

SUSTAINABILITY INDICATORS OF MUNICIPAL SELECTIVE COLLECTION AND WASTE- PICKERS ORGANIZATIONS: CASE STUDY



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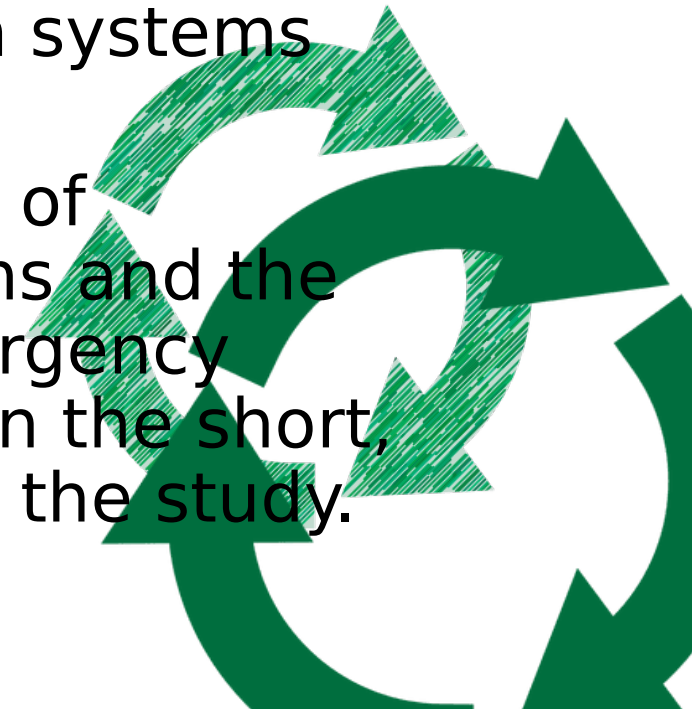


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Introduction

- There is a lack of consistent information on the performance of selective waste collection considering waste pickers organizations (WPO) participation
- Sustainability indicators were chosen for being a current practice to evaluate the selective waste collection systems and a potential tool to support decision makers
- This study determined the indices and the degree of sustainability of both, selective collection programs and the WPO, through 26 indicators and hierarchized emergency actions, categorizing which should be developed in the short, medium and long term giving high applicability to the study.



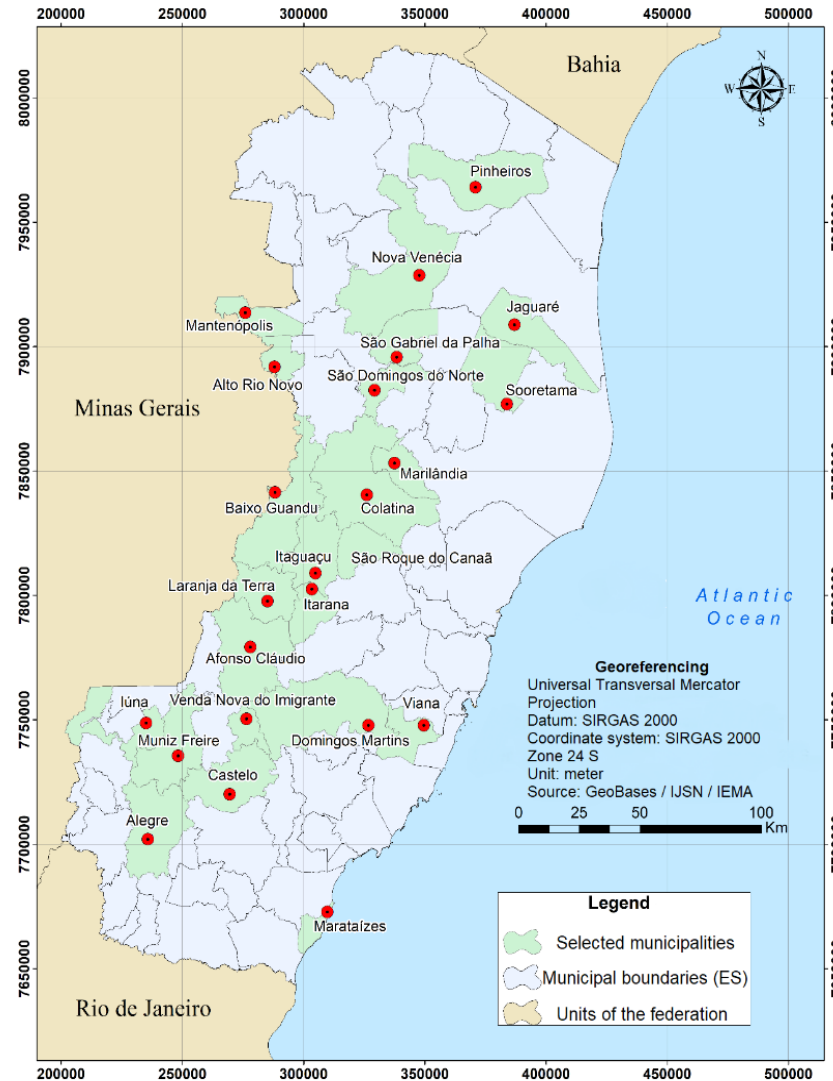
Background of selective collection sustainability indicators in Brazil

- The Indicators of Sustainability of the Selective Collection (ISSC) and Indicators of Sustainability of the Picker Organizations (ISPO) used in this research were based on previous studies of by Lima (2006)
- Besen (2011) started the process of constructing and validating indicators that could be used as a reference for the management, evaluation, and monitoring of municipal selective waste collection and WPO
- The indicators originally validated in 2011 have been under updates, reaching their latest version in 2017 by Besen et al. (2017)



Material and Methods

Study area



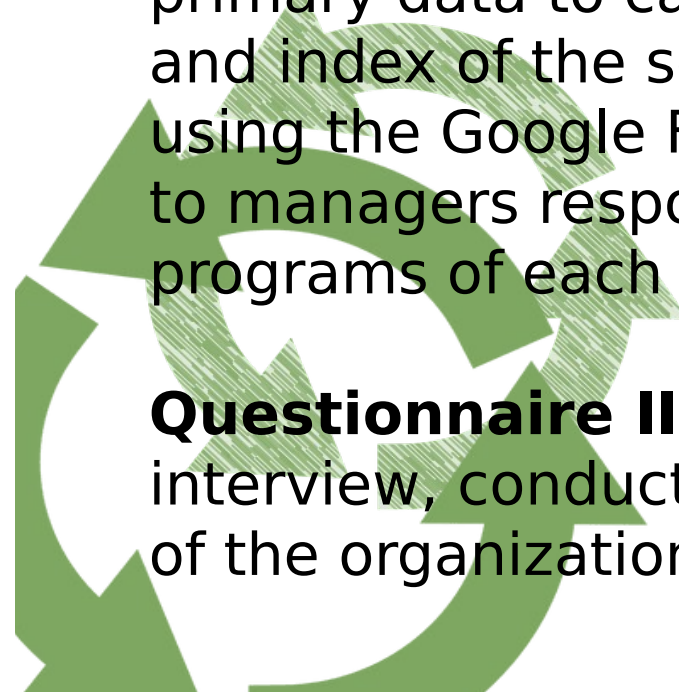
Material and Methods

Data collection

The collection of primary data from WPO was performed through the application of two questionnaires involving open and closed questions:

Questionnaire I was applied in order to collect primary data to calculate sustainability indicators and index of the selective waste collection programs using the Google Forms online tool and was applied to managers responsible for the selective collection programs of each selected municipality

Questionnaire II was applied through an individual interview, conducted face-to-face with the president of the organization by a multidisciplinary team.



Material and Methods

Indicators of Sustainability of the Selective Collection (ISSC)



	ISSC	Goal	Form of measurement
ISSC 1	Legal instruments in the relation of the city with waste collection service providers	Measure the existence of legal instruments in the relationship between city halls and WPO	Existence of: service contract (VF), agreement with financial transfer (F), without financial transfer (U), no contract or agreement (FU)
ISSC 2	Population attendance	Measure the coverage that selective waste collection service achieves in terms of the number of inhabitants served.	
ISSC 3	Self-financing	Measure the economic sustainability of waste management organization.	Charge of rate or rate that: covers the cost of the service including selective collection (VF), covers the entire cost of the service (F), do not cover service costs (U), Budget only (VU)
ISSC 4	Education and dissemination	Measure the education and dissemination of actions carried out in favor of selective waste collection.	
ISSC 5	Partnerships	Evaluate the diversity of partnerships articulated by municipalities in the selective waste collection	
ISSC 6	Population adherence	Measure the effectiveness of selective collection, and the efficiency of the education/communication process, environmental, social and economic outcomes.	
ISSC 7	Recycling rate	Measure the efficiency of the selective waste collection system and the diversion of the dry waste from the landfill.	
ISSC 8	Working conditions in the collection of dry waste	Evaluate working conditions during dry waste collection.	
ISSC 9	Costs of the selective waste collection service	Measure the cost of selective waste collection in relation to the amount of waste collected in the municipality.	
ISSC 10	Cost of selective waste collection / regular + final disposal	Measure the percentage between the cost of the selective collection and the cost of the regular collection plus to the final disposal.	

Material and Methods

Indicators of Sustainability of the Picker Organizations (ISPO)



ISPO		Goal	Form of measurement	
ISPO 1	Institutional regulation	Measure compliance with documentation requirements for regularization of the organization.		
ISPO 2	Municipal legal instruments	Measure the organization's qualification in terms of legal and fiscal requirements for the provision of the selective collection service.		
ISPO 3	Quality of partnerships	Measure the contribution made possible by partners for the organization.		
ISPO 4	Diversification of partnerships	Measure the organization's coordination capacity, the effectiveness of establishing support networks and ability to enable financial and institutional resources.		
ISPO 5	Average income per member	Measure economic gains and, indirectly, the possibility of improving living conditions, health and self-esteem of the organization members.		
ISPO 6	Gender ratio	Measure gender equity in the organization.		
ISPO 7	Self-management	Measure the effectiveness of the organization's own organizational cooperative management.		
ISPO 8	Training	Measure how many waste pickers have taken professional training to carry out activities related to the functions performed within the organizations.		
ISPO 9	Turnover	Measure the institutional capacity to maintain its members.		
ISPO 10	Diversification of activities and services	Measure the operational and organizational capacity of the entity and extend its autonomy.		
ISPO 11	Recovery rate of recyclable materials	Measure the efficiency of the selective waste collection system and the diversion of the dry waste from the landfill.		
ISPO 12	Screening rate	Measure the efficiency of waste separation at source and screening.		
ISPO 13	Waste picker productivity	Measure the average efficiency of the screening work of the organization's members.		
ISPO 14	Working conditions in dry waste collection	Measure working conditions during dry waste collection.		
ISPO 15	Environmental working conditions	Measure work environment conditions related to cleanliness, hygiene, disease vector control, infrastructure suitability, and accident prevention aspects.		
ISPO 16	Waste picker health and safety	Measure the health and safety conditions of the waste picker at the sorting center, associated with the working conditions of the organizations and associated risks.		

Material and Methods

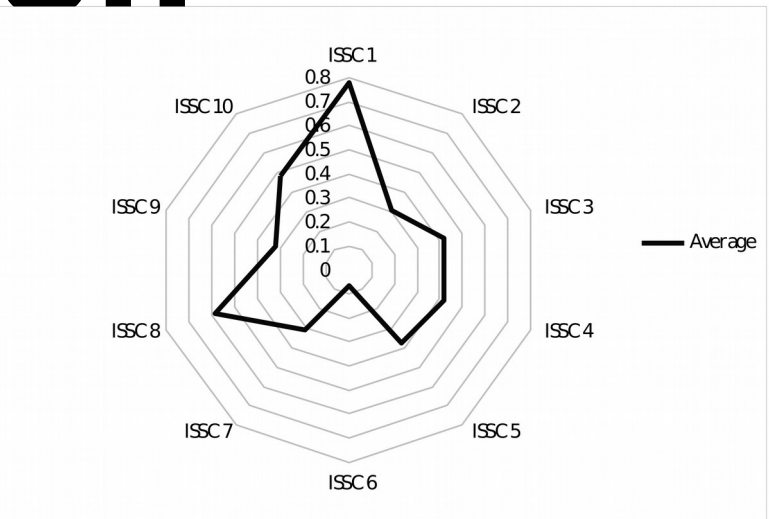
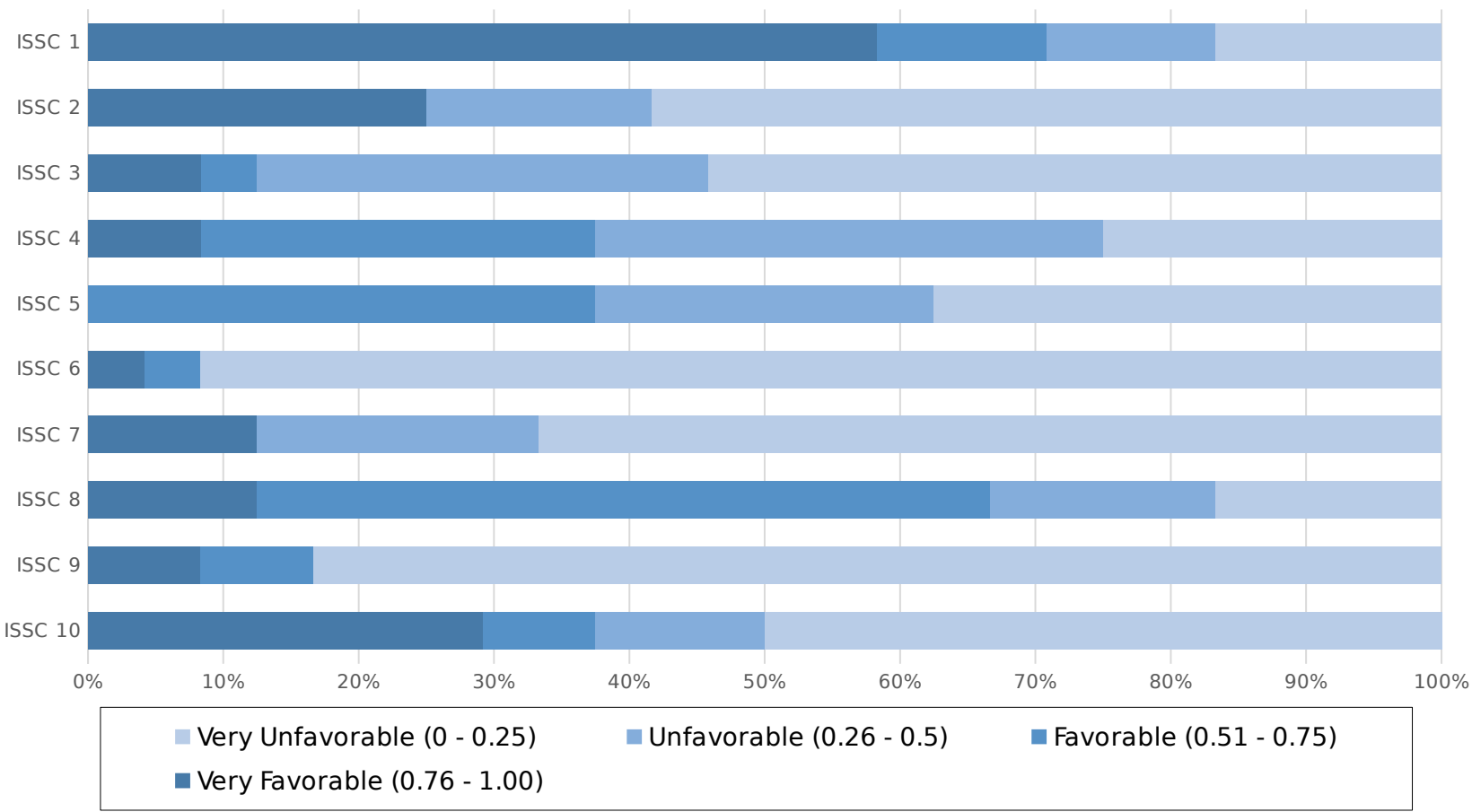
Proposition and Hierarchy of Actions

Weights of Indicators of Sustainability of the Selective Collection (ISSC) and Indicators of Sustainability of the Pickers Organizations (ISPO)	Term	Time Horizon
0.95 - 0.89	Emergency	Up to 3 years
0.88 - 0.84	Short-term	4 to 8 years
0.83 - 0.79	Mid-term	9 to 12 years
0.78 - 0.62	Long term	13 to 20 years

Suggestion of actions using as reference the result (“very unfavorable”, “unfavorable”, “favorable” and “very favorable”) and objective of each indicator.

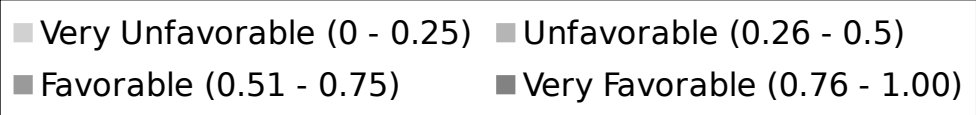
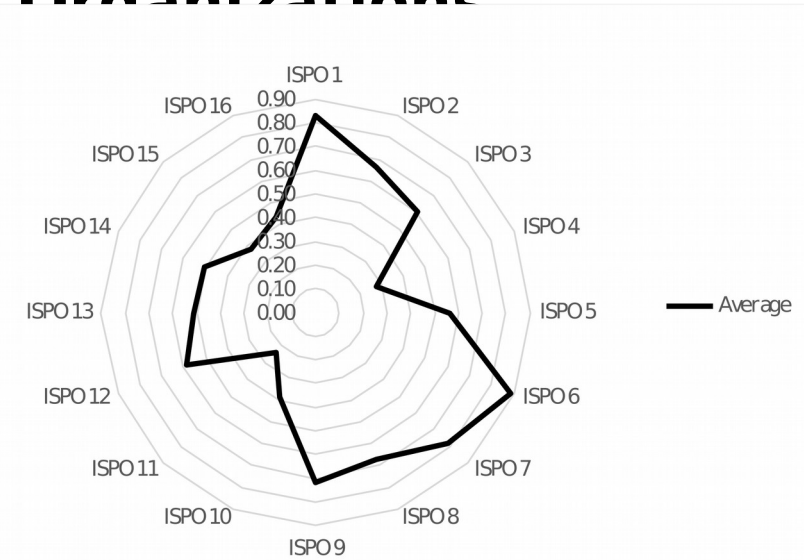
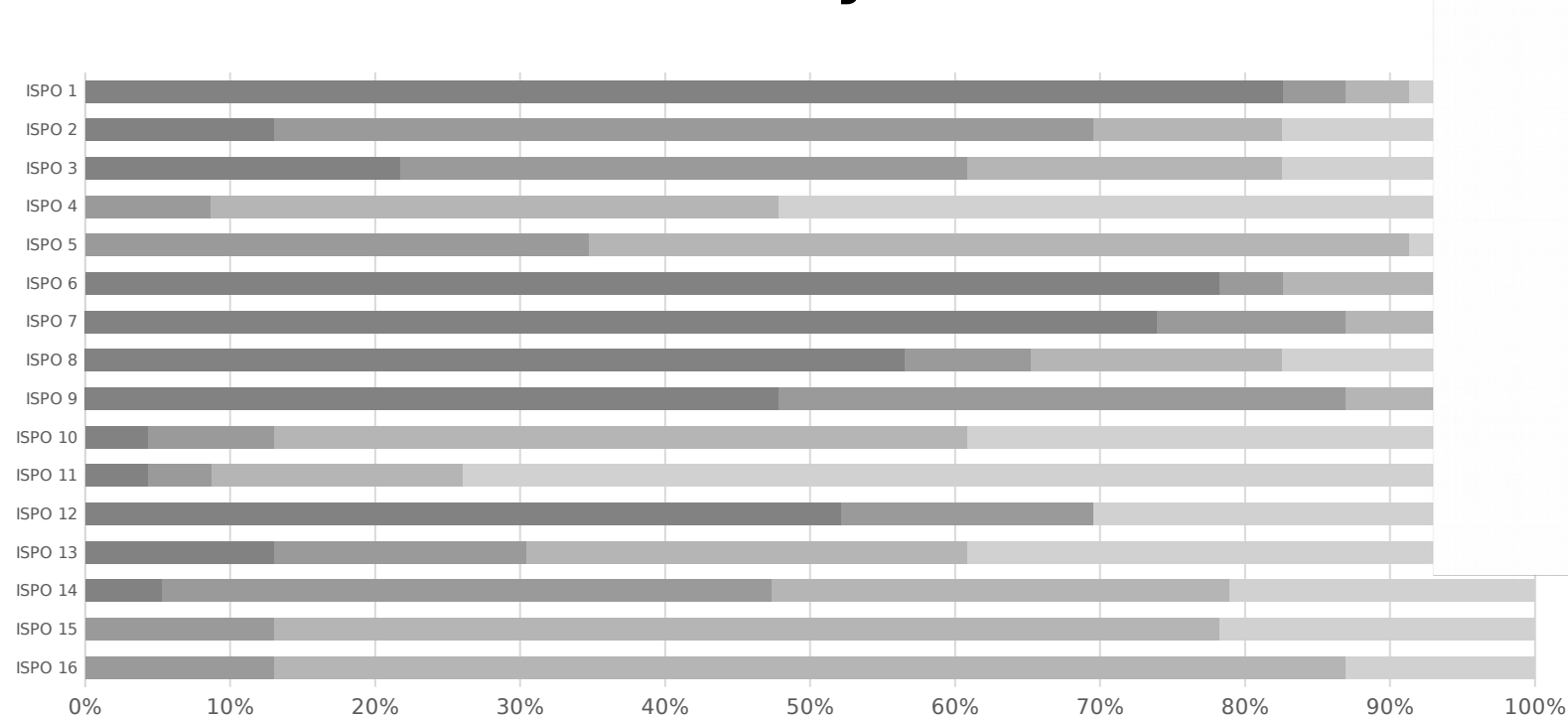
Results and Discussion

Indicators of Sustainability of the Select



Results and Discussion

Indicators of Sustainability of the Waste Pickers Organizations

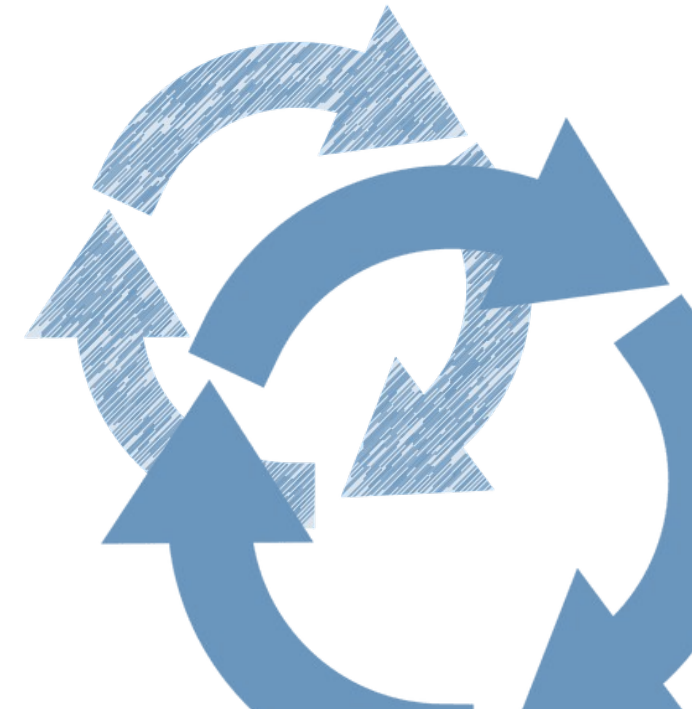


Results and Discussion

Proposition and Hierarchy of Actions

Indicators of Sustainability of the Selective Collection (ISSC) and Indicators of Sustainability of the Picker Organizations (ISPO)		Weight	Term	Time Horizon
Indicators of Sustainability of the Selective Collection	ISSC 6	0.91	Emergency	Up to 3 years
	ISSC 2	0.90		
	ISSC 7	0.89		
	ISSC 8	0.84	Short term	4 to 8 years
	ISSC 9	0.84		
	ISSC 1	0.83		
	ISSC 10	0.81	Mid-term	9 to 12 years
	ISSC 3	0.80		
	ISSC 4	0.79		
	ISSC 5	0.62	Long term	13 to 20 years
Indicators of Sustainability of the Waste Picker Organizations	ISPO 5	0.95	Emergency	Up to 3 years
	ISPO 15	0.89		
	ISPO 11	0.89		
	ISPO 14	0.89		
	ISPO 9	0.80	Short term	4 to 8 years
	ISPO 16	0.87		
	ISPO 1	0.84		
	ISPO 2	0.84		
	ISPO 8	0.84		
	ISPO 13	0.84	Mid-term	9 to 12 years
	ISPO 7	0.82		
	ISPO 10	0.80		
	ISPO 6	0.74	Long term	13 to 20 years
	ISPO 12	0.74		
	ISPO 3	0.71		
	ISPO 4	0.66		

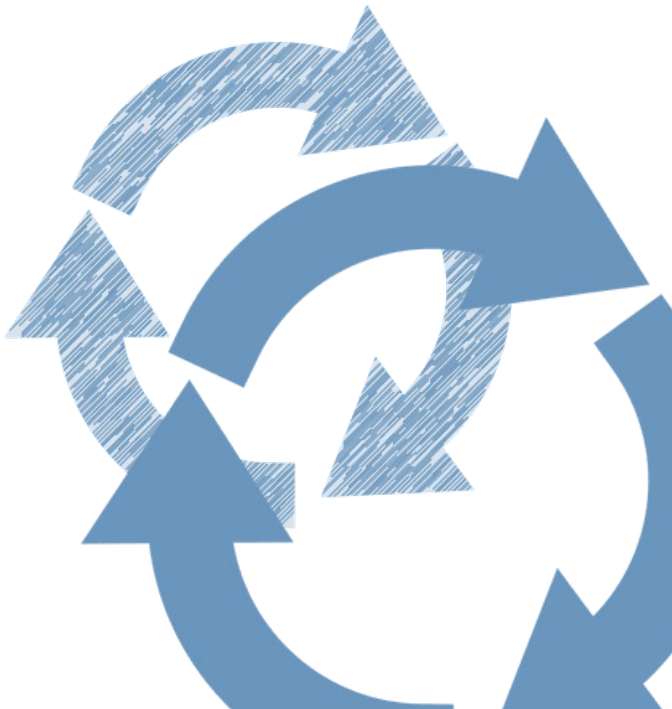
Relationship between indicators ISSC and ISPO, weights and term of actions in the time horizon.



Results and Discussion

Hierarchy of actions suggested for the selective collection municipal programs

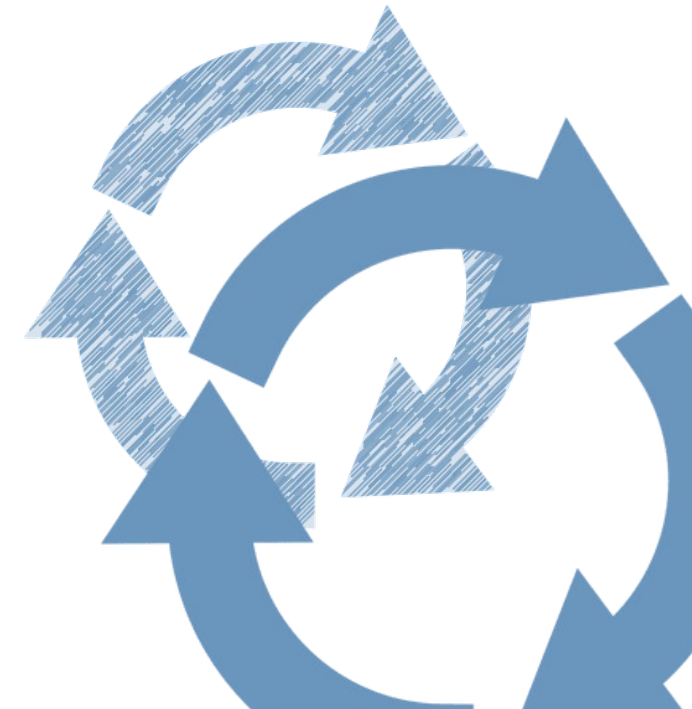
Term	Actions suggested for the development of sustainability
Emergency	<ol style="list-style-type: none">1. Create or/and improve control and registration of the scope of the selective collection in terms of inhabitants.2. Carry out a feasibility study for care in rural areas.3. Measure population adherence and update data record periodically.4. Encourage the growth of population membership rates, such as granting rate or rate discounts according to the amount of recyclable waste delivered.5. Carry out periodical opinion polls to make necessary adjustments to the selective waste collection programs.6. To strengthen the image of the waste picker and the valorization of his work before the population.7. Improve/maintain the quality of waste screening in the generating source and in the sorting centers by means of campaigns and continuous training.8. Maintain/increase investments in selective waste collection chain with suitable trucks and capacity of the waste picker.9. Increase schedule visibility (days and times) for the selective waste collection.10. Supervise the regularity of the selective waste collection service.11. Facilitate the segregation of recyclable dry waste into the generating source by providing appropriate containers.12. Provide equipment that the recyclable material picker organizations do not have yet, such as presses, balances, among others.13. Encourage the local market of recyclables to promote the commercialization of sorted waste (de-bureaucracy of municipal licensing, assignment of land in industrial zones, as well as pressuring the state government for tax relief), thus preventing them from becoming waste.14. Measure the amount of collected waste in the selective collection.15. Measure the amount of waste collected in the regular collection.16. Assess the amount of tailings after sorting.17. Periodically update the waste information system to be implemented with data on the quantity of recyclable materials collected and marketed, quantity of waste and waste collected in the regular collection.



Results and Discussion

Hierarchy of actions suggested for the selective collection municipal programs

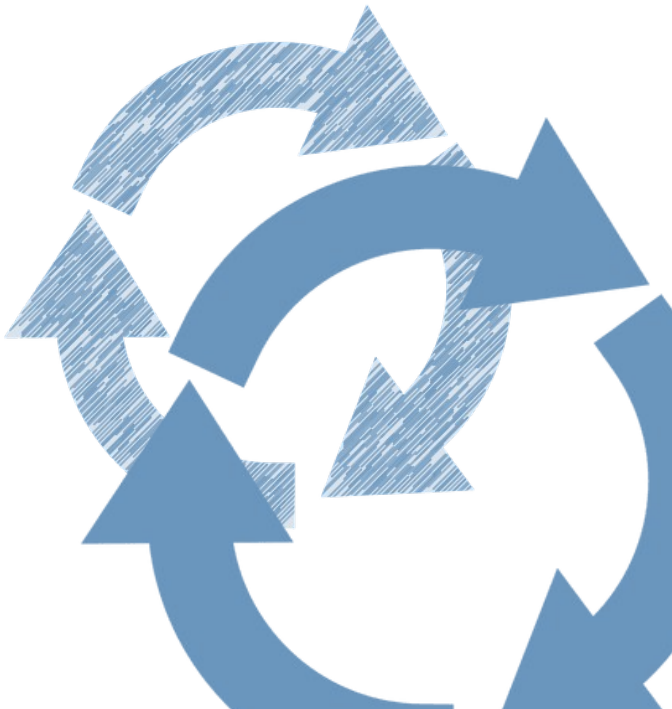
Term	Actions suggested for the development of sustainability
Short term	<ol style="list-style-type: none">1. Regularize documentation, licenses, vehicle property taxes and compulsory insurance of the vehicle (s) used in the selective collection.2. Perform preventive and periodic maintenance on the vehicle (s) used in the selective waste collection.3. Measure the amount of waste marketed.4. Provide and enforce the use of shirts or vests with bright colors, long trousers, cap, raincoat, footwear with non-slip soles, gloves and reflective vest for nocturnal collection by waste picker.5. Establish the individual load limit to be collected.6. Sufficient time for the worker to collect the material without risk.7. Supervise the requirements, in relation to the working conditions in the collection, to be established and those that already practice.
Mid-term	<ol style="list-style-type: none">1. Elaborate / formalize a service agreement, complying with all the requirements for the formalization of the service. Priority should be given to contracting recyclable material picker organizations.2. Carry out occasional and permanent campaigns: teach training activities; awareness activities for municipal employees; activities with the community; insertion into radio and TV programs; mobilizations and/or mobilizations; develop leaflets, publications, and environmental education websites; continue practicing the education and dissemination actions that the municipality already adopts.3. Update periodically the system to be deployed of waste information with data of the monthly costs related to the selective collection.4. Update periodically the system to be deployed with information about waste with data of the monthly costs related to the regular collection and final destination.
Long term	<ol style="list-style-type: none">1. Expand the diversity of partnerships such as state and federal public sector, private sector, NGOs, Universities, neighborhood associations, among others besides those are already established.



Results and Discussion

Hierarchy of actions suggested for the waste picker organizations

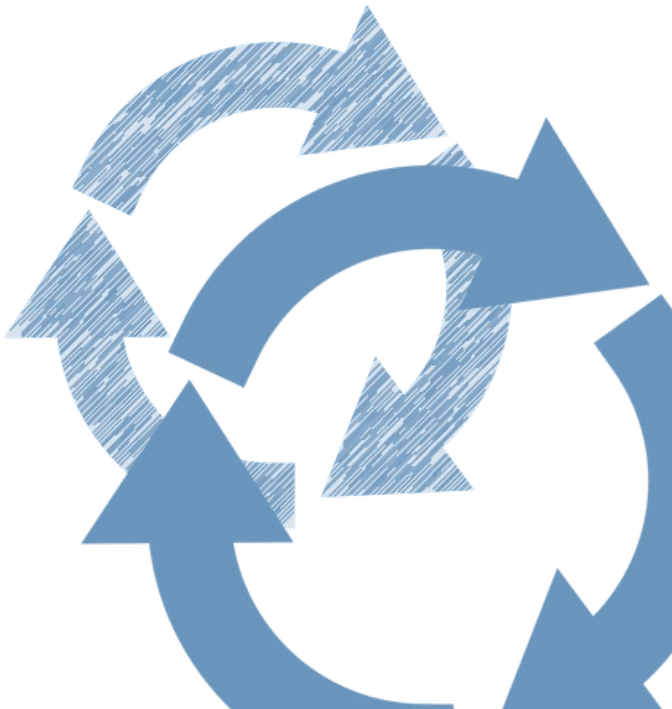
Term	Actions suggested for the development of sustainability
Emergency	<div>1. Measure the amount of collected waste in the selective collection.</div> <div>2. Measure the amount of tailings after sorting.</div> <div>3. Foster contract with city hall to provide service.</div> <div>4. Enforce waste pickers to wear a cap, long trousers, raincoat, reflective vest for night collection, shoes with non-slip soles, shirts or vests with bright colors and a protective glove.</div> <div>5. Sufficient time so that the worker can collect the material without risk to his health.</div> <div>6. Establish a minimum individual load to be collected.</div> <div>In the sorting center:</div> <div>7. Build a cook-room.</div> <div>8. Perform daily cleaning of the cook-room and toilets.</div> <div>9. Perform periodic control of rats, flies, cockroaches and uncomfortable odors.</div> <div>10. Install adequate ventilation and lighting.</div> <div>11. Adjust the coverage of the screening area.</div> <div>12. Adjust the height of the table.</div> <div>13. Define maximum weight limit, according to standards, to be obeyed by workers to avoid injury.</div> <div>14. Implement fire prevention system and actions.</div> <div>15. Implement fire alarm system.</div> <div>16. Establish fire extinguisher and evacuation indicator of the area in case of fire.</div> <div>17. Establish accident prevention barriers on dangerous machines.</div> <div>18. Adjust the height of the seats.</div> <div>19. Adequate electrical installations to avoid shock.</div> <div>20. Implement control of access and movement of people.</div> <div>21. Install a collective height guard (guardrail).</div> <div>22. Seek support from specialized agencies, such as the Safety Engineering and Occupational Medicine Agency, municipal governments, universities, and technical institutes, for guidance in a plan of actions necessary to ensure safety.</div> <div>23. Encourage resources to expand infrastructure.</div>



Results and Discussion

Hierarchy of actions suggested for the waste picker organizations

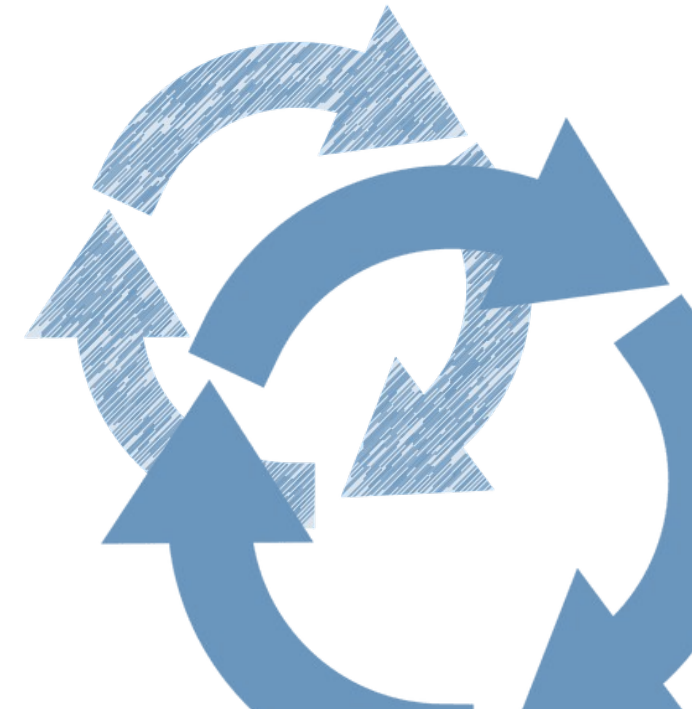
Term	Actions suggested for the development of sustainability
Short term	<ol style="list-style-type: none">1. Prepare a statute.2. Regularize pending issues with government regulators agencies as Social Security Administration, Employee Benefits Security Administration, and Internal Revenue Service.3. Regulate the payment of labor taxes for waste pickers.4. Legalize the situation of the organization in the Internal Revenue Service.5. Update waste pickers records.6. Archive at least the last three records of meetings.7. Carry out financial balance sheets.8. Keep accounts transition records of the last fiscal year.9. Provide organizational operating licenses.10. Improve the self-management system of the organization of recyclable waste pickers.11. Coordinate the activities carried out by the waste pickers in the organization (this action can be carried out by the president or with the support of the municipal public sector).12. Perform periodic cleaning and hygiene at the sorting center.13. Establish mandatory rest by load and routine of activities.14. Ensure regular vaccination of the waste pickers in accordance with the sanitary standard.15. Perform registration of work accidents.16. Install visual communication in work environments as a health and safety measure.17. Prevent injury from repetitive or inappropriate positioning.18. Implement protective devices against physical accidents caused by machines and equipment.19. Conduct periodic medical examinations according to the labor norm.20. Encourage the use of equipment for individual safety.21. Seek support to carry out training about safety and health at work in accordance with the regulatory norms.



Results and Discussion

Hierarchy of actions suggested for the waste picker organizations

Term	Actions suggested for the development of sustainability
Mid-term	<ol style="list-style-type: none">1. Maintain up-to-date communication and information on marketing, expenses, external events, and meetings.2. Keep records of expenses, discounts, and marketing.3. Conduct periodic self-management decision meetings.4. Provide internal rules.5. Present transparency in the apportionment and availability of cash books, spreadsheets, and documents.6. Carry out / promote partnerships with self-management training.
Long term	<ol style="list-style-type: none">1. Search collaborative partnerships for: assignment of equipment and vehicles; assignment of physical space/construction of the sorting center; carry out education and dissemination actions for society; technical support; assignment/donation of recyclable materials; and literacy courses.2. Expand the diversity of partnerships such as: NGOs, municipal and federal public sector, private sector, community or religious organizations and class organizations.3. Promote equal participation of men and women in the construction of rules and procedures, including decision-making processes.4. Promote the acceptance of female leadership.5. Increase the diversity of activities and services, such as: participate in the collection of recyclable materials; promote environmental education for solid waste recycling; provide services to companies; and use recyclable waste for handicrafts, reuse and benefit materials.



Conclusions

- Municipalities of the state of Espírito Santo, Brazil, need to improve solid waste management, especially regarding selective waste collection and recycling, while through the application of the proposed methodological strategy it was possible to identify opportunities for improvement.
- The results obtained in the application of the Indicators of Sustainability of the Selective Collection make it possible to understand the performance of the selective collection programs of the municipalities studied.
- These results indicate that, in general, municipalities still need improvement to reach the desired sustainability in their selective collection programs.

Conclusions

- It was possible to verify some difficulties faced by municipalities and WPO to implement self-management practices and performance evaluation with indicators.
- The main difficulty highlighted was the unavailability and/or low quality of the primary data collected. This fact has a direct influence in the more comprehensive understanding of the selective collection and of the WPO studied.
- Thus, although municipalities and WPOs have answered the questionnaires, it is necessary to create and operationalize data control systems in order to obtain more realistic results and perform continuous monitoring, as well as implement the necessary actions in an appropriate way.

Conclusions

- The calculation of the indicators allowed identifying the critical points that need improvement. Therefore, actions have been proposed and hierarchized following their emergency characters up to those of long terms according to the weight of the indicators.
- Also, using the proposed methodological strategy, it was possible to delineate actions in a way that contributes to the improvement of the sustainability of the municipal selective waste collection programs and organizations of recyclable materials collectors.
- The design of the actions, as well as the results obtained, has a high potential of application in the monitoring and the development of selective waste collection programs and WPO towards sustainability.



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