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ARTICLE

Sustainability indicators and network of cooperatives of waste picker: an impact evaluation of the performance of cooperative members

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Abstract

Networks of cooperatives of waste pickers (NCWPs) are a yet little explored phenomenon in the literature on solid waste management and one that emerges as an alternative organizational model for overcoming the challenges faced by these organizations. This research aims to evaluate the impact of NCWPs on the performance of their members. To that end, the adaptation of the sustainability indicators of cooperatives proposed by Besen et al. (2017) was applied to three NCWPs, and their results were triangulated with document analysis and interviews. The research indicates gains for these organizations regarding the expansion of collection and separation of recyclables, joint trading, productivity, and income growth, the feasibility of logistical routes, gender equality improvement in the workplace, and better health and safety conditions. It also revealed that even when there is no joint trading, the benefits of cooperation foster the political strengthening of these organizations. Finally, we highlight the operational challenges faced by these organizational models, such as the structural asymmetry among network members, conflicts between the networks' objectives and the most immediate needs of their members, and the need to balance government support for establishing NCWPs without compromising their independence and self-management.

Keywords: Recycling. Waste pickers. Network of cooperatives of waste pickers. Sustainability indicators. Recycling chain.

Sistema de mercado de auditoria: uma análise a respeito dos papéis da confiança baseada nos estudos do macromarketing e da governamentalidade

Resumo

As Redes de Cooperativas de Catadores (ROC) são um fenômeno ainda pouco estudado na literatura e emergem como um modelo organizacional alternativo para superar os desafios enfrentados por seus integrantes ao melhorar seu desempenho por meio da comercialização conjunta e acesso direto às indústrias recicladoras. Esta pesquisa tem como objetivo avaliar o impacto das ROC no desempenho de suas organizações-membros. Para esse objetivo, uma adaptação de indicadores de sustentabilidade de cooperativas propostos por Besen et al. (2017) foram aplicados em 3 redes, sendo seus resultados posteriormente triangulados com a análise documental e entrevistas. Os resultados apontam que houve ganhos para as organizações estudadas no que se refere a ampliação da coleta e separação de recicláveis, aumento da produtividade e renda, viabilização de vias logísticas, maior equidade de gênero no ambiente de trabalho e melhoria das condições de saúde e segurança e fortalecimento político dessas organizações. Também foram identificados desafios para o funcionamento deste arranjo organizacional, destacando-se o desnivelamento estrutural entre os empreendimentos que compõem as ROC, conflitos entre os objetivos das ROC e necessidades mais imediatas das cooperativas membros e ainda a necessidade de balancear o apoio governamental na construção das ROC sem comprometer seu necessário grau de emancipação e autogestão.

Palavras-chave: Reciclagem. Catadores. Rede de catadores. Indicadores de sustentabilidade. Cadeia de reciclagem.

Indicadores de sostenibilidad y la red de cooperativas de recolectores: una evaluación del impacto en el desempeño de sus organizaciones miembros

Resumen

Las Redes de Cooperativas de Recolectores (ROR) son un fenómeno aún poco estudiado en la literatura y surgen como un modelo organizativo alternativo para superar los desafíos que enfrentan estas organizaciones. Esta investigación pretende evaluar el impacto de las ROR en el desempeño de sus miembros. Para este objetivo, se aplicó en 3 redes una adaptación de indicadores de sostenibilidad de cooperativas propuestos por Besen et al. (2017), y posteriormente se triangularon sus resultados con análisis documentales y entrevistas. Los resultados señalan que hubo beneficios para las organizaciones estudiadas en cuanto a la expansión de la recolección y separación de reciclables, aumento de la productividad e ingresos, viabilidad de rutas logísticas, mayor equidad de género en el ambiente de trabajo, mejora de las condiciones de salud y seguridad y fortalecimiento político de estas organizaciones. También se identificaron desafíos para el funcionamiento de este arreglo organizativo, destacándose la desigualdad estructural entre las organizaciones que componen la red y los conflictos entre los objetivos de la red y las necesidades más inmediatas de las cooperativas asociadas, y también la necesidad de equilibrar el apoyo gubernamental a la construcción de la ROR in comprometer su necesario grado de emancipación y autogestión.

Palabras clave: Reciclaje. Recolectores. Red de recolectores. Indicadores de sostenibilidad. Cadena de reciclaje.

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INTRODUCTION

Waste pickers are essential in the recycling chain in low and middle-income countries (Aparcana, 2017; Dutra et al., 2018). The state of vulnerability in which waste pickers live has stimulated initiatives aimed at the development of waste picker organisations (WPO) in several countries, including continents such as Latin America and Asia (Zon et al., 2020). The migration from a system of autonomous work to collective organisations allows gains such as increased income with greater financial stability and security, the promotion of better food security and hygiene, a healthier work environment, in addition to enabling the increased bargaining power in the sale of recyclables due to the consolidation of larger volume (Gutberlet et al., 2020; Magni & Günther, 2014).

In the international context, the Brazilian experience of strengthening Networks of cooperatives of waste pickers (NCWPs) is considered an important reference in this process (Besen & Fracalanza, 2016; Dias & Bouvier, 2021). With the generation of about 92.7 million metric tons per year (Ministério do Desenvolvimento Regional, 2022), it is estimated that Brazilian waste pickers are responsible for collecting 90% of the materials that circulate in the complex recycling chain made up by multiple organisations acting in both formal and informal markets (Instituto de Pesquisa Econômica Aplicada [Ipea], 2013). Despite their importance, waste pickers are the ones who profit the least from the activity (Bermudez et al., 2019), with recycling industries being the main beneficiaries of the financial resources generated in the recycling chain (Baptista, 2015; C. Silva et al., 2019). The difference between what is paid for recyclable material to the unorganised waste picker, positioned at the beginning of the waste reverse supply chain, to the price received by the recycling industry at the end of this chain can vary by 100% (Demajorovic et al., 2014).

Within the scope of public policies aimed at valuing and empowering these workers in the recycling chain, what stands out are advances such as the recognition of waste pickers as a professional category (CBO – Brazilian Classification of Occupations) Ordinance No. 397/2002) and the recognition of their important role in the National Solid Waste Policy (NSWP) as service providers in corporate reverse logistics programs (Law No. 12,305/2010). As one of the main results, a significant expansion of NCWPs working in partnership with local government and private companies can be observed in the country.

Such advances, however, have not eliminated the challenges faced by NCWPs regarding the sustainability of their operations (Gutberlet et al., 2020). Various factors stand out: the difficulty of attracting the unorganised waste picker who is still resistant to participation in collective enterprises (J. E. Rutkowski & E. W. Rutkowski, 2017), the lack of marketing knowledge (Dutra et al., 2018), the high turnover of cooperative members (Jesus & Barbieri, 2013), inequality in salary and the division of tasks between genders (Kergoat, 2010; Wirth, 2013), and the low quality of physical infrastructure and lack of appropriate equipment not allowing storage or processing the materials (Siman et al., 2020; Tackla et al., 2017) leading to low added value in trading (Aquino et al., 2009; Danese, 2021). As a result, the possibility of WPO reaching the volume, quality, and frequency standards necessary for direct supply to industry, which would increase the income of WPO, is reduced (Andrade et al., 2020). Aparcana (2017) considers that the persistence of these challenges shows that the formalisation of waste pickers organisations aimed at overcoming the social challenges inherent in the complex reverse chains of solid waste has not been successful, highlighting a lack of knowledge on how to overcome the barriers faced, and the need for the development of new models by public managers to ensure the formalisation of WPO adapted to different circumstances.

Against this backdrop, a recent debate has focused on the construction of NCWPs as a strategy to enable access to credit lines and supplementary resources (Dutra et al., 2018; Tirado-Soto & Zamberlan, 2013). This organisational arrangement favours the improvement of administrative practices (Boeira et al., 2007; Dutra et al., 2018) and the consolidation of large volumes, adding value to recyclable material and allowing for better positioning in the production chain via direct access to the recycling industry (Aquino et al., 2009; Gutberlet et al., 2020). Yet the focus of few studies on the formalisation of waste pickers, little is known to what extent this new organisational model has favoured overcoming the challenges faced by WPO in the recycling chain. Zon et al. (2020), state that the limited information regarding the performance of NCWPs limits the positive impacts of the social inclusion of waste pickers in solid waste management programmes. This research contributes to filling these two gaps, not only by discussing the challenges and perspectives of the performance of NCWPs, but also by making it possible to assess, through the application of sustainability indicators, the impact of NCWPs on the performance of their members.

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Networks of cooperatives of waste pickers

NCWPs, also called second-degree cooperatives, emerge as an alternative for WPO to share activities, enabling joint trading, production, and processing, and increasing the added value of recyclable materials (Cataforte, 2015). Mainly aimed at, but not limited to, meeting the demands of recycling industries (Aquino et al., 2009), they arise from the perception of the need for links and consequent strengthening in an increasingly challenging market (Gutberlet et al., 2020; Tirado-Soto & Zamberlan, 2013). Its members do not lose their legal independence, but the operation presupposes the participation and a high degree of interaction between the actors that compose it, that is, the greater the number of links between the enterprises, the stronger the NCWPs (Gonçalves & Dutra, 2016). The horizontal relationships and self-management character inherent to WPO must also be present (Braz & Cardoso, 2013). The linkage between WPO enables the exchange of information between them, providing access to knowledge that would not be accessible individually, in addition to greater technical training (Siman et al., 2020). As a result, it seeks to guarantee new business opportunities and better positioning in the marketplace, increasing the negotiating power of its WPO (Aquino et al., 2009; Gutberlet et al., 2020). Furthermore, the sharing of information among its members, such as sales prices, can avoid the instances of exploitation by intermediary members of the recycling chain who work in the informal market as scrap dealers and middlemen. Values are determined unilaterally (Siman et al, 2020), and it is common for intermediaries to offer differing values for the same materials in a way which takes advantage of the vulnerability of the organisations (Alves & Meireles, 2013).

NCWPs can also offer financial cooperation and logistical support, reducing risks and costs. They enable access to supplementary resources, especially contributing to less structured WPO as they provide scale gains and improvements in internal management (Aparcana, 2017; M. F. Silva et al., 2015). Another potential benefit is the emergence or consolidation of WPO in regions far from large urban centres, since they enable the creation of logistical routes that allow for the selection and storage of recyclable materials and provide opportunities for trading under favourable conditions (Ipea, 2012). Finally, its members can have easy access to external partners, which also contributes to better performance from this organisational model relative to member cooperatives alone (Siman et al., 2020).

Despite these benefits, the NCWPs organisation model has weaknesses that may negatively impact its operation. The economic viability of NCWPs may vary according to the number and degree of efficiency of the WPO involved, as the consolidation of a strong NCWPs presupposes well-structured members in its composition (Tirado-Soto, 2011). The lack of homogeneity of WPO can represent a challenge (Dutra et al., 2018). WPO with management problems can negatively influence the consolidation of NCWPs (Boeira et al., 2007). Tirado-Soto and Zamberlan (2013) highlight as challenges in the process of consolidating NCWPs the significance of the spontaneity of the emergence of organisations, the voluntary membership of their members, and that with the protagonism of waste pickers in promoting self-management relationships must be anchored in trust and occur organically. Finally, the initial process of formalising NCWPs requires a greater bureaucratic burden for its members, which often limits the interest of WPO to participate in this organisational model (Todeva & Knoke, 2005).

METHODOLOGICAL PROCEDURES

Case study selection and characterization

The number of NCWPs operating in Brazil is still low, totalling 50 in the last survey carried out throughout the country (Campos & Teixeira, 2021). The state of São Paulo is the top solid waste producing region in the country, having 39% of the total number of WPO (Ipea, 2013), and 7 NCWPs, representing 21% of the total number existing in Brazil (Cataforte, 2015).

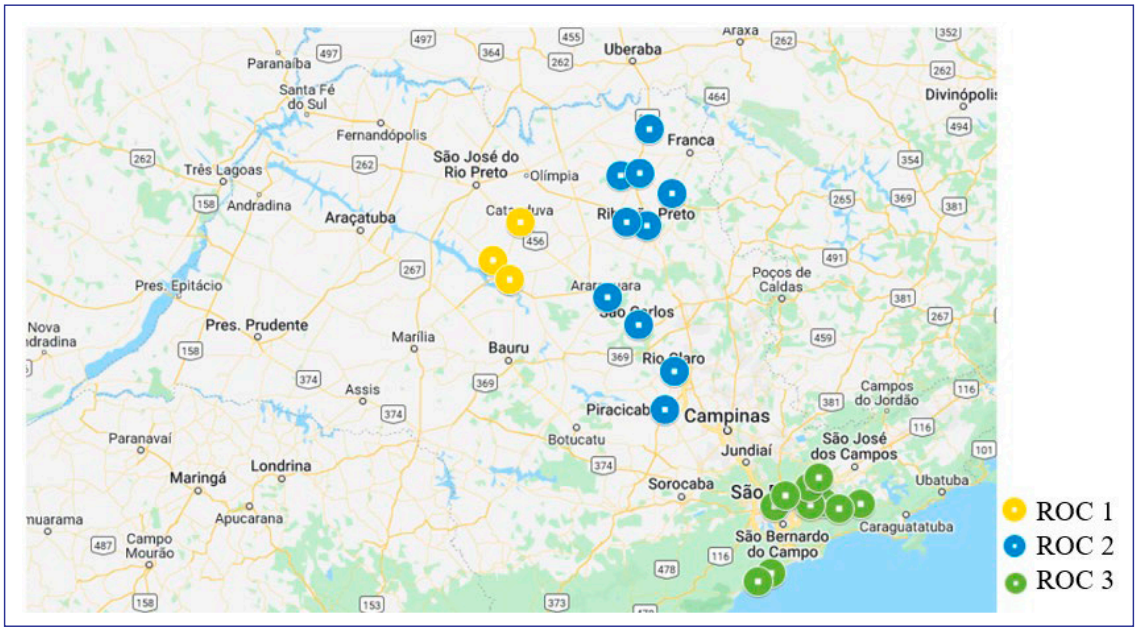
Within this area, three NCWPs were purposely selected considering different characteristics in order to represent the field in its diversity, allowing for the possibility of new theoretical insights (Eisenhardt, 1989). The three NCWPs are part of the Federal Government's 'Cataforte III' programme aimed at strengthening NCWPs in the country. It is coordinated by a strategic committee, of which it is a part: the General Secretariat of the Presidency of the Republic, the Banco do Brasil Foundation (FBB), the National Secretariat of Solidarity Economy of the Ministry of Labor and Employment (Senaes/MTE), the Ministry of

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the Environment (MMA), the National Health Foundation (Funasa), the National Bank for Economic and Social Development (BNDES), Petrobras and Banco do Brasil (BB).

Together the NCWPs are composed of 35 waste pickers organization, with different backgrounds, degrees of maturity, formalisation, and size.

Figure 1
Location of the NCWPs that make up each NCWPs



Source: Elaborated by the authors.

NCWP 1 is composed of two cooperatives and an association set in three municipalities. The most distant towns are 74 km from each other. NCWP 1 emerged from the opportunity presented by the 'Cataforte III' public tender. Seeing the procurement as an opportunity to strengthen the WPO in the region, three different city halls liaised to jointly register their WPO in their respective municipalities. Even though it is considered a NCWP, it has not yet been formalised as a second-degree cooperative. Being a small NCWP, and with the prior need of the regularisation of its members, NCWP 1 had not developed the activities of service provision, collection, sorting, or joint trading by the time this research was concluded. Therefore, its trajectory contributed to the understanding of the challenges of consolidating a NCWP.

NCWP 2 is made up of ten cooperatives and is formed from two regional clusters. Its WPO cover 304 km. The links between member organisations that today make up NCWP 2 had begun before of the formation of the NCWP itself. In mid-2007, two cooperatives in the region participated in a BNDES public call for proposals to strengthen cooperatives, which resulted in encouraging the holding of meetings for networking, political discussion, and strengthening of links with other WPO in the region. This initial liaison evolved into participation in the 'Cataforte III', through which NCWP 2 was formally constituted as a second-degree cooperative in 2017. The NCWP practises the joint trading of glass among some of its members, provides technical assistance to municipalities in the region, and provides selective collection services in some towns.

NCWP 3 is composed of 22 cooperatives from 11 municipalities spread over 166 km. The link-up began with proposals from the Environmental National Program II (ENP II) under the coordination of the Ministry of Environment (ME). Initially aimed at strengthening WPO, ENP II began by discussing the importance of establishing a NCWP for the WPO it had previously helped to form, and by opening lines of communication for the various WPO in the region to jointly discuss the issue. Understanding the main difficulties, the WPO that today make up NCWP 3 began to look at the feasibility of joint trading for the direct sale of cardboard to industry. The WPO with the best physical and administrative infrastructure, started to receive cardboard from the other NCWP 3 members, performing fine sorting and baling to the quality standard required by the industry, and carry out direct sales thereby obtaining better trade prices. The evolution of its activities led to the formalisation of the NCWP 3 as a second-degree

cooperative in 2006. Besides technical assistance and direct actions of administrative strengthening for their members, NCWP 3 has its own collective sorting center. Thirty cooperative members work there exclusively for the NCWP, in other words they are not members of any of its individual members, but of the second-degree cooperative itself. In the sorting center, there is the sorting of cardboard, ferrous scrap, and other materials processed by members and assigned for joint trading. Selective collection services are also provided in the region where the sorting center or shed is located, where sorting and trading of all material is carried out. NCWP 3 also has two administrative units focused on supporting its activities. The first, located in the sorting center itself, is responsible for managing the selective collection contract and activities related to joint trading. The second branch is responsible for taking on and managing NCWP projects, in addition to providing technical assistance to members. Configured as such, it is one of the first and largest NCWP in the state of São Paulo.

Adaptation of sustainability indicators for NCWPs

The 21 sustainability indicators for the management of waste pickers organisations were created and validated in a participatory manner by experts in the field, and by various actors involved in the recycling chain (Besen et al., 2017). The set of indicators, already used in several studies including the recent study developed by Siman et al. (2020), assesses the degree of sustainability of these projects, considering various requirements divided into i) legal/institutional aspects; ii) socioeconomic; iii) organisational; iv) operational efficiency and working conditions, and v) worker´s health and safety. The result of applying the set of indicators also culminates in a sustainability index that places WPO into four distinct categories: very favourable (0.76-1.00); favourable (0.51-0.75); unfavourable (0.26-0.50) or very unfavourable (0-0.25) (Besen et al., 2017).

The indicators and the index were originally conceived for the evaluation of WPO and required adaptation considering the particularities of NCWPs. The process of adapting the indicators for the NCWPs was developed in three (3) stages: (I) two rounds of consultations with the authors of the indicators to evaluate, in their view, the possibility of developing an initial proposal of indicators adapted to NCWPs, (II) consultation with technical staff of the NCWPs and the Federal Government project analyst aimed at strengthening the NCWPs via the proposed indicators, and (III) consultation with waste pickers belonging to the management frameworks of the NCWPs targeted by the research. In each stage, they were asked to suggest modifications and additions that they deemed still necessary considering their practical experience with NCWPs.

From these consultations for the adaptation of the indicators, 16 indicators were fully accepted, 3 partially modified, and 2 excluded for not being applicable to the context of NCWPs, resulting in a set of 19 NCWPs Sustainability Indicators. Box 1 presents the systematisation of the adaptation of the indicators with the reasons for the exclusions and adaptations, in addition to observations on what was considered for each of them at the time of their application to the NCWPs.

Box 1
Adaptation of indicators for NCWPs

Indicator	Fully accepted	Partially modified	Not applied	Observations
Regularisation of the organisation	X			In the documentation requirements, the CNPJ of the NCWPs was considered – Regularization as a second-degree cooperative.
				NCWPs that do not have their own physical space, the cooperative was considered the headquarters.
Legal instruments in relationship with the local government	X			NCWPs that do not have their own physical space, the cooperative was considered the headquarters.

(Continue)

Indicator	Fully accepted	Partially modified	Not applied	Observations
Quality of partnerships	X			NCWPs that do not have their own physical space, the cooperative was considered the headquarters.
				Only the partnerships gained through the NCWPs were considered, and not those gained by the members individually.
Partnership diversification	X			Both formalised and informal partnerships were considered.
Average income per member	X			For NCWPs with exclusive cooperative members, the average income of this group of waste pickers was considered.
				For NCWPs without exclusive cooperative members the average of the average incomes of the members composing the NCWPs was considered.
Gender equity		X		Complementing the composition of the NCWPs board of directors/management board.
				When formalised as a second-degree cooperative, the board of directors was considered. When not formalised, the management board was considered.
Self-management		X		Complementing the requirement to "maintain bulletin boards and communication systems" with remote communication tools (e-mail, Facebook, WhatsApp) and higher frequency of use.
Training in the organisation	X			Only the courses that occur from the linkage with the NCWPs were considered.
				In addition to technical training, training aimed at political strengthening, entrepreneurship, or management was considered.
Participation in meetings	X			Only ordinary and extraordinary meetings held by the NCWPs were considered.
				Numbers related to the last meeting held were considered.
Turnover	X			For NCWPs with exclusive members, the numbers joining and leaving this group of waste pickers were considered.
				For NCWPs without exclusive members, the average numbers joining and leaving the members that make up the NCWPS were considered.
Benefits to members	X			The benefits achieved from the linkage with the NCWPS were considered.
Diversification of activities and services	X			Only activities and services performed within the scope of the NCWPS were considered.
Population adherence			X	Even the NCWPs that provide municipal selective collection services still do not have this type of control, and it is not possible to collect the information.
Recyclable materials recovery rate			X	Even the NCWPs that provide municipal selective collection services still do not have this type of control, and it is not possible to collect the information.
Waste reject rate		X		Applicable only to NCWPs that provide municipal selective collection services.
Self-sufficiency of equipment and vehicles	X			The total number of vehicles and equipment used in the NCWPs operation was compared with the amount belonging to the NCWPs itself.
Productivity per waste picker	X			Applicable only to NCWPs that provide municipal selective collection services.

(Continue)

Indicator	Fully accepted	Partially modified	Not applied	Observations
Working conditions in dry waste collection	X			Conditions were considered in municipal collection, private collection, at events or situations of relocation, and loading and unloading in joint trading.
Environmental working conditions	X			NCWPs that do not have their own physical space, the cooperative was considered the headquarters.
Worker health and safety	X			NCWPs that do not have their own physical space, the cooperative was considered the headquarters.
Use of personal protective equipment	X			NCWPs that do not have their own physical space, the cooperative was considered the headquarters.

Source: Elaborated by the authors.

Data collection

Data collection included the application of the Sustainability Indicators questionnaire (Table 1) of the analysed NCWPs, followed by a document analysis which sought to subsidize and deepen the discussion of the results of the application of the indicators in each of their categories.

The document analysis included eighteen institutional documents, such as bylaws, administrative controls, internal reports, and minutes of meetings. Information on historical data and management practices of the NCWPs was sought from these documents. Thus, in each of the selected documents, the excerpts that referred to the categories and indicators were identified and analysed.

The interviews were carried out using a semi-structured script composed of 36 questions that sought to deepen the quality of each of the categories (Table 1). A total of seven interviews were carried out, comprising a waste picker who was a member of the board (C1, C2, C3) and a technical professional responsible for administrative issues in each of the three NCWPs (T1, T2, T3), in addition to an analyst of the 'Cataforte III' project of the Federal Government (AP1), responsible for monitoring all NCWPs of waste pickers in the state of São Paulo, including those included by the survey. Thus, the interviews made it possible to deepen the discussion of the results by category and indicator used.

Data analysis

The answers given by the interviewees from each of the NCWPs were later calculated considering the weight and range parameters defined by Besen et al., (2017), giving each indicator a result within sustainability quadrants: very favourable (green), favourable (blue); unfavourable (yellow) or very unfavourable (red). The average of the indicators, in turn, resulted in the Sustainability Index of each of the NCWPs presented in Table 1.

The results were analysed by triangulating the results of the NCWPs Sustainability Index questionnaire (Table 1) with the data collected and organised during the interviews and the documentary analysis. The perception of the interviewees about the challenges and the contribution of the network to the performance of its member organizations was also taken into account, considering the analytical categories and indicators surveyed.

RESULTS OF THE APPLICATION OF THE NCWPS SUSTAINABILITY INDICATORS

The consolidated numerical result of the application of the Sustainability Index is presented for each of the NCWPs (Table 1). The colors differentiate the sustainability quadrant in which each indicator is found, and the index in relation to the sustainability status of the NCWPs.

Table 1
Result of the Sustainability Index applied to NCWPs

Very unfavourable (0-0.25)	Unfavourable (0.26-0.50)	Favourable (0.51-0.75)	Very favourable (0.76-1.00)		
Category	N°	Indicator	NCWPs 1	NCWPs 2	NCWPs 3
Legal/Institutional	1	Regularisation of the organisation	0.09	0.71	0.75
	2	Legal instruments in relationship with the local government	0.17	0.67	0.84
	3	Quality of partnerships	0.27	0.36	0.71
	4	Partnership diversification	0.36	0.42	0.54
Socioeconomic	5	Average income per member	0.78	0.93	0.96
	6	Gender equality	0.74	0.74	0.74
Organisational	7	Self-management	0.16	0.49	0.66
	8	Training in the organisation	0.00	0.00	0.84
	9	Participation in meetings	0.72	1.00	0.54
	10	Turnover	0,06	0.03	0.35
	11	Benefits to members	0.00	0.00	0.49
	12	Diversification of activities and services	0.00	0.19	0.37
Operational Efficiency	13	Waste reject rate	0.00	0.00	0.17
	14	Self-sufficiency of equipment and vehicles	0.00	0.00	0.72
	15	Productivity per waste picker	0.00	0.00	0.84
Working conditions/ Worker health and safety	16	Working conditions in dry waste collection	0.00	0.45	0.82
	17	Environmental working conditions	0,59	0.42	0.55
	18	Worker health and safety	0.29	0.58	0.58
	19	Use of personal protective equipment	0.43	0.61	0.78
Total			0.38	0.59	0.79

Source: Elaborated by the authors.

Based on the results presented by the indicators, the performance level among the analysed NCWPs differs significantly, reflecting the degree of maturity and evolution of their organisational practices. Therefore, in relation to their sustainability NCWP 1 is in the "Unfavourable" quadrant (0.38), NCWP 2 in the "Favourable" quadrant (0.59), with NCWP 3 falling into the "Very Favourable" quadrant (0.79).

The following details how the measured categories and indicators impact the sustainability of the NCWPs, and their contribution to the improved performance of its members is discussed.

Legal/Institutional

The first category analysed was Legal/Institutional, highlighting the organization's regularisation, that is, its formalisation as a second-degree cooperative. By being legally formalised and up to date with the tax and legal commitments required at the local, state, and federal levels, the NCWP opens a range of benefits for its members, positively influencing other indicators in this category. As stated by Todeva and Knoke (2005), formalising the NCWP may appear to be an extra burden of activities and bureaucratic obligations, however, in the medium to long term, it avoids unnecessary costs and rework due

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to better planning of activities. NCWPs 2 and 3 stand out with favourable and very favourable indices in these indicators (0.75 and 0.71) and (0.84 and 0.67) respectively. As evidenced by document analysis the legal and tax regularisation made it possible in both cases to establish legal and contractual relationships with local government, in addition to greater diversification and the establishment of quality partnerships in line with Siman (2020). According to the interviewees (T2, T3), it also provided new perspectives within the private sector, which for the supplier accreditation process requires its partners to present their registration with the National Registry of Legal Entities - CNPJ, have tax regularisation, and issue invoices. NCWP 3 also benefited from its better performance in these indicators by broadening the possibilities for its members to assign physical space and a sorting center, vehicles, and access to courses according to the interviewee from the net board (C3). On the other hand, NCWP 1 faces the challenge of the lack of formalisation (0.09), which prevents its accreditation as a provider of municipal collection services (0.17) and makes it difficult to expand commercial relationships with new private companies and recyclers as mentioned by the interviewed waste picker (C1). Although not yet formally constituted, it is important to highlight that when considering the indicators of quality and partnership diversification (0.27 and 0.36) they are similar to those of the NCWP 2. According to the interviewees (C2), its members were able to benefit from partnerships built individually before the consolidation of the NCWP. In other words, previous member relationships were inherited by all, facilitating access to new partners and technical assistance to other members within the NCWP, new partners and technical assistance to other members within the NCWP.

Socioeconomic

Regarding the socioeconomic category, NCWP operation performed well for all three organisations in terms of the average income of members as well as the gender issue. The increase in average income is associated with several factors. In the case of NCWP 3, the excellent performance in this indicator (0.96) according to the interviewees (T3; C3) and corroborated by the documental analysis is mainly due to its greater diversification in its activities and to having a recyclables sorting center dedicated to the NCWP. The operationalisation of a municipal selective collection contract and a sorting center where joint trading takes place contributed to overcoming a series of difficulties faced by the members that compose it. As the federal government analyst states (AP1), joint trading brings benefits to all its members, but especially to the most fragile members who cannot overcome the challenges imposed by the recycling chain. The presence of adequate infrastructure for the storage and processing of materials enables the sale of volumes capable of achieving a better market value (Aquino et al., 2009) and enabling logistical corridors (IPEA, 2012; Siman et al., 2020) since the sorting center is strategically located at an equidistant point from the most distant WPO, requiring a maximum relocation of about 80 km.

In the case of NCWP 2, according to the interviewed waste picker (C2), joint trading was also the initial motivation for the network, but it was not yet possible to operate an exclusive NCWP sorting center. Even so, the average income of its members (0.94) benefited from the joint trading of some types of material, such as glass. As stated by Demajorovic et al. (2014), cooperatives have little interest in glass trading due to the weight-to-market price ratio. However, when consolidating large quantities and selling to large recyclers, the final price can increase by almost 70%, according to the NCWP representative. Despite enabling glass trading, NCWP 2 deals with major logistical difficulties in enabling joint trading more widely (Baptista, 2015; Tirado-Soto & Zamberlan, 2013), since its members are spread over a linear distance of about 300 km. To overcome this challenge, the interviewees (C2; T2) say that NCWP 2 has used its good accounting, legal, and administrative structure to sign contracts for the provision of collection and sorting services in the municipalities where its members are located, providing an improvement in the average income of its members.

In the case of NCWP 1, on the other hand, even with the absence of any joint marketing, the interviewed waste picker (C1) says that the average income also benefited from the process of facilitating sales to buyers who were linked with the other WPO member before it was constituted as such. In addition, the exchange of information ends up strengthening the bargaining power in the region, as they get to know the reality of other WPO, potential buyers, and prices charged.

Regarding gender issues, there was the same positive performance in the 3 analysed NCWPs (0.74). Notably, women hold positions on all boards of directors or management boards. The presence of women in leadership positions and the statement that all NCWPs practice gender pay equity may indicate best practices regarding gender equality in NCWPs operations spilling over to members to reduce inequalities in wages (Wirth, 2013) and division of labour, commonly seen in waste picker cooperatives (Kergoat, 2010; Wirth, 2013).

Organisational

In the organisational category, NCWP 3 again stands out. Its performance is the highest in all indicators of this category, especially regarding self-management (0.66), which favoured its greater independence from the local government. The increased number of partners at different levels of government and other social and private organisations has led to broad technical, administrative, and political capacity-building initiatives. According to the interviewee (C3) The closer links also made it possible for the more organised WPO to better understand the challenges of the weakest members, and to seek solutions and partners that would help overcome such challenges. In addition to better performance results in training (0.84) and benefits to members (0.49), it was the only NCWP to have a slightly better performance on one of the biggest problems faced by cooperatives in their management process: the high turnover rate (0.35) (Jesus & Barbieri, 2013; J. E. Rutkowski & E. W. Rutkowski, 2017).

In contrast, NCWP 1 has an important limitation in this category precisely because it was created without the initiative or active consultation of waste pickers, compromising a key aspect of successful functioning in these cooperation networks: voluntary participation (Giglio & Sacomano, 2016). According to the document analysis and interviewees (C1; T1; AP1), the fact that the NCWP 1 was conceived by an exclusive initiative of the municipalities is reflected by a low level of autonomy and consequent self-management of the WPO (0.16). The literature pertinent to NCWPs shows that the spontaneity of their emergence and the protagonism of the waste pickers in self-management is significant regarding the consolidation of the NCWPs (Tirado-Soto & Zamberlan, 2013). Although partnerships are positive for sustainability, they must take place in an emancipating manner. Magni and Günther (2014) state that municipal governments have great importance in the consolidation of these projects since they collaborate by providing land, sorting centers, equipment, and vehicles, but this relationship only continues to be beneficial if it does not create bonds of dependence. The interviewees (C1; T1; AP1) reinforce the negative nature of this dependence by highlighting the fragility of the ties between its members in stating that the NCWP would cease to exist if the partners ceased to act as such.

Besides the problem of fragility of ties in NCWP 1, all NCWPs reported the difficulty of members' understanding of the NCWP objective, which may explain the low performance in the turnover indicator. A possible reason for such difficulty may be the structural asymmetry of the members that compose them (Tirado-Soto, 2011). NCWPs composed of members with different levels and structural needs may face a challenge as they develop common activities while dealing with very different circumstances. When dealing with the urgent demands of everyday life, it is difficult for WPO to assimilate the need to give up immediate individual gains in exchange for future and possibly uncertain collective gains. WPO are often composed of waste pickers who have already worked in an unorganised manner, which, given their history of exploitation, can contribute to the lack of a culture of investment in the medium and long term. According to the NCWP 3 advisor (T3), it is common for WPO to prefer to sell materials at a lower price to buyers who pay immediately. Joint trading with large recyclers, even at a higher value, requires waiting up to fifteen days for payment, a common standard found in direct sales to industries. Another organisational challenge raised by the interviewees (T3; AP1) is the ability of certain members to exert greater power of influence than others, which can affect, in the medium term, the participation of its members in meetings and the management process.

Operational efficiency

In the category of operational efficiency, the results indicate a large difference in the performance of NCWP 3, also associated with the operation of its own sorting center. The indicators of self-sufficiency of equipment and vehicles (0.72) and productivity of the waste pickers (0.84) stand out.

In the case of the waste reject rate, even considering NCWP 3's low performance in this indicator (0.17), the result, when compared to the other networks analyzed, reinforces its ability to monitor the reject rate and improve the efficiency of the process by expanding collection services carried out directly by the network. On the other hand, NCWPs 1 and 2, in addition to facing very unfavorable conditions in terms of equipment, do not even monitor the reject rate and worker productivity, which are fundamental items for assessing the operational efficiency of their members, corroborating previous studies (Siman et al., 2020; Tackla et al., 2017). In this regard, it is important to note that the main sources for receiving recyclable materials in cooperatives in Brazil are door-to-door collections carried out by municipalities and forwarded to these organizations or the collection carried out by the cooperatives themselves from homes, businesses, and condominiums. The interviews conducted (C1, C2, C3 and T1 and T3) confirmed the existence of these two modalities and their potential impact on making the sorting process more efficient. Traditionally, direct collection by the cooperative is more favorable for increasing the waste picker's production due to the lower reject rate in the operation.

According to research by Siman et al. (2020) with 23 waste picker organizations, 74% had high reject rates showing the inefficiency of selective collection managed by the public authorities. The work of Melo et al. (2019) showed in their gravimetric work on five cooperatives a reject rate ranging from 22.4% to 73%. The lower rates are explained by the work carried out by the cooperatives developing partnerships with condominiums and businesses, resulting in segregated materials of a much higher quality than regular selective collection. This is due to the proximity of the waste pickers to the donor sources, increasing the quality of waste separation when compared to regular municipal collection. For the interviewee (C3), people sort better when they know who is dealing with their waste.

Working Conditions and Worker Health and Safety

Regarding working conditions and worker health and safety, another recurring challenge found in the literature (Magni & Günther, 2014), the research shows similar results in the three NCWPs concerning environmental working conditions (NCWP 1 - 0 .59; NCWP 2 - 0.42, NCWP 3 - 0.55) including ambient ventilation, pest and vector control, and conveyor height, among others that corroborates the results found by Tackla et al. (2017). However, the degree and maturity of the NCWPs also seem to influence the indicators of workplace safety and, principally, the use of personal protective equipment. From the interviews (AP1; C3; T3; C2), it is inferred that the dynamics of NCWPs fostering greater interaction with external actors may favour this performance reinforcing the importance of the partnerships mentioned by Zon et al. (2020). As the federal government analyst (AP1) stated, NCWP 3 is the one with the greatest accumulation of experiences and information among the three NCWPs. Its proximity to relevant external actors brought knowledge that enabled the development of significant know-how, both regarding the operation of the NCWPs itself and the political empowerment of waste pickers that can contribute to raising awareness of health and safety aspects (0.58) and the use of personal protective equipment (0.78).

This would also be true in the issue of the labour of solid waste collection done by the NCWPs, in which the degree of organisation seems to indicate greater awareness of measures for the physical integrity of the worker, such as preventive vehicle maintenance and items of clothing related to worker safety. In fact, in NCWP 1 there was greater awareness of measures for worker integrity, such as preventive maintenance of the vehicle and safety-related clothing items, as reported by the federal government analyst (AP1).

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FINAL CONSIDERATIONS

Despite the efforts made in various developing countries to value and formalize the work of waste pickers through the formation of cooperatives, this group, which is essential to the viability of the recycling chain, continues to work in a marginalized way and has immense difficulties in integrating as suppliers to the recycling industry. This process depends on the consolidation of large volumes, access to better technologies for sorting and baling materials, and improved administrative practices. NCWPs emerge as an opportunity to improve the performance of their member organizations. However, there is a lack of studies in the literature that delve into the realities of how NCWPs work, indicating ways to improve their management processes and helping to support public policies aimed at strengthening these organizational arrangements. This research contributes to advancing this important gap in the literature on the capacity of cooperative networks to increase the performance of their member organizations to improve the socio-productive inclusion of waste pickers.

The research distinguishes itself from recently published work on cooperative networks by applying a set of cooperative sustainability indicators adapted to the reality of NCWPs. As one of its results, this study puts forward a proposal for analytical categories that make it possible to assess the benefits of this organizational model as well as its challenges. Based on these categories, it was possible to dialogue with previous work on the potential of NCWPs and, above all, to propose new ways forward for these organizations. The research corroborates points identified in previous studies, such as the expansion of the collection and processing of recyclables, increased productivity and income, greater balance in the relationship between the sexes, and better performance in health and safety aspects.

The results also show the importance of joint marketing as a starting point for coordinating waste picker enterprises. Because it is a concrete objective, joint marketing facilitates the establishment of meeting spaces and the planning of goals. But it is in the operation that its benefits are even more visible. The results show gains for all members, especially the weaker ones, who can overcome the challenges faced by these organizations individually in the competitive and complex recycling market. Even so, this research advances with new findings and insights for improving networking that can contribute to public policies aimed at strengthening NCWPs. The consolidation of a recycling shed shared by all its members emerges as particularly promising for the sustainability of NCWPs. This structure makes it possible to sign contracts and provide collection and recycling services to municipalities and facilitates access to potential donors and private buyers. The guaranteed delivery of larger volumes at the expected quality and the tax regularization provided by the NCWPs open new avenues for partnerships with companies. However, even without the creation of a warehouse, the legal and tax requirements demanded in the process of formalizing the NCWPs make it easier to sell certain materials together. Contracts are made possible considering the joint production of the NCWPs, regardless of the individual volumes generated by each of its members, overcoming the challenges of cooperatives marketing directly with recyclers located at the top of the recycling chain.

This research also indicates other potentialities of networks, even when joint marketing is not achieved. The interaction between their members enables a deeper reflection on their own reality, making the NCWPs look for the best alternatives to strengthen their enterprises, especially the training programs that contribute to their political strengthening. These gains can already begin to appear even in the embryonic stages of networking. The participation of waste pickers in the training proposed within the NCWPs has helped its members understand their own weaknesses and the importance of cooperation in overcoming the challenges they face.

Another noteworthy point was the identical performance of the three organizations in terms of gender relations, indicating a growing role for women in the management of these organizational arrangements. Recent research has increasingly highlighted the crucial role of women in cooperatives and the reproduction of problems of gender oppression in work environments. This research, however, indicates that networks may be helping to mitigate these challenges. The leadership role played by women in the three networks has been fundamental in contributing to the reduction of wage inequalities between men and women. Such advances in the NCWPs may be multiplying in their member organizations as well. These results show the importance of deepening our understanding of this phenomenon to advance the theory and practices that guarantee gender equity in these organizations.

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Another important aspect was the challenges identified in designing initiatives to increase the results of formalization programs for waste picker organizations. The structural unevenness between the enterprises that make up the networks can hinder the development of joint activities. In the three NCWPs, conflicts were observed between the member organizations regarding the need to give up immediate individual gains in exchange for future collective gains that require networking. The research also revealed a subject little discussed in the literature, which is the need to balance government support in building NCWPs without compromising their necessary degree of emancipation. This research indicates the importance of self-management, built on voluntary adherence, which contributes to strengthening social capital, which in turn is crucial for developing networks. When the initiative comes exclusively from public authorities and not from the waste pickers' own desire, the ties between members can become fragile, jeopardizing the search for emancipation and the very sustainability of the NCWPs.

Even considering the typical limitations of case study development strategies, the research points to emerging themes that need to advance in the theoretical field of NCWPs, broadening and deepening discussions on gender issues and self-management processes in networks, for example. In the practical field, the indicators are a relevant tool for a deeper understanding of this organizational arrangement, contributing to actions that promote better performance by NCWPs in the recycling market. Future studies, with the application of indicators adapted to NCWPs in a higher number of organizations and in different contexts, can advance the understanding of how NCWPs can improve the performance of waste picker organizations and make public policies aimed at the social inclusion of waste pickers more effective.

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DATA AVAILABILITY

The entire data set that supports the results of this study has been made available in the FEI University Center's Institutional Knowledge Repository and can be accessed at https://repositorio.fei.edu.br/browse/author?value=Motta,%20V.%20P.&bbm.return=247

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