

Environmental sustainability balanced scorecard: a strategic map for joint action by municipalities

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Abstract

Purpose – This study seeks to develop an Environmental Sustainability Balanced Scorecard (ESBSC) articulated through a strategic map for collaborative implementation by municipalities by municipalities. In addition, it aims to elucidate the architecture of this tool.

Design/methodology/approach – The research uses qualitative methodology, initiating with document analysis, followed by municipal-level surveys and an interview with the Norte Portugal Regional Coordination and Development Commission (CCDR-N).

Findings – The study constructs an ESBSC that adopts an integrative approach to sustainability, focusing on municipal joint action. The tool fosters synergies and enhances cooperation. By incorporating a strategic mix, the tool contributes to improving the environmental management performance of the participating municipalities.

Practical implications – This study introduces a tool designed for municipalities that aspire to incorporate environmental sustainability into their strategies. This tool facilitates the implementation and management of a long-term environmental strategy, with potential implications for organization and its culture. In addition, it highlights critical environmental factors that should serve as a starting point in future studies or applications of this tool.

Social implications – Involving both an academic institution and multiple municipalities, this research identifies critical environmental factors that enhance environmental awareness within municipalities and designs a tool that, when consciously adopted, can influence the culture dynamics of the population involved.

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Furthermore, it proposes a structured and systematic research method for creating an ESBC for joint municipal action.

Originality/value – To the best of authors' knowledge, this research constitutes the first exploratory attempt to devise an environmental strategy for joint municipal action. Although the tool emphasizes the environmental component, it promotes an integrated vision of sustainability. Despite the extensive application of balanced scorecards in various organizational contexts, their utilization in fostering environmental sustainability at a municipal level remains underexplored. This study addresses this gap by developing a tailored strategic tool that operationalizes environmental priorities within municipal governance frameworks.

Keywords Balanced scorecard, Environmental sustainability, Municipalities, Environmental sustainability BSC, Strategic map

Paper type Research paper

1. Introduction

Organizations have increasingly focused on achieving sustainable development and adopting environmentally responsible practices (Abdel-Maksoud *et al.*, 2021; Hristov *et al.*, 2021). Sustainability involves three core principles: environmental integrity, social equity and inclusion and economic development (Hubbard, 2009; Rasoolimanesh *et al.*, 2022). Within the domain of sustainability, ecological concerns hold significant importance (Ferreira *et al.*, 2016; Hristov *et al.*, 2021; Matteis *et al.*, 2021). The growing political focus on improving ecosystems and incorporating environmental objectives into policy agendas has led to intensified market regulation (Ferreira *et al.*, 2016), as demonstrated by the European Climate Pact.

The European Climate Pact emerged in Europe to link citizens and organizations, thereby fostering climate action, increasing awareness of environmental sustainability and promoting EU initiatives. This pact acts as a platform for disseminating information and stimulating discussions on required climate actions, forming the groundwork for a robust European climate and ecological movement. It addresses scientific calls for critical climate action by 2050 and the concerns of European citizens regarding climate change (European Commission, 2019).

As environmental concerns are incorporated into public management, there arises a necessity to adapt management control and Performance Management Systems (PMS). The Balanced Scorecard (BSC) stands out for its ability to align both financial and nonfinancial aspects (Figge *et al.*, 2002) and has been used by the public sector to aid management (Maccarrone *et al.*, 2014; Sayed *et al.*, 2021). From the integration of the BSC with sustainability (environmental focus), the Environmental Sustainability Balanced Scorecard (ESBSC) emerges.

Hansen and Schaltegger (2016) emphasize the importance of determining the most suitable architecture for developing an SBSC (Sustainability Balanced Scorecard). Hristov *et al.* (2021) also underscore the need to explore the benefits that organizations can achieve by incorporating environmental objectives into their business strategies and plans. However, both Hristov *et al.* (2021) and Sayed *et al.* (2021) observe a lack of management solutions that incorporate the environmental component into PMS. Hristov *et al.* (2021) further argue that research on integrating environmental objectives into public administration strategies remains underdeveloped. Sayed *et al.* (2021) suggest that the limited adoption of the BSC by municipalities could stem from insufficient executive support and the absence of structured models tailored to municipalities. Matteis *et al.* (2021) call for future research to support elected officials and public managers in formulating environmental policies, advocating for the use of planning tools and standardized environmental indicators for targeted monitoring and control.

In response to this call for future research, this study develops a semi-hierarchical SBSC for joint implementation across multiple municipalities to enhance the control and monitoring of strategic environmental objectives. In doing so, it addresses the resources scarcity facing public managers in implementing environmental strategies. Collective implementation entails municipalities sharing

strategic environmental objectives and simultaneously implementing action plans, which are evaluated using a set of key performance indicators (KPIs). Following [Maccarrone et al. \(2014\)](#), this study investigates the drivers behind municipalities' environmental action strategies and proposes strategic initiatives to achieve desired environmental objectives.

This study focuses on the environmental dimension while also incorporating the financial and social aspects. This integrated approach provides a holistic perspective on sustainability ([Mio et al., 2022](#)). Moreover, this study constructs an integrated strategic map, contributing to the theoretical advancement of this subject. In addition, a step-by-step research method is presented to guide future research with similar objectives and contexts. The study concludes with the development of an innovative tool for collective action, comprising a strategic mix that enhances performance. Moreover, increased synergies, control and cooperation among participants can contribute to improved performance.

The remainder of this study is organized as follows: Section 2 provides a literature review. Section 3 outlines the methodology used. The subsequent section presents the results obtained. Finally, Section 5 offers the main conclusions, implications, limitations and directions for future research.

2. Literature review

2.1 Environmental sustainability in municipalities

Environmental sustainability has emerged as a paramount concern for governments worldwide ([Adams et al., 2014](#)). Local authorities are instrumental in executing the mandates of central government ([Ndevu and Muller, 2018](#); [Panya et al., 2018](#); [Tbaishat, 2021](#)) and promoting citizens' quality of life ([Ndevu and Muller, 2018](#); [Panya et al., 2018](#)). As a result, they have been actively involved in environmental management ([Matteis et al., 2021](#); [Panya et al., 2018](#)).

[Matteis et al. \(2021\)](#) assert that municipal involvement in environmental management offers the benefit of local proximity and the capability to customize responses to local conditions. [Monteiro and Ribeiro \(2017\)](#) further emphasize that public administrations serve as both providers and producers of public services, activities that have a significant impact on the environment, necessitating their participation in environmental management. However, [Matteis et al. \(2021\)](#) warn that local public managers might view environmental regulation as conflicting with economic growth objectives. Furthermore, environmental management is a complex process, shaped by various contextual factors, such as the severity environmental issues, community engagement and available resources ([Panya et al., 2018](#)). It is also crucial to consider the lack of specific and qualified knowledge in sustainable themes among human resources ([Ramos et al., 2021](#)).

The coordination and integration of ecological objectives across municipalities are perceived as beneficial for fostering sustainable development and controlling potential deviations by local managers ([Matteis et al., 2021](#)). Collaboration can generate synergies, as some municipalities possess more resources and financial capabilities while others have greater knowledge ([Kusumasari et al., 2010](#)). To effectively address the diverse needs of different regions, it is essential to identify the critical environmental factors that most significantly influence environmental strategies ([Figge et al., 2002](#)). [Table 1](#) summarizes the main environmental critical factors mentioned in the literature.

2.2 Environmental performance and its measurement

[Panya et al. \(2018\)](#) propose four different strategies for local government in environmental management: building a sustainable culture, fostering a learning environmental organization, enhancing revenue while reducing cost and implementing preventive environmental management. These strategies, grounded in the interplay between organizational context, existing inputs and the environmental management performance of local public managers,

Table 1. Main categories of environmental critical factors cited

Environmental critical factors	Author	Year
Climate change and natural disasters	Matteis <i>et al.</i>	2021
	Moe <i>et al.</i>	2007
	Panya <i>et al.</i>	2018
Waste management	Suárez-Eiroa <i>et al.</i>	2022
	Guimarães <i>et al.</i>	2010
	Matteis <i>et al.</i>	2021
	Panya <i>et al.</i>	2018
	Suárez-Eiroa <i>et al.</i>	2022
Air pollution	Tsai <i>et al.</i>	2020
	Li <i>et al.</i>	2020
	Matteis <i>et al.</i>	2021
Water management	Panya <i>et al.</i>	2018
	Suárez-Eiroa <i>et al.</i>	2022
Coastal natural resources management	Matteis <i>et al.</i>	2021
Biodiversity and green spaces (or natural resources degradation)	Panya <i>et al.</i>	2018
	Maccarrone <i>et al.</i>	2014
Noise pollution	Suárez-Eiroa <i>et al.</i>	2022
	Panya <i>et al.</i>	2018

Source: Authors' own elaboration

aim to bolster performance. However, effective performance management, supported by PMS, is crucial for monitoring performance, ensuring sustainable organizational growth and successfully implementing strategy (Hristov *et al.*, 2021; Ndevu and Muller, 2018). This is particularly critical when the success of the strategy and the transformation of the organizational culture depend on the commitment of all stakeholders (Mio *et al.*, 2022).

The success of an organization is frequently measured by its high performance levels (Ndevu and Muller, 2018). Amidst escalating environmental concerns, the evaluation of environmental performance becomes a vital component of performance appraisal (Khalid *et al.*, 2022). Hubbard (2009) looks environmental performance to resource consumption and waste generation in organizations. Suárez-Eiroa *et al.* (2022) suggest analyzing environmental impacts from production and consumption perspectives. Consequently, the assessment of emissions, consumption and recycling becomes essential for assessing the benefits of environmental management (Hristov *et al.*, 2021). Such analysis, conducted using PMS, can induce cultural and motivational shifts within organizations, influencing their reputation and perception by others (Hristov *et al.*, 2021; Mio *et al.*, 2022).

While each organization may have divergent objectives concerning environmental sustainability, KPIs should address the diverse criteria involved (Epstein and Wisner, 2001). Environmental indicators typically encompass air, water and radiation pollution, emissions, resource management and consumption and eco-efficiency (Hristov *et al.*, 2021; Li *et al.*, 2020; Ramsden *et al.*, 2014).

2.3 *Balanced scorecard for municipalities and environmental sustainability*

2.3.1 *Balanced scorecard.* The BSC serves as an encompassing set of metrics providing managers with a comprehensive and multifaceted view of the business from four key perspectives (Kaplan and Norton, 1992). It acts as a management control system, influencing managerial behavior and decision-making (Oliveira, 2021). The BSC integrates a

performance management system through performance indicators. It also functions as a strategic action management tool, aligning objectives with action plans to achieve desired outcomes (Maccarrone *et al.*, 2014). It facilitates the translation of organizational strategy into operational terms by balancing both financial and nonfinancial components (Kaplan and Norton, 1992). Originating from the recognition that corporations have responsibilities extending beyond financial performance (Guimarães *et al.*, 2010; Hubbard, 2009; Sayed *et al.*, 2021), the BSC also emphasizes medium to long-term measures as a focus in management accounting (Figge *et al.*, 2002). The original BSC framework consists of four perspectives: financial, customer, internal processes (IP) and learning and growth. Each perspective addresses a critical question. The financial perspective examines how shareholders perceive the business and company, signifying the creation of value. The IP perspective focuses on how the company should internally prepare to excel. The learning and growth (LG) perspective addresses how the company can evolve and continue to create value. Finally, the customer perspective focuses on how organizations are perceived by their customers, as well as how these organizations aspire to be viewed by them (Epstein and Wisner, 2001; Kaplan and Norton, 1992). The cause-and-effect relationships established between these perspectives form the strategic map (Hansen and Schaltegger, 2016; Ndevu and Muller, 2018).

Developing a strategic map allows organizations to visualize how they aim to achieve their objectives (Maccarrone *et al.*, 2014). The BSC places the organization's strategy and vision at the center of its actions by aligning employee behaviors with desired outcomes through objective measures. This tool effectively communicates strategy and enhances strategic focus by presenting key strategic issues. Furthermore, it facilitates the assessment of whether enhanced performance in one objective is the result of targeted efforts or improvements in other related objectives (Kaplan and Norton, 1992).

The BSC, as a specific type of PMS, comprises processes that support managerial decision-making, value creation and controlled execution of organizational strategies to achieve objectives (Hristov *et al.*, 2021). KPIs play a crucial role in managing performance effectively. They should be quantifiable, complete and controllable. Furthermore, they can be categorized as Lead and Lag indicators. Lead indicators pertain to the processes and inputs necessary to achieve goals, while Lag indicators reflect goal achievement (Epstein and Wisner, 2001; Niven, 2003). A comprehensive BSC incorporates a combination of both indicator types, recognizing that a single KPI can be both lead and lag. For instance, a lagging indicator for an objective at the bottom of the strategic map becomes a leading indicator for a related objective at the top of the map (Epstein and Wisner, 2001).

In a typical strategic map, cause-and-effect relationships typically follow the sequence of learning and growth, IP, customers and financial perspectives (Ferreira *et al.*, 2016). However, the BSC framework can be tailored to the specific realities of each organization by incorporating new perspectives and aligning them with the defined strategies defined (Hristov *et al.*, 2019; Matteis *et al.*, 2021). This realignment allows organizations to streamline their strategy and improve their control by promoting greater clarity of cause-and-effect relationships (Chaker *et al.*, 2021).

2.3.2 Sustainability balanced scorecard. The integration of sustainability within organizational management has gained significant prominence (Hristov *et al.*, 2021). The SBSC emerges as the principal methodology for embedding and gauging the sustainability performance of organizations (Mio *et al.*, 2022). The SBSC enables the integration of sustainable objectives, encompassing environmental, social and economic aspects, into the overall strategy (Hansen and Schaltegger, 2016; Hristov *et al.*, 2019). Two critical issues are

associated with the structure of the SBSC: the sustainability integration level (Figge *et al.*, 2002; Hansen and Schaltegger, 2016) and the hierarchy of perspectives within the model (Hansen and Schaltegger, 2016).

Regarding the integration level, there are different degrees of incorporating sustainability into the BSC (Guix and Font, 2020). Options include creating an exclusively environmental and/or social BSC (Figge *et al.*, 2002; Hubbard, 2009), introducing an additional perspective, resulting in a five-perspective BSC or integrating sustainability components into the existing BSC perspectives, either partially, only into some perspectives, or fully into all (Mio *et al.*, 2022). Figge *et al.* (2002) and Hansen and Schaltegger (2016) discuss an extended SBSC design that combines the latter two approaches.

According to Hansen and Schaltegger (2016), the SBSC's architecture, may be hierarchical, semi-hierarchical or nonhierarchical. A hierarchical architecture strictly delineates the perspectives included in the strategic map and prescribes cause-and-effect relationships. cause-and-effect relationships. Conversely, a semi-hierarchical architecture offers flexibility by allowing the introduction of new perspectives and relationships. It shifts the focus away from a sole financial perspective, enabling a value- and cause-oriented system that emphasizes community and unity. particularly suitable for care-oriented organizations. Nonhierarchical architecture, resembling a network, treats all perspectives and objectives as interconnected and individually significant. While this architecture fosters continuous mutual reinforcement among perspectives and goals, it can lead to complex interpretation and a loss of strategic focus. According to the authors, this hierarchy is suitable for social and nonprofit organizations (Mio *et al.*, 2022). Figge *et al.* (2002) describe the SBSC as a comprehensive strategic management system intended to guide and support the development of sustainable strategies (Maccarrone *et al.*, 2014). Consequently, the cause-and-effect relationships established within the SBSC may differ from those in the original BSC, depending on the defined strategy and the importance assigned to sustainability (Mio *et al.*, 2022).

While the SBSC stands as the most widely used instrument for integrating sustainability into an organization's strategy, scholars have voiced criticisms regarding this approach. Firstly, when the BSC is augmented with a diverse array of stakeholder objectives, as in the case of the SBSC, the tool may lose its equilibrium and transform into a "Stakeholder Scorecard." Another criticism pertains to the SBSC's perceived inability to enhance sustainability levels, irrespective of its underlying architecture. It is crucial to recognize that these critiques stem from certain inconsistencies in understanding the characteristics and actual purpose of the SBSC, which is primarily designed to facilitate the monitoring, control and measurement of strategic performance (Hansen and Schaltegger, 2018).

2.3.3 Balanced scorecard for municipalities. In the public sector, there is an increasing need to adopt internal and external performance measures (Ramos *et al.*, 2021). To meet the demand for quality reporting, public institutions require effective performance monitoring systems (Adams *et al.*, 2014; Ndevu and Muller, 2018; Sayed *et al.*, 2021). The BSC plays a vital role in addressing these concerns (Niven, 2003; Sayed *et al.*, 2021). However, adjustments to the BSC architecture are necessary (Maccarrone *et al.*, 2014).

Public institutions often have ambiguous objectives that are primarily nonfinancial in nature (Sayed *et al.*, 2021). Their focus is on the efficiency and effectiveness of the services they provide to citizens (Maccarrone *et al.*, 2014). As a result, the hierarchical structure defined in the original BSC may not be the most suitable for public administrations (Niven, 2003).

Adams *et al.* (2014) show that the original BSC has been adapted to align with the strategies of public organizations. The financial perspective has been replaced by the customer perspective, which reflects the core mission of these organizations (Adams *et al.*,

2014; Ndevu and Muller, 2018). Consequently, the LG perspective contributes to improving IP, leading to enhanced financial performance and ultimately resulting in increasing citizen satisfaction (Ndevu and Muller, 2018). This strategic realignment prioritizes meeting citizen needs and promoting well-being, with the remaining perspectives driving customer and citizen satisfaction.

Despite these adaptations, the adoption of the BSC by public organizations offers numerous advantages. Niven (2003) highlights that the BSC enables accountability to be demonstrated and results to be achieved. It attracts scarce resources by demonstrating progress in strategy implementation, increasing efficiency and effectiveness. It enhances strategic alignment, generates valuable information and facilitates efficient analysis and achievement of results, thereby ensuring self-preservation. It also promotes change and builds trust.

2.4 Research questions

The existing literature presents various strategies for incorporating sustainability into management control systems (Figge *et al.*, 2002), particularly with respect hierarchical structuring and levels of integration. In addition, it is evident that different organizations, including those in the public sector, must adapt their strategic maps to align with their goals, visions and missions (Mio *et al.*, 2022; Niven, 2003). Consequently, authors such as Hansen and Schaltegger (2016) emphasize the need for further studies to determine the appropriate structure for the SBSC. Should a municipality adopt a semi-hierarchical architecture, since it is an organization that provides services and care, or a nonhierarchical architecture, since it is a social organization? Furthermore, researchers such as Hristov *et al.* (2021) and Sayed *et al.* (2021) emphasize the importance of conducting studies that provide guidance and support to managers in incorporating environmental components into their strategies.

This study focuses on municipalities in the northern region of Portugal (see Section 3.1.) to address and explore these themes within a joint municipal action strategy. Consequently, the study formulates two research questions:

- RQ1. Is the semi-hierarchical architecture appropriate for implementing Environmental Sustainability Balanced Scorecards (ESBSCs) in these municipalities?
- RQ2. What are the most significant environmental objectives, strategic actions and KPIs for municipalities in the northern region of Portugal?

3. Methodology

3.1 Sample selection

The Regional Coordination and Development Commission (CCDR) serve as governmental entities, tasked with fostering coordinated, integrated and sustainable actions across municipalities, thereby enhancing the efficient management of public resources [Decree-Law (DL) n°228/2012]. They are pivotal in championing new strategies for environmental protection, spatial planning, regional development and local administration, thereby promoting competitiveness and cohesion within their respective regions.

This study focuses on CCDR-N, which covers Portugal's Northern region. Within this area, the Metropolitan Area of Porto (AMP), which boasts the highest population density according to recent data from PORDATA (2022) was chosen as the primary *locus* for municipal selection.

The strategic framework for this investigation includes a set of common strategic objectives. An examination of projects, shared services and existing collaborations within the AMP municipalities revealed that Gondomar, Maia, Matosinhos, Porto, Valongo and Vila Nova de Gaia frequently participate in initiatives with shared aims. Among these

municipalities, Porto has the highest population density (PORDATA, 2022). Consequently, the sample selection focused on Porto and the adjacent municipalities to ensure municipal continuity and the relevance of shared objectives. By considering population density, geographic continuity and shared ecosystem services as the main criteria, the sample included five municipalities: Porto, Vila Nova de Gaia, Maia, Gondomar and Matosinhos. All of these municipalities actively participate in climate action and environmental protection, as they have subscribed to initiatives such as the Pacto dos Autarcas para o Clima e Energia or the AMP Sustainable Mobility Action Plan.

3.2 Methodological steps

This research was structured around three methodological steps: content analysis, surveys and an interview. These techniques were essential for data collection and for establishing relationships between strategic objectives, KPIs and strategic actions. The surveys and interviews not only validated the collected and processed data but also highlighted the benefits of collaborative strategies. The combined use of these methodologies ensured data triangulation, enhancing the depth and quality of the collected information (Barros and Ferreira, 2022; Hristov *et al.*, 2019).

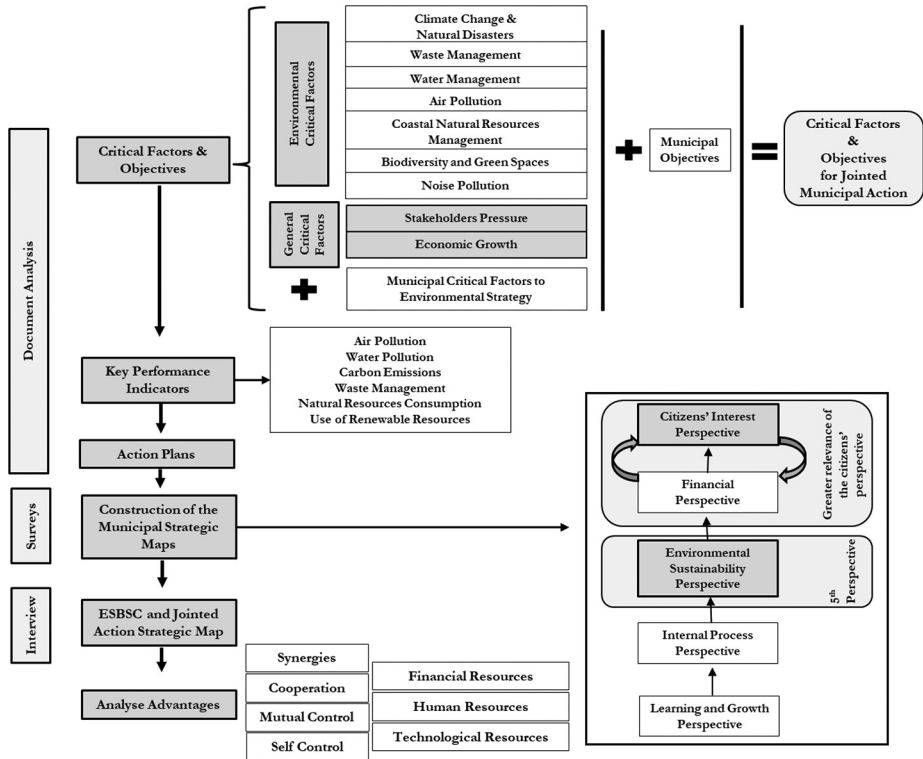
Figure 1 illustrates the main aspects guiding the project's implementation, specifically the development of an ESBSC represented by a strategic map for the joint action of the municipalities. These aspects were defined based on the study conducted by Huynh *et al.* (2020).

3.2.1 First step – municipal strategic maps. The initial phase involved analyzing documents in straightforward and coded language. The materials analyzed consisted of 23 municipal reports related to environmental strategies and actions, obtained from municipal websites and the Portuguese Environment Agency (APA). Sustainable development goals reports from the municipalities were also reviewed. The selection of reports for analysis was based on their relevance in explaining the municipalities' environmental strategies, with preference given to more recent reports. This phase aimed to collect critical factors, strategic objectives for municipal environmental action plans, KPIs and action plans.

Data collection was performed on a municipality-by-municipality basis, categorizing the objectives identified in the reports and municipal websites under each critical environmental factor. New critical environmental factors were created, when new objectives arose that did not align with existing ones. Some objectives were classified according to BSC perspectives if they could be included in more than one critical factor or if their inclusion in specific perspectives was evident. Indicators and strategic actions were documented for further analysis and association with strategic objectives.

While initial analyses were guided by predetermined critical environmental factors identified through the literature review, an inductive analysis approach was also used to uncover new insights (Schreier, 2012). This facilitated the identification of relationships between strategic objectives, which was essential for the subsequent process of constructing the municipal strategic maps. By reviewing various reports, it was possible to identify how the achievement of certain objectives could contribute to the achievement of others. This revealed the existence of relationships that should be reflected in the strategic maps.

Post-analysis, municipal strategic maps were created based on the data collected and processed. Five surveys were then conducted, one for each municipality involved, targeting the municipal representatives responsible for the environment and/or strategy in the selected municipalities, from whom we subsequently received a response, representing the municipalities of Porto, Gondomar and Matosinhos. We did not receive responses to the surveys from the municipalities of Vila Nova de Gaia and Maia. Therefore, in both cases, the results were subjected



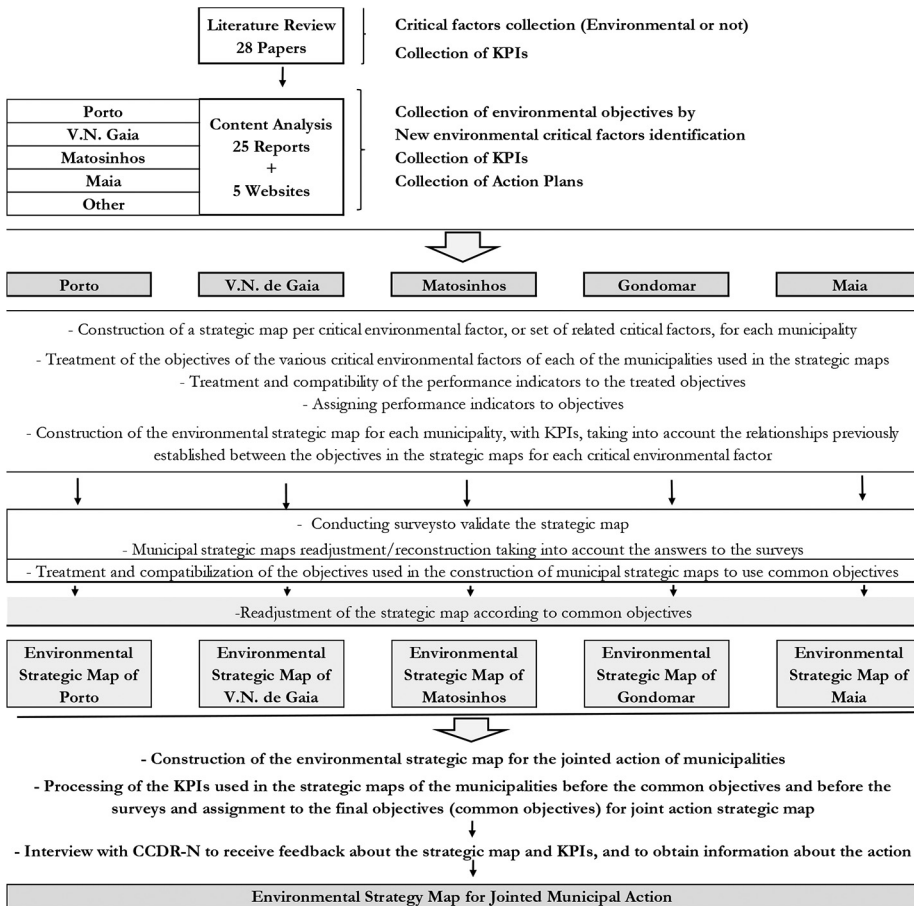
Source: Authors' own elaboration

Figure 1. Research framework

to content analysis. Figure 2 provides an overview of the complete process and the steps required to develop each municipal strategic map, categorized by topics.

The surveys were designed to assess the alignment of strategic objectives with the unique needs of each municipality and to gauge the relevance of objectives set for other municipalities. They also aimed to ascertain the appropriateness of KPIs and gather data to support the assessment of how perspectives are positioned on the strategic map. The surveys also sought to analyze which objectives would benefit most from a joint action strategy and determine the resulting benefits. Although each survey was tailored to the specific municipality, the structure was similar, as indicated in Table 2. Predominantly, closed-ended dichotomous and Likert scale questions were used. The Likert scale questions allowed for the assessment of data adequacy, such as critical factors, objectives and KPIs. The dichotomous questions facilitated the validation and confirmation of the collected data.

It is important to note that the developed maps introduced exploratory KPIs since suitable indicators were not available for all strategic objectives. These KPIs were evaluated for their appropriateness through the surveys conducted.



Source: Authors' own elaboration

Figure 2. Methodological steps

3.2.2 *Second step – Environmental sustainability balanced scorecard for municipalities joint action and strategic map.* Upon completing the surveys and refining the strategic maps and Balanced Scorecards, the subsequent phase entailed their integration to establish the ESBSC for the joint action of the municipalities, along with the corresponding strategic map.

Subsequently, an interview was conducted with the Director of Environmental Services of CCDR-N. The semi-structured interview, lasting approximately 60 min, focused on three topics:

- (1) receiving feedback on the critical factors and strategic map developed;
- (2) receiving feedback on performance indicators; and
- (3) receiving feedback on the joint action plan to be implemented.

Table 2. Surveys structure

Parts	Content	Question type	Number of Questions by Municipality					
			PRT	VNG	MTS	GDM	MAI	
I	Learning and growth perspective	Closed questions	1	1	1	1	1	
		Open questions	2	3	3	3	2	
		Dichotomous (Y/N)	1	1	1	1	1	
		Five-point Likert scale with open question component	1	2	1	2	1	
		Dichotomous (Y/N)	3	3	3	3	3	
II	Internal processes perspective	Closed questions	0	0	0	1	0	
		Dichotomous (Y/N)	3	3	3	4	3	
		Five-point Likert scale with open question component	2	3	3	3	3	
III	Environmental perspective	Closed questions	2	2	2	2	2	
		Dichotomous (Y/N)	2	2	2	2	2	
		Multiple-Choice	0	1	1	1	1	
IV	Financial perspective	Closed questions	2	2	2	2	2	
		Dichotomous (Y/N)	2	2	2	2	2	
		Five-point Likert scale with open question component	2	2	2	2	2	
V	Citizen's perspective	Closed questions	2	2	2	2	2	
		Dichotomous (Y/N)	0	1	1	1	1	
		Five-point Likert scale with open question component	2	2	2	2	2	
VI	Jointed action strategy map	Closed questions	1	1	1	1	1	
		Verification question	1	1	1	1	1	

Source: Authors' own elaboration

The interview encompassed a preliminary presentation of the project to acquaint the respondents with the context and a subsequent discussion on the strategic map tailored for the collaborative initiative. Both the presentation and the structure for the second part of the interview were shared with the respondent in advance to facilitate the quality and accuracy of their responses.

4. Results

4.1 *Global analysis and critical factors for joint municipal environmental action*

The critical factors influencing collaborative efforts among municipalities encompass Climate Change, Waste Management, Air Pollution, Green Spaces, Energy, Circular Economy [in line with [Radu and Lux \(2024\)](#)] and Mobility. Significantly, the authors have introduced three novel factors – Energy, Circular Economy and Mobility – that were previously unrecognized in the existing literature. These factors were unanimously deemed significant or highly significant by all participating municipalities, affirming their critical importance. Among the seven factors under scrutiny, only Climate Change and Green Spaces were classified as highly significant by the municipalities surveyed.

Originally extracted from the literature, the factors Biodiversity and Green Spaces were divided, governed by distinct authorities. Green Spaces fall under the jurisdiction of municipalities, while Biodiversity is managed by the Institute for Nature and Forest Conservation, an independent body of municipal action. Therefore, only Green Spaces can be intervened in by municipalities, making them relevant to this study's focus.

Water Management is not considered a critical factor as it is autonomous from municipalities and is currently the responsibility of Águas de Portugal (AdP).

Municipalities ranked Noise and Coastal Natural Resources as less important factors. In addition, Coastal Natural Resources Management showed disparity in terms of its criticality among municipalities. This disparity could result in a loss of focus for municipalities less affected by this factor when included in a joint action plan, compromising the overall strategic performance. Furthermore, this factor is regulated by the Environmental Protection Agency, not the municipalities.

Animal Welfare was considered important in Porto, Maia, Matosinhos and Vila Nova de Gaia. However, due to its strong association with pet care support, it was deemed less relevant to the environmental focus of this study.

Municipalities rated Pressure from Stakeholders as highly important, and similarly, Economic Growth was also viewed as significant globally. These findings align with the studies conducted by [Abdel-Maksoud et al. \(2021\)](#), [Monteiro and Ribeiro \(2017\)](#) and [Sayed et al. \(2021\)](#), which emphasize the significance of these two issues in the environmental concerns of public institutions. However, during the interview with CCDR-N, it became evident that while the entity recognizes their importance, Pressure from Stakeholders and Economic Growth should not be the driving forces behind the municipalities' mobilization in a joint environmental action strategy. Therefore, these two factors should not be deemed critical in this context. It is important to note that stakeholders, in the context of our study, encompass all potential stakeholders in municipalities without any distinction.

[Appendix 1](#) summarizes the standardized objectives collected from municipalities, organized by BSC perspective. Objectives that were mentioned in three or more municipalities were selected for the construction of the initial joint action strategic map.

4.2 *Perspectives on strategic maps*

The tool developed adopts a comprehensive structure that incorporates environmental objectives across all traditional BSC perspectives ([Guix and Font, 2020](#)). In addition, the

strategic map includes a separate environmental perspective, often referred to as the 5th Perspective (Guix and Font, 2020; Hubbard, 2009; Huynh *et al.*, 2020; Sayed *et al.*, 2021). Appendix 1 and 2 provide clarification on the structure adopted for the constructed SBSC and its representation via the strategy map. This configuration not only facilitates the emphasis on environmental sustainability but also allows for its integration and correlation with other organizational resources and processes. Consequently, this will enable a more proactive approach to strategic monitoring (Hansen and Schaltegger, 2018). Furthermore, this structure aims to achieve the advantages highlighted in the studies of Epstein and Wisner (2001), Hubbard (2009) and Chaker *et al.* (2021) such as increased focus on environmental objectives, easier interpretation of the strategic map, reduced complexity and the use of a perspective specifically tailored for environmental objectives. Consequently, the semi-hierarchical structure is identified as the most suitable for the objectives of this study, addressing the first research question. Adopting a nonhierarchical structure could make the tool challenging to implement and communicate, considering the significant number of critical factors and strategic objectives considered in the ESBSC (Hansen and Schaltegger, 2016). Semi-hierarchical structure provides the desired flexibility that was lacking in the hierarchical structure, facilitating the inclusion of environmental strategic objectives within the ESBSC. In addition, it allows for cause-and-effect relationships and offers a less complex interpretation. Nevertheless, it is crucial to underscore that the tool should be approached with a realistic perspective. Its primary role is to aid in the monitoring and control of strategic implementation. By itself, it will not have the capacity to enhance environmental performance (Hansen and Schaltegger, 2018).

The chosen approach necessitates understanding the positioning of this new perspective in relation to other traditional BSC perspectives. According to Ndevu and Muller (2018) and survey responses, the top priority for local governments is to ensure the satisfaction of local population needs, promote their well-being and contribute to social and economic development at the local level. The significance of the Citizen's and Financial Perspectives is emphasized in the strategies implemented by these entities. Therefore, these perspectives should occupy prominent strategic positions, and environmental objectives should align with the objectives encompassed within them (Huynh *et al.*, 2020).

Adams *et al.* (2014) and Ramos *et al.* (2021) state that the mission of public organizations centers around providing essential public services and safeguarding the welfare of citizens. As a result, the Citizen's Perspective should assume a prominent role in the overall strategy. Furthermore, when asked about the most crucial aspects to achieve in implementing an environmental strategy, no municipalities mentioned improving financial capacity (although Porto recognized that having a strong municipal economic capacity can support better environmental performance). This study advocates for prioritizing the Citizen's Perspective over to the Financial Perspective within public organizations (Niven, 2003; Ndevu and Muller, 2018) enhancing municipal financial outcomes and the well-being of the population. Thus, the environmental perspective serves as a means through which municipalities can reinforce the scope of their mission, making it worthwhile to invest in this strategy.

The surveyed municipalities perceive the LG perspective as vital for the execution of green development strategies, aligning with the fundamental principles of the traditional BSC framework (Ferreira *et al.*, 2016). This perspective aligns with Mio *et al.* (2022) study, which emphasizes the importance of effective training, especially in the context of developing and implementing tools like the BSC (a principle we can extend to the SBSC) to enhance the attainment of the stated objectives.

In conducting a succinct review of the five perspectives that constitute our tool, we begin with the LG perspective, wherein six strategic objectives articulate a strategy aiming at

fostering a sustainable culture through heightened awareness and knowledge among the population to drive behavioral change. These objectives also focus on environmental learning, which enables the identification and implementation of improvements for better long-term environmental performance. These strategic objectives align with the strategies for sustainable culture-building and environmental learning organization discussed in the study by [Panya et al. \(2018\)](#) for improving environmental management performance in local public organizations.

Moving to the IP perspective, all eight identified strategic objectives have been incorporated in the strategic maps of over half of the surveyed municipalities, underscoring their fundamental role in environmental strategic execution. These objectives are interrelated and contribute to improving the IP of municipalities, enhancing their responsiveness in terms of resources and promoting proactive environmental management. This perspective is also consistent with the precautionary approach to environmental management suggested by [Panya et al. \(2018\)](#).

In the Environmental (E) Perspective, ten out of the nineteen strategic objectives were present in more than two strategic maps. The critical factor Coastal Natural Resources Management had a weaker presence, indicating its limited potential to be part of a strategic map for joint action. In the Financial (F) Perspective, the strategic objectives focus on reducing energy and water costs, using natural resources for economic and tourism advantages and promoting sustainable resource consumption. The Citizen (C) Perspective highlights objectives related to the well-being and safety of the population.

4.3 Objectives most benefiting from joint action strategy

Among the objectives identified as potential beneficiaries of a joint action strategy, Green Spaces, Waste Management, Air Pollution and Energy stood out as the most important.

All the objectives that are referred to are defined in [Appendix 1](#). From the Citizen's Perspective, the objective related to contributing to the physical and mental well-being of citizens and improving their quality of life (C1) was deemed highly advantageous within a collective strategy framework, aligning with local governance missions ([Ndevu and Muller, 2018](#)).

From the Financial Perspective, objectives related to reducing energy and water costs (F2), using natural resources (F3), supporting environmental business ideas (F4) and promoting economic growth through sustainable resource consumption (F7) were mentioned. The first two objectives particularly resonate revenue enhancement and cost reduction strategies suggested by [Panya et al. \(2018\)](#).

Regarding the Environmental Perspective, the most frequently mentioned objectives were E2 (Green Spaces and Water Management), E7 (Energy and Climate Change) and E9.1 (Waste Management and Circular Economy). These objectives correspond to the critical environmental factors that concern municipalities the most (Green Spaces and Climate Change).

In the IP perspective, there was consensus regarding objectives related to control practices (IP4), planning (IP5) and innovative strategies (IP7). These objectives emphasize the importance of using control and monitoring tools to enhance decision-making processes ([Adams et al., 2014](#); [Niven, 2003](#); [Sayed et al., 2021](#)). Effective planning is also crucial for successful sustainable strategies ([Rasoolimanesh et al., 2022](#)).

From the LG perspective, objectives promoting education and awareness (LG1) and ensuring the qualification of human resources (LG3) were the most consistent among municipalities. These objectives align with [Panya et al. \(2018\)](#) and are deemed essential for

enhancing environmental performance within municipal contexts through collective action strategies.

4.4 Joint analysis, differences and similarities between municipalities

4.4.1 *Consistency of strategic objectives among municipalities.* After analyzing and aligning the strategic objectives of municipalities, a total of 50 strategic objectives were identified. However, 17 out of the 50 objectives were found in the environmental action strategic map of only 1 or 2 municipalities.

The perspectives demonstrating greater consensus on objectives are the Internal Process Perspective (8 out of 8 objectives with agreement from more than 2 municipalities), followed by the Financial Perspective (6 out of 7) and the Citizen's Perspective (6 out of 10). This indicates a predominant inclination among municipalities to plan their contributions to the environmental strategy in a harmonized manner, as a well-articulated strategy focusing on this perspective could significantly enhance the attainment of environmental goals, as supported by [Panya et al. \(2018\)](#). Therefore, a well-defined strategy that focuses on this perspective may enhance the municipalities' ability to achieve their desired environmental objectives, given its influence in facilitating the attainment of other objectives.

Overall, there is consistency in the strategic objectives across municipalities, indicating the potential for joint action among them.

4.4.2 *Analysis of top strategic objectives.* The analysis of the top strategic objectives was conducted based on the Environmental, Financial and Citizen's perspectives.

In the Environmental Perspective, the objectives requiring the greatest strategic effort were E7 (Energy and Climate Change), followed by E1 and E9.1 (related to Green Spaces and Circular Economy and Waste Management). These objectives showed a higher number of incoming arrows in the strategic map, indicating their dependence on the base objectives for achievement.

From the Financial and Citizen's Perspectives, objectives related to cost reduction, economic growth based on sustainable resource consumption and ensuring citizen well-being and safety required significant strategic effort.

4.4.3 *Strategically important objectives.* For the most strategically demanding objectives, an analysis was conducted based on the Citizen's, Financial and Environmental Perspectives. However, to identify the objectives with the greatest potential to drive results, the focus was on the perspectives forming the foundation of the strategic map, as they contain the main strategic drivers ([Figge et al., 2002](#)).

The IP perspective exhibited the highest inductive capacity, with objectives pertaining to establishing partnerships (JAIP1) and planning (JAIP5) being identified as strategically crucial. The first two objectives align with the studies by [Adams et al. \(2014\)](#), [Kusumasari et al. \(2010\)](#), [Matteis et al. \(2021\)](#), [Niven \(2003\)](#) and [Sayed et al. \(2021\)](#). These objectives exhibit reciprocal causal relationship, where establishing partnerships enables better planning and decision support, and vice versa. This causality provides continuity and interactivity to the strategy, as both objectives continuously influence each other ([Diasio, 2022](#)). Therefore, they are crucial objectives for strategy execution. In addition, objectives emphasizing strategic integration, inter-municipal cooperation, control practices and monitoring were also identified as having high inductive capacity ([Adams et al., 2014](#); [Kusumasari et al., 2010](#); [Matteis et al., 2021](#); [Niven, 2003](#); [Sayed et al., 2021](#)).

In the LG perspective, objectives promoting education and awareness of environmental are seen as objectives with high inductive capacity. The creation of an environmentally aware culture capable of driving behavioral change was considered fundamental by the municipalities ([Panya et al., 2018](#)). Nevertheless, it is crucial to emphasize that altering the

culture of an organization poses a formidable challenge, demanding the active engagement and unwavering dedication of all stakeholders, particularly when implemented across a vast array of self-governing municipalities (Mio *et al.*, 2022).

4.5 Environmental sustainability balanced scorecard, strategic map for joint environmental action and action plan

4.5.1 Strategic map for joint environmental action and environmental sustainability balanced scorecard. The implementation of the environmental strategy, as developed and delineated in the BSC, is poised to usher in a profound transformation in the participating municipalities. This transformation goes beyond merely altering their resource allocation and process methodologies (Epstein and Wisner, 2001). It also holds the potential to instigate enduring cultural shifts, as suggested by Hristov *et al.* (2021).

The ESBSC for joint action among municipalities comprises 36 strategic objectives with assigned KPIs, as detailed in Table 3. The coding of the objectives follows a logic of combining the type of strategy (Joint Action – JA), the perspective it belongs to (e.g. Learning and Growth Perspective – LG) and its order (e.g. 1st objective of the Learning and Growth Perspective – 1) (e.g. JALG1). It is important to note that the majority of the presented KPIs are lag indicators resulting from the research method used. However, these indicators can also be seen as lead indicators for objectives positioned higher on the strategic map. For instance, the indicator “No. of cooperation protocols signed by the municipality, in the year” is a lag indicator for the objective of establishing partnerships, but it can also be seen as a lead indicator for the objective of rehabilitating and conducting public works, as partnerships enable more public works to be accomplished. In addition, most of the presented KPIs are absolute rather than relative. Incorporating more relative indicators could improve comparative analysis of strategy execution among municipalities.

According to Section 4.1, the ESBSC developed and presented in Table 3, encompasses all critical environmental factors except for Water Management, Coastal Natural Resources Management, Biodiversity and Noise.

The strategic map developed has the potential to enhance the environmental performance of municipalities through a combination of four strategies. These strategies include: a sustainability building strategy and an environmental learning organization strategy in the LG perspective, a cost reduction and revenue increase strategy in the Financial Perspective and a preventive strategy in the IP perspective (Panya *et al.*, 2018).

However, it is important to highlight the potential challenges associated with implementing this tool. Contrary to what is stated in Epstein and Wisner (2001) that there is no certain number of measures to be considered in the BSC, controlling 36 strategic objectives and their performance indicators distributed across seven critical environmental factors can become confusing, complex and challenging. One alternative to address these difficulties could be to divide the tool into multiple ESBSCs based on critical environmental factors.

It is worth noting that the alignment of environmental strategic objectives with the municipalities’ mission creates an integrated strategic map. While the focus is primarily on the environmental aspect of sustainability, the other components (social and financial) are also covered, addressing gaps identified in the literature (Li *et al.*, 2020; Maccarrone *et al.*, 2014). Thus, the developed tool provides support to policymakers in implementing strategies that not only prioritize the environment but also promote social and economic development.

Appendix 2 showcases the strategic map developed for the joint action of municipalities within CCDR-N’s area of operation, along with the constructed ESBSC. It should be noted that Appendix 2 differs from Table 3 presented above. They are related to different stages of the research process. Appendix 2 presents the standardized municipal objectives (translated

Table 3. ESBSC for joint action

Code	Objectives	Indicators
<i>Learning and growth perspective</i>		
JALG1	- Promote education and raise awareness of society as a whole, which includes companies and consumers, to the importance of sustainability and behavioral change	- No. of promotion and awareness actions on environmental sustainability through digital channels - No. of environmental management or sustainable accounting training courses promoted by municipalities - No. of environmental organizations, already created or new, existing in the municipalities
JALG2	- Create and encourage the creation of organizations, encouraging the participation of companies, citizens, universities, and research centers in the reflection of actions to be undertaken	- No. of municipal employees involved in training initiatives related to environmental management or sustainable accounting
JALG3	- Ensuring the qualification, involvement and motivation of human resources, to ensure the development of all studies and actions necessary for strategic execution	N/D
JALG4	- Define rules and measures to be used in municipal sustainability plans, which allow for greater dynamism and interconnection of them	N/D
<i>Internal processes perspective</i>		
JAIP1	- Establish various partnerships to increase the municipality's capacity for intervention and reduce the consumption of various types of resources (financial and technological)	- No. of cooperation protocols signed by municipalities, per year
JAIP2	- Rehabilitate, recover and carry out public works, based on the principles of sustainability, responding to environmental needs	- % of projects carried out based on existing environmental regulations, in relation to all existing projects
JAIP3	- Guide the acquisition of goods and services according to the principles of circularity and arrange them according to municipal needs	- % of services provided to municipalities by environmentally certified entities in relation to all services - % of goods acquired by municipalities with environmental certification in relation to all goods acquired
JAIP4	- Ensure quality control, performance control, monitoring and inspection practices	- No. of inspection actions, carried out per semester, to companies licensed by the municipalities, regarding practices and compliance with environmental norms
JAIP5	- Resort to planning, as well as decision support instruments, to increase the municipality's response capacity	

(continued)

Table 3. Continued

Code	Objectives	Indicators
JAI P6	- Use, introduce and maintain infrastructure and technological systems that are more adapted and capable of responding to the environmental needs of the municipality	- Level of performance of the environmental action plans in execution in the municipalities (weighted average by the degree of importance of the plans, of the performance levels of each plan in force)
JAI P7	- Bet on more innovative, efficient, sustainable and integrated management strategies and/or promote the use of natural systems and/or collective use with other municipalities	- No. of places, public spaces or public establishments where new technological solutions were implemented to meet environmental needs, in the year
JAI P8	- Guide municipal policies based on sustainable environmental development principles and institute bioclimatic incentives and measures	- No. of integrated action strategies, related to environmental issues, being implemented by municipalities, in the year
<i>Environmental perspective</i>		
JAE1	- Promote the regeneration of natural resources and ecosystems and environmental balance	- No. of measures in place in municipalities that encourage various sustainable environmental practices
JAE2	- Expand, approach, maintain green spaces, requalify rivers, river beaches and renaturalize riverbanks	- Size of areas classified for nature conservation in the last decade in the municipalities
JAE3	- Protect the forest and identify priority afforestation areas	- Municipal green area per inhabitant of the municipalities
JAE4	- Reduce vulnerability to weather events and increase the municipality's adaptive capacity	- No. of fluvial beaches in the municipality that are in a good state of use and safety, compared to the total number of existing fluvial beaches
JAE5	- Encourage non-motorized and/or collective mobility	N/D
JAE6	- Encourage the use of renewable energies and reduce the consumption of fossil fuels, through less carbon-intensive alternatives	- Average no. of summer days (temperature greater than or equal to 25°C)
		- Average no. of occurrences of moderate to strong wind (>30km/h)
		- Kms of public transport network per 100,000 inhabitants
		- Kms of existing bike paths
		- Kms of projected bike paths
		- No. of charging stations for light electric mobility (bicycles, scooters), in the municipalities
		- Total electricity consumption in the public sector per capita, in the year [KWh/hab]

(continued)

Table 3. Continued

Code	Objectives	Indicators
JAE7	- Improve air quality and reduce greenhouse gas emissions	- Evolution of the average daily no. of goods transport vehicles with internal combustion engines circulating in the municipalities - Air quality index (average concentration values of various pollutants, e.g. CO ₂ ; PM _{2.5} ; PM ₁₀ ; NO ₂ ; SO ₂ ; O ₃)
JAE8	- Improve waste management of any kind, in which construction and demolition waste is included, by promoting recycling, reduction and reuse of materials and by-products	- Greenhouse gas (GHG) production per capita - Tons of municipal waste collected per capita, per year (Tons of undifferentiated, selective and other collections per inhabitant of the municipality, in the year) - Tons of construction and demolition waste collected, per year - % of municipal waste recycled compared to total waste, in the year - % of biodegradable municipal waste landfilled vs. total waste landfilled, in the year
JAE9	- Increase the quantity and quality recovered, prepared and recovered	- % of components prepared for reuse and recycling, in the year, in relation to the total waste produced - Tons of components that were recovered and reintegrated into the market cycle
JAE10	- Promote organic farming	- Individuals in training activities for organic farming promoted by municipalities - No. of requests for plots of land made by municipality inhabitants to organic cultivation
JAE11	- Preserve soil quality	N/D
JAE12	- Minimize and control the proliferation of invasive species	N/D
JAE13	- Eliminate sources of pollution	- No. of active pollution sources in the municipality
<i>Financial perspective</i>		
JAF1	- Increase the Sharing Economy, with regard to local product markets	N/D
JAF2	- Take advantage of the economic, tourist, educational and environmental potential, among others, resulting from natural resources	- % of economic activities developed in municipalities that benefit from environmental potentialities
JAF3	- Support innovative, knowledge- and technology-intensive business ideas that transform environmental challenges into circular business	- Total support granted for the development of innovative, knowledge and technology intensive businesses

(continued)

Table 3. Continued

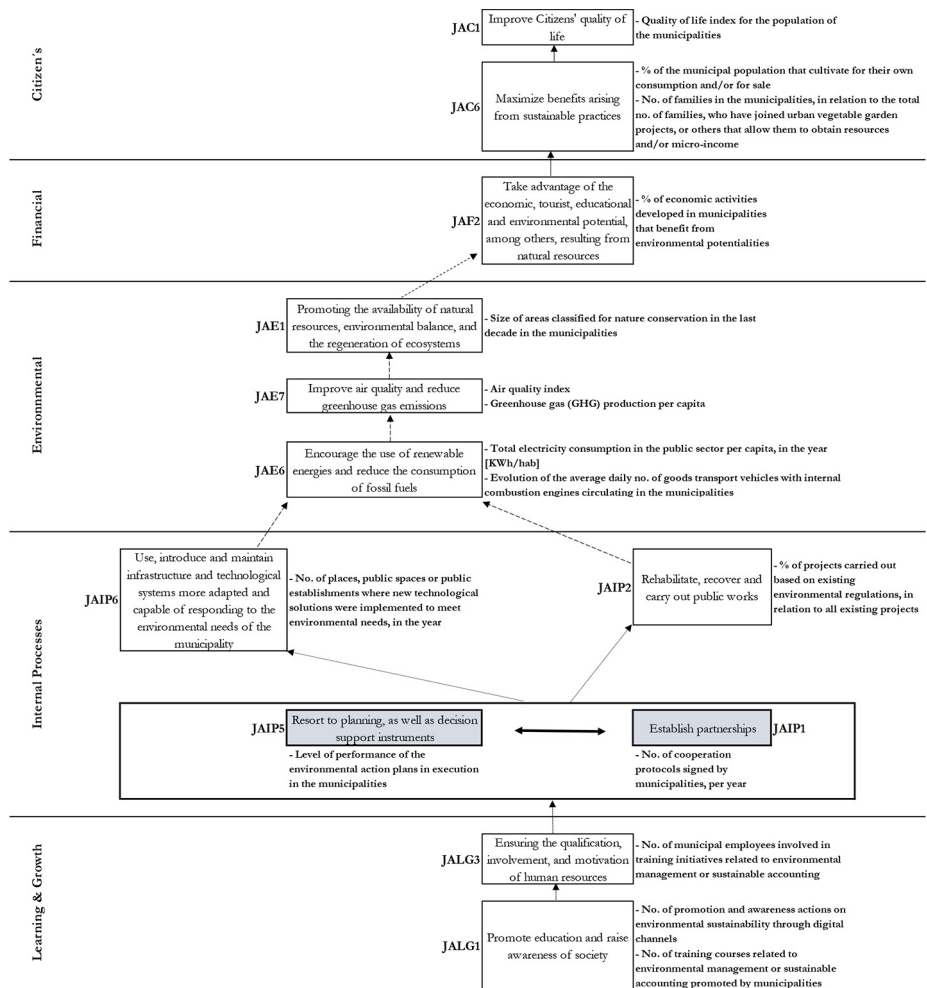
Code	Objectives	Indicators
JAF4	opportunities, capable of creating qualified employment and fostering the municipal economy - Achieve green taxation and green public procurement	<ul style="list-style-type: none"> - % municipal green jobs (% of employees with daily tasks related to environmental sustainability, in municipal companies) - Rate of suppliers contracted by municipalities with environmental certification - % of contractual procedures and public procurement carried out by municipalities that include environmental requirements in the award criteria
JAF5	- Promote economic growth based on conscientious consumption of resources with reduced impact on environmental degradation	<ul style="list-style-type: none"> - Municipal energy intensity (Total energy consumption of municipalities versus municipal GDP) - Emissions of pollutant gases in municipalities, per year, in relation to the annual municipal GDP
<i>Citizen's perspective</i>		
JAC1	- Improve the citizens' quality of life	- Quality of life index for the population of the municipalities
JAC2	- Ensuring the safety of people and property	- % of urban occupation in areas of high risk of ground movement and/or flooding
JAC3	- Reduce car traffic in residential areas	- Road traffic intensity in the most densely populated areas of municipalities (number of vehicles passing through the road sections of the most densely populated areas per unit of time)
JAC4	- Reduce the use of hospitals and contribute to the reduction of the mortality rate of vulnerable people, resulting from the occurrence of heat waves	N/D
JAC5	- Reducing the vulnerability of citizens to thermal discomfort	- Annual level of energy dependence of municipalities (ratio of net energy imports made by municipalities to total energy supply minus change in energy stocks)
JAC6	- Maximize the benefits arising from various sustainable practices and activities related to the environment	<ul style="list-style-type: none"> - % of energy-efficient buildings relative to the total number of existing buildings in the municipalities - % of the municipal population that cultivate for their own consumption and/or for sale - No. of families in the municipalities, in relation to the total no. of families, who have joined urban vegetable garden projects, or others that allow them to obtain resources and/or micro-income

Source: Author's own elaboration

into a common language). Table 3 is the ESBSC developed for the joint municipality action, and Appendix 2 is the representation of the ESBSC developed by a strategic map. The objectives in Table 3 have their origins in Appendix 2. However, some objectives were merged; others are not present in the final ESBSC.

To enhance the tool's simplicity and facilitate its communication and monitoring of the strategy, we present Figure 3, which provides an excerpt of the final strategy map focusing on the critical factors of energy and climate change. These factors were identified as the most important during the interview with CCDR-N.

The objective of the Environmental Perspective is to promote the use of renewable energy and reduce fossil fuel consumption. Based on our research, the performance in



Source: Authors' own elaboration

Figure 3. A simplified strategic map for energy and climate change

achieving this goal can be measured through two indicators: total energy consumption in the public sector per capita and per year, and the change in the average daily number of goods transport vehicles with internal combustion engines circulating in the municipalities.

To foster this incentive, municipalities need to establish IP that enable the adoption of energy-efficient practices by the population, resulting in lower emission levels. Achieving this goal requires municipalities to focus on improving infrastructure and technological systems, which can be achieved through the implementation of public works. For instance, constructing cycle paths to connect different municipalities and establishing zero-emission zones can reduce reliance on fossil fuel-based mobility. However, effective planning and the creation of decision-support tools are essential to complement existing processes.

The bidirectional causal relationship between the objectives of establishing partnerships (JAIP1) and resorting to planning (JAIP5) stands out. This relationship ensures a sense of continuity within the strategy and enhances the synergistic effects of these objectives, contributing to overall performance improvement.

Partnerships also play a crucial role in strengthening the IP of municipalities by fostering cooperation, greater control and synergy among all stakeholders. However, the success of establishing partnerships and implementing action and control plans relies on high levels of staff motivation, qualification and specialization. Municipalities should prioritize training programs to promote these qualities.

Achieving these objectives will not only lead to better ecosystem protection and environmental balance but also yield economic benefits. For example, improved air quality and ecosystems can attract more tourists, enhancing landscapes' quality and population well-being. Consequently, the municipal population can enjoy an improved quality of life, not only through reduced gas consumption but also through the creation of wealth within the municipalities.

4.5.2 Action plan for joint environmental strategy. Table 4 presents the strategic actions associated with each critical environmental factor. Some actions are applicable across all critical environmental factors as they are rooted in the LG perspective, which forms the foundation of the environmental strategy.

Through the interviews, it became evident that improving energy performance in the housing sector is a vital action for climate action, with significant implications for climate change. It is important to note that all actions presented under the Climate Change factor are already being implemented by the municipalities in compliance with the Climate Law, which defines the principles of climate policy. The remaining strategic actions, obtained from the analyzed reports and municipal websites, have a high potential for either being already implemented or under consideration for implementation.

4.6 Advantages of joint action strategy

The analysis of municipal surveys indicates that the establishment of partnerships and the sharing of objectives are seen as positive on a global scale. This finding aligns with the [Matteis et al. \(2021\)](#) study, which recognizes coordination among stakeholders to enhance environmental development and control strategy deviations.

Municipalities perceive partnerships to strengthen their resources and facilitate the achievement of objectives. It is important to note that only the municipality of Porto rated the improvement of responsiveness through financial resources with a lower score (2/5 on the Likert scale).

However, municipalities unanimously agreed on the improvement of responsiveness resulting from enhancements in human and technological resources. They also acknowledged

Table 4. Action plan to be adopted jointly by municipalities

Environmental critical factor	Action plans
Transversal (in terms of the learning and growth perspective)	<ul style="list-style-type: none"> - Carry out joint communication, dissemination and awareness actions on risks associated with climate change aimed at the population - Create an environmental management portal and/or mobile application for the population, with segmentations according to younger or more adult age groups - Create environmentally friendly networks for networking and knowledge sharing, encouraging the involvement of various institutions - Create interpretive centers in the most varied natural valences - Carry out joint training actions for technicians and policy makers in the assessment of vulnerabilities to critical environmental issues and for better capacity building in terms of adaptive management - Carry out joint actions to recover and widen riparian corridors along rivers
Green spaces	<ul style="list-style-type: none"> - Rehabilitate, maintain and enhance riparian galleries - Renaturalize the rivers that cross the various municipalities of the municipalities in CCDR-N's area of intervention - Create larger leisure spaces that allow municipal interconnection - Carrying out the joint maintenance of the arboreal park - Define and implement biodiversity corridors - Carry out the mapping of priority areas for the implementation of green and white roofs and vertical gardens and their implementation at the joint level - Implement strategic zones for access to water points taking into account areas of high fire risk - Create and maintain fuel management strips - Enforce compliance with the fuel management strips - Ensure surveillance at guard posts - Develop a joint forest management plan - Carry out joint actions to combat exotic species - Promote the planting of native species
Mobility	<ul style="list-style-type: none"> - Build cycle paths that allow the interconnection of the various municipalities - Build pedestrian paths that allow the interconnection of the various municipalities - Implement zones with reduced (or zero) emissions - Exempt zero-emission vehicles from municipal fees

(continued)

Table 4. Continued

Environmental critical factor	Action plans
Climate changes	<ul style="list-style-type: none"> - Improve the public transport network - Creation of systems for the identification of risk areas - Develop a joint climate change susceptibility chart - Develop and implement emergency planning measures for extreme events - Map and flag priority climate shelters
Air pollution	<ul style="list-style-type: none"> - Decarbonize fleets
Circular economy	<ul style="list-style-type: none"> - Analyze and implement county networks, or micro-scale networks, for territorial management and traffic limitation - Energize community markets - Streamline second-hand product markets - Expand the network of community gardens - Create/extend a common pool of interested cultivators - Promote home composting
Circular economy/waste management	<ul style="list-style-type: none"> - Install community composters - Enhance the organic recovery of biodegradable urban waste through biological treatment - Enhance the recovery of recoverable materials from undifferentiated waste, through mechanical treatment
Waste management	<ul style="list-style-type: none"> - Establish partnerships aimed at reducing food waste - Create inter-municipal projects for the collection, recovery and repair of unused objects - Create conditions for the transfer of waste, so that it can be treated, in the event of excess treatment capacity - Implement improvement processes in automated sorting stations - Increase joint multi-material selective collection - Diversify the waste collection strategy and apply proximity and door-to-door collection - Improve processing lines by incorporating new equipment and promoting efficiency in recyclable waste separation processes
Energy	<ul style="list-style-type: none"> - Optimize selective collection circuits - Improve the thermal performance of buildings inhabited by socially vulnerable populations - Promoting bioclimatic architecture in new buildings, facades and existing roofs - Promote bioclimatic architecture in new and existing buildings under the administration of the various local authorities - Promote the use of forest biomass

Source: Authors' own elaboration

the benefits of synergies, cooperation, mutual control and self-monitoring in facilitating the achievement of strategic objectives. While not all municipalities agreed on strengthening financial resources as a factor of improved responsiveness, it is worth mentioning that the successful joint implementation of an environmental strategy by municipalities necessitates resilience, commitment and responsibility among all stakeholders. These qualities are essential in fostering the necessary trust for the strategy's success (Leoni *et al.*, 2023).

Another advantage to consider is the potential for synergies among municipalities to implement actions that may not be explicitly covered in the developed ESBSC but are of concern to specific municipalities.

5. Conclusion

This study introduces an approach that municipalities can embrace to promote sustainable environmental development, encompassing both cultural and long-lasting impacts (Hristov *et al.*, 2021). It is crucial to emphasize the need for commitment and active participation from all stakeholders, a necessity that can be more effectively ensured by using the suggested tool. In addition, it is imperative to approach the tool with pragmatism and responsibility, recognizing its dual roles: firstly, as a support mechanism for the implementation of environmental strategies, and secondly, as a means to monitor the performance and contributions of the stakeholders involved. This distinction is crucial to avoid confusion (Hansen and Schaltegger, 2018; Mio *et al.*, 2022).

The developed tool not only addresses the environmental needs of each municipality but also enables strategic control through proposed performance indicators, facilitating the communication of the environmental strategy, as well as its monitoring. Although initially designed for the joint action of CCDR-N municipalities, it can serve as a valuable reference for other municipal associations due to its broad and adaptable objectives.

By adopting this approach collectively, municipalities can benefit from synergies, enhanced strategic control and cooperation. In addition, it facilitates improvements in municipal inputs through resource sharing and the establishment of relationships (Matteis *et al.*, 2021; Kusumasari *et al.*, 2010). Furthermore, the developed ESBSC promotes an integrated approach to sustainability, filling the literature gap regarding the lack of support for managers in developing and monitoring environmental strategies. Thus, this study contributes to the existing literature by providing a management tool that guides public managers in environmental and overall sustainability issues (Hristov *et al.*, 2021; Matteis *et al.*, 2021; Sayed *et al.*, 2021).

The tool complements the study conducted by Panya *et al.* (2018), as it incorporates all four strategies they suggest for enhancing the environmental performance of municipalities: fostering a sustainable culture, building an environmental learning organization, implementing strategies to reduce costs and increase revenues and adopting a preventive strategy. The integration of these strategies within the developed ESBSC is expected to lead to improved environmental performance. Therefore, in addition to supporting environmental management, the ESBSC has the potential to enhance overall municipal performance, adding practical value to the research conducted.

Furthermore, this study deepens the understanding of critical environmental factors mentioned in the literature by identifying three additional factors crucial for the environmental sustainability of municipalities: Energy, Circular Economy and Mobility. The presentation of these critical factors not only contributes theoretically but also provides practical insights for municipalities aiming to adopt a similar strategy.

Moreover, the systematic methodology used in this study serves as an example for future joint action studies. To our knowledge, there is no existing study addressing the implementation of a joint environmental action strategy by municipalities. However, it is important to acknowledge that the objectives, KPIs and strategic actions may vary if this study were conducted with a

different sample of municipalities or considering other countries (Epstein and Wisner, 2001; Hristov *et al.*, 2019; Matteis *et al.*, 2021). Therefore, expanding the study to a larger set of municipalities or including municipalities from other regions or countries would give a greater insight into the management of social issues, in addition to sustainability. In addition, some of the analyzed reports may be slightly outdated, leading to strategic objectives that may require revision. Given that the global strategies of municipalities encompass concerns beyond the environment, it is essential to ensure compatibility between the present environmental strategy and the overall strategy followed by each municipality to achieve successful joint adoption.

For future research, we suggest conducting a similar study that considers the collaboration between public and private organizations and explores the resulting advantages. In addition, conducting an ESBSC focused on each critical environmental factor, with the aim of joint action by municipalities, would enable more detailed and specialized analysis while reducing the tool's complexity. Furthermore, investigating the potential benefits arising from the adoption of a joint action strategy, like the one proposed in this research, would be an interesting avenue to explore.

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Table A1. Common environmental strategic objectives of municipalities

Code	Objectives	Obj Freq
<i>Learning and growth perspective</i>		
LG1	- Promote education and raise awareness of society as a whole, which includes companies and consumers, to the importance of sustainability and behavioral change	5/5
LG2	- Create and encourage the creation of organizations, to encourage the participation of companies, citizens, universities and research centers in the reflection of actions and measures to be undertaken	4/5
LG3	- Ensuring the qualification, involvement, and motivation of human resources, to ensure the development of all studies and actions necessary for strategic execution	5/5
LG4	- Improve communication and dialogue with various strategic and/or municipal stakeholders, understand municipal needs, and develop budgets	2/5
LG5	- Define rules and measures to be used in municipal sustainability plans, which allow for greater dynamism and interconnection of them	1/5
LG6	- Foster space/framework for innovation	1/5
<i>Internal processes perspective</i>		
IP1	- Establish several partnerships to increase the intervention capacity of the municipality and reduce the consumption of resources	5/5
IP2	- Rehabilitate, recover and carry out public works, based on the principles of sustainability, responding to environmental needs	5/5
IP3	- Guide the acquisition of goods and services according to the principles of circularity and arrange them according to municipal needs	3/5
IP4	- Ensure quality control, performance control, monitoring, and inspection practices	5/5
IP5	- Resort to planning, as well as decision support instruments, to increase the municipality's response capacity	4/5
IP6	- Use, introduce and maintain infrastructure and technological systems that are more adapted and capable of responding to the environmental needs of the municipality	5/5
IP7	- Bet on more innovative, efficient, sustainable and integrated management strategies and/or promote the use of natural systems and/or collective use with other municipalities	5/5
IP8	- Guide municipal policies based on sustainable environmental development principles and institute bioclimatic incentives and measures	5/5
<i>Environmental perspective</i>		
E1	- Promoting biodiversity, the availability of natural resources, environmental balance, and the regeneration of ecosystems	4/5
E2	- Expand, approach, maintain green spaces and requalify rivers	5/5
E3	- Protect the forest and identify priority afforestation areas	1/5
E4	- Reduce vulnerability to weather events and increase the municipality's adaptive capacity	3/5

(continued)

Table A1. Continued

Code	Objectives	Obj Freq
E5	- Obtain environmental certifications	2/5
E6	- Encourage non-motorized and/or collective mobility	3/5
E7	- Encourage the use of renewable energies and reduce the consumption of fossil fuels, through less carbon-intensive alternatives	4/5
E8	- Improve air quality and reduce greenhouse gas emissions	5/5
E9.1	- Improve waste management of any kind by promoting recycling, reduction and reuse of waste and by-products	5/5
E9.2	- Increase the quantity and quality of waste recovered, prepared and recovered	3/5
E10	- Ensuring water quality	3/5
E11	- Encouraging the consumption of tap water, reducing the use of plastics	1/5
E12	- Controlling environmental noise	4/5
E13	- Prevent forest fires	2/5
E14	- Promote organic farming and preserve soil quality	2/5
E15	- Minimize and control the proliferation of invasive species	2/5
E16	- Eliminate sources of pollution	1/5
E17	- Promote and requalify river beaches and renaturalize riverbanks	1/5
E18	- Reorganize and requalify the coastal seafront through the construction of support structures and review/clarify the responsibility for coastal management	2/5
<i>Financial perspective</i>		
F1	- Increase the Sharing Economy	2/5
F2	- Reduce costs, namely energy and water and reduce economic losses	3/5
F3	- Take advantage of the economic, tourist, educational and environmental potential, among others, resulting from natural resources	3/5
F4	- Support innovative, knowledge- and technology-intensive business ideas that transform environmental challenges into circular business opportunities, capable of creating qualified employment and fostering the municipal economy	3/5
F5	- Support and create conditions for sustainable urban and business investment	3/5
F6	- Achieve green taxation and green public procurement	3/5
F7	- Decoupling economic growth from resource consumption and environmental degradation, making economic practices compatible with sustainable development	4/5

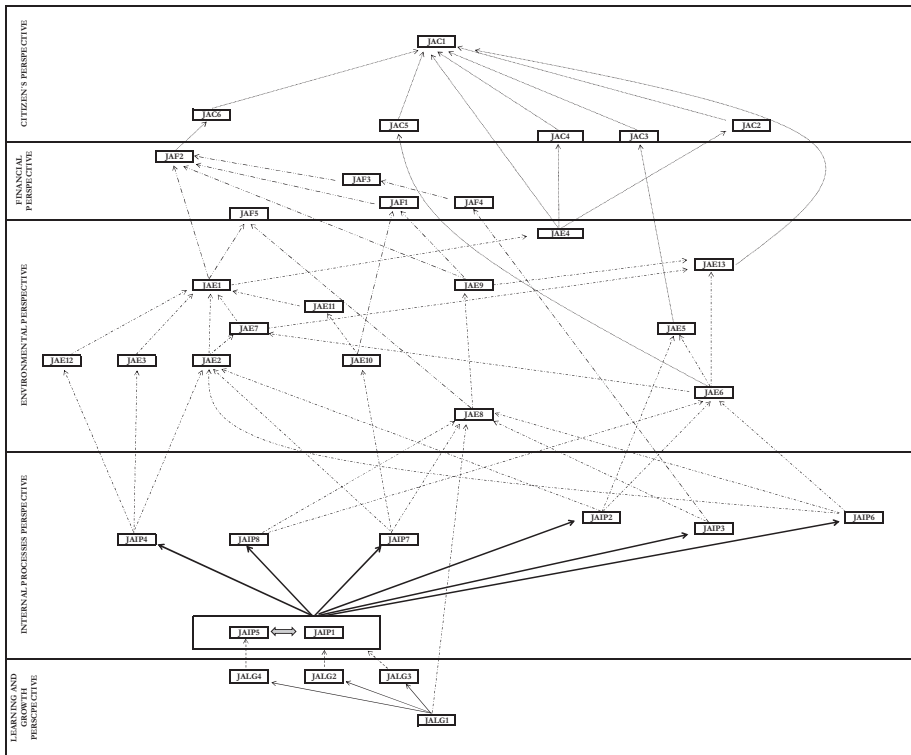
(continued)

Table A1. Continued

Code	Objectives	Obj Freq
<i>Citizen's perspective</i>		
C1	- Contribute to the physical and mental well-being of citizens and improve their quality of life	5/5
C2	- Ensuring the safety of people and property	4/5
C3	- Reduce the risk of disease spread/outbreaks caused by climate change	2/5
C4	- Reduce car traffic in residential areas	3/5
C5	- Decrease population and trade vulnerability in coastal areas most susceptible to sea level rise	2/5
C6	- Reducing the use of hospitals and contributing to the reduction of the mortality rate of vulnerable people	2/5
C7	- Mitigate the exposure of families, companies and the public sector to the high price of energy goods and services, reducing vulnerability to thermal discomfort	3/5
C8	- Maximize the benefits arising from sustainable practices and activities related to the environment, helping to promote the livelihood of the population	3/5
C9	- Ensuring that the needs of the population are met	4/5
C10	- Minimize human, environmental and material damage	1/5

Source: Authors' own elaboration

Appendix 2



Source: Authors' own elaboration

Figure A1. SBSC for joint municipal action and its strategic map

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