.

Regarding the use of EJ as a problem-framing tool, Walker pointed out that EJ typically consists of three steps: the normative ideas that guide what should be; the diagnosis of what are the problems and who bears responsibility for these problems; and "prognosis of solutions and processes of change" [31]. In this study, SD and the principle of equal opportunities feed the normative background, while the interviews and other online and literature sources feed the diagnosis. Lastly, a tentative prognosis is offered in the conclusion. Both Walker's problem-framing structure and Schlosberg's EJ theory [32] set up the backbone of this paper; Schlosberg identifies three key issues to be considered—distribution, participation, and recognition—briefly explained below.

- Distribution: perhaps the most referred aspect of justice in general, including EJ, possibly due to the link with Rawls' classic concept of distributive justice, whereby an individual's life prospects are heavily determined by his initial social position. What distributive justice is mostly concerned with is the allocation (distribution) of material goods and rights/duties, including benefits and burdens among members of a society.
- Participation: in recent decades, social research on participation has grown, with scholars increasingly recommending a wider participatory approach [28, 33, 34]. For EJ, this element means decision-making, referring directly to the groups that have the power to do so and that commonly impede weaker yet often larger groups.

- Recognition: this is the least explored element [35], but it is the ontological root of the previous two. Recognition focuses on why the groups who have the most advantages are in power and how they got there. According to Young, it refers to an identity, or identifying oneself as part of a subgroup. The subgroup should be accepted by the society which it is a part of, and all its members should have the same rights as any other member of that society. She warns that lack of recognition may cause distributive injustice [Young, n.d., as cited in 36].

Taking Schlosberg's theory as a whole, its three elements have the main ingredients to answer the main criticisms against CE as appointed by the current literature. In fact, it brings elements to counterargument against Kirchherr [5], Murray et al. [6], and Geissdoerfer [8], regarding CE lacking a social dimension. By bringing EJ into CE policies, weaker groups such as WPs would engage in the social and economic policies to be applied (participation), and all subgroups of a society should be included in any development attempt (recognition). Finally, distribution—or distributive justice—implies a fair allocation of material and immaterial goods and benefits among the members of the society, and also the damages that may occur in the development process.

EJ is in line with Moreau's requirements for a more social CE [11], as Polanyi [12] states in his historical arguments for an economy more embedded in society. It likewise follows Velis' findings that CE in LMCs is "not mandated by ideology, but by social and market necessities" [36]. The prevailing conditions in developing countries require clear policies that promote inclusion and not exclusion in society. This can be seen in Martinez-Alier's argument of a rising international movement for global EJ and statistical studies as shown in the Global Atlas of Environmental Justice [37]. The Atlas reflects the worldwide conflicts of unequal distribution and social struggles based on unequal access to services and goods, all problems that are common in LMCs. Although Gutberlet et al. [18] mention these social difficulties, their principal objective was to clarify the need for CE to take social aspects into account. While their principle-based ACE framework seems to focus specifically on WPs, it lacks a theoretical perspective to assist policymakers in turning CE from its main economic concerns to include social concerns in CE policies. The present study proposes EJ to guide such a transition.

Methodology and Method

This paper analyzes the potential of CE in the city of Fortaleza, Brazil, using EJ as the main theory, and SD as the supplementing theory. It aims to demonstrate the viability of EJ as the social lens of CE, thus filling the social gap of CE that has been cited by many authors [5, 8, 11, 38–40]. Figure 1 demonstrates the EJ structure used, based on Walker's framing structure (green) and Schlosberg's theory (orange and white). The blue rectangles represent elements of this study.

The EJ-based perspective above was used to analyze the WPs' activities in the city of Fortaleza. The topics of recognition relate to awareness and acceptance of waste pickers—or, in other words, social inclusion. Distribution reflects the division of materials, privileges, and losses within a community, country, or society. Finally, participation encompasses decision-making and discussion opportunities. With the exception of some internal conflicts, most WPs presented similar answers and perspectives, and their comments fall in line with the proposed perspective.

Fig. 1 The core chessboard layout of Fortaleza (source: Personal archive)

The Case Selection

Brazil was chosen for being a southern upper-income LMC with a large population—approximately 210 million in 2018 [41], for its lack of both EJ and CE studies, for its large number of WPs with significant contribution to the country's economy, and for its fast-growing metropolitan areas, among which is Fortaleza. This city experienced a sudden economic growth without an equivalent social-economic distribution, making it a fertile field for disparities, injustices, and EJ studies. Most CE initiatives in the country are located in the southeastern economic center of Rio de Janeiro - São Paulo, but northeastern Fortaleza's distance from that region increases difficulties for WPs [42], well-intended policies, and CE-welcoming companies. The divergence from the southeast adds an innovative perspective to this study.

Fortaleza is Brazil's 5th biggest state capital, and its main income derives from services, especially tourism. The current municipal government is striving to brand it as a smart city, an endeavor possibly facilitated by its core chessboard-inspired design (see Fig. 1). Consequently, many changes happened in the last 5 years, such as the inauguration of a metro system, the implementation of bike lanes, and bike-renting services to encourage healthier lifestyles [43]. Fortaleza has an estimated 2019 population of 2.7 million people, with approximately 37% living on less than 100 dollars a month [44], as reflected on its Human Development Index (HDI) distributional discrepancy (see Fig. 2). The inhabitants produced an average of 0.86kg/person/day of waste in 2017 [49]. Table 2 presents the basic information about Fortaleza, contrasting it with Brazilian averages [44, 49–52].

Most of the waste in Fortaleza is collected by ECOFOR, a subsidiary of a sanitation conglomerate. Similar to Recology in the US city of San Francisco [53], ECOFOR also monopolizes solid waste collection and urban cleaning services, but there is no direct fee required from the consumers. The subsidiary collects household waste door-to-door, but it does not specifically collect source-separated materials—Fortaleza offers this service via its Ecopoints program, which are also managed by ECOFOR, who sells the recyclables to interested industries. The Ecopoints consist of over 60 small drop-off spots for recyclables throughout the city, with many more planned for the upcoming years. According to the municipality, the Ecopoints were originally designed to be managed by registered WP

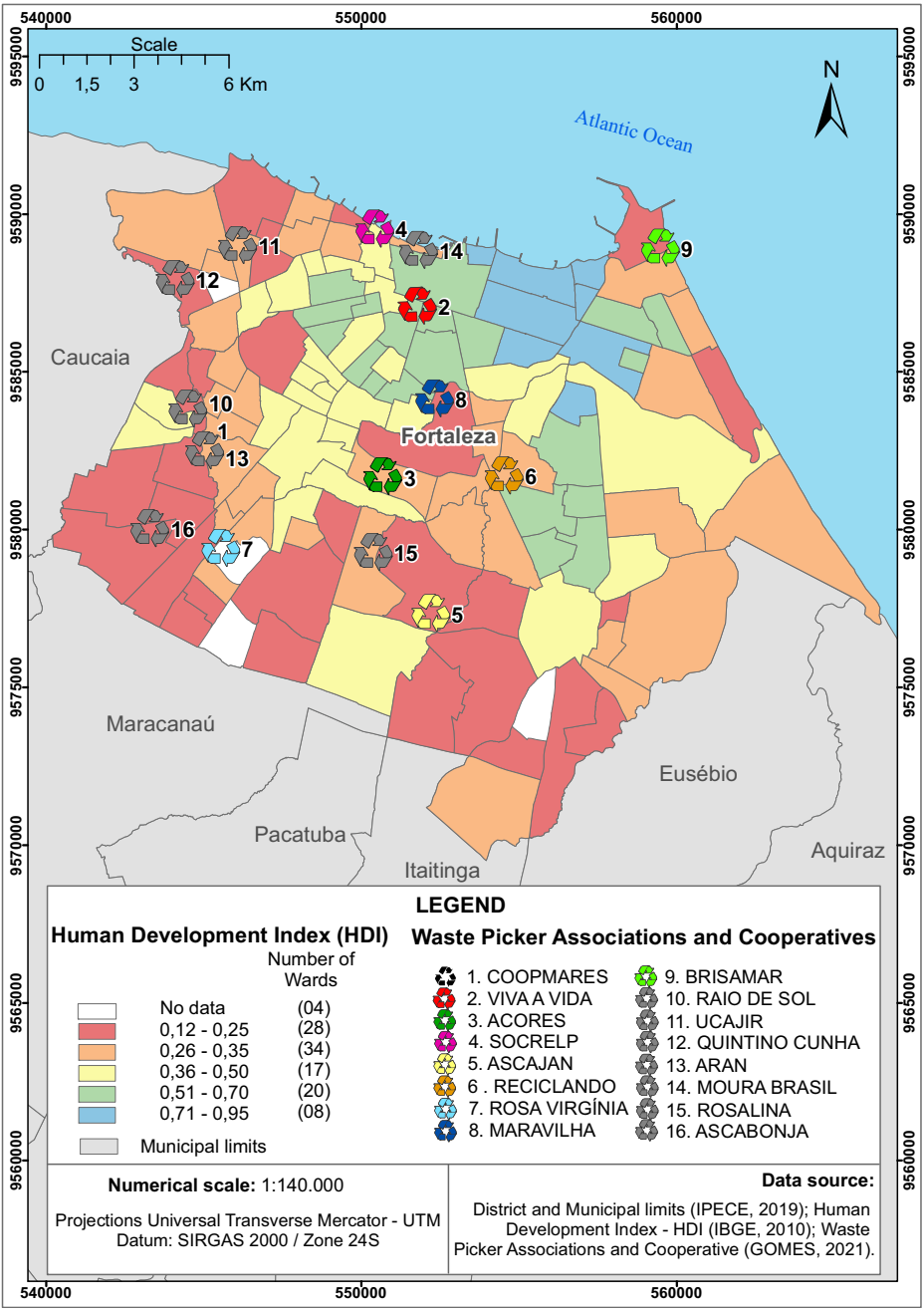

Fig. 2 Fortaleza's HDI values by ward and locations of the WP associations. Based on [45–48]

associations. However, the associations allegedly showed no interest in this formal work, and were also deemed incapable of properly managing the Ecopoints stations. Overall, this case is one example of how social factors can be relevant to CE, but are still overlooked.

Table 1 The interviews with WPs, government officials, and businesses

#	Year	Category	Organization	Position
1	2014	Government	Municipal	Director
2	2014	WP	Association	Leader
3	2014	WP	Independent	Independent
4	2014	Scholar	University A	Professor
5	2019	Government	Municipal	Coordinator
6	2019	Business	Startup recycling	Owners
7	2019	WP	Association	Leader
8	2019	Education	Government program	Government-WP liaison
9	2019	Education	Government program	Government-WP liaison
10	2019	Mix	Government program/association	Liaison/leader
11	2019	WP	Association	Members
12	2019	WP	Association	Vice-leader
13	2019	Government	Municipal	Sanitation bureau
14	2019	Business	Waste management	Environment coordinator
15	2019	Government	State	Coordinator
16	2019	WP	Association	Leader
17	2019	WP	Alliance (REDE)	Leader
18	2019	Government	State	Staff members
19	2019	Scholar	University B	Professor

Source: Field work

Data Collection

Most of the data was collected via 15 in-depth semi-structured interviews conducted on-site in 2019; interviews with the leaders of the associations were followed by a site visit. This style of data collection was chosen because it allows the observance of similar patterns by asking some common questions, while also conceding freedom to both interviewer and interviewee therefore on the discussed topics, i.e., it is possible to explore general and individual characteristics of each interviewee [54, 55], especially concerning their social circumstances. Finally, the planning of the initial questions reflected Schlosberg's three elements, which also guided the non-structured part of all interviews.

Table 1 shows more details regarding the interviewees. At the time the author conducted the interviews, there were nine registered WP associations, and all were contacted, as was the head of their collective network REDE. All ten were interviewed, with the exception of one—due to

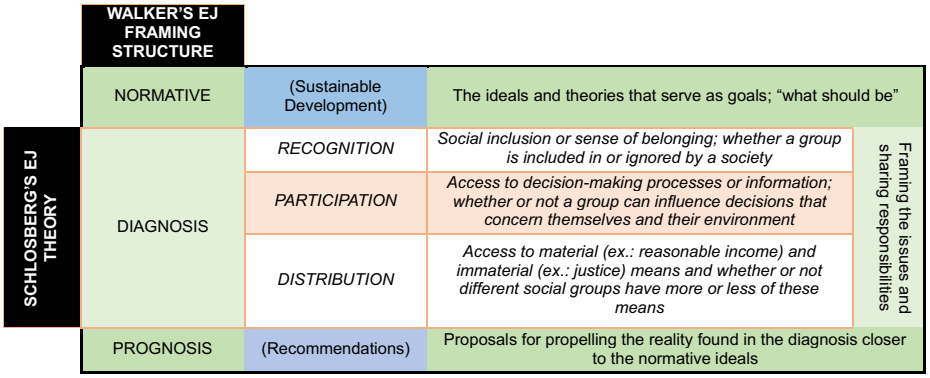

Fig. 3 Proposed EJ perspective for CE. Based on Schlosberg [32, 58] and Walker [31]

Table 2 Basic information from 2017 on Fortaleza and its WM, compared to Brazil's

	Fortaleza	Brazil
Population (urban)	Approx. 2,667,000	Approx. 207,700,000
GDP/capita	Approx. USD 4700	Approx. USD 6400
Economy	Approx. USD 11.67 billion	Approx. USD 1.3 billion
Total domestic and public waste	Approx. 1,460,000 tons	Approx. 62,000,000 tons
Average daily waste	1.52kg/capita/day	0.95kg/capita/day
Registered associations	8 (as of September 2019)	1,232
WM system	Privately contracted (monopoly)	*Mixed*
WM collection system	Door-to-door, voluntary	*Mixed*
Population covered by waste collection (urban)	98%	91.8%
WM-related expenses	- Approx. 5% of the municipal budget - Approx. USD 16 million (2015)	Approx. USD 4 billion
WM cost	USD30/ton	USD34/ton
WM fees/taxes	None	*Mixed*

Source: Based on [44, 49–52]

Note: All currency conversions are based on June 2020 values

schedule incompatibility. Representatives of both the state and municipal governments were also interviewed. Finally, the two interviewed businesses were the sole waste collection service provider procured by the municipality, and an innovative startup recycling company that seeks to work in tandem with the WPs. All interviewees were chosen based on their theoretical relevance and impact on the outcome of the case study.

All interviewees authorized the recording of their interviews, as recommended by Saunders et al. [56], as well as the use of their names, although the author opted not to divulge any. The researcher used two recording devices and took notes throughout all interviews, as recommended by O'Leary [57]. Finally, the ethical aspects of the study were approved in accordance with the internal protocol of the institution to which the author is affiliated.

Data Analysis

The data analysis was of qualitative nature. Based on the proposed perspective (Fig. 3), three are the variables of this study: first, recognition, since it is considered the root of many social inequalities; distribution, which is the most evident symptom of social inequalities; and, lastly, participation, the often invisible symptom. Before the data collection, each variable was assigned expected sub-variables (theoretical codes) [59] based on the literature and a preliminary study, such as "stakeholder" (WPs, business, government), "materials," "services provided," "relationship with other stakeholders," "goals," and "registered/unregistered association" (Table 2).

During the interviews, in vivo [59] variables were added (e.g., "participation in the CATAFORTE program," "conflicts with other members," "ownership of real estate").

After the interviews, the recordings and notes were coded and reviewed in order to identify patterns and conflicts. This study focuses on the results of such patterns.

Results: Evaluating Under the Proposed Environmental Justice Perspective

The following sub-sections further elaborate the findings illustrated in Table 3, which summarizes the main problems identified under each element of EJ during the interviews, following the proposed EJ perspective (Fig. 3).

Recognition

In HICs and LMCs, waste picking is often the sole alternative for the survival of impoverished families. These usually informal workers are common in developing areas, and though the

Table 3 Summary of EJ findings

EJ element	Case study characteristics of Fortaleza
Recognition	Prejudice, violent and unhealthy living environments, underappreciation, informal work
Distribution	Low prices, challenges of cost-effectiveness, access to clean recyclables, regional distances, few or no opportunities, business monopolism, voluntary drop-off
Participation	Different relevance of opinions, non-participant stakeholders, ineffective communication, unequal access to decision-making(ers)

Source: Based on the interviews (field work)

work they conduct is essential to a CE and to a clean environment, they are often overlooked, subject to violent and unhealthy living environments in addition to social injustices. Young argues that such lack of recognition causes many social disparities and injustices [35], seemingly the case of the WPs of Fortaleza. Figure 2, based on [45–48], portrays a map of Fortaleza's city wards according to their HDI, along with the location of the REDE associations. It is clear that most associations are based in wards of low HDIs, a possible indication of the precarious conditions most WPs live in [60, 61].

Although some interviewees mentioned never having experienced any prejudice, other WPs argued that there are considerable preconceptions against them, even when properly organized into associations. However, all interviewed WPs mentioned feeling proud of their work, though they presented different reasons, such as dignity, funding their children's schooling, and contributing to improving the environment.

Distribution

Distributive justice is one of the most common and well-known types of justice. Its classic form is directly attributed to Rawls' veil of ignorance, whereby if those who elaborate the rules of a society were to not know beforehand what their social position is, they would almost certainly desire a more equal society in which all members help each other share equal burdens and privileges. For EJ, distribution relates to the division of positive attributes, such as opportunities of growth and profit accrual, and negative attributes, such as bad living allocations and lower quality of services or environmental conditions. In a related analysis, Qu et al. [62] explain the many factors of global distribution of waste by factoring in shipping rates, labor costs, and stringent environmental regulations, among others, while exploring the global impact of China's 2017 Waste Ban. According to the authors, there is potential for both developed and developing countries to thrive, but cheaper labor seems to offer the poorer group the advantage. Regardless, it is a sign that global circular transactions require change [62] in order to promote fairer trades.

A just distribution stems directly from recognition; unfair divisions or, in this case, lower prices are a direct consequence of the lack of social inclusion. Although WP associations also collect, compress, and sell to the company or agent who will pay them the most, associations are usually at a disadvantage because there is often a minimum volume requirement by the recycling companies that their capacity to collect, store, and process cannot fulfill, or that require longer periods to meet, despite donations from companies and the government. In this scenario, the local network REDE has the potential to improve prices, as it collectively gathers higher quantities, and also enables greater visibility.

Participation

Participation is the element of EJ that examines who are the decision-makers and who are not. It is related to distributive justice and Rawl's veil of ignorance: If decision-makers were made unaware of who would shoulder burdens and it could be themselves, the negative and positive attributes of a society would most likely be equally spread between its members. However, decision-makers are commonly not the same who deal with the worst consequences of urban planning, such as lack of sewage, or the presence of incinerators or waste dumps. Although there are many initiatives to the contrary, WPs often do not participate even when deciding waste-related issues, despite the important role they play.

	WALKER'S EJ FRAMING STRUCTURE		
	NORMATIVE	Sustainable Development	Social aspects should be included in CE policies.
SCHLOSBERG'S EJ THEORY	DIAGNOSIS	*RECOGNITION*	- *Although some circumstances have improved, WPs are still at the margin of society* - *Difficulty in officially registering an association* - *Social prejudice, negative image, humiliation* - *WPs feel proud of their work/are aware of their contributions*
		PARTICIPATION	- *There are some meetings with government officials, but there is doubt about how much WPs are heard* - *WPs are generally not consulted when elaborating MSWM policies* - *ECOFOR is often consulted/included when elaborating MSWM policies*
		DISTRIBUTION	- *WPs play a huge role in circularity, despite limited integration* - *Partnership with different businesses and entities allow WPs access to larger quantities of cleaner recyclables, but it is still limited due to a failure in the logistics design* - *WPs are excluded from the main MSWM policy (Ecopoints), but are included in some MSWM policies* - *ECOFOR is included in the main MSWM policy (Ecopoints)*
	PROGNOSIS	(Recommendations)	- Active inclusion of WPs in circularity-related logistics - Improve communication amongst stakeholders - Facilitate the registration process

Fig. 4 Results represented in the proposed EJ perspective

All interviewed WP associations mentioned that they were neither invited to participate in the Ecopoints initiative, nor were they called upon to give their opinions on the matter. The municipal government argues that they called for WPs to register for the Ecopoints, yet not one did, possibly due to the prices for the collected recyclables being lower than the market price. From that shortcoming, some miscommunication between these two stakeholders is evident, and in order to realize a socially just CE, bridging this gap becomes essential.

Figure 4 presents a summary of the issues uncovered by the applied EJ perspective, which are further explained in the next section.

Discussion

One problem Brazil faces is its 8.5 million km^2 [63] and its regional differences, especially the economical, given the social-economic disparities among populations of different areas. Most of the country's industrial production is concentrated in one center: the southeastern region, mainly the state of São Paulo. The case of glass manufacturing in Brazil illustrates this barrier well, since most of the companies are located in São Paulo, but their products are sold all over the country, which makes recovering these heavy and dangerous materials all the more difficult. Often only small quantities are collected locally, increasing the challenge since transporting from so many different cities in a continental-size country to a central manufacturing center is only cost-effective if there are medium or large quantities. The fact that most of the domestic transportation is executed by trucks crowns the difficulty of returning materials back to manufacturing cycles.

The National Policy of Solid Waste Management (NaPS), enacted in 2010, recognizes WPs as a marginalized group in need of legal protection. Since then, much progress has been made, such as closing over 200 illegal dumpsites [50, 64], including Estrutural, the world's second largest open dumpsite [65]. Despite this, WPs remain a social outcast. This shows that there is much to be done towards the recognition of this group as "the 'invisible heroes' of informal

waste management" [66]. Their absence at the Ecopoints might also be a reflection that there is room for improvement. In this sense, the role of REDE, which represents all the associations, is important to achieve better negotiation and status for the WPs, potentially increasing their recognition, although it still lacks the power to do so.

The Ecopoints in Fortaleza demonstrate how the interests of the state and those of the lesser benefitted populations can simultaneously clash but also align. NaPS was clear regarding its objectives, such as integrating WPs into policies that promote the circularity of materials [67], and that WP associations and cooperatives should have preference when hiring for services related to circularity [67], among other rights. Thus, the city constantly attempts to hire the WP associations for big events that Fortaleza promotes. However, since NaPS was not clear regarding how these services should be offered, hiring WPs is ultimately optional.

NaPS requires local governments to formalize WPs whenever possible, and, according to the government officials, many opportunities were offered, e.g., hiring for big events such as the 2014 FIFA World Cup. WP associates also agree that their general situation improved since 2010, due to policies such as requiring a declaration of final disposal, which can be issued by registered associations and, since then, more businesses donate their recyclables. However, many of these collectives are not registered, and some have spent considerable time attempting to complete the process in order to be able to apply for events, positions, and other benefits provided by a legal status. Registration or lack thereof is an issue which has much influence over opportunities for these groups.

The inclusion of WPs in decision-making is also scarce, and the same happens in many countries [68]. In a study about the progress of CE in Europe, Ivanova mentions that a successful transition requires all stakeholders to get involved and to cooperate with each other [69]. In Brazil, the list of interested actors should without a doubt include the WPs, given not only their already considerable contribution towards CE, but also their large numbers and relatively advanced level of coordination.

WPs are responsible for the removal of almost 90% of all recycled material in Brazil [42], a fact many of the WP interviewees were aware of. In 2018, formal participation of WPs in waste collection services was responsible for 30.7% of all recovered recyclables [70]. Yet, these neglected heroes are often not rewarded for this removal, possibly due to a lack of recognition of their contribution in both cleaning the environment and diverting recyclables from landfills by circulating the materials. Considering this, it should be noted that, as of January 2021, the state of Ceará approved a permanent financial aid of 25% of the minimum wage to WPs in registered associations [71]. After São Paulo, Ceará is only the second state in Brazil to offer some compensation for rendered environmental services.

Starting in 2007, the Catholic Church partnered with financial institutions and promoted workshops to help WPs organize themselves into associations and, therefore, improve their working and economic conditions. At least half of the interviewed leaders of the registered associations attended these workshops and proudly mentioned these events, considering them an upgrade to their skills. As a result, several associations were legalized and attendees had a better grasp of business concepts. The local Catholic Church occasionally ceded space and/or recyclables to some of the associations.

Amidst this scenario, the creation of the Ecopoints proposed a win-win scenario: The registered WPs would be hired as formal workers—a measure recommended by authors such as Medina [72], Aparcana [73], and Gutberlet [18]. Once hired, they would then be trained and posted along the many drop-off points, thus having easier access to recyclables and less harsh labor. The interviewee from the municipal government confirmed an unprecedented 1.5-

million-dollar funding from the World Bank in 2019 for its environmental projects, including the Ecopoints. Citizens can volunteer their recyclables at any of these spaces, where the material will be separated, weighed, and credited based on the market prices displayed at the station. As of yet, there is no cash-back option, but once the benefit is calculated, the contributors may choose between a discount on their electricity bills, or credit with the municipal public transportation system [74], or virtual money, the latter being a recent possibility due to a partnership with a local community bank. The WPs, however, are not operating at the Ecopoints.

While Fortaleza is actively promoting the Ecopoints and is continuously inaugurating new ones, all interviewed WP association representatives, although initially supportive, were displeased with the initiative. The city government alleges inviting the associations at the beginning, but most representatives denied this claim. Regardless, the low prices offered for the recyclables can be appointed as the ultimate cause of the refusal of the WPs to participate, and it is not without reason: WPs have clashed with middlemen for decades, trying to eliminate the many third parties between them and the industries that pay more for recyclables. The Ecopoints commodity prices were lower than the market prices, so WPs would ultimately suffer loss of profits, a situation they logically would like to avoid, given their already low income; it is possible, however, that the larger quantities might cover and perhaps surpass the deficit.

Officials of the city government also pointed out other initiatives and also other conflicts, such as the lack of willingness of the WPs to accept a clock-in and clock-out time. When asked, however, most of the interviewed representatives disagreed about this claim. This disagreement was not the only one detected during the interviews. Another constant issue is the role of the municipality regarding the associations. Most representatives alleged strained relations with the city government, some were indifferent, and other representatives stated getting little help from the municipal administration. Nevertheless, at least three of the associations were located in public property, ceded by the government, and many are benefitted with a small truck for collecting recyclables and/or space to work—the municipality allegedly pays for the fuel. Additionally, the representative of the city government mentioned projects that directly benefit independent WPs who live close to public schools. The city is also stimulating closed residential communities to engage with their local associations or independent WPs, thus rerouting domestic recyclables to these informal workers. Considering the economic benefits of the Ecopoints for the volunteers, however, it is possible the latter campaign for engaging is failing.

While the debate between municipal government and WPs continues, it is ECOFOR that currently operates the Ecopoints, the same single company that collects the city waste. A similarly monopolist yet renowned case is San Francisco (USA), about which it has been argued that a monopoly over the collection and treatment services was a definite positive factor [75]. However, given ECOFOR's monopoly over the service, the additional recyclables accrue their monthly profits, instead of helping to dissuade income disparity. The representative of the company, however, cited that they often support the WPs too: Twice a week, ECOFOR offers a small truck to pick up donations from other companies and bring those to the associations. The company also prioritizes hiring WPs, but alleges they often quit.

Some of the locally based companies regularly offer donations and support to the associations—for example, most of the representatives of the associations cited donations and additional support from Coca-Cola or other big companies. At the same time, they also mentioned the difficulty of collecting these donations, given that most of these businesses

donated the materials, but would not take them to the recycling centers. Some of the associations received a truck from the city government, either as a donation or as a cession, or from local private companies. Few had actually managed to purchase a second truck to reinforce their operations. Thus, it is possible to affirm that the difficulty of WPs is the same as that of implementing reverse logistics, or even that of CE itself: transportation. In other words, bottleneck includes access to clean and re-circulative materials and how to take them back to their manufacturers.

The prices attributed to recyclables at the Ecopoints are subsidized by the city government, not by recycling or scrap businesses. Perhaps involving the latter in this system could offer an increased price, while also eliminating one, two, or more middlemen that intermediate the path of a recyclable from WPs to the transformative industry. Currently, the recyclables brought to the Ecopoints are picked up by the same company that monopolizes the waste collection, and then sold to the buyer offering the highest price.

The Ecopoints are currently the city's main waste-related initiative (aside from the door-to-door municipal waste collection, a service also monopolized by ECOFOR), yet there is potential for to the Ecopoints to offer more social benefits if the associations were involved. However, as Aparcana [73] mentions in her review on case studies of WPs worldwide, the most frequent barriers are the political and institutional ones, reflected by the conflicts between public authorities and the WPs such as this case. Despite there being many opportunities and channels for WPs to communicate with the officials of the city government, there seems to be very few chances for the WPs to participate in elaborating the decisions on waste, such as the ongoing Ecopoints debate. A clear example presented itself at a Seminar on Reverse Logistics held by the State Prosecutors Office during the time of the interviews. Very few WPs were present, one of them being a presenter and also one of the interviewees, who alleged completely altering her speech after the previous speakers presented results that overlooked the contributions of WPs.

Although the analysis in this paper refers to Fortaleza and Brazil, there is no doubt that some of these points may also apply to other locations and circumstances. Individual WPs, for example, occupy an even more fragile social position, working more hours to collect a sufficient amount of material, compared to those who join a registered association who gain by scale. Independent pickers are also subject to more prejudice, which further complicates their access to the materials they need for survival, although this is partly due to their littering. Additionally, individual WPs are also further subject to exploitation by middlemen and companies, and this is true of other cities [76–78].

Despite the challenge, the numbers of WPs in many developing countries reach thousands, which is a clear advantage for such countries. Regions like Pune [79] and Mumbai [80], both big Indian cities, have already seen improvements in the lives of these groups, but, predominantly, WPs are socially excluded. In Brazil, they are estimated as 100.000, a number which, if correctly organized and supported, could collect in a wider area without much cost to the municipality. Diverted costs could instead be directed at financing WP-friendly market regulations on the prices of commodities. Furthermore, there already are many Ecopoints spread citywide, with many more on the way; if at least a part of these were managed by the associations and appointed as the city's official drop-off points, it would definitely increase the amount of clean materials collected by the associated WPs and, therefore, their income. It is also possible that they could accept more WPs, decreasing the number of independent WPs and, thus, possibly reducing their littering of the city. All in all, the Ecopoints hold the potential to promote both circularity and real social equity in Fortaleza.

Conclusion and Recommendations

As long as CE continues to ignore social considerations, mainstream CE cannot be anything but a perversion of the much fought-for principle of SD. Economic sustainability without the equivalent social improvements does not last, and, for LMCs, social aspects are especially crucial, given their already low HDIs. The local characteristics of different regions and those shared by most LMCs require different strategies from CE. However, many of these countries have a significant number of WPs. Mainstream CE might worsen their conditions by eliminating or drastically reducing their source of income—discarded recyclables. The chasm between these stakeholders and the rest of society is detrimental to a CE.

The role of WPs in increasing circularity is vital and indisputable, especially in LMCs, where the activity is often not just economic, but for subsistence. Enacting strong social measures to guarantee schooling, opportunities, health, and dignity to such populations, in order to raise them from poverty and promote their social inclusion, is recommended. Such procedures, however, often occur over long periods of time, but their necessities are immediate. Fundamentally, improving the social standing of WPs by recognizing their contributions to both the environment and the economy might prove most effective. WPs may be essential during the process of implementation of a just CE in LMCs, and their large numbers as collectors of reusable materials might be the missing link to finally close the loop. This might be especially true for Brazil, a country where WPs are highly organized and included in the main legislation enacted thus far, however subpar the enforcement.

In this sense, previous proposals to add a social design for CE included the use of the HDI, and a mix of ecological economy with social solidarity economy. This paper suggested a theoretical perspective based on Walker's EJ structure and Schlosberg's EJ theory (recognition, distribution, and participation) as a much-needed addition to the CE concept, especially for future implementation in LMCs, offering a deeper theoretical lens that investigates causes and explanations, instead of simply examining the effects. Future research might attempt to evaluate a combination of these proposals for a more effective system, as they do not seem mutually exclusive.

Limitations of this study include its focus on one city, Fortaleza, which restricts the scope of the analysis. Although much of the data might be applicable to other regions in Brazil and internationally, the replicability of the methodology needs further research. The accessibility to key stakeholders also posed a challenge: It is possible that other actors might have provided different insights. Additionally, due to the qualitative nature of the study, quantitative data was mostly overlooked, but establishing quantitative indicators should prove helpful to improve the applicability of EJ as a standard critical perspective. Lastly, these interviews were conducted in 2019, a year before the 2020 COVID-19 pandemic, which changed the reality of many WPs worldwide, including in Fortaleza. This study does not reflect those changes, but future research might tackle and other issues that were not covered in this study.

Final recommendations include further studying the application of EJ as a social patch for CE, as well as employing the EJ perspective to other cases in order to further investigate its applicability, elaborating indicators that would identify the key conflicts between economy and social aspects, thus solving their disparity and paving the way for a justly social CE.

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Declarations

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